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RADIO-THERAPY.

Diseases of the Skin, including Radiotherapy and Radiumtherapy. By Prof. E. Gaucher. Translated and edited by Dr. C. F. Marshall. Pp. xii+460. (London: J. Murray, 1910.) Price 15*s.* net.

A FULL account of the use of X-rays and radium in the treatment of various diseases of the skin is given in this volume. The most recent developments in radium treatment are described by Wickham, Degrais, and Dominici. X-ray treatment is described by Gastou and Zimmern. The illustrations are mostly from wax models in the St. Louis Hospital Museum and from Prof. Gaucher's private collection.

The treatment of vascular nævi by radium is fully described and illustrated. The radium salt mixed with finely powdered sulphate of barium is spread with varnish in a thin layer on a metal plate. The treatment consists in the application of this apparatus to the nævus, the dosage being regulated according to the form and depth of the nævus. In flat nævi large doses may be given by direct application for short periods, the dose being timed to cause a certain degree of curative inflammatory reaction. Another method is to give smaller doses filtered through screens which absorb the less penetrating rays, longer exposures being given in this case. There is no reference in the book to the new method of treatment by the application of sticks of solid carbon dioxide.

In cavernous nævi containing large blood-vessels the doses used must not be sufficient to produce inflammation of the surface. The results are very satisfactory, the nævi being decolorised and levelled, and the final results on the whole better than those obtained by any other known means.

In the treatment of cheloid, or scar tissue tumours, very favourable results are obtained both by X-ray and by radium treatment. Radium is less liable to cause dermatitis, and may therefore eventually supplant the X-rays in the treatment of cheloid.

Coming now to the important subject of the treatment of cancer, the very malignant form of growth known as sarcoma, though occasionally greatly reduced in size by X-ray treatment, is seldom cured, and this treatment should on no account be relied upon where there is any chance of success from operative removal of the growth. Treatment by radium may also be tried, but its value remains to be proved; apparent improvement is frequently obtained by its use.

Coming to the skin cancers, or epitheliomata, electricity may be applied in various ways—the electric spark, X-ray treatment, and fulguration. The electric spark treatment is applied by connecting a naked electrode with a high-frequency resonator. The method has been successfully employed in small epitheliomas of the skin. Its action is mainly destructive, while it has the advantage of promoting repair by cicatrisation. The procedure consists in riddling the diseased tissue with small, very short sparks.

Fulguration is a method of using the sparks from a high-frequency resonator by means of Keating-Hart's special electrode for the treatment of growths which are widely and deeply ulcerated, and too great in extent to be destroyed by the cautery. The operation is painful, and must be performed under local or general anæsthesia. The special electrode consists of a hollow metallic rod sliding in an ebonite sheath, and a bellows for blowing a current of carbonic acid gas or air through the rod to prevent the excessive production of heat. The ulcerated surface is subjected to the action of sparks which are usually 7 or 8 centimetres in length. This causes the blood-vessels of the healthy surrounding parts to contract, while the tumour itself is softened within a few minutes. Surgical treatment is then applied, the softened masses of growth being cut or scraped away. The sparking is then repeated carefully and energetically until all growth has been destroyed. A single application is usually sufficient, but any focus of recurrence must be treated again. The results of this treatment are not so good as appeared from the first accounts of patients treated in this way, and the use of the method does not appear to be extending.

The X-ray treatment of cancer is fully treated, the various forms of apparatus for the production of the high-tension current necessary to excite a Crookes's tube being described. The methods of regulating and measuring the dose are also given in full. The author finishes by stating that

"the most ardent partisans of radiotherapy recognise that the X-rays are not always successful in the treatment of epithelioma. Some epitheliomas are rapidly modified by radiotherapy, while others remain unaffected. In the results published, it is necessary to take into account the age of the tumour, its surface, extent, and depth, its situation as regards accessibility to the action of the rays, and also the technique employed, which varies with different operators. In short, radiotherapy may be used in certain cases on the chance of a successful result, provided it is not employed too late; but we must not have too much confidence in this method."

