THURSDAY, SEPTEMBER 15, 1881

THE THEORY OF DESCENT

Studies in the Theory of Descent. By Dr. Aug. Weismann, Professor in the University of Freiburg. Translated and Edited by Raphael Meldola, F.C.S. Part II. On the Origin of the Markings of Caterpillars. On Phyletic Parallelism in Metamorphic Species. With Six Coloured Plates. (London: Sampson Low, Marston, Searle, and Rivington, 1881.)

THE first part of this work, devoted to an examination of the phenomena of seasonal dimorphism in butterflies, was noticed a little more than a year ago (NATURE, vol. xxii. p. 141). We now have a second instalment of much greater bulk, comprising two separate essays. In the first and most important of these Dr. Weismann gives us the results of a detailed study of the changes in the markings of the caterpillars of the Sphingidæ during the course of their growth and development, and enters at great length into the various questions to which the phenomena observed give rise. Accepting the doctrine that the *ontogeny* or development of the individual gives us a more or less accurate notion of the *phylogeny* or course of development of the race, he endeavours with some success to determine the ancestral forms of the various genera of the Sphingidæ by means of the successive changes of form and coloration of the larvæ. The main facts which he has here established are, that all the larvæ are born of a uniform tint—that the first markings are longitudinal lines—that the oblique lines when they exist always appear later, and the ringed or ocellated spots last of all. Great changes of colour also occur in some species, but all the more important changes, whether of colour or marking, only take place after the larvæ have acquired a considerable size. From the whole assemblage of facts in this branch of the inquiry he deduces the following three laws of development:—

"1. The development commences with a state of simplicity, and advances gradually to one of complexity.

"2. New characters first make their appearance in the last stage of the ontogeny.

"3. Such characters then become gradually carried back to the earlier ontogenetic stages, thus displacing the older characters until the latter disappear completely."

These laws are liable to be modified in various ways by the influence of natural selection, and especially by the need for protection, whence arise the various markings of the different groups, and the peculiar divergences often noted in their development at corresponding ages.

Having thus established the general developmental history of the markings of caterpillars, and explained by a few simple principles the chief anomalies they present, Dr. Weismann passes on to the still more interesting inquiry as to the biological value or actual meaning and use of the markings in each individual case. He first shows that colour itself, irrespective of marking, has a distinct biological value, being always either protective or a signal of uneatableness. The Sphinx larvæ when young are almost always green, resembling the leaves of the plants on which they feed and rest. When they get larger, however, they frequently change to brown, and this change is always accompanied by a change in habits, the insect feeding at night, but during the day concealing itself on the ground or amidst dead leaves and branches. This occurs chiefly among the species which feed on low shrubs or herbs and can thus easily descend to the ground to conceal themselves during the day; while those which feed on large trees acquire markings which assimilate them more completely to the foliage or flowers which surround them. The simplest form of marking—longitudinal stripes—is common on all caterpillars which feed on grasses or other plants in which straight *lines* are a prevalent feature, and this style of marking is that which usually appears in the young sphinx larvæ. But as they grow larger diagonal stripes or bands variously tinted or shaded appear, and this style of marking is found to assimilate so well with the oblique veining of the leaves that the caterpillars are very difficult to see when resting among them. This is the case even when the oblique lines are margined with violet or other bright colours, since, however conspicuous these markings may be when the insect is examined in captivity, they are found to blend perfectly with the lights and shadows of the foliage which surround it in its natural habitat. As an example we have the following account of the brilliantly coloured larva of the Death's-Head Moth on one of its natural food-plants:—

"At Cadiz on the hot, sandy shore, *Solanum violaceum* grows to the height of three feet, and on a single plant I often found more than a dozen *Atropos* larvæ resting with the head retracted. It can easily be understood why the lateral stripes are blue when one has seen the South European *Solaneæ*, on which this larva is at home. *Solanum violaceum* is scarcely green: violet tints alternate with brown, green, and yellow over the whole plant, and between these appear the yellow-anthered flowers, and golden yellow berries the size of a greengage. Thus it happens that the numerous thorns, an inch long, between which the caterpillar rests on the stem, pass from violet into shades of blue, red, green, and yellow."

Many of the adult sphinx larvæ however are adorned with ring-spots or eye-spots, and these have been found to serve two distinct purposes. Sometimes they occur on several of the segments, but of slightly different sizes, as in a North American species (*Chærocampa tersa*), the red spots on which imitate the small red flowers of the plant on which it feeds; while in the European *Deilephila hippophaes*, the grey-green larva with orange-red spots so exactly assimilates to the foliage and fruit of the sea-buckthorn on which it feeds, that Dr. Weismann has often shown to people as many as six or eight of the large caterpillars on one buckthorn branch without their being able at once to detect them. In other cases we find very large eye-spots on the fourth or fifth segments only, coupled with the habit of retracting the head and first three segments, so that an appearance is produced of a broad head with two very conspicuous eyes. Whenever the insect is disturbed it thus retracts itself, and it has often been conjectured that the effect is to frighten away its enemies. This Dr. Weismann has proved to be actually the case. On placing the larva of the Elephant Hawk-Moth (*Chærocampa Elpenor*) in a trough used for feeding fowls, a number of sparrows and chaffinches flew down from the neighbouring trees to pick up some stray food.

"One bird soon flew on to the edge of the trough, and

was just about to hop into it when it caught sight of the caterpillar, and stood jerking its head from side to side, but did not venture to enter. Another bird soon came, and behaved in a precisely similar manner; then a third, and a fourth; others settled on the perch over the trough, and a flock of ten or twelve were finally perched around. They all stretched their heads and looked into the trough, but none flew into it."

On removing the caterpillar the birds again assembled, and at once entered the trough to feed. Fowls were also frightened at first, and would draw back just as they were going to peck at the caterpillar. At last, after several had tried, and even made ineffectual attempts to peck, one more courageous than the rest would actually touch it, and after a time, finding nothing disagreeable, the insect would be swallowed. In the genus Deilephila, however, there are uneatable caterpillars, and these have strongly contrasted black and white or yellow spots combined with the habit of fully exposing themselves upon their food plants. Dr. Weismann experimented with two species (*D. galii* and *D. euphorbiæ*) and found that they were refused by birds, though the latter was eaten by lizards. It is to be noted however that the experiments were made with a South European species of lizard, not that of Germany, so that the result has not a direct bearing on the point.

The general conclusion at which Dr. Weismann arrives is, that all the varieties of colour and marking occurring in the Sphingidæ have a distinct biological value, and can in every case be traced to the action of natural selection and correlation of growth.

The next essay is not quite so interesting or important. It is an endeavour to prove, by a distinct line of inquiry, that the markings of the larvæ are not due to a "phyletic vital force" or to general laws of growth and development. The different groups of Sphingidæ are minutely examined and compared in their three stages of larva, pupa, and imago, and it is shown that the changes that occur from species to species in each stage are to a great extent independent of the changes in the other stages. Numerous examples of this want of phyletic parallelism are given, and it is hence argued that the modifications which occur must be due to an adaptation to the special conditions to which the insect is exposed in one or other of its states, not to any innate law of variation and development, which, it is argued, would affect all the stages *pari passu* and produce a "phyletic parallelism" which does not actually exist. The same general facts are shown to prevail, not only among Lepidoptera generally, but among all insects and crustacea—or generally among all organisms which undergo a metamorphosis.

This instalment of the work has been admirably translated and edited by Mr. Meldola, who, in a series of valuable notes and an Appendix, has brought up the information on every branch of the inquiry to the latest date. The six coloured plates of larvæ in their several stages are very well executed, and serve to illustrate the somewhat complex discussion in a clear and effective manner.

ALFRED R. WALLACE

OUR BOOK SHELF

The Wandering Jew. By Moncure Daniel Conway. (London: Chatto and Windus, 1881.)

THIS last volume of Mr. Conway's is a study, not only of the legend of the Wandering Jew, but with it of the large group of analogous myths of undying men who from age to age wander over the earth, or sleep in caverns, or are translated from among men into divine regions, whence however they come back and show themselves still living men. The interest of these stories in the history of philosophy lies in their keeping up men's early ideas of life and death. One of Mr. Conway's purposes in discussing them is to draw attention to their being relics of the primitive period when men were still so far from definitely realising the nature of death, that they had no difficulty in regarding kings, heroes, and prophets as having only departed for a while from among them, to return in a future age to rule and protect their expectant nations. In comparative mythology this group of stories has some importance. They show the beliefs of various races running curiously into one another, as where the Lancashire peasant still hears in the cry of the plover the wail of the Wandering Jew, or in the Harz Mountains his myth has got mixed with that of a grander wanderer, the Wild Huntsman, who courses with his storm-clouds across the sky. The storm-demon whom mythic fancy imagines rushing through the air is often called a *Maccabee*, and Mr. Conway points out why he has this name. It is because of a verse in the Second Book of Maccabees, chap. v., which, by the way, is a good instance of the personal forms taken by the fancy of an excited people: "And then it happened, that through all the city, for the space almost of forty days, there were seen horsemen running in the air, in cloth of gold, and armed with lances, like a band of soldiers." Unfortunately some other etymologies made or quoted by Mr. Conway are not so reasonable as this. When the names of biblical personages, *Herod* and *Ahasuerus*, find their way into European myths, it may not be easy to explain how they got there, but at any rate it is better to leave them alone than to make up imaginary and even impossible German or Scandinavian forms, *Haar-Rote*, *As-Vidar*, to account for their presence. It would be easy to take exception to many of the arguments in this volume, but at any rate there are many interesting points in it.

A Short Sketch of the Geology of Yorkshire. By Charles Bird, B.A. (Univ. Lond.) (London: Simpkin, Marshall, and Co.; Bradford: Thomas Brear, 1881; pp. 187 and Map.)

Geological Map of Yorkshire. By the same Author. (Edinburgh and London: W. and A. K. Johnston; Bradford: T. Brear, 1881.)

IN the preface of this book, written by way of dedication, it is represented to be a "small and cheap volume suitable to the 'general reader' and tourist." It is impossible to say that it is not a useful and interesting one. So much good work has been done on the county, though scattered through very various publications, that a short *résumé* cannot fail to be of value; but there are books and books, and if we measure this by what it might have been, it is poor indeed. It resembles, in fact, geologically speaking, a kind of boulder clay, full of fragments of solid rock, brought from a distance—we will not say to be deposited in mud—but certainly scratched and rubbed in the process. In the beginning of the volume is a list of the surrounding mountains whence the boulders have been derived, but it is not a complete one; and the source of each fragment is not indicated in the body of the text. Its great defect is that it is unstratified; in other words, the extracts are not duly digested, but thrown together without sorting, and with very little alteration; so little indeed that it would not be difficult to trace them to their sources. Thus under the head of "The Carboniferous Period" we have a brief explanation, from a popular lecture, "how from the general mineral character of a rock the circumstances under which it was formed can often be predicated." Then under the head of "Salt water deposits" we have twelve pages on the origin and contents of the Victoria

Cave, which ought surely to belong to the chapter on the "Recent Geological History of Yorkshire," only that the latter happened to be written by one who confined himself to the Holderness drift. Under the head of "The Permian Rocks" there is an exposition of the views of those who would reintroduce the old (not recently suggested) name Poikilitic to include the Trias. It was a pity the author was not acquainted with any recent papers on the series above the Lias, for there are no good boulders in this part of the book. Mr. Hudleston's admirable papers on the Yorkshire Oolites seem to have been written in vain, and there have been modern papers also on the Yorkshire Chalk. It was perhaps excusable for our author to conclude that the third edition of Prof. Phillips' "Yorkshire Coast" contained all the most recent information, though every East-Yorkshire geologist knew that it did not. In examining a work on local geology it is always well to see where the author lived, for the surrounding country will be the best described. So it is here; the best part of the book is the description of the Middle and Upper Coal-measures, which are well developed in the neighbourhood of Bradford. For East Yorkshire and the coast the book is of little value.

The topography of the map requires no other guarantee than the name of the constructors for its excellency. The south-western part of the geological colouring derived from the Geological Survey maps is also very good. Nor can we complain when lack of published material prevents accuracy elsewhere, though it is a reason for regretting the slow publication of the Geological Survey maps which have been long ago completed; but when the whole of the Vale of Pickering is coloured Neocomian, and a patch of the same is placed in the south near Cave, scarcely an acre of rocks of that age being discoverable in the former, and none in the latter locality, one is led still more to regret that the author's map should be spoiled by his not knowing Mr. Hudleston's papers and relying on Prof. Phillips. But he has surely introduced a little mistake of his own, which will be very serious to visitors to the popular watering-places of Scarborough and Filey. The Castle Rock and Filey Brig are coloured —one Lower Oolite and the other Neocomian, whereas they are both what the author would call "Middle Oolite"! It will take more than Mr. Bird to write a good "Geology of Yorkshire."

LETTERS TO THE EDITOR

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

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

Leaves Injured at Night by Free Radiation

FRITZ MÜLLER, in a letter to me from Sta. Catharina in Brazil, dated August 9, supports the view which I have advanced with respect to leaves placing themselves in a vertical position at night, during their so-called sleep, in order to escape being chilled and injured by radiation into the open sky. He says: "We have had last week some rather cold nights (2° to 3° C. at sunrise), and these have given me a new confirmation of your view on the meaning of the nyctitropic movements of plants. Near my house there are some Pandanus trees, about a dozen years old; the youngest terminal leaves stand upright, whereas the older ones are bent down so as to expose their upper surfaces to the sky. These young leaves, though of course the most tender, are still as fresh and green as before; on the contrary, the older ones have suffered from the cold, and have become quite yellowish. Again, the leaves of *Oxalis sepium* were observed by me to sleep in a very imperfect manner during the summer, even after the most sunny days; but now, in winter, every leaflet hangs down in a perpendicular position during the whole night." It is a new fact to me that leaves should sleep in a more or less perfect manner at different seasons of the year.

CHARLES DARWIN

Red Rainbows

THE account in NATURE, vol. xxiv. p. 431, of a pink rainbow seen from Mr. Tennyson's house, recalls to me a rainbow which I witnessed in July 1877 over the Lake of Lucerne from the promenade in front of the Schweitzerhof. The bow in question appeared at sunset, when the whole sky, east and west, was lit up with ruddy tints; and just before it faded out, the bow itself, which was a very brilliant one, showed only red and orange colours in place of its usual array of hues. No fewer than five supernumerary arcs were visible at the inner edge of the primary bow, and these showed red only. I fancy that the phenomenon cannot be very rare, from the circumstance that in pictures of the rainbow red and yellow are frequently the only colours set down by the artist. A few months ago Mr. C. Brooke Branwhite of Clifton showed me a very beautiful sketch in oils by his father, the late Mr. Charles Branwhite, a colourist of no mean power, in which a beautiful and exquisitely pellucid rainbow was drawn with red and yellow tints only. It may also be mentioned that in the copy of Rafael's "Madonna di Foligno" in the Dresden Gallery, there is a semi-circular red and yellow rainbow. I have not seen the original Foligno Madonna in Rome; and should be interested to know whether in this also red and yellow are the only tints accorded by the colourist.

Haslemere House, Clifton SILVANUS P. THOMPSON

IN your issue of the 8th inst. (vol. xxiv. p. 431) your correspondent "A. M." describes what he calls a "pink rainbow" seen by him at Aldworth, near Haslemere, and as a painter I am interested in his description, as it exactly corresponds with the same phenomenon as seen by me here, same date, and viewed with curiosity by myself and friends.

Corrie Hotel, Arran, September 11 DAVID MURRAY

Atoms

ALTHOUGH I am not an "eminent" authority, perhaps you will excuse my troubling you with the following extract from a paper read by me before the Philosophical Society of Glasgow in November, 1875, a copy of which paper I posted to the Editor of NATURE:—"I have long been of opinion that the most probable hypothesis of the origin of atoms is that there is only one kind of matter—ether or its constituents—and that atoms are merely congeries of units of ether circling at enormous speeds round each other, differently grouped, in different numbers, at different velocities, and at different distances, even as the different members of our sun systems. . . . The numbers of units in each similar atom need not be always the same; a few dozens more or less will not be appreciable by us. On the other hand, if a so-called element show a plurality of spectroscopic lines or hues, I do not think it at all doubtful that there is a plurality of units moving to produce these, since they thus show effects of different modes of moving of bodies; all our different states of sensual consciousness of colours are necessarily dependent on differences in the modes of moving of the agents that excite in us such plurality of lines and hues. As the motions of atoms, or rather of groups of atoms, excite in us sensations of sound, so the motions of units, or rather of groups of units, excite in us sensations of colour, and of course the lower-pitched movements of dark heat. Then again, we may hold that the more lines that persist in a spark or a sun, the less easily reducible are the portions of the elements showing them, as far as these lines' constituents are concerned—the lines being still undissociated material." (*Proc. Phil. Soc. of Glas.*, vol. x. p. 61.) HENRY MUIRHEAD

Cambuslang, August 26

Luminous Phenomena on Rupture of Sea-Ice

IN my diary for January 20, 1881, occurs the following passage. I make no attempt to account for the phenomenon, but am certain it was not caused by any reflection of the lights on board the vessel:—

"Started from Christiania at about 2 a.m. in the *Nyland* steamer bound for Christiansand. At Krujero the steamer forced its way through the ice for half an hour till within about a mile of the land, where sleighs met it on the ice. The passengers and cargo were discharged or taken up on the ice, out of which we backed in close proximity to the *Kong Hacon*, which steamer had followed us in. A beautiful sunset and Arctic winter view, clear air, and rich sky, also a distant ship fast in the ice. The *Nyland* stopped at Arendal for the night, having got to the quay through much ice. We observe often phosphorescence or phosphorescence-like sparks and flashes in the ice as it is broken up by the steamer."

I think that the average thickness of the ice might have been about eight inches. I cannot give the temperature, but on the previous day at Christiania the thermometer indicated about 8° or 10° below zero Fahrenheit (about 40° Fahrenheit of frost). The diary from which the above extract is taken was kept jointly by myself and my travelling-companion, Mr. Winter, of the Indian Civil Service, who of course also saw the flashes referred to. I should like to have been able to talk the matter over again with him, but he is now in India. J. ALLEN ALLEN

[The question raised in this letter is a very interesting one. The phenomenon is possibly analogous to the electric flashes which are produced when loaf-sugar is crushed or when mica is rapidly split. It appears very improbable that it can be due to phosphorescent creatures in the water under the ice.—ED.]

Tidal Currents *versus* Wind Waves

IN NATURE, vol. xxiv. p. 286, a writer on "sea-shore alluvion" positively asserts that the travelling of sea beaches is due to wind-waves, and not to tidal currents, and calls a writer in the *Engineer* to task for having stated the latter. Notwithstanding this assertion, I would suggest that the writer in the *Engineer* is right. Twenty-five years ago, when an engineering student, I was taught that sea-beach travelling was due to wind-waves. Afterwards, while knocking about during fifteen years in the vicinity of the south and west coasts of Ireland, I noted facts that went to show that such a theory was not universally correct. This led me to study wind-action on the sea and lakes, also all I could find that had been written on the subject; the result being that as *good* evidence was so contradictory, no opinion could be come to from the evidence of others. But it was not till about ten years ago, when I was so circumstanced that I could properly study wave-action, and after six years' careful observation on the south-east coast of Ireland, that I found that tidal currents were the principal motive power; and on again reading what had been written on the subject, that I found that nearly all the advocates for the driftage of sea beaches by wind-waves had studied on beaches *where the most continuous and powerful winds acted in conjunction with the flow-tide current*. As the results of my observations have been published in the *Proceedings* of the Royal Irish Academy, English and Irish Institutions of Civil Engineers, the Geological Societies of London, Dublin, &c., during the last six or eight years, it is unnecessary to repeat them here. I would, however, point out that when there are only wind-waves and no tidal currents, the beaches as a general rule are banked up, but do not travel (the writer in NATURE seems to have observed this, but does not appear to see the importance of it). This may be seen in the tideless Mediterranean, as pointed out by the late Dr. Ansted in his paper on the Lagoons at the Delta of the Rhone; it may also be seen in Malcombe, or any other bay where there is a "head of the tide" but no tidal current; and in the different freshwater lakes, when the wind-waves are the *only* motive power. But wherever there are tidal currents acting on a coast the beach must travel. Such tidal currents are those that most perplex the erectors of groynes. If there was only the travelling augmented by wind-waves, the erection of groynes would be very simple; but, as a general rule, they are most necessary where there are strong tidal currents (or conflicting currents) due to the regular "flow" tide, "half counter" tides, or "on-shore" tides; which conflicting currents, combined with the action of wind-waves, let them be direct or as "ground swells," make up all the "cutting-out tides." The greater the complications the greater the "cutting out," and the more ingenious have to be the groynes. "Falls" accumulate with the wind-waves, but rapidly disappear when the wind ceases. I presume the writer of the article in question is aware that the greatest rise of tide and the least current is at the "heads of the tides," while the least rise and greatest current is at the "nodal or hinge lines"; and I would be interested to know where permanent beaches accumulate in the latter localities, as from what I have seen those that form rapidly disappear when the wind ceases. G. H. KINAHAN

H.M. Geological Survey

Glaciation

IN NATURE, vol. xxiv. p. 364, I see a notice of a paper by Dr. Woeikoff on the glacial climate, in which it is shown that "the difference of mean temperature at the lower ends of glaciers (in different parts of the world) reaches fully 20°." This might be expected. The extent of glaciation depends not at all on mean or on winter temperature, but chiefly on summer temperature. *Perpetual* snow means *summer* snow, so that summer temperature is what determines the extent of the snow-fields remaining unmelted in the summer, and consequently of the glaciers which are fed by the snow-fields. The extent of glaciation is also much influenced by the amount of snow-fall. All this is stated in Forbes's "Norway and its Glaciers."

