THURSDAY, JUNE 2, 1881

ARCTIC ECHINODERMATA

A Memoir on the Echinodermata of the Arctic Sea to the West of Greenland. By P. Martin Duncan, F.R.S., and W. Percy Sladen. Pp. 82, Six Plates. (London: Van Voorst, 1881.)

MESSRS. DUNCAN AND SLADEN will receive the thanks of zoologists for the publication of this memoir, which will owe its importance as much to the care with which it has evidently been prepared, as to the interest of the group with which it deals, and the value that it has in being a monograph of a definite zoological region. The time would, indeed, seem to have come when no further question is possible as to the existence of a characteristic circumpolar fauna; nearly ten years ago Prof. Alex. Agassiz directed attention to the wide distribution of that common form, which has unfortunately so very long a name, the regular Echinid—*Strongylocentrotus drobachiensis*, in his "Revision of the Echini," and the researches of Mr. Seebohm have led him to a similar conclusion as to the circumpolar distribution of Birds. Further evidence is given by the present authors, who sum up the matter thus:—

"When these details are carefully considered, it becomes evident that each one of the great groups of Echinodermata tells the same story regarding distribution. The fauna, as a whole, is not an extension northwards of species from more temperate climates, but is essentially circumpolar."

Where the range is so wide considerable variations are to be expected in the characters of the species, and we feel inclined to attach as much importance to the accounts which the authors give of the variations they have been able to observe as to their technical zoological definitions of the species. We have been unable to find in the memoir any notice of the number of specimens which were accessible to the authors, but we believe it was quite large enough to have made the account of varietal forms a necessary part of a complete account.

It was, at any rate, large enough to make the number of new species very small; a new *Antedon*, a new member of Sars' interesting genus *Pedicellaster*, to which Mr. Sladen has given the appropriate name of *palæocrystallus*, make up, with an Ophiurid described by Prof. Duncan, the sum of our gains in that direction. So striking were the characters of this Ophiurid that it was found necessary to form a new genus for its reception; curiously enough Dr. Duncan proposed a generic term—*Luetkenia*—which has already been twice used in zoology; but this was a matter of slight importance, as Messrs. Koren and Danielssen had the priority in recognising the generic distinction of the Ophiurid in question, and of giving it the name of *Ophiopleura*. This priority was however merely a matter of months, and not of years, as the English naturalist would lead us to imagine by leaving uncorrected in his proof the date of 1867 for 1877 (see *tom. cit* p. 54). Dr. Duncan holds to the view he expressed in 1878 that the form has affinities with *Amphiura* and *Ophioglypha*; what Prof. Lyman's views are it is impossible to state very definitely, but from the position which he has given to *Ophiopleura* in his lately-published "Preliminary List," it would seem that he attaches greater importance to its Ophioglyphan than to its Amphiuran characters.

We are not quite sure that we should agree with some of Mr. Sladen's views on nomenclature; but it is, we fear, too late now to raise a protest against the use of the term *Asteracanthion*; as the genus to which the name is applied has some eighty constituent species, it would be a matter of satisfaction if of the parties who use *Asteracanthion* or *Asterias* one or other would yield to the arguments adduced by the others. We must confess that for ourselves the latter term appears to have every advantage both of right and of convenience over the more unwieldy title of Müller and Troschel. It is much more satisfactory to direct attention to the way in which the authors have grappled with an old and unknown synonym in the case of *Astrophyton Agassizii*. In the year 1819 Dr. Leach applied the specific term *arcticus* to a specimen of "*Gorgonocephalus*" brought home by Sir John Ross; the definition of this species was too ambiguous and short for practical purposes, and it was not until Stimpson described the Invertebrates of the Grand Manan that the Arctic form got the name by which it has since been called by every naturalist who has had occasion to mention it; Lyman, Verrill, Ljungman, Lütken and Norman have all known it as *Astrophyton Agassizii*. The specimen which is supposed to be the type of Leach's description has no title attached to it, or any known history; in other words, it can never be *known* what Leach meant to describe, though it is easy enough to *guess*; under these circumstances (by detailing which the authors take, as we hope, the wind out of any mere bibliographer's sails), "we do not feel justified in restoring Dr. Leach's name."

This is an eminently satisfactory conclusion; ill-drawn definitions and unlabelled or wrongly-labelled specimens have had their day, and a good long day has it been, in hampering the progress of a growing science; if zoology is to advance with the other branches of biology, a purist sense of justice must not step in and lead us continually away from the real business of natural history to the dryasdust occupation of elaborating synonymical lists. A dictator-speaker and some rules of urgency might well be invented in the interests of zoological progress.

The six plates, on which twenty-six of the thirty species described in this volume are carefully figured, make a very useful addition to a work which the Government Grant Fund of the Royal Society were fully justified in subsidising.

F. J. B.

GREEK GEOMETRY

Greek Geometry, from Thales to Euclid. Part II. By G. J. Allman, LL.D. Extracted from "Hermathena," Vol. iv. No. vii. 49 pp. (Dublin: University Press, 1881.)

IN NATURE, vol. xviii. p. 291, we briefly referred to the first part of Dr. Allman's work, which gave an account of the earlier geometers, more especially treating of the labours of Thales and Pythagoras. The opening years of the fifth century before the Christian era were very dark ones for Greece, but "then followed the glorious struggle. . . . A solid basis was thus laid for the development of

Greek commerce and for the interchange of Greek thought, and a brilliant period followed—one of the most memorable in the history of the world." Athens became the centre of all intellectual movement. To her—the Athens of Pericles—came Hippocrates of Chios, and "in this city geometry was first published."

Our author agrees with Hankel (against Proclus) as to the important influence of the Eleatics (Parmenides and Zeno), "not only on the development of geometry at that time (circ. 450 B.C.), but further on its subsequent progress in respect of *method*." Clairaut, in his "Elements of Geometry" (recently translated by Dr. Kaines, the original text is cited by Dr. Allman), notices this influence in the case of Euclid. The paradoxes of Zeno led to the banishment of the Infinite (which plays so important a part in the modern treatment), "the infinitely small as well as the infinitely great." What Hippocrates may very fairly be supposed to have done in relation to the squaring of the circle is, we think, well put. "Simplicius has preserved in his 'Comm. to Phys. Ausc.' of Aristotle a pretty full and partly literal extract from the 'History of Geometry' of Eudemus." It is to Bretschneider we owe a careful revision and emendation of this fragment, and our author has skilfully attempted to determine what is Simplicius and what is simply Eudemus in this account. It is curious that Bretschneider merely notices the "circumstantiality of the construction and the long-windedness and the over-elaboration of the proofs," and Hankel expresses surprise that this fragment, "150 years older than Euclid's Elements, already bears that character, typically fixed by the latter, which is so peculiar to the geometry of the Greeks." Had the present pamphlet been confined to the elucidation of this single matter it would have had a sufficient *raison d'être*.

The next geometer whose contributions to geometry are determined and discussed is Democritus, more usually regarded as a philosopher. At this stage, too, our author takes stock, and shows that the progress made in this (about) half-century interval since Pythagoras mainly "concerns the circle."

We note the connection of the name of Hippocrates with another of the famous problems of antiquity, viz. the duplication of the cube: he seems to have been the first to reduce this question to the finding of two mean proportionals between two given straight lines, the greater of which is double the less. Many interesting particulars are given in connection with this problem. The general problem is stated to have been first solved by "Archytas of Tarentum, then by his pupil Eudoxus of Cnidus, and thirdly by Menæchmus, a pupil of Eudoxus"; this last used "the conic sections which he had discovered." A third problem, the tri-section of an angle, also came to the front about this time. Dr. Allman fully discusses this also, and shows that it was one which was fairly within the reach of a Pythagorean. Montucla however attributes to Hippias of Elis, a contemporary of Socrates, the invention of the quadratrix (the quadratrix of Dinostratus), by means of which (in a quite different way from Sylvester's Fan) an angle can be not only trisected, but divided into any number of equal parts. Allman sides with Hankel and shows the improbability of Hippias being the inventor, but he is against him when he refers the method of exhaustions to Hippocrates of Chios. It will have been seen that the great geometer of this period is Hippocrates, "who seems to have attracted notice as well by the strangeness of his career as by his striking discovery of the quadrature of the lune." The unfavourable statements of Aristotle, Eudemus, Jamblichus, and Eutocius are examined, and part of the summing up is, "We may fairly assume that Hippocrates imperfectly understood some of the matter to which he had listened; and that, later, when he published what he had learned, he did not faithfully render what had been communicated to him."

An examination of this pamphlet still further shows that the writer, while carefully using the recent works of Bretschneider, Hankel, Cantor, and others, has himself gone over the original authorities and formed his own opinions upon the difficult questions that turn up. It is, in our opinion, a most valuable contribution to the subject, and we shall be glad when the piecemeal work in "Hermathena" is done, and the book appears, as we believe it is the writer's intention that it should appear, in proper book form as one work.

OUR BOOK SHELF

The Zoological Record for 1879. Being Volume Sixteen of the Record of Zoological Literature. Edited by Edward Caldwell Rye, F.Z.S. (London: John Van Voorst, for the Zoological Record Association, 1881.)

THE editor's promise to the members of the Zoological Record Association has been kept, and the *Record* for 1879 was published in the month of April in this year. We gladly note in addition his confident expectation that the *Record* for 1880 will be published ere the present year ends. This sixteenth volume contains nearly 700 pages of well-condensed records of the literature of zoology of 1879. The lion's share of the hard work has fallen to Mr. W. F. Kirby, who, with Mr. McLachlan, records the literature of the Insecta. The Rev. O. P. Cambridge gives the record of the Arachnida for 1878 and 1879. The Vermes and Echinoderms are done by Prof. Jeffrey Bell, and the Cœlenterata and Protozoa are elaborated by A. G. Bourne, S. J. Hickson, and Stuart Ridley. The works on the Mammals are recorded by W. A. Forbes; on the Birds by Howard Saunders; on the Reptiles and Fishes—alas! that we should have to write it—by the late gifted A. W. E. O'Shaughnessy. Prof. E. von Martens still records the literature of the Mollusca and Molluscoidea, the only recorder still remaining as such of that small group who came to the assistance of Dr. Günther in 1864. We miss from last year's list of recorders Dr. C. Lütken, who served during his seven years well and faithfully; in him knowledge and experience of the subject he worked at were combined with much tact. The British Association, the Royal Society, and the Zoological Society of London have, as is now usual, handsomely assisted in aid of the publication of this most useful volume.

The most useful index to new genera and sub-genera seems most carefully done. The list of new genera is for the year almost 1000; so that evidently the zoological kingdom is not as yet worked out.

Wiltshire Rainfall, 1880. (Marlborough: C. Perkins and Son, *Times* Office).

THE compilers of this carefully-printed and, for the class of publications, luxuriously got-up annual merit our hearty commendation for the general excellence of the work thus put before us. From its physical geography Wiltshire forms a well-marked rainfall region, it being a little to the north of the centre of the county that the two Avons and several tributaries of the Thames take their rise. From this plateau the country slopes northward to the

Upper Thames, eastwards along the Kennet, southwards to Salisbury, and westwards along the North Avon. The rainfall of this region is now observed at twenty-eight stations, and the daily amounts are printed *in extenso*, and the eye readily notes the maximum monthly fall at each station, these being printed in thicker type. On each monthly sheet the means of the previous ten years' observations are given for the ten stations at which observations have been made for the whole of that period. The mean annual rainfall of these stations for the past eleven years is 32·14 inches, the monthly maximum being 3·49 inches in October, and the minimum 1·82 inches in March. As contrasted with the more strictly central districts of England, the summer rainfall is relatively less, and the autumnal and winter rainfalls greater; and as contrasted with places more open to the Atlantic to west and south-westward, the rainfall is relatively greater in summer and less in winter. At seventeen stations observations have been made for at least six years, at which, if the averages be struck for the eleven years, differentiating where necessary, the largest mean rainfall is seen to be 40·32 inches at Corsham, near the summit of the long ridge separating the North Avon from its tributary Box Brook, and the smallest 29·76 inches at Pen Hill in the north on the high ground between the Thames and its tributary the Cole; —the former being one of the heights most open to winds from the Atlantic, and the latter one of the most sheltered heights from these winds. As regards annual amount and variation with season and configuration of surface, the rainfall of Wiltshire curiously resembles that of Deeside, Aberdeenshire. An excellent map showing the stations and their heights and the physical features of the county accompanies the Report.

Pheasants: their Natural History and Practical Management. By W. B. Tegetmeier, F.Z.S. Second Edition, greatly enlarged. (London: *The Field* Office, 1881.)

MR. TEGETMEIER is so well known as an authority upon pigeons and poultry of all kinds that everything which he writes on the subject of these birds is sure to be received with attention, and it is therefore scarcely a matter of surprise that a second edition of his well-known "Pheasant" book should have been called for. The work will be found invaluable to any one projecting the cultivation of pheasants either in the covert or in the aviary. After a brief review of the habits of pheasants in a wild state, the author gives ample information as to their management in preserves and in confinement, and also discusses the much-vexed question of the gapes and other diseases to which these birds are subject. The second portion of the work is devoted to the natural history of the common pheasant and its allies which are suitable for introduction into our woods, and also treats of the more gaudily-coloured Golden Pheasant, Monâl, and other species adapted for the aviary. Valuable experiences of the rearing of these birds and their habits in confinement are given by Mr. Tegetmeier, who seems to have spared no pains to make his book interesting and instructive. The illustrations have been executed on wood by the well-known artist Mr. T. W. Wood, who has evidently studied the birds in a state of nature; and although the plumage of the pheasant family does not lend itself readily to this style of illustration, the attitudes of most of the birds are happily rendered, while some of the figures representing the "showing off" of the male birds are excellently conceived.

Nach Ecuador. Reisebilder. Von Joseph Kolberg, S.J. Zweite vermehrte Auflage, mit einem Titelbild, 140 Holzschnitten und einer Karte von Ecuador. (Freiburg-im-Breisgau: 1881.)

THE Archbishop of Quito proceeded to Rome in 1869 to attend the meeting of the Vatican Council, and he bore with him a commission from Don Garcia Moreno, President of Ecuador, to obtain powers to establish a Polytechnic School and College for the Republic. As a result he sent to Quito, in 1870, two Germans and one Italian, members of the Society of Jesus, who should lay the foundation-stone of the establishment, and in 1871 Joseph Kolberg, the author of this quarto volume, followed. The murder of President Moreno in August, 1875, gave a death-blow to the new institution. During the five years of his sojourn in the country Kolberg had been in the habit of sending home notes of his various tours, sketches of the manners and customs of the people he met with, and this in a somewhat methodic manner, as might be expected from a professor of the higher mathematics. These notes and sketches were published from time to time in a publication called *Stimmen aus Maria-Loch*, and they embraced among others an account of the voyage out, of a visit to Chimborazo, and an account of the catastrophe of Havra (1868), and incidental to these latter chapters the author introduces a theory of volcanic eruptions which he evidently thinks the best fruit of his visit to Quito. All these varied sketches and others on the natural history and geography of the country were, at the "request of friends," re-published in one handsome illustrated quarto volume, which was indeed to have been dedicated to President Moreno, but is now dedicated to his memory. The first edition was edited by the author's friend, R. Cornelly, S.J., and was published in 1876. The present edition, which has been corrected and enlarged throughout, has been published under the author's own superintendence. Some of the wood engravings are new and interesting; others, such as those representing the flying-fish and the Coral Island, have well served their generation.

Second Report of the United States Entomological Commission for the Years 1878 *and* 1879. With Maps and Illustrations. 8vo, pp. 322, and Eight Appendices, pp. 74. (Washington: Government Printing Office, 1880.)

THIS Report of the three Commissioners (Prof. Riley, Dr. Packard, and Dr. Thomas) appointed to investigate the ravages of the "Rocky Mountain" and other locusts forms a handsome volume, got up in the exhaustive and elaborate manner so marked in all the U.S. Government publications. It is exceedingly difficult to give an adequate notice in a short space, on account of the varied nature of the subjects touched upon. Our readers will gather from this remark that "Economic Entomology" in the proper sense of the term by no means occupies the entire volume, nor is it entirely confined to the "Rocky Mountain" pest in particular. A large portion is occupied by an elaborate investigation of the habits of migratory locusts in all parts of the world, gathered from a host of publications, some of them of ancient date. The connection of meteorological influences with the migrations and development of North American locusts is fully examined. Chapters IX. to XI. treat on the anatomy of the locust, and form valuable contributions to the anatomy of insects in general, such as one would scarcely expect to find in a report of this nature; of these Chapters IX. and XI. are by Dr. Packard, and treat of the air-sacs and brain respectively; X. is by Mr. Minot, on general histology: these are illustrated by excellent plates. The "economic" chapters are more especially by Messrs. Riley and Thomas, and go exhaustively into the question, more especially as to attacking the insect in its breeding-places, experience proving that war waged against the migratory swarms is comparatively useless; in connection with this, suggestions of a very broad nature are made. The Government is advised to encourage settlement of waste lands and the making of railroads conducing thereto, to induce broad schemes for irrigation, to guard the present timber, and encourage the planting of forests, to effect judicious burning in the breeding-grounds, covering about 400,000

square miles as now estimated, to institute efficient systems of observations and warnings, &c., &c. Prof. Riley treats on the natural enemies of the locust, and illustrates the chapter by a remarkably well-executed plate. The general conclusion arrived at is that the evil may be materially modified, although utter extermination is out of the question.

The lengthy appendices give replies to the official circular from those interested, in widely-separated districts, often showing great practical and frequently scientific knowledge, sometimes combined with the illogical conclusions at which agriculturists often jump. Then there is list of species of locusts, &c., collected in the Western States in 1877, with descriptions of new species, worked out by Mr. Scudder; the plate illustrating this is not so good as usual, and scarcely sufficient for scientific purposes. A general bibliography of locusts (chiefly compiled by Mr. B. Pickman Mann), from 1542 forwards, must have occasioned great labour, and is correspondingly valuable. Other appendices treat on the flight of locusts (translated from the Italian); on a journey to Utah and Idaho, by Dr. Packard; and a translation of Yersin's researches on the function of the nervous system in Articulates. The six large folded maps on thick paper seem to be admirably adapted to illustrate the points to which each is directed.

We do not think it is pretended that some of the most useful chapters from a scientific point of view have any special, or even indirect, bearing upon the subject of Economic Entomology. The investigation of a locust's brain, for instance, will hardly reveal the mental condition of the insect, and show us why it is prompted to migrate or be so maliciously inclined towards destroying the hopes of the agriculturist. We prefer to regard these portions of the report as an outcome of a liberal endowment of research, the application of which to the nominal subject for inquiry is not too rigidly enforced.

