THURSDAY, APRIL 24, 1884

THE EDINBURGH UNIVERSITY FESTIVAL

THE brilliant celebration of its three hundredth anniversary by the University of Edinburgh last week suggests some reflections on the connection between University progress and the growth of Science. One of the most remarkable features in these festive proceedings has been the preponderance given to the recognition of the claims of scientific research to University distinction. A hundred years ago and less, had such a gathering been thought of, the great men who would have been invited to receive the highest academic honours would have been learned scholars, eminent professors of the mediæval branches of education, with perhaps a few distinguished medical men and doubtless a good many candidates whose only claim would have been the possession of a hereditary title of nobility. But now a new host of competitors has arisen, and upon them have the laurels of the University been mainly bestowed. Physicists, chemists, physiologists, botanists, geologists, and other representatives of modern science have almost elbowed the older philosophies out of the field. In the pæan sung at every meeting of the festival the brilliance of scientific discovery, the prowess of scientific discoverers, and the glory shed on the University by its connection with both have been the chief themes.

This great change in the objects of University recognition has been silently in progress for several generations. But it has never been so openly and strikingly proclaimed as during these recent meetings at Edinburgh. It is not that any formal alteration has there been made in the curriculum of study. On the contrary, the same subjects are still required for degrees in Arts as were demanded centuries ago. Outside the conservative government of the University there has, however, been a steady growth of modern ideas, modern life, and modern science. To the Medical School, in the first place, must the credit be assigned of fostering this wider culture. Its professors have thrown open their old monopoly of teaching, and work harmoniously with their competitors outside the walls of the University. They have cast aside the ancient inefficient system of mere prelections, and have introduced practical teaching into every branch of their science. To pass from the state of things in the youth of these teachers to what they have now made it is to cross a gulf such as might be thought to mark an interval of some centuries. Everywhere we see practical scientific research taking the place of musty lecture-notes and dry unproductive text-books. Not only have the professors aimed at being successful teachers, but many of them have themselves led the way in original discovery. They have likewise kept themselves and their students abreast of the progress of research all over the world. Hence the names of Continental men of science have become household words among the rising generation. We can readily understand and sympathise with the uncontrollable outburst of enthusiasm with which the students greeted the actual appearance among them of a Pasteur, a Helmholtz, and a Virchow.

Silently and unconsciously perhaps the Universities are passing from the exclusive domination of the older learning. At Edinburgh the emancipation is far advanced, but has yet to take shape in a definite rearrangement of the curriculum of study. No thoughtful scientific man would advocate a merely scientific education. The foundations of every man's culture should be laid broad and deep in those humanising departments of thought which the experience of centuries has proved to be admirably fitted for the mental and moral discipline of youth. But the day is not far distant when it will be acknowledged that modern science must be admitted to a place with ancient philosophy and literature in the scheme of a liberal education, when in all our Universities provision will be made for practical instruction in scientific methods, and when at least as much encouragement will be given by fellowships and scholarships to the prosecution of original scientific research as has hitherto been awarded to classical study or learned indolence.

To those who hopefully look forward to the widening and broadening of University culture the Edinburgh festival is full of encouragement. Such a gathering of representative intellect has probably never before been assembled. Delegates from the oldest and youngest Universities of the world, from scientific societies and other learned bodies, brought their congratulations to their northern sister. But they felicitated her not so much because she had been a successful educational centre for three hundred years, as because she had held up the torch of scientific discovery, because her professors and graduates had widened the boundaries of knowledge and deciphered new pages in the great book of Nature. If such has been the result of the trammelled past with all its hampering traditions and vested interests, its obstructions and jealousies, what may we not anticipate for the liberated future! After the lapse of another century, what new conquests will there not be to chronicle, what new realms of discovery to celebrate! In this ever-advancing progress, the University of Edinburgh, which has done so much in bygone years, will doubtless more than hold her own. No centre of education and research has greater advantages in its favour. The comparatively small size of the city, the proximity of its lecture-rooms, laboratories and libraries to each other; its vicinity to the sea on the one hand and to a varied and picturesque country on the other, combine to offer exceptional advantages to the student. Not the least of its attractions is its own unchanging beauty, which never ceases to appeal to the eye and to stimulate the imagination. Long may Edinburgh remain a beacon of light in educational advancement, in the cultivation of scientific methods, and in the march of scientific discovery.

PRJEVALSKY'S TRAVELS IN CENTRAL ASIA

Third Journey in Central Asia. From Zaisan through Khami to Thibet and the Sources of the Yellow River. By N. M. Prjevalsky. Russian. (St. Petersburg, 1883.)

THIS large work is the complete account of the third journey of Col. Prjevalsky to Thibet, notices of the progress of which from time to time appeared in our pages during the year 1880. The first journey, it will be remembered, was performed during the years 1870-73, when this distinguished traveller reached as far as the Lama monastery of Cheibsen near Lake Koko-Nor, and to Tsaidam, but was forced to abandon his intention of going to Lhassa, and so retraced his steps to Alashan. From thence he went to Pekin, and returned to Siberia across the Desert of Gobi. The second journey was undertaken from Kuldja to the Lake Lob Nor across the Tian-shan Mountains. On the third journey Col. Prjevalsky started from Zaisan, passing through Barkul Khami, Sa-tzhei, and Tsaidam, where he reached the country he had explored on his first journey. He now proceeded to carry out his former intention of going to Lhassa, and he struggled over the great plateau of Tan-la till he reached the town of Boomtza. At Nap-chu, in the neighbourhood of this town, he was informed that he would be allowed to proceed no further in the direction of the capital of the Dalai Lama. He was then a little more than 160 miles from Lhassa. Negotiations were useless: he was not allowed to proceed. Contenting himself with taking a portrait of the messengers from the Dalai Lama, he turned northwards and retraced the long and wearisome march across the Tan-la plateau. The winter of 1879 80 was occupied with this march and with the observations upon the manners and customs of the people, as well as investigations into the flora and fauna of the district he was passing through. Prjevalsky possesses in an eminent degree the buoyant spirit of the traveller which enables him to observe calmly and critically the surroundings in which he finds himself, even though he is overcome with hardship or pressed by the weight of disappointment. Returning to Tsaidam, he set out on his way to Lake Koko-Nor, where he had been in the year 1873. He remained in this neighbourhood for some time, and he followed the course of the Hoang-ho for about 150 miles. This part of his journey took him over new ground, and his explorations of these upper waters of the Yellow River or Hoang-ho are of the utmost value. He followed the course of the river as far as Gui-dui, which forms an oasis amidst great arid mountain-chains It was so difficult to advance and forage was so scarce that Prjevalsky turned back from the Hoang-ho and directed his steps towards Lake Koko-Nor. The rain, which had stopped for a time, recommenced, and was often accompanied with severe cold, which added materially to the discomforts of the journey. The monastery of Cheibsen was revisited after the lapse of about seven years, and there Prjevalsky was well received by the priests, whose acquaintance he had made on his former visit. The journey was continued through Nan-shan and Alashan amidst the wildest mountain scenery, till a descent was made upon the great Desert of Gobi. The change was great from the high mountains of Pan-cu to the waterless expanse of the desert, but Prjevalsky was always ready with his notebook as well as with his gun; and the result is that this volume contains a mass of information for the ethnologist as well as for the naturalist. The return was made in safety through the desert to Urga and Kiakhta. This is a brief outline of the journey recorded in these pages, and the only regret one has is that so few amongst us can read the language in which it is written. It is to be hoped that the volume will ere long be translated into our own language.

The simplicity of the style, the novelty of the subject, the interest of the narrative, and the personality of the writer, who has reached such a high position amongst adventurous travellers, combine to make this a most invaluable acquisition for the library of the naturalist as well as of the geographer. Very many new species have been obtained of both plants and animals, and one of the most important of the discoveries recorded is that of a new species of horse. Polyakoff has proposed to call this new species (of which a specimen is to be found in the museum of the Academy of Sciences in St. Petersburg) after the discoverer—*Equus Prjevalskii*. But the new species of plants and animals are so numerous that it has been proposed to apply a special name to the flora and fauna of the district, which are found to differ considerably from those of Western China.

OUR BOOK SHELF

Deutsche Kolonien. Ein Beitrag zur Besser Kenntniss des Lebens und Wirkens unserer Landleute in allen Erdteiler. Von Karl Emil Jung. (Leipzig: Freytag, 1884.)

DR. JUNG is well known as an accomplished writer, both on the scientific and economical aspects of the Australian colonies, in which he spent some years His present *brochure* is one of much interest, though its immediate subject is beyond our scope. It is a curious fact that though the Germans have no colonies, they are probably, next to the English, the greatest colonisers of any European nation. Even according to the census returns, the German population of the United States is very great, and as Dr. Jung shows, it is much greater than it seems, for many of the earlier colonists have Anglicised their names, and been absorbed in the general population. To the culture of the States, and indeed to the intellectual side of all the colonies in which they have settled, the Germans have largely contributed. Dr. Jung gives interesting details of German migrations into England, Russia, Australia, South Africa, as well as the States, and from the ethnological standpoint his little work deserves the attention of the scientific student.

Catalogue de la Bibliothèque Japonaise de Nordenskjöld. Coordonné, revu, annoté, et publié par Léon de Rosny. (Paris, 1883.)

THIS collection of Japanese works in all departments of literature, which appears to have been collected by Baron Nordenskjöld while in Japan, has been presented by him to the Bibliothèque Royale at Stockholm. The editor, the veteran Japanese scholar, M. de Rosny of Paris, has not been satisfied with a bald catalogue, but has in many instances added descriptive and analytic notes of the contents, the character of the work, and its place in Japanese literature; and although the collection can hardly equal in extent and value those of several European libraries, we are not aware that such an excellent catalogue exists in any European language. The whole contains about 1000 works in over 5000 volumes, and is divided and subdivided by M. de Rosny with much nicety. The scientific works are not very numerous. On the exact sciences (arithmetic, geometry, algebra, astronomy, &c.) there are only 104 volumes, and on the natural sciences 445. But most of these are dated prior to the opening of the country to foreigners, and to the student who could examine them they would present an interesting picture of the state of scientific knowledge at various periods.

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 Dust of Krakatăo

In the interesting paper by Mr. John Murray and the Abbé Renard, which appears in your last number (p. 585), there is an erroneous reference which it may be well to correct without delay. I am made responsible for a verbal statement concerning Krakatoa dust which fell in Japan. In your issue of the 3rd inst. (p. 525) a letter from myself will be found, stating, on the authority of Prof. John Milne of Tokio, that, contrary to the original statements made on the subject, no dust of Krakatoa is known to have fallen in Japan. My friend M. Renard must have misunderstood the communication which I made to him, which was to the following effect :—I have had the opportunity of examining a great number of specimens of the dust of Krakatoa which fell at different distances from the volcano, ranging from 50 to nearly 1000 miles. The dust collected at the greatest distance from Krakatoa, with which I am acquainted, is that which fell on board the *Arabella* in lat. 5° 37′ S. and lat. 88° 58′ E., Java Head bearing E.½ S. about 970 miles. It is certainly true that the dust which has fallen at the greater distances from the volcano contains less magnetite, augite, and hypersthene than that descending nearer to the source of eruption; and the obvious explanation of this is found in the greater density and compactness of the particles of those minerals as compared with the associated glassy fragments. At the same time it must be remembered that this is not the *only* explanation of the high silica-percentage in these ashes. The prevailing rock in the islands and on the shores of the Sunda Strait appears to be a hypersthene-augite-andesite, containing an unusually large proportion of a brown, glassy base. This base contains a far higher proportion of silica than the included minerals; and hence, as shown by Verbeek and Fennema, these rocks have a percentage of silica ranging up to, and even exceeding, 70 per cent. The same is true of the pumices formed from the glassy andesite rocks, including that of Krakatoa itself. John W. Judd

Hurstleigh, Kew

On January 13 I collected a sample of snow from an open field, and examined under the microscope the residue left by its evaporation. This residue showed a number of objects which are not usually found in atmospheric dust. Great precautions were taken to prevent the entrance of dust during evaporation, the vessel being kept covered with filter-paper. Crystals of common salt were very abundant. There were numbers of rather large prismatic crystals, colourless, insoluble in water, and doubly refracting. But the most characteristic objects were minute granules, transparent, colourless, and scattered in thousands all over the field of the microscope. These were insoluble in water. Many black particles were visible and some of these were attracted by the magnet. In fact, when the magnet was swept slowly over the residue, its poles became covered with fine black crystalline particles, evidently magnetic oxide of iron. However, there are large iron-works in this vicinity, which *may* account for the presence of the magnetic dust. To determine this and other interesting points, it is my intention to examine the snow and rainfall regularly during the next twelve months at least.

A specimen of snow, freshly fallen on March 10 showed none of the prismatic crystals referred to above. With a high power very small crystals of similar shape and properties were observed. The small granules were, however, to be seen along with crystals of common salt and ammonic nitrate. No magnetic dust was found in this specimen.

These results are, in my opinion, in favour of the dust theory of the remarkable sunset phenomena of the past winter.

W. L. Goodwin

Queen's University, Kingston, Canada, March 31

P.S.—Snow fell to-day (April 1), and a sample was examined for dust. The insoluble prisms have comple disappeared, and the minute dust is present in much smaller proportion.

W. L. G.

"Earthquakes and Buildings"

Prof. John Milne, of Tokio, refers in an article under this heading (Nature, vol. xxix. p. 290) to *buildings in Caracas, which are low, slightly pyramidal, have flat roofs, and are bound along their faces with iron.* Being for more than twenty years a resident of this city, I hope I may be credited with knowing something of its architecture, and as such I must say that certainly the houses are generally one-story buildings, but all the remainder of the foregoing description is quite erroneous. However, I do not wish to make Mr. Milne answerable for its inaccuracies, as it appears to be taken from a ridiculous article published by one Horace D. Warner in the *Atlantic Monthly*, March 1883. This article is a most audacious fiction from beginning to end, and in none of the statements it pretends to give with graphic seriousness is there any shadow of truth, as I have pointed out in the *American Journal of Science*, July 1883, with respect to the principal assertion of an earthquake said to have been witnessed by the author on September 7, 1882, in Caracas.

House-building in our good city is of the most ordinary type, and certainly not what it ought to be in a place which already once was ruined by an earthquake (1812): the walls are built of brick and mortar; the roofs are very seldom flat, but have a very slight inclination, say 15 to 20 degrees. They are, however, made too heavy by a thick stratum of loamy mud, spread over the closely-joined laths (generally the stems of the arborescent grass, *Arundo saccharoides*), on which the tiles are set in alternately convex and concave rows.

The earthquake of Cua (Nature, vol. xviii. p. 130) is an instance of the remarkable influence of the soil on the intensity of destruction: all the houses built on the rocky hill in the middle of the town were ruined, whilst those on the surrounding alluvial plain suffered scarcely any damage. The same happened in 1812 in Caracas: the northern part of the city, where the stratum of detritus is less deep, was almost completely laid waste; but the southern part, built on a far deeper deposit of loose matter, experienced comparatively small destruction. A. Ernst

Caracas, March 16

On the Transmission of Organic Germs through Cosmical Space by Meteoric Stones

In his *addendum* to his well-known lecture on "The Origin of the Planetary System" Prof. Helmholtz uses the following remarkable sentence, to which so far as I am aware, attention has not hitherto been directed :—

"But even those germs which were collected on the surface when they reached the highest and most attenuated layer of the atmosphere would long before have been blown away by the powerful draught of air, before the stone reached the denser parts of the gaseous mass, where the compression would be sufficient to produce an appreciable heat."

Helmholtz is contending in favour of the possible transmission of germs from one heavenly body to another, and his point here is that the germs, owing to their being small and light, will be more rapidly retarded (blown back) on reaching the first traces of our atmosphere than the stones on which they reside, and will thus escape the great rise in temperature to which the stones are subject in consequence of friction and air compression.

Now when a germ just leaves its meteorite its velocity is equal to that of the meteorite. If m be the mass of the germ, $\frac{m v^2}{2 J}$ will be the heat developed in destroying its velocity. Were all this heat to go to raise the temperature of the germ, the rise in temperature would be $t = \frac{v^2}{2 J s}$, s being the thermal capacity of the germ. This shows that the rise in temperature is independent of the mass of the body brought to comparative rest by the atmosphere. In reality, since the germ experiences a greater retarding acceleration than the stone, its temperature must rise much more rapidly and consequently higher than that of the stone. Further, the terminal velocity of the germ will be less than that of the stone, which will conduce to further raise the temperature of the former. Of course neither the stone nor the germ will get all the heat generated, but this cannot materially affect the question. J. H. Stewart

Physical Laboratory, Royal College of Science for Ireland

Instinct of Magpies

I HAVE read in NATURE (p. 428) your correspondent's letter relative to the instinct shown by magpies in Scotland as to the time for commencing their nest-building, which goes so far as to assume that this particularly cunning bird is capable of fixing a certain day in March (the Sunday after the 16th as I remember) as the invariable time to start the nest. And the writer observes that it would be well to ascertain if difference of latitude made any difference in the magpies' calculation. Now I live in the south-east of Ireland, a good many degrees south of your correspondent's Scotch magpies' locality, and it so happens that I have for the last twenty years observed the nest-building of magpies, who have enjoyed undisturbed possession, and who invariably build in the trees close to my house. It is curious that this colony (if a single pair may so be called) never increases—four young "mags" are brought out every year—but though I have observed congregations of ten or fourteen at times, the breeding birds never exceed two. The young birds never, like rooks, join a colony near their paternal nests, but are shipped off to new localities. I could mention many traits of my magpies' instinct—"their tricks and their manners"—but will confine myself to the nest-building. They never repair or re-occupy an old nest. A new one is constructed every year, and always, each year, in a different tree. Their nest-building is a serious labour, and takes a long time. So they begin early in *February*, selecting the sites often with much deliberation. The work is entered on very early in the morning, and the "mags" seldom work in the daytime. About the end of March this domed nest with its two openings is finished, and the laying of eggs commenced. I am quite certain that the middle of March is not the time of beginning the nest, and this is important, as the claim set up for the magpies instinctive knowledge of dates therefore falls to the ground. I do not conceive it possible to prove that in this particular magpies have a more highly developed instinct than most other birds; all have their normal time of nesting, although there may be cases of abnormally late or early building; but as to the magpies or any other bird being able to fix dates exactly to the day, it is unproved and incredible.

Inisnag, Stonyford, Co. Kilkenny JAMES GRAVES

Cats at Victoria Station

THAT the cats should repose comfortably amidst all the noise and vibration of a busy railway is not, after all, to be much wondered at. Animals much more defenceless and timid have found out that they need not be afraid of either the vibration or the trains, although they do not seem to have discovered that if they get in the way of the trains they are either maimed or killed. For instance, along the London and North-Western Railway between Manchester and Liverpool, which carries an enormously heavy traffic, rabbits burrow almost immediately beneath the ballast forming the permanent way, and I have often seen them sitting nearer to the train than most human beings would like to stand. It is strange, however, that along this line of railway, which is one of the oldest in England, neither the rabbits nor the grouse and partridges have learnt that, though the train is not to be dreaded as a man is dreaded, it is usually fatal to those who are struck by it. All these creatures, as well as hares, pheasants, &c., are constantly being run over by passing trains. A hen grouse or partridge will frequently take her brood on to the railway, no doubt for the purpose of dusting themselves, and meet with this fate. The survivors, however, do not seem to take warning by the occurrence. The same may be said of the telegraph-wires, against which the birds are constantly flying. The number killed in this way is considerable. This is the more remarkable because along this line wild animals have had such a lengthened experience of rail and wire that one would suppose it might have taught them wisdom.