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim

Yellow Glass in Fog

SOME years ago I was staying at an hotel on the Lake of Constance. One morning a fog came on which completely obscured the opposite shore, but looking through a strip of yellow glass, which formed the border of the window, I was able, to my surprise, to see it distinctly. I presume the yellow glass choked the blue rays reflected by the fog, just as a Nicol's prism, held at the proper angle, chokes the rays reflected from the glass and enables us to see clearly the picture behind it. On my way home I stopped in Paris, and, happening to call on one of the principal opticians, mentioned the circumstance to him. He forthwith showed me a naval telescope provided with a cap at the eye end containing a yellow glass, which could be removed at pleasure. I should like to know if the same simple contrivance has ever been used in our own navy. R.

The New Museum of Natural History

IN your article on "The New Museum of Natural History" (NATURE, vol. xxiii. p. 549 *et seq.*) it is stated that the specimen of *Archæopteryx macrura* in the British Museum is headless. Will you permit me to draw attention to a nodule projecting from the slab in which the fossil lies, which bears a striking resemblance to the cerebral portion of a bird's skull? It is some years since I visited the museum, but I recollect feeling satisfied at the time that the nodule was the missing head, and worth while disinterring from its surrounding slate. E. H. PRINGLE

Calicut, July 31

[The nodule referred to by our correspondent is well known, and has been frequently criticised. Mr. John Evans, D.C.L., F.R.S., drew attention to it in an article published by him in the *Natural History Review*, 1865, pp. 415-421: "On portions of a cranium and of a jaw in the slab containing the fossil remains of the *Archæopteryx*." Although these fragments which occur in the slab in question undoubtedly belong to *Archæopteryx*, yet, as stated in our article, vol. xxiii. p. 551, "The original specimen described by Prof. Owen is headless," whereas the newly-discovered Berlin specimen has the head entire, and fairly well preserved, and still attached by the neck to the trunk.—ED.]

On the Velocity of Light

IN view of the experiments of Young and Forbes on the velocity of light, and of the article published by Lord Rayleigh on the subject, it may not be out of place to state as a fact which seemed at the time too evident to require special mention in my paper "On the Velocity of Light," that if the velocity of red and of blue light in air differed by as much as one-tenth of 1 per cent., the image of the slit which served as the source of light, instead of being white, would be spread out into a spectrum which could not fail to be observed. The total displacement in these experiments amounted to 133 millimetres; therefore, a difference of velocity of the red and the blue rays of 1·8 per cent. would necessitate a spectrum 2·4 millimetres in length.

It is needless to say that no spectrum was observed. These facts appear to be utterly irreconcilable with the conclusion drawn by Messrs. Young and Forbes.

ALBERT A. MICHELSON

Schluchsee, Prussia, August 28

Salmon in Preserved Rivers

HAVING resided for some time lately near one of our salmon rivers which is at present preserved by a club, I have at different times had conversations with men who knew it before its so-called preservation. They all say that when they were allowed to fish when and how they pleased, the supply of fish was much better in regard both to size and quantity. They account for it in the following manner:—Firstly, when the river was free, the people living near used to make spawning-beds for the fish, by placing large stones across the river and throwing gravel where deficient, and where gravel was naturally they used to loosen it with forks and remove the large stones. Secondly, they used to watch the fish at spawning time, and catch and kill all very large fish, say about 16 to 30 lbs. weight, after they had partially or wholly finished spawning, as they say the large fish destroy the salmon fry. Neither this nor the formation of spawning-beds is done at present. Would the above reasons account for the diminution in the size and number of salmon caught in our rivers? The diminution, in the river I speak of, cannot be accounted for by pollution, as the number of houses near enough to send their drainage into the river is too small to affect it, and as the river has a very quick fall and rocky bed, it is subject to such very rapid rises and falls in quantity of water that would prevent any settlement of noxious sediment.

F. C. S.

New Seismometer

IN NATURE, vol. xxiv. p. 113, there is a notice of a new seismometer which has several advantages claimed for it. Might I suggest what seems an obvious and important improvement? As a rule pendulums cannot record vertical or oblique motions, and yet these are often the most necessary and valuable to record. 1. To do this, and yet as easily allow of lateral registration, I would say, support a heavy (leaden) ball of some 100 lbs. by a 30 or 40 feet spiral or rubber spring of suitable strength. It will be found that a very considerable amount of vertical play can take place, especially vertical effort, ere the ball can be affected, and that lateral play of the support will produce very little effect indeed, unless, as is most unlikely, the motion is prolonged and is *continuous* in one direction. 2. Around the sphere, and at a very short distance from its surface, radial rods actuated like the key-plugs of a cornet are supported, say at every 30° all over the surface, contact with any one of which will electrically record *time*, and the pencil attached to the plunger record distance of stroke on revolving paper attached to plunger-tube.

Asam, July 6 S. E. PEAL

THE BRITISH ASSOCIATION

THE actual number of persons who attended the York Meeting of the British Association, as announced at the last meeting of the General Committee, was 2556; divided between 272 old life-members, 27 new life-members, 312 old annual members, 175 new annual members, 1232 associates, 514 ladies, and 24 foreigners. The seven previous occasions on which this number has been exceeded were:—Newcastle-on-Tyne, 1863 (3335); Manchester, 1861 (3138); Liverpool, 1870 (2878); Bath, 1864 (2802); Glasgow, 1876 (2774); Dublin, 1878 (2578); Aberdeen, 1859 (2564). The number fell below 1000 at Cambridge, Plymouth, Southampton, Ipswich, Hull, and Swansea. 1280*l.* were paid out by the Council for scientific purposes after the last meeting, a larger sum than on any occasion since 1873; while between 1873 and 1861 that sum was always exceeded, and at Norwich, in 1868, it amounted to 1940*l.*

The following foreigners were present at the meeting:—Professrs Barker of Pennsylvania; Bergeron, Paris; Bojanowski; Carbonnelle, Brussels; Chemin, Paris; Craig, Johns Hopkins University, U.S.; Dohrn, Naples; Eads, St. Louis, U.S.; Gariel, Paris; Dr. Asa Gray, Harvard University; Halphen, Paris; Dr. Edwin Hall, Baltimore, U.S.; Hubrecht, Leyden; Prof. W. W. Johnson, Annapolis, U.S.; Prof. O. C. Marsh, Yale College; Moser, Berlin; Prof. H. A. Rowland, Baltimore; Stephanos, Paris; Sturm, Münster, Westphalia; Prof. H. M. Whitney, Beloit College, Wisconsin, U.S.A.

We ought to have stated in our report of the doings of the Association in our last number, that Prof. Huxley's lecture on Palæontology, which we gave in the same number, was delivered on the evening of Friday the 9th.

Nearly 350 papers or reports were read before the several sections. Of these the Physical and Mathematical Section received 89; the Chemical Section 49; Geology 59; Biology 79; Geography 16; Economic Science and Statistics 26; and Mechanical Science 29. Of the papers in Section A 23 related to Electricity; 21 were Mathematical; Optics claimed 12; Meteorology 11; Astronomy and Physical Geography 12; Heat 5; and miscellaneous physical subjects 5. Of course prominent subjects of interest were electric lighting, electric measurements, and Faure's cells. Such subjects were thoroughly ventilated by discussions both in Section and Committee, and more intimately during the thousand and one opportunities for interchange of ideas which occurred in the afternoon and evening. Again, the storage of energy, the nature of meteoric dust, the existence of intra-Mercurial planets, the lunar disturbance of gravity, the nature of colours, and the contact theory were each severally discussed. Among the 49 Chemical papers several theoretical matters were introduced—specially the atomic theory, chemical nomenclature, vapour densities, molecular weights, Mendeleeff's law, and molecular attraction; processes of analysis and technical operations were described, and new experiments were explained. Of course a good deal of the geological work bore reference to Yorkshire, especially to the evidences of glacial action which it presents. The geological papers were of a very general and interesting character, and embraced every branch of the subject, from the vulcanology of Japan to the minerals found at Laurium, and from the Cheshire salt beds to the evolution of the Plesiosaurus. Section D furnished a larger number of papers than any other Section except A, but we must bear in mind that it really consists of three sub-sections, devoted respectively to Zoology and Botany, Anatomy and Physiology, and to Anthropology. The latter subject has developed extraordinarily, more than half the papers contributed to the Section were read before this Sub-Section. The report of the Anthropometric Committee, which evoked a good deal of discussion, was read in the Section of Economic Science and Statistics. In this section Mr. Grant Duff delivered a very able address, which was warmly received. A tendency to introduce matter which has a political bearing and which may be discussed from a political standpoint is sometimes apparent in this section, and should be carefully guarded against by the Committee. The Mechanical Section furnished some important reports on patent laws, wind pressure, tides in the English Channel, and the steering of screw steamers. Here also were papers on the different forms of electric lamp, the electrical transmission of force, and the illumination of lighthouses.

Thus it will be seen that all the prominent subjects of science have received their share of attention, and at the hands of one or other of the sections have been either expanded or discussed. The interchange of ideas has been incessantly going on, and many men have become acquainted who might otherwise have remained unknown to each other for years. Some 500 scientific men have been gathered together from various parts of the British Islands; and some 2000 persons have been brought face to face with the burning scientific questions of the day, and have had new interests awakened, or old knowledge resuscitated. There can be little doubt as to the

expediency of continuing the work of the Association, if it keep at all near to the standard of the York meeting. The German Society, founded nine years before our Association, and its prototype, still continues to meet annually; and scientific congresses are becoming more and more general every year in Europe.

Canada has been proposed as the place of meeting for 1885. The difficulties of time and place and expense are far less formidable than they appear at the outset. Great facilities would be put in our way by steamboat companies; and, once arrived, the Colony would receive us with open arms. Again, the Americans wish us to join their Association on some convenient occasion, and *àpropos* of this a practical American observed a few days since, "From the moment you set foot on American soil to the moment of departure, you should not put down a cent." One other fact remains to be noticed in regard to the York meeting. *Thirty-four* local societies and institutions were represented at the meeting by forty-nine delegates; and the Council have under consideration the conditions under which these delegates were present, and their object in attending. Cannot the Association do something for them? Cannot some organisation be introduced to influence the local societies through the Association, and cannot a committee of delegates be appointed to discuss matters connected with their respective institutions?

REPORTS

Report of the Committee, consisting of Dr. J. H. Gladstone, Dr. W. R. E. Hodgkinson, Mr. W. Carleton Williams, and Dr. P. P. Bedson (secretary), appointed for the purpose of investigating the Method of Determining the Specific Refraction of Solids from their Solutions.—Mr. P. P. Bedson, D.Sc., read the Report, and stated that the object of this report was to submit to further examination the method proposed some years ago by Messrs. Gladstone and Dale. According to this method the specific refraction of a solid may be deduced from that of a solution containing it, provided the specific refraction of the solvent is known, as also that of the solution and the composition of the solution. The experiments, of which an account is given in the report, appear to confirm this statement of the above-mentioned authors. The first case examined was that of liquid phenol. Its specific refraction for a ray of light of infinite wave-length was determined at 40° and 45°. The values obtained for the specific refraction of liquid phenol at 40° and 45°, viz., ·4850 and ·4848, are closely approximate to that obtained by Brühl (*Journ.* Chem. Soc., abst., 1880, p. 782) for phenol at 20°, viz., ·4862. Further, these results agree very well with the mean of the specific refractions obtained from the alcoholic and acetic acids solutions. The specific refraction of rock-salt in the solid state has also been determined and compared, with its specific refraction as deduced from its aqueous solutions; and it was found that the specific refraction obtained from the aqueous solution is substantially the same as that obtained from a prism of rock-salt. Further, the specific refractions of fused borax and boric acid have been determined, and in these cases also the specific refraction obtained from their aqueous solutions was found to be approximately the same as the specific refractions of fused borax and boric acid. The indices of fused borax and of fused boric acid were determined by means of prisms of these materials, which were cast in a mould of silver plates and afterwards ground and polished.

Report of Committee on Meteoric Dust, by Prof. Schuster.—This Committee was appointed for the double purpose of examining the observations hitherto recorded on the subject of meteoric dust and of discussing the possibility of future more systematic investigations. With regard to the first point we note that in a paper presented to the Royal Astronomical Society in 1879, Mr. Ranyard has given what appears to be a pretty complete account of the known observations as to the presence of meteoric dust in the atmosphere. It appears that in the year 1852 Prof. Andrews found native iron in the basalt of the Giant's Causeway. Nordenskjöld found particles of iron which in all probability had a cosmic origin in the snows of Finland and in the ice-fields of the Arctic regions. Dr. T. L. Phipson, and more recently Tissandier, found similar particles deposited by the winds on plates exposed in different localities. Finally, Mr. John Murray discovered magnetic particles raised from deposits at the bottom of the sea by H.M.S. *Challenger*. These particles were examined by Prof. Alexander Herschel, who agreed with Mr. Murray in ascribing a cosmic origin to them. For fuller details and all references we must refer to Mr. Ranyard's paper. There cannot be any doubt that magnetic dust, which in all probability derives its origin from meteors, has often been observed, and the question arises, in what way we can increase our knowledge on these points to an appreciable extent. A further series of occasional observations would in all probability lead to no result of great value, unless they were carried on for a great length of time in suitable places. Meteoric dust, we know, does fall, and observations ought if possible to be directed rather towards an approximate estimate of the quantity which falls within a given time. Difficulties very likely will be found in the determination of the locality in which the observations should be conducted. The place ought to be sheltered as much as possible against any ordinary dust not of meteoric origin. The lonely spots best fitted for these observations are generally accessible to occasional experiments only, and do not lend themselves easily to a regular series of observations. Nevertheless experiments continued for a few months at some elevated spot in the Alps might lead to valuable results. The Committee would like to draw attention to an instrument which is well fitted for such observations. It was devised by Dr. Pierre Miquel for the purpose of examining, not the meteoric particles, but organic and organised matters floating about in the air. A description, with illustrations, will be found in the *Annuaire de Montsouris* for 1879. Two forms of the instrument are given. In the first form, which is only adapted to permanent places of observations, an aspirator draws a quantity of air through a fine hole. The air impinges on a plate coated with glycerine, which retains all solid matter. By means of this instrument we may determine the quantity of solid particles within a given volume of air. The second, more portable, form does not allow such an accurate quantitative air analysis. The instrument is attached to a weathercock, and thus is always directed against the wind, which traverses it, and deposits, as in the other permanent form, its solid matter on a glycerine plate. An anemometer placed in the vicinity serves to give an approximate idea of the quantity of air which has passed through the apparatus. These instruments have been called aëroscopes by their inventor. It is likely that the second form given to the apparatus will be best fitted for the purpose which the Committee has in view.

Seventh Report of the Committee on Underground Water Supply, consisting of Prof. E. Hull, the Rev. H. W. Crosskey, Capt. Douglas Galton, C.B., Mr. James Glaisher, F.R.S., Prof. G. A. Lebour, Mr. W. Molyneux, Mr. G. H. Morton, Mr. W. Pengelly, Prof. J. Prestwich, Mr. James Plant, Mr. James Parker, Mr. T. Roberts, Mr. S. Stooke, Mr. G. J. Symons, Mr. W. Whitaker, was read by Mr. C. E. de Rance, of H.M.'s Geological Survey, the Secretary.—The Committee was appointed in 1874 at the Belfast Meeting of the Association, with Prof. Hull, LL.D., F.R.S., as Chairman, and Mr. De Rance, F.G.S., as Secretary and Reporter; its six published reports occupy 125 pages of the Society's *Proceedings*, and the results of the investigations of the Committee show that the Permian, Triassic, and Jurassic formations of England and Wales are capable of absorbing from five to ten inches of annual rainfall, giving a daily average yield of from 200,000 to 400,000 gallons per square mile per day. The area occupied by these formations is, in round numbers, Permian and Trias, 8600 square miles, and Oolites, 6600 square miles, capable of yielding 1720 millions and 1320 million gallons respectively, at the lowest rate of absorption, or, united, a supply for 100 million people, at thirty gallons a head. Mr. De Rance then described the water-bearing condition of the Yorkshire area, and stated that the investigation would now be extended to all the porous rocks of South Britain.

Report on the Earthquakes of Japan, by Prof. John Milne.—The author arrives at the following conclusions:—1. That the actual back and forth motion of the ground is seldom more than a few millimetres (usually not equal to 1mm.), even though chimneys have fallen. 2. The motion usually commences gently, but is very irregular. 3. The number of vibrations per second usually vary between three and six. 4. During one shock *its direction* of motion may be irregular. 5. East and west vibrations, as recorded in Yedo, have in some cases been shown by time observations to have travelled up from the south. 6. Many of the shocks which visit Yedo appear to have come

from the district which is faulted, and which shows distinct evidence of *very recent* elevation.

Second Report of the Committee consisting of Prof. P. M. Duncan and Mr. G. R. Vine, appointed for the purpose of reporting on Fossil Polyzoa; drawn up by Mr. Vine.—The order is divided into three subdivisions :—

1. *Cheilostoma*, Bark. = *Celleporina*, Ehrenberg.
2. *Cyclostomata*, ,, = *Tubuliporina*, Milne-Ed., Hagenow, Johnston.
3. *Ctenostomata*, ,,

The following terms are used in this Report in describing the genera :—

ZOARIUM.—"The composite structure formed by repeated gemmation" = Polyzoarium and Polypidom of authors.

ZOŒCIUM or cell.—"The chamber in which the Polypide is lodged."

CŒNŒCIUM.—"The common dermal system of a colony." Applicable alike to the "Frond," or "Polyzoary," of Fenestella, Polypora, Phyllopora, or Synocladia: or to the associated Zoœcia and their connecting "interstitial tubuli," of Ceriopora, Hyphasmapora, and Archæopora, or species allied to these.

FENESTRULES.—The square, oblong, or partially rounded openings in the zoarium—*connected by non-cellular dissepiments*—of Fenestella, Polypora, and species allied to these.

FENESTRÆ applied to similar openings, whenever connected by the general substance of the zoarium—as in Phyllopora, Clathropora, and the Permian Synocladia.

BRANCHES.—The CELL-bearing portions of the zoarium of Glauconome, Fenestella, Polypora, or Synocladia; or the offshoots from the main stem of any species.

GONÆCIUM.—"A modified zoœcium or cell, set apart for the purposes of reproduction."

GONOCYST.—"An inflation of the surface of the zoarium in which the embryos are developed." Modern terms from the Rev. Thos. Hincks.

Report of the Committee on Erratic Blocks, drawn up by the Rev. B. W. Crosskey.—Many additional instances of the occurrence of erratic blocks were recorded. Particulars were given respecting granite and sandstone boulders found while excavating for the new dock at Maryport, Cumberland. The granite specimens vary in size from small pebbles to a ton in weight, and are rounded. The New Red Sandstone boulders vary from half a ton to two tons or more, and have sharp angles. The nearest granite occurs in the Kirkudbrightshire Hills, on the other side of the Solway, fifteen or twenty miles distant; the New Red Sandstone is the stone of the district. A boulder of Shap granite found near Filey has been removed to the University Museum, Oxford. It rested on Oolitic strata at a height of about 150 feet above the sea. The nearest place where a granite of the same character is found is 108 miles distant, bearing west-north-west from Filey. The attention of the committee was drawn by Prof. T. McK. Hughes to a boulder of porphyritic hornblende diabase, near the centre of Anglesea. It is chiefly interesting as having been considered an inscribed stone, but the supposed characters are entirely due to rock structure. A detailed description of the great erratic called the "Holy Stone," at Humberstone, Leicestershire, was given. Its weight is about twenty-one tons. It rests on a denuded surface of the Rhætic formation. The height from which it travelled is about 400 feet above the sea, and is situated six miles north-west. The present height at which the block now rests is about 240 feet above the sea, and there is a river valley between these two points, running at right angles to the line of transit of the block, which is only 110 feet above the level of the sea. Various groups of boulders in Leicestershire were also described, some containing millstone grit blocks derived from Derbyshire, which must have travelled about thirty-five miles. A catalogue of 191 blocks in the parish of Ashwell, County of Hertford, was given. None of these blocks are local. Their general derivation is from the Oolites of the Midlands and from the Carboniferous and other rocks of more northern districts. The report concluded with an appeal to local observers to give assistance in cataloguing the rapidly-disappearing erratic blocks of the country.

Report on Thermal Conductivity of Certain Rocks, showing especially the Geological Aspects of the Investigations, by Prof. A. S. Herschel and Prof. Lebour.—This is the seventh and final Report of the Committee, and comprises a *résumé* of the results given in the preceding ones, with numerous additions and corrections. A bibliographical list of all papers on the subject, by Mr. J. T. Dunn, B.Sc., is given as an appendix. The apparatus and specimens employed during the investigations of the Committee are preserved in the museum of the College of Physical Science at Newcastle-on-Tyne.

SECTION A—MATHEMATICAL AND PHYSICAL

On the Possibility of the Existence of Intra-Mercurial Planets, by Balfour Stewart, LL.D., F.R.S.—It is a somewhat frequent speculation amongst those who are engaged in sun-spot research to regard the state of the solar surface as influenced in some way by the positions of the planets.