Radium treatment of cancer is fully described by Dominici.

The properties of the alpha-, beta-, and gamma-rays are described, and also the method of eliminating the less penetrative rays by filtration through sheets of lead of various thicknesses. The salts of radium are used mixed in small or large proportions with a salt of barium (sulphate or bromide). This is mixed with varnish and spread on metal or linen. In some cases discs or square sheets of metal are covered with the varnish containing radium; in others rods are used, the ends of which are bulbous, oval, cylindrical, or spatulate. Applications can thus be made to surfaces of various form or to the interior of passages. Another form of apparatus consists of discs or squares of lint covered on one side with the radium varnish and enclosed at the borders in a metal frame; these can be adapted to the shape of the affected region.

The radio-activity of radium is usually compared with that of uranium. If uranium be taken as the unit the activity of pure radium is two million. In the case of a mixture of radium and barium salts, the

activity of the mixture is inversely proportional to the quantity of the barium salt. In the treatment of cancerous tumours, apparatus of 500,000 activity are used. Such an apparatus usually contains from 4 to 10 milligrams of powder, consisting of one part of radium salt to three of barium salt. Cancers suitable for radium treatment range from those of small size to those of 20 to 30 square centimetres in area. The apparatus may be used in two different ways, either by the so-called dry method, consisting of short, frequently repeated applications causing resolution of the diseased tissue without external destruction, or the destructive method in which the apparatus is left in place from seven to ten hours, causing extensive destruction of the morbid tissue followed by cicatrisation in eight to ten weeks.

For cancers which extend, deeply filtration of the rays is employed by the interposition of a half to several millimetres thickness of lead. In this way only the ultra-penetrating rays (the gamma-rays and the hardest beta-rays) are allowed to enter the tissues. Long exposures are then given varying from 24 to 120 hours. These ultra-penetrating rays produce very little change in the healthy cells of the part, while they have a selective action on the cancer cells, leading to their destruction. The progress of a successful case is as follows :—After a short time (three to eight days) the tumour commences to diminish in size. Cicatrisation then begins and is completed in two to four weeks, or longer in obstinate cases. In the case of ulcerating tumours, a certain amount of discharge occurs during all the stages. For large and deeply-extending tumours the method of "cross-fire" is usually employed, two or more radium apparatus being applied at different points around the tumour in such a way that the ultra-penetrating rays cross in the depths of the tumour. In this way the deeper parts of a growth can be subjected to the influence of the gamma-rays far more effectively than with a single disc of radium.

The general conclusion is to the effect that most cancerous growths can be reduced in size by the application of radium. Some of the less malignant forms of growth can apparently be cured, while in the more malignant cases the temporary improvement is of short duration, and is followed by further extension of the growth.

The treatment of lupus is described—the method of using sunlight concentrated by means of a large hollow lens formed of two plates of glass 10 or 12 inches in diameter, one of which is flat and the other convex, the cavity being filled with sulphate of copper solution to absorb the heat rays. The use of the electric arc lamp as described by Finsen arose naturally from the solar method, and is now too well known to require description. In the case of both the sunlight and the electric arc it is recognised that the violet and the ultra-violet rays are those principally concerned in the curative action. The mercury-vapour lamp, being particularly rich in violet and ultra-violet rays, is very effective, particularly when a tube of quartz is used in place of glass. It is far less expensive than the Finsen arc lamp, and has taken the place of Finsen lamps for many purposes. X-ray treatment and radium treatment have also been employed in the treatment of lupus. The author considers light treatment the most efficacious, while radium has not been employed long enough for its value to be estimated in the case of lupus.

