THURSDAY, MARCH 12, 1896.

A GLACIAL HANDBOOK.

Ice-Work Present and Past. By T. G. Bonney, D.Sc., F.R.S., &c. Pp. xiv + 296. (London: Kegan Paul, Trench, Trübner, and Co., Limited, 1896.)

THIS latest addition to the familiar red volumes of the International Scientific Series is in many respects a model of what we may take to be the aim of the whole series. An exposition of the results of modern research and modern thought, which shall be of an unrestricted and international character, written without offence to prejudices or persons, is no mean task for an author to set before himself. And when the subject approaches the chilling atmosphere of the ice-age, we know how frequently the scientific soul waxes warm, and fortifies itself towards the inevitable conflict; while the outer world exclaims,

"That is hot ice, and wonderous strange snow."

Has it been left for Prof. Bonney to "find the concord of this discord"?

The aim of the author in this instance is to give prominence "to those facts of glacial geology on which all inferences must be founded." He begins most appropriately with a description of a "gathering-ground of glaciers" in the Bernese Oberland, a scene as familiar to himself as Bedford Square or King's Parade must be to many of his readers. A sober restraint is put upon his powers as a word-painter, and we have a condensed account of ice and ice-work in Switzerland, crisp and clean as the surface of the snows themselves. It is true that the irrepressible faculty of imagination breaks out occasionally, seeing more before it than the upturned face of the student; and the contrast is almost too abrupt, it betrays the effort at conciseness. Thus we are uncertain whether the "struggle of Solferino" (p. 35) refers to a meeting of descending glaciers, or to the events of recent history, since all the other references in the sentence are to purely geographical features.

In this first chapter, certain conclusions are drawn from the facts described, but so delicately and naturally that they seem to involve no controversy. A confidence is thus established between us and the author, and we follow him with the secure feeling that theories may be suggested, but will not be thrust upon us. If a writer has formulated any opinion of his own, this is the very happiest method of securing a hearing for it.

The second chapter deals with the larger phenomena of arctic and antarctic regions. To some extent this traverses the ground of Prof. Wright's corresponding chapter in "Man and the Glacial Period"; but additional matter is introduced, even in dealing with Alaska. Attention is very properly drawn to the feeble character of the "ground-moraine" in areas covered by an ice-sheet, and to the great accumulation of the materials, in the form of a terminal moraine, as the glacier retreats, when they become (p. 48) "drawn very gradually, like a coverlet, over the bed of the valley." On p. 57, another point of first importance is set down with characteristic delicacy; "it is therefore obvious that in all speculations as to the condition of any region during the Glacial Epoch, account must be taken of the possibility of a not inconsiderable difference in either direction from its present level." The evidence bearing on this subject has been so freely overlooked by those who have felt it easier to accept enormously thick ice-sheets, rather than differential earth-movements, that this innocent little sentence suggests in reality a controversy ranging over both the hemispheres.

The description of the Malaspina Glacier near Mount St. Elias in Alaska, quoted from Mr. Russell, naturally forms the most interesting feature of this chapter. The term "Piedmont Glacier" (p. 68), as it happens, would have been explained more clearly in Mr. Russell's own words. Since the date at which Prof. Bonney wrote this account of the Chaix Hills, with their uplifted marine glacial gravels, he has examined the additional evidence of post-glacial elevation brought forward by Colonel Feilden from Kolguev Island (*Quart. Journ. Geol. Soc.*, London, vol. lii., 1896, p. 57).

After this review of "existing evidence," Part II. describes the "Traces of the Glacial Epoch." The discussion of the origin of lake-basins is concerned with the greater lakes of the world, and the summing-up is in favour of their hollows having been caused by earth-movements. Eskers are dealt with in the same chapter, and the accumulation of sands and gravels in the very areas claimed by some authors as regions of excavation is, in conclusion, neatly pointed out. After Mr. Russell's description, quoted on p. 74, we are left somewhat in the dark (p. 116) as to the probable origin of eskers. The names of Hummel and Holst might well have been quoted in connection with the theories for which they are respectively responsible; and Ireland is so eminently a land of eskers, that one is inclined to ask for a view or section of an esker of home-manufacture, instead of the figure from New Hampshire given us on p. 110.

Why, again, in the next chapter, headed "Ice-work in Great Britain and Ireland," is till illustrated from "Seattle, Washington State," except for the fact that Prof. Wright's block is in the possession of the publishers of this series? All through, Prof. Bonney has been somewhat badly treated in the matter of illustrations. The Alpine drawing in Prof. Wright's book is painfully rigid and antique, and we should consequently have welcomed a photographic view of the Aletsch Glacier to illustrate Prof. Bonney's description. The frontispiece, showing the results of ice-work, is the only novelty of the kind. Even the scratched blocks figured are not from Finchley, or Snowdon, or Glencullen, but from "the till of Boston," which seems far away from an English author, even in an international scientific series.

Such drawings as are given had a special interest when put before us by Prof. Wright; but it is hard that Prof. Bonney, who has trained a full generation of geologists in England, and to whom the Alpine heights are as a garden, should be compelled to select his most effective illustrations from those of an American predecessor. A few views of English boulder-clays, and erratics, and *roches moutonnées*, as they actually appear, would have been at least refreshing. Our students know far too little of their own islands; and, in the case of Ireland, such pictures would have been absolutely novel.

On p. 126, "till" is distinguished from "boulder clay,' and Prof. James Geikie is quoted in support of this position; but the reference is to the first or second edition of the "Great Ice Age," since in the third the distinction is abandoned. The third edition is quoted, however, but again without exact specification, on p. 109.

In describing the principal accumulations due to glacial action in our islands, it would be impossible to follow all the literature that has been poured forth in recent years. Prof. Bonney seems to have made a fair and wide selection, perhaps leaving some extreme views charitably alone; throughout, he describes rather than theorises, and follows out, with steady self-denial, the line of work on which he started. From p. 163 to p. 205, we have a discussion of the opinions of other authors; but we read on with a sense that behind all this exposition there is a guiding mind, gently and steadily influencing our own. Yet it seems that no one can complain of having been misrepresented, which is about as much as Prof. Bonney can hope for, when we look back on the amenities of glacial warfare.

The description of the centres of radiation of boulders of various types (pp. 151–161) would be made of singular value to all students, if, in a second edition, a plate showing typical microscopic sections of the rocks referred to could be inserted. In this connection, we note a curious remark in the foot-note on p. 140, where Ailsa Craig is said to be "too small a place to have furnished numerous specimens to such a distant locality." Megascopic and microscopic examination has again and again proved the occurrence of erratics of the Ailsa rock, not that of Mynydd-mawr, as far south as Greystones on the Irish coast, and their existence was thus proved even under Mynydd-mawr itself. The very smallness of Ailsa Craig may surely be adduced in favour of the view that these abundant blocks have been worn away from it. Of course, some of these boulders may have come from the Riebeckite-eurite of Skye; but of this there is as yet no evidence. Here we touch one of the most frequent paradoxes in glacial essays—boulders are assumed to have come from the self-same levels where similar rocks are now exposed. The frequency of the boulders themselves is a fair measure of the former extension of the rock in question, even if we neglect any possible differential earth-movements.

A somewhat startling omission occurs on pp. 200 and 202, where what we may almost style the life-work of Mr. Maxwell H. Close is attributed inadvertently to Prof. Hull. The wide distribution of the "sands and gravels" in Ireland might perhaps have been further emphasised; but the recent observations of Prof. Sollas on Irish eskers find an appropriate place in the concluding sentences of this section.

Chapter iii. of this part goes further afield, particular attention being given to the wide-spread glacial phenomena in North America. And then we find the vexed "Theoretical Questions" summed up in Part III., conveniently shut in by themselves. The concluding words of the chapter dealing with temperature in glacial times again calls attention to the dependence of the successive stages of the cold period upon the variable level of the land; and, similarly, the next chapter on the "causes of a glacial epoch" closes judicially with the statement that probably "some factor which is essential for the complete solution of the problem is as yet undiscovered, or, at any rate, the importance of one which is already known has not been duly recognised."

The final pages of this admirable book, the strength of which lies largely in its reserve, point to a closer study of Greenland as essential to the solution of our problems. Already some comment has been made, through the latest of researches, on the question raised by Prof. Bonney (p. 135) as to the possibility of stratification in the deposits of land-ice. The spirit in which the author has shown how the field is open to the future should now attract a new band of workers, unfettered by their own past utterances.

Critics are most likely to lay hold of the treatment of contemporary literature, when looking for a weakness in this little volume. We have already indicated that the exactitude of a librarian is not always noticeable in the references, and various editions are not separately quoted. On p. 90 the title of Mr. Whymper's book is not precisely given, and the most important reference to the subject is in chapter xvi., not chapter vi.—at any rate, in the last edition. It is not clear from what work a passage on p. 114 is quoted; the reference should be to James Geikie, "Great Ice Age," third edition, p. 171. On p. 139, we might have liked a reference to some of the later literature on Moel Tryfaen, perhaps to Mr. Mellard Reade's examination of the microscopic materials, or to Miss Andrews's record of foraminifera. The difficulty as to the mingling and crossing of erratics borne by land-ice (p. 171) has been to some extent met by an important paper by Prof. Jas. Geikie, published in the *Scottish Naturalist* in 1881, and in "Fragments of Earth-Lore" in 1893. Why, again, are the figures on p. 21 quoted from an abstract in the *Alpine Journal*, and not from Heim's own book? The reference-figure is so placed on the page as to include a calculation which seems really due to Prof. Bonney. And here and there quotations from other authors have not been checked, so that, as they stand, they are not absolutely accurate. The only important case of this kind, however, seems the slip of "shale" for "strata" on p. 70, second line from bottom.

When, in this seemingly trivial manner, we think we have found a plane of weakness in Prof. Bonney's treatment of "Ice-Work Present and Past," it is like pointing out that David, another standard author, was injudicious in discarding the full panoply of armour. The writer of so many voluminous and yet precise papers in our geological journals has again and again protected himself from this attack. He has displayed a generous indifference as to the originality of any statement he may put forth, and has thereby doubtless lost considerable credit which he might otherwise have gained, as well as opportunities for trenchant criticism. "If any one," he wrote in 1890, "has come to conclusions identical with my own, I can assure the author that there is no plagiarism." In 1886, the matter was put still more clearly. "If," Prof. Bonney wrote, "there is any value in my results, it will be that they have been obtained, as far as possible, independently, and sometimes actually in ignorance of the work of others."

This standpoint is heroic, and involves considerable sacrifice of self; the argument has so obviously two sides to it. Is it a wise one to reiterate before us, juniors and pupils as we are; and shall we not remember how in many cases it was from Prof. Bonney that we received our first literary encouragement? Who amongst us, however, shall pose as his critic in this matter? Rather let us ask it of him as a question.

GRENVILLE A. J. COLE.

PHILOSOPHY AND EVOLUTION.

Evolution and Man's Place in Nature. By Henry Calderwood, LL.D., F.R.S.E. Second edition. Pp. xx + 316. (London: Macmillan and Co., 1896.)

IT is not often that the author of a work on science or philosophy so far accepts the verdict of his critics as to entirely re-model and re-write his book. Much to his credit Prof. Calderwood has done this, for the second edition now just issued is not only nearly twice the bulk of the first, but is also full of new matter, and is greatly improved in its scope and arrangement. The first edition (reviewed in NATURE, vol. xlvii. p. 385) contained eight chapters, while the present work has seventeen, the titles and "contents" of which are so different that the two books seem to have little in common. The chapters on "The Nerve System as an Instrument of Knowledge," "Right and Wrong," "Civil Law," "Modern Thought," "The Ape and Man," and "Cosmic Problems," seem to be wholly new and to embody the results of the most recent researches. In other respects the present work is far superior to the former edition, as it not only gives a much larger body of facts, and contains less repetition, but is a more complete presentation of the whole subject, treated from the point of view of philosophy rather than from that of science.

The author's style, which leads him always to go round about a subject rather than to the heart of the problem itself, to take much for granted which requires systematic proof, and to revel in diffuseness of phraseology and of argument, is still a prominent feature, and is wearisome to the reader who wants to get at the author's conclusions and to have a clear presentation of the facts and arguments on which they are founded. But to those who enjoy diffuse philosophical discussion, and especially to those who want a reply to the supposed materialistic tendencies of the works of Darwin and Herbert Spencer, there is here much food for thought. A few passages will serve to illustrate the author's merits as well as his limitations. In the chapter on "Right and Wrong," he thus explains his view of the essential difference between the human and the animal nature.

"The grand distinction of human life is *self-control in the field of action.* Thought not only reaches a generalised knowledge of existence, and of its laws; it leads to rationalised action, within the many and varied fields of human endeavour. The evidence of this appears, as already described, in the control exercised over all the animal impulses, so that these do not spontaneously and of themselves determine activity. Sensibility operates in human life, just as in the life of the animal; but it does not at once direct our action, as the course of the dog is ruled by sense of smell. Sensibility can influence us in the same way, and a similar result is often seen in our life; but that which is peculiar to man is a concentration which overcomes allurements of sense. Animal appetite is stirred in us, as in animals, physiological law being coextensive with the animal kingdom; our speciality appears in the regulation of animal impulse, so that it is repressed, in accordance with the laws of attention, which weaken or strengthen animal propensity; or limited by reference to propriety; or regulated in its indulgence in recognition of a law higher than present desire. These facts are so familiar, that I have only to refer to them to claim their weight of evidence for a power which does not appear in animal life. The value of this evidence will be still more appreciated, if it be observed that the control of animal impulse no more belongs to the animal nature of man, than it belongs to the animals around him. In respect of animal impulse, his experience is as much determined by physiological law, as animals are visibly moved by it. Man being an animal, no one can suggest that the movements of animal impulse are otherwise determined or have their source elsewhere than in the body. The difference between man and animals appears in this, that by thought and imagination passion may be intensified; and by use of these powers it can be restrained. Even within the sphere of passion, the elevation of human life is seen in the control the rational power wields over the animal nature."

The purport of this wordy and laboured passage is clear enough, but its cogency as an argument is certainly not proportioned to its length. The same idea is pursued through two other paragraphs of equal length, but these do not bring any further sense of completeness to the presentation of the subject.

One more extract may be given from the final chapter on "Cosmic Problems."

"With clearest testimony, scientific observation has led us to innumerable points, whence we have seen intelligent purpose at work providing for life yet unborn. We have been arrested first, and afterwards roused to quickened consciousness, realising that we have seen the lesson all the days of our life, in hundreds of forms, but had not read its full meaning, though it had been written large; for is not the whole vegetable kingdom confessedly a preparation for a coming life? In vain does Agnosticism lift its voice in presence of witness such as this. Testimony for an Intelligent cause springs even from the *dust*, and, as it comes thence, thought moves freely along all fields of science, gathering evidence as readily from the vegetable kingdom as from the animal; finding, with ever-increasing surprise, a growing testimony as science conducts us lower in the knowledge of nature. Not to the heights but to the depths we go, in order to witness the most startling condemnation of Agnosticism. It is not merely the myriad dwellers in the insect world which bear witness; but the inanimate creation itself tells us of treasure stored in its keeping, to satisfy animal wants. Plants can manufacture fresh protoplasm out of mineral compounds, whereas animals are obliged to procure it ready made, and hence in the long run depend upon plants. Thus, even from the *soil*, under our feet, comes the evidence calling us to own an Intelligent First Cause."

A number of illustrations, of the lower forms of life, of the sense organs of various classes of animals, and of the brains of many of the mammalia and of man, will render the work more attractive to those who have not acquired a general knowledge of the subject from other sources.

A. R. W.

OUR BOOK SHELF.

Experimental Plant Physiology. By D. T. MacDougal. (New York: Henry Holt and Co., 1895.)

THIS little book is intended primarily for the use of elementary students of vegetable physiology, and the subject-matter is treated in a somewhat dogmatic fashion. This we cannot avoid regarding as a mistake. The elementary, no less than the more advanced, student requires to be made at the outset to *think for himself*, and this is a far more important matter than the mere following out of directions for experiments. But it is just this stimulus that we miss, in the pages before us, and in not a few instances the author has sacrificed reality at the shrine of conciseness; thus it is simply useless to compare the mechanism by which water "is taken up and forced into the root and upward in the stem" to the action of an osmometer, for the conditions are not at all the same. The state of the water, as it exists in, and finds its way upward into, the tracheids, is by no means directly comparable with that of the solution of salts as it occurs in the tube of a thistle funnel, the lower end of which is closed by a piece of membrane. Here was a good opportunity of insisting on the peculiarity of a living protoplasmic structure, and it was lost. Very few teachers, who are at all *au courant* with their subject, will accept the statements as to ascent of sap, given on pages 28 and 29. "The rectangular wood cells are in the form of a series of chains. Water transpired from the topmost cells of these chains, the cell sap becomes concentrated. . . . There is thus formed a series of osmometers extending from the leaves to the roots and capable of lifting water to any height." Surely a slight knowledge of elementary physics, combined with that of the structure of the "wood cells," should have rendered it impossible that such a passage could have been written.

Again on page 46, one is tempted to wonder whether the author can have ever tried the experiment (54) to prove that oxygen is necessary for *respiration*. Any unwary teacher who performed that experiment for the first time before an intelligent class, would probably have a hard time of it if he trusted himself to Mr. MacDougal's guidance.

The above remarks and quotations will show that there are weak points about the book. And, indeed, the general impression left on the reader's mind is the rather painful one, that an important branch of botanical study has here been but superficially handled.

Exercises in Physical Measurement. By Dr. L. W. Austin and Dr. C. B. Thwing. Pp. x + 193. (Boston: Allyn and Bacon, 1896.)

AFTER working through the experiments described in this volume, a student will have a thorough knowledge of the instruments and methods employed in physical measurement, and will be in a position to accurately investigate physical phenomena. The book is a medium between such a hand-book as the last edition of Kohlrausch's "Praktische Physik" and the elementary text-books in which mathematical formulæ are eschewed. The sixty-five exercises in the first part are all quantitative, and they cover measurements in the chief branches of physics, beginning with measures of length, and ending with experiments on polarisation; while the apparatus required for the experiments should form part of the equipment of all physical laboratories in which students can obtain scientific instruction.

In the second part of the book suggestions are given as to methods of computation and physical manipulations, while the third part is taken up with tables. The book is thoroughly practical and trustworthy, and it can be recommended as a suitable introduction to serious work in physics.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Age of the Wealden.

THE Wealden formation of England has long been studied, and is now well known in nearly all its features. Its stratigraphical relations and its Cretaceous age are usually regarded as fully determined, and this is true, also, of the corresponding strata on the continent.

The vertebrate fauna of the Wealden is of special interest, and has attracted much attention ever since Mantell in 1825 unearthed Iguanodon in the Tilgate Forest. Some of the remains, he sent, through his friend Prof. Silliman, to Yale College, where they have proved of much service. In 1865, I examined the same famous locality, as well as others on the south coast of England especially rich in vertebrate fossils, and at all of them secured interesting specimens. A study of these in connection with the collections at London and Brussels first caused me to question the Cretaceous age of the Wealden, and a later comparison of its reptilian fauna with allied forms found in the Rocky Mountains led me to the conclusion that both series were Jurassic in type, and should be placed in that division of the geological series.