In order to verify this hypothesis observers have tried whether there appear to be solar periods exactly coinciding with certain well-known planetary periods. This method has been adopted by the Kew observers (Messrs. De La Rue, Stewart, and Loewy), who had an unusually large mass of material at their disposal, and they have obtained from it the following results :—

1. An apparent maximum and minimum of spotted area approximately corresponding in time to the perihelion and aphelion of Mercury.

2. An apparent maximum and minimum of spotted area approximately corresponding in time to the conjunction and opposition of Mercury and Jupiter.

3. An apparent maximum and minimum of spotted area approximately corresponding in time to the conjunction and opposition of Venus and Jupiter.

4. An apparent maximum and minimum of spotted area approximately corresponding in time to the conjunction and opposition of Venus and Mercury.

The Kew observers make the following remarks upon these results :—

"There appears to be a certain amount of likeness between the march of the numbers in the four periods which we have investigated, but we desire to record this rather as a result brought out by a certain specified method of treating the material at our disposal than as a fact from which we are at present prepared to draw conclusions. As the investigation of these and similar phenomena proceeds, it may be hoped that much light will be thrown upon the causes of sun-spot periodicity."

The Kew observers have likewise produced evidence of a different kind in favour of the planetary hypothesis, for they have detected a periodicity in the behaviour of sun-spots with regard to increase and diminution apparently depending upon the positions of the two nearer planets, Mercury and Venus. The law seems to be that as a portion of the sun's surface is carried by rotation nearer to one of these two influential planets, there is a tendency for spots to become less and disappear, while on the other hand, when it is carried away from the neighbourhood of one of these planets, there is a tendency for spots to break out and increase.

But whatever truth may be in these conclusions, it appears to be quite certain that periodical relations between the various *known* planets will not account for *all* the sun-spot inequalities with which we are acquainted. They may account for some, but certainly not for all. For there are solar inequalities of short duration which, presuming them to be real, can only be accounted for on the planetary hypothesis by supposing the existence of several unknown intra-Mercurial planets.

Indeed these short-period inequalities in sun-spots and the allied phenomena of terrestrial magnetism and meteorology have so augmented in number of late years as to make some observers inclined to question their reality; while others again resort to the above-mentioned hypothesis, and attribute them to intra-Mercurial planetary agency.

The method to be pursued in detecting the existence of inequalities will be easily understood by an illustration. Suppose that we had in our possession extensive records of the temperature of the earth's atmosphere at some one place in middle latitudes, and that, independently of astronomical knowledge, we were to make use of these for the purpose of investigating the natural inequalities of terrestrial temperature. We should begin by grouping the observations according to various periods taken, say, at small but definite time-intervals from each other. Now if our series of observations were sufficiently extensive, and if some one of our various groupings together of this series

should correspond to a real inequality, we should expect it to exhibit a well-defined and prominent fluctuation, whose departures above and below the mean should be of considerable amount.

Suppose, for instance, that we have twenty-four points in our series, and that we group a long series of temperature observations in rows of twenty four each, the time-distance between two contiguous members of one row being one hour. The series would thus represent the mean solar day, and we should without doubt obtain from a final summation of our rows a result exhibiting a prominent temperature fluctuation of a well-defined character, which we might measure (as long as we keep to twenty-four points) by simply adding together all the departures of its various points from the mean, whether these points lie above or below; in fine, by obtaining the area of the curve, which is the graphical representation of the inequality above and below the line of abscissæ taken to represent the mean of all the points. Suppose next that, still keeping to rows of twenty-four, we should make the time-interval between two contiguous members of a row somewhat different from one hour, whether greater or less, we should now in either case obtain a result exhibiting, when measured as above, a much smaller inequality than that given when the interval was exactly one hour; and it is even possible that, if our series of observations were sufficiently extensive, we should obtain hardly any traces of an inequality whatever.

In fine, when each row accurately represented a solar day, the result would be an inequality of large amount; but when each row represented a period either slightly less or greater than a day, the result would be an inequality of small amount. This process, as far as I have described it, is not new, inasmuch as something of this kind must be pursued in all attempts to detect inequalities. In the present instance we should by its means, after bestowing enormous labour in variously grouping, in accordance with a great number of periods taken at small intervals from each other, obtain definite results. These might be graphically represented in the following manner:—

The line of abscissæ might be taken to denote the exact values of the various periods, forming a time-scale, in fact, while the ordinates might represent the areas or summations obtained as above by employing these various periods. There would thus be in the case now used for illustration a very prominent peak, corresponding to twenty-four hours, which would fall off very rapidly on either side.

By means of the process now described we should at length, after enormous labour, obtain a graphical result, showing the exact position in the time-scale of the observed maximum inequality. In conjunction with Mr. William Dodgson, I have devised a method by which this labour is very greatly reduced, and the process so modified has been applied by us in order to determine whether there be inequalities of short period in the observed areas of the sun-spots occurring on the visible hemisphere of the sun. We have detected an inequality of this nature corresponding in period to 24·011 days, which, when subjected to a certain purifying treatment, appears to us to exhibit the marks of a true periodicity. But it has been suggested by Prof. Stokes that a method of this nature for detecting inequalities might with greater propriety be employed as a crucible for testing the value of some hypothesis introduced into it from without.

Acting upon this suggestion I have ventured to introduce the planetary hypothesis, and to ask whether the above sun-spot inequality of short period may not in reality be caused by an intra-Mercurial planet. It is quite easy to put this hypothesis to a test, taking for our guidance the results obtained by the Kew observers. For what do these results exhibit? In the first place they exhibit the probability of a sun-spot inequality corresponding to the period of Mercury round the sun; and in the next they exhibit the probability of similar inequalities corresponding to the synodic period of Mercury and Venus, and to the synodic period of Mercury and Jupiter.

Now if there be an intra-Mercurial planet of period 24·011 days, it will have the following synodic periods:—

With Mercury	...	33·025 days.
With Venus	...	26·884 days.
With Jupiter	...	24·145 days.

In conjunction with Mr. Dodgson I have applied the above method of analysis with the view of ascertaining whether there be well-marked sun-spot inequalities nearly corresponding to these periods, and we have obtained the following results:—

A very prominent inequality of period	...	32·955 days.
A very prominent inequality of period	...	26·871 days.
A less prominent inequality of period	...	24·142 days.

It will thus be noticed that there are prominent sun-spot inequalities, the periods of which agree very well with the synodic periods of the supposed planet with Mercury, Venus, and Jupiter, more especially if we bear in mind that this is only a first approximation.

The test, however, is not yet complete. Referring once more to the results of the Kew observers, it will be noticed that we have approximately maxima of sun-spot areas when Mercury and Venus, or when Mercury and Jupiter are in conjunction. Now if we assume that there is an intra-Mercurial planet of period 24·011 days, we are as yet unable to assign its exact position in ecliptical longitude at any moment. We know its period, and we may presume that it has considerable excentricity, but we know nothing else. We may, however, assume as most probable that the maximum point of the inequality of period 32·955 days corresponds to the conjunction of the planet with Mercury, the maximum point of the inequality of period 26·871 days to its conjunction with Venus, and the maximum point of the inequality of period 24·142 days to its conjunction with Jupiter. On this assumption, and knowing the average rate of motion of the planet in its orbit, we may deduce approximately its position at a given epoch independently from each of the three synodic periods above mentioned, and these positions ought to agree together, if our hypothesis be correct.

I have done this approximately, but am not able to bring exact figures before this meeting. The agreement is as great as can be expected, bearing in mind that we know only the average rate of motion of the planet, and not the variations of its rate, inasmuch as we are ignorant of its excentricity. I think I may state that three independent values of its position corresponding to January 1, 1832, will be obtained, and that the mean difference of a single value from the mean of the whole will probably not be more than twenty degrees. It would thus appear from this investigation that the evidence is in favour of the sun-spot inequality of 24·011 days being due to an intra-Mercurial planet. Of course a single research of this nature is insufficient to establish a theory of this importance, but as there are several short-period solar inequalities, the same method may be pursued for each, an operation which demands nothing but time and labour. It appears to me of great importance that these short-period solar inequalities should be systematically examined after this method.

The Effects of Gulf Streams upon Climates, by Dr. S. Haughton.—The author said that the Gulf Stream, and its counter current, the Labrador Current, produced important effects upon climate. The northern hemisphere was warmer than the southern from lat. 0° to lat. 30°, and it was colder than the southern from lat. 40° to 60°. The higher temperature of the southern hemisphere in the temperate latitudes was explained by the existence of three gulf streams in that hemisphere, while there was only one in the North Atlantic, and a partial one through Behring's Straits in the northern hemisphere. The general climatal effect of the Gulf Stream was therefore to make the annual range of temperature less, but it had no effect whatever upon summer heat, or upon the fruiting of plants and trees, that required a given July temperature for reproduction. The January temperatures in the North Atlantic at 70° were raised by the Gulf Stream, whilst the July temperatures remain unaffected. The effect of the cold currents, which were indirectly caused by the warm currents to preserve the proper condition of equilibrium, was nothing at all upon the January temperatures, but they lowered the July temperatures. The effect of the cold water was to lower the July temperature and to leave the January untouched, and the effect of the warm current from the south was to raise January and to leave July unaltered.

The Photographic Spectrum of Comet B 1881, by Dr. W. Huggins.—The author stated that in 1868 he applied the spectroscope to the light of comets, the result of his observations being to show the presence of carbon probably in conjunction with hydrogen in the cometary matter. Since then, until the present year, no comet of sufficient brilliancy to admit of observations being made had appeared. On the evening of June 24 last he directed the spectroscope to the head of Comet B with an exposure of an hour; and on the following night he obtained a second photograph with an exposure of an hour and a half. As it happened, the photograph which was the result of the longer period of exposure was the weaker of the two, but, taken together, an examination of the bands confirmed his

previous observations, and showed that part of the light of the comet was reflected sunlight and part original light; and further, that carbon was present in the cometary matter, with strong evidence also of the presence of nitrogen, in addition to carbon and hydrogen.

The Electric Discharge through Colza Oil, by A. Macfarlane, D.Sc., F.R.S.E.—The electrical properties of colza oil which I have examined are its dielectric strength and some phenomena which accompany the passage of the spark. By the dielectric strength of a substance I mean the ratio of the difference of potential required to pass a spark through air under the same conditions. The electrodes used were two parallel brass plates each 4 inches in diameter. When comparing the gases the standard distance of the plate chosen was 5 mm. In the case of liquids it is convenient to observe for a shorter distance, and reduce the result by the law which previous experiments of mine have established, namely, that in the case of the discharge between parallel plates through a liquid dielectric the difference of potential required is proportional to the distance between the plates (*Trans.* R.S.E., vol. xxix. p. 563). One set of observations gave the ratio for colza oil to be 2·7, another gave 2·5. Hence 2·6 may be taken. I have now obtained the following table of dielectric strengths for liquids (1 being unity).

Substance.	Dielectric Strength.
Paraffin oil	3·7
Oil of turpentine	4·0
Paraffin liquefied	2·4
Olive oil	3·5
Colza oil	2·6

The specific gravity of the colza oil is ·91. The passage of the spark was accompanied by the formation of gas bubbles, but there was no deposition of solid particles. As the 4-inch plates were placed horizontally in the oil a bubble produced by the discharge was prevented from escaping by the upper plate. When the upper plate is again electrified such a bubble behaves in the following manner. If it is large enough it will extend itself somewhat like an hour-glass between the plates, but if it is smaller it takes the form of an acorn with a flat base, the base resting on one or other of the plates. When the upper plate is charged positively the bubble is repelled so as to place its base on the lower plate; when the electricity is charged to negative the bubble remains with its base on the upper plate. A reversal of the order of charging did not change the effect. After a few electrifications a sufficient number of solid particles collect to form a chain, and thus interferes with the phenomenon, the bubbles then being lengthened out in a remarkable manner, but never repelled to the lower plate. When the upper plate was charged negatively, gas bubbles appeared to me to rise from the lower plate, as if they had been formed there. To test this point further I took some sparks between two smaller disks placed vertically in the oil. The gas-bubbles were observed to rise up at the negative surface as if they had been formed at the positive surface, and had been repelled or carried straight across, and then rose up at the negative surface. When the spark was taken between two points bent at right angles to two rods dipping into the oil, the bubbles were observed to shoot out in the direction from the positively charged point, and to circulate round the earth-rod some time before rising to the surface. These phenomena indicate that the bubble is positively electrified.

On the Electric Conductivity and Dichroic Absorption of Tourmaline, by Prof. Silvanus P. Thompson.—The electric conductivity of tourmaline differs in different directions; being, according to the author's experiments, a minimum along the optic axis. Tourmaline also possesses the optical property of dichroism, its absorption being a maximum for rays parallel to the axis, and greater for blue rays than for red, equal thicknesses of crystal being considered. According to the electromagnetic theory of light, bodies which are good conductors of electricity should be opaque to light. The author has in the August number of the *Philosophical Magazine* rewritten the equations of Maxwell's electromagnetic theory for the case of crystalline media possessing different conductivities in different directions. From these equations it appears that in tourmaline and negative uniaxial crystals electric displacements at right angles to the axis will be more absorbed than electric displacements parallel to the axis. This accounts for the well-known greater absorption of the ordinary ray, provided the views of Stokes and Fresnel are correct, that these displacements are at right angles to the so-called plane of polarisation. The difference of velocity between rays of different colour accounts for the difference of absorption being greater in that direction in which the conductivity is a minimum. It was also pointed out that in positive uniaxial crystals, in which the electric conductivity is a maximum along the axis, there will be maximum absorption of the extraordinary ray, and there will be least opacity along the axis. Smoky quartz and magnesic platinocyanide fulfil the latter condition. Specimens of tourmaline cut into cubes to show the colours in different directions were shown, and also specimens of magnesic platinocyanide and of herapathite. Mechanico-optical models were also shown illustrating the theory; a tourmaline being represented by a cube built up of layers of glass and wire-gauze. In conclusion it was shown that crystals in which the electric conductivity differs in three different directions will exhibit *trichroism*; and that di- or tri-chroic absorption is a general property of all coloured crystals other than those of the cubical system.

On the Application of Electricity to the Localisation of a Bullet in a Wound, by W. H. Preece.—The author showed how an electric current could be made an invisible and immaterial probe localising the position of a bullet in the human body without touching or giving the slightest sensation of pain. The conception of using electricity alone as the tool occurred to Prof. Graham Bell in Washington, who at once telegraphed to the author to consult him in reference to the use of Hughes' induction balance. In order to apply this apparatus to the localisation of a bullet in a wound, Prof. Hughes recommended that a pair of exploring coils should be made movable and portable, in order that they might be moved over the body of the wounded man. If the coils were brought within three inches of the bullet its presence could be detected, the direction in which the bullet was situated could be determined by observing the position of maximum sound, for in that position the bullet would be in a line with the axis of the coil. In order to ascertain the depth of the bullet a similar bullet is moved along in the direction of the axis of the other coil until neutrality is obtained; the depth of the trial bullet then will be equal to the depth of the buried one.

On the General Coincidence between Sun-spot Activity and Terrestrial Magnetic Disturbance, by the Rev. F. Howlett, F.R.A.S.—The object of this paper was to inquire how far solar activity, more especially as regards sun-spots, is wont to be accompanied by terrestrial magnetic disturbances, as recorded by the automatic magnetic declination curves at Kew and Greenwich. The data for such an investigation were furnished by comparisons instituted between the most striking instances of sun-spots gathered out of a long series of solar observations carried on by Mr. Howlett from the year 1859 to the present epoch, and the synchronous conditions of the magnetic curves at the observatories above mentioned. The telescopic drawings of the spots were obtained with an achromatic of three inches aperture by Dollond, of forty-eight inches focal distance, projecting the sun's image on a large white screen in a darkened chamber. By employing a Huygenian eyepiece magnifying 120 linear, and placing the screen at the distance of five feet two inches from the eyepiece, a very distinct image of the sun was obtained of about five feet four inches in diameter, and of which every inch corresponded to just 30″ of the celestial arc. Not only were the measurements of all the solar phenomena rendered thereby exceedingly easy, but the conditions of amplification, illumination, and definition of details were combined in about the best possible manner for the observer's purpose, which was to maintain an accurate record of the solar spots, and very frequently of the faculæ also, on a large scale, and which have been collected into five volumes and presented to the Royal Astronomical Society. The comparisons commence with the very remarkable and cyclonic group of August, 1859, which was uniquely distinguished by the remarkable outburst of intense white light, far brighter than the photosphere itself, which fortunately was witnessed by the late Messrs. Carrington and Hodgson on the forenoon of September 1, but which Mr. Howlett missed seeing by only a few minutes, having completed his drawings, and left the telescope. Other striking and, if they may be so termed, crucial groups were compared with the magnetic records—very notably the great spot of October, 1865, engravings of which may be found in the volume of the *Proceedings* of the Royal Astronomical Society for the year last mentioned, as also the large groups of February, 1870, which were observed and drawn on the occasion of the recurrences by revolution of the same groups in the three consecutive months of February, March, and April of that year, and on the last of which months the total displacement, at one and the same time,

of the solar photosphere—or in other words, the total area occupied by the sun-spots—was no less than five thousand two hundred million square miles, or about twenty-seven times that of the superficies of the earth! So again in August and September, 1870, immense groups, occupying from four to five thousand million square miles, were observed to make two consecutive revolutions, and on the latter of which two occasions a beautifully enlarged photograph of the sun, twenty-four inches in diameter, was made by Mr. Titterton of Ely, under the auspices of the late Canon Selwyn, and exhibited to Section A. On all these occasions great magnetic disturbances, amounting often to absolute magnetic storms, were unequivocally manifested; and in fact out of twenty-four comparisons instituted, the following is the summary of results, as showing the coincidence of extensive solar activity and synchronous magnetic disturbances:—

Intensely	5	
Very decidedly	3	
Decidedly	9	= 21 affirmatively
Moderately	3	
Negatively (no spots, no storms) ...	1	
Questionable	1	
Contradictory	2	3 contradictory
	24	

Thus then, from the data collected, it would certainly appear that marked periods of solar activity are wont to coincide with marked periods of terrestrial magnetic disturbances; but yet from a careful comparison of the days and hours of the magnetic records appealed to, it also appeared that the disturbances were manifested in a variety of ways, not only as regarded the extent of the magnetic excursions of the needle, the rapidity of the oscillations, or the persistency of the more moderate disturbances, but also they were found to follow at considerably different intervals of time after the commencement of the observed solar outbursts. With respect, lastly, to reactionary influences, Mr. Howlett stated, on the authority of Mr. Whipple, the director of the Kew Observatory, that on the occasion of the perihelion passage of comet *b* 1881, on the 16th day of June last, the terrestrial magnetic curves were unusually quiescent.

On Artificial Flight, by Fred. W. Brearey.—The author proceeded to argue that the weight of the bird plays an active part in its flight, and that this result arises from the action of that portion of the pectoral muscle which depresses the wing. So great is the tension of this muscle that it is highly probable that, in the case of those long-winged and heavy birds which are able to fly without apparently moving a feather, the wings are kept extended against the resistance of the air underneath without any voluntary effort of the bird. Its weight pressing upon the air causes this muscle to expand in raising the wing, and aids in the effect of the downward stroke by its contraction. The author exhibited a model with wings 4 feet from tip to tip and 3 feet 2 inches from head to tail. The wings are moved by M. Penaud's plan of strands of india-rubber previously put into a state of tension, which in unwinding create a flapping of the wings. By an india-rubber cord attached to the under part of the wing and passing under the shaft to which the mechanism is attached an equilibrium between the two forces is attained; that is to say, the india-rubber strands are wound up to that extent that the wings in rising stretch the india-rubber cord—or, as the author calls it, the pectoral cord—until one force neutralises the other; so that, held in the hand, there is no action. When liberated, and committed to the pressure of the air, the weight of the model causes the wings to be elevated, and therefore stretches the pectoral cord, which in its contraction assists the power derived from the twisted rubber in depressing the wings against the weight of the model. During this action the flight is well sustained for 40 feet or more. The author states that an apparatus of the nature of a longitudinal parachute was liberated from a balloon which rose from Woolwich arsenal, and it travelled back, by the aid of gravity alone, to the arsenal, a distance of half a mile. From this he argued that if the fabric can be manipulated so that propulsion also can be imparted to it, then some encouraging results would be likely to follow. He showed a model of large size upon this principle, and how, by the action of the wing-arms, a wave is transmittted from head to tail along a loose surface in shape like a kite. This loose surface requires a fall before it can be inflated by the air underneath; the wave-motion of the wings is then found adequate to its propulsion.