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.*]

Laurentian Gneiss of Ireland

ALLOW me to state that since writing the notice which appears in NATURE (vol. xxiv. p. 81), I have found that white crystalline marble has been described by Sir R. I. Murchison and Prof. Geikie as occurring in the Laurentian gneiss of Loch Maree, in Scotland. I had overlooked this statement, and was under the impression that limestone was absent from the Scottish Laurentian area. Its occurrence in both countries constitutes an additional point of resemblance. EDWARD HULL

Geological Survey of Ireland, May 31

Resonance of the Mouth-Cavity

WILL you give a place in NATURE to the inclosed letter which has just reached me? The writer is an organist and teacher of music of great repute in the North of England. The experiments which he describes will, I believe, interest many of your readers as much as they do me.

Trinity College, Cambridge, May 20 SEDLEY TAYLOR

MY DEAR SIR,—Travelling the other day by express from Scarborough to London, I found myself unconsciously moving my lips as if whistling a tune, which however I was not actually doing. Without any other action than the simple movement of the lips, I very distinctly heard different sounds in my mouth. Persevering in the practice of this discovered power of producing sound, I soon accomplished a fairly satisfactory performance—audible only to myself—of "Home, sweet home."

As soon as the train came to a standstill I found myself powerless to repeat the performance, for there was then no response to the contortions which by this time had attracted the attention of my fellow-passengers, who doubtless thought that I was being conveyed to a lunatic asylum. On resuming our former speed the "power of sound" once more responded to my efforts.

At once I perceived that I had made a discovery of which I had never heard or read in any of the numerous works on acoustics that I have studied. I perceived that I could single out different sounds from the noise of the train by a simple alteration of the size of the resonance-cavity of my mouth.

On my return home it occurred to me that the force of vibration in the air from the note of a harmonium might be able to set up a sympathetic resonance of the mouth. To my delight I found that I was right.

It is known that if a tuning-fork of proper size be held to the open mouth the latter can be so shaped as to give a powerful resonance; but I believe it is not known that the mouth for *any* sound (above about middle C to f''' or g''') is able to give a very distinct resonance.

Further experiments showed me that not only can the primes of notes within this limit be heard, but that any of these sounds are very clearly heard when they are upper partials of low notes.

This can be tested at the harmonium. Holding down, say, G on the first line of the bass, the third and following partials up to about the fifteenth, can be most clearly heard. The same held good when I experimented with men's and boys' voices.

But the most striking results were obtained at the organ. Holding the low C of the 8 ft. trumpet, the partials from e' to $f''\sharp$ were most bright and clear. Other stops, according to their several qualities, yielded corresponding results. I tried in vain however to obtain resonance for a differential and summational tone.

When the upper partials of a compound sound are generated in the mouth, the sounds are so near that with careful adjustment beats come out very clearly.

It is well however to observe that the force or weakness of any single sound thus obtained depends greatly upon the distance from the source. JOHN NAYLOR

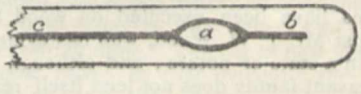
Scarborough, May 13

Suggestion Relating to the Kew Standard Thermometers

I SHOULD like to suggest, through your columns, two slight changes in the manufacture of the Kew standard thermometers, which I think will commend themselves to any observers who often have occasion to use these beautiful instruments.

1. The calibrating chamber at the top of the thermometer is now made as in the figure, where *c a b* is the capillary column which expands at *a* into the calibrating chamber. Instead of being rounded off at *d* the capillary column is continued a short distance to *b*. This causes serious inconvenience in the transportation of the instrument, or in its calibration, because a small particle of mercury readily detaches itself from that in the chamber *a*, and once in *b* with a cushion of air between it and the remainder of the column, nothing but heat will dislodge it.

It does not require very great skill on the part of the glass-blower to form the chamber *a* by means of the pressure of the



mercury itself against the walls of the capillary column. The glass-blower, as is perhaps well known, can soften the finished tube at *a*, and while the glass is in this condition the gentle application of the flame to the bulb will force the mercury into the part at *a*, and the careful application of both flames will then form a pear-shaped cavity of a form which will not retain a particle of mercury, and is exceedingly convenient in use.

2. It is often desirable to hang these thermometers in a comparator or other place, and it would facilitate this if a glass ring were attached to the upper end, as is the case with the ordinary chemical thermometers. It is to be observed that the plane of this ring should be parallel to the enamelling in the tube.

It is often convenient to know the kind of glass used in the

tube, and the date of filling. Something more exact than the commercial name of the glass would be needed in stating the former, but both of these particulars might with propriety be engraved on the tube. LEONARD WALDO

Yale College, New Haven, May 11

"How to Prevent Drowning"

ONE further hint may be added to those of Mr. MacCormac. It is as simple as practical, although it may not have been before recommended in print.

When a person is thrown into the water from an elevation the body sinks for a time, and may not rise quickly to the surface to permit fresh breath to be taken. In that case shut the lips firmly to prevent the escape of the breath, and swallow the breath. This is the art of the diver; it comes naturally to him when he seeks to prolong his stay under water; but it may not as readily occur to one unskilled in diving, whose only desire is to reach the surface. The act of gulping down the breath may be repeated three or four times, and thus protract the chances of escape.

Although every one may tread water, fresh or salt, Mr. Hill is undoubtedly right in saying that all cannot float upon fresh water without assistance from their hands or feet. Not one in ten can do so. When the swimmer shows his toes above the surface his hands are in constant action below, turning half-way round from the wrist and back again, to change the fulciment.

WM. CHAPPELL

Stratford Lodge, Oatlands Park, Weybridge Station

THE bathing—I might almost say the drowning—season is now about to begin, and many lives will unhappily be lost. As the human frame, bulk for bulk, is lighter than water, all that is needful to save life is to permit the body to sink until it shall displace as much water as equals the body's weight. Then paddle gently, as the lower animals do, with hands and feet, the head being held erect, wherever it is desired to go. This direction being carried out is absolutely all that is needful under ordinary conditions to preserve life. These few directions ought to be stuck up in every bathing-place—every boating- and skating-place — in the three kingdoms. Children in every instance ought to be made to tread water from the earliest age, say in shallow slate baths with blood-warm water, or, when convenient and suitable, in some river, pond, or in the open sea. A leather belt with ring, and a stout rod with line and hook, are employed by Portuguese mothers to instruct their children. The mother, rod in hand, stands on the brink; the child learns in the water. In Paris swimming-schools the same procedure is resorted to. The business cannot be begun too soon. I saw mere infants sustaining themselves perfectly in the tepid waters of Africa. Treading water is far safer than swimming in a broken sea. Every adult, man or woman, who has not practised it should begin. Once the conviction instilled that the body is lighter than water, the risk of drowning is reduced to zero. The process involves no uncertainty, no delay. Very different from swimming, it can be acquired at once.

Belfast, May 25 HENRY MACCORMAC

Optical Phenomenon

MR. MURPHY'S experience, described in NATURE, vol. xxiv. p. 80, is general enough. It was observed by Fechner in 1860, and is now commonly associated with his name, though Prof. Brücke of Vienna had also seen and explained the very same phenomenon some years before that. Nor was he the first, for, according to Aubert, there is a still earlier account due to Brewster in *Poggendorff's Annalen* for 1833.

Fechner's side-window experiment, as it is called, is best seen by employing a scrap of white paper on a black ground, or *vice versâ*, the eyes being accommodated for some other distance, so that double images of the paper are secured. Care must also be taken that the light from the window enters the nearer eye only through the sclerotic, so as to receive a reddish tinge. This diffused reddish light renders the eye after a short time comparatively insensitive to red, so that the light reflected from the white paper appears greenish, the black paper alone, from which no light is reflected, appearing of the reddish tinge. In contrast with this, in the other eye, which is sheltered by the nose from the window-light, the white light appears reddish, and the black greenish. Some little time is required for the illuminated eye to be exhausted for red before the contrast is very striking. Such is Brücke's explanation; but who will explain to us this "subjective phenomenon of contrast"? JAMES WARD

Trinity College, Cambridge, May 29

An Optical Illusion

IF your correspondent, Mr. William Wilson, will refer to vol. xxxiii. of the "International Scientific Series," page 86, he will find given by Prof. Le Conte a full description and explanation of the ocular illusion to which he refers in his letter (NATURE, vol. xxiv. p. 53). The explanation is identical with that given by yourself. SAMUEL DREW

Chapeltown, Sheffield, May 24

Occurrence of Neolithic Implements at Acton, W.

IT may interest your readers to know that I discovered, last week, on the surface of a field south of the Priory at Acton, an abundance of Neolithic implements, precisely similar as regards form, type, size, and material to those which occur so abundantly in the neighbourhood of Beer and Sidmouth, in Devonshire. They occur also on a large field on the hill at Acton, west of the Wilesden Railway, and are formed of grey or black chalk flints, which—or the implements—have been imported. On a field south of the Priory I found a flat, circular, grey, quartzite, beach pebble, derived possibly from the Bunter Conglomerate of South Devon, similar to those of the Dorsetshire and Devonshire coasts. Such pebbles are of frequent occurrence on the surface of the fields in the Neolithic districts of Beer and Sidmouth, and have been used as hammer stones and missiles. The association of this pebble with implements so like in every respect to those of South-East Devonshire is very remarkable.

The occurrence of palæolithic implements in the drift of Acton has been known for some years. They occur in remarkable abundance in the high level gravels of this locality as well as in the low level gravels of Hammersmith, and one cannot fail to find in newly-spread gravel examples of the minor implements, such as flakes, drills, &c., and occasionally larger implements. A series of the neolithic implements of Acton I purpose depositing in the Jermyn Street Museum. Their discovery at this locality confirms the conjecture I had formed that neolithic implements might occur in the Thames Valley, from having found implements of neolithic type in the drift, into which they may have got washed. SPENCER GEO. PERCEVAL

21, Notting Hill Square, W., May 20

Birds Singing during Thunder

A THUNDER-STORM of great severity passed over us, travelling round from west to south, between 4 and 8 o'clock p.m., May 28, and killing a man in the open air three miles from my residence. The thermometer stood about 70° all the while. During the storm, and even when the thunder-peals were loudest, the chaffinches kept singing, and the blackbirds' notes alternated with the thunder-claps. The rain was moderate, and as the air filled with insects and perfume, the swallows kept busily, skimming even while forked lightning was flashing. Horses in the fields however exhibited symptoms of terror. J. SHAW

Tynron, Dumfriesshire

Fire-Balls

I HAVE read with great interest Prof. Tait's lecture on Thunderstorms, and have had recalled to mind a singular fireball which I had the fortune to see some years ago during a thunderstorm in Portugal. I have a perfect recollection of the phenomenon without referring to my journal of that date.

I was standing in a window on the second floor of the Hôtel Braganza (in Lisbon), which stands close to and high above the Tagus, and had an unbroken view of the river. There occurred a flash followed by an instantaneous crash, but the tail of the flash, however, gave origin to two balls, which descended separately and not far apart, towards the river, and when quite close to, or in contact with the water, burst in rapid sequence, with explosions which might have been the crack of doom.

Sumatra, April HENRY O. FORBES

Sound-Producing Ants

IN NATURE, vol. xxii. p. 583, which has lately reached me, I read a letter from Mr. Peal on sound-producing ants, and I

can corroborate his observations. It is nearly two years since I noted this fact in a species of *Polyrachis*, which makes its papery nests on the under side of bamboo leaves. The noise, resembling very heavily-falling rain, is caused by the insect striking the leaf by a series of spasmodic taps, both with its head and with the extremity of its abdomen, which it *inflexes* while so doing.

I came on a second large brown species in September last in Sumatra. The noise which, as in the case of the *Polyrachis*, resembled heavy rain, could be heard a long distance off. What struck me most about this species was the singular synchronism of the movements. These ants were spread over a space perhaps a couple of yards in diameter on the stem, leaves, and branches of a great tree which had fallen, and not within sight of each other; yet the tapping was set up at the same moment, continued exactly the same space of time, and stopped at the same instant; after the lapse of a few seconds all recommenced at the same instant. The interval was always of about the same duration, though I did not time it; each ant did not, however, beat synchronously with every other in the congeries nearest to me; there were independent tappings, so that a sort of tune was played, each congeries dotting out its own music, yet the beginnings and endings of these musical parties were strictly synchronous.

HENRY O. FORBES

Sumatra, April

The Pitt-Rivers Collection: Bell-Clappers—the Tooth-Ornament

IN the account lately given in your columns of the Pitt-Rivers Anthropological Collection I find it stated, in speaking of bells: "The clapper is a late addition to the bell which does not exist in Japan or China." When in West Java a year ago I saw in the possession of a gentleman there a bronze (?) bell dug up on the site of one of the old Hindoo settlements, of which now only the graves remain. It had lost the clapper, but the hook, to which I have no doubt a clapper originally was attached, existed still. The form of the bell was much like those figured by Raffles in his "History of Java."

In speaking also of the development of ornamentation reference is made to the W pattern. In the Lampongs this is the most common and almost the only ornamentation. Its origin may possibly be as Mr. Low suggests; but farther up the country, where adornment is more frequent and varied, I find a very common pattern to be a circle ornamented all round the circumference with this toothed design, evidently, I think, representing the sun, and it is not improbable that on the circle being dropped where it could not well be introduced the "tooth-ornament" alone was retained.

Once travelling near Lake Doon, in the West of Scotland, I entered a lonely hut amid the mountains, where a woman was washing the floor—at least the stones set in it, for they were let into the mud at considerable distances apart. As she finished each stone she ornamented it with a piece of pipeclay with concentric circles, combining, where the stone was larger, two of these concentric ornaments into one by a stalk—as of a stem with two flowers on it  . Did she still unwittingly retain the ornamentation of the European Bronze Period?

Sumatra, April

HENRY O. FORBES

ON TOTAL SOLAR ECLIPSES OCCURRING BEFORE THE END OF THE PRESENT CENTURY

AT various times during the last six years we have given in our "Astronomical Column" particulars (including elements) of most of the total eclipses of the sun that will happen before the close of the nineteenth century. As the attention of many astronomers may soon be directed to arrangements for observing the eclipse on May 17th, 1882, we present here, in a collective form, the principal characteristics of such phenomena during the interval in question, which are likely to possess special interest under the circumstances. We shall refer to twelve eclipses, commencing with that of the ensuing year.

(1) 1882, MAY 17.—The most accessible positions on the central line will be in Upper Egypt and the extremity of the peninsula of Sinai about Sherm, but the duration of totality will be greater in the vicinity of Teheran. Where the central eclipse crosses the Nile, totality will commence at about 8h. 33m. a.m. local mean time, continuing 1m. 12s. According to General Stebnitzki's recent determination of the geographical position of the apparatus-room of the Indo-European Telegraph at Teheran, the central line will pass 8′ to the south of it, and here the duration of total eclipse will be 1m. 44s., which may be considered the longest available on this occasion: the sun's altitude will be 67°. The central eclipse passes off the Asiatic coast near Shanghai, running about 18′ north of that place; a direct calculation for Shanghai shows a partial eclipse only, greatest at 5h. 21m. p.m., magnitude 0·996, while at the neighbouring meteorological observatory of Zi-ka-wei, the eclipse is also partial, magnitude 0·994. On the central line in the longitude of Shanghai, the total eclipse continues only 35s. with the sun at an altitude of 18°.

(2) 1883, MAY 6.—In this case we have an eclipse where the totality will extend to nearly six minutes, but unfortunately this long duration falls upon the Pacific Ocean, and it does not appear that there is any land where it can be observed. By the Admiralty chart of the Marquesas, a duration of 2m. 53s. might be available on the Island Fetou-houhou, or Chanel Island, the sun at an altitude of 63°, and totality commencing about 0h. 42m. local mean time. At the head of Anna Maria Bay, Nouka-hiva, there is a partial eclipse only, magnitude 0·97. The central line lies wholly upon the Pacific: greatest duration of total phase 5m. 56s. in about 147° W. and 9° S.

(3) 1885, SEPTEMBER 8.—Observable in New Zealand soon after sunrise. In the longitude of Wellington the duration of totality will be 1m. 55s., with the sun at an altitude of 15°, at Wellington itself the duration will be hardly 40s.; the central line passes some forty-five miles to the north. The greatest eclipse falls in mid-Pacific in 58° S. latitude,

(4) 1886, AUGUST 29.—Totality will continue longer in this eclipse than in any other occurring within the interval which we are considering, but again it will happen that the greatest durations fall on the ocean, in this case upon the Atlantic. At the southern extremity of the Island of Grenada, or in 61° 35′ W. and 11° 59′ S. there will be a total eclipse with the sun at an altitude of nearly 20°, commencing at 7h. 10m. a.m. local mean time and continuing 3m. 15s. In 14° 13′ W. and 2° 58′ S. the sun will be upon the meridian at the middle of the eclipse, and totality will last for 6m. 27s. The central line meets the African coast in about 12° 14′ S. and here the duration of the total phase will be about 4m. 38s., with the sun at an altitude of 39°. [This eclipse is a recurrence of that of 1868, August 18, when the central line passed across Hindostan from near Kolapore to Masulipatam, where the duration of totality was 5m. 45s., but attained a maximum of 6m. 46s. on the west coast of the Gulf of Siam. At its next recurrence, 1904, September 9, the total phase continues 6m. 19s. but in mid-Pacific longitudes a little south of the equator. On September 21, 1922, though there is no land where the totality will be longest, a duration of about 3½ minutes will be available on the east coast of Australia.]

(5) 1887, AUGUST 19.—It was long supposed that the central line in this eclipse would extend to England, but it appears to commence in 11° 39′ E. and 51° 38′ N. It will be most favourably observed in Asiatic Russia, but some fifty miles north of Moscow the total eclipse will continue 2m. 30s. with the sun at an altitude of 17°, and this is perhaps the most westerly station that observers should be induced to fix upon. In Moscow the duration would seem to be about one minute. At Berlin the sun will be totally eclipsed immediately after rising. On Lake Baikal

totality will continue about 3m. 38s., with the sun at an altitude of 50° and near the meridian.

(6) 1889, DECEMBER 22.—The greater duration of totality in this eclipse falls upon the Eastern Atlantic, but where the central line meets the African coast in Angola (about 10° 6′ S.) it continues 3m. 35s., with the sun at an altitude of 56°. At Bridgetown, Barbados, totality commences about 6h. 47m. A.M., with the sun at an elevation of 6°, and continues 1m. 48s.