At the meeting of the British Association at Ipswich, in September last, I read a paper on European Dinosaurs, including two from the Wealden, and thus the question of their geological age came up for determination. The facts I then presented, based mainly upon the reptilian fauna, strongly indicated the Jurassic age of the Wealden, and I urged a re-examination of the question by English geologists. The subject has since been taken up by Smith Woodward, with special reference to the fossil fishes. In the *Geological Magazine* for February 1896, he gives the main results of his investigation, which prove that the fishes, also, of the Wealden are of Jurassic types, thus placing the geological age of this formation beyond reasonable doubt. The concluding statement of this interesting article is as follows:

"The Wealden estuary seems to have been the last refuge of the Jurassic marine fish-fauna in this part of the world, not invaded even by stragglers from the dominant race of higher fishes which characterised all the seas of the Cretaceous period. The Wealden river drained a land where a typically Jurassic flora flourished; the only two known Mammalian teeth from the Wealden resemble those of a Purbeckian genus; and now it is clear that the fishes agree both with these and the reptiles in their alliance with the life of the Jurassic era." O. C. MARSH.

Yale University, New Haven, Conn., February 22.

The Röntgen Rays.

THE following fact regarding the X-rays of Röntgen may be of interest.

I have found that it is possible to obtain a photographic image by these rays, using a "pinhole camera," having the aperture pierced in a piece of sheet-lead backed with aluminium. The Crookes' tube was illuminated by discharges from a Thomson high-frequency coil. The photographs taken in this way show very distinctly the two electrodes, while the glass bulb, which appeared to be brightly illuminated to the eye, is scarcely perceptible It would appear from this that nearly, if not all, the so-called X-rays proceed directly from the electrodes of the tube, and not from the glass where this is acted on by the kathode rays. It likewise affords further illustration of the rectilinear motion of the X-rays. Experiments are in progress with a broken current, and also to study the effect of a magnetic field.

Previous observation has shown that photographic effects were produced equally whether the kathode rays impinged upon the glass, or upon other phosphorescent material (*e.g.* aragonite) within the tube. It has also been noticed in experiments in this laboratory, that the appearance of the tube to the eye affords no criterion of its efficiency in producing the X-rays; tubes showing but little fluorescence of the glass composing them often giving admirable photographic effects, which in some cases are obtainable even from a low-vacuum Geissler tube. But the rays

producing photographic effects always appear to produce strong fluorescent effects on platino-cyanide of barium, so that the fluorescence of this affords an indication of the photographic efficiency of the radiations emitted from the tube.

RALPH R. LAWRENCE.

Massachusetts Institute of Technology,
Boston, February 26.

Is it quite correct, as Prof. Lodge puts it, to call the X-rays *anodic* because they start from a point (surface of glass, or of metal foil, &c.) opposite the kathode? It may be true that a surface upon which the kathodic discharges are being directed acquires thereby some properties common to the anode: but it is not an actual anode. Further, I think that so far there is no proof that these rays start from an anode unless that anode is itself in the line of the kathodic discharge. Hence I submit that *anti-kathodic* would be a more correct term to use in describing them. They can certainly be made to start from a portion of the kathode itself by shaping it so as to concentrate the kathodic discharges (or "radiant matter") upon a prolongation of itself.

Whilst dealing with this point, might I mention that a phosphorescent enamel, made by incorporating calcium sulphide in a very fusible enamel-glass, appears to form an excellent anti-kathodic surface for generating X-rays.

SILVANUS P. THOMPSON.

Finsbury Technical College, March 9.

WE enclose a print of a "Röntgen" photograph taken by us some time ago, which shows very clearly that it is to the mineral constituents that bone owes its opacity to the "X-rays." Two human finger-bones were obtained as nearly alike as possible. One was decalcified by treatment with dilute hydrochloric acid for some days, the other being soaked in water for the same period. The calcium phosphate, carbonate, &c., dissolved by the hydrochloric acid, were precipitated by ammonia and ammonium carbonate, and the precipitate, after washing, was spread on paper, so as to cover an area about equal to that which would be covered by the original bone. This precipitate, together with the bone which had merely been soaked in water, and the "decalcified" bone (which had shrunk during treatment with the acid), were then placed upon a photographic plate and exposed in a cardboard box to the radiations from a Crookes' tube excited by a small "Tesla" apparatus.

The picture thus obtained, shows clearly that while the decalcified bone is almost without action on the "X-rays," the mineral matter is practically as opaque as the bone before treatment with acid.

The print shows, however, that both the original bone and the calcium phosphate are only relatively opaque, but that they do allow some "rays" to pass, for the photograph shows half-tones, and not merely an outline.

J. D. CORMACK.
HERBERT INGLE.

The Yorkshire College, Leeds, March 4.

REMEMBERING that scientific men are pledged, beyond all others, to accuracy and observance of rule, I am emboldened to protest against the use of two words which are sometimes employed to describe the pictures produced through the agency of Röntgen's rays. I mean "shadowgram" and "radiogram."

Both of these offend against a primary rule for the formation of new compound words, which requires that all of the component parts of any word shall be derived from one and the same language.

If a word be desired which shall signify a picture produced by rays, let us go to the Greek language only, and form the word "actinogram"; or to the Latin language only, and form the word "radioscript"; or else let us be content with some purely English compound, such as "ray-sketch." G. H. P.

The Aurora at Waterford.

AFTER a boisterous day and a barometer that went down to 28·85, we were favoured last (Wednesday) night with an auroral display. It was first seen here at 8 o'clock, when it appeared in a cloudless, starlit sky as a sheaf of light springing from the western point of the horizon, and stretching along an arc of 30° up towards the Pleiades.

Its colour, at first silvery white, gradually faded away, reappearing in thin streaks and irregular patches of yellowish light in various parts of the sky between north and west.

At 10 30, it was round in the north. At one time, six well-distanced streaks were counted. They seemed to converge slightly towards the zenith. The light was mainly yellowish, but tinged here and there with pulsating reddish rays. The flickering, or fluctuation in colour and brightness, was distinctly noticeable.

The phenomenon was not observed after 11.30.

As auroræ are essentially electrical in character, having some analogies with the brush discharge, it would be interesting to know whether, like the brush discharge from induction coils and influence machines, *shadowgraphs* might be taken by means of these weird rays. Opportunities for testing their photographic qualities occur very frequently in higher latitudes than ours, and even nightly in circumpolar regions, the home of this interesting phenomenon. M. F. O'REILLY.

De La Salle Training College, Waterford, March 5.

An Unusual Meteor.

AT 8.31 on Sunday evening, March 1, when half a mile north of York Minster, I caught sight of a meteor slowly falling vertically almost due east. It was then passing over the two small stars ν and ξ Ursæ Majoris, which at the time were at an altitude of 43°, azimuth 5° north of east. Seeing that it meant to last awhile, I proceeded to repeat the alphabet in the orthodox manner (once through, each letter quickly but distinctly enunciated, requiring 4 seconds). Having gone over it twice, I must confess that my amazement at the meteor's duration made me pause. But it kept on, so I continued, getting through it twice more. Then, after a second involuntary but very unscientific pause, I finished the alphabet a fifth time before the phenomenon came to a close. In all, I must have watched it at least 25 seconds. After some 10 seconds, when about the same altitude as β Leonis (24°), a smaller meteor (fourth magnitude) appeared 1° to the left, at an angle of about 40°, and, proceeding at the same speed of under 2° per second, lasted 3 or 4 seconds. The original, of which this was doubtless a fragment, was between first and second magnitude, but with a distinct disc, and was followed by a train of sparks, reddish like itself, which was never more than 2° or 3° long, or lasting only 1 or 2 seconds. The fragment had also a slight train. The main mass seemed to pause slightly about this spot, perhaps because of this explosion. From the first it moved slower and slower, doubtless an effect of perspective, and finally disappeared almost due east (within 5° north of east), only 5° or so above the horizon, in the unusually clear sky just above the rising moon.

Whilst making notes, a gentleman came by, who said that he had seen it earlier, when as high as, and very near τ and μ Ursæ Majoris (the hind paw), or about an altitude of 58°, 5° north of east. Thus its angular path was 53°. As the additional distance was nearly half that observed by myself, it must have been visible for at least 7 seconds before I saw it, or 32 seconds in all. This makes due allowance for its apparently quicker motion at first. But the gentleman himself thought that he had not seen the actual commencement.

It is to be hoped that some other reports will be received, for its path must have been of extraordinary length, even if it was only travelling at ten miles per second, which is the almost irreducible minimum for a meteor.

A third observer saw it from indoors, appearing from above the window and falling vertically down the panes. It is a reasonable assumption, for a meteor of so great duration, that it first appeared at a height of 100 miles and reached within 30 miles of the earth. If so, its approximate path would be from above 25 miles off Bridlington to the coast of Denmark, north-east of Heligoland. The flight would be 360 miles, or rather over 10 miles per second.

Bootham, York. J. EDMUND CLARK.

RECENT WORK OF THE GEOLOGICAL SURVEY OF THE UNITED STATES.

I.

OWING to the fact that much of the sphere of operations of this Survey lies in a new country, it is compelled to undertake a great deal of work of a class which does not usually fall to the lot of a body of geologists; chief amongst this stands topographical

work. It was found that large tracts of country were unmapped, or else that such maps as did exist were worthless for geological purposes; so the Survey set itself to produce the necessary maps, and a very considerable advantage is likely to accrue to the country from the two types of survey being directed by one organisation. A map that is good enough for the reception of geological lines, is capable of all the uses for which a small scale map is ever available, while the employment of men who understand something more of the origin and types of topographic features than map-makers usually do, must conduce to the more accurate generalisation and delineation of surface features.

It is from this point of view that the monograph of topographic methods by Mr. H. Gannett[1] is likely to be of considerable use, both on the staff of the Survey, for whom it was primarily designed, and elsewhere. In addition to giving a concise description of the chief instruments employed and the methods of using them, this work contains a set of logarithmic and other tables for use in the field, with a short account of the method of origin of the chief surface features; this shows the usual types of contour and outline special to different cases, and it is so written as to give those charged with the sketching of these features some rough guides for the better delineation of them. The same work gives a map to show the progress of the topographic map executed by the Survey, and the contributions toward this work by other bodies, such as the following: The survey of the Fortieth Parallel, Hayden's survey of the Territories, Powell's Rocky Mountain survey, the U.S. Coast and Geodetic survey, the U.S. Lake survey, the General Land Office, the surveys of various States, the Engineers of the U.S. Army, several railway, astronomical, and private surveys, and the Town and County maps.

The completed maps will be on the scales of one mile and two miles to the inch, and the size of the sheets will be so regulated that all sheets on the latter scale will contain one-half, and those on the former, one-quarter of a degree, both of latitude and longitude.

One of the bulletins[2] contains a series of sketch maps showing the systems of primary triangulation adopted by this Survey and its predecessors and coadjutors. Another most useful publication, also by the same writer, is a set of geographical dictionaries of the several States; of these, the following are already published: Rhode Island,[3] Massachusetts,[4] Connecticut,[5] New Jersey.[6] Each of these "is designed to aid in finding any geographic feature upon the atlas sheets of the State, published by the U.S. Geological Survey. It contains all the names given upon those sheets, and no other. Under each name is a brief statement showing the feature it designates and its location, and opposite to it is the name of the atlas sheet, or sheets, upon which it is to be found." The heights of many important points, the length of many streams, and the areas of townships are given. It need hardly be said that such a task as this is one which might with great advantage be taken up by the Ordnance Survey at home, and the exact latitude and longitude, as given on the map, might be added for the purpose of precision in location.

An article by Mr. Gannett, in one of the annual reports,[7] deduces from the contoured maps some useful estimates of the height of most of the States in the Union, and the average elevation of the whole country. From this we gather that, while the country contains 200,000 square miles under 100 feet in height, there are nearly 20,000 square miles above 10,000 feet. The largest part of the area, half a million square miles, is between 500 and 1000 feet; the loftiest State is Colorado, closely followed by Wyoming 6700, and Utah 6100 feet, while the average elevation of Delaware is but 60 feet. The average height of the United States is 2500 feet. This article is illustrated by a beautiful orographic map of the country.

Turning now to publications of a more strictly geological interest, we may say a word or two about their character as a whole. In addition to the maps, of which the issue has now begun—these consist of three sets, the annual reports, monographs, and bulletins—statistical papers on the mineral resources of the States are published annually as well.

It is not quite easy to see what is the guiding principle underlying the division of these different works. The monographs are of course reserved for important and original researches bearing on all branches of geology. The annual report contains an account of the work executed within the year, together with a collected set of the more important investigations completed within the same period. These do not appear to differ in any marked degree from the bulletins in character, while they are decidedly bulky and difficult to handle and read. They are, however, profusely illustrated, and may presumably be taken as the more popular of the publications—works intended to be used by those seeking for information on soils, water, mines, and such-like topics—and as containing the researches of interest to the ordinary citizen or reader. This idea seems to be borne out by the amount of rather rudimentary matter given, occasionally in somewhat high-flown language, in these papers. Presumably the form of language employed is well understood in the States; but, over here, one cannot help thinking that simpler language would be a more fitting garment for such elementary ideas. The bulletins as a rule contain simple and straightforward statements of fact, with theory kept well in subjection; they consist of descriptions of particular areas, accounts of work in the field, the laboratory or the cabinet, palæontological and correlation papers, and compact pieces of petrological investigation.

Hitherto the annual reports have been loaded with a mass of details which, after once being presented to Congress, need hardly have gone further, such as the travelling bills of each exploring party, and other statements of accounts. We are glad to notice that now the administrative report of the director and those of the heads of divisions are bound with that account in a separate volume, while for several years the work on irrigation has been placed within separate covers.

We pass now to papers dealing with physiography from a standpoint more or less geological, and generally with the idea of providing matter of use to the general public. In the first place stands the treatise by Prof. Shaler on soils.[1] After a preliminary description of the average soil and its composition as regulated by the amount of stony and organic constituents which it contains, certain types of soils are classified as follows:—

Cliff-talus soils.
Glaciated soils.
Volcanic soils.
Soils of recently-elevated ocean-bottoms.

The chief formative agencies are in each case described, and the peculiar suitability of certain soils for particular purposes, such as talus soils for vineyards, is

[1] *Monograph* xxii., "A Manual of Topographic Methods," by Henry Gannett. (1893.)
[2] *Bulletin* 122, "Results of Primary Triangulation," by Henry Gannett. (1894.)
[3] *Bulletin* 115, "A Geographic Dictionary of Rhode Island," by Henry Gannett. (1894.)
[4] *Bulletin* 116, "A Geographic Dictionary of Massachusetts," by Henry Gannett. (1894.)
[5] *Bulletin* 117, "A Geographic Dictionary of Connecticut," by Henry Gannett. (1894.)
[6] *Bulletin* 118, "A Geographic Dictionary of New Jersey," by Henry Gannett. (1894.)
[7] Thirteenth Annual Report of the United States' Geological Survey, 1891-1892. (1893.)

[1] Twelfth Annual Report of the United States' Geological Survey, 1890-91. (1891.)

pointed out. The author then turns to the slow disintegration of glaciated surfaces contrasted with the easily rotted and fertile volcanic soils, and describes the succession of vegetable organisms in reclaiming new soils, and gradually rendering them suitable for tillage, beginning with the most humble, and passing up to the more conspicuous plants, and those useful for the purposes of man.

We next proceed to the ordinary types of soil in the valleys and plains, and opportunity is taken to give the life-history of soil from its first separation from the parent rock, all through its slow journey down the hillside, until it passes out to the streams and the sea. The action of frost and rain, of snow and wind, of carbonic acid and oxygen, but not of the very important humus acids, is given in full detail, and the great importance of widespread forest vegetation in preparing the soil for subsequent tillage by deep disintegration is rightly insisted on. The pumping of air in and out of the soil by rain and evaporation is shown to be of vast use, not only to the larger plants, but to the bacteria and fungi, which are of such great import in the life and death of higher organisms.

A capital series of pictures illustrates this monograph; one can only wish that in all cases the localities were specified. The function of roots, whether alive or dead, is well described. Darwin's work on earth-worms is referred to, and the operation of beetles, ants, crawfish, burrowing birds, reptiles, and rodents dealt with. A section of the paper relates to deposited soils, and great stress is laid on the circulation of soil and the functions of materials, which are the survivals of rocks which may have long ago disappeared, but whose influence in the soil does not pass away for very long periods. Certain peculiar soils, such as those of swamps, marine marshes, and sand dunes, are not neglected, and prairie soils are explained as due to the destruction of forests by fire. Man and the soil succeeds, and it is pointed out how great an action and reaction there is between these two, so that not only the distribution of disease, but even that of slavery can be shown to have a distinct direction with the soil. The following words may be noted in conclusion: "A heedless neglect of our duty toward it has led to the destruction of the soil over an aggregate area of not less than 4000 square miles. This means the loss of food-giving resources which would be sufficient, with proper care, to support a population of about one million people."

Prof. Shaler contributes to another annual report[1] a valuable and original article on the geological conditions of harbours. The following types are of importance in the United States, and it would be easy to recognise them elsewhere:—

Delta harbours; the Mississippi.
Re-entrant Delta harbours; Mobile Bay.
Glacial or Fiord harbours; Cape Breton.
Mountain Range harbours; Lower California and North of Puget Sound.
Moraine harbours; East end of Long Island.
Lagoon and Sand-bar harbours; Chatham harbour.
Sand-spit and Travelling Beach harbours; Provincetown harbour on Cape Cod.
Coral Reef harbours; Florida and Atolls.
Volcanic Crater harbours; not known in the States.

Prof. Shaler points out how important good harbours are in developing a race of sailors, and through them acquiring commerce and influence. His text is pointed by reference to the fact that the English-speaking race, or their kindred, the Dutch, possess nine-tenths of the valuable islands beyond the limits of Europe, and that North Europeans bid fair in time to dominate every part of the world fit for their occupation. "These considerations make it plain that the way to national power is over the waves, and that this way is the natural path of our race."

It is essential that a good harbour should fulfil the following conditions:—

It should be protected from the incursion of heavy waves.

There should be a deep and roomy channel from the anchorage to open water.

There must be ample room to receive and discharge cargoes.

It should be convenient for access from the interior.

In addition to this, it should be roomy, not in the path of heavy currents, not liable to shifting channels or deposits, nor likely to be obstructed at any time by ice. Harbours may be injured in greater or less degree by floods, winds, tides, by movements of the solid land, and by the indirect consequences of all these causes. The great preservers are the scour of tides and currents; the great destroyers, sediment and the growth of organisms. The action of sediment is fairly well understood and allowed for by engineers, but the influence of animals and plants is here dealt with in more detail than we remember to have seen elsewhere. The protecting work of algæ and seaweed is thoroughly explained, and the "eel-grass" (*Zostera maritima*) described in detail; this seems to have great influence in arresting the deposit of sediment, and causing the silting-up of harbours. The general operation of the tide-water grasses is to diminish the area of the harbour, and to deepen the channels which remain; that of mangroves is to occlude the harbour by cutting out the storage of water at high tide. The destructive work of plants appears to far exceed that of polyps. The article concludes with a review of the whole coast-line of the States, and the origin of all the important harbours.

The article on potable waters, by Mr. McGee,[1] contains a good deal of useful information, from the building of cisterns to the fouling of well-water by cesspools. Direct rain-water supplies are first dealt with, and the necessary filtering, which such water needs, described; next stream-water, and then that from shallow and deep wells, the latter source being termed *phreatic* water, whether from deep-seated springs, from artesian wells, or deep-pump wells.

Dr. A. C. Peale, who has done such an immense amount of unassuming and scarcely appreciated work for the survey in past years, contributes a much more important paper on natural mineral waters of the country.[2] This includes a table of all mineral springs which yield more than 1000 gallons per hour; these number more than 120. Mineral springs are found to be usually associated with areas of sedimentary rock, particularly in the neighbourhood of mountain ranges, where they have suffered much disturbance, and where volcanic action is now, or recently has been, rife. The annexed classification is adopted:—

(A) Non-thermal.
(B) Thermal.
  (1) Alkaline.
  (2) Alkaline-saline.
  (3) Saline.
  (4) Acid.