On the Arrestation of Infusorial Life, by Prof. Tyndall.—Three years ago I brought with me to the Alps a number of flasks charged with animal and vegetable infusions. The flasks had been boiled from three to five minutes in London, and hermetically sealed during ebullition. Two years ago I had sent to me to Switzerland a batch of similar flasks containing other infusions. On my arrival here this year 120 of these flasks lay upon the shelves in my little library. Though eminently putrescible, the animal and vegetable juices had remained as sweet and clear as when they were prepared in London. Still an expert taking up one of the flasks containing an infusion of beef or mutton would infallibly pronounce it to be charged with organisms. He would find it more or less turbid throughout, with massive flocculi moving heavily in the liquid. Exposure of the flask for a minute or two to lukewarm water would cause both turbidity and flocculi to disappear, and render the infusion as clear as the purest distilled water. The turbidity and flocculi are simply due to the coagulation of the liquid to a jelly. This fact is some guarantee for the strength of the infusions. I took advantage of the clear weather this year to investigate the action of solar light on the development of life in these infusions, being prompted thereto by the interesting observations brought before the Royal Society by Dr. Downs and Mr. Blunt in 1877. The sealed ends of the flasks being broken off, they were infected in part by the water of an adjacent brook, and in part by an infusion well charged with organisms. Hung up in rows upon a board, half the flasks of each row were securely shaded from the sun—the other half being exposed to the light. In some cases, moreover, flasks were placed in a darkened room within the house, while their companions were exposed in the sunshine outside. The clear result of these experiments, of which a considerable number were made, is that by some constituent or constituents of the solar radiation an influence is exercised inimical to the development of the lowest infusoria. Twenty-four hours usually sufficed to cause the shaded flasks to pass from clearness to turbidity, while thrice this time left the exposed ones without sensible damage to their transparency. This result is not due to mere differences of temperature between the infusions. On many occasions the temperature of the exposed flasks was far more favourable to the development of life than that of the shaded ones. The energy which in the cases here referred to prevented putrefaction was energy in the radiant form. In no case have I found the flasks sterilised by insolation, for on removing the exposed ones from the open air to a warm kitchen they infallibly changed from clearness to turbidity. Four and twenty hours were in most cases sufficient to produce this change. Life is, therefore, prevented from developing itself in the infusions as long as they are exposed to the solar light, and the paralysis thus produced enables them to pass through the nighttime without alteration. It is, however, a suspension, not a destruction, of the germinal power, for, as before stated, when placed in a warm room life was invariably developed. Had I had the requisite materials I should like to have determined by means of coloured media or otherwise the particular constituents of the solar radiation which are concerned in this result. The rays, moreover, which thus interfere with life must be absorbed by the liquid or by its germinal matter. It would therefore be interesting to ascertain whether, after transmission through a layer of any infusion, the radiation still possessed the power of arresting the development of life in the same infusion. It would also be interesting to examine how far insolation may be employed in the preservation of meat from putrefaction. I would not be understood to say that it is impossible to sterilise an infusion by insolation, but merely to indicate that I have thus far noticed no case of the kind.

The Sun-Spot Period and Planetary Tides in the Solar Atmosphere, by F. B. Edmonds.—The author said that the influence of the planet may be localised on a surface or stratum of small thickness, so that the disturbing force would vary as the square of the distance of the planet. Under this supposition the predominance of Jupiter seemed to shut out the idea that sun-spot maxima and minima could depend simply on the opposition and conjunction of the planets. The consequence of such a supposition was not to be lost sight of, but may be taken together with the more general supposition that the attractive force is exercised on a gaseous envelope, of which the altitude is not insignificant. Again, the mass of the sun is acted on by the planets, and such parts as are fluid, whether in the liquid or

gaseous form, are subject to a disturbance of a tidal character as a matter of course. The author argued that a disturbing body would therefore raise a tide on the sun more than one hundred times greater than the same force would raise it if acting on a globe the size of the earth, the other circumstances being the same. Looking at the sun-spot numbers as a record of spring tides and as a first approximation, recognising only such tides as would be due to the conjunction and opposition of Venus and the earth, it remained to establish a relation between these tides and the tide due to Jupiter in the form of special tides varying in magnitude with the sun-spot numbers.

On a New Integrating Anemometer, by H. S. Hele Shaw and Dr. Wilson.—An ordinary Robinson's cup anemometer is used to drive a train of wheels and thus ultimately a serrated roller, which moves a board in the direction of, and with a velocity proportional to, that of the wind. On the board, which is horizontal and about two feet square, is placed a sheet of paper, upon which the roller presses, and in turning leaves the required trace, at the same time moving the paper underneath it. The board is prevented from having a rotary motion by means of a pair of frames, the upper moving by means of wheels on the lower, each of which can only move in one direction, and these directions are perpendicular to each other. By a clockwork adjustment the time element is able to be introduced, which, taken in connection with space, gives velocity. A method of performing this was shown, as also a proposed form of the instrument for observatories.

On a Universal Sunshine Recorder, by G. M. Whipple.—The author gave a description of a new form of card-supporter for the Campbell sunshine recorder. It consisted of a light frame capable of holding the slip of cardboard, to be burned by the sun in any position. It was arranged so as to receive ordinary parallel strips of card at all times of the year, and to allow of the instrument being employed on any part of the earth's surface without detriment to its efficiency. The card-holders themselves are movable, so as to permit of the cards being changed indoors or dried, if wet, before removal, in order to avoid mutilating the record of the observation. The instrument also has an appliance for placing the card correctly in position to receive the sun's image.

On the Calibration of Mercurial Thermometers by Bessel's Method, by Prof. Rucker.—The author stated that the late Mr. Welsh of Kew Observatory described to the British Association in 1853 the methods which he introduced of making and correcting mercurial thermometers. The correction with which the author dealt was that due to the variations in the bore of the tube. Mr. Welsh's method of making this correction, which is still employed at Kew, is less theoretically perfect than others, and has been unfavourably criticised abroad. The author, in conjunction with Prof. Thorpe, has recently corrected a number of thermometers with great care by Bessel's method, which is the most elaborate and perfect hitherto proposed. One set of three thermometers were made for them at Kew, and were calibrated according to Welsh's method. Afterwards the measurements necessary for the application of Bessel's method were made by the Kew authorities, the calculations being performed by the author and Prof. Thorpe. The Kew thermometers were thus subjected to the most rigorous possible test, and they were able to announce that in one instrument the errors left after the application of Welsh's method were not greater than four-thousandths of a degree Centigrade, and in no case did they exceed one-hundredth of a degree. As it is impossible to read on these thermometers less than a hundredth of a degree with certainty, Welsh's method, as applied at Kew, is practically perfect.

SECTION B—Chemical Science

On a Process for Utilising Waste Products and Economising Fuel in the Extraction of Copper, by J. Dixon (Adelaide, South Australia).—This paper contains an account of a process for extracting copper from sulphurous ores, in which the heat generated by the combination of the oxygen of the air with the sulphur of the ore is utilised for the smelting of the ore. This process is based upon experiments, which, although the author regards as incomplete, show (1) that the charge grows visibly hotter by simply blowing air through it; (2) that the melting of the raw ore or regulus and its reduction can be carried on in the same furnace; (3) that if the ore is in lumps, and fed at the top whilst the air is admitted by the side, a practically clean slagg can be obtained; but if added in a coarse powder, as it is generally found in the market, it either blows out again or chokes the furnace; (4) that a rough copper of about 96 per cent. pure metal can be obtained by the successful working of this process.

On the Chemical Action between Solids, by Prof. Thorpe, Ph.D., F.R.S.—The author drew attention to the extremely rare instances of such action hitherto observed, showing how many of these might be explained on the supposition that combination actually occurred between the bodies either in solution or in a state of gas. For example, the formation of cement steel, by the combination of carbon with iron, which had long been adduced as an example of such combination between solids, was now explained by the fact that iron at a high temperature was permeable to gases, and that in the actual process of cementation oxides of carbon were formed, which were in reality conveyors of carbon to the metal. He then illustrated by experiments the formation of several compounds by bringing together the components in solid form, choosing as examples such as would manifest their formation by characteristic colouring. Thus, as instances, potassium iodide and mercuric chloride, potassium iodide and lead nitrate, and silver nitrate and potassium chromate, were powdered together in a mortar, and in each case evidence of an action was exhibited by the production of characteristic colours of the product of the reaction of these compounds. The author referred to the memoir of the Belgian physicist, Prof. Spring, on the same subject, some of whose experiments he had repeated and in the main confirmed. One of the most remarkable results obtained by the Belgian professor was the formation of coal from peat by subjecting the latter material to a high pressure. Peat from Holland and Belgium, when exposed to a pressure of about 6000 atmospheres, was, according to Spring, changed into a mass which in all physical characters resembled ordinary coal. Experiments of the same nature made by Dr. Thorpe with various samples of British peat yielded, however, a very dissimilar result. These experiments were made with pressures which were considerably less and more than those employed by Spring. Although solid, compact masses, hard and very much changed in structure, were attained, in no case was any product obtained which could be confounded with bituminous coal. He said it was highly improbable, on purely chemical grounds, that mere pressure had been little more than an important factor in the transformation of woody matter into coal.

Metallic Compounds containing Bivalent Hydrocarbon Radicals, Part ii., by J. Sakurai.—This is a continuation of the work, an account of which was given at the last meeting (NATURE, vol. xxii. p. 448, or *British Association Report*, 1880). *Dimercury methylene iodide*, $CH_2(HgI)_2$, is obtained by exposing methylene iodide with an excess of mercury to the action of light. It is a yellowish crystalline powder insoluble in ordinary solvents, but soluble in hot methylene iodide; it melts at 230° with partial decomposition. Iodine converts this compound into methylene iodine and mercuric iodide. This same compound is easily obtained by the exposure of the mono-mercuro-compound described last year (*loc. cit.*), mixed with mercury and mercuric iodide, to the sunlight. Hydric chloride reacts on dimercury methylene iodide, producing mercury iodomethide. The insoluble compound mentioned in the former publications (*loc. cit.*) the author regards $CH(HgI)_3$, and therefore contains a trivalent hydrocarbon radical. We have thus the following series of organo-mercury compounds:—

$$CH_3(HgI),\ CH_2(HgI)_2,\ CH_2HgI_2,\ \text{and}\ CH(HgI)_3.$$

On the Occlusion of Gaseous Matter by Fused Silicates at High Temperatures, and its Possible Connection with Volcanic Agency, by I. Lowthian Bell, F.R.S.

On the Siliceous and other Hot Springs in the Volcanic District of the North Island of New Zealand (with Photographic Illustrations), by W. Lant Carpenter, B.A., B.Sc., F.C.S. The author gives an account of his visit to this district in December, 1880; analyses of the water of many of the springs in the district are also given. The water of the springs in the neighbourhood of Lake Taupo were found to be chiefly siliceous; they are all more or less impregnated with free iodine, and possess a medicinal value. The water of one spring was found to be strongly impregnated with sulphates of iron and alumina. The water of the springs in the Hot Lake district of Rotona and Rotomahana contain large quantities of silica; the deposits from two of these form large siliceous terraces. The water of the springs in the White Island, which is the summit of an extinct volcano,

contains free hydrochloric acid in large quantities. The water of these springs deposits sulphur and sulphate of lime.

On the Two First Lines of Mendeleeff's Table of Atomic Weights, by W. Weldon, F.R.S.E. The author draws attention to certain relations exhibited by the fourth and eighth powers of the atomic weights of the elements in these two lines of Mendeleeff's series. The atomic weights used to exhibit these relations differ but slightly from those generally accepted. The fourth powers of the atomic weights of the elements from lithium to fluorine, viz. lithium, beryllium, boron, carbon, nitrogen, oxygen, and fluorine, are, with the exception of carbon, related to one another as the whole numbers 1, 3, 6, 16, 27, and 54. In order to establish a similar relationship for the atomic weight of all these elements, it is necessary to raise their atomic weights to the eighth power; when the following relationship is found to exist:—

$$\begin{array}{ll} & Li^8 = 1N^8 = 2^8 \\ G^8 = 3^2 & O^8 = 3^6 \\ B^8 = 3^2 \times 2^2 & F^8 = 3^6 \times 2^2 \\ C^8 = 3^2 \times 2^3 & \end{array}$$

Similar relationships are established for the fourth powers of the atomic weights of the elements in the next line of Mendeleeff's table. The author concludes that, in the case of each of these fourteen elements some power of their atomic weight is a simple multiple of the corresponding power of the atomic weight of lithium; further, that this multiple is a function of 2 or 3, or of 2 and 3 combined.

Note on the Chrome Iron Ore of Japan, by E. Divers, M.D.—This paper contains a description and analysis of a specimen of chrome iron ore found in serpentine rocks, in the prefecture Oita. Analysis shows it to contain magnesia, replacing ferrous oxide, and the formula $MgO2FeO.2Cr_2O_3$ is attributed to it.

On the Oxides of Manganese, by V. H. Veley, B.A.—The author at the outset gives an historical sketch of the researches on this subject, in order to show how far it has been satisfactorily proved by them—(1) that manganese forms a series of definite oxides (apart from those present in manganic and permanganic acids); (2) that manganese dioxide forms a series of dioxides. An account is also given of the researches of Dittmar, Wright, and others on the conditions of formations of these oxides, and their behaviour when heated to various temperatures in certain gases. The author has studied the action of air, oxygen, nitrogen, and hydrogen at temperatures varying from 60°–200°, on an oxide having the formula Mn_6O_{11}. Hydrates of the following higher oxides, $Mn_{24}O_{32}$, $Mn_{24}O_{44}$, $Mn_{24}O_{45}$, $Mn_{24}O_{46}$, $Mn_{24}O_{47}$, have been prepared and analysed. When these oxides are heated in air or oxygen, at low temperatures, two changes are observed: (1) a loss of water of hydration; (2) an absorption of oxygen. When heated in nitrogen they are dehydrated, and at higher temperatures lose available oxygen. Heated in hydrogen, they are simultaneously dehydrated and reduced. The author regards these oxides as distinct chemical entities, and not mere combinations of molecules, or molecular compounds.

On the Inferences deducible from High Molecular Weights as exhibited by the Oxides of Manganese, by Prof. Odling, M.B., F.R.S.—In the course of his remarks Prof. Odling brought under the notice of the Section the various considerations which affected the determination of the relative weights of the reacting units of chemical substances. He contended that estimations of vapour-density had not had, and could not have, an absolutely determining influence, but thought these estimations always required to be checked by purely chemical considerations. In particular he referred to the cases of bodies which had two or more distinct vapour-densities—cases which were becoming added to daily. He expressed his entire concurrence with the views of the President of the Section as to the non existence of two distinct forms of combination, atomic and molecular, and strongly opposed the notion that various metallic elements possessed a definite capacity of saturation. He brought forward various illustrations to show that the saturation capacity of both metallic and non-metallic elements was indefinite. He contended that the doctrine of atomicity furnished a very inadequate idea of the most important facts of chemical combination, and that the representation of atomicity notions by graphic formulæ was highly misleading.

On Peppermint Camphor (Menthol) and some of its Derivatives, by R. W. Atkinson, B.Sc. (Lond.), and H. Yoshida.—This paper contains an account of the determinations of the physical properties of menthol ($C_{10}H_{20}O$), menthone ($C_{10}H_{18}O$), menthene ($C_{10}H_{18}$), and those of a hydrocarbon, $C_{10}H_{16}$, which latter compound is obtained by the action of hydric iodide upon menthol and subsequent treatment with caustic soda and metallic sodium. The authors also discuss the constitution of the above compounds.

Note on the Occurrence of Selenium and Tellurium in Japan, by E. Divers, M.D.—The author draws attention to the fact that the presence of these two elements has been observed in Japanese sulphuric acid, and considers it probable that these substances occur in material quantities in Japan.

Note on the Sodium Alum of Japan, by E. Divers, M.D.—An analysis is given of a specimen of this substance; it occurs as an efflorescence on decomposing sodium albite, which contains pyrites scattered through it. It is found in the province of Idzumo, in the prefecture of Shiniané, near the coast. It is said to occur in considerable quantities. It occurs in two forms, one massive, finely fibrous, greyish white and translucent, and the second in friable opaque tears, slightly coloured by iron oxide.

Brewing in Japan, by R. W. Atkinson, B.Sc. (Lond.).—The Japanese brewing process is divided into two parts comparable with the malting and brewing processes of beer-making. The mode of preparation and the properties of the diastatic materials are different in the two cases. The Japanese equivalent of malt or "köji" hydrates maltose in addition to cane-sugar, dextrin, and starch, and the ultimate products of its action on starch-paste are dextrose and dextrin, or perhaps dextrose alone. Köji differs from malt in being rendered inactive by heat at a much lower temperature than malt. Köji is prepared as follows: a mixture of steamed rice and water is allowed to remain in shallow tubs at a low temperature (0°–5° C.) until quite liquid; it is then heated, fermentation commences, and continues until nearly all the dextrine first formed is exhausted. This product is now used like yeast, and is added to fresh quantities of steamed rice and water, fermentation proceeding until the percentage of alcohol amounts to about 13 or 14 per cent. by weight. After the greater part of the rice added has been used up, the mash is filtered and clarified by standing. The "saké" so produced requires very careful watching, and when summer approaches, or it exhibits signs of putrefactive fermentation, it is then heated in iron vessels; this operation has frequently to be repeated. Analyses of various specimens, fresh and diseased, are given in the paper.

Observations on the Specific Refraction and Dispersion of Light by Liquids, by J. H. Gladstone, Ph.D., F.R.S.—The general conclusions arrived at from a large series of observations on different liquids are as follows:—

I. The confirmation of the statement made by the Rev. T. P. Dale and the author, viz., that the length of the spectrum (the difference between the refraction of the Fraunhofer lines A and H) decreases with elevation of temperature.

II. It would appear that the length of the spectrum divided by the density, *i.e.*, $\frac{\mu H - \mu A}{d}$, is approximately, but not exactly, constant for different temperatures.

III. The specific dispersion appears to decrease with increase of temperature.

IV. The specific dispersion is influenced by the chemical constitution of a compound. In the case of hydrocarbons the change of the refractive equivalent of the carbon from 5·0 to 6·1 or 8 influences the specific dispersion to a far greater extent than the specific refraction.

V. Finally, the specific dispersion of a compound does not appear to be the means of the specific dispersions of its constituents.

On the Production of Crystals by the Action of Metals on Carbon Disulphide in Sealed Tubes, by P. Braham, F.C.S.—The author described a series of experiments which consisted in sealing up fifteen different metals in carbon disulphide. Some of these tubes were sealed up in 1879, and in those which contained gold, antimony, and bismuth, microscopic crystals were found. The composition of these crystals has not as yet been determined. The author also exhibited a micro-goniometer.

On the Alleged Decomposition of the Elements, by Prof. Dewar, M.A., F.R.S.—In his remarks Prof. Dewar dealt chiefly with the spectroscopic work from which Mr. Norman Lockyer had drawn conclusions very different from those of Professors Liveing and Dewar, especially concerning the value of evidence on the subject. Prof. Dewar argued that Mr. Lockyer's views regarding the existence of carbon vapour in the corona of the sun would not bear scientific investigation, and that his views regarding the modifica-

tion of the spectrum of magnesium were equally illusory, and gave no proof of the decomposition of elementary substances. Finally he discussed Mr. Lockyer's theory of "basic lines," and addressed himself to a refutation of the same. The results recorded, he said, strongly confirmed Young's observations, and left little doubt that the few as yet unresolved coincidences either would yield to a higher dispersion, or were merely accidental. It would indeed be strange if amongst all the variety of chemical elements and the still greater variety of vibrations which some of them were capable of taking up, there were no two which could take up vibrations of the same period. They certainly should have supposed that substances like iron and titanium, with such a large number of lines, must each consist of more than one kind of molecule, and that not single lines, but several lines of each, would be found repeated with the spectra of some other chemical elements. The fact that hardly a single coincidence could be established was a strong argument that the materials of iron and titanium, even if they be not homogeneous, were still different from those of other chemical elements. The supposition that the different elements might be resolved into simple constituents and even into a single substance had long been a favourite speculation with chemists; but however probable that hypothesis might appear *à priori*, it must be acknowledged, according to Prof. Dewar, that the facts derived from the most powerful method of analytical investigation yet devised, gave it but scant support.

On Manganese Nodules and their Occurrence on the Sea-Bottom, by J. Y. Buchanan.—The author exhibited specimens of the nodules obtained from the South Pacific, and also from Loch Fyne; an account of those obtained in Loch Fyne was given in NATURE, vol, xviii. p. 628. Some nodules containing cobalt were also exhibited; these the author had obtained from New Caledonia. An account is given of the author's method of dredging for mud. The nodules have been found to contain iron oxides, copper, cobalt, nickel, sand, &c. Further, in no case was the amount of oxygen found to be sufficient to form a peroxide with the manganese. The kernels of these nodules are usually richer in manganese oxides than the external portions. Concerning their mode of formation the author thinks that this takes place *in situ*, and that the nodules are not brought from a distance. Further, it would appear that living organisms assist in this formation, although indirectly, insomuch as the decomposing animal matter reduces the sulphates of the sea-water to sulphides, which in their turn react on the iron and manganese minerals (chiefly silicates) in the mud, and thus forming sulphides of these metals. When the organic matter is exhausted these sulphides are oxidised to oxides by the oxygen of the water, forming concretions or incrustations of the ochreous oxides, which naturally inclose the other and unaltered constituents of the mud.