ROOKE PENNINGTON

Wild Duck laying in Rook's Nest

WITH reference to Mr. Willmore's note in NATURE (p. 573), I have met with several instances in Lincolnshire of wild ducks nesting at a considerable height above the ground—once in an oak in a plantation in the old nest of a carrion crow—in ivy on a ruined wall, and on the top of a straw stack; once also on the roof of an old bean stack in the marches. I have known a wild duck nest on the ground amongst brambles and rough grass in the centre of a plantation a mile or more from pond or running stream. JOHN CORDEAUX

Junior Athenæum Club, April 21

Science and the Public Service

THE public are greatly indebted to your correspondent for drawing attention in NATURE of March 27 (p. 511) to the astounding proposal of the War Office to adopt the scheme of examination described by Lord Morley in the House of Lords on March 27—a scheme so absolutely retrogressive, and opposed to the recommendations of the Public School Commission of 1862 and of the Commission on Scientific Instruction in 1872 (composed of many eminent men and presided over by the Duke of Devonshire), and to the rapidly strengthening opinion in favour of education in science. The Government must be asked to withdraw the scheme. S.

Whittington, Chesterfield, April 16

THE HONG KONG OBSERVATORY

1. IT was found to be impossible to select a suitable site for the new Observatory near the city of Victoria, as the mountains shut off from view a large section of the southern sky, extending up to 25° of altitude. It is for the same reason impossible to determine the direction and velocity of the wind accurately near the town. Besides it is likely that the ferruginous rocks would deviate the plumb-line, not to mention the magnetic needles.

2. The Observatory was therefore built on the peninsula of Kaulung opposite. It stands on the top of Mount Elgin, a small hill built up of decomposed granite, rising abruptly on all sides from the surrounding level ground, and culminating in two humps distant over 300 feet from each other. The top of one of these is flat, and forms, roughly speaking, a circle of about 200 feet in diameter, and 110 feet above mean sea-level. Here the main building is situated, about 75 feet south-west of which the stands for the meteorological instruments, including the self-recording rain-gauge, are placed. It commands an unobstructed view of the sky, the tops of the hills rising only about seven degrees above the horizon. The magnetic hut is erected on the other prominence, the top of which was levelled, and forms a rectangle 36 feet by 30 feet.

3. The situation of the Observatory is rather secluded. It is surrounded by villas and summer residences; and the picturesque town rising opposite on the side of the steep mountain at a distance of a couple of miles, and the harbour, filled with the most bewildering mixture of men-of-war and merchant ships belonging to nearly all nationalities, and literally swarming with boats and sampans, make up a charming view from the verandas of the Observatory, which, on the other hand, forms a prominent object as seen from the town and harbour.

4. I was appointed to take charge of the Observatory on March 2 last year, and when I arrived in the colony on July 28, the foundations of the building had been already laid. It was then erected under my superintendence, and I was allowed to arrange every detail to suit the requirements. By January 1 the main building was so far finished that I could take up my residence there, and start tri-diurnal meteorological observations, and issue a daily weather report, containing also information concerning the direction and force of wind indicated by the gradients, based on telegrams received from the Treaty Ports, Manilla, and Nagasaki. I receive a telegram from Wladivostock in addition. The observations are made at 10 a.m. and at 4 p.m. on the previous day.

5. The main building of the Observatory is a rectangular block, 83 feet long and 45 feet wide (not including the transit-room), the architecture of which does credit to the Surveyor-General's department. The upper floor is devoted entirely to my quarters. The ground floor com-

prises four rooms, each 20 feet long, 16 feet wide, and 14 feet high. In the entrance hall is placed the telegraphic apparatus; to the right is my private office, where the library is placed, contained in glazed teak-wood book-cases, to protect the books from insects in the summer. I have already received extensive donations from scientific institutions in all parts of the world. The room next to this contains the clocks, which are fixed to brick piers neatly covered with teak wood. The piers, which rest on cement concrete, are carried down 6 feet below the ground in holes lined with bricks. Behind this is a small room in which the galvanic batteries are placed.

6. The mean-time clock, which is to discharge the time-ball automatically, is furnished with a magnetic apparatus for setting to correct time without touching any part of the clock. The time-ball will be dropped at Tsim-sh'at-sui Point, opposite the harbour, about a mile from the Observatory. It is 6 feet in diameter. Opposite the mean-time clock is the sidereal standard clock, which is of the most finished construction. It communicates by wire with a sympathetic dial placed in the transit-room. The face of the latter is black, and the hands and the figures are white, which I found very convenient at Markree Observatory, but unfortunately, Messrs. Dent and Co., who made all the horological apparatus, have omitted a second every minute. For marking a chronograph such an arrangement is most desirable, but it is rather awkward in observing with eye and ear. The clock-room contains the relays, and also one sidereal and two mean-time chronometers.

7. The transit instrument, by Troughton and Simms, is placed in a wing room painted dark gray, 14 feet square and 14 feet high, next the clock-room. The meridian opening is 1 foot wide. The transit instrument has also a delicate level for observing zenith distances according to Talcott's method. The pivots are made of chilled bell-metal, a material which, I believe, was introduced to astronomical instrument-makers by Brinkley of Dublin, whose instruments remain serviceable up to this day, while the pivots of transit instruments of much later date are corroded, being made of steel—a material that should not be used except where unavoidably necessary. An adjustable meridian mark is placed on a pier 66 feet north of the transit instrument. It is observed through a lens of that focal length, which is fixed in the meridian opening of the transit-room.

8. To the left of the entrance hall is the general office and computing room, next to which is the room where the barometers, as well as the self-recording thermograph and barograph, are placed. Behind this is a small room that serves as a photographic laboratory. Every part of these two rooms, including ceilings, floors, and furniture is painted dark red, and there are only a few panes of glass in the windows, which are glazed with double red glass. The thermograph is supported by massive blocks of wood fixed on solid masonry, but the barograph is placed on a stand merely screwed to the floor. The screw that holds the self-registering thermograph is made of zinc.

9. Over the upper story of the building a turret rises 8 feet above the flat roof. This holds the self-recording parts of the anemometer, which is erected on top of it. The cups are 45 feet above the ground. The roof forms a convenient platform for making observations. The sunshine-recorder is placed in a groove in the coping-stone on the parapet, 34 feet above the ground. Lightning conductors are placed on the two chimneys. They rise a few feet higher than the anemometer.

10. A one-storied block of outbuildings, containing servants' quarters and store-rooms, communicates with the main building by a covered passage.

11. The magnetic hut is 17 feet long, 13 feet broad, and the roof rises 11 feet high. It is made of wood, painted pure white outside and inside. Bamboo chips instead of nails were used in its construction, as well as in that of the furniture. It has double doors, louvered and glazed, to the north and south, and two windows on either side, as well as two windows in the roof, which is convenient for reading the verniers. On top of massive teak-wood blocks sunk 3½ feet in the ground and rising 4 feet above the floor are placed the dip-circle and the unifilar magnetometer. All the instruments were brought out safely, except the dipping needles, which appear not to have been sufficiently cleaned before packing. The hut is very comfortable, and forms therefore, in my opinion, a contrast to other structures used for making magnetic observations, in arranging which the importance of attending to the comfort of the observer in the hut is but too often lost sight of. The deviation is only 47 minutes easterly. The dip is 32 degrees (north end dipping). A broad road leads from the main building to the magnetic hut. This road is broken in the middle by a depression, across which a bridge will shortly be built.

12. Beside this road, at a distance of about 75 feet from the main building, it is intended to build a small house for the assistants, and near this has been selected the site for the refractor of 6 inches aperture, the loan of which I was promised by the Astronomer-Royal. That will complete the outfit.

W. DOBERCK
Government Astronomer

Hong Kong Observatory, March 11

THE CEDAR FOREST OF CYPRUS

IN 1879 Sir Joseph Hooker communicated to the Linnean Society[1] the unexpected discovery of a form of the cedar of Lebanon (*Cedrus libani* var. *brevifolia*, Hook. f.) by Sir Samuel Baker in Cyprus.

The following extract from a letter lately received by the Director of the Royal Gardens, Kew, from Sir Robert Biddulph, K.C.M.G., C.B., the High Commissioner, gives a more detailed account of the forest, and will no doubt be interesting to many readers of NATURE:—

"*Cyprus, March* 25

"With regard to the cedars, I went last summer all through the thickest part of the forests, including the cedar forest, and I am able to give you some of the particulars you ask for, having noted them at the time. The cedar forest occupies a ridge on the principal watershed of the southern range, and about fifteen miles west of Mount Troodos. The length of the forest is about three miles, its breadth very much less. A few outlying cedar-trees were visible on neighbouring hills, but on the ridge they were quite thick, and probably many thousands in number. I took the height above the sea by an aneroid barometer, and found it to be 4300 feet. The trees are very handsome and in good condition, but comparatively young. The smallest seemed to be from ten to fifteen years old; the largest, I am told by the principal forest officer, are probably not over sixty or seventy years. The worst feature is that there were *no* seedlings or young trees under ten years; and indeed this is the same with regard to the pine forests. It would seem as if the great influx of goats has been comparatively recent. I made a tour through the heart of the forest last August. I started from a point on the west coast, and from thence ascended to the main watershed, and kept along the top till I reached Mount Troodos, taking three days to do it. The country through which we passed on the first day was perfectly uninhabited, and a mass of hills and forest, chiefly *Pinus maritima* [*P. halepensis*] and the Ilex. The trees were in very great number, but there was a scarcity of young trees, and most of the old ones had been tapped for resin. On the second day we passed through the cedar forest, and the same sort of country as before, the *Pinus Laricio* beginning at an altitude of 4000

[1] *Journ. Linn. Soc. Bot.* xvii. pp. 517-19.

feet. We got as far as the monastery of Kikko that day, and the next day I continued along the watershed to the camp at Troodos. Our road as far as Kikko was a mere track on the side of the hill, in some parts rather dangerous, and we had to lead our ponies on foot, in many parts very steep. The difficulty on the road is the want of water at that elevation. We halted the first night at a beautiful spring, but we had to carry with us food for man and beast for the whole party, muleteers, &c. The scenery was wild and romantic. This spot is the centre of the '*moufflon*' ground; three of them were at the spring when we approached it. It gave me a clearer idea of the forests of Cyprus than I ever had before.

"We have had a great deal of rain this winter, and the country is clothed with vegetation."

MINERAL RESOURCES OF THE UNITED STATES[1]

THIS volume, published by the United States Geological Survey, is the first statistical report upon the condition of the mining industries of the United States, and contains much valuable information concerning the great and ever-increasing production of metals, especially in the States west of the Missouri and the Rocky Mountains.

In addition to the columns of figures of weights and values constituting the statistical matter proper, the author, or rather his coadjutors, for the volume is the work of many contributors, have furnished notices and descriptions of processes, especially in the metallurgical section; and a review of the course of the markets for the preceding eight years (to 1875) is given for each important metal. By a curious provision in the Act of Congress providing for the publication of these statistics, the field is restricted to mineral products other than gold and silver, but, in order to present as complete a view of the total output as possible, the best available figures of the production of precious metals are given in a concise form. This, though valuable, is rather disappointing, as we miss the interesting accessory descriptions which are given in other parts of the volume. How important the production of these metals has been during the last quarter of a century is seen in the statement that the aggregate yield up to the middle of last year has been 2707 tons of gold and 15,680 tons of silver, and of these enormous quantities less than 1 per cent. of the gold, and none of the silver was raised before 1858 At the present time the annual production varies from 12 to 16 millions sterling coinage value, divided about equally between gold and silver, the latter being usually a little in excess.

The coal raised in the different States is a little over 87 million tons, of which 29,120,000 tons were anthracite and the remainder bituminous coal and lignite of all kinds, and some anthracite mined "outside" of Pennsylvania, the recorded value being 29,326,000*l*. The above totals represent 1·8 ton per head per annum of the population, which is, however, somewhat less than the consumption, in addition to enormous quantities of wood and charcoal. Among the most interesting recent developments are the Tertiary and Cretaceous coal-basins which extend along the base of the Rocky Mountains and are also seen at different points on the Pacific Coast, the total area of these being reported as greater than those of the Carboniferous formations proper in the Eastern States. These areas are, however, marked as doubtful by the author. At Crested Butte and Irwin, in the very heart of the Rocky Mountains, both anthracite and good coking coals are found in these newer formations, the quality of the latter especially being comparable with the coal of Connellsville or the best coking coal in Pennsylvania.

[1] "Mineral Resources of the United States." By Albert Williams, jun. 8vo. (Washington, 1883.)

The iron industry of the United States is now of first-rate importance, and the subject is well treated in a paper contributed by Mr. J. M. Swank, the well-known secretary of the American Iron and Steel Association. The iron ore raised is in round numbers 9 million tons, and the pig iron made from it 4,623,000 tons. The value of the latter is given at 21,267,000*l*., which is only a few pounds less than that of the gold, silver, copper, and lead taken together. The largest production of iron ore is in the district producing the richest quality, namely Lake Superior, whose yield of 2,948,000 tons is comparable with those of the other great hematite districts of the world, Furness, Whitehaven, and Bilbao.

The United States are now among the largest producers of copper, and here we are met by the peculiarity of the unequal distribution of the producing centres. Thus, of a total product of 40,903 tons, 25,439 tons were from a single district, namely, Lake Superior, and of this again the larger proportion, 14,309 tons, was from a single mine, the "phenomenal" Hecla and Calumet of Houghton, Michigan. The Lake copper is entirely produced from the native metal, and is of the highest degree of purity. Latterly, however, a competitor of some importance has arisen in the south, in the barren desert country of Arizona, where masses of carbonates and oxides have been discovered in considerable quantity under conditions resembling some of the famous mines of South Australia. The handling of these ores is not, however, easy. The smelting must be done on the spot, and when the furnaces are at a distance from railways, the coke used may cost from 10*l*. to 15*l*. per ton. The most remarkable mine in this district, the Copper Queen, has already paid 200,000*l*. in profits, and produces copper at a cost of 4½*d*. to 5*d*. per pound.

Lead is another metal in which the United States have taken a prominent position during the last few years, the product being now 132,890 tons, while in 1870 it was only 17,830 tons. This great increase is due to the development of several important groups of mines in the Western States, but more particularly in Utah, Nevada, and Colorado, the latter State alone producing 58,642 tons, or nearly half the total production of the country; while in 1873 the State was credited with only 56 tons. This enormous increase is due to the development of the carbonate deposits of Leadville, in the Rocky Mountains, where ores containing only 10 to 20 per cent. of lead are smelted in enormous quantities to obtain the silver and gold contained, which are relatively high in proportion; the pig lead or "base bullion" produced being sent eastward by railway to the refineries at Omaha, Chicago, St. Louis, Pittsburg, and even New York. The information given in the volume concerning this important branch of industry is so full that it will be a welcome one to the library of every metallurgist.

Another important and almost specially American mineral industry is that of petroleum, the production being restricted to the States of Pennsylvania, New York, California, West Virginia, Ohio, and Kentucky, the last four being, however, insignificant as compared with the first three. Here again there is a considerable disparity, the States of Pennsylvania and New York yielding 61,200 barrels daily, while in California the annual total is only 70,000 barrels. The barrel contains 42 gallons U.S. measure, which is the same as the old English wine gallon of 231 cubic inches. The consuming power of the world seems in this article to have been passed by the supply, the average price of 41*s*. 2*d*. per barrel in 1864 having fallen to 3*s*. 4*d*. in 1883. Notwithstanding this great fall in price the total produce of the year is valued at £4,740,000, or about one-half more than that of the copper.

The minor metallic and other minerals are of less importance, but their statistics are set forth in considerable detail in other parts of the volume, which we hope to see reprinted, if not annually, at least at short intervals of years, as furnishing one of the most valuable contributions to economic geology. H. B.

THE LATE DR. ENGELMANN

SO many years have elapsed since Dr. Engelmann, whose death was recently announced in your columns, wrote his academic dissertation "De Antholysi Prodromus, 1832," that it is no matter for surprise if many among the younger generation of botanists have forgotten this little treatise, or have failed to associate its author with the historian of American conifers and other selected orders. This is the less surprising as, although in Dr. Engelmann's systematic memoirs there are frequent traces of his early morphological studies and of the interest he felt in them, he, so far as I know, wrote no treatise specially devoted to teratology other than the one already mentioned. A few words on this little book may therefore not be unacceptable to those who honour Engelmann's memory. It would be an interesting and not an unprofitable task to trace out the connection between teratology and the modern views of evolution, which is much closer than is generally imagined, albeit the ideas of natural selection and survival of the fittest find no place in the older teratological literature. For such a task I have neither the requisite ability nor the necessary leisure. My object in alluding to the matter is to call to mind the light in which Engelmann considered the subject, influenced as he was by the writings of his great fellow-countryman Goethe, whose views, originally published in 1790, were by no means universally accepted, even in 1832. Schimper and Alexander Braun were among those who appreciated the value of Goethe's theory, and those two learned men and acute morphologists were Engelmann's teachers, and as we learn from himself, exerted great sway over him.

It is curious to contrast the modest pamphlet "De Antholysi Prodromus," written in Latin, which I at least do not find very easy to construe, with the more elaborate "Élémens de Tératologie Végétale" of Moquin-Tandon, published nearly ten years later (1841). Moquin's work is written in a style which even a foreigner can read with pleasure. Its method, too, is clear and symmetrical, but when we compare the two works from a philosophical point of view, and consider that the one was a mere college essay, while the other was the work of a professed botanist, we must admit that Engelmann's treatise, so far as it goes, affords evidence of deeper insight into the nature and causes of the deviations from the ordinary conformation of plants than does that of Moquin. A few illustrations will suffice to make this clear. Speaking of progressive development, or as he calls it "*evolutionis progressus*," Engelmann says that while it is only obscurely indicated in celestial bodies, and with difficulty studied in animals, "*clarissime apparet in plantis*." Plant-history is for Engelmann the narrative of the progress of evolution—"*evolutio progrediens*"—and variations from the ordinary course are to be accounted for, "*ex nimio motu, et ex nimio impeditione*," or, as we should now say, from excess or from arrest of development.

The main end of a plant is to produce seed, and the morphology of the plant appears to have been considered by Engelmann as the result of a compromise between this tendency (*nisus*) and the progressive development of each individual part. The morphological unit for him, as for Goethe, from whom he derived the notion, was the leaf—"*unitas autem in foliis posita est*"—and the variations from the leaf-type were, as we have seen, attributed to arrest of development, to reversion (*regressus*), or to progression. But these changes were looked upon then chiefly in relation to the greater or less development and specialisation of individual parts with little or no reference to their possible genealogical significance as elements in a general pedigree of plants, or at any rate as suggestive of such elements. Hereditary influence, however, was not wholly overlooked; on the contrary, Engelmann speaks of it as "*magni momenti*," and goes on to show how woody plants frequently show, year after year, the same malformations, how perennial plants less frequently do so, and how such repetition is much less frequently observable in annuals and plants propagated wholly by seed. Only "*antholyses epiphyticæ hereditariæ esse possunt*" (§ 69), says our author, by which he means that partial changes are not perpetuated by descent, but only those in which "*omnes plurimive flores morbosi sunt*." It is not necessary to stop to consider what amount of truth there is in this assertion, but it is interesting to see the use then made of the word "epiphyte." Engelmann, influenced by his medical studies, spoke of "local," "epiphytical," "sporadic," "enchoric," and "enchronic" affections; enchoric changes being limited to certain localities, enchronic alterations occurring at definite times. These terms have not been generally adopted, while the signification now attached to the word "epiphyte" is widely different from that which Engelmann intended. He, at least, had not the right of priority in this matter, for Bischoff, in his "Botanische Terminologie" (1830), speaks of epiphytes as external parasites (citing as examples *Cuscuta* and *Viscum*), in contradistinction to entophytes. It would seem from this that in matters of terminology custom overrides priority. But this by the way. Our present concern is with the fact that certain changes, or certain degrees of change, are more likely to be perpetuated than others. Similarly we find Engelmann calling attention to certain "critical" regions of the plant,—spots, that is, more subject than others to teratological change,—the apex of the stem in definite inflorescences for instance (§ 67), a point subsequently dwelt on by Darwin at some length, though he does not seem to have been aware of what Engelmann had previously written on the subject.