Ringworm is now almost universally treated with the Röntgen rays. A full account of the technical details of this method is given, and the precautions necessary to prevent injury to the patient. The object of the method is to accomplish the removal of all the diseased hairs from the affected area of the scalp. It is found that a properly applied dose of X-rays results, after a fortnight, in the loosening of the hairs, which then fall out leaving a perfectly bald area which can be readily and effectively treated by antiseptic applications. When there are numerous patches of ringworm scattered over the scalp it is necessary to produce epilation of the entire scalp. For this purpose the scalp is divided into ten or twelve areas which are exposed in turn, care being taken to prevent overlapping, as this would result in the administration of an excessive dose to some parts of the scalp. Dermatitis would appear in the over-exposed portions, and permanent baldness would probably result. After a correct dose the hairs begin to grow anew after two or three months, and the new hairs are free from the disease. By the X-ray method of treatment the cure of a case of ringworm is completed in three months, whereas the older methods of treatment by local applications extended for periods of two years or even longer. In the case of the children of the poor treated in public institutions the saving of public funds that has resulted from the introduction of the X-ray treatment of ringworm has been very considerable, and the advantage to the education of the children is self-evident, for while there are any infected hairs on the head it is necessary for the children to be rigorously excluded from intercourse with other children.

Many other diseases are described in which electrical methods of treatment have been used with success. The methods are now firmly established, and the range of their utility is being defined with ever-increasing accuracy. A. C. JORDAN.

DEDUCTION AND DENUDATION.

Geographical Essays. By Prof. W. M. Davis. Edited by Prof. D. W. Johnson. Pp. vi+777. (London, Boston, New York, and Chicago: Ginn and Co., n.d.) Price 12*s.* 6*d.* net.

PROF. D. W. JOHNSON has done good service to science by editing this collection of the valuable memoirs by which Prof. W. M. Davis has done so much to advance physical geography and improve geographical education. The volume includes twenty-six papers hitherto scattered in twenty-one serials. The first twelve contributions are essays and lectures on geographical pedagogics; the remaining fourteen deal with various principles of physiography. It would perhaps have been more convenient if the two series had been issued separately, for the volume, though containing no plates, is heavy for its size, and while the physiographic essays may be read with great

advantage by advanced students of geology and geography, the educational section is of most use to a different circle of readers. The author's criticisms of teachers and text-books would probably have been better confined to a work expressly for teachers, as it is not always good for the intellectual discipline of students to have their often scanty faith in their instructors still further reduced. Geographical education should, moreover, proceed on such different lines in countries in different stages of development, that its discussion is of more local interest than that of physical problems, which are of universal application. The educational essays should, however, be read by all geographical teachers, who must benefit from their high ideals and valuable practical suggestions.

The fourteen physiographic essays in this volume show the development of Prof. Davis's views on denudation. The earliest in date deals with the rivers of Pennsylvania and New Jersey, and led to his well-known classification of rivers according to their relation to the original slope of the land. The wearing away of the land to a plain sloping slowly to the sea is brought out in two papers on the peneplain and on base level, and they lead to the geographical cycle due to the interaction between uplift and denudation. The course of the geographical cycle in an arid climate is discussed in a memoir first published by Prof. Davis in 1905. Among the other papers included are those on glacial erosion in France, Switzerland, and Norway (1900), on the sculpture of mountains by glaciers (1905), on the mountain ranges of the Great Basin, and on the remarkable instances of river capture in the valleys of the Seine, Meuse, and Moselle.

The most striking feature in Prof. Davis's geographical writings is his devotion to the deductive method. He rejects emphatically the view that geography is to be advanced chiefly "by observation, description, and generalisation." To use those methods only is, he says, to walk on one foot. He claims that invention and deduction are as necessary to geography as to any other science. Many of his valuable results are due to his keen insight and not to his method, which cannot be unduly adopted without altering the position of geography in the circle of sciences. The very name geography implies that the subject is descriptive rather than deductive, although some deduction is required by all schools of geographers. But it has hitherto been found convenient to limit geographical work mainly to observation, description, and generalisation, restricting advanced deductive methods to the special problem of geography—the relation of the earth to man. The subject-matter of geography is so enormous that it seems reasonable as well as convenient that there should be a special science and societies devoted to the mapping and description of the earth as it is, leaving its evolution and explanation to other sciences.