Each of the four last divisions is again divided into sulphated and muriated, and the last into siliceous as well. It is recommended that, in future, analyses shall conform to the scheme laid down by the Chemical Society of Washington, the most important points in which seem to be that solids shall be expressed in parts per million, and that the radicles actually found shall be expressed; while the chemist is at liberty to express, in addition, the probable state of combination in which the different ingredients occur. A brief account is given of the various

[1] Thirteenth Annual Report of the United States' Geological Survey, 1891-92. (1893.)

[1] Fourteenth Annual Report of the United States' Geological Survey, 1892-93. (1894.)

[2] *Ibid.*

purposes for which the more important waters are used, and two maps are appended; the second of these indicates the distribution of waters used commercially, and the first shows, as might be expected, the much wider dispersal of springs used as health resorts. A complete list of known springs closes the paper.

Mr. Merrill follows[1] with an account of the results of stream measurements. These are carried out by means of current meters, while the fluctuation of streams is recorded by nilometers. The "run-off" is expressed in second-feet (*i.e.* the water carried by a stream 1 foot wide and 1 foot deep flowing 1 foot per second), and the total discharge in acre-feet. The records have been continued monthly for many years, and yield a vast body of useful hydrographic information with regard to such rivers as the Missouri, Yellowstone, Rio Grande, Arkansas, Bear, and Snake Rivers. Curves are drawn where possible, and there are two maps, one delineating the rainfall of the States, and the other the run-off of the principal river basins. The latter quantity reaches a maximum in the eastern States, and at the southern end of the Rocky Mountains in Wyoming. Run-off is a function of rainfall and topography, with modifications introduced by other conditions, such as climate, structure, and vegetation; the ratio of run-off to rainfall is greater in mountain districts than in valleys.

A list of Californian earthquakes in 1893, by Mr. C. D. Perrine, is given in *Bulletin* 114.[2]

We have reserved till last the modestly told account of Mr. I. C. Russell's exploration of the Malaspina glacier, and his plucky attempt to reach the summit of Mount St. Elias.[3] Although unsuccessful he appears to have done enough to be able to point out a route which, with better luck and weather, will probably lead the way to this coveted point; and one cannot but hope that it may fall to the lot of this explorer to be the first climber to reach the top.

The Malaspina glacier is fed by all the southern and western ice-streams of the St. Elias range, which is but an outpost of a vast mountain area to the north. From the highest point which he reached, Russell saw this new land spread out before him like a map; but the point of view was not reached without much labour in the carrying of camp equipments, and in step-cutting up the great ice-falls. The glacier seems to be a great reservoir or sea of ice, stagnant or retreating, rather than a living and growing river of ice, and it deserves the term "piedmont glacier" bestowed on it by our author. It only pushes out into the sea at one point, Icy Cape, to the west, but elsewhere it is separated from the ocean by a belt of flat land of varying width. This border gave the same trouble to Russell's party that it has done to English explorers, on account of its icy-cold rivers and dismal swamps, somewhat mitigated in this case by the vast strawberry meadow in which the first camp was pitched.

Cutting a way through the great forest-belt, and pushing through the thick moraine at the margin of the ice, the party went across the glacier in the direction of the Chaix Hills, noting here and elsewhere the astonishing feature that the live moraine was often covered with a dense coat of vegetation, including trees of considerable age and size.

The Chaix Hills are made of stratified sands and clays containing marine shells, and some 4000 or 5000 feet in thickness; these deposits were evidently formed in the sea at the extremity of a glacier, and subsequently uplifted. The uplift appears to have taken place along a line of fault extending from the Robinson Hills at the west, past the Chaix Hills, and on to the Samovar Hills and Pinnacle Pass at the east. Thence they pushed across the Agassiz and Newton glaciers, passing many ice-falls, the surface between which had a gentle and, even in some cases, a reversed slope. Capital descriptions of the scenery are often given, and numberless glacial observations recorded.

Although the party camped for twelve days at the entrance of the amphitheatre at the head of the Newton glacier, the weather only permitted of one advance during the time. They then reached an altitude of 14,500 feet on the col between the summit of Mount Newton and that of St. Elias; but here they found themselves forced to return, as they had not strength to accomplish the 6500 feet between themselves and the summit in addition to the labour of returning to camp that night. It was concluded that it would be necessary to camp on the col itself, when a final attempt of the peak was made. A second effort was made, but the avalanches and the dangerous condition of the snow compelled a speedy retreat, and, bad weather setting in, they were obliged to abandon the attempt, and confine themselves to investigations on the glacier at lower levels, and on its margin. They had, however, reached high enough to obtain a glorious panorama extending to Mount Fairweather, 200 miles away to the south-east, and to mountains of equal altitude and distance to the north-west. They looked to the north over a great "land of nunataks," a vast area of snow 8000 feet high, dominated by peaks rising yet 4000 feet higher.

The expedition then retreated down the glacier to where the Yahtse River emerges from its cavern of ice; thence they went along the shore to Yakutat Bay, exploring the edge of the ice on the way, and then they extended their survey along Disenchantment Bay, which, judging from the vivid description given, might well dispense with the first syllable of its name. It appears to be a charming region of mountains, glaciers, and bays, which may well in the future attract the notice of travellers and climbers in search of new ground.

The height of Mount St. Elias was determined, within a plus or minus error of 100 feet, as 18,100 feet. The work at the edge of the ice gave many useful results. The supremacy of the water action in the sea, and even in the rivers, soon made itself felt in the characters it induced on the material transported by the ice, but laid down in the water; the ice frequently traversed unconsolidated material without disturbing it, and ridges of gravel, very like kames and eskers, were found to have been deposited by glacial rivers when at a higher level than that at which they at present flow.

On the main mass of the glacier there are many new facts recorded; but we have room for only a few of them. Dykes of veins of hard ice, frozen in fissures, are added to the many structures in which ice resembles less transient rocks. A rough sorting of débris takes place on the ice surface as the rocks roll down the numerous irregularities, due to melting and other causes; moulins become filled with gravel when the water-action ceases, and then, becoming preserving causes, give rise to "sand cones," which recall the earth pillars of the Tyrol. In the stationary parts of the ice numerous lakelets of strange hour-glass-shaped section occur. Lakes of the same method of origin as the Märjelen Lake are frequent where the ice passes nunataks and valleys. The main drainage of the ice is englacial or subglacial, and surface streams are rare and evanescent. Finally, these streams tend to cut their channels upward through the ice as their floor gets coated with débris, which not only checks mechanical erosion, but is a bad conductor of heat. An immense amount of water-rolled material takes its place amongst the more truly glacial detritus, and it is somewhat noteworthy that nothing corresponding to *moraine profonde* is described by Mr. Russell in his report.

The strictly palæontological work in the period under

[1] Fourteenth Annual Report of the United States Geological Survey, 1892-93. (1894.)
[2] *Bulletin* 114, "Earthquakes in California in 1893," by C. D. Perrine. (1894.)
[3] Thirteenth Annual Report of the United States Geological Survey, 1891-92. (1893.)

review is rather scanty. It includes a short paper on the American Tertiary Aphidæ, by Mr. Scudder.[1] This comprises a list of known species and five plates. A monograph, by the same author, on the Tertiary *Rhynchophorous Coleoptera*[2] contains descriptions and figures of a great number of new genera and species, 193 species having been found in the older American Tertiaries, while only 150 species have been described from the whole of the European Tertiary rocks. This makes a first instalment towards a history of fossil Coleoptera.

Mr. Whitfield has written a description of the mollusca and crustacea of the Miocene formation of New Jersey.[3] This work, which is illustrated by twenty-four plates, describes the only brachiopod and cirripede found in these beds, with a large number of gasteropoda and lamelli-branchiata, many of which are now described for the first time.

Mr. C. R. Keyes gives, in *Bulletin* 121,[4] a bibliography of North American Palæontology 1888-1892. This comprises 251 pages, and in an alphabetical series are included a list of names of authors, with a short synopsis of essential points, including lists of genera and species described and figured, a title-index, and subject entries and cross references. A list of subjects is given in the introduction, and also a list of works examined, which may save a good deal of trouble. The list is by no means perfect, but it is undoubtedly a most important contribution to bibliography.

In a subsequent article it is proposed to deal with researches in petrological, dynamical, and stratigraphical geography.

OSTWALD'S ENERGETICS.

IN the February number of *Science Progress* there is an interesting article, by Prof. Ostwald, on "Emancipation from Scientific Materialism." There are so many vague fallacies underlying it, that it would hardly be worth answering, only that there is considerable risk that others, chemists especially, may be carried away by the arguments of one whom they rightly value as a leader in their own domain when he descants positively about the realm of mechanics.

Prof. Ostwald begins by saying that the current view of a mechanical universe fails in two respects. (1) It does not fulfil the purpose for which it was designed, and (2) it is inconsistent with known truths. It is, in the first place, to be remarked that nobody who has considered the matter really seriously can maintain that atoms and motion must constitute the whole universe. Such a view leaves thought out of account, and all that can be held is that material phenomena are so explicable. Prof. Ostwald ignores such theories as that of vortex atoms, which postulate only a continuous liquid in motion; but, it may be, this is omitted because it is merely a way of explaining the atoms. He also ignores metaphysical questions, such as whether motion be not only the objective aspect of thought, and also whether an intuitively necessary explanation of the laws as distinct from the origin and consequent arrangement of phenomena is not postulated by the fact that the universe must be intelligible. Consequently his attempt to deal with nature in a purely inductive spirit is unphilosophical as well as unscientific. The view of science which he puts forward—a sort of well-arranged catalogue of facts without any hypotheses—is worthy of a German who plods by habit and instinct. A Briton wants emotion—something to raise enthusiasm, something with a human interest. He is not content with dry catalogues; he must have a theory of gravitation, a hypothesis of natural selection. This deadly science without hypothesis is far worse than the materialistic *ignorabimus* of Du Bois Reymond; it is the culmination of the pessimism of Schopenhauer.

Prof. Ostwald's first line of attack is that the materialistic hypothesis does not fulfil the purpose for which it was designed. When this is investigated, it turns out that all he means is that everything in nature has not yet been explained on mechanical principles. And long may it be so. The zest of science is discovery. If everything were explained—well, it is so far off we may wait till it comes to describe what will happen. He notices several things which are certainly not explained yet. Such, for instance, as why when atoms combine they produce a result so very different from their components. As nobody has yet suggested any reason why the atoms themselves possess the very curious properties they do, we can hardly expect a satisfactory explanation of why these properties change when they combine. Any way, the existence of an uninvestigated region of this kind does not create any reasonable doubt as to the foundations of the road that has led us well so far.

His second attack is deliberately founded on this, that mechanical hypotheses have not yet been found to explain everything. "I grant," he says, "that for many individual phenomena the mechanical analogues have been given with more or less success. But all attempts to completely represent the whole of the known facts in any department by means of some such mechanical analogue have resulted without exception in some unexplainable contradiction between what really happens and what we should expect from our mechanical model. This contradiction may long remain hidden; but the history of science teaches us that it sooner or later makes its inevitable appearance, and that all we can say with complete certainty regarding such mechanical similes or analogues—usually termed mechanical theories of the phenomena in question—is that they will doubtless on some occasion fail."

All that this really means is that we have not yet explained everything on mechanical principles, and that when we do get a little way on, we are delayed again by something more that requires explanation. But surely this and nothing else is what we ought in all reason to expect. It is about the best test we have that we are on the right track. Prof. Ostwald cites optical theories as an example of the kind of failure he refers to. He seems for some extraordinary reason to imagine that the *elastic solid* theory of the ether is in some curious way specially connected with the mechanical hypothesis of the universe. It is far from being so. The mechanical theory of an elastic solid itself has been only very dimly foreshadowed, and Prof. Ostwald's contention that transverse vibration "presupposes a solid body" is in direct contradiction to Lord Kelvin's theorem that a liquid in turbulent motion could transmit transverse vibrations. Even Lord Kelvin's elastic solid ether in a state of tension could exist if it be infinite, so that here again Prof. Ostwald is mistaken in saying that, because it could not be stable if finite, it can have no physical existence. And finally Prof. Ostwald takes refuge in the as yet unexplained constitution of an ether whose properties were discovered by assuming them to be mechanical, and were only discovered about thirty years ago, and have not been seriously investigated until within the last ten years. Surely no argument can be based upon the fact that there are limits to our present knowledge.

Prof. Ostwald's third attack opens out a new view. We see here a human reason for his desire for emancipation from the mechanical hypothesis. He is dissatisfied with Du Bois Reymond's *ignorabimus*. But even Du Bois

[1] Thirteenth Annual Report of the United States Geological Survey, 1891-92. (1893.)

[2] *Monograph* xxi., "The Tertiary *Rhyncophorous Coleoptera* of North America." By Samuel Hubbard Scudder. (1893.)

[3] Monographs of the Geological Survey of the United States, vol. xxiv. (1894.)

[4] *Bulletin* 121, "A Bibliography of North American Palæontology, 1888-1892," by C. R. Keyes. (1894.)

Reymond is not infallible, and most prophecies as to the limits of human knowledge have turned out to be only limits to the ingenuity of the prophet. It is very much more likely that Du Bois Reymond's apparently resistless logic has a flaw, than that the path of progress of science for three hundred years has been along the wrong route. There are plenty of philosophical speculations, which no doubt Du Bois Reymond brushes aside as hardly worth consideration, which would entirely invalidate the greater part of his arguments. Even though they do not, it is certainly quite unscientific to leave a road that has led to great discoveries merely because you imagine that there is some curious spectre in the distance to which you think it is leading you.

Prof. Ostwald's fourth attack is based on the fact that seeds grow into trees, but that trees do not grow back again into seeds. He thinks that if the universe were a mechanical system, there is no more reason for one than the other, and that they should occur equally often. As he says, "the tree could return again to the sapling, &c." But that is not the question. The question is, *must* it, if this is a mechanical universe. The order of events depends entirely, in a mechanical universe, upon the *initial conditions*, and all we can say is that the initial conditions of this earth were such that trees generally grow from seeds, and that the reverse operation has never been known to occur. That it *has* never occurred has nothing on earth to say to the question of whether this is a mechanical universe. As a matter of fact, I believe that this and other much simpler cases, such as are usually classed under irreversible actions in thermodynamics, can be shown to be not only, as I have here argued, *possible* mechanical processes, but to be *the most probable* mechanical processes. Hence it is quite possible that the actual sequence of events which Prof. Ostwald cites as disproving the mechanical theory of the universe may be the very best proof extant, not only that the mechanical theory is the most probable theory, but it may even lead us to conclude that it is the only possible theory.

Finally, Prof. Ostwald tries to build up something instead of what he thinks he has demolished. A vague energetics is what he presents instead of the mechanics of the past. He advocates the deadly view that science should be a catalogue, well arranged, no doubt, but free from those dreadful hypotheses. He prefers volume energy to the molecular theory of gases. He criticises this latter by neglecting to see that the quantity often quoted as energy per cubic centimetre of the gas is really momentum per second carried across a plane, and has consequently that very element of direction which he accuses it of not possessing, and the absence of which in volume energy one might possibly expect him to explain. Prof. Ostwald's idea of science as free from hypothesis is the most advanced form of pure positivism. If he were consistent, he should deny the existence of thought in the moving coloured, soft, objects he sees and feels around him, and calls men. That other men think is a hypothesis; and if he rejects all hypotheses, why not this?

In conclusion, Prof. Ostwald seems to have some dim doubt whether energetics will explain everything. As the doctrine of the conservation of energy will not determine by itself the motion of even a single planet round the sun, it is somewhat curious to see the doubt that seems to haunt him in answering this question. The doctrine of the conservation of energy is most valuable, but it goes only a very little way in explaining phenomena. More than energetics is certainly required unless we are prepared to endow energy with all sorts of curious properties after the manner of our predecessors, who used to invent a new subtle fluid with convenient properties in order to explain every new difficulty. Prof. Ostwald's energy seems more like one of these subtle fluids than any product of modern thought.

GEO. FRAS. FITZGERALD.

THE HIGHLANDS OF PERU.[1]

THE two first volumes of this work were noticed in NATURE, vol. li. p. 388, and the general remarks made there apply in great measure to the new volume also. We must, however, observe that the highlands of Peru afford material for a much more interesting description than the coast and the capital, which were dealt with in somewhat wearisome detail. Here the narrative form is not unwelcome, for there is always a charm in the

The Andes from Chililaya, Lake Titicaca

[1] "Beobachtungen und Studien über das Land und seine Bewohner während eines 25-jährigen Aufenthalts." III. Band. Das Hochland von Peru. Von E. W. Middendorf. Pp. 604. (Berlin: Robert Oppenheim [Gustav Schmidt], 1895.)

record of travel in the Cordillera, even upon the beaten tracks.

A short general introduction gives some account of the Andes as a whole, with remarks on the characteristic scenery, on the roads, the methods of travelling, and a few pages on the vegetation. Then follows the description of a series of four journeys through different parts of highland Peru, with observations drawn from official sources regarding some places not personally visited, such as the Amazon territories and the Bolivian coasts of Lake Titicaca. The first journey led over the Cordillera Negra and the Cordillera Blanca in Central Peru to Huanuco and the famous mining town of Cerro de Pasco, 4350 metres in elevation, with great silver-mines tunnelled into the mountains. The best room of the best hotel in this loftiest town in the world was found in such a condition that Dr. Middendorf could not say whether its floor was of tiles, mud, or boards, and he hailed the invitation of the Scotch engineer in charge of the mines as a happy deliverance.

The second journey was in the northern part of the republic, from the seaport of Pacasmayo by Cajamarca to the Maranon valley and Chachapoyas, returning across the Cordillera by Huanachuco to Trujilla. A short account of the Amazon province of Loreto is added, and an historical narrative of the discovery and exploration of the Amazon.

The third journey was a visit to the great plateau-lake of Titicaca, with many particulars regarding the ancient ruins of the Inca time. The concluding section, on the mountains of Southern Peru, describes the return journey down the long valley to Cuzco, and thence over the Cordillera past Ayacucho to Lima.

Throughout the work there are happy descriptions of the native peoples, the scenery, and the incidents of the journey. Dr. Middendorf seems to have paid considerable attention to linguistic studies, and also to the architecture of the ancient ruins. He especially remarks the contrast between the mud-huts, or dwellings built of sun-dried bricks, which characterise the arid coast-strip, and the megalithic masonry of the lofty plateaus and high mountain valleys.

The illustrations throughout are extremely well chosen, really illustrative of the natural features of the great Cordillera, and they are numerous enough to satisfy the most exacting. An index to all three volumes completes the work.

SEKIYA SEIKEI.

ALL students of seismology and vulcanology will learn with regret that Prof. Sekiya has passed from amongst us. He was born towards the end of 1855, a year well remembered by the inhabitants of Yedo as that of the great earthquake. In 1876, whilst on a visit to England to complete his studies as a mechanical engineer, he fell a victim to consumption, the symptoms of which gradually grew more and more severe until January 9 of this year, when they culminated in his death.

After acting as assistant to Prof. J. A. Ewing, in 1886 he was appointed to the newly-created chair of Seismology at the Imperial University of Japan.

A lasting testimony to his ingenuity and perseverance, which is to be seen in many museums, is a model illustrating the path followed by an earth particle at the time of an earthquake. Although he wrote much in Japanese, he contributed many valuable papers and memoirs in English or French to the journal issued by his own college, to the *Transactions* of the Seismological Society, and to other periodicals.