On the Action of Zinc, Magnesium, and Iron on Acidified Solutions of Ferric Sulphate, by Prof. T. E. Thorpe, Ph.D., F.R.S.—The extent of the reduction of the ferric salt may vary with the strength of the solution, with its temperature, with the amount of free acid present, and lastly with the specific nature of the metal employed. The author has studied the conditions under which the hydrogen does work as a reducing agent. Experiments were made on dilute solutions of ferric sulphate, containing known quantities of free acid. The author finds (1) that the extent of reduction, produced by a given weight of zinc in dissolving, increases with the temperature; (2) that it is also affected, although to a less degree, by the initial surface of the metal exposed. Whilst the extent of reduction, as also the rapidity of solution, increase with the temperature, at a given temperature the extent of reduction increases, although at a gradually diminishing rate, with the time of solution. The rapidity of solution and extent of reduction produced by a given quantity of zinc, of a given area and in a solution of a given temperature, and containing a definite weight of free acid, increase with the amount of reducible iron present. Experiments made by placing zinc in contact with platinum showed that, although the time of solution of zinc in contact with platinum is considerably diminished, as compared with that of zinc alone, little difference in the reducing effect is observed. Similar results were obtained with magnesium, although the amount of reduction is from one-fourth to one-third of that produced by zinc under similar conditions. The diminution of the rate of solution with decrease in the amount of free acid present, is far greater in the case of magnesium than in that of zinc. The author concludes that his experiments strongly support the view that the reducing power of nascent hydrogen is connected with the existence of this body in the atomic condition, since all conditions tending to prolong the duration of this atomic condition augment the reducing power.

On the Reducing Action of Zinc and Magnesium on Vanadium Solutions, by Prof. Roscoe, LL.D., F.R.S.—From his original experiments on this subject the author had drawn the conclusion that, whilst the reduction in the case of zinc and sodium took place from V_2O_5 to V_2O_2, in the case of magnesium it only proceeded to V_2O_3. Later experiments have, however, shown that each of these reducing agents acts in the same manner, but that the reduction from V_2O_5 to V_2O_2 takes place very slowly when magnesium is used.

Note on a New Method of Measuring Certain Chemical Affinities, by A. Tribe.—The author points out that when a metal is immersed in an electrolytic field, *i.e.*, in an electrolyte in the act of electrolysis, and the electromotive force set up on any part of its surface is sufficient to decompose the medium, then the positive *ion* separates out on that part of the surface which has received negative electrification, and the negative *ion* on the portion which is positively electrified. If such a plate be of a rectangular form, and it be so placed that the lines of force are perpendicular to its surface, then the maximum electromotive force is set up in the central part of the plate, and at the edges it becomes so weak as to be unable to initiate any electro-chemical action. If the sheet be placed in the electrolytic field, so that the lines of force are parallel with its sides and with two of its edges, then the maximum electromotive force is at the end of the plate and is the weakest at the centre, where it is unable to bring about electro-chemical changes. That this is the case is shown by the boundaries of the deposits, which in many cases are very sharply defined. From the intimate connection between electromotive force and chemical affinity, the author supposed that if, in a series of trials, the chemical affinities were altered, other circumstances remaining the same, the magnitude of the intermedial space between the boundaries of the electro deposits would increase with the force required to overcome the affinities of the *ions* of the electrolytes. This supposition has been confirmed by several experiments, *e.g.*, with sheets or analysers of silver immersed in solutions of chloride, bromide, and iodide of zinc, it was found that the intermedial space was the greatest in the case of the chloride, and in the case of the bromide it was greater than in the case of the iodide.

On some Phenomena of the Nature of Chemico-Magnetic Action, by W. Thomson, F.R.S.E.—The author had observed that the colour from a piece of cloth dyed with Prussian blue was discharged in the neighbourhood of a piece of iron which had been lying upon it for some weeks. The ash of the portions of cloth from which the colour had been discharged was found to contain but a trace of iron. Experiments were made in which no iron was used, and the blue colour was bleached but slightly, showing that the action could not be attributed to light alone. Further experiments, in which small pieces of iron or magnets were used, showed not only that the colour was discharged, but that the colour so discharged appeared to be rearranged in semicircles on each side of the bar of iron. When magnets were used, the colour assumed more or less of circular forms, which were developed not only from the poles, but from all parts of the magnets. These phenomena the author does not regard as due to magnetic action, for when a piece of gutta percha tissue was placed between the wet cloth and the magnet, no action took place, even after several weeks. Similar observations have been made with cloth dyed with aniline colours, and with a like result.

On the Double Iodide of Copper and Mercury, by Prof. Silvanus P. Thompson, D.Sc.—After describing the preparation of this compound, which is cuproso-mercuric iodide, Cu_2HgI_4, the author draws attention to one property, viz., its change of colour by a comparatively small change of temperature. At the ordinary temperature this substance possesses a brilliant red colour, and when heated, it becomes black, changing back to red on cooling. In thin layers this substance transmits light, but becomes opaque on heating. Now according to the electro-magnetic theory of light, opaque bodies are the best conductors of electricity; therefore this double iodide of copper and mercury should conduct heat better at a high than at a low temperature. Experiment has shown this to be true to a certain extent only, as beyond a certain temperature its conductivity becomes less; this is probably due to its decomposition when heated beyond a given temperature. In conclusion, the author pointed out several ways in which this change of colour of this

compound could be used in lecture experiments. For instance, it may be used to show the conduction of heat along a copper rod; for this purpose the rod is coated with the red compound, which is gradually blackened as the heat travels along the rod. It may also be substituted for wax in Tyndall's experiment for showing how crystals conduct heat. There are also a variety of other ways in which it may be applied.

The Effect of the Spectrum on Silver Chloride, by Capt. Abney, R.E., F.R.S.

Alterations in the Properties of Nitric Ferments by Cultivation, by R. Warington.—The author, after giving an account of his experiments on the cultivation of these ferments, which consist of organisms resembling bacteria, states that these nitrifying ferments are capable of existing in three forms—(1) the nitric ferment of soil, which converts both ammonium salts and nitrites into nitrates; (2) the altered ferment, which converts ammonium salts into nitrites, but fails to convert nitrites into nitrates; (3) a surface organism which converts nitrites into nitrates.

On the Fluid Density of Certain Metals, by Prof. W. Chandler Roberts, F.R.S., and T. Wrightson, C.E.—This is an account of a continuation of experiments upon this subject, some of which were submitted to the Section at Swansea (*vide* NATURE, vol. xxii. p. 448). The authors also exhibited the *oncosimeter* described in the *Journal* of the Iron and Steel Institute (ii. 1879, p. 418), by the aid of which these results were obtained. The following table contains the results obtained:—

	Sp. gr. solid.	Sp. gr. liquid.	Percentage of change in volume.
Bismuth	9·82	10·055	Decrease 2·3
Copper	8·8	8·217	Increase 7·1
Lead	11·4	10·37	,, 9·93
Tin	7·5	7·025	,, 6·76
Zinc	7·2	6·48	,, 11·10
Silver...	10·57	9·51	,, 11·2
Iron	6·95	6·88	,, 1·02

On Molecular Attraction, by F. D. Brown, B.Sc.—The author points out that, if we regard chemical affinity as neutralised by the union of two elements, we are then unable to account for the reactions taking place between molecules, and involving an interaction of the atoms composing different molecules. If, however, the act of combination be regarded as producing no change in the chemical forces, and it be supposed that the same attraction is exerted between any given pair of atoms without regard to the state of combination of one or both of the atoms, then a reasonable account can be given of chemical reactions, and the existence of molecular combinations does not appear very remarkable. Further, we are provided with a more or less effective explanation of the relative volatility of substances. Reasoning from this point of view, and considering the carbon compounds specially, the author concludes that intermolecular attraction should be greater in an acid than in a corresponding alcohol; greater in an alcohol of high molecular weight than in a homologue of which the molecule is less complex; greater in a primary alcohol than in the secondary or tertiary isomeride; and finally, greater in a chlorinated compound than in the corresponding substance containing hydrogen. If the volatility of a substance be a measure of the forces of attraction between the molecules, then it must be admitted that the boiling points of organic compounds show with some reason that the above expression represents the value of intermolecular attraction. From this point of view the study of the latent heat of many carbon compounds would materially aid us in the solution of the problem of chemical affinity.

On the Relative Atomic Weights of Silver, Manganese, and Oxygen, by Prof. Dewar, M.A., F.R.S., and A. Scott, B.A., B.Sc. The authors have determined the atomic weight of manganese, in relation to silver and oxygen, by a complete analysis of silver permanganate. Taking the atomic weight of silver to be 108, that of oxygen to be 16, the following values have been obtained for the atomic weight of manganese, 55·51, 54·04, 54·45. These numbers do not agree very well amongst themselves, nor with the numbers obtained from the analysis of pure manganese peroxide, made from manganese nitrate. By this latter method the following values were obtained, viz., Mn = 53·6 and 53·3.

Note on the Phosphates of Lime and Ammonia, by J. Alfred Wanklyn.—When ammonia is added to a soluble calcic phosphate a precipitate is obtained, which dissolves on heating, forming a viscid solution which solidifies on cooling. The soluble salt formed the author regards as having the composition $P_2O_5CaO(NH_4)_2OH_2O$. The author confirms Morfit's observation, that bone earth dissolved in acid is reprecipitated by alkalies in the form of a hydrated tribasic phosphate; a fact which he considers of great importance to agriculture.

On the Separation of Hydrocarbon Oil from Fat Oils, by A. H. Allen, F.C.S.—The author pointed out that the extensive production of hydrocarbon oils and their cheapness had led to their being employed for the purpose of adulterating animal and vegetable oils. Indications of their presence are afforded by the determination of the density of the oil, by the lowering of its flashing point and boiling point, further by its taste and the odour produced on heating. An oil so adulterated is not completely saponified, and the hydrocarbon oil may be removed from the product of saponification by extraction with ether. Fluorescence is also to some extent a useful indication of the presence of such a mineral oil; the fluorescence of some mineral oils may, however, be destroyed by chemical means, and as some mineral oils are not fluorescent the absence of fluorescence in an oil does not therefore indicate the absence of a mineral oil.

On Bowkett's New Thermograph, by W. Lant Carpenter, B.A., B.Sc., F.C.S.—This is an instrument for recording changes of temperature, which are measured by the action of heat upon a hollow circular metallic ring connected with a circular vessel, the whole being filled with fluid and hermetically sealed. One end of the ring is fixed, the other is free to move, and its motion is magnified by a series of levers, to the end of which is attached a recording pen. Increments of heat cause increments of pressure in the ring, which moves at its free end. The instrument has hitherto been used for clinical purposes only, but the author thinks it might with advantage be used in chemical and physical researches.

The Blowing Wells near Northallerton, by T. Fairley, F.R.S.E.—The author gave an account of a series of observations on these wells, of which there are three in the neighbourhood of Northallerton. The gas issuing from the fissures in these wells has been analysed, and is apparently nothing more than common air.

On the New Metal Actinium, by J. L. Phipson.—The author stated that he had been able to separate a new element from the pigment zinc-white. The oxide of the new element is said to be slightly soluble in caustic soda, and is soluble in ammonia and ammoniacal salts. Its colour is uninfluenced by exposure to light. The sulphide of actinium is described as a pale yellow canary-coloured substance; it is insoluble in ammonium sulphide, is soluble in acetic acid, and becomes darker on exposure to the air.

On some Vapour-Density Determinations, by Prof. Dewar, M.A., F.R.S., and A. Scott, B.A., B.Sc.—The authors described the apparatus they employed for the determination of the vapour-densities at high temperatures, and the means adopted for examining the vapours to ascertain whether or not decomposition had taken place. The vapour-densities of the halogen compounds of several metals have been determined, and it is interesting to note that the authors find, according to its vapour-density, the molecular formula for ferrous chloride is $FeCl_2$.

Some Remarks on Crystallogeny, by Prof. J. P. Cooke (Harvard University, U.S.A.).

On a New System of Blow-pipe Analysis, by Lieut.-Col. Ross.—The author described his system of blow-pipe analysis, and exhibited a compact form of blow-pipe and other necessary apparatus for use when travelling.

On Experiments with Manures on Barley Crops, Season 1881, by Ivison Macadam, F.C.S.—The author gave a detailed account of his experiments on two fields sown with barley in April of this year. The previous rotation of crops was as follows:—in 1878 potatoes with 20 tons of farmyard manure per acre, and 4 to 5 cwt. of dissolved manure; in 1879 wheat, no manure; in 1880 turnips, 20 tons per acre of town ashes and 5 to 6 cwt. of dissolved manure. The only difference between the two fields was that in one case the turnips were carted away, whilst in the other they were eaten on the ground by sheep. From the time when the barley appeared to the time of cutting, determinations of the following points were made every week: (1) the weight of the plant; (2) length of straw; (3) rate of storage of saline matter by the plant; (4) amount of water, nitrogen (given as ammonia), organic and vegetal matter; (5) the amount of the various saline ingredients present in the ash. The results appear to show that, in the case of the field where the turnips had been eaten on the ground, the barley crop grew more rapidly and was more healthy than that on the other field.

SECTION C—GEOLOGY

On the Laurentian Beds of Donegal and of other Parts of Ireland, by Prof. Edward Hull, LL.D., F.R.S., &c., Director of the Geological Survey of Ireland.—After a perusal of the writings of previous authors, and a personal examination made in the spring of 1881, in company with two of his colleagues of the Geological Survey, Mr. R. G. Symes, F.G.S., and Mr. S. B. Wilkinson, the author had arrived at the following conclusions:—1. That the Gneissose series of Donegal, sometimes called "Donegal granite," is unconformably overlaid by the metamorphosed quartzites, schists, and limestones which Prof. Harkness had shown to be the representatives of the Lower Silurian beds of Scotland (*Quart. Journ. Geol. Soc.*, vol. xvii. p. 256). This unconformity is especially noticeable in the district of Lough Salt near Glen. 2. That the Gneissose series is similar in character and identical in position and age with the "Fundamental Gneiss" (Murchison) of parts of Sutherlandshire and Ross-shire, and is therefore, like the latter, presumably of Laurentian age. That the formation is a metamorphosed series of sedimentary beds, has been shown by Dr. Haughton and Mr. R. H. Scott. 3. That the north-western boundary of the Donegal gneiss is a large fault between the Laurentian gneiss and the metamorphosed Lower Silurian beds, owing to which the older rocks have been elevated, and by denudation have been exposed at the surface. 4. That the Cambrian formation of Scotland is not represented in Donegal, and that the unconformity abve referred to represents a double hiatus, and is of the same character as that which occurs in Sutherlandshire, in the district of Fornaven and Ben Arkle, where the Lower Silurian beds rest directly on the Laurentian gneiss. 5. That Laurentian rocks may be recognised in other parts of Ireland, as in the Slieve Gamph and Ox Mountains of Mayo and Sligo, at Belmullet, and in West Galway, north of Galway Bay, where the rocks consist of red gneiss, horneblende rock, and schist, &c., similar to those in Donegal; also possibly in Co. Tyrone, as suggested by Mr. Kinahan.

Laurentian Rocks in Ireland, by G. H. Kinahan, M.R.I.A., &c.—The writer first mentioned that Cainozoic and Mesozoic rocks only occurred in the province of Ulster, while in the rest of the island there was a nearly continuous sequence of Palæozoic rocks, proved by the work of Griffith, Jukes, and their subordinates, from the Coal-Measures down to the Cambrian. He then pointed out that a recent attempt had been made to try and disturb their natural order, but that the new theory was solely founded on assertions that would not bear investigation. He proceeded to observe that the geologists of the pre-Cambrian school appeared to lay more weight on lithological evidence than that to which it was entitled, and in continuation he gave the localities for the oldest rocks in Ireland, with the reasons for and against the rocks being Laurentian. The localities are *Carngore*, or South-East Wexford, while it was shown that although the rocks were lithologically similar to the Laurentians, yet they contained Cambrian fossils—*Galway, South-East Mayo, Sligo, and Leitrim*—rocks that, from their lithological characters, were said to be Laurentian by Murchison, who recanted his statement when Harkness showed that stratigraphically this was an impossibility. These rocks occur on two zones, those on the highest being now said to be Laurentian—*Erris, North-West Mayo*—very old rocks, about which nothing can be positively said, except that they are older than the associated metamorphic rocks, also of uncertain age. *Donegal, Londonderry, and Tyrone*—the Laurentian age of some of these, years ago, was suggested by Jukes, while now it is positively asserted, but solely on lithological characters. The author pointed out that, although lithologically very like Laurentians, they were more like Huronians, Logan's description of the latter being very suitable for those of Donegal. He also pointed out that it was unnecessary to make vague assertions, as the stratigraphical position of the rocks ought to be easily worked out, either by starting from the Pomeroy fossiliferous rocks, or from the fossiliferous rocks found in Donegal by Dr. King; but that, at the same time, the work must be much better and more correctly done than that in the neighbourhood of Pomeroy, where the unaltered fossiliferous beds are classed with those they lie on, although the latter were extensively metamorphosed, contorted, upturned, and denuded, prior to the fossiliferous rocks being deposited on them. *North-East Antrim*-rocks, supposed to be of the same age as the older rocks near Pomeroy (*Upper Cambrians*).

On the Occurrence of Granite in situ about Twenty Miles South-West of Eddystone, by A. R. Hunt, M.A., F.G.S.—The author described and exhibited a fragment of granite brought up by a Brixham trawler twenty miles south-west of the Eddystone. He believed it to have been torn off a mass of granite *in situ*, and pointed out that in mineral composition it agreed with the gneisses of the Eddystone Reef and of the Shovel Reef in Plymouth Sound—all these rocks being composed of mica, quartz, and felspar, without hornblende or schorl. The author believed that the occurrence of gneiss in Plymouth Sound without altering the adjacent Devonian rocks was an indication that these Channel typical gneisses, and probably the typical granites too, were of pre-Devonian age.

Some Observations on the Causes of Volcanic Action, by J. Prestwich, M.A., F.R.S., &c., Professor of Geology in the University of Oxford.—The hypothesis generally accepted in this country as to the cause of volcanic action is that of the late Mr. Poulett Scrope, who considered that "the rise of lava in a volcanic vent is occasioned by the expansion of volumes of high-pressure steam, generated in a mass of liquefied and heated matter within or beneath the eruptive orifice," and that the expulsion of the lava is effected solely by high-pressure steam generated at great depths, but at what depths is not mentioned, nor is it explained how the water is introduced, whether from the surface, or whether from water in original combination with the basic magma. The objections to this hypothesis are—1. That during the most powerful explosions, *i.e.*, when the discharge of steam is at its maximum, the escape of lava is frequently at its minimum. 2. That streams of lava often flow with little disengagement of steam, and are generally greatest after the force of the first violent explosion is expended. 3. That it is not a mere boiling over, in which case, after the escape of the active agent—the water—and the expulsion of such portion of the obstructing medium, the lava, as became entangled with it, the remaining lava would subside in the vent to a depth corresponding to the quantity of lava ejected; but the level of the lava, *cæteris paribus*, remains the same during successive eruptions. Of the important part played by water in volcanic eruptions there can be no doubt, but instead of considering it as the primary, the author views it as secondary cause in volcanic eruptions. All agree in describing ordinary volcanic eruptions as generally accompanied or preceded by shocks or earthquakes of a minor or local character, to which succeed paroxysmal explosions, during which vast quantities of stones, scoriæ, and ashes, together with volumes of steam, are projected from the crater. The first paroxysms are the most violent, and they gradually decrease and then cease altogether. The flow of lava, on the other hand, which commences sooner or later after the first explosions, is continued and prolonged independently. Ultimately the volcano returns to a state of repose, which may last a few months or many years. Adopting the theory of an original igneous nucleus, the author considers a certain fluidity of the former, and mobility of the latter. The one and the other feebly represent conditions of which the phenomena of the rocks afford clearer and stronger evidence as we go back in geological time. Although thermometrical experiments, of the necessary accuracy and length of time, are yet wanting, it has been estimated that a small quantity of central heat still reaches the surface and is lost by radiation into space, and the escape of liquid lava and steam from volcanoes, and of hot springs from these and other sources, must bring, in however small a quantity, a certain increment of heat from the interior to the surface, where it is lost. This should lead to a certain contraction at depths, and of readjustment of the external crust, in consequence of which the fused masses of the interior will from time to time tend to be forced outwards, whenever tension became sufficient to overcome resistance. In this the author agrees with many other geologists. The further hypothesis respecting volcanic action, he now suggests, he has been mainly led to form by his researches on underground waters. A portion of the rain falling on the surface not only of permeable and fissured sedimentary strata, but also of fissured and creviced crystalline and other rocks, passes below ground, and is there transmitted as far down as the permeable rocks range, or as the fissures in the rocks extend, unless some counteracting causes intervene. Those causes are the occurrence of impermeable rocks, faults, and heat. The former two are exceptional, the latter constant. The increase of temperature with depth being 1° Fahr. for every 50 to 60 feet, the boiling point of water would be reached at a depth of about 10,000 feet, but owing to the pressure of the superincumbent rocks, it has been estimated that water will retain its liquidity and continue to

circulate freely to far greater depths. Unfortunately, very little is known of the substrata of volcanoes. Etna and Hecla apparently stand on permeable Tertiary strata, Vesuvius on Tertiary and Cretaceous strata, while in South America some of the volcanoes are seemingly situated amongst palæozoic and crystalline rocks. Under ordinary circumstances all the permeable strata and all fissured rocks become charged with water up to the level of the lowest point of escape on the surface, or if there should be an escape in the sea-bed, then to that level, *plus* a difference caused by friction. The extreme porosity of lavas is well known. All the water falling on the surface of Etna and Vesuvius (except where the rocks are decomposed and a surface soil formed) disappears at once, passing into the fissures and cavities formed by the contraction of the lava in cooling. Not only are these fissures filled, but the water lodges in the main duct itself, and occasionally rises to a height to fill the crater. Beneath the mass of fragmentary and cavernous volcanic materials forming the volcano, lies the original compact mass of sedimentary strata, &c. Owing to the fortunate circumstance of an Artesian well having been sunk at Naples, we know the underlying sedimentary strata there to consist of alternating strata of marl, sands, and sandstones, some water-bearing, others impermeable. The water from the lowest spring reached in this boring rose at first 8 feet above the surface, and 81 feet above the sea-level. Where the strata crop out in the sea-bed, the same pressure of the column of inland water forces the fresh water outwards, so as to form a freshwater spring in the sea, as at Spezzia and elsewhere on the Mediterranean coast. It is this fundamental hydrostatic principle which keeps wells in islands, and in shores adjacent to the sea, free from salt water, as in the Isle of Thanet. Where, however, the head of inland waters is small or impeded, sea-water will enter the permeable strata, and spoil the springs, as in the case of the Lower Tertiary sands at Ostend, and the Lower Greensand at Calais and in the Somme, in which latter department the underground spring was found affected to a distance of about one mile from the sea, but pure at a distance of nine miles. Further, if where the head of inland water is sufficient to force back the sea-water under ordinary conditions, those ordinary conditions are disturbed by pumping to an extent that lowers the line of water-level to below that of the sea-level, then the sea-water will flow inwards until an equilibrium is established. The flow of water under a volcanic mountain may be also influenced by the quaquaversal dip, which there is some evidence that the underlying strata there take, owing probably to the removal of matter from below, and the weight of the mountain. If we are to assume that the volcanic ashes and tufas below Naples are subaërial, the original land-surface has sunk not less than 665 feet, and a dip of the underlying strata from the seaward, as well as from inland, has in all probability been caused. This Artesian well was carried to the depth of 1524 feet, and passed through three water-bearing beds—one in the volcanic ashes, the second in the sub-Apennine beds, and the third in the Cretaceous strata at the bottom. No eruption of lava can then take place without coming in contact with these underground waters. The first to be affected will be the water in the cavities of the mountain in and around the crater. As the pressure of the ascending column of lava splits the crust formed subsequently to the preceding eruption, the water finds its way to the heated surface, and leads to explosions more or less violent. When the fluid lava breaks more completely through the old crust, and the mountain is fissured by the force and pressure of the ascending column, the whole body of water stored in the mountain successively flows in upon the heated lava, and is at once flushed off into steam. Then take place those more violent detonations and explosions—those deluges of rain arising from the condensed steam—with which the great eruptions usually commence. In conclusion, the author conceives that the first cause of volcanic action is the welling up of the lava in consequence of pressure due to slight contraction of a portion of the earth's crust. Secondly, the fluid lava coming into contact with water stored in the crevices of the masses of lava and ashes forming the volcano, the water is at once flushed into steam, giving rise to powerful detonations and explosions. Thirdly follows an influx of water from the underlying sedimentary or other strata lying at greater depths into the ducts of the volcano; and, lastly, as these subterranean bodies of water are thus converted into steam and expelled, the exhausted strata then serve as a channel to an influx of sea-water into the volcano. A point is finally reached when, owing to the cessation of the powerful shocks and vibrations, and the excessive drainage of the strata, the flow of the lava is effected quietly, and so continues until another equilibrium is established and the lava ceases to escape.