(7) 1892, APRIL 26.—Almost entirely an ocean track on the South Pacific, commencing indeed in the Antarctic Ocean at a latitude of upwards of 75°: an impracticable eclipse, though the duration of totality attains a maximum of more than four minutes.

(8) 1893, APRIL 16.—Probably, all classes of observation considered, this will be the most favourable eclipse occurring before the end of the century. On the west coast of South America, rather less than a degree north of Coquimbo, where the sun will have attained an altitude of 24°, totality will continue nearly three minutes, commencing about 8h. 14m. a.m.: hence the central line traverses Brazil, passing off the South American continent near Ciara, and here the sun, at an altitude of 77°, and near the meridian, will be totally eclipsed 4m. 44s., or within a second or two of the longest interval possible on this occasion. Perhaps the central eclipse may pass about 10′ north of Ciara. After traversing the Atlantic it enters Africa close to Bathurst, at the mouth of the Gambia, where the total phase still continues about four minutes, thence through Central Africa to a point from 4° to 5° west of Khartoum, where it leaves the earth. From these circumstances an extended course of observations may be expected.

(9) 1894, SEPTEMBER 28.—On this occasion we have either a sea-track or a passage over inaccessible regions, except that the eclipse may ultimately be found to be total in the Seychelles; the tabular position of the moon, upon which our calculations referring to this phenomenon are founded, perhaps admitting of alteration to the amount required. The central line commences in the middle of Africa just north of the equator, leaving that continent near the Juba River, the mouth of which is almost upon the equator. In the longitude of Mahé in the Seychelles it appears to pass about 38′ to the south. The maximum duration of totality occurs in about 86° E. and 34° S., and is close upon two minutes. From this point the course of the central line is in the direction of Macquarie Island, near to which it passes off the earth, without, so far as a preliminary computation enables us to say, certainly encountering land after leaving the African continent.

(10) 1896, AUGUST 9.—Stations will doubtless be found for the observation of this eclipse, as although in the first half of its course, at least, the track lies at considerable northern latitudes, the season of the year is favourable. The central line enters Norway, near Tana in Finmark, and in 28° 46′ E. and 70° 31′ N. the duration of totality is 1m. 43s. with the sun at an altitude of 15°. After rising to a still higher latitude the central eclipse begins to descend, until we find it occurs with the sun on the meridian in about 112° 21′ E. and 65° 38′ N., and the latitude continues to diminish until the total phase leaves the earth. In 136° 21′ E. and 51° 5′ N., near the Amoor River totality continues 2m. 38s. with the sun at an altitude of 46°. The total eclipse may be observed also in the northern parts of Yesso, Japan, but does not afterwards meet land. [This will be a recurrence of the eclipse of 1806, June 16, observed by Bowditch in America, of that of 1842, July 8, well observed in the South of France and in Italy, and of the "Himalaya eclipse" of 1860, July 18, when a numerous party was conveyed to the south-west of Europe in H.M.S. *Himalaya*, there meeting with observers from all parts of the Continent, and unitedly putting upon record important details of the phenomena observed. Its last recurrence was on July 29, 1878, when so good an account of it was given in the United States by American and European astronomers.]

(11) 1898, JANUARY 22.—This eclipse may be well observed in Hindostan, where the central line enters the peninsula in about 73° 25′ E. and 16° 38′ N.; totality will commence at 0h. 45m., and continue about 2m. 6s. It commences in Senegambia, and leaves the earth in East Mongolia. Although many observations may probably be made in India, it will be seen that the duration of the total phase is comparatively short.

(12) 1900, MAY 28.—The central line entering upon the earth in the Pacific in 18° N. traverses the south-east portion of the United States, from Louisiana (not far from New Orleans) to Norfolk, on the Atlantic coast, and at the point where it leaves the American continent totality commences about 8h. 47m. a.m., and continues 1m. 40s. with the sun at an altitude of 47°. Crossing the Atlantic, upon which the greatest duration of totality falls, it enters Portugal near Ovan in about 40° 49′ N., and here the total phase continues 1m. 30s., with the sun at an elevation of 42°. The eclipse may be well observed in Portugal and Spain; at Alicante totality lasts 1m. 18s. This eclipse will be a recurrence of that of May, 1882, and the available durations of totality, it will be seen, are about the same on both occasions. In Hallaschka's *Elementa Eclipsium*, by an oversight, this eclipse is represented as broadly annular; the geocentric excess of the moon's semi-diameter over that of the sun will be, however, about 9″.

The following table exhibits the approximate positions of beginning and ending of total phase, and of the central eclipse at apparent noon, for the twelve eclipses included in the above remarks:—

Year.	Central Beginning.		Total at Apparent Noon.		Central Ending.	
	°	°	°	°	°	°
1882...	3·1 W.	10·7 N.	63·8 E.	38·8 N.	138·9 E.	25·5 N
1883...	155·9 E.	34·8 S.	147·2 W.	9·2 S.	86·9 W.	13·6 S.
1885...	156·9 E.	40·9 S.	138·7 W.	57·7 S.	75·6 W.	74·6 S.
1886...	79·6 W.	9·9 N.	14·2 W.	3·0 N.	47·3 E.	22·0 S.
1887...	11·7 E.	51·6 N.	102·3 E.	53·8 N.	173·8 E.	24·5 N.
1889...	78·9 W.	15·4 N.	6·5 W.	11·1 S.	60·9 E.	6·9 N.
1892...	144·1 W.	76·1 S.	138·7 W.	67·3 S.	81·7 W.	38·4 S.
1893...	95·7 W.	36·3 S.	36·6 W.	1·0 S.	28·6 E.	16·4 N.
1894...	26·9 E.	1·7 N.	86·3 E.	34·3 S.	163·0 E.	56·4 S.
1896...	1·0 W.	63·5 N.	112·4 E.	65·6 N.	179·1 W.	18·6 N
1898...	10·0 E.	11·0 N.	68·8 E.	12·9 N.	119·3 E.	45·9 N.
1900...	116·6 W.	18·0 N.	44·8 W.	45·0 N.	31·8 E.	25·4 N.

A CHAPTER IN THE HISTORY OF THE CONIFERÆ[1]

THE CUPRESSINEÆ

THESE are classed as the first tribe of the Coniferæ in Hooker's "Genera Plantarum," wherein seven genera are recognised. The Cupressineæ are large trees or shrubs, very resinous, with small scale-like leaves. The cones are small and globular, and composed of six, eight, or rarely ten peltate and persistent scales, except in the juniper, in which they coalesce into a fleshy galbulus or berry. The seeds are small, compressed, frequently triangulated, and, except in *Juniperus* and the Biota section of *Thuja*, provided with small membranaceous wings at the angles. The order comprises many of the hardiest shrubs in existence.

Their origin can possibly be traced back to the Permian genus *Ulmannia*, and they seem to have become the preponderating tribe during the Jurassic and Wealden, to judge from the prevalence of wood known as Cupressinoxylon. The earlier forms, described as *Widdringtonites*, *Echinostrobus*, *Thuyites*, and *Thuyopsis*, though of great interest are still imperfectly known, even from the Cretaceous, but with the Tertiary period most of the

[1] Continued from vol. xxiii. p. 414.

existing genera appear, apparently as completely differentiated from each other as at the present day.

A few of the Cupressineæ, as cypress and some of the junipers, inhabit swamps or places liable to inundation, while other species of the same genera seek out the loftiest mountains and excel almost all other shrubs in hardiness, the juniper and cypress being found in Central Asia at altitudes respectively of 15,000 and 16,000 feet.

Many of them seem able to adapt themselves to a great range of climate. *Fitzroya*, a stately cedar 100 feet in height on the western slope of the Patagonian mountains, dwindles to a small bush a few inches high on the confines of perpetual snow, and the Chilian *Libocedrus*, 100 feet high on the Cordilleras, dwarfs to a small bush in Magellan. Of all the genera, however, *Juniperus* is the most hardy, extending itself as low scrub-bushes on most mountain chains to far beyond the limits of trees, and occupying to the south the barren rocks of Cape Horn (*J. uvifera*), and to the north penetrating Labrador, Newfoundland, Hudson's Bay, and Greenland (*J. Canadensis*).

Although of relatively less bulk than the Sequoiæ or the Pines, some species attain colossal dimensions, as the Oregon red cedar, *Thuja gigantea*. This tree, said by Gordon to be from 50 to 150 feet, and by Herschel 200 feet, high, seems actually to have reached an altitude of 325 feet, and a diameter of 22 feet, for a gigantic plank, exhibited by the State of Oregon at the Philadelphia Exhibition, was stated to have been cut at 118 feet from the ground from a trunk of these dimensions. *Libocedrus decurrens* exceeds 200 feet, and in the Himalayas the gloomy *Cupressus torrulosa* has been met with 150 feet in height and 16 feet in girth at five feet from the ground.

The woods of many of the species are valuable—those of *Frenela columnaris*, *Callitris quadrivalvis*, and some species of juniper being esteemed by cabinet-makers for furniture and veneering. The mottled butt wood of the "Thuja" of Pliny, and the "citrus" of Horace commanded fabulous prices during the Roman Empire. Cicero is said to have paid a million sesterces[1] (9000*l.*) for a table made from this wood, and of two tables belonging to King Juba, and sold by auction, one fetched 1,200,000 sesterces, although the largest recorded diameter is only about 4½ feet. The wood is still turned into tazza in Paris, and examples of it are preserved in the Kew Museum. Some of the most valuable gums, balsams, and resins, and amber are obtained from the tribe.

The first, and palæontologically most important, genus is CALLITRIS. This is subdivided into four sections, by many authors recognised as distinct genera—(1) *Pachylepis* or *Widdringtonia*; (2) *Tetraclinis* or *Callitris* proper; (3) *Hexaclinis* or *Frenela*; and (4) *Octoclinis*. The first section is doubtfully recorded as *Widdringtonites*, from the Lias of Switzerland and Würtemberg and from the Wealden and Cretaceous of North Germany, and Kome in Greenland. *Widdringtonia* is definitely found at Aix and other Eocene localities of France by Saporta, in the Miocene of Oeningen, at Bilin, and questionably so in the absence of fruits in the Greenland Eocene. It is now confined to South Africa and Madagascar.

The second section, *Callitris* proper, is distinguished by its cone formed of four truncated valves in pairs, and is represented at present by a single species confined to Northern Africa. Its fruits however are not only met with at Sheppey, but at Aix, St. Zacharie, and Armissan in France, and at Häring in the Tyrol.

Between this and the next section of *Callitris* should be placed, if cupressineous at all, the extinct genus (?) *Solenostrotus* of Endlicher, founded on Bowerbank's figures of fruits with five valves each.

The third section, *Frenela*, has a cone of six scales in opposite pairs, and is now entirely confined to Australia and New Caledonia, nearly two dozen species being more or less known. One of the most distinctly Cupressineous fruits yet met with fossil corresponds exactly with the Port Jackson *C. Endlicheri*, but has eight scales, and therefore falls into the *Octoclinis* section, also Australian, but now limited to a single species.

We have thus the most absolute proof that different sections of CALLITRIS flourished in these latitudes during the Eocene period, and therefore that the Palæarctic, Ethiopian, and Australian botanical regions overlapped and intermingled to some extent at that time. They do not seem, however, to have been present much to the north of our own latitude.

The genus ACTINOSTROBUS does not appear to have been found fossil except by Ettingshausen at Sagor (1859), and even these two specimens seem very indistinct and much smaller than either existing species, and are ignored by Schimper in his list of species. The existing Patagonian FITZROYA has no known fossil representative.

The fourth genus, LIBOCEDRUS, is distinguished by its flattened oblong cone of four to six leathery and very unequal scales, and by its thick scale-like and peculiar foliage. It occasionally forms very large trees, and in distributed over all but the Oriental and Ethiopias regions,[1] though the actual species have a limited range. The range of Libocedrus in the Tertiaries is singular. It appears from below the London clay at Bromley, then completely disappears in Europe until the Miocene, when it reappears at Bilin, Schossnitz, Radáboj, Armissan, Sinigaglia, from near Bonn, from Monod in Switzerland, and the amber-beds of Prussia. Another species, said to be allied to the Chilian tree, is found in the Eocene of Greenland. As most of the species of Libocedrus inhabit considerable altitudes, even reaching the snow level, and all of them are hardy in England, it is fair to infer that prior to the London clay the climate (and this is borne out by the rest of the flora) was much cooler than during subsequent Eocene times. That Libocedrus was really absent from temperate Europe during the latter part of the Eocene period is beyond all doubt, and that we actually experienced a change in climate such as had been inferred from the faunas of the Thanet sands and Woolwich and Reading beds is fully confirmed by the flora.

THUYA has small ovate or oblong cones of 6-10 valvate unequal scales, and foliage somewhat similar to Libocedrus, though less symmetric. There exist twelve to twenty-one species, divided into five sections, and some forming trees that are gigantic. The great majority are Japanese, but two species inhabit the Nearctic regions. The genus first appears in the Arctic Eocenes, descending into Europe during the Miocene, when it formed the vast amber-producing forests along the Baltic. The oldest beds to the south from which it is known, though it is rare there, are those of Armissan in France, and the late Miocenes of Marseilles and Tuscany. It is unknown from England, and the *Chamæcyparites* of the older Eocenes of Europe are now transferred to Sequoia.

The sixth genus, the stately CUPRESSUS, is only known fossil from two German Miocene localities. The existing species are mostly found in mountainous regions.

The seventh genus, JUNIPERUS, is very extensive, and is present in every geographical region except the Australian, being also one of the three British indigenous Gymnosperms. It has been recorded fossil from Aix, Häring, and the amber-beds of Prussia, but the smallness of the fragments and the absence of any traces of berries renders its occurrence, especially in the former localities, somewhat doubtful.

The range of the fossil CUPRESSINEÆ, as ascertained throughout the Tertiaries, is thus seen to be perfectly

[1] Hooker, "Tour in Marocco," p. 389.

[1] As restricted by Wallace.

natural; the hardy genera are never associated with the more tropical Eocene floras, and the sub-tropical genera did not range farther north than the present temperate latitudes, nor extend into the later Miocenes. Hardy species occupied these latitudes in the old temperate Eocene times, retreated as the temperature increased, and re-descended from the north as it again decreased, reaching finally as far south as North Italy. The habits and even the species of the genera have not materially altered since the Tertiaries commenced, and they appear to furnish comparatively safe data for physiological inquiries. The most remarkable fact taught by them, a fact beyond all question, is that types now distinctive of widely separated botanical regions actually lived side by side together in Western Europe in the Eocene age.

As the true nature of the various Eocene and Miocene floras becomes unfolded, thanks principally to the able work of Saporta, the fluctuations in temperature that Europe and America have experienced will be measurable and their ebb and flow calculable, with some approximation to certainty. The sensational extremes implied by the over-positive determination of fragments that no human being could determine with certainty, will then, it is to be hoped, be once and for ever discredited.

THE STORAGE OF ELECTRIC CURRENTS

PRACTICAL electricians seem to have made up their minds that a system for the distribution of electricity for the purposes of electric lighting or of driving electric motors will be incomplete unless it comprises a means of storage of the currents to provide against the risk of any temporary derangement or inconstancy in the generating apparatus. An accumulator of currents would in fact render the same service in an electrical system as do gasometers in systems for distributing gas, or the hydraulic accumulators in a system of hydraulic machinery.

At the present time much attention is directed to such *accumulators*, or, as they have been hitherto called, *secondary batteries*.

The principle of the secondary battery dates back to the very early days of Voltaic electricity, when in 1801, one year after Volta's "pile" had made its appearance, Gautherot, a French *savant*, observed that wires of platinum or of silver which had served as electrodes for the decomposition of water containing a little salt or sal ammoniac acquired the property of giving a brief current after being detached from the pile. This phenomenon, familiar to every electrician under the name of "polarisation of the electrodes," was observed again by Ritter of Jena, in 1803, with electrodes of gold wire; and the observation immediately led him to devise a battery from which these secondary currents could be readily obtained, and which constituted the first of all secondary batteries. He tried many different arrangements, using various metals—platinum, silver, iron, &c., but with lead he obtained no result. He attributed this secondary action to a soaking or accumulating of the two opposite kinds of electricity into the surfaces of the plates or into the intervening liquid. The true explanation was given by Volta and Marianini, and later by Becquerel, when they showed that the action arose from the deposits of oxygen and hydrogen, or of acid and of base upon the two electrodes, whose surfaces thus became chemically changed and capable of acting towards one another like the zinc and copper plates of an ordinary battery. Grove, in 1843, brought the matter to a decisive proof by constructing his curious gas battery, in which the positive and negative poles were both platinum plates, the one surrounded by oxygen gas, the other by hydrogen. Ritter's failure to obtain any effect from electrodes of lead arose from his employment of solutions of chlorides as the liquid, the chloride of lead which resulted on the passing of the current being a non-conductor, which at once stopped the current. M. Gaston Planté, who, in 1859, took up the study of the subject, found, after experimenting with many metals, that electrodes of *lead*, when immersed in dilute sulphuric acid, gave rise to very marked polarisation-effects; for after passing through lead electrodes the current from two Bunsen's cells, the

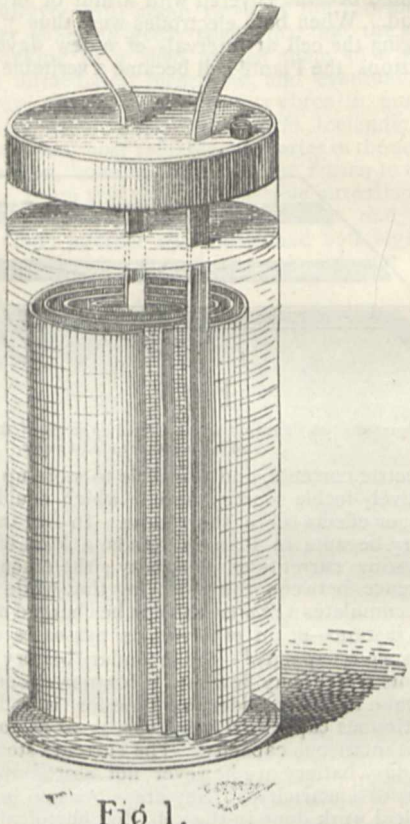


Fig 1.