The impetus he gave to seismology by the enlargement of the University Laboratory, the establishment of instruments throughout Japan, and to the extension of the seismic survey of that country, which now boasts of 968 stations, is well known to his colleagues and acquaintances. Sekiya was a kind and sincere friend, and his honesty and unflinching straightforwardness of speech were a by-word amongst all who knew him. J. M.

NOTES.

PROF. J. J. SYLVESTER, F.R.S., has, with the approval of his Majesty the King of Italy, been elected a Foreign Member of the Royal Academy of Sciences of Turin.

A NUMBER of admirers of Prof. Mittag-Leffler, the founder of the *Acta Mathematica*, will shortly present him with a congratulatory address, written in four languages—German, French, Italian, and English—and expressing the appreciation of mathematicians of the services he has rendered to their science. It is proposed to present him at the same time with his portrait in oils, and a subscription list has been opened to obtain funds for that purpose. Prof. Appell, 6 rue Le Verrier, Paris, will be glad to receive subscriptions.

SIR J. RUSSELL REYNOLDS has expressed his intention to retire shortly from the Presidency of the Royal College of Physicians.

THE Chairman of the Local Committee for the Toronto meeting of the British Association for the Advancement of Science is Dr. A. B. Macallum.

AT the ordinary meeting of the Royal Meteorological Society, on Wednesday next, a lecture will be given by Mr. Frederic Gaster, on "Weather Forecasts and Storm Warnings, how they are prepared and made known."

A LIVE gorilla, said to be the largest ever imported into this country, has just been received at the Zoological Gardens, Regent's Park. The animal comes from near Ngove or Iquela, on the French Congo, and is in excellent health.

THE De Morgan medal, which is given triennially by the London Mathematical Society, will be awarded in June next, and nominations may be made at either the March or April meetings of the Society. Prof. Klein, of Göttingen, editor of the *Mathematische Annalen*, was the last recipient.

THE Paris correspondent of the *Times* states that a tablet commemorating Franklin's residence at Passy, then a village outside Paris, was unveiled on Sunday in the wall of the Christian Brothers' School, Rue Raynouard. M. Faye, of the Academy of Sciences, and M. Guillois, a local antiquary, delivered addresses.

SIR W. M. CONWAY proposes to take a party to Spitzbergen next summer, for the purpose of exploring the interior. He expects to be accompanied by Mr. Trevor-Battye, and by four others, all of them scientific experts in different branches, so that the journey may result in valuable increase to scientific knowledge.

WE regret to announce the deaths of Mr. James Abernethy, past-President of the Institution of Civil Engineers, and a Fellow of the Royal Society of Edinburgh; Dr. Alfred D. Kennedy, a distinguished chemist and toxicologist, of Philadelphia; Dr. H. Ernest Goodman, Professor of Surgery in the Medico-Chirurgical College, Philadelphia; Dr. R. M. Hodges, Professor of Surgery at Harvard; and Christophe Negri, the Italian economist and geographer.

THE second International Horticultural Exhibition will be held at Dresden, from May 2 to 10 next, under the patronage of

the King of Saxony. Prizes will be awarded for exhibits of flowers and plants, cut flowers, arrangements of flowers for decorative purposes, plans of gardens and greenhouses, garden buildings, heating appliances, and other horticultural requisites. Applications for space to exhibit flowers and fruit, as well as for forms of entry and programmes of the exhibition, must be made, not later than April 10, to the "Geschäftsamt der II. Internationalen Gartenbau-Austellung, Dresden."

HERR ANDRÉE'S balloon for his polar expedition is taking shape. The upper half is already sewn together, and the parts of the lower half are cut out. The Société Nordenfelt, who desired that this trust might be given to them, are superintending and controlling the work on the balloon. Arrangements have been made with the builder, Mr. F. O. Peterson, in Gothenburg, to construct a balloon house, to be ready by May 25, and two competent men, who are assisting in the construction, will go to Spitzbergen to erect the house. The *Virgo*, the steamer in which the aeronauts will set out for Spitzbergen, will carry about thirty-five tons of sulphuric acid to generate the hydrogen. Great interest is felt in the enterprise all over Sweden.

IN the House of Commons on Tuesday, for the first time since the question of the opening of museums and galleries was raised in Parliament, a majority was obtained in its favour. Mr. Massey-Mainwaring's motion was:—"That, in the opinion of this House, it is desirable that the national museums and art galleries in London should be open for a limited number of hours on Sundays, after 2 p.m., upon condition that no officer shall be required to attend on more than six days per week, and that any who may have conscientious objections shall be exempt from Sunday duty." On a division, an amendment to the resolution was rejected by 178 votes against 93, and the resolution was then agreed to. It only remains now for the Government, and the Trustees of the British Museum, to put the resolution into effect.

THE Lord Mayor presided on Friday, at the Mansion House, over a meeting held for the purpose of discussing the arrangements for the International Horse and Horseless Carriage and Roads Locomotion Exhibition, which it is proposed to open at the Crystal Palace in May next. Mr. A. Sennett was elected honorary executive commissioner, and executive committees for horse-drawn and mechanically-propelled vehicles respectively were appointed, the members including Sir Frederick Bramwell, Sir Douglas Galton, Sir H. Trueman Wood, Prof. Boys, Sir David Salomons, Mr. G. N. Hooper, Mr. Jacobs, Mr. W. Warby Beaumont, and Mr. E. Macrory, Q.C. It was announced by Sir David Salomons, who occupied the chair during the latter part of the proceedings, that Lord Kelvin had consented to join the honorary Council.

WE learn through the *Engineer* that the management of the *Cosmopolitan*, a monthly magazine, is offering £600 in premiums to be awarded to horseless carriages presenting the greatest number of points of excellence, as exhibited in a trial trip to be made on May 30. This trip will be from the City Hall Park, in New York, to Irvington and back, a total distance of 52 miles. The award will be made upon the following points, the maximum aggregate being 100:—Speed, 50; simplicity and durability of construction, 25; ease in operating, and safety, 15; cost, 10. The route will be along Broadway, through Central Park and over the Washington Bridge, thence along the main road to Yonkers, where the course will include five miles of asphalt paving, and then on to Irvington, on the Hudson River, 26 miles. There is a good road for the entire distance.

A BRIGHT aurora was seen at Worcester and other places on Wednesday, March 4. Mr. Lloyd Bozward says that at 7.30 on that evening "a remarkable beam of white light of dazzling brilliancy, far exceeding anything of the kind of recent years, arose from a point in the north-west, extending to the zenith, and spreading out fan-like in rising. So rare have been the appearances of the aurora here of late, and so startling the radiant effulgence, that many persons attributed the beam to the effect of an electric search-light."

A DISCOVERY of much interest has, says *Science*, recently been made in Western Kansas of an extinct species of Bison, the skull having an expanse of nearly four feet. Embedded below the humerus of the skeleton was a small but perfectly formed arrow-head. The Bison has not yet been identified with certainty, but seems closely allied to *B. antiquus*, though evidently larger. The formation is apparently the same as that which yielded the skeletons of Platygonus, recently obtained by the University of Kansas. The Bison skeleton, that of a bull, will shortly be mounted in the University museum.

THOUGH the coral rock in the northern part of the island of Ceylon has long been used in many departments of building, the *Ceylon Observer* thinks that builders do not avail themselves of the material so fully as they might. The stone is admirably suited by its lightness and toughness of texture for use as arch stones, being very readily shaped by an ordinary saw. Several long arched bridges have been built with it in the Jaffna Peninsula, and have proved its great durability as a building stone. It has also been applied to ornamental uses, the dressings and Gothic windows of St. John's Church at Chundikuli having been constructed of it. Cut into slabs, it has furnished the covering for nearly all the road drainage of the same locality. It is suggested that much employment could be economically found for this rock in the southern districts of Ceylon, its extreme lightness favouring the cost of freightage.

THE effect of African grass-fires in changing the aspect of the vegetation, forms the subject of a short paper by Mr. Scott-Elliot in the current number of *Science Progress*. Owing to the annual clearing of the ground by these fires, there is no accumulation of leaf-mould and stems, and the soil therefore never becomes improved. The season of flowering for many trees and herbaceous plants is completely altered, a large number of the latter sending up flowering stems, entirely without leaves, after the first shower of the rainy season; and the stems only begin to produce leaves when the rains have well set in. Another curious effect of the fires is the manner in which trees are either kept down or obliged to protect themselves in some way against their action. Of the trees which do manage to exist in spite of the annual conflagration, the most remarkable are the tree Euphorbias, which seem to come out of the most violent fire with only a few scorched branches. Mr. Scott-Elliot brought home with him several specimens of the bark of the six or seven forms of trees which manage to survive the ordeal by fire, and an examination of them led Prof. Farmer to conclude "they all agree in possessing cells which show a certain amount of gummy degeneration of the cells in the bark, together with the presence of a considerable amount of sclerotic cells; it seems not impossible that these two facts may be connected with the resistance of the plants to the fires."

AN ambitious scheme, but, at the same time, one which deserves the careful consideration and full support of all British geographers, was laid before a technical meeting of the Royal Geographical Society, held last Friday, by Dr. H. R. Mill. Dr. Mill proposes that a complete geographical description of the British Islands should be prepared from existing data, supplemented to a small extent by new researches and by the collection of unpublished information. This should be done on a uniform scale for every small selected unit of the country; then combined into a series of regional memoirs dealing with natural

districts; and ultimately the whole would be generalised into one memoir on the whole country, the result of a series of generalisations carried out much in the same way as the various maps of the Ordnance Survey are obtained by successive generalisations from the largest scale produced. The chief sources of information would be the topographical map of the Ordnance Survey, the maps of the Geological Survey, the charts of the Hydrographic Department, the publications of the Meteorological Office, the Census reports, the reports of the Board of Trade and other Government departments, the publications of such societies as the Royal Agricultural, the Archæological, the Statistical, the Institution of Civil Engineers, and many others, and the pictures of amateur photographic societies. Dr. Mill explained in detail the plan of the proposed memoir, and the method in which it should be carried out. After a discussion, Mr. Clements Markham, who occupied the chair, said he should certainly recommend to the Council that the memoir be prepared under the Society's auspices. The practical problem of expense has, however, to be solved before the plan can be developed.

AN important contribution to the knowledge of the origin and movement of sand, shingle, and alluvial matter around our coasts, was made by Mr. W. H. Wheeler at the meeting of the Institution of Civil Engineers last week. It appears that the generally accepted theory, that the travel of drift along a coast is due to and is in the direction of the prevailing wind, is contrary to fact. In England the prevailing winds are from the south-west; whereas the travel of drift on the east coast is southward, on the south coast from the westward, and on the west coast northward, in each case being in the same direction as the flood tide. Mr. Wheeler has been unable to find a single instance where the regular and continuous travel of drift along a coast is in the opposite direction to that of the flood tide. While winds and waves are the agents which operate in eroding cliffs and producing the supply of drift, the continuous progressive movement of sand and shingle along the sea coast is caused by the wave action of the flood tide, which is increased when the wind blows in the same direction as the flood tide. With regard to alluvial matter in estuaries, this is derived from detritus brought down by rivers, and does not come from the sea, nor is it supplied from the waste of clay or chalk cliffs along the sea coast. The only current along the coasts of England which can transport material in suspension is that due to the tidal wave, which travels each way for about six hours at the rate of between 2 knots and 2½ knots. It is known that the material in suspension is not carried upwards for any great distance above the mouth of a river or estuary. The tidal wave propagated up a river creates only an oscillating current, and the same quantity of tidal water which goes up returns on the ebb, with the addition of the current produced by the fresh water; the tendency of movement is, therefore, downward, and not upward. Mr. Wheeler applied these and other facts to determining the principles which are essential in the construction of harbours on shingly or sandy coasts.

THE current number of the *Comptes rendus* (March 2) contains a paper by M. Henri Becquerel, on some invisible radiation emitted by phosphorescent bodies. In some previous experiments the author has shown that phosphorescent bodies give out radiation which is capable of traversing bodies which are opaque to ordinary light rays. The great interest at present shown in this subject has induced him to give an account of a number of recent experiments. The phosphorescent bodies employed have been crystals of the double sulphate of uranium and potassium. The phosphorescence of this body is very marked, but only lasts, as far as the rays which affect the eye are concerned, at any rate, for less than one-hundredth of a second. It can easily be shown that the rays emitted by this body when exposed to diffused daylight or to direct sunlight are capable of traversing not only black paper, but also aluminium and thin sheets of copper. For if an ordinary dry photographic plate, enclosed in a tin-plate slide with an aluminium window, is exposed to sunlight even for a whole day, the plate is unaffected. If, however, a crystal of the uranium salt is placed on the aluminium window, and the whole is exposed to sunlight for a few hours, then on developing the plate a shadow of the crystal will appear in black. If a thin plate of copper, cut into the form of a cross, is placed between the crystal and the aluminium window, a clear image of this cross is formed on the plate. The curious result has, however, been obtained that although the plate-holder and the uranium salt are not exposed to the light, but kept inside a wooden or cardboard box, the photographic plate shows the same images as when the salt is exposed to light. The author rather tentatively suggests that the uranium salt may continue to emit by phosphorescence radiation that is invisible to the eye, but which is capable of traversing paper and aluminium for a time infinitely great compared with the time during which it continues to emit visible rays.

THE February number of the *Journal de Physique* contains a paper, by M. C. Limb, on the determination of the electromotive force of a Clark cell in absolute measure. Instead of adopting the usual method, which is to compare the difference of potential at the ends of a known resistance when traversed by a known current with that of the cell, the author has adopted a novel method which is independent of the units of current and resistance. A magnet is rotated inside a long helix about an axis perpendicular both to its own magnetic axis and the axis of the coil. The magnetic moment of the magnet is determined by Gauss's method. If H is the field which would be produced at the centre of the long coil if the spirals were traversed by unit current, ω the angular velocity of the magnet and M its magnetic moment, then the maximum value of the electromotive force induced in the coil will be $HM\omega$. A correction has to be applied on account of the finite length of the coil which involves the distance between the poles of the magnet. The angular velocity is measured by simultaneously registering the turns made by the magnet and the beats of a seconds pendulum, the velocity being maintained constant by a specially designed tachyometer. By means of a commutator fixed to the axle of the magnet, the circuit of the coil is only closed at the moment when the induced electromotive force is a maximum. This maximum electromotive force is compared with that of the cell by means of a modified form of Clark potentiometer, a Lippmann capillary electrometer being employed to indicate when the balance is secured. This electrometer is capable of indicating a difference of potential of 0·00005 volt. The Clark cell was of the H pattern, and the author gives as his final result for the electromotive force of this form of cell at 0° C. the number 1·4535. The number obtained by Lord Rayleigh was 1·4527 volts.

THE habit of opium-smoking forms the subject of a paper, by M. H. Moissan, in the *Annales de Chimie et Physique*. M. Moissan finds that the Chinese do not smoke crude opium, but a preparation of it called *Chandu*, which, when heated to about 250° produces a smoke formed of volatile perfumes and a small quantity of morphine; this appears to produce no more ill-effects than tobacco-smoking. The commercial quality of opium, however, is very different; the residues that remain after opium-smoking are sold as dross, and when this is treated to a temperature of 300° to 325° various toxic compounds are given off.

WE have received, from Mr. E. Kayser, a pamphlet containing a considerable number of measurements of cloud-heights taken at Dantzig last summer. The observations were taken

by various kinds of instruments, but the principle was the same throughout—viz. two corresponding stations of known base were selected, and the apparatus directed at the same instant on the same point of the sky. A full description of the instruments and method is given in the text, and printed in vol. ix. of the *Schriften* of the Dantzig Philosophical Society. The publication of the work is timely, as on May 1 next a year of special cloud observation in all parts of the world is to commence, under the auspices of the International Meteorological Committee. The pamphlet contains much useful information for intending observers.

THE *Verhandlungen* of the German Geographical Society (No. 1, 1896) contain a lecture, by Mr. A. Berson, on the use of balloons for geographical purposes. As Mr. Berson has made many ascents, both in free and captive balloons, in connection with the Berlin Meteorological Office and other German institutions, his remarks possess considerable interest. He refers to the importance of captive balloons in voyages and in Arctic expeditions, and regrets that Dr. Nansen did not take one with him as he originally intended. He strongly condemns the proposal to use a free balloon in the Andrée polar expedition, and thinks it must certainly end in disaster. Mr. Berson found during his ascents that in all types of weather, and at all seasons, the temperature at great heights decreases more rapidly, or at least as quickly, as in lower altitudes, and that at a height of over 5000 metres much lower temperatures exist than those assumed after Mr. Glaisher's ascents. Also that the increase of wind velocity is much greater than was supposed; in one ascent, when the wind velocity was only about seven miles an hour at a height of between 1000 and 3000 metres, it reached thirty-seven miles an hour, between 4000 and 6000 metres. A preponderance of winds with westerly components was also observed in great altitudes, as is shown by cloud observations made at the earth's surface.

DR. C. SAPPER has studied the customs and religious views of the Kekchi Indians of Guatemala (*Internat. Arch. f. Ethnogr.*, viii. p. 195), and it is interesting to trace the Pagan-Christian overlap in the religion of these professed Roman Catholics. They will not worship in a church out of their own district, as they believe that the god of that church cannot understand them; indeed, when they go to neighbouring places, they renounce all religious exercises. Crosses are erected on mountain-passes by all the Maya Indians, and a native on first crossing a pass puts a stone at the foot of a cross, and often offers flowers and incense, and sometimes he will dance before it. If there is no cross on a pass, the Kekchi Indian prays and brings offerings to the heathen god. In order to make green parrots tender—for they are very tough—the natives put them in a hammock before cooking, and rock them, whistling to them, as if they were sleepy children. Money presents, formerly to the value of 2½ dollars, were paid by the bridegroom's father to the bride's father, but the price has now risen to 7 dollars. A girl can have a husband bought for her, but it is more expensive, as he costs 10 dollars.

IN the same journal (p. 215), Dr. J. Walter Fewkes gives a "Provisional List of Annual Ceremonies at Walpi," his idea being to bring together in proper sequence the prescribed yearly observances of the Tusayan Indians. It appears that the dates for the various festivals and ceremonies were fixed by the extreme summer and winter solstitial points of risings and settings, and by certain hillocks, notches, or trees on the horizon. When the sun appears to rise or set behind recognised definite points on the horizon, certain religious ceremonies are announced, and secular occupations, as that of planting, initiated. The author briefly describes the various annual ceremonies, the period of their commencing, and their duration. It will be evident that this is an important paper, as it coordinates previous observations.

UNTIL Busse last year proclaimed the existence of a species of yeast possessing pathogenic properties, this class of microbes had escaped all imputation as regards disease-producing characteristics. Busse's researches have been followed up by others from Colpe, and Sanfelice, but the latest contribution to the subject has been received from Dr. Lydia Rabinowitsch, who has worked at it under the superintendence of Dr. Robert Koch at Berlin. Fifty different varieties of yeast were collected, and out of these, seven were found possessing pathogenic properties. These yeasts appear to be distinct from those pathogenic varieties isolated by other observers. Amongst them is *Monilia candida*, a yeast already investigated by Jörgensen, and of considerable interest on account of its remarkable fermentative properties, but which Dr. Rabinowitsch found was fatal to both rabbits and mice, although guinea-pigs were in no way affected by it. Another yeast, pathogenic to mice, was obtained from some figs which had been allowed to ferment, whilst a so-called "wild" yeast, found on grapes, killed both rabbits and mice. A variety of yeast isolated by Prof. Delbrück from ale, and sent from America, was also found to be fatal to rabbits in from nine to ten days, and to mice in from four to six days when subcutaneously introduced. The fact that these pathogenic yeast cells were usually found abundantly present in the blood, and in the various organs of the animals' bodies, justifies, says Dr. Rabinowitsch, the assumption that the effect produced by them was not due to intoxication from the products elaborated by them, but to direct infection through their copious multiplication within the animals' system. Sanfelice's observation that the yeast cells presented a different appearance when taken from artificial cultures, and from the bodies of animals respectively, was not confirmed by Dr. Rabinowitsch, who could detect no difference.