Geology, on the other hand, is a "logos," not a "graphe"! and hence requires a more intimate connection of observation and inference than does physical geography. Much that Prof. Davis calls geography has been generally regarded as geology. The distinction that has been so long established and has worked so well in this country, is shown by Prof. Davis himself to have been accepted also in America; for he is professor of geology at Harvard and not of geography. Most of his physiographic essays are quite appropriate to a geological school, and they have been more read in this country by geologists than by geographers. Four of them were published in geological and six in geographical journals.

Prof. Davis, however, regards geology and geography as essentially the same. "They are parts of one great subject," he says (p. 196). "It is a misfortune that we have no English word to include both geography and geology" (p. 198). "To set them apart" he describes as an "obsolescent system" (p. 204). Prof. Davis, moreover, restricts geology to a minor section of the joint subject; he regards it (p. 37) as the sequence of events in the earth's history, and he regrets that such questions as rock weathering are not included in geography. The geographer must, of course, know some of the elementary facts of geology, as he does of meteorology and physics; but he has so many difficult problems connected with man on the earth that he may conveniently refer the study of complicated physical causes to astronomy, meteorology and geology. The abandonment of the conventional boundary between geography and geology would probably prove ultimately detrimental to both sciences.

The classification of some of Prof. Davis's memoirs as geology instead of geography does not lessen their high value. Probably no living writer has done so much to improve the interpretation of denudation. His deductive method and his keen insight have enabled him in studying the history of river systems to unravel confused tangles of facts, and by skipping intermediate phases to go back to stages of which most geologists thought that no traces could be surely recognised in existing geography. The two chapters on glacial erosion illustrate the advantages and the dangers of the deductive method; for according to some geologists, it has led Prof. Davis to attach undue weight to certain striking features of mountain form, and to overlook features which must be included in a complete explanation. Prof. Bonney's presidential address to the British Association has brought the controversy on glacial erosion to a head. It may be hoped that the authoritative and masterly statements on both sides will lead to an agreement as to the main facts, but no settlement can be expected until the arguments of those who limit the efficacy of glaciers as eroding agents have been directly answered. J. W. G.

TECHNICAL ORGANIC ANALYSIS.

Allen's Commercial Organic Analysis. Vol. iii., Hydrocarbons, Petroleum, Aromatic Acids, Explosives. Edited by W. A. Davis and Samuel S. Sadtler. Fourth edition, entirely re-written. Pp. x+635. (London: J. and A. Churchill, 1910.) Price 21*s.* net.

THE original "Allen's Commercial Organic Analysis" had established a place of eminence in all analytical and technological laboratories and was a book—it may be said still is a book—of every-day reference. At the same time the trend of modern

chemistry and the rapid advances which are taking place owing to chemical research and improved methods prevent any book, however well up-to-date on its publication, from holding its place unless it is continually revised. In this respect Allen's book required revision along with other reference books of a similar nature. The work has now been taken up by new editors, and when this is the case one naturally scrutinises somewhat carefully the new edition to ascertain whether real improvements have been made. It must be said at once that the revision of another man's work is much more difficult than to start to write a book *de novo*, and the attempts which one naturally makes to leave in paragraphs untouched which were written ten years ago and incorporate them with new material, the reverse of easy.

The editing is being jointly carried out by Mr. W. A. Davis, of London, and Mr. Samuel S. Sadtler, of America. As British and American methods of analysis are not always quite similar this editorship strikes one as being a wise, but at the same time rather difficult arrangement. The individual sections are, as is always the case in reference books of this nature, written by different collaborators. In this volume Dr. F. C. Garrett deals with hydrocarbons of the aliphatic, olefine, and acetylene series and of tars. This section, also under acetylene, includes the valuation of calcium carbide and a reference to the method of Lunge and Cedercreutz in the *Zeitschrift für anorganische Chemie* is given. The abstract of the method, however, is hardly sufficiently full. Surely such books as the one under review are written to enable the reader to carry out estimations without having to refer to the original literature. We do not mean that all processes for the analysis of a given substance should be given, but surely one—the one the writer of the section considers the best—should be set out in detail. The others need be only briefly referred to, or the references to the original literature given.