This figure represents two sheets of *lead*, separated by two sheets of canvas rolled up together and placed in a glass jar containing water, two strips of sheet-lead protruding through the closed top of the jar.

secondary currents were extremely strong and of considerable duration. He therefore constructed large secondary batteries, using for this purpose two sheets of lead immersed in dilute acid. In order to reduce the internal resistance by bringing the opposed surfaces as nearly as possible together the two sheets were of large size and

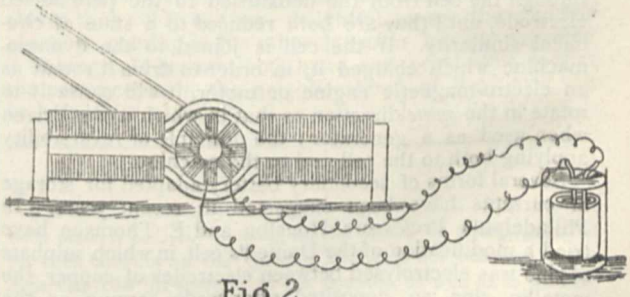


Fig 2

were rolled together in a spiral form, being kept from touching by the interposition of sheets of coarse canvas, or in later forms by means of bands of india-rubber. The general form of a single cell of Planté's secondary battery is shown in Fig. 1. Such cells weighed over twenty pounds, and when properly prepared had an electromotive

force 2½ times that of a Daniell's cell; their internal resistance was also very small, being from one-eighth to one-twentieth of an ohm. These cells improved with use; the liberated gases attacking the surface of the lead electrodes, so that they gradually became of a spongy texture, while the surface of the plate at which oxygen was liberated became covered with a film of brown peroxide of lead. When both electrodes were thus "formed" by charging the cell at intervals of a few days in opposite directions, the Planté cell became a veritable *accumulator* of electric currents, and was able to store up from a comparatively feeble source a supply which could yield vastly stronger effects for a short time. In fact the secondary battery became in Planté's hands a kind of Leyden-jar for storing currents of electricity; the essential point of difference between the two being that while the Leyden-jar accumulates a *charge*, and can be charged or discharged in an instant—or in other words possesses only an "instantaneous capacity"—the secondary battery accumulates currents which may flow into it for many hours, and which may take also a considerable time for their discharge, its "continuous capacity" being very great as compared with its instantaneous capacity. The currents stored up in the secondary battery are however not stored up as accumulations of electricity. They are stored up in the form of chemical work done in the cell, this chemical work being capable of being retransformed at will into the energy of electric currents. When the charging current from an independent battery or from a dynamo-electric machine (see Fig. 2) is passed through a Planté cell, the electrode by which the current enters becomes more highly peroxidised than before, while a corresponding amount of deoxidisation takes place at the electrode by which the current leaves the cell. When the cell thus charged is used as a battery it gives back a current which flows *out* from the electrode by which it formerly flowed *in*; passing through the cell from the deoxidised to the peroxidised electrode, until they are both reduced to a state of chemical similarity. If the cell is joined to the dynamo-machine which charged it, in order to drive it round as an electro-magnetic engine or motor, it will cause it to rotate in the *same* direction as that in which it was driven when used as a generator; the principle of reversibility applying both to the cell and to the machine.

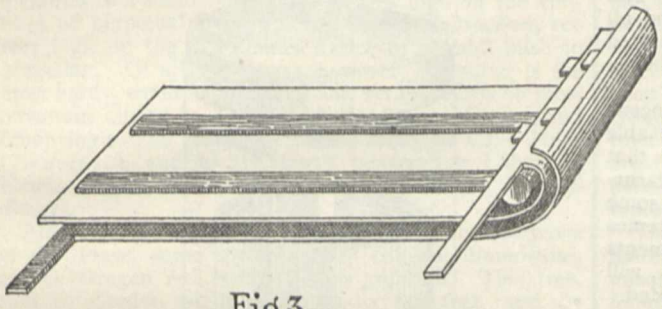


Fig 3

Represents two sheets of lead, separated by strips of thick felt, prepared for rolling together round a roller.

Several forms of secondary battery adapted for storage of currents have been suggested in recent years. In Philadelphia Professors Houston and E. Thomson have tried a modification of the Daniell's cell, in which sulphate of zinc was electrolysed between electrodes of copper, the metallic zinc so deposited afterwards serving as the negative pole of the cell. Another suggestion, due to M. d'Arsonval, was to use an electrode of lead along with one of zinc, dipping into a solution of sulphate of zinc. The charging currents deposited metallic zinc upon the latter and liberated oxygen at the former, which, as in the Planté cell, became coated with spongy peroxide of lead. As this latter is not a very good conductor M. d'Arsonval further proposed to increase the effective surface by laying the sheet of lead horizontal and covering it with leaden shot, which should also become peroxidised.

The latest form of secondary battery is that of M. Camille Faure, described in NATURE, vol. xxiv. p. 68, of which there has been so much talk in the semi-scientific press, and which is now being made the central point of a great financial "operation" in Paris. There can be no doubt that this instrument, though the accounts of its performances have been grossly exaggerated, is an improvement upon that of Planté, of which it is a slight modification. The labour and difficulty of "forming" the Planté cell, that is to say of charging and recharging it until a sufficient film of peroxide of lead should be produced, led M. Faure to try the effect of coating the lead plates at first with a film of *red lead* or minium, a lower oxide than the dark brown peroxide. The two sheets, after having been covered with minium, are rolled together precisely as in the Planté cells, as shown in Fig. 3, a sheet of felt being interposed to prevent internal contact. It was stated by M. Reynier that the capacity of such cells was forty times that of the Planté cell; but four times would have been nearer the mark if cells of equal size were compared. M. Faure's cells are made of large size and weigh 75 kilogrammes, or nearly 200 lbs. It is stated that one such cell would store a sufficient amount of current as to be able afterwards to yield in an hour an amount of work equal to one horse-power. Confirmatory observations are yet needed. Meantime let us just remind the enthusiast who brought over to England the "million foot-pounds" of energy stored up in a Faure cell, that he would have imported a dozen times as much stored energy if he had brought over instead a lump of coal of the same weight.

The uses for such secondary batteries may be of three kinds:—1. They may serve as portable supplies of electricity to be left and called for to recharge when exhausted. 2. They may serve to accumulate supplies of electricity from dynamo-electric machines, and store them until required for furnishing electric light or motive power on a small scale. 3. They may serve as equalisers of electric currents in a system in which the supply is liable to fluctuations. Suppose, for example, a dynamo-electric machine is employed to produce electric light. Any least thing which alters the speed of the machine, even for an instant, makes the light flicker and change in intensity; while the breakage of the engine-strap would at once cause total darkness. But if a secondary battery of suitable dimensions and power were inserted across the circuit between the dynamo-machine and the lamp, the inequalities of the current would be greatly modified. When the light was not in use the battery would store up the current. If the engine failed the battery would at once put forth its power. It is probably in this direction that the secondary battery will find no unimportant field of usefulness.

A SINGULAR CASE OF SHIPWRECK

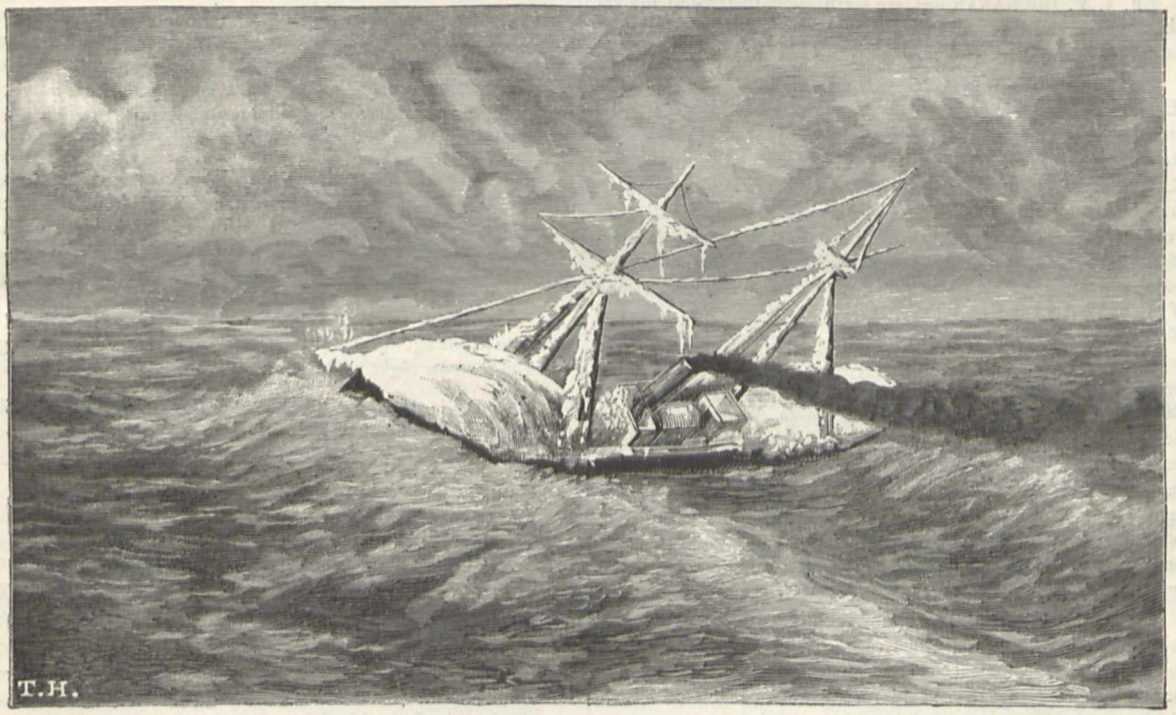
THE wreck of the Danish mail steamer *Phœnix*, which took place off the west coast of Iceland on January 29, was attended by rather unusual circumstances deserving of note. The vessel (about 450 tons burden) sailed with cargo and the mails from Copenhagen for Leith, the Faröe Islands, and Iceland, about the middle of January.

Nothing particular occurred until after leaving the Faröes, when she ran into a severe gale, which rapidly increased to a perfect hurricane, while at the same time the temperature fell to about 50° F. of frost (— 18° F.). Such cold is not extraordinary in these latitudes in winter, but fortunately it is seldom associated with very high winds. Under the circumstances in which the *Phœnix* was placed every sea that she shipped froze, and the deck soon became covered with a foot or two of solid ice.

As time passed on the continued action of the sea raised a perfect iceberg on the forward part of the vessel, while the showers of spray carried along by the steadily increasing gale covered the masts, yards, and rigging with an ever-thickening coating of ice. Two or three days passed without the least abatement of the storm, and then the half-smothered steamer went over on her beam ends. The crew succeeded in cutting away the masts, and she once more righted.

It however was clear, the gale showing no signs of breaking, that the relief was only temporary. The ice continued to form on the vessel, particularly about the forecastle, where, piled high above the bulwarks, and overhanging the sides, it threatened, by altering her trim, to raise the propeller out of the water.

Under these circumstances, on the morning of January 29, Capt. Kihl decided to run the steamer ashore while daylight lasted. At some distance from the land she struck on a sunken rock, and the crew, taking to the boats, only succeeded with the greatest difficulty in reaching the shore, saving nothing but their lives, the English mail, and a bundle of blankets which (when carried ashore) was found to be useless—frozen into a solid lump. Their situation in deep snow on the desolate coast of Iceland, about 100 miles to the north-west of Reykjavik, was very critical, and a party of two or three of the stronger sailors under the command of M. Jaspersin, the first officer, proceeded in search of assistance. It was not however until about three in the morning of the 30th, after suffering great hardships, that the sound of a pony kicking in a shed guided them to a house. The farmers immediately turned out, and eventually the scattered crew, twenty-two or twenty-three in number, were picked up, some of the clever little Icelandic dogs proving themselves most valuable auxiliaries in the search. Many of the men, however, were all but frozen to death in the snow. From this time all possible attention was given to them; but one, having both legs and arms frost-bitten, died; another afterwards had both legs amputated below the knees; and the steward lost three



fingers of each hand. Hardly one escaped more or less injury from the effects of the extreme cold to which they had been so long exposed. Capt. Kihl and the bulk of his crew soon after succeeded in getting to Reykjavik, and on April 13 they sailed in the sister steamer, the *Arcturus*, for Copenhagen. The officers and men of the wrecked vessel are of opinion that had Capt. Kihl not decided on the 29th to run the *Phœnix* ashore in daylight not a soul would have been saved, as the gale did not moderate for several days after; and the steamer, buried as it was under an enormous mass of ice, must have foundered in the night.

In Iceland this storm will be long remembered by the destruction it caused; and it is said that such a terrible winter has not been known for years. Sheep have perished in large numbers, and ponies have been killed to save hay. Then as the Icelanders depend on the outer world for flour, &c., the loss of the *Phœnix* with its cargo was a terrible misfortune. A letter from Reykjavik to a lady in Edinburgh, published on April 21 (and dated the 10th), states that the magazines were empty, and concludes thus: "It was very delightful to see the steamer *Arcturus* coming in the other day after having expected it so long. It brought both news and provisions, so that the poor people in the neighbourhood of Reykjavik can be helped for a while." J. ALLEN ALLEN

NOTES

CAPT. FREDERICK JOHN OWEN EVANS, C.B., F.R.S., has been made a K.C.B. Among all the crowd of names gazetted for such honours on the Queen's birthday, not one had better deserved it by his services to his country, as well as to science, than the well-known Hydrographer to the Admiralty.

THE Visitation of the Royal Observatory takes place on Saturday. No doubt it will be numerously attended, as it is announced that Sir George Airy has resigned his post for the 1st of August

THIS is a week of *soirées*. The Royal Society *soirée* on Wednesday is followed by the Society of Arts *soirée* to-night, while the President of the Institution of Civil Engineers has issued invitations for another on Friday. These two last are held in the galleries of the South Kensington Museum.

MUCH interest has always been attached by anthropologists to the Stone Age of Egypt, on account of its bearing on the antiquity of man. Hitherto the finds of stone implements have been purely superficial, but in March last General Pitt-Rivers, President of the Anthropological Institute, discovered worked flints two to three metres deep in stratified gravel and mud near Thebes. The gravel had become so indurated in Egyptian times that they were able to cut square-topped tombs supported by square pillars in it, and these have remained in their original condition to this day. Some of the implements were chiselled out of the gravel in the sides of these nombs. General Pitt-Rivers will read a paper giving an account of this discovery at the Anthropological Institute on Tuesday text, the 7th inst.

MR. J. Y. BUCHANAN has, we learn, gone to Italy to see the ship which the Italian Government has fitted out for deep sounding in the Mediterranean.

THE "General Report of the Norwegian North-Atlantic Expedition" is being published in parts, each Memoir being distributed immediately on its leaving the press. The General Report will comprise the following Memoirs:—Capt. Wille, R.N. (Narrative of the Expedition—Description of the Apparatus, how constructed and used—Magnetical Observations); Prof. H. Mohn (Meteorology—Deep-sea Temperatures—Motion of the Sea—Astronomical, Geographical, Geological Observations); Mr. H. Tornoe (Amount of Air in Sea Water—Amount of Carbonic Acid in Sea Water—Amount of Salt in Sea Water); Mr. L. Schmelck (the Salts in Sea Water—Investigation of Bottom Samples); Prof. G. O. Sars (Crustacea, Pycnogonida, Tunicata, Bryozoa, Hydrozoa, Spongozoa, Rhizopoda, Protophyta); Drs. Danielssen and Koren (Holothurida, Echinida, Asterida, Crinoida, Gephyrea, Anthozoa); Mr. H. Friele (Mollusca, Brachiopoda); Dr. G. A. Hansen (Annulata); Mr. R. Collett (Fishes). The publication of the Report, for which a grant of money has been obtained from the Norwegian Storthing, is conducted in conformity with the directions of His Norwegian Majesty's Government. Of the memoirs we have received that on "Fishes," by Mr. R. Collett, and "Chemistry," by Mr. H. Tornoe.

WE greatly regret to learn that Dr. James Croll, F.R.S., has been compelled, in consequence of ill-health, to retire from his position on the Geological Survey. The same reason will account for his not replying to certain correspondence and criticisms which would otherwise have claimed his attention.

DR. AUGUST WILHELM EICHLER, Director of the Royal Botanic Garden and Museum, Berlin, and Professor of Systematic Botany at the University, has recently been elected a Foreign Member of the Linnean Society in the room of the late G. P. Schimper of Strassburg. Prof. Eichler is well known among botanists for his memoir, "Loranthaceæ et Balanophoræ," in Martius's "Flora Brasiliensis"; also as author of "Entwicklungeschichte des Blattes," and "Blüthendiagramme," &c.

WE regret to have to record the sudden death early in March of Mr. John Sanderson, one of the oldest colonists of Natal. From his arrival in 1850 he resided in Durban, where he conducted for many years one of the most influential newspapers. He was otherwise much occupied with public business, and was for some time a member of the Legislative Council. To botanists in Europe he was well known as an ardent explorer of the South African flora and active correspondent, and his name is commemorated by the beautiful genus *Sandersonia*.

A MONUMENT is to be erected to the memory of the late Dr. Broca, the founder of the Paris Anthropological Society; not less than 14,000 francs have already been collected. We are desired to state that the list will soon be closed, and that all subscriptions are to be sent as early as possible to M. Leguay, treasurer of the fund, at the Paris Anthropological Society.

THE Dorpat University offers two prizes of 750 and 500 roubles respectively for the two best models of a monument in memory of Karl Ernst von Baer. Sculptors are informed that the models will be received by the University until September 15 next, and that the carriage to and from Dorpat will be defrayed by the University. Professors Dr. Grosse (Dresden) and Bohnstedt (Gotha) are members of the committee of decision.

A MONUMENT of the celebrated naturalist, Freiherr von Siebold, was unveiled in the park of the Vienna Horticultural Society on April 22 last. The monument is four metres high, and is in the form of an obelisk with a granite pedestal. The upper part is formed by a very ancient memorial stone ornamented with floral designs, which was originally sent to the Vienna Exhibition by the Japanese Government, and was afterwards destined for this monument. Below this stone is a slab of marble bearing an excellent bas-relief of Siebold, the work of Schwanthaler. The whole monument is surrounded by living fir-trees, which were obtained from the Rax Alpe.

THE death is announced of Dr. Ludwig Rabenhorst of Meissen (Saxony). He was a well-known botanist and editor of the *Hedwigia*. Among his numerous publications we may point out "Die Süsswasser Diatomaceen" (Leipzig, E. Kummer) as an indispensable companion to all students of microscopical plants.

THE *conversazione* of the Society of Arts takes place to-night at South Kensington, and that of the Institution of Civil Engineers to-morrow night at the same place.