AMONG the excursions which the Geologists' Association are arranging for the coming season, the farthest afield are those to the Dorsetshire coast (Easter), Chippenham and Calne (Whitsuntide), Ipswich, the new railway at Catesby (Northants), and West Somerset and North Devon (in July). Nearer town, Galley Hill (Kent), Hendon, Leith Hill, Chingford, Reading, Hitchin, and High Barnet will be visited.

THE present volume (vol. xiv.) of the *Proceedings* of the Geologists' Association will be largely devoted to Indian geology. The two presidential addresses of the late President, Lieut.-General C. A. McMahon—the first published in the number for May 1895, the second not yet published—deal with the Himalayas. The February number, which has only just been issued, contains a paper, by W. H. Hudleston, on the geology of India in general, with special notes on a journey from Bombay to Kashmir. The first part gives an excellent summary of the geology of India, illustrated by a coloured map; while a number of sections accompany the second part.

THE monthly notes on Petrography, contributed by Dr. W. S. Bayley to the *American Naturalist* for 1895, have been reprinted and issued together as a "Summary of Progress in Petrography," which should be welcomed by those who are unable to keep themselves abreast of the rapid increase of knowledge in this department. A subject- and an author-index are added. As the author omits his own papers, with one exception, from the list, we may add that his researches on the Basic Massive Rocks of the Lake Superior region, published in the Chicago *Journal of Geology*, should not be overlooked by students of Petrography.

AN order has been made by the Home Secretary, which prohibits the taking or destroying of the eggs of the following species of wild birds throughout the administrative county of Durham:—

Blackheaded gull, common buzzard, kestrel, merlin, owls (all species), bittern, curlew, dipper, dotterel, dunlin, golden plover, goldfinch, heron, hawfinch, kingfisher, martins (all species), nightjar, nuthatch, pied flycatcher, peregrine falcon, raven, ring ouzel, snipe, swallow, treecreeper, water rail, wagtails, woodpeckers (all species), woodcock. It is also ordered that the Wild Birds Protection Act, 1880, shall apply throughout the county of Durham to the following species of wild birds:—Bearded tit, buzzards (all species), hobby, kestrel, martins (all species), merlin, osprey, peregrine falcon, swallow, swift, wryneck.

IN the *Entomologist's Monthly Magazine* for March, Dr. T. A. Chapman records an experiment on the artificial prolongation of the larval stage in Lepidoptera, which, although brief and incomplete, indicates an important line of research in connection with metamorphosis. Caterpillars of *Agrotis comes*, on reaching the last normal stadium, were starved so as to delay growth, and after six weeks were then placed on abundant diet. Some died, several turned normally to pupæ, and others endeavoured to prolong the larval condition. Two alone succeeded, and assumed a further larval instar, accompanied by modifications in the antennæ, maxillæ, legs and eyes. Those which failed were shown by dissection to be endeavouring to accomplish similar changes. In this way an aberrant larva, with certain pupal or imaginal characteristics, was obtained. These experiments have some analogy with the production by Grassi of intermediates between the normal forms found in a nest of Termites, and perhaps with certain phenomena of hypermetamorphosis. Further and more complete experiments will be awaited with interest.

CREMATION as a means of disposal of the dead is steadily gaining favour. From the report of the Council of the Cremation Society for 1895, we see that 150 cremations were carried out at Woking during the year, and fifty-eight at Manchester. When the Society commenced operations in 1885, only three bodies were cremated, but this number has continuously increased since that year. At the present time, the crematorium at Manchester is the only one in operation in England besides the one at Woking. Another is, however, being erected near Liverpool, and will shortly be opened for use; and last November, a building, comprising a crematorium, chapel, and waiting-rooms, situated on the outskirts of Glasgow, was opened by Sir Charles Cameron.

WE have on our table the sixth edition of M. P. Schützenberger's well-known work on "Les Fermentations," published by M. Félix Alcan in the comprehensive Bibliothèque Scientifigue Internationale. The whole of the text has been revised, and numerous additions have been made. The "Résultats de l'examen de dix mille observations de hernies," communicated to the last French Congress of Surgery, by Prof. Paul Berger, has been published in volume form by M. Félix Alcan. Mr. Ernest Hart's criticism of "Hypnotism, Mesmerism, and the New Witchcraft" (Smith, Elder, and Co.) has blossomed into a second edition. A chapter has been added, embodying the confessions of a professional medium, and some new matter has been placed in an appendix, but no other changes have been made.

A NEW monthly magazine—the *Ornithologist*, edited by Mr. H. K. Swann—has just appeared, its claim to distinction among the periodical literature of natural history being that it is the only monthly journal of ornithology published in the British Islands, though there are several which devote a large share of their space to the subject. The first number of the new publication contains, among other contributions, notes on birds seen during a continental tour, by Mr. O. V. Alpin, notes on the nesting habits of the oyster-catcher, by Mr. F. B. Whitlock, and on British birds at Wiesbaden, by Mr. Graham W. Kerr. There is also a full-page plate showing the nest of a wheat-ear, built in an old tin can, and a portrait of the late Mr. Seebohm. We welcome this addition to the ranks of scientific journals, and hope that it will long live to encourage observation and research.

THE recent discovery of argon in atmospheric air, by Lord Rayleigh and Prof. Ramsay, aroused such great interest, that it has been resolved, on the repeated request of the "general public," to prepare a volume containing an account of the methods of extracting the new gas from air, and of its properties, explaining, where necessary, in popular language, the basis of the reasoning employed in drawing conclusions relative to argon. But the whole history of the determination of the gases in air is so closely related to this recent discovery, that it would hardly have been possible to present the subject in its entirety without a preliminary sketch of the discoverers and their work. The little work, which has been written by Prof. Ramsay, and will be published by Messrs. Macmillan and Co., therefore treats of all the progress made in this fascinating branch of chemistry by a number of men, almost all of them English. In this sense, England may be said to "rule the air," as in another she rules the sea. The volume will contain portraits of Cavendish, Boyle, Lavoisier, and other early discoverers.

THE additions to the Zoological Society's Gardens during the past week include a Hairy Armadillo (*Dasypus villosus*) from La Plata, presented by Mr. A. H. Robinson; two Fennec Foxes (*Canis cerdo*) from Egypt, presented by Mr. Dixon Bey; a Pale Genet (*Genetta senegalensis*), two Home's Cinixys (*Cinixys homeana*), an Eroded Cinixys (*Cinixys erosa*), a Delalande's Gecko (*Tarentola delalandii*) from West Africa, presented by Mr. W. H. Boyle; a Lesser Kestrel (*Tinnunculus cenchris*) captured at sea, presented by Mr. A. J. Leith; a Greater Black-backed Gull (*Larus Marinus*), British, presented by Mr. G. Smith; one Slender-billed Cockatoo (*Licmetis teniurostris*) from Australia, presented by Mr. John J. Sapp; a Laughing Kingfisher (*Dacelo gigantea*) from Australia, presented by Mrs. Hillier; a Hawfinch (*Coccothraustes vulgaris*), British, presented by Mr. C. Bates; two Black Swans (*Cygnus atratus*, ♂ ♀) from Australia, purchased; a Gorilla (*Anthropopithecus gorilla*, ♀) from Naove or Iquela Congo Français, four Short-Death Adders (*Hoplocephalus curtus*) from Australia, deposited; an Eland (*Oreas canna*, ♂) bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

PERRINE'S COMET (1895).—Some interesting photographs of Perrine's comet were taken at Prague by J. and J. Fric, during its appearance in November last (*Acad. Sci. de l'Emp. Fr. Jos.*, 1896). One of the photographs was taken on November 23 with an exposure of thirty minutes, and another a week later with an exposure of twenty minutes. The nucleus resembles an ordinary star in both cases. The tail proceeds from the head in the form of a fan opened out to about 30°, and is clearly divided into two parts. In the first photograph the northern part of this double tail is curved, and has a length of about 30′, while the other is straight, and can be traced through about 3½°, the width being about 5′. Notwithstanding the shorter exposure of the second photograph, both tails are extended, the curved one being 50′ in length, and the other very nearly 7°. The principal tail is only 3′ wide for the first degree of its length, but it suddenly widens out and forms a band 10′ broad. We seem to have here the long straight "hydrogen" tail and the strongly-bent "iron" tail which Bredichin's theory attempts to explain.

Photographs taken at the Lick Observatory also exhibit the double tail, and Prof. Campbell's observations show that the spectrum of the comet was one consisting of carbon bands. The comet is still visible, and rises some hours before the sun. Dr.

E. Lamp gives the following ephemeris for Berlin midnight (*Ast. Nach.*, 3338).

	R.A. h. m. s.	Decl. ° ′	Brightness.
March 12 ...	19 45 30	+5 12·8	0·09
14 ...	45 0	5 46·4	
16 ...	44 25	6 20·2	0·09
18 ...	43 44	6 53·9	
20 ...	42 56	7 27·7	0·08
22 ...	42 3	8 1·7	
24 ...	41 3	8 35·7	0·08
26 ...	39 57	9 9·8	
28 ...	38 45	9 44·0	0·07
30 ...	19 37 26	+10 18·2	

COMET PERRINE-LAMP.—The revised elements of this comet, which have been arrived at by Dr. Lamp, indicate the following places for Berlin midnight (*Ast. Nach.*, 3338):—

	R.A. h. m. s.	Decl. ° ′	Brightness.
March 12 ...	3 1 59	+48 34·4	0·15
14 ...	15 11	47 41·2	0·12
16 ...	26 9	46 51·8	0·10
18 ...	35 25	46 6·5	0·08
20 ...	43 21	45 25·4	0·07
22 ...	50 17	44 47·9	0·06
24 ...	56 25	44 13·9	0·05
26 ...	4 1 53	43 43·1	0·04
28 ...	6 51	43 15·1	0·03
30 ...	4 11 22	42 49·4	0·03

The unit of brightness is that of February 15·7. On March 14 the comet will be nearly 2° south of α Persei.

ORBIT OF δ CEPHEI.—From an investigation of the displacement of the lines in the spectrum of δ Cephei, Dr. Belopolsky came to the conclusion in 1894 that the light changes of this short period variable are closely associated with an orbital movement (NATURE, vol. li. p. 282). The results have been generally confirmed by another series of photographs which were taken last year, but there are some differences in the numerical data (*Ast. Nach.*, 3338). For the velocity of the system towards the sun the later value is 15·2 English miles per second, and the time of periastron passage is altered from 1·05 days after minimum to 0·9 days. The following data for the construction of a curve of velocities of the bright star relatively to the dark one, with which we must suppose it to be associated, are derived from the figures given by Dr. Belopolsky:

Interval from minimum in days.	Relative velocity in Eng. miles per sec.
0·8	... +13·4
0·5	... + 7·8
1·0	... − 1·8
1·5	... −10·6
1·7	... −11·5
2·0	... −12·9
2·5	... −10·6
3·0	... − 6·5
4·0	... + 1·4
5·0	... + 8·3

A + sign indicates a movement in a direction away from the sun, and a − towards the sun. The period of revolution is equal to that of the light changes, 5d. 9h., and the maximum occurs 1d. 15h. after the minimum. At the time of minimum the stars lie very nearly along a line at right angles to the line of sight, so that the reduction of light cannot be produced by an eclipse.

Attention is drawn to several notable differences in the intensities of the lines in the star spectrum and in the spectrum of the sun. Mr. Lockyer has also recognised such differences, and has shown that the spectrum of δ Cephei is practically identical with that of γ Cygni, a star of increasing temperature; four other variables of the δ Cephei class have also been shown to give a similar spectrum.

THE ABSOLUTE VELOCITY OF 61 CYGNI.—The combined results obtained for the proper motion of a star by meridian observations, and for the velocity in the line of sight by the spectroscopic method, enable the absolute velocity and direction of movement to be determined. Dr. Belopolsky has recently applied this to the brighter component of 61 Cygni, employing the velocity derived from spectrum photographs taken at Pulkowa. The mean velocity in the line of sight, corrected for the earth's movement, and thus referred to the sun, is 33·7 English miles per second towards the solar system. Taking the position of the apex of the sun's way as R.A. 267°, decl. +31°, and supposing the velocity of the solar system in space to be 9·3 English miles per second, the correction to be applied to 61 Cygni for the movement of the sun is 6·9 miles per second. Thus, the velocity of the star towards a fixed point in the direction of the sun is 26·8 miles per second.

Adopting a parallax and proper motion of 0″·5 and 5″·2 respectively, the linear velocity across the line of sight will be 30 miles per second, or, when freed from the velocity of the solar system, 22·6 miles. The resultant absolute velocity is accordingly 35 miles per second, the direction of movement having a position angle of 61° and being inclined at an angle of 140° to the line of sight.

ON THE APPEARANCE OF THE SPECTRAL LINES OF CLEVITE GAS IN STELLAR SPECTRA.

IT is very rarely that so rapid progress is made as that which followed Prof. Ramsay's discovery of the line in the yellow, corresponding with the solar line D_3, in the spectrum of the gas obtained from the mineral clevite. As early as May 9, Mr. Lockyer communicated a paper to the Royal Society,[1] in which a table was given showing that many of the unknown lines in the stars with few lines in their spectra were really due to the new gases. It seems to take some considerable time for English work of this kind to get to Berlin, for on October 24 Prof. Vogel made the same announcement to the Berlin Academy.[2] His confirmation, therefore, is of great interest.

It is not a little curious that the first star which he discusses is not one of the stars in Orion to which Mr. Lockyer had specially referred, but to β Lyræ, which the same observer had demonstrated a year or two ago to be a double star, the spectra of the components resembling that of Rigel and Bellatrix, both in Orion.

Vogel found that a comparison of the lines of this star with those in the spectrum of clevite gas showed in an unexpected manner a great number of coincidences.

His attention having been directed, in this perfectly independent manner, to the question, he was led to examine the spectra of many other stars, and to this end he employed the rich material collected by Dr. Wilsing. In the communication to the Academy, Prof. Vogel gives only a general survey of the work, leaving a more detailed account for a later publication. The first series of stars investigated were those in the constellation of Orion, for there the line λ 447 μμ plays an important part. The comparison, the results of which are here given in tabular form, exhibited many coincidences; the lines of clevite gas most common to the stars β, γ, δ, ε, ζ, λ, ν, π_3, π_5, ω of Orion were those of wave-length 382·0*, 388·9*, 402·6*, 414·4, 438·8, and 447·2*, those of helium being marked with an asterisk.

It was at first thought that, in consequence of the paucity of stars of the Orion type in other parts of the heavens, few would be found exhibiting the lines of clevite gas. An examination, however, of 150 of the brighter stars of Class I. disclosed the fact that no less than twenty-five, in which the characteristic Orion lines, or, in other words, the lines of clevite gas, were visible, were observed.

Prof. Vogel informs us that until the spectra of all the stars of Class I., down to about the 5th magnitude, have been obtained and examined, an accurate idea of the distribution of these stars in the sky cannot be formed. He further adds that a third part of this work is already accomplished. Some of the stars in which the lines in the clevite gas spectrum are well pronounced are: 102 Herculis, ι Herculis, α Virginis, γ Pegasi, β Piscium, β Cephei, *u* Herculis, ι Andromedæ, τ Herculis, ζ Draconis, η Leonis, ρ Pegasi, β Persei, η Aurigæ.

The above-mentioned investigation leads Prof. Vogel to form the following deductions with regard to stellar classification. These we give in full, remarking that while Dr. Vogel had previously classed the stars which now turn out to contain the helium lines with stars like Sirius, Mr. Lockyer had classed them apart.

[1] *P.R.S.*, vol. lviii. p. 117.

[2] *Sitzungsberichte der Königlich-Preussischen Akademie der Wissenschaften zu Berlin*, October 24, 1895.

"By an inspection of the numerous spectra my opinion is strengthened that in arranging stars according to their spectra only general marked characteristics should be considered, and a rational classification can only be thought of if based on the supposition that the various stellar spectra indicate different phases of development.

"I think it is much to be regretted that, in the extensive spectroscopic examination of all stars down to about the seventh magnitude, which Pickering by means of an objective prism has undertaken, the classification of stars, based on no general grounds, but only according to the appearance of the spectrum, which is very often misrepresented by incorrect exposure, especially in the case of brighter stars, leads him to adopt sixteen classes, denoted by the letters A–Q."

On this it may be remarked that Mr. Lockyer has already shown in NATURE that Prof. Pickering's classification is quite philosophical, and that, moreover, it brings stars together to which he also has assigned special places in his classification on account of their special features.

Prof. Vogel then continues:—

"The attempt, on the lines mentioned above, which I made twenty years ago, with regard to the classification of stellar spectra has for the most part been corroborated, in spite of the great progress of stellar spectroscopy during the last few years, namely by the fine detailed researches of their spectra by Scheiner.

"In relation to the stars of Class III., direct observation of the less refrangible part of the spectrum of the photograph is yet to be considered. Of my two suggested divisions, *a* and *b*, the criterium as to which belongs to the more advanced stage of development is entirely absent. One can only say this, that in both divisions the almospheres of the stars have so far cooled as to stop the dissociation of the materials and allow compounds to be formed. There is therefore, no reason given why stars of Class III.*b*, in which chiefly the absorption bands are produced by carbon compounds, should be placed in a special Class IV. For the same reason direct observation is a good means of recognising spectra of Class II. Also here there is no reason to adopt subdivisions other than the two already assumed by me before we are in possession of more accurate investigations of the spectra of Class II.*b*.

"It is different in the case of the spectra of Class I. In these spectra the application of photography makes it in general possible to step further and obtain more minute points of difference than was the case before. It appears also that the study of the spectrum of these stars is of special interest, inasmuch as, starting from the simplest spectrum, in which only hydrogen lines are visible, the first traces of a further development can be found by the appearance of lines of other substances, and we can follow them up to the numberless lines exhibited in the spectra of Class II. Perhaps it will be possible by a more extended investigation of the details of the spectrum of Class I. to find the first beginnings and individual parts of both from successive series, the extremities of which, so different in appearance, are spectra of the type of Class III.*a* and III.*b*.

"The observations mentioned above have led me to the opinion that the appearance of the lines of clevite gas in stellar spectra, if closely watched, may give us a good basis for the classification of these spectra.

"The spectrum appearance of clevite gas has such a similarity with that of hydrogen, as has long been known to be the case, through the constant appearance of the D_3 line with the hydrogen lines at all parts of the chromosphere of the sun, as well as in the prominences, that one may expect to find, after the appearance of the hydrogen lines in the first place, that of the lines of clevite. The paucity in lines of the spectrum of this gas makes it especially easy to be at once recognised. Although the brightest line, λ 388·9 $\mu\mu$, as already mentioned, falls so near constantly the present hydrogen line Hζ in the spectrum of Class I. that a separation is impossible, and although in only very few cases does the sum-total of both these strong lines appear distinct—as, for instance, in the spectrum of β Lyræ—the lines λ 382·00 $\mu\mu$, λ 386·8 $\mu\mu$, λ 402·6 $\mu\mu$, and λ 447·2 $\mu\mu$, on the other hand, and those in the less refrangible part of the spectrum, namely λ 492·2 $\mu\mu$, λ 501·6 $\mu\mu$, and D_9, λ 587·6 $\mu\mu$, are so easy to find and recognise that the proof of the presence of clevite gas is not beset with difficulties.