The Connection between the Intrusion of Volcanic Action, by Prof. W. J. Sollas, M.A.—In a volcanic eruption there are concerned first the elevation of the lava column in the axial pipe of the volcano, and next the explosion by which the lava is ejected into the air. The author attempts to find a *vera causa* for the latter. Sorby's researches on included cavities prove that steam at a high tension must have been everywhere present throughout plutonic rocks when these were in a state of fusion, and the presence of steam in ejected lava is well known. He considers it probable that the axial pipe of a volcano is occupied by fused rocks permeated by steam, which is probably in a liquid state, and the tension of which will depend on the hydrostatic pressure due to the lava column above it. Any sudden diminution of this pressure will tend to a sudden expansion of the steam, and tend to produce a volcanic explosion. The mere elevation of the lava in the volcanic pipe cannot directly produce a diminution of pressure, though an overflow at the surface of the ground would, but this infers that the overflow of lava should precede an eruption, which is not the case; hence the author concludes that an overflow of lava from the sides of the pipe and other places underground, and the pressure on the lava column being reduced beneath the point of overflow, an eruption follows. The ascendant pressure of intruded sheets and dykes of igneous rock known to occur beneath volcanic cones thus stands in close connection with the production of volcanic explosions.

A Restoration of the Skeleton of Archæopteryx, with some Remarks on Differences between the Berlin and London Specimens.—Prof. H. G. Seeley, F.R.S., traced the forms of the bones from a photograph, and arranged the skeleton so as to represent a bird which stood about ten inches high. The head has a post-occipital process in the cormorants; the neck is curved forward; the tail reached almost to the ground; and the limbs were exactly as in birds.

On Simosaurus pusillus (Fraas), *a Step in the Evolution of the Plesiosauria.*—Prof. H. G. Seeley gave a detailed description of the skeleton of Simosaurus recently discovered in the Trias near Stuttgart, and briefly noticed and figured by Dr. Oscar Fraas. He then drew special attention to the difference from Plesiosaurus, especially in the form of the pectoral arch and in the characters of the fore and hind limbs. The hind limb was discussed, to show how it might assume like character with the fore limb. Prof. Seeley concluded that the Plesiosaurus were originally land animals, and that their ancestors and affinities must be sought in Simosaurus, Nottosaurus, and allied types of amphibious Triassic reptiles.

Influence of Barometric Pressure on the Discharge of Water from Springs, by Baldwin Latham, M.Inst.C.E.—The author of this paper mentioned that it was alleged, by some of the long-established millers on the chalk streams, that they were able to foretell the appearance of rainfall from a sensible increase in the volume of water flowing down the stream before the period of rainfall. He had, therefore, undertaken a series of observations to investigate the phenomena, and he found, in setting up gauges in the Bourne flow in the Caterham Valley, near Croydon, in the spring of this year (1881), and selecting periods when there was no rain to vitiate the results, that whenever there was a rapid fall in the barometer, there was a corresponding increase in the volume of water flowing, and with a rise of the barometer, there was a diminution in the flow. The gaugings of deep wells also confirmed these observations; for where there was a large amount of water held by capillarity in the strata above the water-line, at that period of the year when the wells became sensitive and the flow from the strata was sluggish, that a fall in the barometer coincided with a rise in the water-line, and that under conditions of high barometric pressure the water-line was lowered. Percolating gauges also gave similar evidence, for after percolation had ceased and the filter was apparently dry, a rapid fall of the barometer occurring, a small quantity of water passed from the percolating gauges. The conclusion arrived at was, that atmospheric pressure exercises a marked influence upon the escape of water from springs.

On Evaporation and Excentricity as Co-factors in the Causes of Glacial Epoch, by the Rev. E. Hill, M.A.

On some Points in the Morphology of the Rhabdophora, by John Hopkinson.—The author, after reviewing the characteristics of the group, concludes from his investigation into the morphology of this group that they are the Palæozoic representatives of the recent Hydroida.

The Glacial Deposits of West Cumberland, by J. D. Kendall, C.E., F.G.S.—The extent, form, and inner nature of these deposits is first described; a number of new and important facts being brought forward on the distribution of boulders both in the boulder clays and in other glacial deposits. The conclusions arrived at from the facts are (1) that the boulder-clays were formed in the sea, partly by glacier action and partly by icebergs. The occurrence of boulders from distant localities, often in very different directions, in a matrix partaking of the character of the underlying rocks, is explained in an entirely new way. 2. That the middle sands and gravels are the result of marine and river action combined. 3. That the mounds of sands and gravels occurring in the mouths of valleys were accumulated by floating ice from pre-existing deposits. A somewhat novel explanation is given of the occurrence of boulders on higher levels than the rocks from which they were derived.

On "Flots," by J. R. Dalyns, M.A., Geological Survey of England and Wales.—The word "flot" is a miner's term for ore lying between the beds, or at certain definite horizons in the strata. In text-books flots are generally called "flats" or "flattings." They are of two kinds: (1) those connected with "cross-veins"; (2) those connected with courses of dun limestone. Firstly, cross-veins are veins (generally mere spar veins on Greenhow Hill) which cross and intersect or shift the metal veins, but which often bear ore at their intersection with the metal veins. Where these cross-veins cut the flot planes, ore is found. Secondly, similarly with courses of dun limestone. Dun limestone, so-called from its colour, is a dolomitised form of ordinary limestone. The dun lime occurs in beds or irregular masses, or more frequently in dyke-like courses, running north-north-west and south-south-east. These courses are often several yards or even fathoms wide, and where the dun course crosses the flot plane ore is developed along the joints between the dun and the white limestones. Ore is not found along the flot plane except at its intersection with the cross-veins or with the courses of dun limestone.

On the Lower Cambrian of Anglesea, by J. McK. Hughes, Woodwardian Professor, Cambridge.—In this paper the author gives the results of further examination of the basement beds of the Cambrian, which he has now traced all along the north-west flank of the Archæan axis of Llanfaelog. The sequence he found almost invariably was in ascending order:—(A) Quartz conglomerate passing up into (B) grit, which in turn becomes finer, and passed into (C) sandstones weathering brown, which get split up in their upper part by thin slabby shales; (D) black shales with subordinate beds of black (D 2) breccia, and occasionally sandstone in the lower part.

On the Gnarled Series of Amloch and Holyhead in Anglesea, by T. McK. Hughes, Woodwardian Professor, Cambridge.—The author offers the results of his inquiries into the age of certain schists which form the main mass of the rocks of northern and Western Anglesea, leaving for the present the consideration of the masses of somewhat similar rock which occur south of the Llanfaelog gneissic axis in the central and south-east part of the island. The author believes these felspathic gnarled rocks must be either the marine equivalents of the Bala volcanic series, or the result of a later (probably Silurian) denudation of those beds. As Lower May Hill (= Birkhill) fossils only occur in the slates immediately south of the area in question, the latter supposition is the only one tenable in the present state of the evidence.

Notes on the Subsidences above the Permian Limestone between Hartlepool and Ripon, by A. G. Cameron, Geological Survey of England and Wales.—In this paper attention is drawn to the numerous forms of shrinkages of the land-surface, often extending to considerable depths into the rocks beneath, observable over the top of the Permian rocks betwixt Hartlepool and Ripon. As a general explanation of their origin, it is suggested that where the underground water, flowing over the limestone surface, reaches the margin of the sandstone, it receives a check whereby it accumulates, forming a chain of dams or pools along the line of junction of these rocks. As denudation proceeds, hollows form above, until ultimately the phenomena of the pits appear. This being so, "the water bubbling and frothing all over" is explained without calling in the aid of river-action. Allusion is made to the Home Farm Colliery accident at Hamilton, N.B., in February, 1877, through a subsidence in the gravelly alluvium of the Clyde; also to the recent subsidences at Blackheath, near London, and to the extensive caverns in the hematite districts of Furness.

The Great Plain of Northern India not an old Sea-Basin, by W. T. Blanford, F.R.S.—The author described the distribution of land in the Indian Peninsula and the intervention of a vast plain traversed by the Indus, Ganges, and Brahmaputra. This plain has constantly been considered, both by geological and lithological writers, as the basin of a great sea; but on examining the evidence, there does not appear to be a single fact in favour of the sea having at any geological period occupied the Gangetic or eastern position of the plain. The tract is evidently an area of depression filled up to above sea-level, through a long period of geological range of time.

The Gold-Fields and the Quartz Outcrops of Southern India, by William King, Deputy-Superintendent (for Madras), Geological Survey of India.—The paper is a *résumé* of the knowledge ascertained through the author's original survey of the Wainád gold-field in 1874 and by the later surveys and examinations of others; also in his examination of the Travancore and other areas in the beginning of the year. The geographical distribution of the gold areas is briefly treated of as being at Manyapet, on the Godávari River, near Dûmbal, in the South Mahratta country, near Kolár in Mysore, at Salem, in part of the Travancore State, and in the Nilgiri and Malabar country; and these are reduced to the more important fields of Malabar (including Wainád, and the Nilgiris) and Mysore. The reefs of Wainád are developed to a remarkable extent over a very large area of country; but their gold-bearing quality is only displaced over a portion of this, chiefly in the south-east of Wainád and in the adjacent low country of Malabar, in a generally east and west belt, the reefs outside of this being fewer and only very locally auriferous. The "leaders" or offshoots of the reefs in this belt are strongly and numerously developed, and they and the "casing" are rich in gold. The author expects the gold-yield to be seven pennyweights to the ton. He does not think that a paying return can be obtained on less than three pennyweights of gold to the ton.

Geology of the Island of Cyprus, by R. Russell, C.E.—The author described the physical features of the island as consisting of two great mountain chains, the axes of which are mainly parallel to each other, distinct from each other in structure and in physical matter. The southern range, rounded in outline, rises to 6340 feet; the northern range rises up from hummocky ground, on both sides, as it were, in one great continuous wall-like cliff. The central area consists of flat-topped irregular hills rising abruptly from the low ground, and therefore show more prominently than they would otherwise. The rocks which occur may be classified as follows:—

Post-Tertiary.	Blown sand.	
	Alluvium (vent).	
	Kavara (solidified surface).	
	Raised beach.	
	Sand and gravel (old river deposits).	
	Calcareous tuff and travertine.	
Tertiary.	Pliocene	Kerynia rock.
		Nicosia beds.
	Miocene	Idalian beds.
Secondary	Upper Cretaceous.	Konnos.
	Jurassic	Mount Hilarion limestone.
	Igneous rocks.	

The last upheaval of the island took place in a comparatively recent period, and was not more than fifteen or twenty feet in vertical height.

On some Sections in the Lower Palæozoic Rocks of the Craven District, by J. E. Marr, B.A., F.G.S.—The author showed by means of a thin band containing *Phacops elegans*, Bœck and Sars, that a series of beds consisting of pale green shales, underlain by black shales, passing below into a conglomerate which rested unconformably upon the Bala beds (the whole exposed in Austisich Beck, near Settle), were the equivalents of the Stockdale shales of the Lake District, and of the May Hill beds of the Continent. The beds are lithologically similar to those of the Lake District, and, like them, are surmounted by blue flags containing *Monograptus priodon* and *M. vomerinus*.

Life in Irish and other Laurentian Rocks, by C. Moore, F.G.S.—The author drew attention to certain forms found by a microscopic examination of specimens of certain Laurentian and other Palæozoic limestone prepared by trituration, solution in acid, and washing. These forms were clearly those of organic structures, some apparently hairs and other feather barbs. The author considered that he had taken precautions to eliminate

sources of error, through admixture of foreign materials, and he was led to think that the organisms belonged to the rocks.

The Subject-matter of Geology and its Classification.—Prof. W. J. Sollas, M.A., stated his object was to remove certain prevailing misconceptions as to the aim and scope of geology. The accepted definition of geology as "the history of the earth's crust and the fossils it contains," was considered to be both too wide and too narrow; the former since it includes palæontology, which, so far as it is a study of forms of life, belongs to biology; and too narrow, since the science of the whole, necessarily embraces much more than a study of its crust. Geology is one of the group of concrete sciences which include astronomy, geology, and biology. The scope of geology, or the science of the earth, is so wide, that a fresh classification of its subject-matter is required, and the author proposes *Morphological Geology*:—embracing geography, petrology, lithology, and mineralogy corresponding to anatomy and histology in biology; minerals, rocks, rock masses, constituting the earth's crust as cells, tissues, organs constituting living organisms, while palæontology is a study of successive morphological states, corresponding to embryology or development. *Physiological Geology*, considering the movement of the earth as a whole, and of all activities produced upon it, by extrinsic and intrinsic forces, acting singly or in combination; it rightly includes meteorology, hydro-geology, as well as the physiology of the earth's crust. *Distributional Geology* seeks to determine the distribution of the earth in time and space, and *Otiological Geology* corresponds roughly to what is known as cosmogony.

Exploration of a Fissure in the Mountain Limestone at Raygill, by James W. Davis, F.G.S.—Attention was first called to this fissure by Mr. Tiddeman about eight years ago. It occurs in a quarry in Lothersdale, about five miles from Skipton. The mouth of the cavern is blocked with glacial drift; under this occurs a finely laminated clay, beneath which is a brown sandy clay with well-worn boulders. The fissure, when excavated, proved to be forty feet in length, horizontal, with a second branch, both of which are abraded and smoothened by the action of running water. Contains bones of *Elephas*, teeth of *Hippopotamus*, *Rhinoceros leptorhinus*, remains of the roe-buck and hyæna, and one or two teeth of lion, and a single tooth of bear.

On the Zoological Position of the Genus Petalo-rhynchus, Ag., *a Fossil Fish from the Mountain Limestone*, by J. W. Davis.—The species described resemble genera *Janassa*, Munst., and with it appear to occupy an intermediate position between the genera *Myliobatis* and *Cestraciontes*.

On Diodontopsodus, Davis, *a New Genus of Fossil Fishes from the Mountain Limestone at Richmond in Yorkshire*, by James W. Davis, F.G.S.—These teeth resemble those of the modern fish Diodon.

Preliminary Remarks on the Microscopic Structure of Coal from East Scotland and South Wales, by Prof. Williamson, F.R.S., Owens College.—This subject will not be worked out until ten years, but he described layers of vascular tissue which can be separated layer by layer, while in other cases the charcoal layer on the surface of the coal and the organic structure is not capable of separation, and he stated that charcoal contains a tubular structure, like tissues of ordinary bark. The association of tissues resembles that of Cycadian plants; and referred to the genus *Cordaites* having been proved to belong to this group by M. Renault; the author has made nearly a thousand distinct observations on the structure of coal. Separates ordinary coal with large quantities of mineral charcoal, with macrospores of Lepidendroid plants filled up with myriads of microspores which were certainly not floated to the spots, from the *paraffine coals* which do not contain these large macrospores. He divides coals into "Iso-sporous" coals and "Heterosporous" coals; both abound in *Cordaites*, which form the mineral charcoal.

On an International Scale of Colours for Geological Maps, by W. Topley, Geological Survey of England.—The author described the objects of the International Geological Congress which is to meet at Bologna this month. Three main subjects are there to be discussed, (*a*) colours and signs for geological maps, (*b*) nomenclature of rocks and formations, (*c*) nomenclature of species. This paper is concerned only with the first of these questions, and especially with the resolutions passed by the English Map Committee, of which Prof. Ramsay is president, and the author secretary. At present all countries and many map-makers in each country have different systems of colouring maps, and it is necessary carefully to study the index, or scale of colours used, before the map can be at all understood. The Congress proposes to frame some scheme of colouring which can be used and readily understood by all nations. It may not be possible, at least for some time to come, to obtain any alteration in national surveys in progress. But it is to be hoped that in new small-scale maps the scheme to be decided on will be adopted. One important point which the Congress proposes is the preparation and publication of a general map or atlas of Europe, compiled under the authority of the Congress, from the various national surveys and the work, of independent observers. The scheme of colouring proposed is one based on the order of colours in the solar spectrum, violet denoting the older rocks. Bright reds are reserved for igneous rocks; metamorphic rocks will be shown by dark bands of colour over the colour denoting the age; to these will be added bands of colour showing the period at which metamorphism has taken place, when such fact is clearly established: thus, Silurian rocks metamorphosed in Cretaceous time would be shown by violet striped with alternate lines of dark violet and green. The sub-divisions of a formation will be shown by shades of the body colour, the darkest shade denoting the oldest sub-division. The letter denoting the formation will be the capital initial letter of the name of the formation; with very small arrangements one system of lettering can be made to apply to all countries. It has been found impossible to adhere strictly to the order of colours of the spectrum, and an interpolation has been made of browns and greys for the series of beds between the Silurian and the Lias. Examples of maps and tables of strata coloured according to the plan adopted were exhibited, as were also a series of Indexes of Colours issued at various dates by the Geological Survey, commencing with one in MS. by Sir H. de la Bêche in the year 1832. The author also drew attention to a proposal made by Mr. J. W. Salter before this Association in 1847, and again at the International Exhibition in 1862, to colour geological maps in the order of colours of the solar spectrum. The plan recommended by the English committee differs considerably in detail from that of Mr. Salter.

On the Rhætics of Notts, by E. Wilson, F.G.S.—The author gave a summarised account of the Rhætic series in Nottinghamshire. The Rhætic sections of this district already known to geologists comprise those at Gainsboro', Newark, and Elton. The author described several additional new sections in the Rhætics of the county—viz. at Cotham and Kilvington between Newark and Bottesford; at Barnstone, between Bingham and Stahern; the boring for coal at Owthorpe, near Colston Bassett; and the section at Stanton-on-the-Wolds, between Nottingham and Melton Mowbray. A list of the Rhætic fossils of Notts was given, and the presence of bone-beds noticed. The author could not agree with certain geologists that the green marls which are found beneath the Paper shales in Notts (nor probably also the "Tea-green marls" of the West of England) belong to the Rhætic series, but took them to be Upper Keuper marls, once red in colour, which had become discoloured by some de-oxidising agent, probably carbonic acid evolved during the decomposition of the organic matters of the fossils of the Paper shales. For, in lithological character the green marls agreed with underlying beds in the Keuper, but differed markedly from the overlying Rhætics; then there was every appearance of a passage between the green marls and the underlying red and green marls of the Keuper; and, lastly, the green marls, like the rest of the Keuper marls, were practically unfossiliferous, while with the commencement of the Paper shales we get the remains of an abundant and distinctly marine fauna, in part Liassic.