Lastly, reference may be made to the assertion made by Engelmann that plants of a high state of relative structural perfection "*structurâ magis evolutâ et typo magis composito*," are specially liable to retrograde metamorphis. This is a statement that from the nature of things seems so reasonable that it is generally accepted without question. Nevertheless, it is one which requires qualification and further investigation. To take one case which occurs at the moment. Let any observer call to mind the number of instances in which he has seen the carpels the subjects of retrograde metamorphosis, and he will probably find that such changes are far more common in cases where the carpels are free and superior, than in those in which they are in union one with another and with the thalamus, as in the so-called inferior ovaries, which are considered to represent a higher type of structure than do the free carpels.

But the object of this note is not to discuss any particular view that Engelmann may have held, but merely to call attention to his claims as a morphologist, claims which are overlooked by reason of his greater—numerically greater—claims as a systematist.

MAXWELL T. MASTERS

SIWALIK CARNIVORA [1]

BY the publication of the present memoir on the Siwalik and Narbada Carnivora, Mr. Lydekker completes the second volume of the series of the "Palæontologia Indica" devoted to the Indian Tertiary and Post-Tertiary

[1] "Palæontologia Indica," Series x. Indian Tertiary and Post-Tertiary Vertebrata, Vol. ii. Part 6. Siwalik and Narbada Carnivora. By R. Lydekker, B.A., F.G.S., F.Z.S. Published by order of His Excellency the Governor-General of India in Council. (Calcutta, 1884.)

Vertebrat·. Both these volumes, it may be remarked, treat of mammalian forms, and, with the exception of a memoir on *Rhinoceros deccanensis*, by Mr. R. B. Foote, are from the pen of Mr. Lydekker. Each volume contains about 300 pages and forty-five plates.

No traces of mammals have yet, it would appear, been detected below the Eocene in India, and even in this formation only some very fragmentary bones have been obtained from the Punjab. From the Miocene the remains of a rhinoceros have been found. In the Pliocene mammalian remains begin to be pretty numerous. Thirty-three species of Carnivora from Siwalik are described in the present memoir; they belong to the following families: Mustelidæ, Ursidæ, Viverridæ, Hyænidæ, Felidæ, and Hyænodontidæ. Of the first of these families, two species of the genus Mellivora are described; one of these, *M. sivalensis*, was first noticed in the supplemental plates of the "Fauna Antiqua Sivalensis," and the original is in the British Museum. A second skull and the ramus of a mandible are in the Science and Art Museum, Dublin. The annexed woodcut shows the right side (Fig. 1, *a*) of the palate of this latter. The original describers of these specimens, Colonels Sir W. Baker and Sir H. Durand, remark on their close affinity to the recent *Mellivora indica*, and Mr. Lydekker says that in most respects the forms of the recent and fossil jaws are exceedingly alike. In the fossils the *pm*.2 and *pm*.3 are slightly larger in the upper jaw than in the recent form, and the true molar (*m*.1) of the former differs from that of the latter by being much less expanded at its inner extremity. In the mandible (Fig. 1, *b*) there is not much difference between the fossil and recent forms. The difference, however, between the extinct and recent Indian ratel may be summed up as being about the same in degree as between the recent Indian and African forms, leaving it probable that India may have been the original home of the genus. A second species is described as new, *M. punjabiensis*. A new genus (Mellivorodon) is formed for a form intermediate in size between the ratel and the glutton, while the form and relative proportions of its teeth indicate that it was more nearly allied to the former than to the latter. Two species of Lutra, *L. palæindica*, F. and C., and *L. sivalensis*, F. and C., are described from the region of the typical Siwalik Hills in the neighbourhood of the Ganges and Jumna Valleys, and one, *L. bathygnathus*, Lyd., from the Siwaliks of the Punjab; this last is of extreme interest, as, while presenting no sort of affinity to any of the existing Indian species, it is most closely allied to the recent South African otter (*L. lalandi*), and thus affords another well-marked example of the intimate connection of the Tertiary mammalian fauna of India with the present African fauna.

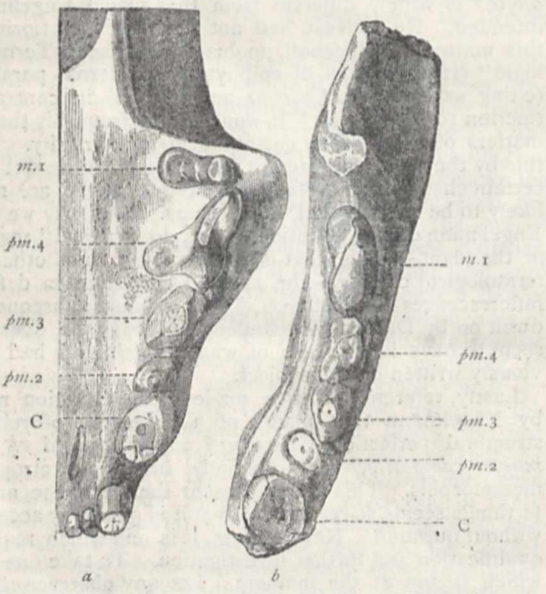

FIG. 1.—*Mellivora sivalensis* (F. and C.). The right half of the palate (*a*) and the left ramus of the mandible (*b*). Natural size.

The evidence of the close relationship of the bears and the dogs appears to Mr. Lydekker too strong to refer them, at all events for palæontological purposes, to separate families. We therefore have the Ursidæ comprehending the two modern families Ursidæ and Canidæ, these being formed into groups as Ursinæ and Caninæ. The author does not, however, attempt to form a definition of the family as thus extended, nor is he even quite certain as to the limits of the sub-groups. Of the species described, one, *U. namadicus*, F. and C., is from the Pleistocene Narbada beds; the other, *U. theobaldi*, Lyd., was obtained by Mr. Theobald from the Siwaliks of the Kangra district. It would seem to be nearly related to the recent *U. labiatus*, which itself seems to stand quite isolated from all the other recent bears, its strangely modified molar dentition being the result of the nature of its food. Three species of Hyænarctos are mentioned: *H. sivalensis*, F. and C., *H. punjabiensis*, Lyd., and *H. palæindicus*, Lyd. The line of descent of the genus is thought to be from the bears, through Dinocyon, to the true dogs. *Amphicyon palæindicus*, Lyd., is redescribed and refigured; it approaches *A. intermedius*, Myr., described from the Miocene of Bohemia on the eastern side of Europe. Of the genus Canis the following are described:—*C. curvipalatus*, Bose, and *C. cautleyi*, Bose. The occurrence of this latter species in the Siwaliks is one "of extreme importance in regard to the Pliocene age of at least a large portion of those deposits, for in the Tertiaries of Europe, with which the Siwaliks are in many respects closely allied, true wolves are unknown before the Pliocene." Among the Siwalik fossils in the Science and Art Museum, Dublin, there is an associated portion of the skull and two fragments of the mandible of this wolf, portions of which are represented in the woodcut (Fig. 2). In A are shown *m*.1 and *m*.2 in a very perfect and almost unworn condition, and also the broken fang of *m*.3. In B the left side of the palate shows the canine and the earlier premolars.

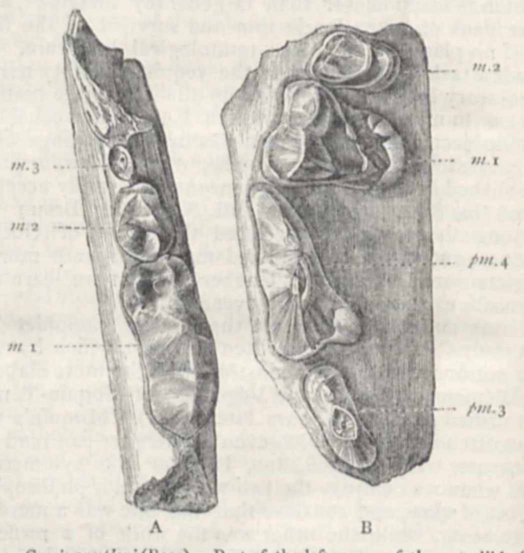

FIG. 2.—*Canis cautleyi* (Bose). Part of the left ramus of the mandible (A) and the left side of the palate (B).

Of the Viverridæ we find the following:—*Viverra bakeri*, Bose, and *V. durandi*, Lyd. Of the Hyænidæ four species of Hyæna are described, based on specimens in the collections of the British, Indian, and Dublin Museums, and there are not wanting evidences of a fifth form. It is remarkable to find so many species of hyæna existing contemporaneously in India; but, when the large number of Proboscidia and other ungulate forms that existed at the same time is recalled to memory, to find the genera of Carnivora equally strongly represented in species is perhaps only what might have been expected. The earliest notice of the remains of Hyæna from the Siwaliks appeared in 1835 in the *Journal of the Asiatic Society of Bengal*, where Sir W. L. Baker described a specimen as "the most perfect fossil we have yet been so fortunate as to meet with." This specimen is figured in the annexed woodcut (Fig. 3), and is at present in the Dublin Museum. The species has been described by Mr. Bose as *H. felina*. Its affinities are towards the recent *H. crocata* of South Africa, a species common in Europe during the Pleistocene period; and this fact points, Mr. Lydekker thinks, to the conclusion that Asia rather than Africa may be regarded as the cradle of the race of hyænas. *H. colvini*, Lyd., *H. macrostoma*, Lyd., the latter a species that seems to constitute an important link between the more typical members of the genus and the viverroid and canoid Carnivora. *H. sivalensis*, Bose, is redescribed and figured. A new genus, Lepthyæna, is made for a species previously recorded as *Ictitherium sivalense*.

The Siwalik Felidæ embrace *Æluropsis annectans*, Lyd., a new genus and species of which but little is known; *Ælurogale sivalensis*, Lyd., for a carnivore intermediate in size between the Thibetan lynx and the leopard. Six species of Felis are either described or indicated; of those described are *F. cristata*, F. and C., *F. brachygnathus*, Lyd., and *F. subhimalayana*, Bronn. Of the genus Machærodus two species are included in the list of Siwalik forms. *M. sivalensis*, F. and C.: a

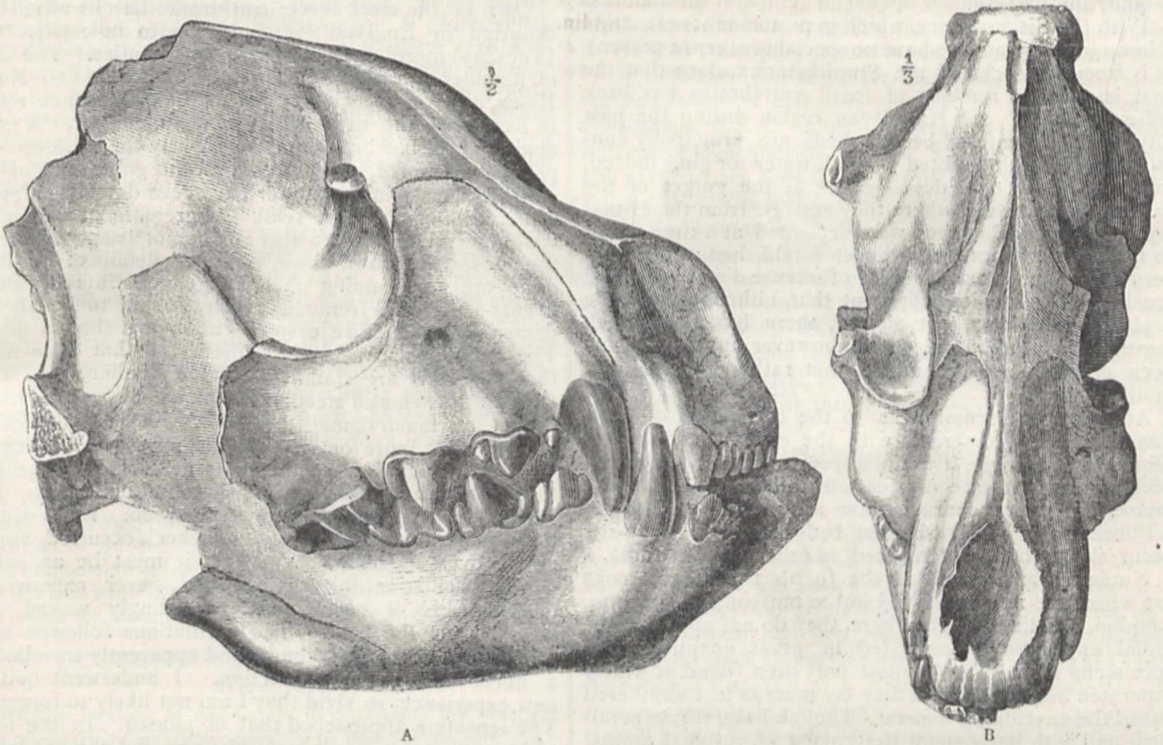

FIG. 3.—*Hyæna felina* (Bose). A, oblique view of right side of cranium; B, front view.

nearly complete left ramus of the mandible of this species is in the Dublin Museum, and is represented in Fig. 4; posteriorly it is complete, with the exception of the coronoid process, while anteriorly it is broken through the symphysis; it shows part of the alveolus of the canine and the greater portion of the descending expansion. The three cheek teeth are preserved, but in a more or less broken condition; a large part of the outer surfaces of *pm.*4 and *m.*1 have been chipped away. These teeth agree with the type specimen in the British Museum, with the exception that *pm.*3, though still small, is inserted by two distinct fangs. The last family, that of Hyænodontidæ, is one considered by Prof. Huxley as occupying a position connecting the Carnivora with the Insectivora. Only one species belonging to the genus Hyænodon has been found. This genus has hitherto only been recorded from Europe and North America. The species *H. indicus*, Lyd., is represented by teeth from the Siwaliks of Kúshalghar and the Punjab.

Perhaps the most striking feature in this list of extinct forms is the fact that by the side of ratels, bears, jackals, and civets, some hardly to be distinguished from living species, there are to be found essentially primitive forms,

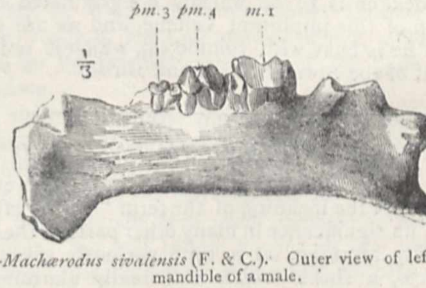

FIG. 4—*Machærodus sivalensis* (F. & C.). Outer view of left ramus of mandible of a male.

proving the survival in India of old types long after they had disappeared from other parts of the world. Equally noteworthy is the apparently contemporaneous existence of specialised and generalised forms of the same genus; this is well seen in the hyæna. It will also be seen that the Siwalik carnivorous fauna fill up many gaps in the chains of relationship, such as that between the bears and dogs, the viverroids and hyænas, and these latter and the cats.

The rock series in which these fossils occur is therefore one of very great interest. From the Brahmaputra to the Jhelum, for a distance of 1500 miles along the base of the Himalayas, there extends with varying width a succession of ridges or ranges which are known as the sub-Himalayan hills. Physically and constitutionally they are readily distinguished from the ranges belonging to the mass of the Himalayas proper. The rocks forming them are all of Tertiary age, and they are divisible into an upper (the Siwalik) and a lower (the Sirmur) series; these again are further divisible respectively into upper, middle, and lower groups. This is the principal and classic area of these rocks, but they occur also in Burmah, Perim Island, and in Sind.

With the Sirmur series, which in part consists of marine (Nummulitic) strata, we have no special concern at present. It is from the rocks of the Siwalik series alone that the vast harvest of remains of fossil vertebrates has been collected in the sub-Himalayan region during the past fifty years. The fossil-bearing beds are principally conglomerates of undoubtedly fresh-water origin, indeed, owing to their local development at the gorges of the existing great rivers, where they emerge from the Himalayas, it is clear that they were deposited at a time when, so far, the configuration had been established; but, as the very highest beds exhibit signs of intense disturbance and crushing, it is no less apparent that, although the main drainage lines have not altered, there has been much movement and upheaval, which, however, appears to have been effected, not by sudden, but rather by slow and gradual action.

After much discussion as to the correlation of these fossiliferous conglomerates with the established order of sequence in Europe, it would appear to have been finally adopted that, in spite of a certain Miocene facies in the fauna, the general characteristics are such as to indicate a Pliocene age. Fossil-bearing beds of Post-Pliocene age occur, it may be here remarked, in other parts of India.

Numerous and varied as the fossils from these rocks are which are now preserved in the museums of Calcutta, London, Dublin, and elsewhere, they do not appear to be found anywhere concentrated in great quantities, the specimens having for the most part been found at widely separated intervals, where they lay more or less weathered out of the enveloping matrix. Though naturally mineralised, and with but a small percentage of residual animal matter, they are often beautifully preserved, but occasionally, owing to the hardness and tenacity of the matrix, it has required the utmost patience and skill to chisel out the details of structure, while sometimes it has been found impossible to do so.

Mr. Lydekker is to be warmly congratulated on the completion of this important volume, and we are glad to know that he is busy with volume iii., which is to include an account of the Siwalik Suina and Birds.

AN EARTHQUAKE IN ENGLAND

At last the people of these islands have been enabled to realise the meaning of the term "earthquake," so terrible in its significance in many other parts of the globe. On Tuesday morning, at a time variously given from 9.15 to 9.30, a shock which was really alarming and did considerable damage was felt over the Eastern Counties and as far west as London and even Rugby. The centre of disturbance seems to have been at Colchester, and the wave apparently travelled from south-east to north-west, though impressions vary on this point. At Colchester, in addition to the undulations of the earth, subterranean rumblings were heard, buildings rocked to and fro, the streets were strewn with debris of fallen chimneys, a chapel spire was thrown to the ground, and other signs of seismic disturbance were evident, familiar enough to those who have been in countries where such phenomena are common occurrences. The shock, when it was most intense, commenced with a rumbling sound, increasing in intensity for about twenty seconds, and then suddenly stopped. It extended to Chelmsford, Cambridge, Northampton, Ipswich, Sudbury, Rugby, Leicestershire; it included London and the surrounding district in its sweep, and even caused some alarm in the Strand. At Woolwich it was so strong that some persons attributed the shock and noise to the bursting of a heavy gun.