"As a second point of difference for subdivisions of Class I. the presence of the calcium lines λ 393·38 $\mu\mu$ and λ 396·86 $\mu\mu$ is convenient, the second of these lines coinciding nearly with the hydrogen line Hϵ (λ 397·02 $\mu\mu$). If the first of these lines be thin and sharp, the second only influences the hydrogen line Hϵ to a very small extent. If the lines of calcium increase both in intensity and breadth, then Hϵ broadens in a very distinct manner; both lines then very soon excel with respect to intensity and thickness, the strongest and broadest hydrogen lines in the spectra of Class I. On further development they form together the characteristic pair of lines in Class II. which Fraunhofer called H."

Prof. Vogel then concludes his paper with a re-division of stars of the first class into three parts, *a*, *b*, and *c*.

Although *c* includes stars having spectra which exhibit bright lines, he suggests that from the present point of view it would be perhaps better to place them first, as they represent the first stage of development. The fact that they are here retained in subdivision *c* is because a definite conclusion has not yet been arrived at as to their true position, so the old position has, *pro tempore*, been maintained.

THE RÖNTGEN RAYS.

THE following is a summary of some of the work with Röntgen rays brought under our notice during the past week:—

The results of a scientific study of the properties of Röntgen rays are stated in a paper by Prof. G. Vicentini and Dr. G. Pacher, in a paper read before the Reale Istituto Veneto di scienze, lettere, ed arti, on January 26, and now issued as an excerpt from the *Memorie* of the Institute (vol. xxv. No. 7). The authors found distinct evidence of an irregular reflection from a parabolic brass mirror; the Crookes' tube and the sensitive plate were placed on opposite sides of an iron plate, so that the rays to reach the plate had to be reflected from the mirror. No effect was observed with a similar glass mirror, or with the arrangements used by previous observers to test the existence of reflection. Photographs accompany the paper, showing shadows of fish, a hand, two feet, and a rat with mercury introduced into its intestines. Experiments showed that a gold-leaf electroscope, turned towards the kathode, became charged positively; a wire cage, however, completely annulled the action. The following list of transparencies to Röntgen rays is interesting:—Solid bodies (opaque): Potassium, phosphorous, fused sulphur, glass, sealing-wax, tin, zinc, iron, brass, copper, lead, platinum, mercury, crystallised sulphur, rock-salt, quartz, calc-spar, fluor-spar, topaz, beryl, aragonite, baryta, lead carbonate, tourmaline, borax. Semi-transparent: Aluminium, sodium, ebonite, retort-carbon, mica (along both axes). Transparent: Cardboard, wax, paraffin, sugar, wood-charcoal, amber, shellac. Liquid bodies (opaque): Carbon disulphide, sulphuric acid (saturated solutions of), sulphates of zinc, copper, iron, cobalt, nickel and magnesium, bichloride of mercury, chlorides of sodium, ammonium and platinum, neutral oxalate of potash, potassium bichromate, and ammonium nitrate. Semi-transparent: Acetic acid, nitric acid, glycerine, ammonia, and, in a less degree, distilled water and alcohol. Transparent: Ether, benzene, in a less degree vaseline, petroleum, aniline, and olive oil. There appeared to be no clear relation between the opacity and density of the substances experimented upon.

In order to get distinct shadows of objects opaque to Röntgen rays, it is obviously necessary to avoid a penumbra, by employing a source of the rays approaching as nearly as possible to a point. The Crookes' tubes, however, as usually put on the market, are given a pear-shape, for the purpose of having as extended an area as possible under the action of the kathode rays. To obtain clear shadows with such a tube the objects must be very close to the sensitive plate or the fluorescent screen, a condition which cannot always be realised if the objects are enclosed in envelopes of considerable thickness. Prof. E. Salvioni described to the Accademia Medico-Chirurgio di Perugia, on February 22, two methods whereby the kathode rays may be brought to a point on the walls of the tube, producing a very restricted but intensely fluorescent area. In Crookes' tubes, with the usual spherical cup-shaped kathode, the rays issue from this normally, and meet in a point generally inside the tube. By moving a magnet in the neighbourhood of the tube, this focus may be brought on to the tube wall. A more convenient method of arriving at the same result was found by chance. On moving the hand over the tube, the position of the focus of the kathode rays is altered, and the same action takes place on touching the tube

with a metallic point connected to the ground or to the kathode. The rays then are attracted to a point on the tube exactly opposite to that touched by the conductor; the best position for the latter is at a distance from the kathode equal to its radius of curvature. Tubes could, of course, be constructed so that the focus of the kathode rays fell normally on the wall of the tube; it is found, however, that after some time the glass loses its fluorescent property, showing a dark spot at the incident point of the rays. The device with the metallic point enables the fluorescent spot to be changed from time to time.

The surgical aspects of photography with Röntgen rays are considered by Mr. Albert Carless in the March number of the *Practitioner*. The conclusion arrived at with reference to radiography is "that it can be of real value in a certain limited number of cases there can be no doubt, but unless very considerable improvements are made in the technique, it will be but little resorted to in practical work."

Prof. M. J. Pupin contributes to the March number of the *Engineering Magazine* (New York) an account of his experiments with Röntgen rays. He has obtained excellent results with a pear-shaped Crookes' tube, of five inches diameter, excited by a six-plate Holtz machine. He finds that a cylindrical vacuum tube without internal electrodes, but with external tinfoil coatings at the extremity of the tube, will do very well as a substitute for a Crookes' tube.

Our American correspondent writes, under date February 28: "The new art of 'radiography' is still prosecuted in America with unabated ardour. The most successful apparatus yet devised seems to be that of Prof. John S. McKay, of the Packer Institute, Brooklyn. It is a small tube five inches long, and an inch, or rather more, in diameter, which is known and sold by instrument-makers as a 'perfect vacuum' tube. This is attached directly to the terminals of the secondary coil. The copper electrodes are less than an eighth of an inch apart; but the vacuum is so perfect, that the spark will leap the whole length of the tube outside rather than cross this small interval inside. The tube produces very little light, and is sometimes, when in use, perfectly dark. This tube is light and convenient, and does not become hot like the Crookes' tube. After running it continuously for half an hour with a pressure of 200,000 volts, it is scarcely warm to the touch. But the special advantage is that the rays radiate in all directions from the centre, so that exposures may be made simultaneously within a radius of two feet from the centre of the tube. The best results were found at a distance of one foot, and with an exposure of five minutes. Experiments to determine the relative opacity of different substances show that the opacity to X-rays is generally in inverse proportion to the diathermancy of the substances tested. Thus rock-salt is most opaque; next comes alum, then glass, then quartz. Camphor gum, gum copal, and vulcanite are almost equally transparent; amber somewhat less so, and sealing-wax quite opaque. Iceland spar, mica, and selenite are quite transparent. Iceland spar seemed to give evidence of double refraction. Charcoal is quite transparent, more so than wood. Anthracite coal is somewhat opaque, but not so much as glass. Egg-shells, like bones, are opaque. Of liquids tested, mercury, sulphuric acid, glycerine, and kerosene were somewhat opaque, the opacity varying about as the density. Prof. McKay has also produced pictures on a sensitive gelatine film wrapped in paper with some metallic object upon it, and placed in the dielectric of an electric condenser, the terminals of which are connected with an induction coil or Holtz machine. After rapidly charging and discharging this condenser or Leyden jar for two or three minutes, a distinct image of the metallic body is found to be radiographed upon the sensitive film.

"A remarkable application of Prof. McKay's apparatus has been made by Edward P. Thompson, an electrician, who has devised a fluorescent screen on which shadows may be thrown showing the action of the bones in motion, as of the hand, and he hopes to show the motion of the bony skeleton of a bird in flight. It has been stated that the great drawback to aerial locomotion is our ignorance of the exact way in which a bird flies. Hence the inventor attaches much importance to his apparatus, which he calls the 'kinetoscotoscope.' It will show, among other things, the motion of the parts of a broken bone, indicating the locality and nature of the fracture, as the bones may be moved or bent back and forth before the screen, thus opening and closing the crack. The taking of pictures is not the design of this apparatus. The fluorescent screen is prepared by pulverising barium platino-cyanide to a fine powder, and pouring upon a draughtsman's tracing cloth a small quantity of varnish, or of a mixture of oil and turpentine, stirring the powder in with it, and drying."

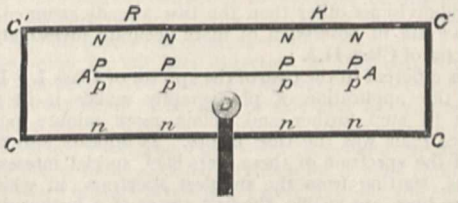
With regard to seeing Röntgen shadows by means of a fluorescent screen, Mr. Swinton informs us that he finds that instead of employing blotting-paper saturated with barium platino-cyanide, it is much better to make a hot emulsion of the barium platino-cyanide in gelatine and water, and apply this in a thick coat to a piece of glass On cooling, the barium platino-cyanide crystallises out, and the gelatine protects it from abrasion. A thick and uniform coating is what is wanted. The glass being rather opaque to the X-rays, but transparent to light, the plate should be obviously placed with the gelatine side next to the Crookes' tube, and the glass side next the eye.

ON THE GENERATION OF LONGITUDINAL WAVES IN ETHER.[1]

IN a short note published in NATURE of February 6, I suggested an arrangement of four insulated and electrified spherical conductors with their centres in one line, giving rise to ethereal waves in the surrounding atmosphere, of which the disturbance in the line of centres is essentially longitudinal. But at any finite distance from this line there must also be laminar or distortional waves of the kind expressed in Maxwell's equations. The object of my present communication is to show an arrangement by which a large space of air is traversed by pressural disturbance, or by waves essentially longitudinal, or by condensational-rarefactional vibrations; with but a very small proportion, practically evanescent, of laminar waves.

Let AA be a plane circular metal plate insulated within a metal case CCC'C', as indicated in the drawing. Let D be a discharger which can be pushed in so as to make contact with A.

Let A be charged to begin with, positively for instance as indicated by the letters PP*pp*; NN*nn* showing negative electricity



induced by it. Let now the discharger be pushed in till a spark passes. The result, as regards the space between AA and the roof RR over it, will be either an instantaneous transmission of commencement of diminution of electrostatic force, or a set of electric waves of almost purely longitudinal displacement, according as ether is incompressible or compressible.

Hence, if the theory of longitudinal waves, suggested by Röntgen as the explanation of his discovery (for the consideration of which he has given strong reasons), be true, it would seem probable that a sensitive photographic plate in the space between AA and RR should be acted on, as sensitive plates are, by Röntgen rays. Either a Wimshurst electrical machine or an induction-coil, adapted to keep incessantly charging AA with great rapidity so as to cause an exceedingly rapid succession of sparks between D and A, might give a practical result. In trying for it, the light of the sparks at D must be carefully screened to prevent general illumination of the interior of the case and ordinary photographic action on the sensitive plate.

The arrangement may be varied by making the roof of sheet aluminium, perhaps about a millimetre thick, and placing the sensitive photographic plate, or phosphorescent substance, on the outside of this roof, or in any convenient position above it. When a photographic plate is used there must, of course, be an outer cover of metal or of wood, to shut out all ordinary light from above. This arrangement will allow the spark gap at D to be made wider and wider, until in preference the sparks pass between AA and the aluminium roof above it. The transparency of the aluminium for Röntgen light will allow the photographic plate to be marked, if enough of this kind of light is produced in the space between the roof and AA, whether with or without sparks.

[1] A paper by Lord Kelvin, read before the Royal Society on February 13

The new photography has hitherto, so far as generally known, been performed only by light obtained from electric action in vacuum; but that vacuum is not essential for the generation of the Röntgen light might seem to be demonstrated by an experiment by Lord Blythswood, which he described at a meeting of the Glasgow Philosophical Society on Wednesday, February 5. As a result he exhibited a glass photographic dry plate with splendidly clear marking which had been produced on it when placed inside its dark slide, wrapped round many times in black velvet cloth, and held in front of the space between the main electrodes of his powerful Wimshurst electrical machine, but not in the direct line of the discharge. He also exhibited photographic results obtained from the same arrangement with only the difference that the dark slide, wrapped in black velvet, was held in the direct line of the discharge. In this case the photographic result was due, perhaps wholly, and certainly in part, to electric sparks or brushes inside the enclosing box, which was, as usual, made of mahogany with metal hinges and interior metal mountings. It is not improbable that the results of the first experiment described by Lord Blythswood may also be wholly due to sparking within the wooden case. I have suggested to him to repeat his experiments with a thoroughly well closed aluminium box, instead of the ordinary photographic dark slide which he used, and without any black cloth wrapped round outside. The complete metallic enclosure will be a perfect guarantee against any sparks or brushes inside.

If the arrangement which I now suggest, with no sparks or brushes between AA and the roof, gives a satisfactory photographic result, or if it shows a visible glow on phosphorescent material placed anywhere in the space between AA and the roof above it, or above the aluminium roof, it would prove the truth of Röntgen's hypothesis. But failure to obtain any such results would not disprove this hypothesis. The electric action, even with the place of the spark so close to the field of the action sought for as it is at D, in the suggested arrangement, may not be sudden enough or violent enough to produce enough of longitudinal waves, or of condensational-rarefactional vibrations, to act sensibly on a photographic plate, or to produce a physical glow on a phosphorescent substance.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—At a Congregation held on Tuesday, the series of resolutions relating to the claims of women, the consideration of which was adjourned last week after the rejection of the proposal for admitting women to the B.A. degree, were discussed and rejected.

CAMBRIDGE.—Mr. Charles Davison, well-known for his researches on earthquakes and and other seismic phenomena, has been approved by the General Board of Studies for the degree of Doctor of Science.

The Isaac Newton Studentship in Astronomy and Physical Optics has been conferred on Mr. John Gaston Leathem, Scholar of St. John's College.

Dr. Joseph Griffiths has been appointed an additional Examiner in Surgery.

The Panjab University has, like the University of Calcutta and Allahabad, become affiliated to the University of Cambridge. Graduates in Arts of the Panjab are thereby exempted from the previous examinations, and may proceed to their degree by means of a Tripos Examination after two years' residence in Cambridge.

The Syndicate for the consideration of the question of degrees for women has been nominated, and consists of the Vice-Chancellor, Dr. Butler, Master of Trinity, Dr. Peile, Master of Christ's, Mr. Austen Leigh, Provost of King's, Prof. E. C Clark, Prof. Clifford Allbutt, F.R.S., Prof. Sidgwick, Dr. Jackson, Prof. Forsyth, F.R.S., Dr. Keynes, Prof. Armitage Robinson, Prof. Foster, F.R.S., Mr. R. T. Wright, Mr. W. L. Mollison, and Mr. R. A. Neil. Its appointment will be opposed on the ground that an excessive proportion of its members have already committed themselves to definite views on the questions at issue, and that only two members of less than twenty years' standing are included.

The Examination in Sanitary Science for the diploma in Public Health will begin on April 7, and will extend over ten days.

A conversazione will be held to-night in the Cavendish Laboratory, in commemoration of the opening of the new buildings. The President of the Cambridge Philosophical Society (Prof. J. J. Thomson) and Mrs. Thomson are the hosts.

THE hall which Mr. M'Ewan has added to the Edinburgh University buildings, at a cost of between £60,000 and £70,000, will be opened early in the ensuing summer.

THE University of Indianapolis has just been organised by representatives of Butler College, the Medical College of Indiana, the Indiana Dental College, and the Indiana Law School.

PRESIDENT JOHN M. COULTER, of Lake Forest University, has resigned in order to accept the head Professorship of Botany in the University of Chicago, which has been endowed with 1,000,000 dollars in its Botanical Department.

THE following are among recent appointments:—Dr. Christopher Childs to be Assistant in the Hygienic Department at University College, London, under the direction of Prof. Corfield; Dr. Allan MacFadyen to act as hon. secretary of the British Institute of Preventive Medicine; M. Salih Zéky to be Director of the Observatoire Impérial Météorologique et Séismique at Constantinople, in succession to the late M. A. Coumbary; Dr. W. Kurchinski, of Kieff, to be appointed Extraordinary Professor of Physiology at Turieff (Dorpat).

THE Executive Committee of the City and Guilds of London Institute have awarded the second Salters' Company's Research Fellowship, for the encouragement of higher research in chemistry in its relation to manufactures, to Dr. Sidney Williamson, who was for two years a student at the City and Guilds Technical College, Finsbury, and subsequently for three years at the City and Guilds Central Technical College. The Fellowship is tenable at the latter, and Dr. Williamson proposes to work on some questions bearing on food-stuffs generally, more particularly the examination of some definite albumenoids, with the ultimate object of ascertaining the influence of various manures on the growth of crops in so far as *quality* of produce is concerned.

THE Middlesex County Council have voted the sum of £10,785 for the purpose of technical education classes in the county during the current year. This is a slight increase on the amount appropriated during 1895, but since the available amount exceeds twenty-two thousand pounds, there still remains a large surplus which ought to be devoted to its proper purpose. The explanation of the unwillingness of the Council to benefit education in their midst to the fullest possible extent may be found, perhaps, in the falling off in the number of candidates for county scholarships. This diminution is most marked. For the fifteen scholarships of £20 each for three years for boys, there were 100 candidates fewer than in 1893, in which year the scholarships were first offered. The decrease in the number of competitors has been gradual. In 1894 the number was 220, in 1895 it had fallen to 184, and it is less again this year. As there are at least 80,000 children in elementary schools in Middlesex, the number of candidates ought certainly to be much larger.

The Report of the Director of Technical Instruction to the County Council for the County Palatine of Lancaster for the year ending August 31, 1895, which was presented to the Council at a meeting held on the 6th ultimo, contains many interesting statistics of the work which is being accomplished in Lancashire. The work in many departments is pre-eminently satisfactory. We are glad to notice that the Committee have made a grant of £250 to each of the University Colleges of Liverpool and Manchester, for we believe that one of the surest ways of improving the education of any county is to strengthen the centres of higher instruction within its borders. It is certainly one of the weaknesses of the Lancashire scheme for technical education that they give no assistance to secondary schools in their county. The middle classes are as much in need of all kinds of education as any section of the community, and though in Lancashire the following annual grants can be afforded—viz. horology, £500; plumbing and sanitary science, £750; horticulture and bee-keeping, £500; practical agriculture (including veterinary science, poultry-keeping, and allied subjects), £1000; as well as grants to encourage the study of music, yet for the development of the modern side of their secondary schools nothing is allowed. It is interesting to compare the decision of the Lancashire Committee with the recommendation of the recent Commission, "that this grant . . . ought to be all of it paid in future to the local authorities for secondary education . . . not merely to technical education,

but to secondary education generally." The work completed during the past year on the County Council Farm at Hutton has been very successful, both as regards the instruction given and the amount of research work carried out. It seems rather anomalous that while Preston devotes no part of its share of the Customs and Excise Fund to the purposes of education, yet, as the report shows, the County Committee make a grant of £650 a year to the Harris Institute in that town. Surely the borough authority will not abstain much longer from following so good an example.