The processes of tar analysis differ so considerably in detail in different works and with the various processes of distillation—that is to say, high- or low-temperature distillation—and the quality of the coal, that probably the author is right in giving a more or less general survey of the subject. We think, however, that the tars produced from the water-gas process and coke-oven tar might have been described in greater detail.

Mr. Sadtler has compiled the section on bitumens, and treats of the distillation of petroleum, ozokerite, asphalt, petroleum and shale products, cyclic hydrocarbons from coal tar, coal tar naphtha, and other similar products. This section is fairly full, and occupies 223 pages, that is to say, rather more than one-third of the book. On the whole the section on petroleum oils is very good. The subject is a big one, but most of the ground is covered in a quite satisfactory manner. One can see that the author is largely writing at first hand, and although he quotes many authorities, he usually lets the reader know which he considers is the most trustworthy method to adopt.

Mr. Sadtler is also responsible for anthracene and its associates and for the phenols. The latter section is naturally of great importance owing to the extended employment of phenols and phenolic derivatives for disinfecting and antiseptic purposes. The subject is treated in a broad and comprehensive manner, and deals not only with phenols and creosotes from coal tar, but also from various other sources, such as blast-furnace tar, shale-oil tar, and so on.

Mr. W. A. Davis is responsible for the sections on naphthalene and its derivatives, and phthalic acid and phthaleins, Mr. W. P. Dreaper for gallic acid and its allies, and Mr. Edward Horton for the aromatic acids.

Taken as a whole, the volume has been well brought up-to-date, and will, we think, still maintain its place as an invaluable book of reference in the laboratory, particularly of the technical chemist. Its one fault to our mind is that the authors are apt to be rather too discursive and rather disinclined to put the analytical particulars in a concrete form. The book professes to deal with commercial organic analysis, but sometimes one has to read a very long way before coming to any analytical facts. Of course, it is of great assistance to read all about the properties of the substance, but the exact analytical methods are of the utmost importance.

By these remarks we do not wish to detract from the merits of a most valuable work, but to point out where the succeeding volumes might, in our opinion, be strengthened and made even more valuable.

F. M. P.

TASMANIAN SKULLS.

Dioptrographic Tracings in Four Normal of Fifty-two Tasmanian Crania. By Prof. R. J. A. Berry and A. W. D. Robertson. (Melbourne, Transactions of the Royal Society of Victoria, vol. v., part i.) (Melbourne: Kemp, 1909.)

WITH the death of "Lalla Rhook" in 1876 one of the most interesting of human races passed out of existence. "When we reflect," write the authors of this atlas, "that the Tasmanian aboriginal carried into our own times the primitive culture of Palæolithic man and many of the structural peculiarities of *Homo neanderthalensis* we realise, the scientific importance of the study of Tasmanian remains." They have made by far the largest contribution to the material on which our conception of the Tasmanian race must be based, and made it at a most unexpected period. In his well-known monograph on the Tasmanian race, published two years ago, Sir William Turner gave a detailed list of all the skulls then known, seventy-nine in number, and was of opinion that further additions were unlikely. The authors of this atlas have been successful in finding forty-two hitherto unknown specimens, thirty-three of which they discovered in various private and museum collections in Tasmania, while nine they unearthed from a native burial ground. In preparing and publishing an atlas which contains 212 accurate tracings of these crania, the authors had two objects in view: they wished to make the material thus discovered available for the study of anthropologists throughout the world; they also wished to secure a permanent record of crania which, being chiefly in the hands of private owners, are liable to be lost or destroyed.

The authors have thus rendered a signal service to the cause of anthropology, nor must we overlook the liberality of the Royal Society of Victoria for undertaking the expensive work of publishing these elaborate records. It is especially pleasing to note that a strong school of physical anthropology is springing up in Melbourne, one that is keenly alive to the necessity of studying the native races as they now are, and of securing permanent records of their physical characters.

The publication under review may be described as a craniological monograph of a new type; there is practically no letterpress, no columns of measurements, merely tracings from which measurements may be estimated. In brief, the authors have made a large addition to Tasmanian records, but added nothing to the story of this extinct native race. Very likely they intend to give their interpretations of these tracings when they come to deal with their investigations of the Australian natives. Still, we are of opinion that the scientific value of the present publication would have been greatly enhanced if the authors had included the results of the elaborate study they have made of this new collection of Tasmanian crania.