We have received the following communications with reference to the earthquake:—

One of the most severe earthquake shocks which has occurred in England for many years took place this (Tuesday) morning in the Eastern Counties. The area of its chief operation lay over South Suffolk and North Essex, and the principal focus of the disturbance seems to have been the neighbourhood of Colchester. A great deal of harm has been done to property there: houses are partially unroofed, many chimneys and gable-ends of the very old houses in Colchester have been demolished, part of the spire of the Lion Walk Congregational Chapel (a well-known building), to the amount of twenty feet from the apex, was thrown down, and other details of mischief done are fast coming in. Langenhoe Church, about twenty-four miles from Colchester, is said to be all but demolished, the entire eastern end being shaken down. The Rectory also severely suffered, so that little more than the walls are standing. At Wyvenhoe, near Colchester, the church steeple is thrown down and many houses are much damaged. Other villages around Colchester have more or less suffered: Lexden, Abberton, Greenstead, Hythe, &c., all show evidences of the disturbance in their more or less shattered buildings. The shock was severely felt here at Ipswich. I was sitting down at 9.18 a.m. when the first shock occurred, and it nearly overbalanced me. I felt it must be an earthquake oscillation, although I had never experienced anything like it before, and accordingly waited and watched for the next. The oscillations followed each other for about three seconds, and apparently travelled in a north-north-easterly direction. I underwent quite a new experience, so vivid that I am not likely to forget it. The sensation approached that of nausea. In the town of Ipswich many people were alarmed, for the bells were set ringing, the pictures on the walls shaking, &c. The occurrence is too recent, however, to carefully note the direction of the oscillations. The London Clay in Suffolk and North Essex, when cut into, abounds with small faults and creeps, and this shock may be leaving another such token behind it. J. E. Taylor

Museum, Ipswich, April 22

At about 9.20 this morning I distinctly felt a slight earthquake. The motion though slight was unmistakable, the chair on which I sat, and the whole house, seemed to move to and fro for the space of, as near as I could judge, ten seconds. I regret I cannot give the exact time when I felt the shock, as I had omitted to put my watch in my pocket. A. Percy Smith

Rugby, Tuesday, April 22

This morning the earthquake was very perceptible here at exactly 9.22. It was travelling from north to south in short rapid undulations. It lasted for thirty-three seconds. My chief object in writing is to draw attention to the fact that this is the second earthquake which has shaken

London this year. On Sunday afternoon, January 13, about 4.5 p.m., while sitting in my rooms here along with my wife and my brother, I was suddenly sensible of a severe earthquake; I pulled out my watch to take the exact time, and while I was in the act of drawing their attention to the phenomenon, my wife, who has experienced with myself, numerous shocks in the Malay Archipelago, exclaimed also that an earthquake was occurring. My brother distinctly felt the shock, but was unaware what it was. It was composed of two severe shocks, with an interval of short duration between them. The house was quite still, and nothing was passing in the street, nor for more than twenty minutes did any carriage come along it. Being accustomed for several years to observing earthquake movements, I am perfectly confident of the occurrence of an earthquake at that time; and in the hope that some other observer has noted the fact, I have sent this note to NATURE. HENRY O. FORBES

87, Queen's Crescent, Haverstock Hill, N.W., April 22

MR. E. B. KNOBEL, F.R.A.S., F.G.S., writes to the *Times* from Bocking, near Braintree:—"A sharp shock of earthquake was experienced here at about 9.18 a.m. this morning. A slight trembling was first felt, followed by an oscillation sufficient to make one stagger and cause some alarm. Among the incidents which resulted, house bells were set ringing, one or two doors of cottages burst open, and clocks stopped. The safety-valve of a boiler was lifted and steam blown off for an instant. The phenomenon lasted from two to three seconds, though perhaps the latter estimate is slightly in excess of the true duration of the oscillation. The following facts may be useful in determining the direction of the wave. Three pendulum clocks in different houses stopped, the line at right angles to the plane of oscillation of the pendulum being in all cases north-west and south-east. Pendent gaslights in a factory were caused to sway in the same direction, northwest and south-east. A door was burst open, the position of which when closed was north by west and south by east. These facts would indicate a south-easterly origin of the earthquake wave."

A CORRESPONDENT at Southend states that the wave seemed to travel from north to south, while in the neighbourhood of Oxford Street the direction seemed east to west, and so also at Gray's Inn, where a correspondent felt as if the bed were slipping from under him. Doubtless by next week we shall have fuller and more precise details.

NOTES

THE final meeting of electricians to determine the practical units of electricity and light assembles in Paris on the 28th inst., when England will be represented by Sir William Thomson, Messrs. Preece, Hughes, Adams, Jenkin, Foster, Graves, and Hopkinson and Capt. Abney. The Congress is expected to last or several days.

DR. KOCH and the members of the German Commission sent last autumn to Egypt and India to investigate the cause of cholera have left Alexandria on their return to Europe.

THE Senate of Glasgow University have resolved to confer the degree of LL.D. on Prof. Osborne Reynolds, Victoria University, and Mr. Thomas Muir, High School, Glasgow.

AT Ekhmeem, a large provincial town of Upper Egypt, situate about half way between Assiout and Thebes, Prof. Maspero, returning from his annual trip of inspection up the Nile, has just found a hitherto undiscovered and unplundered necropolis of immense extent. As far as has been yet ascertained, the necropolis dates from the Ptolemaic period; but as the work of exploration proceeds, it will probably be found that it contains more ancient quarters. The riches of this new burial field would meanwhile seem to be almost inexhaustible. Five great tombs or catacombs already opened have yielded 120 mummies, and within the short space of three hours Prof. Maspero verified the sites of over 100 more similar catacombs, all absolutely intact. The necropolis of Ekhmeem, at a rough estimate, cannot contain fewer than five or six thousand embalmed dead. Of these perhaps not more than 20 per cent. will turn out to be of archæological or historical value; but the harvest of papyri, jewels, and other funeral treasures cannot fail to be of unprecedented extent. Ekhmeem is the ancient Khemnis—the Panopolis of the Greeks. Its architectural remains are insignificant.

THE Granton Zoological Station was formally opened last week; the ceremony was to have been performed by Prof. Ernst Haeckel, but illness prevented him from coming to Edinburgh, as he had intended, to be present at the tercentenary celebration.

THE annual meeting of the Iron and Steel Institute will be held on Wednesday, April 30, and May 1 and 2, at the Institution of Civil Engineers, 25, Great George Street, commencing each day at 10.30 a.m. The list of papers and subjects for discussion is as follows:—Adjourned discussions: (1) On the tin plate industry, by Mr. E. Trubshaw, Llanelly; (2) on the coal-washing machinery used by the Bochumer Verein, by Mr. F. Baare, Bochum; (3) on the manufacture of anthracite pig iron, by Mr. J. Hartman, Philadelphia, U.S.A. Adjourned papers: (1) On recent results with gas puddling furnaces, by Mr. R. Smith-Casson, Brierly Hill; (2) on a new form of gas sampler, by Mr. J. E. Stead, F.C.S., Middlesborough. New papers: (3) On the use of raw coal in the blast furnace, by Mr. I. Lowthian Bell, F.R.S., &c., Rounton Grange, Northallerton; (4) on the behaviour of armour of different kinds under fire, by Capt. C. Orde-Browne, Lecturer on Armour at Woolwich; (5) on recent progress in iron and steel shipbuilding, by Mr. William John, Barrow-in-Furness; (6) on the most recent results obtained in the application and utilisation of gaseous fuel, by Mr. W. S. Sutherland, Birmingham. In addition we believe that a paper may be expected on the important subject of iron or steel sleepers, as now used largely in Germany, in place of the timber sleepers with which we are all familiar; and possibly papers on other subjects may be at the last moment forthcoming. It will be seen that the programme presents several features of interest. Mr. Lowthian Bell, we have every reason to believe, will exhibit the conditions attending the use of raw coal instead of coke in the blast-furnace in a clearer and more satisfactory form than has ever before been achieved. Again, the great duel being fought out between armour and guns is always a matter of keen interest, and Capt. Orde-Browne's position as a skilled and yet independent observer of the struggle gives him a special right to speak upon it. He will be able to give the last results obtained with the compound or steel-faced armour now coming so much into fashion. The ordinary business of the meeting includes the election of members, reading of the Council's report, and the presentation of the Bessemer gold medals to Mr. E. P. Martin, late of Blaenavon, but now General Manager of the great works at Dowlais, and to Mr. E. Windsor Richards, General Manager to Messrs. Bolckow, Vaughan, and Co., Middlesborough, to whom we are indebted for the practical realisation of the basic process of steel-making.

COL. KINCAID, Political Agent, Bhopal, writes to us under date March 30:—"We have had a renewal of the after-glow here lately, but not nearly so intense as we had in September October, November, and part of December. The natives of the country have naturally been much exercised by the prolonged phenomenon, and still believe it portends war and tumult." Col. Kincaid also sends us an extract from Malcolm's "History of Persia," referring to an "extraordinary change in the appearance of the sun" in the year 1721, which greatly alarmed the Persians of the period.

Mr. Sydney Hodges, of Ealing, sends us a letter he has received from Mr. C. St. Barbe, of Wellington, New Zealand, dated February 17, on the green moon. "The phenomenon of a green moon," Mr. St. Barbe writes, "has been distinctly visible here during the last week or two. The colour was sufficiently decided to attract the attention of many people, and the local journals took notice of it. The moon at the time was east of north (though very little), while the crimson after-glow was in the south-west, and consequently at the back of an observer looking at the strange colouring of the moon. I am not aware whether these positions would have anything to do with the question of complementary colours, as I know nothing about such matters, and I am unfortunately unable to say whether the green tint appeared on the moon before the crimson after-glow appeared, as the latter has become such a commonplace occurrence here as hardly to be noticed." Mr. Hodges has also received a letter from his son, who reached New Zealand from Calcutta on February 13. In it he says: "I don't know whether you heard of the volcanic eruptions in Java last September. To show what a quantity of stuff was thrown up, we were sailing for *twelve days* through a sea of pumice-stone. You could see nothing else as far as the horizon on every side, and this four months after the eruption."

Dr. L. Waldo, *Science* states, has just completed the erection of a normal clock at the Yale College Observatory, to be used as a mean-time standard in the horological work of that institution. The movement and pendulum are parts of the gravity escapement clock built by Richard Bond (No. 367), and which had a phenomenal record under Mr. Hartnup at Liverpool, and later under Prof. W. A. Rogers of Cambridge. The case, from Dr. Waldo's designs, is built of cast-iron, with planed back and front, to which are clamped the plate-glass doors. The entire case rests upon two brick piers, which rise to the height of the movement, and insure stability to the pendulum suspension. Thermometers, a barometer, and a cup of calcic chloride are placed within the case, which can be exhausted to any barometric pressure desired by an air-pump attached to its side. The escapement and arc of vibration can be observed and adjusted with the greatest accuracy. The clock is erected in the clock-room of the Observatory, which was specially built to secure uniformity of temperature.

Captain Blakiston, who has been resident in Japan for more than twenty years, has recently issued an amended list of the birds of that country, with the ornithology of which he certainly possesses a better practical acquaintance than any living man. The list is founded on a previous catalogue, published in 1882 by Capt. Blakiston and Mr. H. Pryer, but the species are now arranged geographically, so as to show the distribution of birds through the different islands of Japan. The author draws attention to the natural division in the fauna of Japan, which is marked by the Strait of Tsungaru, to the southward of which the true Japanese avifauna is emphasised, while north of this strait the avifauna is Siberian in character.

The following meetings of the Society of Arts have been arranged:—Ordinary meetings (on Wednesday evenings)—April 30, "The New Legislation as to Freshwater Fisheries," by J. W. Willis-Bund. May 7, "Bicycles and Tricycles," by C. V. Boys. May 14, "Telpherage," by Prof. Fleeming Jenkin, F.R.S. May 21, "Telegraph Tariffs," by Lieut.-Col. Webber, R.E. May 28, "Primary Batteries for Electric Lighting," by I. Probert. In the Foreign and Colonial Section the following paper will be read on April 29, "The Transvaal Gold Fields; their Past, Present, and Future," by W. Henry Penning. In the Applied Chemistry and Physics Section on May 8 a paper will be read on "Cupro-Ammonium Solution and its Use in Waterproofing Paper and Vegetable Tissues," by C. R. Alder Wright, F.R.S., D.Sc.; and on subsequent evenings in the Indian Section the following papers will be read:—"Economic Applications of Seaweed," by Edward C. Stanford, F.C.S. May 9, "Indigenous Education in India," by Dr. Leitner. May 30, "Street Architecture in India," by C. Purdon Clarke, C.I.E. This paper will be illustrated by means of the oxy-hydrogen light.

During the next few weeks the following Penny Lectures will be delivered on Tuesday evenings at the Royal Victoria Coffee Hall, Waterloo Road:—April 22, "Camping out on the Thames," by the Rev. P. H. Wicksteed. April 29, "A Visit in the *Sunbeam* to the West Indies," by Sir Thomas Brassey, M.P. May 6, "Ice, and its Work in Earth-shaping," by Dr. W. B. Carpenter. May 13, "Fire, Electricity, and other Forms of Power," by Mr. Vernon Boys. May 20, "A Working Man's Dinner," by Prof. H. G. Seeley. May 27, "The Recent Eruption of Krakatão," by Mr. J. Norman Lockyer.

We have received two pamphlets on the vivisection question, viz. "Vivisection in its Scientific, Religious, and Moral Aspects," by E. P. Girdlestone (Simpkin, Marshall, and Co., pp. 68, price one shilling), and "The Utility and Morality of Vivisection," by G. Gore, LL.D., F.R.S. (F. W. Kolkmann, 2, Langham Place, W., pp. 32, price sixpence). These pamphlets are alike in that their authors argue the question on general grounds of common sense. The essay by Mr. Gore is issued by the Association for the Advancement of Medicine by Research, and is an admirable contribution to the subject of which it treats. Not being himself a physiologist, Mr. Gore's pleading is of all the more force from its non-professional character; while the fact of his being so busy a worker in other departments of science, as well as a man who has made a special study of the methodology of research, or "the art of discovery," enables him to speak not only with authority, but with unusual lucidity. The calmly forcible style in which he writes contrasts favourably with the hysterical vituperation which he quotes from the other side. This pamphlet ought to be read by every one who desires to obtain a rational as well as a truly moral view of the subject.

The fourth edition of Henfrey's "Elementary Course of Botany" will be published by Van Voorst early in May. The morphology of flowering plants has been revised and added to by Dr. Maxwell Masters, who has also made great additions to the physiological portions, while Mr. A. W. Bennett has rewritten the sections relating to Cryptogamia. This new edition will be still further enriched by numerous additional illustrations.

Hartleben of Vienna has issued the first part of a work on the oceans and their life, entitled "Von Ocean zu Ocean, eine Schilderung des Weltmeeres und Seines Lebens," by A. von Schweiger-Leichenfeld.

At a recent meeting of the Asiatic Society of Japan (reported in the *Japan Weekly Mail*), Mr. O. Korschelt read a paper on "The Chemistry of Japanese Lacquer." The paper opened with a brief account of the source and preparation of the lacquer, and of the conditions under which it hardens to the best advantage. The interest of the paper lay, however, in the very complete discussion of the chemical constituents of the substance, and the synthetic determination of which of these were most essential. The summary of results was given in these terms:—1. The raw lacquer juice is an emulsion which contains—(*a*) a peculiar acid called urushic acid (*urushi*, the native name for lacquer), (*b*) a gum, (*c*) a nitrogenous body, (*d*) water, and (*e*) a volatile acid in traces. 2. The hardening of the lacquer juice, which takes place when the latter is exposed in a thin layer of moist air of 20° to 27° C., is due to the oxidation of urushic acid into oxyurushic acid. 3. This oxidation is caused by the nitrogenous body, which is an albuminoid and acts as a ferment.

4. The oxidation is not accompanied by hydration. The water must be present only to keep the ferment in solution, which else would not act. 5. The oxidation takes place within narrow limits of temperature, ranging from about zero Centigrade to that of the coagulation of albumen. 6. The gum seems to have a favourable influence in keeping the other substances in emulsion; but in the hardened lacquer its presence is injurious, causing it, when in contact with water, to rise in blisters. 7. By a mixture of the raw juice with urushic acid, the quantity of gum present is diminished, and the dried lacquer is enabled better to resist the injurious influence of water, besides obtaining a greater transparency. 8. The admixture of more than five parts urushic acid with one part juice weakens the action of the ferment, and so deteriorates the quality of the lacquer. 9. The gum is very similar to gum-arabic, but gives a sugar with two-thirds only of the reducing power of arabinose. 10. The ferment has the composition of albumen, except that it contains much less nitrogen. 11. Diastase and the ferment in the saliva cannot replace the lacquer ferment. 12. The difference between good and bad lacquers seems to depend mainly on the relative quantities of urushic acid and water present, the inferior lacquer having less acid and more water than the superior kind. 13. The durable quality of lacquer is a property of the oxyurushic acid, which is singularly negative in its actions, resisting all solvents tried, and affected by strong nitric acid only. In the course of the discussion which followed it was observed that probably the direct effect of the investigations would be the improvement of the lacquer process, which was peculiarly a Japanese art; also that lacquer poisoning was due to the urushic acid, which only gradually disappeared during the hardening process, the best and oldest lacquers having none at all. Sugar of lead was mentioned as the best antidote for the poison.

THE last number of *Naturen* contains an interesting report by Herr L. Stejneger of the result of his last summer's exploration of Ostrof Mednij, or Copper Island, the smallest of the Komandorski group (Commodore Islands). On his arrival the chief town was found to be nearly empty, its numerous roomy and gaudily painted houses and church having been deserted while the inhabitants had gone for the fishing season to the "Lesjbitscha," or fur-seal fishing-grounds, on the other side of a rocky promontory. The dense mists which never fail at that season interfered with the naturalist's field work, but he was so fortunate as to discover a new species of Anorthura, differing equally both in form and colouring from the earlier described *A. alascensis* of of Prof. Baird, and from the Japanese *A. fumigata*, which is believed to belong also to the Aleutian Islands. Herr Stejneger, who has given this new form the name of *Troglodytes* (*Anorthura*) *pallescens*, considers that, although essentially the same as its Norwegian representative, it is still more closely allied to the Eastern Central Asian forms. Since his visit to Copper Island Herr Stejneger has found on Behring's Island another Anorthura, which differs widely from *A. pallescens*, and which he believes may prove to be the same as *A. fumigata*, common in Kamchatka. *A. pallescens* is of frequent occurrence on Copper Island. It builds its nest in the clefts of rocks at inaccessible points, and in the sound of its note, as well as in its general habits, it resembles its European kindred. The rosy finch (*Leucosticte griseinucha*), supposed to be American, was found on the Aleutian Islands, and has not been observed, as far as we know, in any other part of the Old World. Its brilliant colouring, hoarse, unmelodious song, and its preference for steep, inaccessible, rocky peaks which abound on Copper Island, make it one of the most characteristic of the local birds. Herr Stejneger has largely availed himself of the opportunities opened to him of studying the various representatives of Otariidæ and Phocidæ, which abound on the Aleutian shores, and in his paper on *Callorhinus ursinus* (the Kólik, sea-cat of the Russians, and well known as the fur-seal of the American and English traders), he has given the readers of *Naturen* an extremely interesting and comprehensive description of the appearance, habits, and commercial importance of these valuable animals. He graphically describes the forcible tactics employed by the older seals, "Sichatchi" (Russ. husbands), in keeping the juniors, "Cholustjaki" (bachelors), within their allotted grounds, and supplies many hitherto unknown details concerning distinctive characteristics dependent upon differences of age, &c.

THE last number (thirtieth) of the *Mittheilungen der deutschen Gesellschaft für Natur und Völkerkunde Ostasiens* (Yokohama) commences with an article on mines and mining in Japan, by Herr Metzger—the third important work on this subject published by Germans. The writer, who has been for five years at the copper mines at Ani, professes merely to supplement the previous writings of his countrymen. Herr Metzger's account of Japanese practical mining is somewhat melancholy reading; on all hands he finds ignorance, incompetence, waste. There is a total absence of technical officials, everything appears to be in the hands of contractors, the mining law is in a most unsatisfactory condition, and the position of the foreign mining engineer is such that he can do little to remedy evils which he sees plainly. In this respect the complaint is everywhere the same. "The scope of the foreigner is much less than might be expected under the circumstances. It seems at present to be the full intention of the Japanese to do everything themselves; and at the most to use their Europeans as advisers, although their contracts call them engineers, &c. It not unfrequently occurs that foreigners get the impression that the advice of Japanese of the lowest rank, with or without technical training, is of equal weight with their own." Herr Metzger further alleges that since Europeans have been withdrawn the production of the gold mines of Sada has considerably diminished. He asserts that by avoiding the extraordinary waste caused by ignorance and mismanagement, the mineral production of the whole country could be increased by at least fifty per cent. Herr Lehmann writes on the indoor games of the Japanese. From the reports of the meetings it appears that the capital of Japan had its Fisheries Exhibition last year. There were 15,205 exhibitors—an unexpectedly large number; and, as a consequence, the Exhibition was divided into forty-seven separate exhibitions, corresponding to the various administrative divisions. This method rendered a journey through the Exhibition wearisome by constant repetition, and added greatly to the difficulties of a systematic study of the exhibits, which were not lessened by the absence of a catalogue. The number of articles connected with fishing amounted to 3967, while the various goods made from fish and water plants reached 6474. The fishing population of Japan is given at 1,601,406. Some interesting information respecting the rearing of fish in Japan is also given.