THE death is announced of Herr Andreas Schmid of Eichstätt (Bavaria), the editor of the *Bienenzeitung*, and author of numerous treatises and pamphlets on bee-culture.

THE Whit-Monday excursion of the Geologists' Association is to be to the Isle of Wight, and will last three days.

DR. SCHLIEMANN has recently been nominated "honorary citizen of Berlin," and has also been presented with the large gold medal "for Arts and Sciences" by the Grand Duke of Mecklenburg-Schwerin.

IN a brickfield near Lützen (Saxony) some 200 sepulchral urns, skulls, and bones have been found. Dr. Virchow has examined one of the skulls, and declares it to be of a very peculiar type, somewhat resembling the well-known Neander Valley skull, but yet differing from it sufficiently to form a special type of its own. The whole discovery at Lützen, combining cremation and ordinary burial, is at present unique. No ornaments of any kind were discovered.

THE Jablonowski Society at Leipzig offers the following prizes in its scientific section for 1881:—700 marks (35*l*.) for an investigation of the motion of Encke's comet, at least for the period since 1848, taking into account all disturbing influences; for 1882: the same amount for a compilation of our present knowledge of the corrosion-figures of crystals, with an account of original experiments on this subject and a deduction of general maxims regarding the cohesion and structure of crystals as well as their molecular conditions; for 1883: the same amount for a determination of the photo-electrical tensions produced in artificial and suitably-coloured crystals by the action of light and their relations to the thermo-electrical effects produced by changes of temperature.

THE works will begin immediately for the construction of the International Exhibition Electrical Railway, as we are glad to state that the request of Messrs. Siemens has been granted by the Municipal Council of Paris.

OUR Paris Correspondent was present last Friday during an experiment made by M. Trouvé on a small boat between Port Royal and Pont des Arts. The boat, measuring 5m. 50 by 1·30, and carrying three persons, obtained a mean velocity of 1m. 30 per second, with a magneto-electric motor weighing 2 kilogr., and two series of six Wollaston elements weighing 12 kilogr. each. The trial lasted an hour and a half, and was interrupted by darkness. These experiments will be repeated shortly on the Bois de Boulogne lakes. The motor, which was constructed to give 8 kilogrammetres per second, did a duty which a single rower would have been unable to perform. The electro-magnetic motor was placed on the rudder, and the motion communicated to a small screw placed in the lower part by a chain. This system is not calculated to utilise the whole extent of the motive power generated by the elements, but it dispenses entirely with any alteration to the boat. This last circumstance is considered as decidedly important in popularising the system amongst yachtsmen. There is not the slightest vibration or noise of any description felt on board.

THE lectures which were delivered in connection with the Glasgow Naval and Marine Engineering Exhibition are about to be published.

MR. W. R. BROWNE has issued a carefully revised edition of the Library Catalogue of the Institute of Mechanical Engineers, combining both a list of authors and of subjects. It also contains a Subject-Index of papers in the *Proceedings*, 1847-80.

MR. C. W. HARDING, of King's Lynn, received prizes for two papers at the Recent Norwich Fisheries Exhibition:—1. "Essay on the Artificial Propagation of Anadromous Fish other than the Salmon, and the Re-stocking of the Tidal Waters of our Large Rivers Artificially with Smelts," &c.; 2. "On the Utilisation of Localities in Norfolk and Suffolk suitable for the Cultivation of Mussels and other Shell Fish."

ON Monday night shocks of earthquake were felt at the Observatory on Mount Vesuvius and at the villages at the foot of the mountain, especially at Torre del Greco. At nine o'clock on Tuesday morning the seismographic activity was decreasing.

THE Swiss Federal Commission for Meteorology has been definitively constituted for three years as follows:—M. Schenk, president; Professors R. Wolf (Zürich), Hagenbach (Basel), Plantamour (Geneva), Ch. Dufour (Morges), Forster (Berne), and Weber (Zürich), and M. Coaz Inspector of Forests at Berne. The Commission met at Berne on May 23, and discussed the institution of a Central Board at Zürich. Want of means has prevented it from opening the important meteorological station on the summit of Mount Sentis.

M. DE LESSEPS has been urging upon the Khedive of Egypt the re-establishment of the Cairo Observatory, originally founded by Mehemet Ali; its fine instruments have been long ago dispersed among various establishments. The atmosphere of Egypt is peculiarly favourable for observatory work, and we hope the Khedive will take M. de Lesseps' advice.

A MARINE Exhibition will be held at Hamburg in September next, of which nautical and astronomical instruments will form the principal part.

A CORRESPONDENT (A. H. McC.) of the New York *Weekly Evening Post*, writes on the question of the Sound of the Aurora:—In your edition of Saturday I noticed an abstract from "Record of a Girlhood," in regard to hearing the aurora borealis, and therefore beg to give you my experience on the subject. In the winter of 1846 I crossed the Atlantic from Newfoundland to Greenock in the brig *Amanda*. We had strong southerly winds the whole passage, without seeing the sun until after making land; three days previously a strong southerly gale carried away our only top-sail, leaving us without sufficient after sail, and consequently we were driven far to the northward. The day before we made land the wind suddenly changed to the north-west, and as night approached the sky became clear. At about 9 o'clock p.m. the captain called all passengers on deck, and a more magnificent spectacle was never contemplated—the whole heaven was a blaze of white light, the aurora darted and rushed from every point and reflected each colour of the rainbow. While it lasted we could distinctly hear the sound, as if the folds of heavy silk were shaken, sometimes sharp and quick, and then receding until the sound was lost, according to the intensity of the flash. During most of the time a book could easily be read on deck. The phenomenon lasted about four hours, during which time we all remained on deck. Next morning we made land, which proved to be Barra Head, Southern Hebrides, and were able to lay our course.

ON May 2 the German Fisheries Society held its annual meeting at Berlin, his Imperial Highness the Crown Prince being present. Herr Friedel, the director of the Märkische Museum, delivered a festive address on "Pre-scientific Fishing." Afterwards the president of the Society, Herr von Behr-Schmoldow, read the report for the year, which was highly favourable. Some 6,000,000 ova have been "sown out" in German waters. Excellent results were obtained with 300,000 American salmon ova and a similar number of shad ova. The intercourse with the fisheries societies in Austria, France, and the United States was very successful and remunerative.

AT the annual general meeting of the Sanitary Institute of Great Britain on May 25, Dr. Richardson, F.R.S., who for four years past has acted as Chairman of Council, and who now goes out of office by rotation, after expressing his thanks to his colleagues for all the courtesies they had shown him, said he could not, he thought, conclude his work as chairman more usefully than by giving a short account of some recently conducted researches which he had made as to the periods of incubation of the infectious diseases which the sanitarian has to combat. He proceeded to indicate that there are twenty-six well-known diseases of this kind, and they each have their special periods of incubation, which, though open to exceptions, are fairly regular. The period of incubation was that period which intervened between the acceptation of the poison that caused the disease and the first manifestation of effect. Diseases might thus be grouped according to their stages of incubation into five classes—*Shortest*, *Short*, *Medium*, *Long*, *Longest*. The shortest period was one to four days: under this head came plague, cholera, malignant pustule, and dissection poison. The second period was from two to six days, and under this head came scarlet fever, diphtheria, croup, erysipelas, hooping-cough, influenza, glanders, and pyæmia. The medium period was from four to eight days, and in it are included cow-pox and relapsing fever. The long period had ten to fifteen days, and included in it measles, mumps, typhus, and typhoid. The longest period, forty days, included syphilis, and might include hydrophobia. Dr. Richardson concluded his address by showing the important practical sanitary lessons that were connected with a correct knowledge of these periods of incubation.

THE Technological, Industrial, and Sanitary Museum of New South Wales is, we learn, intended to occupy a similar position and fulfil the same purpose in that colony which the South Kensington Museum, the Bethnal Green Museum, the Museum of Practical Geology, the Patent Office Museum, and the Parkes Museum of Hygiene do in London. To this end, it is intended

to collect together typical collections of all materials of economic value belonging to the animal, vegetable, and mineral kingdoms, from the raw material through the various stages of manufacture, to the final product or finished article ready for use. It is intended that the following shall be more or less completely represented:—Animal products; vegetable products; waste products; foods; economic entomology; economic geological specimens; educational apparatus and appliances; sanitary and hygienic appliances and systems; mining, engineering, and machinery; agricultural tools, appliances, and machinery; also soils, manures, &c.; models, drawings, and descriptions of patents; ethnological specimens; examples of historical furniture and of artistic workmanship in iron and other metals; photographs, electrotype, plaster, and other reproductions of examples of art workmanship where originals are not to be obtained. Exhibition catalogues, trade journals, price lists, and descriptions of new processes or industries. The acting secretary is Mr. Charles R. Buckland.

We have received the abstract of *Transactions* of the Anthropological Society of Washington for the first two years of its existence, ending January, 1881. It contains brief notices of the meetings of the Society, the papers read, as might be expected, relating mostly to American Indians. A paper by Col. Mallory, "On the Comparative Mythology of the Two Indias (Asia and America)" shows that many resemblances exist between them, arising solely, however, from the efforts of two quite distinct primitive peoples to interpret the same natural phenomena. Prof. Gill deals with the Zoological Relations of Man. The principal papers, however, are the annual addresses of the president, Mr. J. W. Powell, on the Evolution of Language, as Exhibited in the Specialisation of the Grammatic Processes, the Differentiation of the Parts of Speech, and the Integration of the Sentence, from a Study of Indian Languages; and on Limitations to the Use of Anthropological Data. Mr. Powell has also a long paper on "Wyandot Government—a Short Study of Tribal Society."

We have received a long letter from Mr. Gerald Massey on our review of his "Book of the Beginnings," which we regret we are unable to print. We should state, however, that the word *bottle*, p. 49, col. 1, line 17 from bottom, was a misprint for *beetle;* and the following extract from Mr. Massey's work (vol. i. p. 145) will show the sense in which he quoted Prof. Max Müller:—"If the first man were called in Sanskrit Adima, and in Hebrew Adam, and if the two were really the same word, then Hebrew and Sanskrit could not be members of two different families of speech, or we should be driven to admit that Adam was borrowed by the Jews from the Hindus, for it is in Sanskrit only that Adima means the first, whereas in Hebrew it has no such meaning."—(Quoted from Max Müller's "Science of Religion," p. 302).

The additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius* ♀) from South Africa, presented by Mrs. Findlay; a Common Marmoset (*Hapale jacchus*), a Black-eared Marmoset (*Hapale penicillata*) from South-East Brazil, presented by Mr. C. Stewart; a Two-spotted Paradoxure (*Nandinia binotata* ♀) from West Africa, presented by Mr. W. H. Hart; a Bennett's Gazelle (*Gazella bennetti*) from Afghanistan, presented by Brigadier-General Tanner; a Globose Curassow (*Crax globicera*) from Central America, presented by Mr. Allan Lambert; a Slow-worm (*Anguis fragilis*), British, presented by Mr. G. Mengee; three Peacock Pheasants (*Polyplectron chinquis* ♂ ♂ ♀) from British Burmah, six Nuthatches (*Sitta cæsia*), British, deposited; two Ring-necked Pheasants (*Phasianus torquatus* ♂ ♀) from China, two Swinhoe's Pheasants (*Euplocamus swinhoii* ♂ ♀) from Formosa, four Chilian Pintails (*Dafila spinicauda*) from Antarctic America, an Antarctic Skua (*Stercorarius antarcticus*) from the Antarctic Seas, a Dominican Gull (*Larus dominicanus*) from the Falkland Islands, a White-marked Duck (*Anas specularis*) from the Straits of Magellan, an African Wild Ass (*Equus tæniopus* ♂) from Abyssinia, purchased; a Cashmere Shawl Goat (*Capra hircus*), a Mouflon (*Ovis musimon* ♀), born in the Gardens; three Variegated Sheldrakes (*Tadorna variegata*) bred in the Gardens.

OUR ASTRONOMICAL COLUMN

A New Variable Star.—Prof. Julius Schmidt publishes an account of his observation of a star of from 8m. to 9m. in Canis Minor on April 1, which had not been remarked as late as March 28, and of which not a trace was visible on the following night. On November 25, 1879, Mr. Baxendell discovered a star in Canis Minor of about 8·8m., and of a decided orange colour, where the *Durchmusterung* showed no star, which gradually diminished, until on January 11, 1880, it was estimated 9·6. Prof. Schmidt gives the position of this star from observations at Athens and at Dunecht, with the places of two of Bessel's stars as follows for 1880·0:—

	R.A. h. m. s.	Decl. ° ′ ″	
W.B., 7h. 1014 ...	7 34 18·04 ...	+ 8 40 20·9 ...	(*b*)
Baxendell's star ...	7 34 49·98 ...	+ 8 39 30·1 ...	(*x*)
W.B., 7h. 1029 ...	7 34 54·17 ...	+ 8 42 29·4 ...	(*a*)

Examining this neighbourhood with a 5½-feet refractor on the evening of April 1, he remarked a star (*c*) of between the eighth and ninth magnitude, and by "eine Ordinaten-construction" from a diagram then made, he judged its position for 1880·0 to be in R.A. 7h. 34m. 56·4s., Decl. + 8° 41′·4. If these places are reduced to the epoch of the *Durchmusterung* (1855·0) they will stand as follows:—

	m.	R.A. h. m. s.	Decl. ° ′	
b ...	9 ...	7 32 56·6 ...	+8 43·7	
x ...	9 ...	7 33 28·5 ...	+8 42·8	
a ...	8·3 ...	7 33 32·8 ...	+8 45·8	
c ...	9 ...	7 33 35·0 ...	+8 44·4	without a greater error than 0′·7.

On April 2, at 8h., with the same refractor, not the slightest trace of *c* could be discovered, and on taking the precaution to examine the stars within a space of two minutes (time) preceding and following the place by the previous night's observation, no similar object was found: a star 10m., wanting in Argelander, showed no motion in two hours. On April 3 and 4 Prof. Schmidt was similarly unsuccessful. Baxendell's star had been compared with Bessel's two stars with the Cometen-Sucher on eighty-six evenings between 1879, December 6, and 1881, March 28 (an instance, by the way, of the scrutinising system of observation which the indefatigable astronomer of Athens is accustomed to apply in his variable-star work): on no occasion was any object noted in the place of the star *c*.

Prof. Schmidt has remarks upon this observation to the following effect: if the object had been a distant planet it would have been found on April 2, 3, and 4 close to its place on April 1. If it had belonged to the group of minor planets it would have been readily identified on one of the evenings the vicinity was examined, by means of the *Durchmusterung*, without knowledge as to the direction of motion. If it were a variable star there was a variation of light from 8·5m. to absolute invisibility in twenty-four hours, which has never been remarked in any other variable; and lastly, if it were a *Nova*, of the class to which the well-known stars of 1848, 1860, 1866, and 1876 have been assigned, its illumination is limited to the interval between the evenings of March 28 and April 1, and therefore could have extended only to four days.

Referring the places of the objects observed by Baxendell and Schmidt to the star of 8·3m., No. 1029 of Weisse's Bessel, we find—

	Angle of position. °	Distance. ″
For Baxendell's star	207·8	135
For Schmidt's star	153·2	73

Fellöcker's careful work for the Berlin Chart, Hour VII., does not render any assistance in this case. One of our many amateurs might advantageously take up the systematic and frequent obser-

vation of the neighbours of W.B. 7h. 1029. It may be ultimately found that Schmidt's star affords an extreme illustration of the laws affecting variables of the class of U Geminorum.

Can Mr. Baxendell put anything upon record as to dates when he has examined the vicinity, which may bear upon the length of invisibility of Schmidt's star?

THE COMETS OF 1810 AND 1863 (V).—At the suggestion of Prof. Bruhns new elements of the Comet of 1810 have been investigated by Herr Thraen from the ten observations made at Marseilles by Pons, who discovered the comet on August 22. We had previously orbits by Bessel and Triesnecker. The observations are unfortunately affected with considerable errors, but the following appears to be the best system of elements obtainable from them:—

Perihelion passage, 1810, October 6·23793, M.T. at Greenwich.

Longitude of perihelion	63° 46′ 43″	M. Eq.
,, Ascending node ...	308 50 31	1810·0
Inclination	62 55 39	
Log. perihelion distance	9·986603	

Motion—direct.

We subjoin Prof. Weiss's parabolic elements of the Comet 1863 (V), discovered by Respighi at Bologna on December 28; notwithstanding their striking resemblance to those of the comet of 1810, Prof. Weiss was inclined to consider the comets different: he tried an ellipse with period of fifty-three years, but the comparison of the observations in January, 1864, was not so satisfactory as with the parabola. Michez, by direct calculation upon a month's observations, obtained a period of 109 years.

Perihelion passage, 1863, Dec. 27·76369, M.T. at Greenwich.

Longitude of perihelion	60° 24′ 28″	M. Eq.
,, Ascending node ...	304 43 26	1864·0
Inclination	64 28 46	
Log. perihelion distance	9·887344	

Motion—direct.

There is perhaps room for a further and more minute discussion of the observations of 1863-64, though the result may be adverse to the idea at one time entertained that the comets are identical. There was a near approach to the Earth at the end of January, 1864 (0·18), and the perturbations from this cause will require to be taken into account in a more refined determination of the orbit. The comet was observed at Kremsmünster till February 14; Prof. Julius Schmidt sought for it ineffectually at Athens on March 4.

Probably we have, in the case of these comets, an illustration that mere similarity of orbits, even though it may be pretty close, is not to be regarded as proof of identity.

CHEMICAL NOTES

HERR DRECHSEL claims (*Journal Pract. Chem.*) to have converted ammonium carbonate into urea by the continued action of a galvanic current, the direction of which is rapidly reversed by a self-acting commutator.

A MODIFICATION in the process for manufacturing iodine from seaweed is described by MM. Pellieux and Allary (*Bull. Soc. Chim.*), whereby, it is said, nine times more iodine is obtained than by the older process. The unburnt seaweeds are allowed to ferment in large heaps; the liquor which drains off is concentrated and dialysed in Dubrunfaut's apparatus before evaporation. The plants are burnt without further drying.

SEVERAL of the tinned preparations of the St. Louis Canning Company have been examined by Mr. Wigner (*Analyst*). The dietetic value of the corned beef is about twice that of boneless fresh beef; the cooked ox-tongues contain less salt and more nutritive matter than ordinary dried tongues. *Succotash*, an American preparation of haricot beans, Lima beans, and maize, cooked in the tin, with addition of a little fat, is recommended as a good specimen of boiled vegetable food.