PHILOSOPHY.

(1) *Wolffsche Begriffsbestimmungen. Ein Hilfsbüchlein beim Studium Kants.* By Prof. Julius Baumann. Pp. iv+56. Price 1 mark.

(2) *Wilhelm von Humboldts ausgewählte philosophische Schriften.* Herausgegeben von Johannes Schubert. Pp. xxxix+222. Price 3.40 marks.

(3) *Fichte, Schleiermacher, Steffens über das Wesen der Universität.* By Eduard Spranger. Pp. xlii+291. Price 4 marks.

(4) *Baruch de Spinoza. Ethik. Siebente Auflage.* By Otto Baensch. Pp. xxxii+315. Price 3.40 marks.

(5) *Encyklopädie der Philosophie.* By A. Dorner. Pp. vii+334. Price 6 marks.

(Leipzig: Verlag der Dürr'schen Buchhandlung, 1910.)

(1) A COMPILATION of Christian Wolff's definitions, by the professor of philosophy at Göttingen. Dr. Baumann made this compilation many years ago, for his own needs, purposely confining himself to the problem of the theory of knowledge. Recently, when re-reading Kant's "Kritik der reinen Vernunft," he took up his compilation and recognised the parallelism with Wolff. This little book is therefore now published as a help to the study of Kant. It contains useful definitions, with references, of terms such as *Empfindung, Vorstellung, Wahrnehmung, Idee, Begriff,* which are the chief elementary difficulties in the way of the student of Kant, and of German philosophical writers in general.

(2) This selection of Humboldt's philosophical writings is intended to spread the knowledge of his many-sided nature and powers among a wider circle of readers than has hitherto been reached. Those who wish to go more deeply into his treatment of the subjects may be referred to the great standard edition of his works, which appeared during the course of last year. The present volume contains chosen specimens on such diverse subjects as Goethe's "Hermann and Dorothea," "Latium and Hellas, or Considerations on Classical Antiquity," "Philosophy of Language," "Philosophy of Religion," the "Bhagavad-Gîtâ," and "Pedagogy." The matter seems, naturally, a little old-fashioned, and the æsthetical parts appeal chiefly to readers who make a special study of the history of German literature. Humboldt was a humanistic philosopher, leaving behind him the individualism and general æsthetic hurly-burly of the "Sturm and Drang" period.

(3) Another book of chiefly historical interest, consisting of reprints of various writings of the three authors named, concerning ideals of university teaching. The centenary of the University of Berlin, which was recently celebrated, gives the suitable occasion. Dr. Spranger furnishes an introduction in which he compares Berlin with other universities. The former "was born in an hour of great changes: this birth in the living flux of things, permeated with the thoroughly modern spirit, gave her living power, and made her a model to her older sisters, who are but now stripping off the old forms, and growing into the new."

(4) In his "Biographical History of Philosophy," G. H. Lewes said that he never hoped to find foothold in the boundless morass of metaphysics, after he once fairly saw the reasons which rendered Spinozism unacceptable. The present edition of the famous "Ethics" (the seventh in German translation from the original Latin) seems to indicate that there are readers still to be found for the writings of the subtle-minded though intensely spiritual Jew, to whom—as justifiably as in the case of Novalis—the term "God-intoxicated" has been applied. The translator writes an introduction, in which he remarks that "Spinoza's philosophy is the most impressive concentration of the thought of the seventeenth century into a coherent view of the world and of life," even though those times produced Descartes and Leibniz. And modern philosophy, for the most part, will certainly agree.

(5) Dr. Dorner, who is professor of theology at Königsberg, is a follower of Hegel rather than of the great analyst whose name is inevitably recalled by Königsberg. The present volume, which is not an encyclopædia in the English sense, is a metaphysical work dealing chiefly with the theory of knowledge and doctrine of categories. The following sketch will give the author's general attitude.