THE Tiflis *Izvestia* contains an interesting paper on the population of the Caucasus, a new census having been made in the course of the year 1882 in several of the larger provinces of the country. It appears from this census, although incomplete, that the population has much increased since the last census of 1877. In 1867 the whole population of the Caucasus was reckoned at 4,661,800; it rose to 5,391,700 in 1876-77. It is now more than 6,500,000—the total being reckoned at 6,449,850—which figure is still considered below the reality. This large increase of more than 1,200,000 in five or six years is partly due to the recent annexations (162,980 in the province of Kars, and 92,450 in the district of Batoum), to immigration, to natural increase, and to the incompleteness of the former census. As to the natural increase, due to the surplus of births over deaths, it is estimated at an average of 13 per thousand every year in the Government of Tiflis (1875 to 1880), and at 12 per thousand in the Government of Erivan. Altogether, the mortality is, however, very great, and it is compensated only by a great number of births. As to the density of population, the 224,221 square kilometres occupied by the Northern Caucasus have 10·3 inhabitants per square kilometre, which figure reaches as much as 13·6 in Transcaucasia (248,445 square kilometres), where the density of population is the same as in European Russia. The Governments of Kutais (the valley of the Rion), Erivan, and Tiflis have respectively 33·6, 20·8, and 17·8 inhabitants per square kilometre.

AMONG the recent additions to Chinese scientific literature are translations of Margutti's "Elementary Chemistry" and Fresenius's "Chemical Analysis." These works have been translated into Chinese by M. Billequin, one of the professors of the Jung Wên Kwan, or Foreign College, at Pekin.

THE Secretary of State for India in Council has appointed Mr. David Hooper, F.C.S., of Birmingham, to the Nilgiri Government Cinchona Plantations in the Madras Presidency.

THE additions to the Zoological Society's Gardens during the past week include a Ludio Monkey (*Cercopithecus ludio*) from West Africa, presented by Mr. F. W. Robinson; a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. E. Drew; a Vulpine Phalanger (*Phalangista vulpina*) from Australia, presented by Mr. J. C. Martin; a Central American Agouti (*Dasyprocta isthmica*) from Central America, presented by Mr. Hugh Wilson; a Herring Gull (*Larus argentatus*), European, presented by Mr. Thomas Daws; a Common Viper (*Vipera berus*), British, presented by Mr. H. German; a Burchell's Zebra (*Equus burchelli* ♀) from South Africa, three Michie's Tufted Deer (*Elaphodus michianus* ♂ ♀ ♀), four Darwin's Pucras (*Pucrasia darwini* ♂ ♂ ♂ ♀), an Elliot's Pheasant (*Phasianus ellioti* ♂) from China, deposited; three Corn Buntings (*Emberiza miliaria*), British, purchased.

OUR ASTRONOMICAL COLUMN

SOUTHERN COMETS.—Dr. Oppenheim of Berlin has published elements of the comet discovered by Mr. Ross of Elsternwick, Victoria, on January 7, founded upon the Melbourne observations in *Astron. Nach.*, No. 2579, though, as he remarks, they were calculated with difficulty, owing to the existence of three oversights in the seven positions there given; hence their connection for an orbit would involve a troublesome tentative process. The position for January 17 is in error nearly two degrees.

Mr. Tebbutt has also computed elements from his own observations at Windsor, New South Wales, on January 19, 23, and 28, which represent closely the observation on February 2, the last he was able to obtain, the comet having become very faint; on January 19 he had considered it just beyond naked-eye vision. He remarks upon the discordance of his elements with those calculated by M. Barachi of the Melbourne Observatory, and observes: "I cannot account for these discrepancies, unless there be some error in the Melbourne data." We subjoin both orbits:—

	Tebbutt		Oppenheim
Perihelion Passage, 1883, Dec.	25·30038	... ...	Dec. 25·3027
	° ′ ″		° ′ ″
Longitude of perihelion	125 44 24	...	125 46 12
,, ,, ascending node	264 24 0	...	264 25 14
Inclination	65 0 55	...	65 0 51
Log. perihelion distance ...	9·491046	...	9·49094

Motion retrograde.

The time of perihelion passage is for the meridian of Greenwich, and the longitudes are referred to the mean equinox of 1884·0. It will be seen from the close agreement of the two orbits how completely Dr. Oppenheim succeeded in eliminating the Melbourne errors from his work.

In a communication to the *Observatory* of the present month Mr. Tebbutt refers to a notice in the Sydney journals copied from a Tasmanian newspaper, reporting that a bright comet had been seen at New Norfolk at 4 a.m. on December 27, bearing about east, and a few degrees above the horizon; he had searched for it in the morning sky without success. In the *Sydney Morning Herald* of March 5, Mr. Tebbutt writes:—"Within the past few days I have received, through Commander J. Shortt, R.N., the Meteorological Observer at Hobart Town, communications respecting a fine comet which was seen in Tasmania on December 25 and 27 in the morning sky. It is described as rising above the eastern horizon a few minutes before the sun; and I am strongly inclined to the opinion that this is no other than the comet whose elements I have just communicated" (the comet found by Mr. Ross). There are difficulties, however, in the way of accepting this identification, judging from such information as we have to hand. The great increase of light near perihelion passage is not explained by the elements of the comet of January 7, which by theory would only have possessed five times the intensity of light that it had at the first Melbourne observation on the evening of January 12.

THE OBSERVATORY OF PALERMO.—In *Pubblicazioni del Real Osservatorio di Palermo, anni* 1882-83, Prof. Cacciatore, the director, has collected a large number of interesting observations made chiefly in the year 1882. Prof. Riccò's astro-physical observations of the planet Jupiter extend from December 1881 to June 1883, and his descriptions of the appearance of the disk are accompanied by eighteen well-executed tinted lithographs. An extensive series of observations of the great comet of 1882, also illustrated, follows; it was last perceived with difficulty on April 7, 1883. After the conjunction of the comet with the sun it was again sought for; with a power of 110 on the refractor, and in the best condition of atmosphere, the search was unsuccessful on three evenings in September. There are other cometary and planetary observations and an appendix with the meteorological results obtained at the auxiliary station of Valverde.

GEOGRAPHICAL NOTES

THE meetings of the International Polar Conference began in Vienna last week under the presidency of Herr Heinrich Wild, the Director of the Physical Central Observatory of St. Petersburg. In his address the President praised the great merits of Count Wilczek with regard to Polar research, referred to the lamented death, since the last conference, of the Secretary of the Polar Commission, Capt. Hoffmeyer of Copenhagen, and finally gave an outline of the work done since the St. Petersburg meeting by the various expeditions and observing stations. Herr R. Müller, Director of the Hydrographic Office at Pola, was elected secretary in the place of Capt. Hoffmeyer, deceased. The principal subject discussed at the first meeting was the determination of the minimum extent to which each expedition party is bound to work out and publish its own observations at its own expense, and the establishment of a universal form of publication of results for their easier comparison. First of all the meteorological observations were discussed in this regard. The debate turned on the uniform way of noting down the obligatory observations at each station, *i.e.* the observations of temperature, atmospheric pressure, humidity, wind, clouds, hydrometeors, rainfall, and temperature of the ground, snow and ice. Among those who have arrived at Vienna are the following:—MM. R. Lenz (Professor at the St. Petersburg Technological Institute), H. Mohn (Director of the Christiania Meteorological Institute), R. H. Scott (Director of the London Meteorological Office), Lieut. P. H. Ray of Washington, Lieut. E. von Wohlgemuth (Vienna), Herr Wijkander, Prof. Guido Cora (Turin University), Capt. Dawson (Chief of the Fort Rae Expedition), Dr. Giese of Hamburg (Chief of the German Antarctic Expedition), H. Paulsen of Copenhagen (Chief of the Danish Polar Station at Godthaab), Lieut. Payen (Paris), Dr. Snellen (Director of the Utrecht Meteorological Observatory), Aksel S. Steen (of the Christiania Meteorological Institute), Count Hanns Wilczek (Vienna). The following were expected to arrive shortly:—Prof. G. Neumayer of Hamburg (Director of the German Seewarte), Prof. E. Mascart (Director of the Paris Meteorological Central Bureau), Dr. Börger (of the Kiel Marine Observatory), Prof. Lemström (Helsingfors), E. Riese (Chief of the Finnish Polar Station at Sodankyla).

THE *St. Petersburger Zeitung* contains the following details concerning the expedition which Col. Prjevalsky is now leading in Thibet. The points of departure of the expedition were Kiakhta and Ourga. From thence it was to go to Tsaidam by Alashan and Koko-Nor. In Tsaidam, at the foot of Burkhan Buda, it was the intention to establish a camp, and leave behind a section of the party and of the escort. Col. Prjevalsky, with his companions, will push forward to the sources of the Yellow River, and even to the towns of Chambo and Batanou. If the circumstances are propitious, the expedition will devote the spring and summer of 1884 to the exploration of the region of Sifanei, between Koko-Nor and Batanou, where it will surely find abundant natural riches to explore. In autumn the expedition will return to its encampment. A part of the baggage will be sent to Gast, in Tsaidam, where they will establish a second camp. From Gast the expedition will traverse Northern Thibet in the direction of Lhassa, and will try to penetrate as far as the Lake Tenegri-Pora, to reach afterwards, if circumstances permit, either the province of Dsang, or to the Brahmaputra. If not successful, however, the expedition will return part of the way and then go northwards to Ladak and to Lake Daigro-Jum-Tcho. From thence it will return to Gast, and try afterwards to go across the plateau of Thibet in another direction. From Gast, which they expect to reach in the spring of 1885, a part of the expedition will go towards Lob-Nor, and the other part towards Keria, that they also may reach Lob-Nor by way of Tcherkin. The two sections of the expedition will afterwards go together to Karakorum, and along the Khoton, and then return by Alsa to Asiatic Russia, near the Lake Issak-kul. Col. Prjevalsky left St. Petersburg on August 3, 1883, accompanied by Sub-Lieutenant Roborovsky, his assistant, and a volunteer, Kozloff. At Ourga they were joined by twenty soldiers for an escort, and on November 8 they left Ourga to cross the Desert of Gobi. The telegram just received from Alashan (dated January 20) tells of the safe arrival there of the expedition.

GEOGRAPHERS will be glad to find in the last volume of the *Izvestia* of the Caucasus Geographical Society a number of astronomical determinations of positions of places in the Transcaspian region, by M. Gladysheff. We find in the list a number of points in the oases of Akhal-tekke and Merv, and in Khorassan, and notice that the exact position of Sarakhs (western corner of the citadel) is 36° 32′ 14″·5 N. lat. and 61° 10′ 10″ E. long., 860 feet above the sea; that of Merv (garden at Kaushut-khan-kala) 37° 35′ 18″·3 N. lat. and 60° 47′ 16″ E. long., 900 feet above the sea; and that of Meshed (cupola of Imam Riza) 36° 17′ 25″·6 N. lat. and 59° 37′ 27″ E. long. The same volume contains a great number of heights measured in Asia Minor by Russian officers.

THE last issue of the *Izvestia* of the Russian Geographical Society contains a preliminary report of a journey made by MM. Adrianoff and Klementz in the still little-known islands to the south-west of Minusinsk; a note by MM. Hedroitz and Lessar, being a reply to M. Konshin's paper on the Kara-kum sands and the former bed of the Amu; a note, by M. Malakhoff on the remains of prehistoric man on the Nyeman, close by Druskeniki; the necrology of Admiral Putyatin, by Baron Osten-Sacken; and a note by M. Piltchikoff, on a magnetic anomaly between Kursk and Kharkoff.

ON THE PROGRESS OF GEOLOGY [1]

IN addressing you to-night at the opening of the session 1883 of Canterbury College, may I be allowed to appeal first to your kind indulgence? On an occasion like this you have a right to expect that only the best and most refined English should reach your ear; and if this to-night is not the case, you will, I trust, be lenient with me, as only very few foreigners have ever been able to master the beautiful and expressive English language so thoroughly that they would not now and then offend the ear of an educated audience.

When I look round me in this fine hall, and see before me such a large audience, of which a number consists of graduates of Canterbury College, it appears almost like a dream and not a reality—a reality of which we have every reason to be proud.

It is about sixteen years ago that a few earnest men, having the intellectual advancement of Canterbury at heart, met and proposed to found a university in Christchurch; but they were told by a not inconsiderable number of our citizens, some in high positions, that we were about a hundred years in advance of the wants of the colony. However, we persevered, and at last succeeded; and the best proof of the correctness of our views is the number of the graduates of the New Zealand University, of whom there are now twenty-one Masters of Arts and forty-nine Bachelors of Arts, together seventy; of whom Canterbury College can claim twenty-nine of its own, many of whom would be an ornament to any university of the home country.

And although the greater portion of our graduates mostly apply the knowledge gained to the education of others, they continue their studies for their further intellectual progress long after they have gained their well-earned degrees.

To my mind no more ennobling or higher sphere can be selected by anybody than that of the teacher. What mental energy, what moral devotion are required in the teacher, who can only be successful if he has his whole heart in the work, so that the chain of human sympathy, the most powerful tie in mankind, unites him with his pupil. In a young country, where wealth is generally considered to give power, position, and influence, and the "*auri sacra fames*" is much developed, only a refined mind can gladly and willingly turn away from those pursuits by which wealth is more easily obtained, in order to devote himself entirely to the education of the young.

Moreover, nothing shows us more clearly than teaching that we have only put our foot on the first step of the ladder leading to knowledge. We remain students our whole life; and I trust that none of our graduates will ever overrate the step gained, but that they will consider that the degree obtained has only given them an insight into the dominion of Knowledge, and has shown them how much they have still to learn; and that in fact they have become masters of the art how to learn to the advantage of themselves as well as of others.

Before entering into the subject I have chosen for to-night's address, I wish to make only a few remarks upon the development the University of New Zealand ought to take, so as to satisfy the present and future wants of our population. It was only to be expected that in the beginning its founders should have been guided by the curriculum of the great centres of learning in Great Britain, although even then some of the newer improvements were not adopted; but I may point out that under the different circumstances in which we live in a colony, we ought to have more cosmopolitan views, and profit by the experience of those States and communities which our conditions resemble most. In fact, the University of New Zealand ought to be eclectic, and to select for assimilation in its constitution the best as to manner and matter of teaching from all parts of the world.

According to my views it ought not to be at present the highest aim of a university course to offer a mass of knowledge of a chaotic character in a number of subjects, but to make the student acquainted with the general principles of the stock of knowledge possessed by the world and its application to life; to know in what direction that general stock is most deficient, and in what manner it can be augmented and made more useful both intellectually and practically.

The study of philosophy, in the highest and most general acceptance of the term, is one of the greatest wants for any university that intends to educate thinkers, men and women who not only wish to use their acquired knowledge for earning their daily bread, but to advance the human understanding.

Advancing to the subject upon which I wish to address you to-night, I have thought that some remarks on the progress geology has made and is daily making would not be inappropriate. I should also like to show, though owing to the short time assigned to me this can only be done in a fragmentary manner, how from an empirical science it has gradually been raised to be an inductive science fully deserving, as far as actual observations go, to claim the position of an exact science.

If we consult "The Cyclopædia, or an Universal Dictionary of Arts and Sciences," by E. Chambers, F.R.S., London, four large folio volumes, of which the first appeared in 1779 and the fourth in 1783, an excellent work, for which some of the most eminent men of the last century wrote, we find that the word geology, or geognosy, did not exist at that time, the principal information upon the formation and constitution of our earth being contained in the articles on basaltes, earth, fossils, geography, lithology, marine remains, mineralogy, mountain, rocks, stone, and volcano.

The explanation of the formation of "stones" is in many instances exceedingly erroneous, and appears ludicrous to us; whilst the explanation of the nature and occurrence of fossils is given quite correctly, although the theory of Tournefort, pro-

[1] An opening address delivered to the students of Canterbury College on March 28, 1883, by Julius von Haast, Ph D., F.R.S., Professor of Geology and Palæontology in Canterbury College (N.Z. University).

posed in 1702 to the Royal Academy of France, that all stones, fossils included, were derived from liquid stone seeds, is gravely considered and rejected.

The description of volcanoes, both active and extinct, is also given in a lucid manner; but the opinions as to the cause of vulcanicity are sometimes very peculiar, including the theory of Dr. Lister—that they are originated by an inflammable mineral called pyrites.

The origin of basalt (basaltes) is correctly given, according to the researches of Desmarest in Auvergne, and Raspe in Germany, so that before Werner no erroneous views on that subject were held.

But it is a most remarkable fact that there was not even an attempt made to give an explanation of stratigraphical geology, and how the different rocks were formed, or to connect certain sets of fossils with certain rocks in which they occur; so that in many respects we can claim that geology is a child of the last hundred years.

Abraham Gottlob Werner, the great teacher of the Freiberg Academy of Mining, may be considered one of the founders of modern geology. In 1785 he delivered the first course of geognosy, as distinct from mineralogy, and by his great knowledge of all matters connected with the latter science and mining, and his excellent method of teaching, he had an enormous influence upon the advancement of geology. Therefore, as far as I am aware, the word geognosy was first used two years after the last volume of Chambers' "Cyclopædia" appeared.

A great retrograde step was, however, made by Werner when he brought out his famous theory of the aqueous origin of basalt, usually named the theory of Neptunism. After the war between the Neptunists and the Plutonists (those who maintained the igneous origin of basalt) had been raging for some years, most of the disciples of Werner—acting as partisans, and instead of trying to elucidate the truth, were only bent upon making by all means in their power the cause advocated by them victorious—for a time managed to get the upper hand. Those scientific men, who knew from their own experience that Werner's doctrines on the subject were incorrect, preferred to retire from the contest, and refused to fight with the same unfair weapons.

Of equal, if not of greater importance, are the labours of James Hutton, who, in 1788, published his "Theory of the Earth," in which, for the first time, the complicated structure of the surface of the earth is explained by the agency of natural forces, still at work at the present day. With this the foundation of modern geology was securely established, and though in some respects the great Scotch philosopher went too far, his system was, nevertheless, the only true one on which his successors could build that branch of knowledge now claiming a prominent rank amongst its sisters as an inductive science. And when William Smith, the modest English land surveyor, in 1790 published his "Tabular View of the British Strata," in which the first attempt was made to connect certain fossils with certain strata, an attempt turning out a masterpiece of patient research and skill, a further great step was made in advance, and instead of merely theorising on disconnected facts, the greater portion of geological students began to rely more upon the facts collected by them and others, than upon speculative views, however fascinating they might be.

In entering upon a short review of the physics relating to the great system of which our earth is only a very inconsiderable speck, we find that although men of the highest scientific merit had tried to explain the origin and nature of the Cosmos, and the laws by which it is governed, not one speculation had been adopted at the time of the publication of the "Cyclopædia" of Chambers, as possessing all the necessary precision for the entire satisfaction of inductive reasoning.

It was only at the end of last century that Pierre Simon Laplace published his two great works, "Exposition du Système du Monde" in 1796, and "La Mécanique céleste" in 1799. This cosmogony, usually called the "Nebular Hypothesis," has hitherto stood the test of inquiry nearly a whole century; all the facts—and they are innumerable—tending invariably to testify at least to the great probability of its general correctness. In justice I ought here to mention that Immanuel Kant published in 1755 his cosmical theories in his work "Allgemeine Naturgeschichte und Theorie des Himmels," in which the great Königsberg philosopher came to the same conclusions afterwards so convincingly demonstrated by the French mathematician.

But when we leave the Cosmos and confine ourselves to our small planet, we find ourselves surrounded by such difficulties that we appear just as far now from a true conception of the constitution of the earth's interior as our predecessors were at the beginning of this century.