WE learn from the February number of the *London Technical Education Gazette*, that seventeen secondary schools in different parts of the metropolis have been aided by grants from the Technical Education Board of the London County Council. These grants have been very useful in encouraging the establishment of laboratories and science lecture-rooms in schools which have hitherto been without these advantages, and in improving the equipment and teaching in schools in which practical science has been taught. We notice with much satisfaction that in a large number of these schools physical laboratories have been provided, and that every facility is being given for the study of practical physics as well as chemistry. Too much stress cannot be laid upon the incompleteness of that practical science teaching which confines the student's attention to elementary qualitative analysis, and we note that it has been already found that "the influence of the Board's grants is as much apparent in the character of the teaching given in the several schools as in the appliances available for such teaching." The old method of teaching practical chemistry is giving place "to a more rational system, in which the laboratory and the lecture-room are brought into close relation, and in which the importance of measurement is insisted upon as the basis of all scientific work." Two at least of the schools receiving aid are for girls. A laboratory and lecture-room in James Allen's Girls' School, Dulwich, and a laboratory for practical science and school of domestic economy at the Camden School for Girls, have been equipped at the cost of the Board. The London Committee are, in this matter, as in so many others, setting the country local authorities an example which we hope soon to see emulated. The development following upon these grants can be seen at a glance from the statistics collected by the Board's science inspector, and published in these columns on February 13 (p. 357).

The cost of the new technical school at Salford, which is to be shortly opened by the Duke and Duchess of York, is likely to amount to £70,000. This amount is in excess of the anticipated cost, and the original loan of £55,000, sanctioned by the Local Government Board, is to be augmented by a further one of £13,500. Even then the difficulty of the expenses of maintenance will have to be faced. The experiences of the Salford Committee show only too plainly the necessity for legislation to prevent the appropriation of accumulated funds from the technical education grants of former years for ordinary purposes in the district. The Technical Instruction Committee of Salford had up to March 1894, been holding in reserve moneys received under the Local Taxation (Customs and Excise) Act of 1890, but the corporation becoming involved in financial difficulties, laid hands on these moneys, which amounted to £12,000. It is now left to the Committee to meet a heavy annual expenditure out of their revenue from the rate of a penny in the pound, the fees, grants, and other sources of income.

As a supplement to last week's account of what has been done for the support of education by some of the London Livery Companies, it is interesting to note the efforts in the direction of (probably) the only surviving provincial Company of the same type—the Master, Wardens, and Commonalty of Merchant Venturers of the City of Bristol. The supreme importance, for a commercial and manufacturing people, of what is now known as "technical instruction" seems to have been realised in Bristol earlier than in most other parts of England; for as long ago as 1856 there was founded in that city the Bristol Diocesan Trade School (afterwards called the Bristol Trade and Mining School), for the express purpose of providing sound and systematic education for the industrial classes. The school, being appreciated by those for whom it was intended, soon acquired a more than local reputation, and steadily grew in numbers, up to the limit which its buildings and its finances imposed. In 1880, when this limit had been reached, it happened that the Merchant Venturers—whose work of creating, and governing for centuries, the port of Bristol was then accomplished—resolved to devote their energies for the future to the furtherance of education; and, seeing the position of the Trade and Mining School, and the great value of the kind of teaching which it supplied, agreed to adopt it. Accordingly, at an outlay of some £45,000, they provided it with new buildings, upon a larger site, and with a more complete equipment; they also undertook to maintain it and develop it upon existing lines; and they gave it their own name. The Merchant Venturers' Technical College, as it is now called, has a junior department, a senior department, and a multitude of evening continuation classes; so that any boy, or young woman, destined for an industrial occupation of whatever kind—whether as architect, engineer, designer, chemist, dressmaker, or the like—may both begin and finish his or her entire education within its walls. The total number of students now exceeds 2000. In keeping with the special object of the institution, its curriculum is limited to comparatively few of the main branches of knowledge, and necessarily leaves out many of the most important. It hardly touches, for instance, the fascinating realm of literature, ancient and modern, or the subjects of music, medicine and law; and it ignores altogether the whole range of the mental and moral sciences. But ample provision for the teaching of all these exists, or can be made, in the other schools and colleges which Bristol is so fortunate as to possess, and thus the Merchant Venturers are enabled to occupy, with undivided attention, their own restricted field of operations, and to carry out, with ever-increasing thoroughness, their scheme of industrial or technical education sketched out forty years ago. Not a term passes without some addition to the apparatus with which their College is equipped, and hardly a session without provision for some newly-recruited trade or class; and it is an open secret that, as soon as the necessary land can be acquired, the extent of the buildings, and the convenience and efficiency of every department, will be very largely increased. It may well be supposed that no effort will be spared to enable the College to keep the lead, which it has hitherto held, in matters pertaining to technical instruction, or to ensure that, in this respect, it shall remain without a successful rival in the West of England. The Merchant Venturers, like their brethren in London, have a position to justify, a character to maintain, a distinguished past which they must not disgrace; and it is likely that, in the new work to which they have set their hands, they will evince the same activity and perseverance, and the same prudent liberality in furnishing means for the attainment of their ends, as characterised them in olden times, when their ventures were mostly for their own private gain, rather than, as now, for that of the community.

SCIENTIFIC SERIALS.

American Journal of Science, February.—Researches in acoustics, by A. M. Mayer. This paper, dealing with the variation of the modulus of elasticity with change of temperature, and the acoustic properties of aluminium, was read before the British Association at the Oxford meeting.—On the improbability of finding isolated shoals in the open sea by sailing over the geographical positions in which they are charted, by G. W. Littlehales. Suppose that A discovers, in the open ocean, a shoal r miles in radius, and determines the geographical position of its centre subject to extreme errors of m miles in longitude and n miles in latitude; and that B, who is able to establish his geographical position within the same limits of extreme error as A, attempts to find the shoal again by proceeding to the geographical position assigned to it by A, what is the probability that he will find it? The author works out this probability mathematically, and finds a general formula for it. If $r = 1$ mile, and m and $n = 10$ miles, B would stand one chance in 6173 of coming within two miles of the shoal. This shows that the reported non-existence of a charted shoal must be accepted with great care.—The counter-twisted curl aneroid, by Carl Barus. A curl aneroid, less than a metre long, provided with a mirror for registry, will indicate variations of atmospheric pressure of a thousandth of a millimetre of mercury, provided the mounting is sufficiently free from tremor, and the temperature is kept constant to a few thousandths of a degree during the interval of observation. The conditions are made much less severe if the coiled tube, after being twisted, is kept untwisted by a spiral spring. Effects of viscosity and rigidity may be thus compensated.

Wiedemann's Annalen der Physik und Chemie, No. 2.—Methods of determining dielectric constants, by W. Nernst. The author employs a bridge in which two branches are always equal; the third contains the dielectric trough, and the fourth a variable resistance and a variable capacity in parallel. Connecting two opposite terminals with a high-frequency induction coil, and the two others with a telephone, the latter is only silent when the resistance and the capacity in the fourth branch are equal to those of the dielectric in the third. An attempt to verify this by comparison with the electrometer method was foiled by the uncertainty of the latter.—A modification of the electrometer method, by J. F. Smale. This is based upon the attraction of a needle immersed in the dielectric by conductors kept at a constant potential. The conductors are two semi-ellipses nearly surrounding the flat needle of platinum, which is suspended by a quartz fibre. The deflection of the needle from its position of rest is proportional to the dielectric constant of the medium. A comparison with Nernst's method gave practically identical results.—An apparatus for varying self-induction, by Max Wien. This consists of a fixed and a movable coil. The fixed coil is subdivided into four, each of which can be placed in circuit, so that the self-induction can be abruptly changed. The interval between each abrupt change is filled up by moving the movable concentric coil about its diameter, by means of an arm travelling over a graduated circle. The range of the apparatus is very large, and self-inductions from 5×10^3 to 10^{10} can be measured.—Refraction and reflection of electric waves by water and alcohol, by A. D. Cole. For waves 300 to 600 cm. long, water has an index of refraction of 8·95, alcohol 5·20. Calculated by Fresnel's formula from the reflection of polarised rays, the refractive indices for wave-lengths of 5 cm. come out as 8·8 for water, and 3·2 for alcohol; so that alcohol shows a remarkably higher refraction for long than for shorter waves.—Lowest temperatures and the liquefaction of gases, by C. Linde. Air is liquefied exclusively by the action of its own expansion, each portion of the expanded air being conducted past the next expanding proportion, and cooling it down to a lower temperature. The apparatus is almost identical with that recently described by Prof. Dewar, but the author claims priority.—The wave siren, by Rudolph König. This paper contains the results of a minute and careful investigation of the behaviour of the air current in a wave-siren. The air is blown through a slit, which is lengthened or shortened by the curved edge of a plate rotating in front of it. Any tone is thus directly reproduced from its wave-form. The air current remains sharply defined to a distance of about 1 cm. from the slit, and the wave-plate need therefore not be mounted very close to it. There is no accumulation of air by the closed portions of the slit leading to irregularities in the tone, and the vortex effects at the edges are without any influence upon the tone. The loudness of the sound produced by a simple sine curve increases with the width of the slit, reaching a maximum where the width is half the wave-length. Most vowels can be correctly reproduced from their known wave-forms.

Bollettino della Società Sismologica Italiana, vol. i., 1896, No. 9.—Review of the principal eruptive phenomena in Sicily and the adjoining islands during the four months, May-August, 1895, by S. Arcidiacono.—Notices of Italian earthquakes (July-August, 1895), by M. Barratta, the more important being those of the Comacchio earthquake of July 30, and part of those of the Adriatic earthquake of August 8.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 30.—"On the Rhythmic Contractility of the Spleen." By E. A. Schäfer, F.R.S., and B. Moore.

The authors have investigated the rhythmic contractility of the spleen, which was discovered by Roy (*Journ. Physiol.*, vol. iii.), and the influence of nerves, drugs, and animal extracts upon it. For this purpose the changes in its volume have been studied by aid of a specially constructed plethysmograph, so arranged as to afford the least possible obstruction to the blood-vessels entering and leaving the hilum. Under these circumstances, the spleen exhibits evidence of responding immediately by alterations in volume to every alteration in blood pressure, respiratory and cardiac, and *à fortiori* to such greater changes as are produced by compression of the aorta (contrary to Roy). This is even manifest when the organ is left connected with the rest of the vascular system by one artery and vein only. The conclusion which Roy arrived at, that the spleen is practically cut off from the arterial system, and that its circulation is maintained by its own contractions, is thus shown to be incorrect.

The rhythmic contractions are independent of the central nervous system.

They are excited to increased activity by intravenous injection of certain drugs and animal extracts which act specifically upon the organ. Indifferent fluids, such as normal salt solution, produce in moderate quantity no such effects (contrary to Roy).

Dyspnœa causes marked contraction of the spleen. This contraction is of central origin, for after severance of all nerves to the organ it is replaced by a passive dilatation, due to the rise of general blood pressure, followed by an increase in extent of the rhythmic contractions. Temporary cessation of the blood flow through the organ also has the effect of increasing their extent, probably because the splenic tissue is thereby deprived of oxygen.

The splanchnics contain not only nerve fibres which produce contraction of the spleen, but also others which cause dilatation.

There is no evidence that the vagi contain any centrifugal fibres which influence the volume of the spleen (contrary to Roy). Provided their inhibitory action upon the heart is neutralised by atropine, even the strongest stimulation of the peripheral end of either cut vagus produces no direct effect upon the spleen.

There is evidence of the existence of numerous afferent (sensory) fibres in the nerves supplying the spleen.

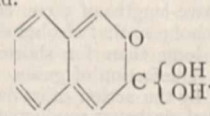
Entomological Society, February 19.—Prof. Raphael Meldola, F.R.S., President, in the chair.—Dr. D. Sharp, F.R.S., exhibited preparations of *Dytiscus latissimus* and *Cybister roeselii*, to show the so-called secondary wing, noticed by Meinert. He stated that this structure is only a part of the elytron, to which it is extensively attached, and that he considered that it corresponded with the angle at the base of the wing seen in so many insects that fold their front wing against the body. He could not consider that this structure afforded any support to the view that the elytra of beetles correspond with the tegulæ of Hymenoptera rather than with the front wings. He also exhibited specimens of Neuroptera, and pointed out that this secondary wing agreed in position and structure with a small lobe on the front wing of Raphidia. Mr. McLachlan, Prof. Meldola, and Mr. Gahan made some remarks on the subject.—Mr. C. G. Barrett exhibited, for Dr. H. G. Knaggs, cells of *Retinia resinana* formed of resin but lined with wax. A portion of the cell had been removed and the resin dissolved away with spirit, leaving a slight film of wax. Mr. Tutt stated that a secretion of wax had been detected by Dr. Chapman in *Parnassius apollo*. Prof. Meldola suggested that as Dr. Knaggs had shown how to separate the resin from the wax, it would be of interest to make a chemical investigation of the latter, since a sufficient supply of this material could easily be obtained. No insect wax, with the exception of that of the bee, had been submitted to investigation by chemists. Mr. Hampson and Mr. Blandford continued the discussion.—Mr. Gahan exhibited drawings of the dorsal segments of the abdomen of *Dyscritina longisetosa*, formerly described by Prof. Westwood in *Trans. Ent. Soc.*, 1881, a specimen of which was shown by Mr. E. E. Green at the last meeting of the Society. He regretted that no drawing, showing the ventral service, had yet been prepared.—Mr. B. A. Bower exhibited specimens of *Argyresthia atmoriella*, Bankes, taken in Kent, in June 1894, a recent addition to British Lepidoptera.—Mr. Green read notes on the habits of the Indian ant, *Œcophylla smaragdina*, Fabr. He said he believed that at some previous meeting of the Society, Mr. Ridley, of the Singapore Museum, made some remarks on this ant and its supposed habit of using its own larvæ as web-spinners in the formation of its nest, but he had not been able to find anything on the subject in the *Proceedings*. Mr. Green stated that he was now able to produce corroborative evidence from an independent source. The facts were noted by his friend Mr. W. D. Holland, of Balangoda, Ceylon, a most careful observer. Mr. Green exhibited the specimens referred to by Mr. Holland, and pointed out that the larvæ were still tightly grasped by the jaws of the ants, and he thought it probable that other web-spinning ants utilised their larvæ in the same way. Mr. Hampson said he could confirm this statement.—Mr. G. F. Scott-Elliot read a paper entitled "Notes on Flower-Haunting Diptera." The author pointed out that some of the higher types of Diptera

appeared to prefer red and blue flowers, and more often visited the complicated types of plants than the smaller Hymenoptera. He also alluded to the effect of insect visitors in isolating particular individuals. Prof. Meldola stated that although he was aware, from the writings of Hermann Müller and others, that Diptera played an important part in the fertilisation of flowers, he was unaware of the very great importance which these insects possessed for the function of pollination until he heard Mr. Scott-Elliot's paper. He also called attention to the urgent need of a manual of British Diptera. Mr. R. Trimen, F.R.S., mentioned that in South Africa some species of Orchidaceæ were fertilised by Diptera. Dr. Sharp said Prof. Plateau thought that neither the colour nor form of the flower played any part in attracting insects. Mr. McLachlan remarked that the flowers of Scrophularia possessed a great attraction for wasps. Lord Walsingham, F.R.S., inquired whether any observation had been made as to the Diptera which visited differently coloured flowers of the same species, such as Petunias. Mr. Barrett, Mr. Green, and Mr. Scott-Elliot continued the discussion.—Mr. Tutt read a paper, by Prof. A. Radcliffe-Grote, entitled "On the Nomenclature of the Geometridæ."—A discussion on the rules of nomenclature followed, in which Lord Walsingham, Prof. Meldola, Mr. Hampson, and Herr Jacoby took part.

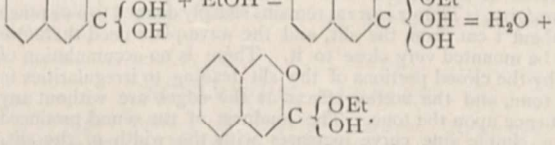
Royal Meteorological Society, February 19.—Mr. Edward Mawley, President, in the chair.—The report on the phenological observations for 1895 was presented by Mr. Mawley, in which it was shown that, owing to the great frost at the beginning of the year, all the first spring flowers made their appearance very late; and it was not until the middle of June that plants began to come into blossom in advance of their usual time. During July the dates recorded were, as a rule, exceptionally early. The yield of all the farm crops, except potatoes, was exceedingly poor. Pears and plums yielded badly, but there was a splendid crop of apples, and also of all the small fruits. As regards vegetation generally, seldom has a year ended under conditions as favourable for the one succeeding it.—Mr. R. H. Scott, F.R.S., read a paper on the recent unusually high barometer readings in the British Isles, in which he stated that the Daily Weather Chart for 6 p.m. on January 8, was the first in these islands that ever showed 31 inches. The station was Stornoway, and by the next morning all over the northern portions of Great Britain and Ireland the barometers were above 31 inches. The highest reading of all was 31·119 inches, photographically recorded at Glasgow at 9 a.m. on the 9th. The barometric pressure then gave way, and the region of highest readings moved southwards along our west coast, and finally left the south of Ireland on the 15th. Weather throughout the period was mild, an unusual thing with a very high barometer. At the end of the month a second anticyclone spread over the country, when the barometer rose to 30·96 inches at Cork. Reference was made to previous excessively high barometer readings in England and in Siberia, and it was stated that a reading of 31·62 inches at Barnaoul in Siberia, in 1877, was probably the highest ever observed.—Mr. R. Inwards read a paper on Turner's representations of lightning, which he considered to be true to nature, and demonstrated the same by placing an actual example of Turner's work side by side with a photograph of a real flash of lightning.

Linnean Society, February 20.—Mr. C. B. Clarke, F.R.S., President, in the chair.—Mr. Clement Reid exhibited a collection of acorns planted by rooks, and made remarks upon the agency of these and other birds in the dispersal of seeds. A discussion followed, in which the President and Messrs. Cole, Druery, Harting, and Kirby took part.—Mr. Bernard Arnold exhibited and made remarks upon an abnormal growth of *Dactylis glomerata*, Linn., gathered at Shorne, near Gravesend, criticisms being offered by Messrs. B. Daydon Jackson and H. Groves.—Mr. W. H. Lang exhibited under the microscope some prothalli of several varieties of *Nephrodium Filix-mas*. These illustrated the apogamous production of the sporophyte which has been described in this species by De Bary and Kny. Dr. D. H. Scott and Mr. C. T. Druery took part in the discussion which followed.—On behalf of Mr. John Young there was exhibited an unprecedented case of hybridism between *Carduelis spinus* and *Linota cannabina*, the formerbeing the male parent. Some remarks were made on the subject by Mr. Harting, who took occasion to exhibit, on behalf of Captain M. Murphy, another hybrid, viz. one between black grouse and pheasant, which had been shot near Bunessan, Mull, in the month of January last.—On behalf of Mr. E. J. Lowe, F.R.S., a paper was read by Mr. Druery in which details were given regarding the culture of divided and redivided prothalli of *Scolopendrium vulgare*. Apart from the fact that by such subdivision and the consequent separation of parts bearing archegonia and antheridia, the oophoric stage of fern life was maintained for a number of years without the sporophoric generation appearing; the ultimate results, when fertilisation eventually took place, were very remarkable. In numerous instances several marginal plants appeared on the same prothallus of presumably the parental type; but single plants originating from the centre of each prothallus were, though of varying character, all distinguished by bearing prothalli upon their edges or terminal points, such prothalli developing root-hairs, archegonia and antheridiæ, although the young plants had formed a distinct axis of growth and thrown up a circle of such aposporous fronds. The paper embodied also the observations of Mr. C. T. Druery, Prof. F. O. Bower, Prof. Farmer, Dr. Scott, and Mr. Lang on material sent to them, and one of the plants in question, clearly showing the aposporous growths, was exhibited by Mr. Druery in illustration. A discussion followed, in which Dr. Scott, Mr. Lang, and Mr. Druery remarked upon the interesting nature of these and similar breaches of the law of alternation of generations in the Archegoniatæ.