The progress of philosophy seems the same now as in antiquity. Kant occupies the same position in modern philosophy as Socrates did in the ancient. After Socrates came Plato and Aristotle, to whose systems our modern philosophy of the Absolute corresponds. Then came the Stoics and Epicureans, with a revulsion to the practical side of things. The modern analogue is found in those thinkers who lay emphasis on feeling and will. The chief difference between old and new is, that the subjective side is now much more in the foreground, which tendency shows itself particularly in the importance assigned to psychology. Some, indeed, candidly regard it as the central science. Also, in modern life the empirical

sciences, and history, play a much greater part than in antiquity. Result: mysticism and agnosticism. Prof. Dorner combats both. The physical sciences themselves point the way to metaphysical principles; the problem of philosophy is not merely epistemology or the making of a world-conception out of the disparate elements of knowledge and experience, but is rather the search for a unified metaphysic by which the fundamentals of the world and of the spiritual life may equally be grounded in an Absolute Being.

AMERICAN TEXT-BOOKS OF MATHEMATICS.

(1) *College Algebra.* By Prof. H. L. Reitz and A. R. Crathorne. Pp. xiii+261. (New York: H. Holt and Co.; London: G. Bell and Sons, 1909.) Price 6*s*.

(2) *Trigonometry.* By Prof. A. G. Hall and F. G. Frink. Pp. x+146+93. (New York: H. Holt and Co.; London: G. Bell and Sons, 1909.) Price 7*s*. 6*d*.

(3) *First Course in Calculus.* By Prof. E. J. Townsend and Prof. G. A. Goodenough. Pp. xii+466. (New York: H. Holt and Co.; London: G. Bell and Sons, 1908.) Price 12*s*.

THESE books are the first three of a series which is intended in the first place for students taking a university course in engineering, and also, to a certain extent, for mathematical students. It will be noticed that each book has two authors, who have been selected to represent the interests of readers of both classes.

(1) and (2). The chief novelty in these books is to be found in the variety of examples, selected from very different subjects. Thus, as an example on evaluating algebraic expressions ("Algebra," p. 24), the student is asked to verify in a few cases a formula for the day of the week, which (after an obvious simplification) can be written [1]—

$$2+p+2q+[\tfrac{8}{8}(q+1)]+s+[\tfrac{1}{4}s]-2r+[\tfrac{1}{4}r]\equiv t \pmod 7$$

where t is the day of the week (Sunday being 1 and Saturday 7), and the date is the pth day of the qth month in the year $100r+s$. The reader interested in such matters may find it instructive to reconstruct this formula, of which the most interesting feature is the part depending on q; it will be found that starting from March (and ignoring February) the lengths of the months recur after intervals of five months, and this is the basis of the formula.

The problems proposed in the trigonometry are chosen so as to illustrate the practical difficulties of surveying so far as possible. Great stress is laid on the advantage of making a *form* for numerical calculations, before starting to use the tables at all. One useful consequence is that, in the typical examples worked out, the logarithms to be added are placed in *vertical* columns, as would be done in practical work; writers of text-books are very apt (in order to save space) to arrange such logarithms *horizontally*. The result is that imitative readers are liable to arrange their work in the same way, with disastrous results.

The last ninety-three pages in the trigonometry contain a good set of five-figure tables. The table of logarithmic functions, however, makes no special provision for finding the log sin and log tan of *small* angles; a very simple rule applies to four-figure or five-figure tables (with a difference of 1′ in angle), namely—

$$\log\sin\theta=\log\sin\alpha+(\log\theta-\log\alpha)$$

and this (or some similar rule) ought to be given in all tables which do not provide a special table for the first few degrees. The table of squares is interesting, as it gives the *exact* squares from 1 to 1000^2, without occupying more space than an ordinary four-figure table; this is effected by following the arrangement of Crelle's multiplication tables, where every number in the same horizontal line is terminated by the same two digits. Both in the algebra and trigonometry certain of the best-known power-series are given and used for numerical calculations; but the authors of the algebra are content to refer to the calculus (No. 3) for proofs, while in the trigonometry some proofs are provided, which would not be accepted nowadays. It might be better definitely to cut out all such proofs from books on trigonometry; in modern teaching the elements of the calculus are certainly regarded as easier (and more generally useful) than the "calculus-dodging" of the old-fashioned books.