THE number 197·2 is generally accepted as the atomic weight of platinum; Herr Seubert has very recently shown, in the *Berichte* of the German Chemical Society, that this number is very probably too high. As the mean of thirty-nine closely-agreeing results, Herr Seubert obtains the number 194·46. If this number is accepted the atomic weight of platinum is less than that of gold.

HERR TH. WILM has studied (*Berliner Berichte*) the action of finely-divided palladium, platinum, and rhodium, when heated in a stream of coal-gas. He finds that these metals decompose the gas, that when palladium is used a deposit of carbon takes place at some distance from the heated metals; that with platinum the carbon is deposited on the metal, but that on heating in a stream of air the carbon is burnt completely away, and the metal remains in its original form; with rhodium, however, the carbon appears to form a compound, the volume of which is considerably greater than that of the metal itself; this compound is decomposed only with difficulty, leaving metallic rhodium in a much more bulky form than that which it possessed before the experiment.

MICHAELIS AND SCHULTE describe, in *Berliner Berichte*, a new derivative of benzene, analogous with azobenzene, but containing arsenic in place of nitrogen. *Arsenobenzene*, $C_6H_5—As=As—C_6H_5$, produced by the action of reducing agents on C_6H_5AsO, forms slightly yellow coloured needles which are insoluble in alcohol and ether, and crystallise well from hot xylene. The new compound, unlike azobenzene, readily takes up two atoms of chlorine, forming—

$$C_6H_5—\underset{\displaystyle Cl}{\underset{|}{As}}—\underset{\displaystyle Cl}{\underset{|}{As}}—C_6H_5.$$

DR. A. R. LEEDS describes, in the same journal, the action of nascent oxygen, ozone, and hydrogen peroxide on benzene. Nascent oxygen was produced by the action of moist phosphorus on air in presence of benzene; if the action proceeds in sunlight a large quantity of phenol is produced, together with oxalic acid; but if in diffused daylight no phenol is formed. Phenol was also produced by the direct action of hydrogen peroxide on benzene, but when ozone acted on the same hydrocarbon, carbon dioxide, acetic, formic, and oxalic acids were produced, but no phenol was formed.

IN a preliminary note in the *Berliner Berichte*, Herr Donath states that the ordinary method of volumetric determination of oxidisable substances by titration with potassium permanganate in presence of acid may, in many cases, be advantageously replaced by an inverse process in which a neutral solution of the substance to be oxidised is added to a strongly alkaline solution of permanganate, whereby oxidation occurs with precipitation of manganese dioxide:—thus with manganese salts and with chromic salts the following actions occur:—

$$(1)\ 3MnO + Mn_2O_7 = 5MnO_2.$$
$$(2)\ Cr_2O_3 + Mn_2O_7 = 2CrO_3 + 2MnO_2.$$

A METHOD for determining molybdenum in molybdates is described by Danesi (in *Atti della Accademia*), based upon the fact that hydriodic acid is decomposed by molybdenum trioxide with separation of iodine. A weighed quantity of the molybdate under analysis is mixed with hydrochloric acid and a solution of potassium iodide; the amount of iodine liberated in the reaction is determined by titration with sodium thiosulphate solution. The results are very accurate.

IN the same journal a method for determining nitrites and nitrates in the same solution is described by Piccini: the method is based on the decomposition of ferrous chloride by nitrous and nitric acids with evolution of nitric oxide, and on the greater readiness with which this decomposition is accomplished by nitrous than by nitric acid.

HERR M. GRÖGER has prepared (*Wien. Akad. Ber.*) several sulphochromites, *i.e.* salts of a chromous acid in which oxygen is replaced by sulphur; the following salts are mentioned among others:—

$Na_2Cr_2S_4$	$CdCr_2S_4$
$Ag_2Cr_2S_4$	$SnCr_2S_4$.

THERE are about 300 known optically active carbon compounds. The specific rotatory power of but seven of these has been accurately determined for the pure substance, and for solutions of the substance in various solvents in all possible degrees of dilution; these seven are tartaric acid and ethyl tartrate, cane-sugar, dextrose, terpene from turpentine oil, nicotine, and camphor. The nature and quantity of the solvent employed exerts a marked influence on the rotatory power of the active compound; as a contribution to this subject the measurements made by Herr A. Becker (Deut. Chem. Ges. *Berichte*) of the rotatory power of asparagine and aspartic acid deserve mention. An aqueous solution of either compound exhibits left-handed rotatory powers;

addition of hydrochloric or sulphuric acid diminishes the lævo-rotatory action, and eventually converts it into a marked dextro-rotatory one; addition of acetic acid has a similar, but much less marked effect; with asparagine a point is reached at which the solution, in acetic acid, is optically inactive.

ATTENTION was recently drawn in these "Notes" to an attempt made by Th. Thomsen to show that the numbers expressing the specific rotatory powers of various carbon compounds might be expressed as whole multiples of certain fundamental constants; each of these constants was supposed to be characteristic of a group of allied compounds. Thomsen's methods of calculation have been severely criticised by Landolt (in the *Berichte*), who has shown that from the limited accurate data at our disposal such an attempt as that of Thomsen can only be regarded as a play on numbers, and is devoid of all scientific value.

EXPERIMENTS are described in the May number of the *Journal* of the Chemical Society by Jones and Taylor, which appear to leave little doubt that these chemists have succeeded in preparing a gaseous hydride of boron, and that the probable formula of this compound is BH_3. The new compound—the existence of which establishes another point of analogy between boron and the nitrogen elements—is prepared by decomposing magnesium boride by a dilute acid; the gas has only been obtained largely mixed with hydrogen; it burns with a green flame, and is decomposed by heat with deposition of boron.

IN the course of a paper on the appearance of nitrous acid during the evaporation of water (Chem. Soc. *Journal*), by Warrington, experiments on the detection of this acid, by the use of hydrochloric acid and naphthylamine hydrochloride, are described, which show that one part of nitrous acid is easily detected in 10,000,000 parts of water, and that as small a quantity as one part in 1,000,000,000 can be detected.

IN the *Zeitschrift für anal. Chem.* Herr Seelheim describes experiments on the percolation of waters through soils, from which he draws the following general conclusions:—Only that stratum of any soil which is composed of the smallest particles need be considered in determining the permeability by water of the soil of a district. The composition of a soil must be ascertained, otherwise experiments on a large scale furnish no measure of the permeability of that soil. The thickest stratum of sand allows the passage of many hundred times more water than a layer of clay only one centimetre thick. The permeability of dykes may be regulated by inserting layers of clay between layers of sand.

SMALL quantities of carbon monoxide may be detected, *e.g.* in the air of rooms, by drawing the suspected gas over powdered glass moistened with diluted blood, shaking the blood with a drop of ammonium sulphide and examining by the spectroscope. Strips of paper soaked in a solution of 0·2 gram. palladium chloride in 100 c.c. water serve to detect carbon monoxide: the dried slips are suspended by platinum wires in a large flask with a very little water, and the flask is corked; with five parts of carbon monoxide in the atmosphere of the flask, a black shining deposit of metallic palladium appears on the paper in a few minutes; with one part, in two to four hours; and with 0·5 part, in from twelve to twenty-four hours.

A USEFUL historical account of the investigations made on the subject of dephosphorising pig-iron, appears in *Dingler's polytechnisches Journal*, and in abstract in the May number of the *Journal* of the Chemical Society.

THE rate of chemical reactions having been lately the subject of several investigations and discussions, M. Kayander publishes in the Russian *Journal* of the Chemical and Physical Society (vol. xiii. fascicule 4), the results of his last measurements. Without seeking to establish theories as to a connection between chemical affinity and the rate of reactions, M. Kayander simply tries to make measurements in a branch of chemistry insufficiently worked until now. To simplify the results he has employed a solid body and a liquid one, and has measured the rate of dissolution of magnesium in various acids; the magnesium was taken in the shape of small plates, having a surface of about 2000 square millimetres; the acids, in solutions of 0·01 of the atomic weight (in grammes) in a litre of water. Experiments as to the influence of various degrees of concentration will be published in a second paper. As to the influence of time, he arrives at the conclusion that the reaction begins at the very moment of the immersion of the magnesium in the acid; acids when mixed produce the same action as if taken separately. As to temperature, its influence is precisely that which it exercises on the diminution of the internal friction of the particles of the liquid against one another, and does not seem to influence the chemical properties of the reacting bodies; the figures M. Kayander has arrived at from a long series of measurements establish that the speed of the reaction is inversely proportional to the internal friction of the medium. The researches will be continued.

PHYSICAL NOTES

ON heating a plate of boracite lately Herr Klein (*Gött. Soc. of Sci.*) was surprised to observe a complete change of the optical image. The boundary lines of the optical fields prove variable with temperature, and often wholly disappear, perhaps reappearing in quite different places. Herr Klein concludes from these and previous observations that boracite does not owe its origin to a twin-like formation of parts of lower symmetry, but is regular, and produces simple individuals; and the optical properties, apparently in sharp contradiction to this, are really due to tensions produced in growth. These divide the crystal into parts of different tension, of which the sometimes stronger suppress the weaker, for certain temperatures and positions of the crystal. (Similar properties in crystals of analcime have been described by Herr Ben Saude to the Göttingen Society.)

AN ingenious, somewhat complex, apparatus, named an *automatic methanometer*, or automatic analyser of fire damp, has been recently brought before the Geneva Physical Society by Prof. Monnier (*Arch. des Sci.*, April 15). The fire-damp, in presence of air in excess, is decomposed in a glass vessel by a platinum wire rendered incandescent, and the condensation produced acts directly on a mercury manometer, having platinum wires inserted in its tube. The air of the mine is automatically forced by bellows, every hour and half hour, into the burner. The receiving apparatus stands in the central office. The system includes several electro-magnets, two batteries, pendulums with escapement, an alarm-bell, &c.

THE influence of pressure on the electric conductivity of metal wires has been studied anew by M. Chwolson (Imp. Acad. of St. Petersburg *Bull.*, March); Wartmann's previous experiments, in which wires were compressed between steel plates with caoutchouc lining, having failed to show whether pressure changes the *specific* resistance. M. Chwolson used a piezometer, giving pressures up to 60 atmospheres, the wire being wound round a glass tube, then passed through it, and the tube inserted in another, which was connected with the piezometer. (The two wire ends were brought out through binding screws.) Among other results, at 3·8 C. the copper wire showed a relative diminution of resistance of about 0·0000013 by one atmosphere of pressure; a hard brass wire about 0·0000011; and a lead wire (at 7° C.) about 0·000011, or ten times more than the brass. Pressing at 17° C. the calorific action preponderates over the direct action of pressure for copper and brass, while the reverse occurs with lead. Moreover, the author proves, in the case of the brass wire, that the pressure causes change of the specific resistance besides change of the resistance through change of the length and thickness. Every relative change of volume involves a relative change of the specific resistance about 3·6 times as great.

M. MASCART showed recently how the phenomenon of Talbot's fringes could be applied to measuring the refractive indices of gases and the difference between the refractive index of a solid and that of a liquid. M. Hurion has further thus measured the difference of the refractive indices of liquids, and in the *Journal de Physique* for April he shows how the refractive index of a liquid may with those fringes be directly determined. The two interferent rays are rendered vertical, so as each to traverse one of the halves of a partitioned rectangular vessel with glass bottom. The liquid being first at the same level in both divisions, its level in one is gradually lowered by a special contrivance, and this has the effect of displacing the fringes in the field of the telescope. Let e be the variation of level, f the number of fringes that have passed a point in the field corresponding to light of wave-length λ, then $e(m-1) = f\lambda$. The letter m represents the refractive index of the liquid for light of wave-length λ. (For further details we refer to M. Hurion's note.)

PROF. TROWBRIDGE lately observed that a steel bar magnetised to saturation at 20° C. and subjected to a temperature of −60° C. lost 66 per cent. of its magnetism (a much greater percentage than that formerly observed by Wiedemann).

PROF. ROBINSON of Ohio concludes from experiments (*Jour. Frankl. Inst.*, March) that vibrations in extended media from a remote single centre of disturbance, can only be longitudinal, even in light; that vibrations will be to some extent transversal when due to two or more centres of disturbance not in the same line; and that undulations, to be in a condition called polarised, must consist of vibrations which are transversal, and that no necessity exists for assuming vibrations transversal in front of a polariser. These views are not only contrary to the accepted wave-theory of light, and to the conclusions derived from Maxwell's electromagnetic theory, but appear to be directly negatived by the experiments of Stokes and Figeau.

IN his third paper on electrical shadows (*Gott. Soc. Nachr.*, February 5) Herr Holtz studies, *inter alia*, the differences in form of the light surface and shadows from the two electricities; the effects of using differently-conducting surfaces under the silk, and of using convex and concave spherical or cylindrical surfaces; the double shadows from two surfaces used as electrodes; the use of a silk screen between pointed electrodes, &c.

A NEW seismometer is described by Dr. G. Wagener of Kioto, Japan, for which he claims several advantages over the ordinary heavy-pendulum seismometers. It consists of a strong rigid frame in the form of a short quadrangular pyramid, from which is suspended an iron ball weighing about fifty pounds by means of a bundle of untwisted silk fibres three feet long. Below this ball is an indicating pendulum consisting of a hollow sphere pivoted near its centre of suspension upon a small polished ball, also rigidly fixed to the frame, and carrying beneath it a light arm, whereby its motions are multiplied twenty-four times. A small sphere fixed to the bottom of the iron ball plays into a cavity in the summit of the indicating pendulum. The latter has, by reason of its construction, a *very* short period of oscillation as compared with that of the iron ball. Hence when an earthquake occurs the inertia of the heavy ball will keep it for a considerable time in its position, while the pointer of the indicating pendulum moves toward the region whence the disturbance came, and can return almost instantly if the horizontal displacement be succeeded by a displacement in the opposite direction. That the movement of the pendulum may be registered accurately in point of time, a small silk thread attached to the bottom of the indicating pendulum passes through a small eye-hole in a porcelain plate immediately beneath, and thence passes round a light indicating wheel which is also in connection with a lever which at the slightest movement drops, and stops a clock. A kindred apparatus is employed to register the direction of the shock, eight threads from the indicating pendulum of a similar instrument being wound round eight indicating wheels for the eight chief points of the compass. For these instruments it is claimed that there is less error from oscillations than in the usual instruments, the inertia of the indicating pendulum checking the tendency of the weight to swing. A further registering apparatus, consisting of a chronograph drum actuated by a clock which is started by the first shock, is also described. It does not appear that the registering apparatus of Dr. Wagener is in any way an improvement upon the electrical apparatus hitherto employed. Lastly, Dr. Wagener describes an instrument for measuring any possible vertical displacements, a heavy body of considerable inertia being counterpoised while immersed in a tub of water, its movements being magnified by a lever and registered by a thread-wheel arrangement.

M. GAIFFE gives us reason to suppose that part of the disturbance in telephone lines, usually set down to "induction," is due to the conducting-wires being of a magnetisable metal iron, which, when moved in the magnetic field of the earth, experience induction-currents. M. Gaiffe introduced into a telephone-circuit two pieces of steel wire, one magnetised, the other not. On hitting them so as to make them vibrate sharply, sounds were produced in the telephone more strongly by the magnetised strip. The remedy is obviously to employ conducting-wires of some non-magnetic substance, such as copper or manganese bronze.

ACCORDING to P. Tacchini, there are in the sun two regions of spots and faculæ at about equal distance (20° and 22°) from the equator, and about the same longitude, which showed continual activity last year. The fact he considers important for theories as to the sun's physical constitution.

THE last number of the *Journal* of the Chemical and Physical Society of St. Petersburg (vol. xiii., fascicule 4) contains two letters by Prof. A. M. Boutleroff on ice under critical pressure. The former of them was written on February 13, when Prof. Boutleroff had not yet received the number of NATURE which contains a detailed description of Prof. Carnelley's experiments; the second on March 17. The experiments which he has made, and which he describes in this second letter, were made, Prof Boutleroff says, on the same conditions as those of Prof. Carnelley, but the temperature of ice remained at −6°; a rise of temperature was observed only when a part of the bulb of the thermometer was free from ice, but even in this case it was very slow. "The refrigerating influence of ice was quite manifest, but it was not at any time possible to discover anything showing a rise of temperature." Prof. Boutleroff supposes that Prof. Carnelley has raised the temperature of his thermometer without raising that of ice. "It is true," he says, "that the calorimetric experiment of Prof. Carnelley seems to speak in favour of a heating of the ice itself; but can we not suppose that a kind of covering of hot vapour which was around the ice, remaining on its surface, was transported into the water of the calorimeter, and there neutralised the refrigerating power of the ice?" Prof. Boutleroff proposes also, for the same experiments, to make use of a cryophorus which might be easily appropriated for that use, and which he describes in that case as a cryoscope. When repeating Prof. Carnelley's experiments with a cryoscope, Prof. Boutleroff happened to raise the temperature of the thermometer to +40°, whilst the bulb of the thermometer was *nearly* completely covered with ice; but he failed to raise the temperature when he covered the surface of the bulb with a small sheet of platina. He concludes that the bulb of the thermometer in those cases, when it shows a temperature above zero, enters into contact with ice only at some few spots; and the rise of the thermometer might be explained, not only by the thermal translucency of the ice, but also by the circumstance that the vapour disengaged by the melting ice is heated, and reaches the bulb of the thermometer by the small channels formed in the ice; he therefore concludes that Prof. Carnelley's condition as to the ice being in a special state not quite reliable.

GEOGRAPHICAL NOTES

DR. WILD, president of the International Polar Commission, has issued a circular stating that six countries have already intimated their intention to co-operate in carrying out the scheme of simultaneous meteorological, magnetical, and other physical observations in the Arctic regions. These countries, with the proposed stations, are Denmark at Upernivik, Norway in Finmark, Austria-Hungary in Jan Mayen, or perhaps East Greenland, Russia in Novaya Zemlya and at the mouth of the Lena, Sweden in Spitzbergen, and the United States at Point Barrow and in Lady Franklin Bay. Should other countries send in their adhesion to the scheme, this disposition of the stations may be somewhat modified. We are glad to see there is a probability that Germany may establish a station in the Island of South Georgia, and France a station at Cape Horn. An interesting feature in the scheme is that two of the eight proposed Arctic stations are to be equipped at the expense of private individuals, viz., the station in Jan Mayen or in East Greenland at the expense of Count H. von Wilczek of Vienna, and the station in Spitzbergen, as our readers are already aware, by M. L. O. Smith of Stockholm. Is it possible that no public-spirited Englishman will be found to provide the means for England co-operating in this truly international scheme of physical observations in the Polar regions, which play such an important *rôle* in the meteorology of the globe?