Notes on the Cheshire Salt-Field, by C. E. De Rance, F.G.S., of H.M.'s Geological Survey.—The author described the brine-springs of the Keuper marls in Cheshire and part of Shropshire as having been derived from rainfall absorbed at the line of the original outcrop of the beds of thick rock-salt, which is represented by a porous bed. These waters flow out by pressure in various natural springs, and are bored into by the wells or artesian shafts of the brine-pumpers. The natural solution of the rock-salt has caused the characteristic subsidences that occur in the district. Northwich subsidences, however, have been chiefly caused by bad mining.

On the Strata between the Chillesford Beds and the Lower Boulder Clay. "The Mundesley and Westleton Beds," by J. Prestwich, M.A., F.R.S., Professor of Geology in the University of Oxford.—The beds between the Chillesford Clay and the Lower

Boulder Clay present such a series. Its exhibition on the coast of Norfolk, although very limited, is accompanied by special palæontological features that have caused it to be divided into the number of local beds which have been described by Trimmer, Green, Gunn, Wood, and Harmer, the author, Reid, Blake, and others. It includes the "Laminated Clays" of Gunn, the "Bure Valley Crag" of Searles-Wood, the "Westleton Shingle" of the author, and the "Rootlet-bed" and "Norwich Series" of Blake. Without reverting at present to the exact correlation of the several beds in the Norfolk area, respecting which there is still some difference of opinion, the author suggests that they should be included under a general term founded on the localities where, on the one hand, their varied palæontological characters are exhibited, and on the other where their peculiar petrological characters are well marked—characters which the author proposes to show, in another paper, have a very wide range, and serve to mark an important geological horizon in some interesting questions of local physical geology. The Mundesley beds were described by the author in 1860, and consist of alternating beds of clay, sands, and shingle, some containing freshwater and others marine mollusca, with a forest-growth and mammalian remains at their base; and again in 1871, including them in his Westleton group (No. 5 in the author's sections), which he showed to consist entirely of great masses of well-rounded shingle, with intercalated seams containing traces only of marine shells. Seeing the inconvenience of attaching the same term to the two very distinct series of beds, and that it may conflict with other local terms, the author now proposes to group this series under the term of "The Mundesley and Westleton Beds," indicative of their stratigraphical position in Norfolk, and of characters in Suffolk which serve to trace them in their range westward and inland to considerable distances beyond the Crag area, to which alone these beds have hitherto been restricted. At the same time it may be convenient, for brevity, to use one term only in speaking of typical cases.

On the Upper Bagshot Sands of Hordwell Cliff, Hampshire, by E. B. Tawney, M.A., F.G.S.—The descriptions of former writers having been cited, it was found that there were two main views regarding the affinities of these sands, which occur in the cliff between Long Mead End and Beacon Bunny. The view formulated by the distinguished foreign geologists, D'Archiac, Dumont, Prof. Hebert, and Prof. C. Mayer, is that they are parallel to the upper sands of the Beauchamp (= Barton) period, and allied, therefore, to the marine Barton beds. This view is much the same as that of E. Forbes, and the Geological Survey, who called them the Upper Bagshot Sands. Latterly Prof. Judd has sought to revive the term Headon-Hill Sands for them, presuming them to be most nearly connected with the Headon series, and extending the bounds of that series to receive them. The author now gives a list of twenty-eight species obtained from the bed at Long Mead End; of these 35 per cent. are common to the sand and the Barton beds, but do not occur in the Headon series; while only 21·4 per cent. are common to the sand and Headon series, but do not occur in Barton beds. It is shown that this sand belongs to the zone of *Cerithium pleurotomoïdes*, Lam., and is exactly parallel to the sands of Mortefontaine, which belong to the same horizon, constituting the upper portion of the Beauchamp deposits. This is altogether below the *C. concavum* zone. From these sands being intimately connected with the Barton beds in both areas, it is held that the term Upper Bagshot is the most fitting designation that has been proposed for them.

NOTES

THE Emperor of Germany has, by Imperial Decree dated June 1, 1881, awarded the Gold Medal of Merit for Agriculture to Mr. Lawes and Dr. Gilbert jointly, in recognition of their services for the development of scientific and practical agriculture.

THE death is announced, at the age of sixty-two years, of Mr. Frederick Currey, F.R.S., F.L.S. Mr. Currey was well known as a botanist, and was secretary to the Linnean Society from 1860 to 1880. It is stated that Mr. Currey has left his valuable collections of fungi to Kew.

THE honour of knighthood has been conferred upon Dr. G. C. M. Birdwood, C.S.I., of the India Office; and also upon Dr. John Kirk, H.M. Political Agent and Consul-General at Zanzibar, well known as the friend of Livingstone, and naturalist to his second exploring expedition, and as having done so much to promote African exploration.

THE Sedgwick Memorial Fund (Cambridge) now amounts from subscriptions and interest to more than 14,000*l.*, but this sum is not sufficient to build the new geological museum which it has been decided to erect in honour of the late professor. As, however, the present museum was built partly by subscriptions collected mainly through the exertions of Prof. Sedgwick, with a view to the erection of a geological museum, as well as of the library and other University buildings, the value of the portion occupied by the present museum should be taken into account in estimating the sum available for the new memorial building. An architect has been consulted as to the possibility of erecting a new geological museum and a chemical laboratory on the vacant space in front of the new museums and lecture-rooms facing Pembroke Street, but after examination of his plans and report it was found that the proposal could not be carried out, and it has consequently been decided to await the result of further negotiations for the purchase of the contiguous property. The recent acquisition by the University of some adjoining land will, it is hoped, diminish the difficulties now existing in the way of finding a suitable site for the erection of the new geological museum.

A LONG and interesting article in the *Daily News* of Tuesday describes the progress which has been made in carrying out the scheme of Mr. Holloway for the erection of a college for the education of young ladies. Mr. Holloway's endowment is of the amplest liberality; the building is all that could be desired, and is in a fair way of being completed; there is no danger of the institution becoming one for the benefit of the teachers and not of the students; the programme of education is meant to place science on a footing of absolute equality with learning. "The governing body will consist of twenty-one persons, to be appointed partly by the University of London, and partly by the Corporation of London, and it is stipulated that a certain portion shall always be women. Religious opinions are not in any way to affect the qualification for a governor. It is the founder's desire that power by Act of Parliament, Royal charter, or otherwise, should be eventually sought to enable the college to confer degrees after due examination; and that until such power is obtained the students shall qualify themselves to pass the Women's Examination of the London University, or any examination of a similar or higher character which may be open to women at any of the existing universities of the United Kingdom. The curriculum will not be restricted to subjects enjoined by any existing university. Instead of being regulated by the traditions and methods of former ages, the system of education will be mainly founded on studies and sciences which the experience of modern times has shown to be most valuable, and as best adapted for the intellectual and social requirements of students. The governors will therefore be empowered to provide instruction in any subject or branch of knowledge which shall appear to them, from time to time, most suitable for the education of women; and the curriculum of the college will not discourage students who may desire a liberal education apart from the Latin and Greek languages." All this is admirable, and we trust the spirit of the founder's wishes will be faithfully carried out. This building and the Sanatorium are not far from Virginia Water, and the total cost, with endowments, will probably amount to close upon a million.

IN connection with the Smoke Abatement Committee, an International Exhibition and trials of smoke-preventing appliances will be held in the East and West Arcades, and in buildings adjoining the Royal Albert Hall, at South Kensingto

from October 24 to November 26. Gold, silver, and bronze medals and certificates of merit will be awarded upon the report of a special committee. Regulations and forms of application for space may be had on application (by letter) addressed to Mr. Gilbert R. Redgrave, Superintendent of the Exhibition, Exhibition Buildings, Queen's Gate, South Kensington; or to Mr. W. R. E. Coles, Hon. Secretary to the Smoke Abatement Committee, 44, Berners Street, W.

THE Parkes Museum is closed until the end of September. In October it will again be opened free to the public on Tuesdays, Thursdays, and Saturdays, and during the winter lectures on sanitary science will be given in the Museum. The lectures will be illustrated with the sanitary appliances deposited in the Museum, which now include many new contributions sent from the recent Medical and Sanitary Exhibition at South Kensington. We believe it is intended to distribute the awards to the exhibitors at the Exhibition, at the second public annual meeting of the subscribers to the museum in October or November.

A NEW College of Practical Engineering has been opened at Muswell Hill, near London, under the auspices of a number of eminent practical engineers, among whom we may mention Sir John Anderson, late chief engineer at Woolwich, Sir Henry Bessemer, Sir R. M. Stephenson, Sir Joseph Whitworth, Bart., and Mr. Charles Manby, honorary secretary of the Institution of Civil Engineers. The principal of the College is Mr. John Bourne, C.E., author of several works on the Steam Engine and other kindred subjects. The instruction it is stated will combine the best theory with the best practice.

As a special number of the *Journal* of the Society of Telegraph Engineers, a valuable Guide-Book to the British Section at the Paris Electrical Exhibition has been issued, edited by Prof. W. E. Ayrton, F.R.S.

THE success of the Siemens electrical railway in Paris is very great, and the mode of locomotion very highly prized by Parisians. It is certain that steps will be taken after the Exhibition for rendering it a permanent feature of the French capital.

DURING the recent meeting of the British Association a conference of delegates from scientific societies was held, and the chair was occupied by Mr. W. Whitaker, F.G.S., Norwich Geological Society. The following resolution was adopted:—"That a committee be appointed, consisting of Sir Walter Elliot, F.R.S., Mr. H. George Fordham, Mr. John Hopkinson, Mr. G. J. Symons, F.R.S., and Mr. W. Whitaker, to arrange for a conference of delegates from scientific societies to be held at the annual meetings of the British Association, with a view to promote the interests of the societies represented by inducing them to undertake definite systematic work on a uniform plan; that Mr. Fordham be the secretary, and that the sum of 5*l.* be placed at their disposal for the purpose." An interesting conversation followed as to the best methods of stimulating the local societies to more active work. Mr. John Hopkinson, F.L.S., F.G.S., gave a most interesting account of the operations of the Hertfordshire Natural History Society. He had induced several members to take up the registration of the rainfall, and they had now twenty-eight observers of rainfall in their small county. Every one did not care about such observations, but there were plenty of other matters needing attention. Other members had been induced to take up the recording of the migration of birds, the flowering of plants, the appearance of insects, and other periodical phenomena; and the club furnished about one-third of the entire phenological observers of the Meteorological Society. They were also preparing lists of the fauna and the flora of the county, and one ornithologist was collecting a record of all the birds that are, or have been, observed in Hertfordshire. A resolution was unanimously adopted appointing Sir Walter Elliot and Messrs. Fordham, Hopkinson, Symons, and Whitaker a committee to arrange for the next Conference, and to send out a circular to the local scientific societies pointing out the work of the various committees of the British Association to which they might render aid, and other scientific work of a systematic character that they might usefully undertake.

AT a recent meeting of the Banburyshire Natural History Society Mr. E. A. Walford read a note "On the Occurrence of a Fire-ball at Watergall" on August 23. In answer to Mr. Walford's queries, Mr. Fessey, jun., had sent an account as follows, dated "Watergall, Leamington, August 30:—As regards the fire-ball, I was about 200 yards from it, in a waggon hovel. I saw it directly it left the sky, as I was looking in that direction at the time. When I first saw it, it looked like a ball of fire, about as large as a dinner-plate. It slowly descended, and I have no doubt I could have run twenty yards from the time I first saw it until it struck the ground; but when about fifteen to eighteen feet from the ground, it exploded with a loud crash, quite as loud as a cannon, distinctly before the thunder, which was very loud also. The explosion shook the whole buildings. I certainly thought the slates were falling in, but when it exploded one part struck the hedge, making a hole in the ground about a foot deep, and laying all the roots bare, but not damaging them. For some time the place looked all on fire, and there was a considerable quantity of smoke when it hit the ground, lasting for a second or two. It was seen by myself and four men. They also agree with me that this is as near as possible a correct explanation of it. We dug the hole out yesterday, but found nothing. The soil was blackened for several inches deep."

DR. C. S. MINOT, in a paper read at the Cincinnati meeting of the American Association, recommended the following method of mounting chick embryos whole. The blastoderm is removed and cleaned in the usual manner, and then floated out on a glass slide, where it remains permanently. It is carefully spread out and allowed to dry until the edges become glued to the slide. It is then treated with a 0·5 per cent. osmic acid solution, until a slight browning occurs. Stain with picro-carmine. The next step is particularly important, because it prevents the further darkening by the osmium, which otherwise injures or ruins the specimen. Pour Müller's fluid, or 0·5 per cent. chromic acid solution, on the slide, and leave it over night. The next morning the blastoderm is ready for dehydration by alcohol, and mounting in the usual manner in balsam or Dammar lac. Embryos prepared in this manner make particularly beautiful specimens.

THE winter session of the Charterhouse Science (the largest in the United Kingdom) and Art School and Literary Institute will, under the presidency of the Rev. Henry Swann, M.A., commence on September 24. During the late session about 700 students attended this institution; and of this number nearly 500 presented themselves for examination, and were successful in obtaining no less than 100 Queen's prizes. At a nominal fee instruction of a practical character is given in most of the sciences. Chemical students have the opportunity of working in a well-fitted laboratory capable of holding sixty students. During the session Mr. W. B. Carpenter, F.R.S., will deliver a course of lectures on physiology, to which teachers will be admitted free. This will prove a great boon to the teachers of the metropolis. Dr. Gladstone, F.R.S., Prof. Farrar, Mr. Sydney B. J. Skertchley, F.G.S., and others will lecture during the session.

THE Berlin Museum is now the fortunate possessor of archæological treasures which are perfectly unique. They are the long-expected sculptures from the Central American field of ruins at

Santa Lucia de Cosumalgapan, Guatemala, purchased for the Museum by Prof. Bastian when upon his American journey.

A SEVERE earthquake was felt three weeks ago in the southern part of the North Island, New Zealand. No lives were lost, but in some of the townships in the Manawater district scarcely a chimney was left standing. In Foxton, for instance, no less than 250 were thrown down. Fissures extending for many miles are reported to have been made, and the railway line was rendered unsafe in that neighbourhood, owing to the undulations of the earth alternately raising and depressing the rails. Since the large shock a good many of a slight nature have occurred. Two shocks of earthquake, each lasting from four to five seconds, were felt at noon on September 2 at Spalato in Dalmatia. The earthquake, which was accompanied by a subterranean rumbling, passed from the south-west to the north-east. It also made itself felt in the neighbouring islands of Brazza and Mascarsa, and in the town of Sebenico. A shock of earthquake was distinctly felt by several individuals at Courtown House, Gorey, Ireland, on August 27, at a quarter to five o'clock. Many heard a rumbling noise as of thunder, some noticed the rattling of doors and windows, and one experienced what he called a "shiver." Lord Courtown noticed a rumbling noise, coming apparently from the north, passing under the house, and so away to the south; the door of the room in which he was sitting rattled. A slight shock of earthquake was felt at Naples at eight o'clock on Saturday morning. At about the same hour severer shocks took place at Popoli, Pescara, and Orsogna, in the Abruzzi. The seismographic instruments on Mount Vesuvius show great activity. In the Abruzzi the earthquake shock has damaged several houses at Chieti and Castelfrentano, where some people have been wounded. At Lanciano two people were killed. At Orsogna one was killed and several were wounded. At Atessa the church of St. Giustina was seriously damaged. There is a great panic everywhere amongst the population. A shock of earthquake occurred at Sanpietro Brazza (Dalmatia) on August 29, at 9 p.m. It lasted four seconds. On September 2, at 10.48 a.m., two strong oscillations were felt at Sign, Spalato, and Brazza (in Dalmatia). Direction east-west. Over forty shocks of earthquake have been felt at Khoi, Persia, between the 28th ult. and September 11. Some houses were destroyed, but no lives have been lost. Most of the inhabitants have left the town, and are encamped outside. The direction of the earthquakes was from north to south. The shocks were accompanied by rumbling noises.

A TERRIBLE disaster has occurred at Elm, a village in the Canton of Glarus. The place has been almost destroyed by a fall of rock. It is believed that at least 200 persons are buried beneath the ruins.

THE German Ornithological Society held its annual meeting early this month at Hamburg. Prof. Landois (Münster) spoke on birds' nests and on the origin of egg-shells; Dr. Reichenow (Berlin) on the classification of ducks.

ACCORDING to the last report of the director of the Central Sanitary Bureau of Japan, the Central Government has granted the necessary funds for the establishment of a hospital in the capital for the special treatment of *kakke*, a disease which has been spreading more and more in the country, and one of the usual symptoms of which is œdema of the legs. It is intended to investigate carefully the causes and proper treatment of the disease at this institution. The average mortality, from all causes, is given at 10·43 in every 1000 of the population, and is stated to be lower than that of places in Europe and America under similar conditions. The director observes, however, that the registration of deaths is not efficiently carried out; but measures are being taken to render this as complete and accurate as possible. It is noticeable that deaths from diseases of the digestive organs and nervous disorders greatly preponderate over all others. In the former the proportion is 24·1 per cent., and in the latter 23·1. Small-pox was the most destructive epidemic of the year, but the number of annual vaccinations is largely increasing. During the year covered by the report it was 1,659,298.

THE second part of Dr. Lang's "Butterflies of Europe" is before us, and quite justifies our mostly commendatory remarks in a recent number. When the work more nearly approaches completion we may probably again find occasion to notice it.

FROM Surgeon-Major Bidie's Report on the Government Central Museum at Madras, we see the number of visitors during 1880–81 was less than in the previous years, due, however, to trivial and temporary causes. The total number of visitors was 173,898, of whom 39·36 were women and girls. Many of course go simply for curiosity, but a very considerable number visit the museum for the express purpose of obtaining information, and there seems no doubt that, under Mr. Bidie's energetic and intelligent management, the institution is doing much good. Very considerable additions have been made during the year, and the whole is in a fair way of being catalogued.

THE additions to the Zoological Society's Gardens during the past week include two Greater Black-backed Gulls (*Larus marinus*), British, presented by Mr. A. Allen; a Blue-shouldered Tanager (*Tanagra cyanoptera*) from South America, presented by Mr. Ernest L. Marshall; a —— Tanager (*Tanagra*, sp. inc.) from Brazil, presented by Dr. Arthur Stradling; a Green Lizard (*Lacerta viridis*), South European, presented by the Misses Parry; two Pantherine Toads (*Bufo pantherinus*) from North Africa, presented by Mr. R. E. Holding; six Common Lizards (*Lacerta vivipara*), two Smooth Snakes (*Coronella lævis*), two Sand Lizards (*Lacerta agilis*), British, presented by Mr. J. T. Mann; a Grey Parrot (*Psittacus erithacus*) from West Africa, four Passerine Parrakeets (*Psittacula passerina*), two Lineated Finches (*Spermophila lineata*) from South America, a Goffin's Cockatoo (*Cacatua goffini*) from Queensland, deposited; six Common Chamæleons (*Chamæleo vulgaris*) from North Africa, purchased. The additions to the Insectarium include larvæ of the Tussch Silk Moth (*Attacus mylitta*); several larvæ of the Poplar Hawk Moth (*Smerinthus populi*), presented; an imago of the Death's-Head Moth (*Acherontia atropos*), presented by Mr. M. H. Temple, Warwick, and two specimens of *Ceratocampa ixion*, bred from pupæ received a short time since from South America; also many species of aquatic Coleoptera from Askham Bog, near York, presented by Mr. W. A. Forbes, including *Haliplus elevatus*, *Hyphydrus ovatus*, *Hydroporus rufifrons* and *lineatus*, *Colymbetes exoletus* and *grapei*, *Ilybius ater* and *uliginosus*, *Agabus dispar* and *abbreviatus*, *Noterus sparsus*, *Helophorus aquaticus*, *Hydrobius fuscipes*, *Philhydrus melanocephalus*.

OUR ASTRONOMICAL COLUMN

THE DEARBORN OBSERVATORY, CHICAGO.—The annual report from Prof. Hough to the Board of Directors of the Chicago Astronomical Society, dated May last, has been issued. The planet Jupiter has been made a special object of study with the great equatorial, the first observation having been secured on May 6, 1880, and the last on January 30, 1881. The observations made at the Dearborn Observatory do not support the idea that the surface of the planet is "subject to sudden and rapid changes, which may be accomplished in a few days or even a few hours." On the contrary, the observations in question show that all minor changes in the markings or spots have been slow and gradual. "In fact the principal features have been permanent, no material change being detected by micrometer measurement." With regard to the rotation of Jupiter, the discussion of the measures on the great red spot made from September 25, 1879, to January 27, 1881, or over a period of 490 days, gave

for the mean value 9h. 55m. 35·2s., but when the individual observations are compared with it, a well-marked maximum displacement of the centre of the spot, to the amount of 1″·4, is exhibited, apparently indicating that it gradually oscillated to this extent in longitude, which on the surface of Jupiter corresponds to about 3200 miles. The observations however may be well represented by making the period of rotation a function of the time; thus the period 9h. 55m. 33·2s. + 0·18s. $\sqrt{t}$ is found to satisfy all the measures with a mean maximum error of 0″·5: the zero-epoch being September 25, 1879, and t the number of days after that date. The mean-rotation period derived from observations of polar spots is 9h. 55m. 35·1s., that deduced from the small spots indicating an average displacement during two months of 2″, or about 4600 miles. The rotation resulting from the observations of equatorial spots is 9h. 50m. 9·8s. with uniform motion. Prof. Hough states that the actual size of the great red spot, as seen with the Chicago telescope (18½ inches aperture) is—length, 29,600 miles; breadth, 8300 miles; and he remarks that smaller telescopes make the approximate length considerably less than the real value.