Numerous theories, based upon careful calculations, as to the thickness of the crust of the earth have been advanced. Some physicists give to our earth so thin a crust that it has been compared to the rind of an orange, the fruit inclosed in it representing the molten matter of the globe; others affirm that the crust is of much greater thickness, while there are some who maintain that our planet has cooled so thoroughly that it now forms a mass of rock of various density from the surface to the very centre. Other theories (or, better stated, hypotheses) giving to our globe a crust of more or less thickness, with a hard metallic nucleus in the centre, and matter in a high state of fusion filling the space between both, have been advocated by other scientific men, and mathematical proofs in support have not been wanting. However, objections apparently fatal to them all have been brought forward at one time or another by physicists, astronomers, or geologists, according to their particular line of study, and we can therefore only wait patiently and follow attentively the careful researches continued in all civilised countries, applying at the same time every new discovery to the elucidation of a problem, the more tantalising as its solution has for many years appeared to be within our grasp.

The great hopes that the deep borings lately obtained in artesian wells, or careful temperature observations in deep mines, would supply us with some material for advancing this question, by offering important and reliable data of a uniform character, have not been fulfilled. It appears, on the contrary, from the deep borings at Sperenberg, in Germany, reaching nearly to 4200 feet, that the increase of heat exhibits a remarkable retardation of its rate the deeper we descend. And even if we take convection and conductivity of the rocks into account, there are scarcely two localities where the same ratio of increase in the temperature has been observed, in some that ratio being more than treble that of others. There may once have been a uniform cooling of the original crust of the earth, now almost entirely removed or remodelled, but there is no doubt that this difference in the increase of temperature depends now either upon local generation of heat by hydro-chemical action or mechanical agencies of enormous power still at work. Thus in localising the variable increase of temperature, the *vera causa* both for the crumpling and metamorphism of rocks, for the formation of mountain chains, as well as for the origin of volcanic action, might be traced with more reliance than to seek to establish a general law that most probably no longer existed when the strata accessible to our examination were formed.

Leaving the dominion of theory and returning to the actual work of the geologist in the field, I need scarcely say that the task already accomplished has been truly gigantic. Patient research in the civilised countries of Europe, in the United States of North America, and most of the English colonies, as well as the work of travellers to almost every part of the globe—of the latter I wish only to allude to Baron von Richthofen's excellent late researches in China—have made us acquainted with such remarkable and innumerable data that it is impossible for any man, however studious he may be, to gain more than an imperfect knowledge of the material already accumulated.

The relations of the plutonic, metamorphic, sedimentary, and volcanic rocks to each other have been clearly defined, and most valuable facts have been brought together, from which the past history of our globe is being constructed, while the palæontologist has done his work equally well in classifying the wonderfully complex animal and vegetable life, always in harmony with the conditions of the earth's surface, gradually and during untold ages reaching, by evolution, the present stage of existence and perfection.

It would lead me too far to enter into a discussion of all the theories advanced as to the cause or causes by which mountain chains and seas have been formed, and volcanoes and earthquakes—because in most instances the two latter are intimately connected with each other—have been originated. Elie de Beaumont's theory of the sudden upheaval of parallel mountain chains, first published in 1833, although at one time finding great favour on the continent of Europe, was never adopted by any geologist of note, the teachings of Hutton and Lyell leaving no room for the doctrines of the paroxysmal school. Moreover, when the size and direction of mountain chains were taken into account, and the rocks composing them were carefully examined, it was found that the explanations offered by the eminent French geologist could not be adopted.

Many valuable publications have been issued upon these subjects, of which those of Robert Mallet may in many respects claim our greatest attention. Another work of great value is that of Prof. E. Suess, the eminent Professor of Geology in the University of Vienna, "Die Entstehung der Alpen," the formation of the Alps, in which this difficult question is treated in a masterly manner. Prof. Green's "Physical Geology" contains also an exhaustive *résumé* of the physics of the earth's crust, in which all the newest researches and theories are thoroughly examined and sifted by an excellent observer and practical geologist. However, there is another distinguished geologist and physicist, Constant Prevost, whom I should not omit to mention, he having already explained, in 1822, the elevation of mountain chains by tangential and lateral pressure, now mostly adopted as the correct theory. The deep-sea dredgings have also offered us considerable material to elucidate the former history of our globe, both from a stratigraphical and palæontological point of view.

The oscillation of land and sea is another subject of great importance that has hardly received that attention it deserves, whether we take the so-called glacial period into account or not. There may be with many geologists the fear of appearing heterodox if they state their belief that the hydrosphere is, like the lithosphere, subjected to considerable oscillations, by which great changes in the climate of the globe may have been brought about in past geological ages. For years I have held and stated this opinion.

However, I find that lately a great deal of attention has been paid to this subject. Thus, for instance, Ph. Fischer, Heinrich Bruns, and others, in discussing pendulum observations, have come to the conclusion that the sea-level is not a regular spheroid, but may vary many hundreds of feet even along the same parallel of latitude. Dr. Penck will also explain raised beaches and other signs of the glacial period by the oscillation of the sea-level. Penck's views in this respect are different from those of Adhemar and Croll.

Another factor for explaining great changes on the earth's surface, brought about in geological periods long past, has lately been put forward under the name of Tidal Evolution, a very ingenious theory, first worked out in its entirety by G. H. Darwin. It is based upon the action of the moon, once a part of our planet, on the earth, producing the tides and retarding its motion, as well as upon the reaction of the earth upon its satellite. Gradually the moon was driven away from our planet, and the length of day has thus at the same rate become more considerable.

However, when Prof. Robert Ball, in Dublin, and others attempt to make out that the former much larger tides, when the moon was closer to the earth, formed a powerful agent for the destruction of rocks existing at that time, and for the formation of newer beds from them, by which the thickness of the older sedimentary and fossiliferous strata can be explained, I think we have to pause before we can accept such a sequence.

Moreover, according to Sir William Thomson, there has not been any great change in the ellipticity of the earth's figure since its consolidation, consequently Mr. Darwin's views as to higher tides have to be modified, as he presupposes a more considerable ellipticity for his calculations. However, even assuming Prof. Ball's calculation, that when the moon was only 40,000 miles distant from the earth the tides at that time would rise and fall between 600 and 700 feet twice in twenty-four hours, to be correct, I have no doubt that it was long before the Cambrian or lowest fossiliferous rocks with which we are acquainted were deposited. The occurrence of numerous fossils in the oldest beds, belonging to animals that could live only in clear water, and minute ripple marks on the rocks, speak clearly against Prof. Ball's hypothesis.

This speculation in physical geography has already been tested by various geologists to account for the so-called marine denudation. This expression was first introduced by Sir Andrew Ramsay for the higher portions of ridges over large areas, that, if laid down on an imaginary plane, appear to have once formed one surface with a very gradual slope in one direction.

However, this peculiar appearance can, as I have repeatedly suggested in former publications, be easily explained by the fact that when the land gradually rose above the sea-level, abrasion on a gigantic scale must have taken place, by which, in the case of our Southern Alps, the whole had the appearance of a shallow dome, of which the western side was much steeper than the eastern, till the subaërial erosion by atmospheric agencies, or, as I called it, ridge-making, took place.

Before leaving this subject, to which I have devoted more time than perhaps I ought to have done, I may add that many speculations have been built upon it. Thus, Mr. O. Fisher attempts to prove that the ocean basin represents the scar whence the mass forming the moon separated from the earth.

Another cause of gradual retardation in the rotation of our planet, and to which, as far as I am aware, very little attention has hitherto been paid, is the increase of the bulk of our planet by meteorites and cosmic dust.

There is not the least doubt in my mind that matter, even in the most diffused state, cannot leave the outermost or gaseous portion of our planet, but that an enormous amount of matter in the form of meteorites must have been accumulated year by year. If we add to this the cosmic dust falling upon the surface of the earth, which, according to a calculation by Nordenskjöld, may amount to half a million tons yearly, the size of our planet must have been gaining in dimensions and weight to an almost inconceivable degree, even since a rich and diversified flora and fauna inhabited it. But even assuming that Nordenskjöld's estimate is far too high, and reducing it to a tenth, or to 50,000 tons yearly, the result of any calculation upon this basis is most astounding. Thus, if we take only a period of twenty millions of years, a short interval in the life-history of our planet, the cosmic dust falling during that time would add not less than 1,000,000,000,000 or one billion of tons.

And this result is obtained without accounting in any way for the further addition by the fall of meteorites, without doubt of very considerable magnitude. Such a factor, as Prof. von Nordenskjöld forcibly points out in his last work, ought certainly not to be overlooked if we wish to account for various changes in the form, position, and rate of rotation of our planet since it began to consolidate.

I am well aware that several scientific men, who have carefully examined some of the cosmic dust, have come to the conclusion that it is in most cases of terrestrial origin; but the fact remains that some of the dust collected shows its cosmic origin by its constituent parts, and that all the meteorites reach us from far beyond the atmosphere of our earth.

The importance of the great doctrine of evolution as first fully established by Darwin cannot be overestimated by the palæontologist. Applying the leading facts of the origin and distribution of animal and vegetable life, as at present existing, to the numberless past generations preserved in the marvellous stone-book of Nature, he is able to unravel more fully their history, to account for the missing leaves, and to estimate at their just value those few remaining, and of which he now and then is privileged to decipher a small portion. Darwin himself, in his classical chapter "On the imperfection of the geological record," in his "Origin of Species," has pointed out to us in his usual masterly manner how to avail ourselves of the scant material at our command, and how future discoveries, adding to the palæontological stock, will open out new vistas in the past history of our globe.

I need scarcely add that every new addition to our knowledge will assist us to gain more fully day by day an insight into the harmonious unity of the whole.

It is not yet a quarter of a century (1859) since the "Origin of Species" appeared, but if we compare our knowledge of palæontology at that time with that obtained at present, we find that striking progress has been made. Instead of a collection of facts, more or less loosely connected, we now possess a system of remarkable strength and harmony, a powerful aid to an inductive science like geology.

Evolution might be compared to an architect, who succeeds in raising an edifice of pure and noble proportions, placed upon a stable and firm foundation, from a large accumulated material of finely and ingeniously wrought building stones stored up promiscuously without any apparent plan or order.

Since the appearance of the "Origin of Species" I have always held this opinion; and I may be allowed to mention that as far back as 1862, in my opening address as first president of the Philosophical Institute, I spoke of this incomparable book as "the great work of the age."

The researches of the palæontologist have shown already convincingly that there are innumerable intermediate links between present species and those which lived in past ages. I may here, to give only one instance, refer to Huxley's important researches into the relations of the members of the family Equidæ, the Anchitherium, Hipparion, and Equus. At the same time the gulf between the different classes of vertebrates is being gradually bridged over by careful research. Thus Prof. O. C. Marsh has shown that the jurassic bird Archæopteryx from Solenhofen is closely connected with the Dinosaurs, generally considered to be most nearly allied to birds. Archæopteryx has besides true teeth in sockets, bi-concave vertebræ, the pelvic bones are separate, and the metatarsals either separate or at least imperfectly united. American fossil birds, such as Ichthyornis, have also bi-concave vertebræ (like fishes and some Saurians), and teeth in sockets. The skull of *Otontopteryx toliapicus*, found in the Isle of Sheppey, in the London Clay, has also true teeth in sockets.

There is, however, in palæobotany still a great deal that is in many respects unsatisfactory and inconclusive. This is mainly owing to the fragmentary material at our command, consisting mostly of leaves, the determination of which in many instances may lead us to wrong inferences. To give only one instance, I wish to refer to O. Feistmantel's latest researches on the palæozoic and mesozoic flora of Australia, with which our own fossil flora is closely connected.

The eminent palæontologist of the Indian Geological Survey comes to the conclusion that Phyllotheca, in Europe and Siberia of jurassic age, is palæozoic in New South Wales, and upper mesozoic in Victoria; Glossopteris, palæozoic in Australia, is jurassic in India and Russia. Noeggerathiopsis, beginning to appear in palæozoic beds in Australia, is represented by the jurassic Rhiptozamites in Siberia.

It is unquestionable that such conclusions, before they can be adopted, have to be confirmed by evidence of a still more reliable character than the present material for comparison can have afforded.

Returning to the physical conditions under which the surface of our globe has been formed and is still forming, I may here point out that since evolution has been adopted by most scientific men as a beacon to guide them to truth, the greater portion of the so-called uniformitarian school of geologists, following in the footsteps of Lyell, has become somewhat modified in its views, and may now be called the evolutional school. But let me hasten to add that Lyell himself, with his great love for truth, may be claimed as one of its first disciples, he having reviewed his own writings by the light Darwin held up to us, which is sure to advance geology even more than we can at present realise.

There is one question of great importance, in the solving of which both the geologist and the palæontologist have to go hand in hand with the archæologist. There is no doubt that the human race existed already in pliocene times; and if we can trust the reports of discoveries in Portugal and other portions of Southern Europe, man may have lived as early as the miocene age.

However, we want further and clearer evidence before this latter view can be adopted. If we consider the enormous space of time that separates us from our first ancestors, the oldest historical facts preserved seem to us as of to-day; and taking into account the wonderful progress the human race has made from the condition of the cave-dwellers, with their rude stone implements, to our present state of civilisation, we ought to look proudly upon the position mankind has attained. And we can therefore scarcely conceive the high degree of perfection, both physically and mentally, the human race may reach in future.

Although, as far as our researches go, the autochthones of New Zealand cannot boast of great antiquity when compared with the inhabitants of the Northern Hemisphere or of the tropical regions, there is nevertheless strong reason to believe that this country has been inhabited for a much longer time than was formerly generally assumed.

It is, however, possible, that some of the traces we have hitherto found of the oldest occupancy of these islands may have been left behind by occasional visitors, adventurers in search of new countries, or by crews of wrecked ships coming from distant shores.

But we have only begun to examine these questions; and although, as is always the case, the wiseacres will first shake their heads, if our researches are only continued without fear and without preconceived conclusions, we may be certain that valuable results will be in store for us.

The existence of loess beds, often of considerable thickness, in numerous parts of New Zealand, of which many have begun to be deposited before the beginning of our great glacier period, will be of great use, and offer us an excellent field for research in this direction. These beds being of subaërial origin, not only the remains of land animals are preserved in them, but we shall find in them also the traces of man. I may here mention the strange fact that the true nature of these beds has for a long time been misunderstood and misinterpreted by most English geologists. Even in the last edition of Lyell's "Elements of Geology," the loess of the Rhine is described as fluviatile loam, whilst the author himself shows that only the remains of land shells and land vertebrates are embedded in it. It has always been inconceivable to me how such an error should have remained so long uncorrected; the more so as, as far back as 1847, Alex. Braun, in "Leonhard and Bronn's Neues Jahrbuch," has shown the true state of things, and German geologists have repeatedly furnished new facts in illustration and given analyses of loess and of recent and older fluviatile deposits of the Rhine for comparison.

But, as I have previously pointed out, the peculiar nature of the loess deposits—the minute vertical capillary structure caused by the empty spaces once filled by the rootlets of innumerable generations of grasses—is a sure guide even to a tyro in geology. This structure amongst these localities is well exhibited in the fresh cuttings near Lyttelton.

I fear that the time allotted to me will not allow me to enter more fully into a review of what has already been accomplished to make geology an inductive science, and what remains still to be done, but I may be permitted to allude to one of the principal causes that retarded geology from taking its present position. This was the fear of the student to enter into antagonism with the established religious cosmogony. It is unnecessary to allude to the middle ages, because the stake or disappearance in the dungeons of the holy inquisition were the rewards of fearless physical research, and men like Galileo and Descartes were obliged to use often evasive language, unworthy of such great thinkers, in order to preserve their lives or freedom, and therefore my remarks will only apply to our own times. In proof of this I wish only to quote one work, "Vestiges of the Natural History of Creation," of which the first edition appeared in 1844. If we read this book at the present time, we can scarcely understand how it could have created such intense indignation amongst a large portion of the community, or that so much could have been written against it. Lyell himself, when publishing his "Principles of Geology," a work of a true philosopher, was, judging from some letters in his biography, very careful not to hurt too much the prejudices of his time, not wishing to mar the usefulness of his work. Even at the present time are there not thousands and thousands of well-meaning but narrow-minded persons, at once entering into strenuous opposition when there is any reference made to scientific cosmogony differing from that they have been accustomed to from their youth, and that cannot stand before the light of modern research?

However, the great principle of liberty for the teacher, so well expressed by the German word "Lehrfreiheit," cherished by the whole Teutonic race, a principle even preserved in the German universities during the darkest days of absolutism, is a safeguard of inestimable value, possessed fortunately also by our New Zealand University, the *Alma Mater* for whose advancement to the highest attainable position and general utility we ought willingly to devote our whole strength and best energies.

DUST-FREE SPACES[1]

WITHIN the last few years a singular interest has arisen in the subject of dust, smoke, and fog, and several scientific researches into the nature and properties of these phenomena have been recently conducted. It so happened that at the time I received a request from the Secretary of this Society to lecture here this afternoon I was in the middle of a research connected with dust, which I had been carrying on for some months in conjunction with Mr. J. W. Clark, Demonstrator of Physics in University College, Liverpool, and which had led us to some interesting results. It struck me that possibly some sort of account of this investigation might not be unacceptable to a learned body such as this, and accordingly I telegraphed off to

[1] Lecture to the Royal Dublin Society by Dr. Oliver J. Lodge, April 2.

Mr. Moss the title of this afternoon's lecture. But now that the time has come for me to approach the subject before you I find myself conscious of some misgivings, and the misgivings are founded upon this ground: that the subject is not one that lends itself easily to experimental demonstration before an audience. Many of the experiments can only be made on a small scale and require to be watched closely. However, by help of diagrams and by not confining myself too closely to our special investigation but dealing somewhat with the wider subject of dust in general, I may hope to render myself and my subject intelligible if not very entertaining.

First of all, I draw no distinction between "dust" and "smoke." It would be possible to draw such a distinction, but it would hardly be in accordance with usage. Dust might be defined as smoke which had settled, and the term smoke applied to solid particles still suspended in the air. But at present the term "smoke" is applied to solid particles produced by combustion only, and "dust" to particles owing their floating existence to some other cause. This is evidently an unessential distinction, and for the present I shall use either term without distinction, meaning, by dust or smoke, solid particles floating in the air. Then "fog": this differs from smoke only in the fact that the particles are liquid instead of solid. And the three terms, dust, smoke, and fog, come to much the same thing, only that the latter term is applied when the suspended particles are liquid. I do not think, however, that we usually apply the term "fog" when the liquid particles are pure water: we call it then mostly either mist or cloud. The name "fog," at any rate in towns, carries with it the idea of a hideous, greasy compound, consisting of smoke and mist and sulphur and filth, as unlike the mists on a Highland mountain as a country meadow is unlike a city slum. Nevertheless the finest cloud or mist that ever existed consists simply of little globules of water suspended in air, and thus for our present purpose differs in no important respect from fog, dust, and smoke. A cloud or mist is, in fact, fine water-dust. Rain is coarse water-dust formed by the aggregation of smaller globules, and varying in fineness from the Scotch mist to the tropical deluge. It has often been asked how it is that clouds and mists are able to float about when water is so much heavier (800 times heavier) than air. The answer to this is easy. It depends on the resistance or viscosity of fluids, and on the smallness of the particles concerned. Bodies falling far through fluids acquire a "terminal velocity," at which they are in stable equilibrium—their weight being exactly equal to the resistance—and this terminal velocity is greater for large particles than for small; consequently we have all sorts of rain velocity, depending on the size of the drops; and large particles of dust settle more quickly than small. Cloud-spherules are falling therefore, but falling very slowly.

To recognise the presence of dust in air there are two principal tests: the first is the obvious one of looking at it with plenty of light, the way one is accustomed to look for anything else; the other is a method of Mr. John Aitken's, viz. to observe the condensation of water vapour.

Take these in order. When a sunbeam enters a darkened room through a chink, it is commonly said to be rendered visible by the motes or dust particles dancing in it; but of course really it is not the motes which make the sunbeam visible, but the sunbeam the motes. A dust particle is illuminated like any other solid screen, and is able to send a sufficient fraction of light to our eyes to render itself visible. If there are no such particles in the beam—nothing but clear, invisible air—then of course nothing is seen, and the beam plunges on its way quite invisible to us unless we place our eyes in its course. In other words, to be visible, light must enter the eye. [A concentrated beam was passed through an empty tube, and then ordinary air let in.]