AS much has been heard of late respecting the magnificent harbour which the French are likely to make of Lake Bizerta in Tunis, it may be well to correct a misapprehension which has long existed as to its depth. Even in the most recent gazetteers this is said to be fifty fathoms, whereas in a brief but excellent paper which he sent to the Geographical Society many years ago, Admiral Spratt, speaking from his own soundings on the spot, explicitly states that the greatest depth of water in the lake is *eight* fathoms, with an average of from five to six fathoms. This would no doubt be sufficient for all practical purposes, but at the

same time it is vastly different from the great depth given to the lake by old travellers, whose mistake has been perpetuated.

In his anniversary address to the Geographical Society last week Lord Aberdare paid a just tribute to the services rendered to geography in the region west of Lake Nyassa by Mr. F. C. Selous, who has hitherto been best known as a mighty hunter of large game. This gentleman, we learn, in 1878 penetrated for 150 miles the unknown country north of the Zambesi, in the direction of Lake Bangweolo. He has since crossed in various directions the Matabele country south of the Zambesi, discovering two new rivers and defining the courses of others which had previously been laid down from vague information. His notes on the River Chobe have already been published by the Geographical Society. We understand that the fine trophies of the chase which Mr. Selous brought back from South Central Africa have been placed in the hands of Messrs. Rowland Ward and Co. for preparation.

From the report of the progress of the Ordnance Survey which has just been issued, accompanied by useful diagrams, we learn that it is expected that the whole survey will be completed by 1890, as the staff is to be augmented in consequence of increased funds being placed at the disposal of the Director-General.

The programme of the first German "Geographentag" at Berlin, on June 7 and 8, contains the following addresses:—Prof. Zöppritz (Königsberg), on the condition of the earth's interior; Prof. Neumayer (Hamburg), on the importance of magnetic researches from a geographical point of view; Prof. Rein (Marburg), on the Bermuda Islands and their coral reefs; Prof. Bastian (Berlin), on the problems of ethnology; Prof. Kirchhoff (Halle), on the methods of teaching geography in schools. Professors Wagner, Meitzen, and Ascherson will speak on similar subjects.

Dr. Crevaux has completed his third South American journey. He descended the Guayabero River (a tributary of the Orinocco) on rafts, and made an exact survey of this river. The survey comprises 1275 miles, of which 375 are a complete desert. By the assistance of natives Dr. Crevaux and his companions reached Ciudad-Bolivar, whence they embarked for Trinidad on board a steamer. Shortly before the end of the journey one of the travellers, a sailor of the name of Burban, was killed by a sting-ray (*Trygon pastinaca*). Later on Dr. Crevaux visited the villages of natives in the Orinocco delta, collecting interesting anthropological data.

The Central Union for Commercial Geography at Berlin intends to erect a Commercial Geographical Museum in that city. The preliminaries are so far completed that a hall for exhibiting the objects has been hired, a provisional committee formed, and the bye-laws printed. The Union is rapidly extending its branches all over Germany. Among the latest foundations are those at Cassel, Marburg, Hanau, Frankfurt, and Wiesbaden, *i.e.* no less than five in the province of Hessen-Nassau.

At the May meeting of the Berlin Geographical Society the latest news of the German explorers in Africa were communicated to the members. A letter from Dr. Rohlfs was dated from Gondar. The traveller knew nothing of the death of the King of Abyssinia. The disposition of the king for the further journey of Dr. Stecker was very favourable, and the latter was to leave at once for Shoa-land with a guide. Dr. Pogge and Lieut. Wissmann had arrived at Malange on January 25. Here they intended to stay a while before leaving for the interior. Dr. Buchner arrived at Malange on March 8 on his return journey, and met Major von Mecho. Buchner's misfortune of being obliged to turn back after three unsuccessful attempts to penetrate further is already known to our readers. From Madagascar a letter was received from Dr. Hildebrandt. He left Tananarivo on February 17, and travelled southwards with great hopes of a speedy success.

A letter from Dr. Junker to the Austrian Consul at Chartum dispels all the rumours afloat regarding his supposed assassination. He only returned to his station in December last from the journey he had taken. He first crossed the Welle River and travelled in a westerly direction to the Mangbattu tribe. Then he proceeded to some Government stations in Eastern Mangbattu land, getting a little beyond Munsa's former residence, in the vicinity of which is Miam's tomb (not in the Niam Niam land, as indicated by the Italian map). The traveller crossed the Gadde and Bibali rivers at their confluence, and then returned to his station.

The new number of *Le Globe* opens with a continuation of M. de Morsier's papers on the plains and deserts of the two continents, and also contains a sketch of the geographical work of last year by M. Bouthillier de Beaumont, as well as notices of the Arctic campaign of 1880 and the *Jeannette* expedition.

Some long letters have recently been received from Père Livinhac, the head of the Algerian Missionary Expedition in Uganda. In referring to the organisation of the country he says that under the *Kabaka*, or absolute monarch, are the chiefs of the great families, called *Mohamis*, of whom three specimens came to England last year with Messrs. Wilson and Felkin. After these come chiefs of inferior rank, who own allegiance to the *Kabaka* through the *Mohamis*. Last of all is the class of slaves or *Wadu*. Mtesa, Père Livinhac says, is regarded by his subjects as a species of divinity, and they attach a supernatural virtue to objects which he has touched. He however appears to be very much under the influence of a clique of *Mohamis*, who threaten to dethrone him if he encourages foreigners.

The Queensland Government have lately issued a large scale map of part of the Colony, on which is laid down the proposed route of the transcontinental railway to Point Parker, on the Gulf of Carpentaria. This, we observe, crosses the lower course of the Gregory, where, according to a recent official report, that river overflows and covers most of the plains for a considerable distance on either bank. It is difficult to reconcile this uncomfortable fact with the report of Mr. Watson's expedition, to which we lately referred, that high ground ran right down to Point Parker. If this be really the case, the surveying expedition must have followed a different course to the westward of that laid down for it, possibly crossing the Gregory at a much higher point in a comparatively unknown part of the country.

We regret to learn that Père Law, whose unfortunate expedition from Gubuluwayo to Umzila's country was referred to in Nature of May 5, died of fever and general exhaustion at that chief's kraal last November. During his comparatively short stay in Africa he had rendered conspicuous service to geography by the determination of numerous heights and positions.

A very interesting experiment is to be tried in West Central Africa by the members of the Livingstone (Congo) Inland Mission. We understand that seeds of the different species of Chinchona, which have been obtained from the Government plantations in India, are to be sent out to them with a view to ascertaining whether it could be successfully cultivated in the mountain valleys of the Congo.

It is probable that the successor of Admiral La Roncière le Noury, late President of the French Geographical Society, will be M. Ferdinand de Lesseps.

SOLAR PHYSICS—SUN-SPOTS [1]

To the student of science who contemplates the sun by day or the stars by night two questions will inevitably occur. The first will have reference to the source from which those vast orbs have derived their stupendous store of high-class energy; the second to the astonishing regularity with which they are able to give it out. It is not impossible to measure in a rough way the amount of heat which our own sun must have possessed. For in the first place we are forced to allow that our luminary must have shone as it does now for millions of years. In the next place the amount of solar heat received by the earth in one year will about liquefy a layer of ice 100 feet thick covering the whole surface of the earth; and lastly, the sun gives out 2,300,000,000 times as much heat as the earth receives.

These considerations viewed together will perhaps enable us to form a faint conception of the amount of light and heat which our luminary must have given out during its prolonged existence. And yet the sun is by no means one of the most powerful stars, being only about the average in brightness.

We ask then, in the first place, from what source has this inconceivably vast store of energy been derived? If science be not able with absolute certainty to reply to this question, it is yet able to indicate the most probable origin of the supply.

The only hypothesis yet thought of that can account for it is that which first occurred to Mayer and Waterston, and which has been worked out by Helmholtz and Thomson in such a way

[1] Lecture in the Course on Solar Physics at South Kensington; delivered by Prof. Balfour Stewart, F.R.S., April 27.

as almost to prove that there is no other known power capable of producing such a stupendous result.

According to this hypothesis we may imagine the particles of matter, when originally produced, to have been at a great distance from each other, all however being endowed with the power of gravitation—forming in fact a chaotic mass. As these particles gradually came together in virtue of their mutual attraction, heat would be generated in the condensing mass, and it has been calculated that this cause, by storing up a vast amount of heat in the sun, is sufficient to account for its wonderful outpouring of heat and light throughout a long series of ages.

But the whole of the riddle is not thus solved. A man may have vast resources and yet a total absence of ready money. Or a nation may have plenty of food and yet not be able to bring it fast enough into a famine-stricken district. And so the sun may possess in its interior abundance of high-class energy and yet be unable to bring it quickly to the surface—indeed it has been calculated by Sir William Thomson that if the sun were an incandescent solid body its surface would probably cool in a few minutes of time. The perplexing fact about the sun and stars is not so much that they have somehow obtained a vast store of energy, as that they are able to bring it to the surface with an astonishing regularity. Nevertheless this regularity, great as it is, is not apparently perfect. There are a good many examples of variable stars of which some few suffer sudden and extreme changes of brilliancy, while in others the variation is much less conspicuous. In these orbs the transport service by which the heat is brought to the surface appears to work unequally, and even in some cases to break down altogether. Were we much nearer to them than we are we might study these inequalities with advantage, and perhaps gain some insight thereby into the nature of the wonderful machinery that brings the heat to the surface.

As it is however we must chiefly confine ourselves to a study of the sun. Can we therefore hope to find out the nature of the machinery by which the light and heat of our sun are brought to the surface? and is this machinery unequal in its action? Is the sun, in fine, a variable star? First of all, let us have a clear conception of the precise meaning of this question. No doubt the clouds by day and the earth itself by night interpose themselves between us and our luminary so as to render its direct influence exceedingly variable; but this is not the point. Frequently in passing along the streets of an evening we see into the interior of some room which has just been lighted up; but immediately the blind is pulled down, and we see it no longer. The gas may however be all the while burning behind the blind with a constant lustre; or it may be that from water in the pipe or some other cause the flame is intermittent. Now this is the point which we wish to determine about our sun. Is sunlight intrinsically constant, or is it subject to variations? and if so, can we determine the extent and the periods of these variations? Now at first sight it seems exceedingly strange that we are compelled to ask this question.

It might naturally be imagined that astronomers, who can give us the light variations of Beta Lyræ or some other variable star with the greatest precision, must certainly be able to give us similar information about the sun. That they are totally unable to do so is unquestionably very strange. When however we begin to examine we find several reasons for this curious failure. In the first place we must all be glad to think that within historic times at least the variations of the sun's light-giving power can never have amounted to a large proportion of the whole. Had this been otherwise none of us could have been alive at this moment to speculate on solar variability.

Nevertheless these suspected differences, although not exceedingly great, may still be large enough to enable astronomers in some remote part of the universe to pronounce our sun to be a variable star. How is it then that we who are mainly concerned in this variability are yet unable at first sight to decide upon the fundamental question of its existence?

We have not far to seek for an answer to this enigma. The fact is we are too near and too deeply concerned in the issues to be able easily to detect the variation. We have never the opportunity of comparing the sun's light with the pure light of the stars in the way in which we can compare the light of one star with that of another. We must therefore resort to means by which the direct light and heat of the sun may be accurately measured. Now it cannot be said that instruments for this purpose do not exist, but they have not been systematically made use of to determine this important point, and indeed there almost appears to be a reluctance in humanity to face the fact of the sun's variability.

When, in process of time, the telescope came to be invented, by its means Fabricius and Galileo speedily discovered that the face of our luminary was not altogether free from spots. This fact had been previously known to the Chinese, who in the course of their long and peculiar civilisation had recorded many instances where such spots were large enough to be visible to the naked eye. But at present we have to do with the progress of European thought. The first accurate observer of these phenomena was Hofrath Schwabe of Dessau, a distinguished German astronomer. More than fifty years ago he set himself to the task of taking frequent sketches of the disk of the sun, which might record approximately the positions and areas of the various groups of spots. For forty years he continued to labour at this somewhat monotonous task with great perseverance, until at length his unwearied labours were crowned by a singular and unlooked-for discovery. This consisted in the evident periodicity of these phenomena. During some years Schwabe found the sun to be almost entirely free from spots, while on other occasions the solar disk was mottled over with very frequent groups, the period from maximum to maximum, or from minimum to minimum, being nearly eleven years. From the observations of Schwabe and others it would appear that 1828, 1837, 1848, 1860, and 1870 were years of maximum-spot frequency, while 1833, 1843, 1856, 1867, and 1877 were characterised by a nearly total absence of spots. Carrington, of this country, followed in the steps of Schwabe, and gave the world a very accurate record of the spots which appeared from 1854 to 1860 inclusive.

In 1858 De La Rue introduced the application of photography to solar research, and since then photoheliographs have been at work at Kew, Ely, and Greenwich, in this country, at Wilna and Moscow in Russia, at Mauritius, Melbourne, India, and Cambridge, U.S., more or less continuously up to the present time.

I can only allude to the magnificent solar pictures produced by Langley at the Alleghany Observatory, and more recently by M. Janssen, the distinguished French astronomer, as forming a new point of departure in the history of solar delineation. Janssen's pictures are more than a foot in diameter, and in them every minute detail of the sun's structure is accurately represented.

But it is time to tell you what a sun-spot really is. Prof. Wilson of Glasgow made in 1774 an observation which greatly startled the scientific world. He found that sun-spots behaved exactly as if they were caverns with sloping sides dug into the body of the sun. The bottom of these caverns is generally black, while the sloping sides are less so. The black portion is therefore called the *umbra*, while the less black sloping sides are called the *penumbra* of the spot. It is easy to explain the nature of Wilson's reasoning. The sun, it is well known, revolves on its axis about once in twenty-six days from east to west, so that a spot will take about thirteen days to travel across the visible disk or hemisphere. It will come on at the left-hand border or limb and disappear at the right, provided it remains so long. Now Wilson noticed that when a spot is near the limb the penumbra on the side nearest the sun's visual centre is hidden from our view, on the same principle by which, when looking into a silver jug, for instance, from one side of it, that interior which is nearest the eye is hidden from the view. In fine, he concluded, with perfect justice, that spots were pits or hollows with sloping sides, and we are justified in adding that they are cloud pits, and not caverns of solid matter.

These conclusions of Wilson have been abundantly confirmed by the Kew observers, Mr. De La Rue and his colleagues, and also by the spectroscopists who have devoted themselves to the sun.

It has furthermore been shown by these observers why the bottoms and sides, but more especially the bottoms, of such caverns should be blacker than the sun's ordinary surface. They are blacker because they are colder, and they are colder because they represent a down-rush of matter from the high and comparatively cold regions of the solar atmosphere—of some kind of celestial hail, we may perhaps imagine. So magnificent is the scale of operations that fifty or sixty of our own earths might be dropped into the cloud-cavern formed by the down-rush—at least in the case of large spots.

But a down-rush implies an up-rush, and we may add that a down-rush of matter comparatively cold implies an up-rush of

matter comparatively hot. We have abundant evidence of the existence of such up-rushes in the sun. Astronomers have been long familiar with the existence of two solar phenomena which occur together—*spots* and *faculæ*. Just as a spot represents something which is blacker, and therefore colder, than the ordinary solar surface, so a facula (torch) represents something which is brighter, and therefore hotter, than the surrounding regions. As I have said, faculæ and sun-spots accompany each other, and we have evidence from various quarters that the former are not merely high up in the solar atmosphere, but that they frequently represent matter in the very act of ascending, just as a sun-spot frequently represents matter in the very act of falling down.

If we turn now to those regions of the sun's disk in which there are no spots we do not find a uniformly luminous appearance. We find rather a fine mottled or granular surface consisting of certain bright patches and of others comparatively dark. The black patches may perhaps be regarded as very minute sun-spots, and the bright patches as faculæ on a small scale. Probably, too, the bright are up-rushes of comparatively hot, and the dark down-rushes of comparatively cold matter.

Thus we may imagine that the difference between a spotted and an unspotted portion of the solar surface does not consist so much in a difference in the kind of things there present as in their size. In the unspotted portion we have down-rushes and up-rushes side by side but on a small scale, while in the spotted region we have also down-rushes and up-rushes, but on a large scale.

It thus appears that a prominent characteristic of the solar surface is the presence side by side of gigantic up- and down-currents, the up-rushes consisting of very hot and very bright matter carried upwards from the heart of the sun, while the down-rushes consist of comparatively cold matter carried downwards from above.

We may add that this system of currents appears to be in all respects most powerful during periods of maximum sun-spots, at which times the velocities of solar matter are absolutely enormous. By a spectroscopic method we can estimate these velocities, and we find that on some occasions they reach the almost incredible speed of 150 miles per second.

As yet, however, we have only added another to the puzzles of solar physics. We began by expressing our astonishment at the power which the sun possesses of continuously pouring out vast quantities of heat and light, and we must now add to this our astonishment at the almost incredible velocity of its surface currents. We are thus presented with a couple of wonders instead of one; but is it not possible that the one of these may explain the other?

May not these gigantic currents denote the very machinery we are in search of, and in virtue of which the sun becomes able to carry light and heat from the interior to the surface, so as to give us a continuous and powerful supply?

The sagacity of the late Sir John Herschel was not behind in detecting the true state of the case. He suggested the probability that at times of maximum sun-spots the *sun-pot*, as he expressed it, may be in reality boiling very fiercely, and may therefore be giving us more of what we all want instead of less—be in fact preparing for a banquet instead of making arrangements for a famine.

Indeed we may be perfectly certain that the peculiar machinery which enables the sun to continue shining must be something which brings up with great promptitude to the surface new particles of hot matter from within, while it carries down with equal promptitude those that have already performed their light-giving office.

The sun is required to fire off without intermission a vast number of light- and heat-shots into space. And the battalions of particles that have done their work must quickly step behind to reload, while their places must be taken as quickly by a fresh and unexhausted levy of particles from within. Now this recruiting process, *which must exist*, can surely be nothing else than those violent up-and-down atmospheric currents which observation reveals to us on the surface of our luminary, and we are thus entitled, as a matter of speculation, to infer that our earth will probably receive peculiarly large supplies of sunlight on those occasions when there is most manifest disturbance on the surface of the sun. In fact we may regard the sun as a species of heat-engine. The ordinary conception of such an engine is that of something provided with cylinders, pistons, valves, wheels, and other mechanical appliances, the furnace and the boiler being kept generally out of sight; but the physical conception is something very different from this. A heat-engine, according to the physicist, is a machine having two temperatures: one being that of the source of heat, and the other that of the refrigerator: and it produces work while heat is carried from the higher to the lower temperature—from the source to the refrigerator, and not only so, but the faster the heat is carried the more work does it produce.