Chemical Society, February 20.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read:—The origin of colour, No. XI. The yellow colour of 2 : 3-hydroxynaphthoic acid, by H. E. Armstrong. The yellow colour possessed by this naphthoic acid and its salts may be readily explained by assigning to it an orthoquinonoid structure of the following kind.



—Note on etherification, by H. E. Armstrong. 2 : 3-hydroxynaphthoic acid is converted into its ethylic salt more readily than the isomeric α-hydroxynaphthoic acid; an acid having the constitution indicated above should readily combine with alcohol yielding a substance which could easily give the ethylic salt by losing water, thus:—



—The relation of pinene to citrene, by H. E. Armstrong.—The conditions involved in the occurrence of inversion in the case of asymmetric (optically active) compounds, by H. E. Armstrong. The remarkable conversion of dextro- or lævo-malic acid into its optical antipodes is possibly due to the formation of a chlorophosphonium compound, which is then acted on by hydrogen chloride giving chlorosuccinic acid and phosphorus oxychloride. The production of naphthalene and of isoquinoline derivatives from dehydracetic acid, by J. N. Collie and N. T. M. Wilsmore. The yellow condensation product obtained from diacetylacetone is a benzene derivative, and condenses with ammonia, giving two isoquinoline bases.—Note on a difficulty encountered in the determination of nitrogen by the absolute method, by W. R. Dunstan and F. H. Carr. Very high values are obtained on determining the nitrogen in aconitine by the absolute method; this is shown to be due to the formation of methane during the combustion. Experiments with mixtures of methane and nitrogen show that the hydrocarbon in the diluted state is only burnt with great difficulty by red-hot copper oxide.—Mixed diazoamides containing an orthonitro-group, by R. Meldola and F. W. Streatfeild.—Allyl-p-dinitrodiazoamidobenzene: a study of the relations between melting-point and constitution, by R. Meldola and F. W. Streatfeild.

EDINBURGH.

Royal Society, February 17.—Prof. Copeland in the chair.—Prof. John G. M'Kendrick made five communications. He first described the case of a boy, four and a half years old, who showed a remarkable appreciation of pitch, being able at once to

name any note struck on a piano. Then followed a demonstration of the acoustic turbine of Dvoràk and Mayer, and of a flame so sensitive that it was affected by the ticking of a watch. Next, Prof. M'Kendrick exhibited Graham's method of producing a musical tone in a circuit containing a variable resistance apparatus and a telephone. The sound emitted was like that of a cornet or flute. Finally, Prof. M'Kendrick made some further observations on the phonograph. He described apparatus by which the sounds could be magnified, and detailed his methods of studying the curves on the wax cylinder, of which he exhibited photographs. He showed that each note and sound had its characteristic curve, and, to show it, spoke the words "Arrubnidē fo Eetisrevenū" into a machine moving backwards, and the meeting was considerably startled to hear, on the instrument being turned in the proper direction, the words coming out "University of Edinburgh."

CAMBRIDGE.

Philosophical Society, February 10.—Prof. J. J. Thomson, President, in the chair.—Exhibition of a method of measuring osmosis at atmospheric pressure, by Dr. Lazarus-Barlow.—Exhibition of specimens showing the communication between the peritoneal cavity and renal veins through the nephrostomial tubules in the frog, by E. J. Bles.—On the effect of currents on the assimilation of water-plants, by F. Darwin and D. F. M. Pertz. The amount of gas given off by water-plants under the influence of light is markedly increased by continuously stirring the water. This holds good in the case of Elodea, but only under certain circumstances with Potamogeton. That form of gas-evolution which continues in darkness, owing to the gas-pressure in the water, is also increased by disturbing the water. The authors described simple methods of showing the effect of barometric pressure and of surface tension on the yield of gas.—On a collection of plants from New Britain (*Neu Pommern*), by I. H. Burkill. This collection was brought home by Baron A. von Hügel, having been made in the neighbourhood of Blanche Bay. There are in it a number of species not hitherto known as natives of New Britain; among them a new *Eranthemum* described as *E. Huegelii*. The name *Alpinia oceanica* is suggested for a plant described by Prof. K. Schumann as *A. nutans*: this being also held as possibly not identical with Rumphius' *Globba sylvestris minor*. The total number of species known from New Britain is still small, two-thirds of them having been found in German New Guinea, and about one-half in the Fiji Isles.

PARIS.

Academy of Sciences, March 2.—M. A Cornu in the chair.—On the divergence of the series used in astronomy, by M. H. Poincaré. The results obtained by M. Hill are shown to be in agreement with those previously obtained by the author, the contradiction being only apparent.—Observations on the subject of photography through opaque bodies, by M. A. d'Arsonval. In reviewing the work of M. G. Le Bon and his critics, it is shown that their results are not necessarily contradictory. The solar rays do not appear to penetrate a thin plate of metal, even of aluminium; if a plate of glass, however, especially a fluorescent glass, be placed above the metal screen, the photographic plate is affected.—On the invisible radiations emitted by phosphorescent bodies, by M. Henri Becquerel. The light emitted by crystals of uranyl-potassium sulphate, $K(UO).SO_4 + H_2O$, can pass both through thin sheets of metal and also through black paper. This effect was first shown by covering a sensitive film with a metal screen, placing some crystals of the double sulphate on this, and then exposing to sunlight. But it was afterwards found that the crystals exerted the same photographic effect in the dark, a phenomenon which can hardly be attributed to phosphorescence, since $\frac{1}{100}$th of a second after exposure to light, these radiations are no longer visible (see p. 445).—The relation between the energy of muscular work and albuminoids in food, by MM. A. Chauveau and C. Contejean. The albuminoids in food are not directly concerned with the production of muscular energy, since the amount of nitrogen excreted in the urine is independent of the work done by the animal.—Observations on the Comet Perrine (1895 *c*), made at the Observatory of Toulouse with the Brunner equatorial, by M. F. Rossard.—On a means of recognising small variations in the rate of astronomical clocks, by M. G. Bigourdan. The use of a free pendulum, working in a vacuum at a constant temperature, is suggested.—On groups of operations, by M. Levavasseur.—Reply to the observations of M. H. Poincaré on the theory of the kathode rays, by M. G. Jaumann.—Observations on the subject of the preceding communication, by M. H. Poincaré. Presentation of prints obtained by M. Röntgen's method, by M. Londe.—Dark light, a reply to some criticisms, by M. Gustave Le Bon.—Diffusion of the Röntgen rays, by MM. A. Imbert and H. Bertin Sans. The experiments show that if the rays are regularly reflected, it must be only to a very small extent; they can, however, be readily diffused, and the diffusion appears to depend rather on the nature than on the condition of the surface of the diffusing body.—On the photographic representation of a medal obtained by the Röntgen rays, by M. J. Carpentier.—On the passage of the Röntgen rays through liquids, by MM. Bleunard and Labesse. Water, either coloured or not, and solutions of borax and potassium permanganate are transparent to the rays. Solutions of potassium bromide, antimony chloride, and potassium bichromate, on the other hand, are not so transparent.—Discovery and extraction of a needie embedded in the hand by means of the Röntgen rays, by M. P. Delbet.—Applications of the method of Röntgen, by MM. C. Girard and F. Bordas.—Extraction of rhodinol from the essence of pelargonium and from essence of roses; identity of these two alcohols, by MM. P. Barbier and L. Bouveault.—On the preparation of silicochloroform, silicobromoform, and on some derivatives of triphenyl-silicoprotane, by M. C. Combes. Silicide of copper, prepared in the electric furnace, and containing 20 per cent. of silicon, is heated in a current of dry HCl to the boiling point of diphenylamine. The liquid obtained consists of silicochloroform (80 per cent.) and silicon tetrachloride (20 per cent.), readily separated by fractional distillation. In this way there is no difficulty in preparing 1 kilo. of silicochloroform at one operation.—Oxidation of crotonic aldehyde, by M. E. Charon. By careful oxidation with silver oxide only one crotonic acid is produced.—The elements of the retina vibrate transversely, by M. A. Charpentier.—On functional assimilation, by M. F. Le Dantec.—A new function of the tubes of Malpighi, by M. V. Mayet.—Some diseases of the potato, by M. E. Roze.—The Hypostomaceæ, a new family of parasitic fungi, by M. Paul Vuillemin. A description of two new parasitic fungi discovered in the needles of Conifers.—On the inversion of the folds on the two sides of the Atlas of Blida (Algeria), by M. E. Ficheur.—On the secondary layers of the provinces of Murcie, Almeria, Grenada, and Alicante (Spain), by M. R. Nickles.—The Observatory of Mount Argoual (Gard), by M. G. Fabre.

PHILADELPHIA.

Academy of Natural Sciences, February 18.—A paper entitled as follows was presented for publication, "Contributions to the Life-history of Plants, No. xii.," by Thomas Meehan. (1) Fecundity of Heliophytum Indicum; (2) origin of the forms of flowers; (3) spines on the Citrus family; (4) flowers and flowering of *Lanium purpureum*; (5) cleistogamy in Umbelliferæ; (6) rhythmic growth in plants; (7) pellucid dots on some species of Hypericum; (8) honey glands of flowers; (9) varying phyllotaxis in the elm; (10) special features in a study of *Cornus stolonifera*; (11) Folial origin of cauline structures; (12) polarity in the leaves of the Compass and other plants; (13) hybrids in nature; (14) origin and nature of plant glands; (15) nutrition as affecting the forms of plants and their floral organs; (16) some neglected studies.—Mr. D. S. Holman exhibited a new stage for the microscope devised for the purpose of studying large objects and widely-spread preparations. It can be adapted to all instruments provided with square stages, and has a motion of two inches each way.—Preparations of minerals containing diatoms in transverse section, and other microscopic arrangements of diatoms prepared by Mr. John A. Schulze, were exhibited by Mr. F. J. Keeley.—Prof. Edw. D. Cope described specimens of fossil reptilia from the Permian and Trias. They belonged to the order Cotylosauria, which had been described by him in 1879, and was afterwards characterised by Seeley from African types. The order embraces the families Elginiidæ, Pariasauridæ, Pariotichidæ, the distribution and characters of which were dwelt on. New genera of Diadectidæ were described under the names Bolbodon and Diatomodon, the teeth of which, as well as of the other genera of the family, were illustrated. The Platodontia may have been derived from the Diadectidæ. The roof over the temporal fossa and the foramen for the temporal eye were illustrated by specimens. The molar teeth of a species of Empedias, the cranium of *Bolbodon tenuitectis*, and the lower jaw of Diatomodon were

exhibited. Another form, described under the name *Conodectes favosus*, may belong to the Diadectidæ, but its relationships are at present uncertain.

GÖTTINGEN.

Royal Society of Sciences.—In the *Nachrichten*, No. 4, 1895 (mathematico-physical section) the following memoirs communicated to the Society are published.

October 19.—J. Orth: Report on the work done in the Göttingen Pathological Institute in the summer half-year 1895.

November 16.—W. Schur: Further communications on the results of pendulum-observations in or near Göttingen.

November 30.—Georg Landsberg: Foundations of the arithmetical theory of the algebraic functions of one variable.—Eduard Riecke: The quantities of electricity concerned in a lightning-flash (43 to 98 coulombs).

DIARY OF SOCIETIES.

LONDON.

THURSDAY, MARCH 12.

ROYAL SOCIETY, at 4.30.—The Croonian Lecture: Observations upon Isolated Nerve: Electrical Changes a Measure of Physico-chemical Change: Dr. A. D. Waller, F.R.S.

MATHEMATICAL SOCIETY, at 8.—On the Enumeration of Groups of Totitives: Prof. Lloyd Tanner.—(1) The Catenary on the Paraboloid and Cone; (2) The Motion of the Top: Prof. Greenhill, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—High-Voltage Lamps and their Influence on Central Station Practice: G. L. Addenbrooke.

SOCIETY OF ANTIQUARIES, at 8.30.

CAMERA CLUB, at 8.15.—Lord Armstrong's Experiments in Electric Discharge: Dr. Bowles.

FRIDAY, MARCH 13.

ROYAL ASTRONOMICAL SOCIETY, at 8.—Observations of the Variable Star R Carinæ, December 1890 to August 1895: J. Tebbutt.—Discovery and Observations of Comet Brooks (*d* 1895); W. R. Brooks.—Observations of the Variable Stars W. X, and Y Sagittarii: Lieut.-Colonel Markwick.—Elliptical Orbit Elements of Comet 1894 *b* (Gale): Rev. T. Roseby.—Results of Double Star Measures at Windsor, New South Wales, in 1895: J. Tebbutt.—On the Determination of the Errors of the Cape Réseau: David Gill and Harold Jacoby.—Royal Observatory, Edinburgh: Observations of Comets.—Note on Mr. Stone's Paper, "Expressions for the Elliptic Co-ordinates of a Moving Point to the Seventh Order of Small Quantities": Prof. E. W. Brown.—Fireball of 1895, November 22: W. F. Denning.—On the Systematic Errors of Measures of Photographic Plates: Prof. H. H. Turner.—Note on the Zodiacal Light as seen at Oxford, 1896, March 4: Prof. H. H. Turner.—Variation of T Centauri: A. W. Roberts.—Royal Observatory, Greenwich: Results of Micrometer Measures of Double Stars made with the 28-inch Refractor in the Years 1894 and 1895.

PHYSICAL SOCIETY, at 5.—An Addition to the Wheatstone Bridge for the Determination of Low Resistances: J. H. Reeves.—A Communication on Kathode Rays: Herr Puluj.

MALACOLOGICAL SOCIETY, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Tests of Centrifugal Pumps: J. C. Cornock.

SATURDAY, MARCH 14.

ROYAL INSTITUTION, at 3.—Light: Lord Rayleigh, F.R.S.

ROYAL BOTANIC SOCIETY, at 3.45.

ESSEX FIELD CLUB (at Loughton).—Demonstration Meeting.—Mosses and Scale Mosses (Muscineæ): G. M. Holmes and E. D. Marquand.

MONDAY, MARCH 16.

ROYAL GEOGRAPHICAL SOCIETY, at 4.30.—On the Maps used by Herodotus: John L. Myres.

VICTORIA INSTITUTE, at 4.30.—Relations of Mind and Body.

CAMERA CLUB, at 8.15.—The Faroe Islands: K. Grossman.

TUESDAY, MARCH 17.

ROYAL INSTITUTION, at 3.—The External Covering of Plants and Animals: Prof. C. Stewart.

ZOOLOGICAL SOCIETY, at 8.30.—A Contribution to our Knowledge of the Hymenopterous Fauna of Ceylon: Lieut.-Colonel C. T. Bingham.—On British Hydroids and Medusæ: Edward T. Browne.—On some Extinct Fishes of the Teleostean Family Gonorhynchidæ: A. Smith Woodward.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Lixiviation of Silver Ores: J. H. Clemes.—Mining and Treatment of Copper Ore at Tharsis, Spain: C. F. Courtney.—Tin Smelting at Pulo Brani, Singapore: John McKillop and T. Flower Ellis.

ROYAL STATISTICAL SOCIETY, at 5.—Reformatory and Industrial Schools: John Watson.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Screens for Process Work; and a Note on Photogravure: Captain Collardon.

ROYAL VICTORIA HALL, at 8.30.—Gold Mining: Dr. T. K. Rose.

WEDNESDAY, MARCH 18.

SOCIETY OF ARTS, at 8.—Bahamas Sisal Industry: Dr. D. Morris, C.M.G.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Weather Forecasts and Storm Warnings: F. Gaster.

ROYAL MICROSCOPICAL SOCIETY, at 8.—American Rotifera: Dr. A. C. Stokes.

ENTOMOLOGICAL SOCIETY, at 8.—Classification of Three Sub-families of Moths of the Family Pyralidæ: the Epipaschiinæ, Endotrichinæ, and Pyralinæ: George Francis Hampson.—Descriptions of New Oriental Scolytidæ: Walter F. H. Blandford.

THURSDAY, MARCH 19.

ROYAL SOCIETY, at 4.30.

SOCIETY OF ARTS (Imperial Institute), at 8.30.—The Great Landslip at Gohna, in Gurhwal, and the Measures adopted to prevent Serious Loss of Life: J. H. Glass, C.I.E.

LINNEAN SOCIETY, at 8.—On the Scructure of the Female Flowers and Fruit of Sararanga, Hemsl (Pandanaceæ): Dr. A. Stapf.—On Two Little-known Opisthoglyphous Snakes: G. S. West.

CHEMICAL SOCIETY, at 8.—The Constitution of a New Organic Acid: H. J. H. Fenton.—The Volume and Optical Relationships of the Monoclinic Series of Double Sulphates $R_2M(SO_4)_2.6H_2O$: A. E. Tutton.

SOCIETY OF ANTIQUARIES, at 8.30.

CAMERA CLUB, at 8.15.—Views in Cashmere: G. Millais.

FRIDAY, MARCH 20.

ROYAL INSTITUTION, at 9.—Immunisation against Serpents' Venom and the Treatment of Snake-Bite with Antivenene: Prof. T. R. Fraser, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.—On Puerperal Mortality: a Statistical and Etiological Inquiry: Dr. Williams.—An Outbreak of Typhoid Fever in Beyrout, Syria: Dr. Wortabet.

QUEKETT MICROSCOPICAL CLUB, at 8.

SATURDAY, MARCH 21.

ROYAL INSTITUTION, at 3.—Light: Lord Rayleigh, F.R.S.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—By Meadow and Stream: The Amateur Angler (S. Low).—Intensity Coils, 17th edition (Perken).—Alternating and Interrupted Electric Currents: Prof. G. Forbes (Biggs).—Physical Units: Dr. M. Maclean (Biggs).—Hypnotism, Mesmerism, and the New Witchcraft: E. Hart, new edition (Smith).—Les Fermentations: P. Schützenberger, sixiéme édition (Paris, Alcan).—The New Photography: A. B. Chatwood (Downey).—The Story of the Nations: The West Indies and the Spanish Main: J. Rodway (Unwin).—Leçons sur la Cellule, Morphologie et Reproduction: L. F. Henneguy (Paris. Carré).—Mechanics for Beginners: W. Gallatly (Macmillan).—The Number Concept: Dr. L. L. Conant (Macmillan).—An Elementary Treatise on Rigid Dynamics: W. J. Loudon (Macmillan).—Electric Wiring: R. Robb (Macmillan).—Griffin's Electrical Engineer's Price-Book, new edition, Edited by H. J. Dowsing (Griffin).

PAMPHLETS.—Zur Mechanik des Vogelfluges: Dr. Fr. Ahlborn (Hamburg).—Preliminary Report on the Tsetse Fly Disease, or Nagana, in Zululand: Surgeon-Major D. Bruce (Durban).—How to Assist the Sight (J. H. Steward).

SERIALS.—Bulletin of the American Mathematical Society, February (New York, Macmillan).—Geographical Journal, March (Stanford).—Journal of the Royal Microscopical Society, February (Williams).—Psychological Review, Monograph Supplement. No. 2. Association: M. W. Calkins (Macmillan).—Science Progress, March (Scientific Press).—Revue de l'Université de Bruxelles, Nos. 1 and 2 (Bruxelles).—Proceedings of the Physical Society, March (Taylor).—Engineering Magazine, March (Tucker).

CONTENTS.