The other test, that of Mr. Aitken, depends on the condensation of steam. When a jet of steam finds itself in dusty air, it condenses round each dust particle as a nucleus, and forms the white visible cloud popularly called steam. In the absence of nuclei Mr. Aitken has shown that the steam cannot condense until it is highly supersaturated, and that when it does it condenses straight into rain—that is, into large drops which fall. The condensation of steam is a more delicate test for dust than is a beam of light. A curious illustration of the action of nuclei in condensing moisture has just occurred to me, in the experiment—well known to children—of writing on a reasonably clean window-pane, with, say, a blunt wooden point, and then breathing on the glass: the condensation of the breath renders the writing legible. No doubt the nuclei are partially wiped away by the writing, and the moisture will condense into larger drops with less light-scattering power along the written lines than over the general surface of the pane where the nuclei are plentiful and the drops therefore numerous and minute. Mr. Aitken points out that if the air were ever quite dustless, vapour could not condense, but the air would gradually get into a horribly supersaturated condition, soaking all our walls and clothes, dripping from every leaf, and penetrating everywhere, instead of falling in an honest shower, against which umbrellas and slate roofs are some protection. But let us understand what sort of dust it is which is necessary for this condensing process. It is not the dust and smoke of towns, it is not the dust of a country road; all such particles as these are gross and large compared with those which are able to act as condensers of moisture. The fine dust of Mr. Aitken exists everywhere, even in the upper regions of the atmosphere; many of its particles are of ultra-microscopic fineness; one of them must exist in every raindrop, nay, even in every spherule of a mist or cloud, but it is only occasionally that one can find them with the microscope. It is to such particles as these that we owe the blue of the sky, and yet they are sufficiently gross and tangible to be capable of being filtered out of the air by a packed mass of cotton-wool. Such dust as this, then, we need never be afraid of being without. Without it there could be no rain, and existence would be insupportable, perhaps impossible; but it is not manufactured in towns; the sea makes it; trees and wind make it; but the kind of dust made in towns rises only a few hundred yards or so into the atmosphere, floating as a canopy or pall over those unfortunate regions, and sinks and settles most of it as soon as the air is quiet, but scarcely any of it ever rises into the upper regions of the atmosphere at all.

Dust, then, being so universally prevalent, what do I mean by dust-free spaces? how are such things possible? and where are they to be found? In 1870 Dr. Tyndall was examining dusty air by means of a beam of light in which a spirit-lamp happened to be burning, when he noticed that from the flame there poured up torrents of apparently thick black smoke. He could not think the flame was really smoky, but to make sure he tried first a Bunsen gas-flame and then a hydrogen flame. They all showed the same effect, and smoke was out of the question. He then used a red-hot poker, a platinum wire ignited by an electric current, and ultimately a flask of hot water, and he found that from all warm bodies examined in dusty air by a beam of light the up-streaming convection-currents were dark. Now of course smoke would behave very differently. Dusty air itself is only a kind of smoke, and it looks bright, and the thicker the smoke the brighter it looks; the blackness is simply the utter absence of smoke; there is nothing at all for the light to illuminate, and accordingly we have the blankness of sheer invisibility. Here is a flame burning under the beam, and, to show what real smoke looks like, I will burn also this spirit-lamp filled with turpentine instead of alcohol. *Why* the convection-currents were free from dust was unknown: Tyndall thought the dust was burnt and consumed: Dr. Frankland thought it was simply evaporated.

In 1881 Lord Rayleigh took the matter up, not feeling satisfied with these explanations, and repeated the experiment very carefully. He noted several new points, and hit on the capital idea of seeing what a cold body did. From the cold body the descending current was just as dark and dust-free as from a warm body. Combustion and evaporation explanations suffered their death-blow. But he was unable to suggest any other explanation in their room, and so the phenomenon remained curious and unexplained.

In this state Mr. Clark and I took the matter up last summer, and critically examined all sorts of hypotheses that suggested themselves, Mr. Clark following up the phenomena experimentally with great ingenuity and perseverance. One hypothesis after another suggested itself, seemed hopeful for a time, but ultimately had to be discarded. Some died quickly, others lingered long. In the examination of one electrical hypothesis which suggested itself we came across various curious phenomena which we hope still to follow up.[1] It was some months before what we now believe to be the true explanation began to dawn upon us. Meanwhile we had acquired various new facts, and first and foremost we found that the dark plane rising from a warm body was only the upstreaming portion of a dust-free *coat* perpetually being renewed

[1] For instance, the electric properties of crystals can be readily examined in illuminated dusty air; the dust grows on them in little bushes and marks out their poles and neutral regions, without any need for an electrometer. Magnesia smoke answers capitally.

on the surface of the body. Let me describe the appearance and mode of seeing it by help of a diagram. [For full description see *Philosophical Magazine* for March 1884.]

Surrounding all bodies warmer than the air is a thin region free from dust which shows itself as a dark space when examined by looking along a cylinder illuminated transversely, and with a dark background. At high temperatures the coat is thick; at very low temperatures it is absent, and dust then rapidly collects on the rod. On a warm surface only the heavy particles are able to settle—there is evidently some action tending to drive small bodies away. An excess of temperature of a degree or two is sufficient to establish this dust-free coat, and it is easy to see the dust-free plane rising from it. The appearances may also be examined by looking along a cylinder *towards* the source of light, when the dust-free spaces will appear brighter than the rest. A rod of electric-light carbon warmed and fixed horizontally across a bell-jar full of dense smoke is very suitable for this experiment, and by means of a lens the dust-free regions may be thus projected on to a screen. Diminished pressure makes the coat thicker. Increased pressure makes it thinner. In hydrogen it is thicker, and in carbonic acid thinner, than in air. We have also succeeded in observing it in liquids—for instance, in water holding fine rouge in suspension, the solid body being a metal steam tube. Quantitative determinations are now in progress.

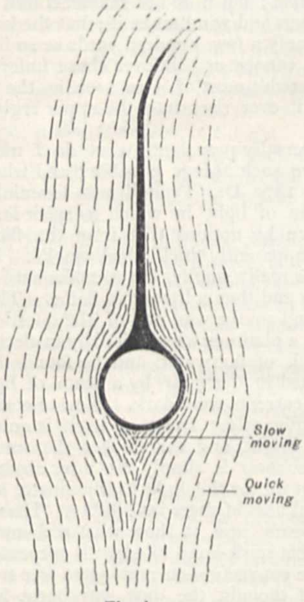

Fig. 1

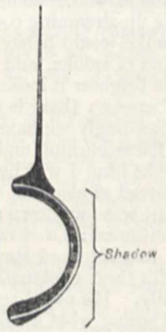

Fig. 2

Fig. 1 shows the appearance when looking along a copper or carbon rod laterally illuminated; the paths of the dust particles are roughly indicated. Fig. 2 shows the coat on a semi-cylinder of sheet copper with the concave side turned towards the light.

It is difficult to give the full explanation of the dust-free spaces in a few words, but we may say roughly that there is a molecular bombardment from all warm surfaces by means of which small suspended bodies get driven outwards and kept away from the surface. It is a sort of differential bombardment of the gas molecules on the two faces of a dust particle somewhat analogous to the action on Mr. Crookes' radiometer vanes. Near cold surfaces the bombardment is very feeble, and if they are cold enough it appears to act towards the body, driving the dust inward—at any rate there is no outward bombardment sufficient to keep the dust away, and bodies colder than the atmosphere surrounding them soon get dusty. Thus if I hold this piece of glass in a magnesium flame, or in a turpentine or camphor flame, it quickly gets covered with smoke—white in the one case, black in the other. I take two conical flasks with their surfaces blackened with camphor black, and filling one with ice, the other with boiling water, I cork them and put a bell-jar over them, under which I burn some magnesium wire; in a quarter of an hour or so we find that the cold one is white and hoary, the hot one has only a few larger specks of dust on it, these being of such size that the bombardment was unable to sustain their weight, and they have settled by gravitation. We thus see that when the air in a room is warmer than the solids in it—as will be the case when stoves, gas-burners, &c., are used—things will get very dusty; whereas when walls and objects are warmer than the air—as will be the case in sunshine or when open fireplaces are used, things will tend to keep themselves more free from dust. Mr. Aitken points out that soot in a chimney is an illustration of this kind of deposition of dust; and as another illustration it strikes me as just possible that the dirtiness of snow during a thaw may be partly due to the bombardment on to the cold surface of dust out of the warmer air above. Mr. Aitken has indeed suggested a sort of practical dust or smoke filter on this principle, passing air between two surfaces—one hot and one cold—so as to vigorously bombard the particles on to the cold surface and leave the air free.

But we have found another and apparently much more effectual mode of clearing air than this.[1] We do it by discharging electricity into it. It is easily possible to electrify air by means of a point or flame, and an electrified body has this curious property, that the dust near it at once aggregates together into larger particles. It is not difficult to understand why this happens: each of the particles becomes polarised by induction, and they then cling together end to end, just like iron filings near a magnet. A feeble charge is often sufficient to start this coagulating action. And when the particles have grown into big ones they easily and quickly fall. A stronger charge forcibly drives them on to all electrified surfaces, where they cling. A fine water-fog in a bell-jar, electrified, turns first into a coarse fog or Scotch mist, and then into rain. Smoke also has its particles coagulated, and a space can thus be cleared of it. I will illustrate this action by making some artificial fogs in a bell-jar furnished with a metal point. First burn some magnesium wire, electrify it by a few turns of this small Voss machine, and the smoke has become snow; the particles are elongated, and by pointing to the charged rod indicate the lines of electrostatic force very beautifully: electrify further, and the air is perfectly clear. Next burn turpentine and electrify gently: the dense black smoke coagulates into black masses over an inch long; electrify further, and the glass is covered with soot, but the air is clear. Turpentine smoke acts very well, and can be tried on a larger scale: a room filled with turpentine smoke, so dense that a gas-light is invisible inside it, begins to clear in a minute or two after the machine begins to turn, and in a quarter of an hour one can go in and find the walls thickly covered with stringy blacks, notably on the gas-pipes and everything most easily charged by induction. Next fill a bell-jar full of steam, and electrify, paying attention to insulation of the supply point in this case. In a few seconds the air looks clear, and turning on a beam of light we see the globules of water dancing about, no longer fine and impalpable, but separately visible and rapidly falling. Finally make a London fog by burning turpentine and sulphur, adding a little sulphuric acid, either directly as vapour or indirectly by a trace of nitric oxide, and then blowing in steam. Electrify and it soon becomes clear, although it takes a little longer than before; and on removing the bell-jar we find that even the smell of SO_2 has disappeared, and only a little vapour of turpentine remains. Similarly we can make a Widnes fog by sulphuretted hydrogen, chlorine, sulphuric acid, and a little steam. Probably the steam assists the clearing when gases have to be dealt with. It may be possible to clear the air of tunnels by simply discharging electricity into the air—the electricity being supplied by Holtz machines, driven say by small turbines—a very handy form of power, difficult to get out of order. Or possibly some hydro-electric arrangement might be devised for the locomotive steam to do the work. I even hope to make some impression on a London fog, discharging from lightning-conductors or captive balloons carrying flames, but it is premature to say anything about this matter yet. I have, however, cleared a room of smoke very quickly with a small hand machine.

It will naturally strike you how closely allied these phenomena must be to the fact of popular science that "thunder clears the air." Ozone is undoubtedly generated by the flashes, and may have a beneficial effect, but the dust-coagulating and -expelling power of the electricity has a much more rapid effect, though it

[1] See NATURE, July 26, 1883 (p. 297).

may not act till the cloud is discharged. Consider a cloud electrified slightly; the mists and clouds in its vicinity begin to coagulate, and go on till large drops are formed, which may be held up by electrical action, the drops dancing from one cloud to another and thus forming the very dense thunder-cloud. The coagulation of charged drops increases the potential, as Prof. Tait points out, until at length—flash—the cloud is discharged and the large drops fall in a violent shower. Moreover, the rapid excursion to and fro of the drops may easily have caused them to evaporate so fast as to freeze, and hence we may get hail.

While the cloud was electrified, it acted inductively on the earth underneath, drawing up an opposite charge from all points, and thus electrifying the atmosphere. When the discharge occurs this atmospheric electrification engages with the earth, clearing the air between, and driving the dust and germs on to all exposed surfaces. In some such way also it may be that "thunder turns milk sour," and exerts other putrefactive influences on the bodies which receive the germs and dust from the air.

But we are now no longer on safe and thoroughly explored territory. I have allowed myself to found upon a basis of experimental fact a superstructure of practical application to the explanation of the phenomena of nature and to the uses of man. The basis seems to me strong enough to bear most of the superstructure, but before being sure it will be necessary actually to put the methods into operation and to experiment on a very large scale. I hope to do this when I can get to a suitable place of operation. Liverpool fogs are poor affairs, and not worth clearing off. Manchester fogs are much better and more frequent, but there is nothing to beat the real article as found in London, and in London if possible I intend to rig up some large machines and to see what happens. The underground railway also offers its suffocating murkiness as a most tempting field for experiment, and I wish I were able already to tell you the actual result instead of being only in a position to indicate possibilities. Whether anything comes of it practically or not, it is an instructive example of how the smallest and most unpromising beginnings may, if only followed up long enough, lead to suggestions for large practical application. When we began the investigation into the dust-free spaces found above warm bodies we were not only without expectation, but without hope or idea of any sort, that anything practical was likely to come of it: the phenomenon itself possessed its own interest and charm.

And so it must ever be. The devotee of pure science never has practical developments as his primary aim; often he not only does not know, but does not in the least care, whether his researches will ever lead to any beneficial result. In some minds this passive ignoring of the practical goes so far as to become active repulsion; so that some singularly biased minds will not engage in anything which seems likely to lead to practical use. I regard this as an error, and as the sign of a warped judgment, for after all man is to us the most important part of Nature; but the system works well nevertheless, and the division of labour accomplishes its object. One man investigates Nature impelled simply by his own genius and because he feels he cannot help it: it never occurs to him to give a reason for or to justify his pursuits. Another subsequently utilises his results, and applies them to the benefit of the race. Meanwhile, however, it may happen that the yet unapplied and unfruitful results evoke a sneer, and the question, "Cui bono?" the only answer to which question seems to be: No one is wise enough to tell beforehand what gigantic developments may not spring from the most insignificant fact.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The following are the University and College lectures in natural science for the summer term:—

In the Physical Department of the Museum Prof. Clifton lectures on the instruments and methods of measurement employed in optics; Mr. Heaton lectures on problems in elementary physics; and practical instruction is given by the Professor and Messrs. Heaton and Walker. At Christ Church Mr. Baynes lectures on conduction of heat, and gives practical instruction on the measurements of electricity and magnetism; at Balliol Mr. Dixon lectures on elementary electricity and magnetism.

In the Chemical Department of the Museum Dr. Odling will hold an informal discussion on chemical constitution, Mr. Fisher lectures on inorganic and Dr. Watts on organic chemistry. At Christ Church Mr. Harcourt lectures on quantitative analysis and Mr. Veley on the relation between the physical properties and the constitution of organic compounds.

In the Morphological Department of the Museum Prof. Moseley lectures on the relations of the anthropoid apes and man, Mr. S. Hickson on the embryology of the chick, Mr. Jackson on Osteological Types, Mr. Poulton on Descriptive Histology, Mr. Morgan on Odontography, and Mr. Barclay-Thompson on the Anatomy of the Sauropsida.

In the Physiological Department Prof. Burdon-Sanderson lectures on the Chemical Processes of the Animal Body; at Magdalen Mr. Yule lectures on Practical Physiology.

Prof. Prestwich lectures on the Strata in the Neighbourhood of Oxford, and gives practical instruction in the field on the days following his lectures.

Prof. Gilbert will give an introductory lecture on May 6, on the Sources of the Constituents of Plants—the Soil, the Atmosphere. Dr. Tylor lectures on the Development of Arts and Sciences.

Prof. Pritchard concludes his course on the Planetary Theory, and will give a public lecture on his recent journey to Egypt in order to measure the absorptive power of the atmosphere on the light of the stars.

SCIENTIFIC SERIALS

American Journal of Science, April.—Recent explorations in the Wappinger Valley limestone of Duchess County, New York, by Prof. William B. Dwight. To the paper is appended a plate of the Wappinger Valley fossils.—Description of the Kettle-Holes near Wood's Hall, Massachusetts, with map of the district showing the positions and direction of the larger diameter of the Holes, by Prof. B. F. Koons.—Examination of Mr. Alfred R. Wallace's modification of the physical theory of secular changes of climate (second paper), by Dr. James Croll. Here the question is studied from the physical standpoint, and it is argued that a geographical change in the crust of the earth is not necessary to remove the Antarctic ice.—A contribution to the geology of Rhode Island (continued), by T. Nelson Dale.—On Mesozoic Dicotyledons (Angiosperms), by Lester F. Ward.—On the tourmaline and associated minerals of Auburn, Maine, by George F. Kunz.—On andalusite from Gorham, Maine, by the same author.—On the white garnet from Wakefield, Canada, by the same author.—Horizontal motions of small floating bodies in relation to the validity of the postulates of the theory of capillarity, by John Le Conte.—The principal characters of American Jurassic Dinosaurs; Part vii., the order Theropod (with plates 8 to 14), by Prof. O. C. Marsh.—A new order of extinct Jurassic reptiles (*Macelognatha*), (one illustration, *M. vagans*), by the same author.

THE first article in the *Journal of Botany* for April is a monograph, by Dr. Masters, on the singular "umbrella pine" of Japan, *Sciadopitys verticillata*. The most important points which he brings out are that the true leaves of *Sciadopitys* are the homologues of the true or primordial leaves of *Pinus*; that the so-called "needles" of *Sciadopitys*, although occupying the same relative position as the leaves of *Pinus*, are not necessarily morphologically homologous with them; and that the bracts of the cone of *Sciadopitys* are homologous with the true leaves of that plant, and also with the bracts of Abietineæ generally.

THE most important article in the *Nuovo Giornale Botanico Italiano* for January 1884 is one by Sig. A. Borzi, on a parasitic organism of a very low type which he finds in the ordinary cells of *Spirogyra crassa*, and to which he gives the name *Protochytrium Spirogyræ*. In its systematic position it displays, on the one hand, affinities with the Myxomycetes, on the other hand, with such genera of Chytridiaceæ as *Woronina*, *Rozella*, and *Olpidiopsis*. The entire absence of a cell-nucleus identifies it, according to the author, with Klein's family of Hydromyxaceæ, along with *Monas*, *Vampyrella*, *Monadopsis*, and *Protomyxa*. Its ordinary condition is that of a naked mass of protoplasm, endowed with amœboid movements, and living on the chlorophyllaceous contents of the cells of the host, these plasmodia having the power of coalescing like myxamœbæ; but it also has an encysted state, and in certain conditions propagates itself by the production of uniflagellate zoospores.

Rendiconti del Reale Istituto Lombardo, March 6.—Observations made at Milan on the passage of the atmospheric waves produced by the Krakatoa eruption, by E. G. Schiaparelli.—On a sensible deviation observed in the plumb-line between Milan and Genoa, by E. G. Celoria.—On a hitherto neglected sulcus or depression frequently occurring in the frontal bone of the human skull between the boss and the temporal eminence, by Prof. G. Zoja.

March 20.—Obituary notice of the late Quintino Sella, by Prof. T. Taramelli.—Memoir on Antonio Angeloni Barbiani and his literary productions, by E. B. Prina.—Biological notice of *Alosa vulgaris* and *Salmo carpio*, inhabiting the Italian and sub-Alpine lakes, by Prof. P. Pavesi.—On the complete integers of some classes of partially derived equations of any order with two independent variants, by Prof. G. Pennacchietti.—Note on the quantitative determination of alogenous bodies, by P. Ritter-Zähony.—On the two human parasites *Anguillula intestinalis* and *A. stercoralis*, by E. C. Golgi and A. Monti.—Absolute values of the magnetic elements in Milan for the year 1883, by Dr. Ciro Chistoni.