Here the object or end is to produce work, and the means employed is the carriage of heat. But if we regard the sun as an engine we may with propriety reverse this relation between means and end, and look upon the carriage of heat and light to the surface as the end aimed at, and the powerful surface-commotion as the means by which this end is accomplished.

I am by no means satisfied that we can fully explain why the currents on the sun's surface should be so very violent as observation proclaims them to be, but yet it is easy to see that the conditions there present are such as to favour the development of convection-currents of enormous power. Let us agree for a moment to study an ordinary furnace fire. We have here in the first place a carriage of hot air up the chimney which ultimately mixes with the cold air outside, while we have in the second an in-rush along the floor of the room of the cold air which feeds the fire, and which ultimately as hot air goes up the chimney and mixes with the cold air above. Now here we have a true convection-current, an up-rush of hot and an in-rush of cold air, and the more intense this current the more quickly will the fire burn.

It is easy to see in the first place why the hot air ascends the chimney. It does so because it has been expanded by heat, and is therefore specifically lighter than the cold air around it.

But why does a thing specifically lighter than the air ascend? Clearly on account of terrestrial gravitation. If there were no earth it would not ascend at all, and if the earth were less massive than it is it would not ascend so fast as it now does. Clearly then the draught of our chimneys depends upon the mass of the earth.

Again, the draught will depend upon the intensity of the fire, and also upon its size and that of the chimney, for it is obvious that an exceedingly small fire and short chimney would not draw well even though the temperature of the fire should be very high.

We thus perceive that the intensity of convection-currents depends—

1. On the temperature of the source of heat as compared to that of the cold parts of the arrangement.
2. On the force of gravity.
3. On the scale of the arrangement.
4. We may add that for strong currents it is necessary to have some substance, such as air, that expands greatly under an increase of temperature.

And furthermore such currents are still more augmented in violence by the presence of a condensable substance in the atmosphere, and are thereby rendered abrupt, and, to some extent, incalculable, in their operations, inasmuch as a small cause may produce a very great effect.

Now we have all these elements of power together on the sun's surface. For in the first place the intensity of the sun's heat is very great as compared with the cold of surrounding space. Secondly, solar gravity is very great, being about twenty-eight times greater than terrestrial gravity. Thirdly, the scale of the whole arrangement is very great; and lastly, the substance there present, gas and vapour, is one which expands greatly on being heated. On the sun's surface therefore all these causes of convection-currents exist in great strength; and if we bear in mind that they must be multiplied together rather than added we shall not fail to perceive how strong must be the effects which they will produce. Notwithstanding all this, it appears to me that we have more to learn with respect to the causes which produce the extraordinary violence of solar currents.

Although the series of sun pictures made by Schwabe is the first having pretensions to accuracy, yet Prof. Rudolph Wolf has endeavoured to render observations of sun-spots made at different times and by different observers comparable with each other, and has thus formed a list exhibiting approximately the relative number of sun-spots for each year. This list extends back into the seventeenth century, and is in many respects of much value.

By this means Prof. Wolf has shown that the eleven-yearly

period runs through all the recorded observations of sun-spots since the telescope came to be used. And furthermore it appears that these eleven-yearly oscillations are not always of the same magnitude; sometimes they are large, and sometimes small. They were probably small about the middle of last century, becoming large towards the end of it; they were again small about the early part of the present century. They have recently been large, and we may suspect that in future there will again be a falling off.

Besides exhibiting this complicated periodicity, sun-spots have many other characteristics, the most prominent of which I will now bring before you. Of these the most peculiar is a proper motion of their own. If there were no sun-spots it would be very difficult to determine the elements of the sun's rotation. Accordingly sun-spots have been used for this purpose ever since the telescope was invented. They are carried by the solar rotation from east to west across the visible disk of the sun in about thirteen days, and hence we may conclude that the sun, roughly speaking, rotates round its axis in twice thirteen, or twenty-six days. But Carrington found that spots move fastest when nearest the solar equator, and slowest when nearest the solar poles; and in consequence of this proper motion of spots there is an uncertainty as to the exact period of solar rotation. Another point of interest is the distribution of spots over the solar surface. There are never any at or near the sun's poles, the zone in which they break out having its limits about 30° on each side of the equator. It might be expected from this that we should have a maximum of spots close to the equator, but such is not the case. There are very few at the equator, the maximum number corresponding to a solar latitude of about 15° north or south. We must not however conclude that spots invariably exhibit a preference for this latitude, for Carrington has shown that on certain occasions they appear by preference to seek a higher latitude, widening out on each side of the solar equator simultaneously, while at other times they prefer a lower latitude, coming together towards the equator simultaneously on each side.

Dr. Smysloff of the Wilna Observatory has likewise observed a sort of hemispherical see-saw in the behaviour of spots. Sometimes they prefer the northern hemisphere of the sun—at other times the southern; but this observer is inclined to think that if we pursue our researches for a length of time sufficiently great we shall find an equal amount of spots in each hemisphere.

I have thus endeavoured to bring before you the fact that sun-spots exhibit curiously complicated laws of a roughly periodical nature. Two questions arise from this discussion: the one is of a theoretical nature, and has reference to the possible causes of this behaviour; while the other is of great practical as well as of theoretical interest, and has reference to the effect which these strange solar phenomena produce upon the magnetism and meteorology of the earth and upon the general well-being of the human race.

To be continued.

PROF. ALLMAN ON THE DEVELOPMENT OF THE CTENOPHORA

IN accordance with his usual practice of making his anniversary address at the Linnean Society an exposition of recent progress in certain departments of zoological research, the President on this occasion (24th May, 1881) selected as his subject the advances which, during late years, had been made in our knowledge of the development of the Ctenophora.

He referred especially to the beautiful researches of Alexander Agassiz, and to those of Fol, Kowalewsky, and most recently of Chun. He pointed out the phenomenon to which he was the first to call attention, that immediately after the earliest stages of the egg cleavage a remarkable peculiarity shows itself, in the fact that the continued cleavage is no longer uniform, but takes place much more energetically in certain cleavage spheres than in others, whereby the former are broken up into a multitude of small cells, which gradually envelop the latter, thus giving us at this early period of embryonic development the foundation of the two germinal leaflets, ectoderm and endoderm. He showed, how the body thus formed becomes excavated by an internal cavity, which soon communicates by an orifice with the exterior, thus presenting, as shown especially by the researches of Chun, the condition of a *gastrula*; how the gastrula-mouth becomes afterwards closed by the continued extension over it of the ectoderm; how a new orifice, the permanent Ctenophore-mouth, makes its appearance at the opposite hole, the ectoderm here becoming invaginated, so as to form the permanent stomach which opens into the central cavity, which becomes the "funnel" from which spring all the vessels which are destined to distribute the nutritive fluid through the body; how, in the spot formerly occupied by the gastrula-mouth, certain cells of the ectoderm become differentiated, so as to form the rudimental nervous system; and how the great vascular trunks are formed by the differentiation of portions of the endoderm, into which offsets extend from the central cavity.

Prof. Allman further referred to the facts connected with the metamorphoses which the larvæ of the Ctenophora undergo between the moment of leaving the egg and the attainment of the mature form—facts for which we are mainly indebted to the researches of Alexander Agassiz and of Chun. He showed how the lobed section of the Ctenophora, as proved by the investigations of A. Agassiz on *Bolina*, and by those of Chun on *Eucharis*, are at first quite destitute of the "lobes" which constitute so characteristic a feature in the adult; and how the young Ctenophore has at this time all the characters of the more simply constructed Cydipidæ, *Eucharis* being also compressed like a *Mertensia* in the direction of the stomach axis, while in the adult the compression of the body is at right angles to this; how the lobes afterwards grow out laterally from the oral side of the body; how the meridional vessels at first ending in blind extremities extend themselves into the rudimental lobes, and there form the anastomoses and rich convolutions which become so striking in the adult, the stomach vessels finally entering into the anastomoses.

He also referred to Chun's remarkable discovery of the sexually-mature condition of the very early larva of *Eucharis*, from which was reared a young brood which returned to the larvæ form from which it originated.

Chun's observations on the metamorphoses of the Venus's girdle (*Cestum Veneris*) were also dwelt on. It was shown how the young cestum had a nearly globular form, and possessed all the essential features of the Cydipidæ, so that notwithstanding the extremely aberrant characters of the adult the young may be taken as affording a type of the gastro-vascular system, with the distribution of the vessels in the Ctenophora generally. The gradual extension of the Cydippe-like larva in the direction of the funnel-plane changes it into the long, flattened, band-like form of the adult, and brings about (with modifications in the number and direction of the swimming-plates, and the substitution of new tentacles to replace those of the larva which had disappeared) the singularly aberrant course of the vessels characteristic of the mature Venus's girdle.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—Mr. J. W. Clark is to be re-appointed Superintendent of the Museums of Comparative Anatomy and Zoology for two years, at the end of which time the Council of the Senate appear to anticipate that some fresh arrangements as to this office may be made.

Mr. W. Hillhouse, Assistant Curator of the Herbarium, will give a course of lectures on Morphology and Systematic Botany during July and August, suited to candidates for the Natural Sciences Tripos. In connection with the course there will be practical work in the Gardens and Botanical Laboratory; and a botanical excursion will be made, weather permitting, on Wednesday in each week.

DUBLIN.—The Professors of the Medical School in Trinity College have, at the suggestion and with the sanction of the Rev. Dr. Haughton, the senior lecturer of the College, introduced into their summer courses of lectures, to a very large extent, practical instruction, instead of the time-honoured and now somewhat antiquated series of prelections. These summer courses chiefly consist of Chemistry, Histology, Botany, Comparative Anatomy, and Operative Surgery. In the Chemistry, instead of listening as formerly to an hour's lecture three times each week, the students work in the laboratory under the superintendence of Prof. Emerson Reynolds, F.R.S., for two hours every alternate day, and on one day in each week attend a demonstration by the Professor on the analysis of water, air, and articles of food. In the Histology Prof. Purser gives a lecture on one day in each week, at the close of which illustrative preparations are shown in the laboratory. On the other days the students are engaged on practical work in the new physiological laboratory, where, as in the chemi-

cal laboratory, each student has his own place, with full set of apparatus and reagents. The laboratory is open from 11 a.m. to 5 p.m. In Botany, Prof. E. Perceval Wright gives the first ten lectures to the class in the lecture-room, on the general details of the structure and morphology of flowering-plants. The second part of the course consists of ten demonstrations on such forms as Bacteria, Yeast-mucor, Saprolegnia, Oïdium, Mushroom, the Algæ; and the remaining portion is given in the College Botanical Gardens, when each student is required to have a practical acquaintance with a certain number of natural families. The demonstrations in Comparative Anatomy are conducted by Prof. Macalister, F.R.S., who is fortunate in having the resources of the gardens of the Zoological Society to assist in the practical work of his class. So far as the experiment has this session gone, the results have been most happy, the students showing a far greater interest in their work, and the demonstrations being less formal than the lectures, they have greater facilities for asking questions.

THE fiftieth anniversary of the foundation of the Technische Hochschule at Hanover is being celebrated during this week. Numerous guests from all parts of Germany, as well as from England, Sweden, Norway, the Netherlands, and Russia have arrived at Hanover.

SCIENTIFIC SERIALS

Journal of the Academy of Natural Sciences of Philadelphia, vol. 7, second series, part 4, 1874-1881.—Wm. M. Gabb, descriptions of Caribbean Miocene fossils; descriptions of new species of fossils from the Pliocene clay-beds between Limon and Moen, Costa Rica, together with notes on previously known species from there and elsewhere in the Caribbean area (with four plates).—Andrew Garrett, on the terrestrial mollusca inhabiting the Cook's or Harvey Islands.—Dr. C. Chapman, the placenta and generative apparatus of the elephant (with three plates).—Dr. Joseph Leidy, on some parasites of the Termites (gives full descriptions, with figures, of the strange forms briefly described in the *Proceedings* of the Academy of Natural Sciences, Philadelphia, for 1877. *Trichonympha agilis* is a truly extraordinary form, possibly a protozoan intermediate between the Gregarines and Infusoria).—Dr. Joseph Leidy, remarks on *Bathygnathus borealis*.

Zeitschrift für wissenschaftliche Zoologie, Bd. 35, Heft 3, 1881.—Dr. J. W. Spengel, the organ of smell and nervous system in the mollusca, a contribution to our knowledge of the unity of the molluscan plan (plates 17, 19).—Dr. O. Bütschli.—Short contributions to a knowledge of the Gregarines: (1) on the development of *Gregarina* (*Clepsidrina*) *blattarum*; (2) on the power of adhering in *Monocystis magna*, and on the pseudonavicella in the monocysts of the earth-worm; (3) on some egg-shaped Psorospermia in the intestine of *Lithobius forficatus* (plates 20, 21).—Prof. F. E. Schulze, researches on the structure and development of sponges, x. On *Corticium candelabrum*, Schdt. (plate 22).—Dr. A. Gruber, on the process of division in *Euglypha alveolata* (plate 23).—B. Ulianin, on the development in amphipods (plate 24).—Dr. Paul Fraisse, on molluscan eyes with an embryonal type (plates 25 and 26) (Patella, Haliotis, Fissurella).—Dr. P. A. Loos, on the albuminiferous glands in amphibia and birds (plate 27).

Atti della R. Accademia delle Scienze Fisiche e Matematiche, Napoli, vol. vii.—F. Panceri, the phosphorescence and the phosphorescent organs in some Annellida (Chætopterus, Balanoglossus, Polynoe), plates 1 to 4.—On the seat of the phosphorescence in some Campanularia (with a plate), and observations of some new species of marine nematoid worms (*Desmoscolex elongatus* and *D. lanuginosus*, *Echinoderes meridionalis*, *E. minutus*, *E. eruca*, and *E. spinosus*, *Tristicochæta inarimense*, n.gen. et n.sp. near Chætosoma); all the new species are figured.—A. Costa, notes of a visit to Egypt, Palestine, and the coasts of Turkey (zoological).—V. Cesati, on a new species of Battarræa (*B. Guicciardiniana*), with a plate.—On a collection of Pterydophytes made at Borneo by Signor D. Beccari, with 4 plates.—G. Licopoli, on the fruit of the vine and its chief constituents, with a plate.—G. A. Pasquale, on a new species of Lonicera (*L. stabiana*), with a plate.—F. Gasco, account of the whale (*Balæna Biscayensis*, Esch.) captured at Taranto on February 9, 1877, with 9 plates.—G. Battaglini, on projective geometry.—E. Fergola, on the dimensions of the earth.—G. Nicolucci, the Cola grotto near Petrella di Cappadocia, in the province of Abruzzi, with three plates of animal remains.—On prehistoric researches about the environs of the Lake of Lesina.—L. Palmieri, on the present condition of electrical meteorology.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 12.—"Investigations on the spectrum of magnesium," by Professors Liveing and Dewar.

The flame of magnesium burning in air shows strongly, generally well reversed, the line at wave-length 2850 (Cornu); a strong triplet, resembling in the relative distance of its lines the other magnesium triplets, close to the solar line M; the well-known triplet near L; and a remarkable series of lines and bands, generally resembling the spectra of some compounds, extending from M to between L and K. Neither the strong triplet at M nor this series of bands are represented in the spectrum of magnesium either in the arc or spark. These flame-lines are remarkable as further evidence of the power of substances to emit, at comparatively low temperatures, radiations of short wave-length.

In the arc the authors notice a series of triplets, of which the least refrangible lines have wave-lengths about 2767, 2736, 2798, 2673, 2649, 2633 respectively. These, with the well-known triplets *b*, and those near the solar lines L, P, and S, form a series, similar to those described by the authors in the spectra of sodium, potassium, and lithium, in which the alternate members are sharp and diffuse, and succeed one another at shorter and shorter intervals in a way which indicates that they follow a definite law and are probably harmonically related, though not forming a simple harmonic series. They observe that the line w.l. 2850 is the strongest line of magnesium both in the flame and arc, and one of the strongest in the spark, and that it is nearly the octave of the line some time since observed by them at wave-length about 5710. They observe in the arc only the strongest two of the quadruple group described by Cornu from the spark at wave-lengths 2801, 2795, but they notice both in arc and spark a group of five lines a little higher at wave-lengths about 2782, 2781, 2779, 2778, 2777. All these lines, including the diffuse members of the series of triplets, they have often observed reversed when the arc is taken in one of their crucibles. The line w.l. about 4570, so conspicuous in the flame, first noticed by the authors in the spark, is well seen and easily reversed in the arc, and they believe it to be represented in the solar spectrum by the line w.l. 4570·9 in Ångström's map. Besides these lines they observe in the arc a pair of lines slightly less refrangible than the pair in the spark, described by Cornu near the solar line U. In the spark they observe two pairs of ghost-like lines below the triplet near L, which together with the fainter two of the quadruple group (2801, &c.), seem to suggest the possibility that some of the particles of magnesium have, owing to particular circumstances, their tones a little flattened in regard to these particular vibrations, though the constancy in the amount of displacement of the lines militates against such an hypothesis.

In regard to the *b* group, observations on the spectrum of the fourth order given by a Rutherford grating of 17296 lines to the inch showed that the iron line in b_4 is a little less refrangible than the magnesium line. The additional lines near this group observed by Fievez they ascribe to a periodic inequality in the ruling of the Rutherford grating, arising from an imperfection of the screw of the ruling machine, which produces a series of *ghosts* on either side of each principal line. The positions of these *ghosts* have been investigated mathematically by Peirce (*Math. Journal* of John Hopkins University), and observations of them tally with the theory. They are embarrassing in the case of bright lines, but may be detected by their changes of position in the spectra of different orders.

The magnesium-hydrogen spectrum which the authors have previously investigated and found to be produced at ordinary and reduced pressures when both elements are present, but not otherwise, they have now investigated further by observing the spark discharge between magnesium poles in hydrogen, nitrogen, and carbonic oxide, at pressures varying from one to twenty atmospheres. They find that in hydrogen, when no Leyden jar is used, the peculiar fluted spectrum of magnesium hydrogen is much more brilliant at higher pressures, becoming fully equal in brightness to the *b* group, notwithstanding the increase in