The nebula near Merope in the Pleiades, of which so much has been written, was not seen with the Chicago refractor in 1879, but as so many observers have described it, Prof. Hough, in conjunction with Mr. S. W. Burnham, made a thorough examination of the locality, with the result that they satisfied themselves that "the nebula did not exist, but that the appearance described by different astronomers was wholly an optical illusion, due to the glow from *Merope* and neighbouring stars." This opinion will probably be disputed in many quarters.

THE WASHBURN OBSERVATORY, WISCONSIN.—No. 1 of "Contributions from the Washburn Observatory, of the University of Wisconsin," has been received. The establishment is under the direction of Prof. Edward S. Holden, late of the Naval Observatory, Washington. Work was commenced in the latter part of April in the present year, with the Clark refractor of 15·56 inches aperture, and Prof. Holden has had the good fortune to secure the co-operation of that eminent observer, Mr. S. W. Burnham, who left Chicago at the beginning of April to accept a post in Washburn Observatory, and although the publication to which we refer is dated May 31, some five weeks after the commencement of operations, thirty-four new double-stars had been detected and measured by Mr. Burnham, and a number of other doubles, discovered in the course of zone-observations in which Prof. Holden took part, were also measured. In addition we have a list of new nebulæ detected in the zone-observations, several of which appear to deserve special attention. On May 2, in R.A. 18h. 8m. N.P.D., 108° 20′, a void space was remarked in the Milky Way; it is thus described: "This is a black circular hole (10′) in the Milky Way. The stars around it are excessively crowded, and inside there are but two stars, one 10 mag., the other very small."

The number of newly-discovered objects—double stars and nebulæ—of which we have the particulars in this first "Contribution" from the Washburn Observatory, is quite extraordinary, considering the few weeks over which observations have extended. We wish continued success to the Observatory of the University of Wisconsin.

SCHAEBERLE'S COMET.—The following meridian observations S.P. of Comet *c* 1881, made with the transit-circle at the Radcliffe Observatory, Oxford, have been communicated by Mr. F. J. Stone, the Radcliffe observer. The N.P.D. is uncorrected for parallax.

	G.M.T.		R.A.		N.P.D.
	h. m. s.		h. m. s.		° ′ ″
July 31,	9 54 47·5	...	6 28 21·6	...	44 3 46·1
(*a*) Aug. 2,	9 56 28·0	...	6 37 55·6	...	42 57 (36)
4,	9 59 56·5	...	6 49 17·7	...	41 47 13·3
6,	10 6 1·3	...	7 3 16·6	...	40 35 47·9
10,	10 29 50·1	...	7 42 55·6	...	38 21 31·6
(*b*) 19,	12 35 2·4	...	10 23 57·4	...	40 44 50·7

(*a*) Comet very faint. Only an approximate observation.
(*b*) Much brighter. Observation good.

ENCKE'S COMET.—The early observations of this body point to a negative correction of the mean anomaly to the extent of 3′, which corresponds to a retardation in the time of perihelion passage of about 0d·169. The perturbations from the action of Jupiter during the last revolution have been much greater than between 1875 and 1878, in which latter year the necessary correction to the mean anomaly given by the calculations of the late Dr. von Asten, was about one-third as great, but in the same direction. The work of his successor, Dr. O. Backlund of Pulkowa, has been executed with a most thorough determination of the planetary perturbations, which is extended to the preparation of the ephemeris.

The first glimpse of the comet, so far as we know at present, was obtained by Dr. Hartwig and Prof. Winnecke with the six-inch comet-seeker at the Observatory of Strassburg on August 20. Five days later it was clearly seen in the same instrument as a nebulosity 4′ in diameter.

ELONGATIONS OF MIMAS.—The following Greenwich times of apparent preceding elongations of this difficult object depend upon the same elements as previously used in this column:—

h. m.	h. m.	h. m.
Sept. 19 at 15 36	Sept. 21 at 12 50	Sept. 23 at 10 4
20 at 14 13	22 at 11 27	24 at 8 41

GEOGRAPHICAL NOTES

THE International Polar Conference, which was held last year at Berne, and the previous year at Hamburg, met last month at St. Petersburg. The object of this Conference is the organisation of a series of stations around the Polar area for the continuous prosecution of scientific observations. Since its last meeting it has lost Lieut. Weyprecht, who was the originator of the idea of such a scheme. Delegates were present from all the leading European States except England, and from the United States of America. The first subject discussed was the time at which observations should be taken, and their frequency. Observations will begin for all the expeditions in the Polar regions, as also for observations in the temperate zones, as soon as possible after August 1, 1882, and will finish as close as possible to September 1, 1883. All the meteorological and magnetical phenomena will be observed hourly during all this time; and, besides, there will be taken on the 1st and 15th of each month magnetic observations every five minutes for twenty-four hours, and every twenty seconds during an hour of the day fixed on in advance, and that everywhere after the mean time of Göttingen. These latter observations have for their special end to obtain a perfect knowledge of perturbations or magnetic storms, and their connection with the aurora borealis. On the basis of a programme of observations to be made, already elaborated by the Hamburg Conference, the obligatory meteorological observations were discussed—*i.e.*, observations which all the stations must make in order to insure the scientific success of the enterprise. The result of the discussion was the fixing of the principles, and in part also of the methods and instruments of observation, to insure the accuracy and comparability of the meteorological observations to be made. Happily the Conference numbers among its members several distinguished men of science, who have acquired in former expeditions in the Polar regions very great experience of the difficulties to be met with in taking observations, who were able to give advice useful in obviating beforehand those obstacles, by the arrangement of the instruments, and by the method of taking observations. One day was devoted by the Conference to visiting the celebrated meteorological and magnetic observatory of Pavlovsk, and discussing there the choice of the best apparatus. The members visited in detail the provisional installations which have been made at the observatory for inspecting the magnetic instruments intended for the Russian expedition to the mouth of the Lena. At the third sitting of the Conference, the magnetic observations were discussed: these also meet with difficulties unknown in temperate zones. It is not only the great cold, but also the feebleness of the horizontal intensity of terrestrial magnetism, as also the frequency and greatness of the perturbations, which render observations very difficult and delicate. At the fourth meeting the Conference was occupied with observations on the aurora borealis, and with the question of facultative observations, those which are recommended to the expeditions, without being considered indispensable—as observations on the temperature of the soil, evaporation, terrestrial galvanic currents, atmospheric electricity, &c. The conference, among other things, decided to apply to different institutes to assure their co-operation, and to request magnetic observatories in the temperate zones, especially those in the southern hemisphere, to participate in the simultaneous observations, as also to ask the directors of the telegraphs of different countries to study more accurately terrestrial

galvanic currents in the telegraphic wires when aurora borealis or magnetic perturbations appear. Finally the assembly unanimously approved three proposals by Count Wilczek:—1. To found, if possible, a special publication to convey more quickly to the knowledge of the scientific world, as well as to the leaders of the expeditions, the proposals and reports concerning the expeditions, as also their first results. 2. To leave, if possible, on the spot the buildings and other arrangements likely to be useful to future expeditions of the same kind, and to recommend them in each country to the care of navigators or of the inhabitants. 3. To ask railway and steamboat companies to grant a reduction in the fares for the staff and effects of the various international Polar expeditions. The stations proposed, we may state, are two on the north coast of Siberia, one in Novaya Zemlya, one in Spitzbergen, one on Jan Mayen Island, one on the west coast of Greenland, one at Lady Franklin Bay, one in the Behring's Strait region, and the participating countries are Russia, Sweden, Denmark, Germany, Austria, and the United States.

ON the 3rd of next month the members of the Italian scientific expedition for the exploration of the Arctic Seas will embark at Genoa in one of Lovarello's steamers. The zoology will be under the care of Dr. Vinciguerra; the botany will be confided to Dr. Lorenzo, at present residing at Buenos Ayres; mineralogy and geology to Prof. Lovisato, of the University of Sassari; and to Lieut. Roneagli the artistic department is given, for which purpose he will take photographic apparatus, &c. At Buenos Ayres the Commission will embark on a vessel belonging to the Argentine Republic. Lieut. Bove, who will take the command of the expedition, has already left for Buenos Ayres.

THE U.S. Government have been officially advised of the arrival of Lieut. Greeley's Polar Expedition at Lady Franklin Bay, six days after leaving Upernivik. The expedition entered Discovery Harbour on August 11, where a station was formed. The party were all well and plentifully provided.

ADVICES from Copenhagen state that the news received from the Dutch Polar Expedition on board the schooner *Willem Barents* is very unfavourable. Owing to the continuous ice barrier, which extends nearly to Norway, Spitzbergen could not be reached, nor yet even the Bear Islands; and after one more attempt to force through northward, the expedition will return home, as the captain is convinced that this year Novaya Zemlya is completely inclosed in a barrier of ice.

THE Russian Geographical Society has prepared short notices on the progress of different branches of geographical science from 1875 to 1881, *i.e.* from the second to the third Geographical Congress. Three of them are printed: (1) "Aperçu des Travaux Hydrographiques"; (2) M. Bogdanow: "Aperçu des Recherches Zoo-géographiques en Russie"; (3) P. Matveiew and A. Stichinsky: "Aperçu des Études sur le Droit coutumier en Russie." Besides there are in preparation notices on botanical geography by M. Bataline, on geology by M. Alénitzin, and on Count Uvarow's work on the Stone Age in Russia, by L. Maikof. A. W. Grigorief and Dr. A. Woeikof will be the Russian official delegates to the third Geographical Congress. The absence of the celebrated Russian cartographers is much to be regretted; one of them, General Stubendorff, hoped to attend the Congress, but now it is known he will not be present.

THE new number of the Geographical Society's *Proceedings* is remarkable for the excellent map of Khorasan and the neighbouring countries, in illustration of Col. Stewart's account of his journey and investigations in the Tekke Turkoman country and the region of the Tejend and Murghab Rivers. The map goes beyond Merv and Herat on the east and takes in the south-east part of the Caspian on the west. There is also an article on the recent journey of two Baptist missionaries from Vivi, by the north bank of the Congo, to Stanley Pool. Dr. Matteucci's great geographical achievement in North Central Africa and subsequent death in London are sympathetically referred to in the Geographical Notes. The Society's telegram of condolence to the Geographical Society at Rome appears to have been much appreciated there, as it has been reproduced in the Italian papers. One of the most interesting items in the present number is a letter from Mr. W. H. Dall, of the United States Coast Survey, on "The Chukches and their Neighbours in the North-Eastern Extremity of Siberia." The letter is written in reply to some strictures which Lieut. Nordqvist, of the *Vega*, addressed to the St. Petersburg Geographical Society, and which were noticed in the *Proceedings* for June.

THE Berlin African Society has received further news from several German explorers in Western Africa. Dr. Pogge and Lieut. Wissmann were at Malange at the end of May, hoping to start early in June, and to reach Kimbundo at the end of that month. From Robert Flegel news are to hand up to June 4. The members of the station at Kokoma are occupied with scientific collections and the exploration of the environs. Dr. Stecker is trying to reach the Central African lakes from Abyssinia.

A NEW volume of travels by Mr. E. A. Floyer, F.R.G.S., &c., entitled "Unexplored Balûchistan, a Survey of a Route through Western Balûchistan, Mekran, Bashakird, Persia, Kurdistan, and Turkey," will be published during the autumn by Messrs. Griffith and Farran. Mr. Floyer was the first to explore the wild district of Bashakird; he contributed a paper on that little-known country to the Plymouth meeting of the British Association. Besides the narrative, which is full of interesting personal incident and adventure, the work will contain original illustrations, a map, vocabularies of dialects, lists of plants collected and tabulated, and observations, astronomical and meteorological.

PROF. SIMONY has published a list of the greatest depths of various Alpine lakes, which may interest our readers: Gmunden Lake, 191, Hallstadt Lake 125, Attersee 171, Mondsee 67, Wolfgang Lake 114, Achensee 132, Königssee 188, Lake of Constance 276, Chiemsee 89, Starnberg Lake 131, Lake Leman 309, Neufchâtel Lake 144 metres. The last-named four measures 92, 57, 589, and 240 square kilometres surface. The greatest depth of the northern part of the Adriatic is only 243 metres.

SCIENTIFIC SERIALS

The Journal of the Royal Microscopical Society, August, 1881, contains:—On some remarkable enlargements of the axial canals of sponge spicules and their causes, by Prof. P. Martin Duncan (plates 7 and 8).—On a blue and scarlet double stain, suitable for nerve and other animal tissues, by Dr. B. Wells Richardson. With the summary of recent researches, zoology, and botany, pp. 575 to 651; Microscopy, pp. 651-711.—Proceedings of the Society for June.

The American Naturalist for August, 1881, contains: The great crested fly-catcher, by Mrs. Mary Treat.—On the reasoning faculty of animals, by Joseph F. James.—On the progress of anthropology in America during 1880, by O. T. Mason.—On the manuscript Troana, by Cyrus Thomas.—The Editor's Table.—Some recent literature.—General notes and scientific news.

Proceedings of the Academy of Natural Sciences of Philadelphia, Part I, January to May, 1881, contains: Dr. Jos. Leidy, Rhizopods as food for young fishes.—Thomas Meehan, note on treeless prairies; motility in plants; sexual characters in *Fritillaria atropupurea*, Nutt.—R. Arango, descriptions of new species of terrestrial mollusca of Cuba.—Rev. H. C. McCook, on the honey-ants of the Garden of the Gods. (This detailed memoir on the structure and habits of *Myrmecocystes melliger* is illustrated with ten plates.)—John A. Ryder, on the structure, affinities, and species of Scolopendrella. *S. gratiæ* is figured and described. An American specimen of what is presumed to be *S. notacantha* is also figured. The author places these strange insects in an order Symphyla, indicating that it has affinities to Thysanura; trachea are present. Henry Hemphell, on the variations of *Acmæa pelta*.—R. E. C. Stearns, observations on Planorbis (with many woodcuts).

American Journal of Science, August.—Method of obtaining and measuring very high vacua with a modified form of Sprengel pump, by O. N. Rood.—Geological relations of the limestone belts of Westchester county, New York; origin of the rocks of the Cortlandt series, by J. D. Dana.—New meteoric iron of unknown locality, in the Smithsonian Museum, by C. U. Shepard.—The relative motion of the earth and the luminiferous ether, by A. A. Michelson.—Observations on the light of telescopes used as night-glasses, by E. S. Holden.—Nature of dictyophyton, by C. P. Whitfield.—Observations on the comet, by H. Draper, C. A. Young, W. Harkness, L. Boss, and A. W. Wright.

Journal of the Franklin Institute, August.—Boiler explosion in Philadelphia in June, by W. B Le Van.—Auchincloss's averaging machine.—Rad o-dynamics II., by P. E. Chase.—The properties of air relating to ventilation and heating, by R. Briggs.

Annalen der Physik und Chemie, No. 8.—Experimental investigation of the tones which arise in passage of gases through slits, by W. Kohlrausch.—On the observation of air-vibrations in organ-pipes, by R. König.—On the conductivity of metals for heat and electricity (continued), by L. Lorenz.—On the application of photometry to the study of the phenomena of diffusion in liquids, by S. v. Wroblewski.—Experimental contribution to the theory of influence-machines, by W. Holtz.—On the development of polar electricity in hemimorphous crystals by variation of pressure in the direction of the unsymmetrically formed axes, by W. Hankel.—On the decomposition of water on platinum electrodes by discharge of Leyden jars, by F. Streintz.—On the resistance of polarised cells, by E. Cohn.—On the phenomena in Geissler tubes under external action, by E. Reitlinger and H. v. Urbanitzky.—Note on the maximum of temporary magnetism in soft iron, by C. Fromme.

La Nature, August.—The air-barometer, by Prof. Ferrini. The electro-photometer of Dr. Nachs.—On the electric phenomena of Canton's jar, by Prof. Righi.—On the origin of electricity in storm-clouds and atmospheric air, and on electricity in general, by Dr. Nachs.—On the direction of sounds and the object of double hearing, by Prof. Pinto.

Journal de Physique, August.—Researches on the capacity of polarisation (continued), by R. Blondlot.—Discharge of a condenser, and energy of telephonic currents, by H. Pellat.—On a new interrupter for induction-coils, by M. Deprez.—Note on the registering instruments of MM. Richard frères.

Bulletin de l'Académie Royale des Sciences de Belgique, No. 6.—Note on a new dolphin of New Zealand, by M. van Beneden.—A word on some new infusoria parasitic on Cephalopoda, by M. Fœttinger.—Study on the hypophysis of Ascidians and the neighbouring organs (second paper), by M. Julin.—Note on the fossiliferous Porphyroids met with in Brabant, by M. Poussin.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti. Vol. xiv. fasc. xii., xiii.—Researches on the phenomena of sense, motion, circulation, and respiration in hypnotism, and on their modification by æsthesiogenic agents, by Prof. Tamburini and Dr. Sepilli.—On some products of transformation of chinoline, by Prof. Körner.—Theorem on linear systems in projective measurements, by Prof. D'Ovidio.—Consequences of pachymeningitis and hematoma of cerebral membranes, by Prof. Sangalli.—Fasc. xiv.—On the small volcano of Querzola in the province of Reggio, by S. Taramelli.—On the resistance to passage of the voltaic current in an iron wire at different temperatures, by Dr. Poloni.

Rivista Scientifico-Industriale, July 1 and 15.—Determination of vapour density, by Dr. Valente.—Palæontological peregrinations in the Pliocene of Mount Falcone Apennino, in the province of Fermo (Marche), by Prof. Spada.—On determination of the electromotive force of the Voltaic couple by Fuchs' method, by Dr. Guglielmo.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, September 5.—M. Wurtz in the chair.—The following papers were read:—The direct-vision spectroscope applied to physical astronomy, by M. Zenger. One may (as before shown) compound refringent media whose index for the red ray A is less than that of crown glass or quartz, while the index for the violet ray H is much greater. The spectrum so produced is fan-shaped, and, with a single dispersion parallelepiped (two similar prisms with their refringent angles opposite), may be made of considerable length (25° and more). With one arrangement all the rays, except blue or red, may be eliminated, and the sun, *e.g.*, viewed in monochromatic light. M. Zenger specifies various combinations of quartz or crown glass with anethol, benzene, alcohol, &c. He obtains effects equal to those of the most powerful spectroscopes hitherto made.—Influence of nutrition on poisoning with strychnine, by M. Delaunay. Strychnine affects more quickly and intensely strong frogs than weak ones; frogs well fed than those which have been fasting; frogs that have been in vigorous exercise than those at rest; frogs that are exercised immediately after injection than those which are not; a frog hung by the leg than one hung by the head; an intact frog than one which has been bled; the right side of frogs than the left, &c.—Observations of Cruls' comet (*b* 1881) at Marseilles Observatory, with an equatorial of 0·26 m. aperture, by MM. Borelly and Coggia.—Observations of Schäberle's comet (*c* 1881) in the same way and place, by M. Coggia.—Observations of Encke's comet, by M. Tempel. He observed it on the 21st ult. A letter from M. Loewy stated that M. Struve found it on the 24th (MM. Winnecke and Hartwig at Strasburg about the same time). The comet (according to M. Tempel) was large, but very diffuse, without nucleus or condensation towards the centre, and so, very difficult to observe.—On the light of comets, by M. Respighi. He considers we are not yet in a position to say that comets have a light of their own, due to incandescence of cometary matter. The discontinuity of the spectrum, and the bright lines and bands, may arise from reflected light as affected in traversing the gases and vapours of the comet; the same cause as affects the spectrum of the sun when near the horizon. Only the phenomenon is exaggerated in comets by reason of the enormous thickness of the absorbent layers, their richness of chemical composition, and the weakness of the light they reflect to us.—On observations of meteors from July 25 to 30, 1881, by M. Cruls (Rio). More than 90 per cent. of the meteors seemed to radiate from near Fomalhaut. The horary average increased rapidly between the evening and morning hours, and there was a remarkable recrudescence shortly before sunrise. It would thus seem that the stream of meteors moves in opposite direction to the earth. This is corroborated by the fact that the morning meteors, especially after 5 a.m., all moved with great velocity, and were very brilliant. They were all sensibly displaced in the plane of the ecliptic; their direction is probably very little inclined to this plane.—On ferruginous carbonated waters, by M. Ville. Neutral alkaline carbonates precipitate such water immediately; neutral alkaline earthy carbonates also have this effect, but more slowly. Alkaline and alkaline-earthy bicarbonates do not alter ferruginous water. Chlorides and sulphates sensibly retard the decomposition of ferruginous water in air. The disturbing influence of neutral alkaline carbonates may explain the relation between the richness of ferruginous carbonated waters and the presence of these saline compounds. The action of neutral carbonate of calcium explains the existence of considerable beds of limonite in calcareous strata.—On absorption by the vesical mucus, by MM. Cazeneuve and Lépine. The sound bladder absorbs the normal elements of urine. Certain toxical or medicamentary substances (*e.g.*, sulphate of strychnine) are not absorbed.—On experimental tuberculosis, by M. Brunet.

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