Rivista Scientifico-Industriale, March 15.—Note on Wroblewski's experimental studies on the liquidation of hydrogen.—On the variation in the electric resistance of solid and pure metallic wires according to the temperature, by Prof. Angelo Emo.—On the pretended spontaneous combination of oxygen and hydrogen without increase of temperature effected by the exclusion of light, by L. Ricciardi.—On the migration of *Fuligula rufina* and *Erismatura leucocephala*, Scop., by Dante Roster.

Atti della R. Accademia dei Lincei, March 2.—Report on Alfredo Capelli's monograph on the composition of the groups of substitutions, by S. Battaglini.—Report on Prof. G. Bellonci's memoir on blastopore and the primitive line of the vertebrates, by S. Todaro.—Remarks on a group of curves of the fourth order, by Francesco Brioschi.—An experimental refutation of the hypothesis that every double link between carbon and carbon causes an increase of molecular refraction by a constant quantity, by Rodolfo Nasini.—On the stratification of the serpentine rocks in the Apennines, part i., by Torquato Taramelli.—Note on barometric hypsometry, by Aurelio Lugli.

March 16.—Obituary notice of the late Quintino Sella, by S. Maggiorani.—Meteorological observations at the Observatory of the Campidoglio during the months of January and February.

March 23.—On some unpublished and unknown works of Bartolomeo Marliani, by Enrico Narducci.—A chemical analysis of some brass and bronze objects found at the lacustrine station of Benaco, in Lombardy, by Luigi Pigorini.—Report on the antiquities discovered in various parts of Italy during the month of February 1884, by S. Fiorelli.—On barometric hypsometry, second note, by S. Tacchini.—Absolute values of the magnetic elements in Rome for the year 1883, by S. Tacchini.—On the stratification of the serpentine rocks in the Apennines, part ii., by Torquato Taramelli.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 3.—"Spectroscopic Studies on Gaseous Explosions." By Professors Liveing and Dewar.

Having occasion to observe the spectrum of the flash of a mixture of hydrogen and oxygen fired in a Cavendish eudiometer, the authors were struck by the brightness, not only of the ubiquitous yellow sodium line, but of the blue calcium line and the orange and green bands of lime, as well as of other limes which were not identified. The eudiometer being at first clean and dry, the calcium must be derived either from the glass or from some spray of the water over which the gases with which the eudiometer was filled had been confined. It seemed incredible that the momentary flash should detach and light up lime from the glass, but subsequent observations have pointed to that conclusion. Experiments were subsequently made on the flash of the combining gases inclosed in an iron tube, half an inch in diameter and about three feet long, closed at one end with a plate of quartz, held in its place by a screw-cap and made tight by leaden washers.

The tube was placed so that its axis might be in line with the axis of the collimator of a spectroscope, and the flash observed as it travelled along the tube.

It was seen at once that more lines made their appearance in the iron tube than in the glass vessel, and one conspicuous line in the green was identified in position with the E line of the solar spectrum. Several other lines were identified with lines of iron by comparison with an electric spark between iron electrodes. There could be no doubt that the flash in an iron tube gave several of the spectral lines of iron. The authors supposed that this must be due to particles of oxide shaken off the iron by the explosion, and proceeded to try the effect of introducing various substances in fine powder, and compounds, such as oxalates, which would give fine powders by their decomposition in the heat of the flame. Several interesting observations were made in this way. When some lithium carbonate was introduced, not only were the red, orange, and blue lines of lithium very brilliant, but the green line hardly less so. After the lithium had once been introduced into the tube, the lithium lines continued to make their appearance even after the tube had been repeatedly washed. When the lithium had been freshly put in, the red line was observed to be much expanded, very much broader than the line given by lithium in a Bunsen burner reflected into the slit for comparison. The light was dazzling unless the slit was very narrow; and it was noticed that if the spark by which the gas was fired was at the distant end of the tube, so that the flame travelled along the tube towards the slit, there was a reversal of the red line; a fine dark line was plainly visible in the middle of the band. When the spark was at the end of the tube next the slit, no reversal was, in general, seen. Later observations showed that some other metallic lines might be reversed in this way, and photographs taken of the reversals. These observations with the eye on the reversal of the red lithium line were made with a diffraction grating, and were repeated many times. They show that there are gradations of temperature in the flame, and that the front of the advancing wave of explosion is somewhat cooler than the following part. The combination of the gases is not so instantaneous that the maximum temperature is reached at once. When some magnesia was put into the tube the continuous spectrum was very bright, but the iron lines were still brighter. No line which could be identified as due to magnesium was observed with certainty; there was only a doubtful appearance of *b*. With sodium, potassium, and barium carbonates, only the lines usually seen when salts of those metals are introduced into a flame were noticed; but eye observations of this kind are extremely trying, on account of the suddenness of the flash and the shortness of its duration. Thallium gave the usual green line.

Subsequently the interior of the tube was bored out so as to present a smooth bright surface of iron, and the iron lines which were conspicuous in the flash were noted.

For the purpose of identification the pointer in the eye-piece was first placed on one of the strong iron lines given by the electric discharge between iron electrodes, and then, the discharge being stopped but the field sufficiently illuminated, the eye was fixed steadily on the pointer while the gas in the tube was exploded. In this way it was not difficult to see whether any given line was very bright in the flash. The lines thus identified were those having the wave-lengths about 5455, 5446, 5403, 5396, 5371, 5327, 5269 (E), 5167 (b_4). These lines were all many times observed in the way described, and as a rule were always present in the flash. Lines with wave-lengths about 5139 and 4352 were seen, and may possibly have been due to iron, and several more lines were seen occasionally, but were not so regularly seen that they could be well identified. The lines λ 4923 and λ 4919 were specially looked for, but neither of them could be seen. A group of blue lines were noticed, and were afterwards identified by photography, a method much less trying than observations by eye. To give intensity to the photographs ten or twelve flashes were usually taken in succession without any shift of the instrument, so as to accumulate their effects in one photograph. For identification the spark between iron electrodes was also photographed, but with a shutter over the lower part of the slit, so that the image of the spark should occupy only the upper part of the field.

Some sixty of the iron lines in the indigo, violet, and ultra-violet were thus photographed.

As a rule no iron lines above O make their appearance; in a few plates T is visible, and it is possible that other lines may be obscured by the water spectrum, which always comes out and extends from near *s* to below R. Above T no line at all is visible in any of the photographs, though the spark lines come out strongly enough, and several of the strongest groups of iron lines, both of spark and arc lines, are in the region beyond T.

Other experiments were made with explosions of carbonic oxide and oxygen, and with coal-gas and oxygen. The explosions of these gases were attended with much more continuous spectrum, and the metallic lines were not always as well developed as they were with hydrogen and oxygen, but on the whole there were as many metallic lines photographed from the flashes of carbonic oxide as from those of hydrogen.

When the iron tube was lined with copper foil, only one copper line in the visible spectrum, λ 5105, was seen, and in the ultra-violet two lines, λ 3272 and λ 3245·5. All three lines were very strong, and the two ultra-violet lines were in some cases reversed. These lines were also frequently developed when no copper lining was in the tube, probably from the brass of the small side tubes.

Copper also gave a line in the indigo, λ 4281 about, decidedly less refrangible than the copper line, λ 4275, coincident apparently with the strong edge of one of the bands developed when a copper salt is held in a Bunsen burner.

A lining of copper which had been electro-plated with nickel developed only one nickel line, λ 5476, in the visible part of the spectrum, but gave by photography twenty-five lines in the ultra-violet.

When copper wire electro-plated with cobalt was put into the tube twenty-two cobalt lines in the violet and beyond were photographed.

No other metal gave anything like the number of lines that were given by iron, nickel, and cobalt.

A lining of lead gave the lines λ 4058, 3683, and 3639 strongly, and these lines were frequently developed, though less strongly, when there was no lead lining; the metal being without doubt derived from the leaden washers used to make the ends of the tube air-tight.

A strip of silver gave the lines λ 3381·5 and 3278, and these lines were sometimes reversed. No trace of the channelled spectrum of silver was developed even when silver oxalate was put into the tube, and furnished plenty of silver dust after the first explosion.

A magnesium wire about 2 millims. thick and two-thirds the length of the tube gave the *b* lines very well; that is to say b_1 and b_2 were well developed, and b_4 was also seen, but as the iron and magnesium components of b_4 are very close together, and the iron line had been observed before the introduction of the magnesium, it was not possible to say with certainty whether or not the magnesium line were present too. No other magnesium line could be detected. The blue flame line was carefully looked for, but could not be seen. The photographs showed none of the magnesium triplets in the ultra-violet, nor any trace of the strong line λ 2852, which appears in the flame of burning magnesium, and is yet more conspicuous in the arc when that metal is present.

Metallic manganese, introduced into the tube in coarse powder, gave the group at wave length about 4029 with much intensity, but no other manganese line with certainty. In the visible part of the spectrum the channellings in the green due to the oxide were visible.

A lining of zinc produced no zinc line, and zinc-dust gave only a very doubtful photographic impression of the line λ 3342. A strip of cadmium gave no line of that metal either in the visible or in the ultra-violet part of the spectrum.

Tin, aluminium, bismuth, and antimony, also failed to produce a line of any of those substances, and so did mercury which was spread over copper foil made to line the tube.

Thallium spread as amalgam over the copper lining gave the lines λ 3775·6, 3528·3 and 3517·8.

Chromium was introduced as ammonium bichromate, which of course left the oxide after the first explosion. This gave the chromium lines with wave-lengths about 5208, 5205, 5204, 4289, 4274·5, 4253·5, very well and persistently, also the lines with wave-lengths about 3605, 3592·5, 3578·5.

Sodium salts (carbonate, chloride) developed the ultra-violet line λ 3301; and potassium salts give the pair of lines about wave-length 3445; but no more refrangible line of either metal was depicted on the photographs. Lithium carbonate gave, besides the lines in the red, orange, green, and blue, the violet line, λ 4135·5; but no more refrangible line.

Photographs of a flame of mixed coal-gas and oxygen, in which an iron wire was burnt, show, as might be expected, the same iron lines as are developed in the flash of the detonating gases, and of the same relative intensities. These intensities are not quite the same relatively as they are in the arc spectrum. Thus the lines λ 3859, 3745, 3737, 3735, and 3719 come out in great strength, much stronger than the lines λ 3647, 3631, 3618, which are remarkably strong in the arc.

German-silver wire, burnt in the flame of coal-gas and oxygen, gave the same nickel lines as were given by nickel in the detonating gases, as well as those of copper and lead.

Copper wire gave, besides the lines λ 3272, 3245·5, a set of bands in the blue, which correspond with those given by copper salts in flames, and are probably due to the oxide.

The greater part of the lines observed in the flames of the exploding gases have been observed by the authors to be reversed when the several metals were introduced into the arc in a crucible of lime or magnesia; which is quite in accord with the supposition that the metals experimented on are volatile, and emit as well as absorb these particular rays, at temperatures lower than that of the arc.

That iron is volatile at a temperature below the fusing point of platinum, which is about 1700° C., has been pointed out by Watts (*Phil. Mag.*, vol. xlv. p. 86), who observed in the flame of a Bessemer converter almost all the green and blue lines of iron which we have seen in the exploding gases, besides one or two lines which we have not observed or identified. Having regard to this volatility of iron, it does not seem so surprising that iron lines should be observed accompanying those of hydrogen to great heights in the sun's atmosphere as that they should not be always seen there.

Copeland (Copernicus, December, 1882) observed in the spectrum of the great comet of 1882 four lines nearly identical with four of the green lines of iron seen in the detonating gas.

It is remarkable that such volatile metals as mercury, zinc, and cadmium should give no lines in the flame of the exploding gases.

The absence of any metallic lines more refrangible than T in the flame of the exploding gases may be in part due to a falling off in the sensibility of the photographic plates for light of shorter wave-lengths; but as the spark lines of iron seem to be quite as strongly depicted on the plates in regions of the spectrum far above T as they are in the regions below, want of sensitiveness in the plates cannot be the only reason for the absence of higher lines, but probably the emissive power of the metals for these lines is feeble at the comparatively low temperature of the flame.

Gouy (*Comp. R.*, 1877, p. 232), using a modification of Bunsen's burner fed with gas mixed with spray of metallic salts, observed at the point of the inner green flame three or four iron lines which have not been observed in the flame of the detonating gas, the lines b_1 and b_2 of magnesium, two cobalt lines in the blue which are not seen in the detonating gas, one line of zinc, and one of cadmium, and the two strong green rays of silver. Can the appearance of these rays under these circumstances imply that the temperature of the inner green cone of a Bunsen burner, when the proportion of air to coal-gas is near the exploding point, is higher than that of the explosion of hydrogen and oxygen?

The interesting theoretical questions which are suggested by the facts recorded in this paper the authors leave for further discussion.

Linnean Society, April 17.—Alfred W. Bennett, M.A., in the chair.—Messrs. R. Lloyd Patterson and Benjamin Lomax were elected Fellows.—Dr. J. Poland exhibited under the microscope a series of preparations, stained by reagents, illustrating the *Bacillus* of anthrax of man. He remarked on the severely fatal character of the malady, not only in this country but on the Continent and certain places abroad. The *Bacillus*-spores were in many instances doubtless conveyed in the dried skins and hides imported from abroad, and under favourable conditions inoculated those handling the dried hides, &c., the germs developing in the usual manner of the low vegetable organisms. —Dr. R. C. A. Prior drew attention to specimens of *Draba aizoides* obtained from Pennard Castle, Swansea, said to be the only locality where this plant grows wild in England.—The ninth contribution to the ornithology of New Guinea, by Mr. R. Bowdler Sharpe, was read, and it dealt with some few birds obtained by Mr. A. Goldie in the Astrolabe Mountains.—A paper was read by the Rev. J. M. Crombie on the algo-lichen-fungal hypothesis. The author gave a brief sketch of the hypothesis as enunciated by Schwendener, Bornet, and others, noticing the various arguments and illustrations which had been adduced in its support. He then discussed the result which had been obtained from experiments in lichen-culture, whether from the spore or by synthesis—observing that in both cases these were confessedly but small, owing to the very great difficulty of cultivating beyond a rudimentary stage except under the same atmospherical conditions in which they grow in nature. Two fatal objections he said might be taken to th theory: (1) the one having reference to the very peculiar nature of the parasitism it assumed, and the other (2) to the fact that notwithstanding a similarity of appearance there were in reality no true fungal-mycelia nor true algal-colonies in lichens. As to any direct genetic or any indirect parasitical connection between the gonidia of lichens and the hyphal filament, it was further pointed out that none such existed, but that on tracing the evolution of the thallus from the germinating spore, it is seen that the gonidia originate in the cellules of the first parenchymatous tissue formed upon the hypothallus, and that subsequently through the resorption of the lower portion of the cortical stratum they became free, and constituted the thin gonidial stratum. Where seen lying amongst the medullary hyphæ they are often attached to these, not as the result of any copulation, but by means of the lichenin which permeates the whole thallus. The origin of the gonidia and their relation to the rest of the lichen thallus, the author stated in conclusion, thus belonged to the very elements of morphological botany.—There followed a note on a remarkable variation in the leaf of *Banksia marginata* observed by Mr. J. G. Otto Tepper in South Australia; and he questions whether this might not be regarded as the spontaneous production of a new variety or species or the remnant of an extinct form.—Mr. R. A. Rolfe then discoursed on *Hyalocalyx*, a new genus of Turneraceæ from Madagascar. According to Dr. J. Urban (the latest authority) the order consists of five genera and eighty-three species distributed in America from North Carolina and Mexico to the Argentine Republic, and in Africa from Abyssinia to Mozambique and the Cape of Good Hope, while outliers are found in the islands of Zanzibar and Rodriguez. The unique example now added was obtained by Dr. C. Rutenberg on Nossi-bé, a small island on the north-west of Madagascar. Its peculiarities incline Mr. Rolfe to regard it as the type of a new genus with a position between *Mathurina* and *Turnera*; its most remarkable character being its glassy transparent calyx totally destitute of chlorophyll.

Chemical Society, April 17.—Dr. Perkin, F.R.S., president, in the chair.—A ballot was held, and the following gentlemen were elected Fellows:—W. D. Borland, J. C. Bose, W. D. Crumbie, A. F. Dimmock, H. G. Greenish, W. J. Grey, J. Gaskell, J. W. Pratt, A. G. Perkin, W. H. Perkin (jun.), G. H. Wainwright.—The following papers were read:—On the influence of incombustible diluents on the illuminating power of ethylene, by P. F. Frankland. Mixture of ethylene with carbonic anhydride, nitrogen, aqueous vapour, and air, have a lower illuminating power than pure ethylene. Mixtures with oxygen have a greater illuminating power than pure ethylene; carbonic anhydride is the most and air the least prejudicial to the illuminating power.—On trichloropyrogallol, by C. S. S. Webster. The author has prepared mairogallol by the method of Stenhouse and Groves. He finds that the reaction can be separated into two stages, in the first of which trichloropyrogallol is formed. Its reactions are identical with tribromopyrogallol. The author confirms the statements of Stenhouse and Groves in almost every particular.—The synthesis of galena by means of thiocarbamide, by J. Emerson Reynolds. The author has succeeded in coating glass vessels, brass tubes, &c., with a nitrous galenoid coating, by the decomposition of an alkaline solution of lead tartrate with sulphur urea.—On the analysis of Woodall Spa, by W. T. Wright. This spring contains a large amount of bromine (49·7 parts per million) and iodine (5·21 per million); it is much richer in these elements than any other spring in this country.—On the critical temperature of heptane, by T. E. Thorpe and A. W. Rücker. By calculation it is found to be about 281°.

SYDNEY

Linnean Society of New South Wales, February 27.—The following papers were read:—Monograph of the Australian sponges, by R. von Lendenfeld, Ph.D., part I. This paper is introductory to a monograph upon the Australian sponges, large materials for which have already been accumulated by the author, partly from his own collections, and partly from those in the Museums of Christchurch and Dunedin, New Zealand, and of Adelaide, South Australia. The real investigation of this branch of the Cœlenterata may be said to begin with the work of Grant, 1826; to have risen to a new and much higher level under Schulze, 1875-1881, and to have been continued by Lollas, Keller, Vosmaer, Marshall, the author, and others, with continually increasing success up to the present time. A sufficient account of the bibliography of the Spongida is presented in this paper to enable those interested to find any desired information upon the subject, a matter of no small difficulty at present.—The *Scyphomedusæ* of the southern hemisphere, by R. von Lendenfeld, Ph.D., part I. The *Scyphomedusæ* or "jelly-fish" appear to be more numerous in the southern than in the northern hemisphere. Of the 210 known species, 104 have already been found in the former, and as the animals of that hemisphere are not nearly so well known as those of the northern, the number of southern species must doubtless be much greater than that mentioned. Only twenty-six of the 104 southern species are Australian, but this apparent poverty of the Medusæ of our shores is due to the limited investigation that has been made. In this paper all the species of this hemisphere are described.—Notices of some new fishes by William Macleay, F.L.S. Four species are here described. Two of them, *Platycephalus longispinis* and *Urolophus bucculentus* were taken in the trawl in deep water outside the Heads of Port Jackson. The third, *Petroscirtes wilsoni*, was found by Mr. J. D. Wilson at the North Shore; and the fourth, *Athirinosoma jamiesoni*, was a small freshwater fish from the Bæmer, one of the head waters of the Brisbane River.—On the improvement effected by the Australian climate, soil, and culture on the Merino sheep, by P. N. Trebeck. In this paper Mr. Trebeck traces the changes and improvement which wool has undergone in Australia since the first introduction of German and Silesian sheep. Samples of the wool of all the periods and flocks alluded to were exhibited. Mr. Trebeck concludes his paper by stating his opinion that the whole of the country on our western watershed was eminently suitable for the Merino sheep, and that we only required the fostering assistance of an intelligent Government to keep in the front ranks of the wool-producing countries of the world.

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