(3) Compared with recent English books having similar titles this book contains fuller treatment of the applications of the calculus to applied mathematics; for instance, centroids, moments of inertia, resultant fluid pressure, are considered at some length, as exercises on integration.

As in the other books of the series, a large variety of illustrative examples will be found; thus the exponential function is connected with the chemical problem of inversion of cane-sugar. The theory of maxima is illustrated by the efficiency of a rough screw, the speed of signalling in a cable, and the h.p. transmitted by a hemp-rope.

In dealing with the Taylor's series derived from a given function, care is taken to point out that the series *may* converge without being equal to the function; this is a point quite commonly overlooked in the theory, and possibly an example would have helped to emphasise it.[1]

As might be anticipated from the character of the series, a good deal of stress is laid on methods for approximate integration, such as Simpson's rules and other similar methods, and several examples are given of their application to irregular solids such as rails. It seems strange, however, that the *exact* form of Simpson's rule is not mentioned, for finding the volume and centroid of a railway embankment (or the slice of an ellipsoid) in terms of the areas of the ends and the area of the central section.

The use of infinite series for finding an integral

[1] The notation is that of the theory of numbers: that is, $[x]$ denotes the integral part of x, and $y\equiv z$ means that $y-z$ is divisible by 7. Note that January and February are regarded as belonging to the *previous* year, with the values $q=13$, 14.

[1] Thus, Pringsheim's function $\Sigma\frac{(-1)^n a^n}{n!(1+x^2a^{2n})}$ has the Taylor's series $e^{-a}-x^2e^{-a3}+x^4e^{a5}\ldots$: but if $a>1$, although both series converge for all *real* values of x, they are unequal except for $x=0$. For instance, if $a=2$, $x=2$, it will be found that the first series is less than 0·109, while the second is greater than 0·133; on the other hand if $a=\frac{1}{2}$, $x=\frac{1}{2}$, both series are equal to 0·434 (nearly).

is also classed by the authors as "approximate integration"; this is a view which does not seem altogether satisfactory. At any rate, the nature of the approximation involved in using an infinite series is certainly different from that associated with the use of Simpson's rules. Incidentally, at least one example (p. 379), in which the integration is effected by a series $\left(\int\{y/(y+c)\}d\text{S}\right.$ integrated over a circle), is easily reduced to finite terms in the form,

$$\pi a^2 - 2\pi c\{c-(c^2-a^2)^{\frac{1}{2}}\}.$$

Some of the integrals proposed for evaluation by the aid of series are not very easy to evaluate *directly*; for instance (p. 380), the elliptic integrals,

$$\int_0^x \frac{dx}{\sqrt{(\sin x)}} \text{ and } \int_0^1 \frac{dx}{\sqrt{(1-\frac{1}{2}x^4)}}.$$

Both of these can be expressed in various forms, but the series which are more immediately suggested are not very suitable for ordinary calculations; in particular the second of them suggests the binomial expansion of $(1-x^4)^{-\frac{1}{2}}$, but the resulting series is quite hopeless for numerical work. Of course, there are several ways of transforming the integrals before conversion to series; but such transformations might well be suggested in the questions, or the reader may not succeed in guessing what to do first.

In reading the chapters on applications to plane curves one cannot help regretting some of the old-fashioned geometrical types of proof; no doubt the older books contain much that is not only unsound, but incapable of being made sound. But in spite of this, a geometrical treatment is more attractive to the ordinary reader, and in many cases the proofs can be made reasonably accurate by the aid of very little additional analysis.

T. J. I'A. B.

BOOKS ON NATURE-STUDY.

(1) *Der Naturfreund am Strande der Adria und des Mittelmeergebietes.* By Prof. Carl I. Cori. Pp. viii+148+22 plates. (Leipzig: Verlag von Dr. Werner Klinkhardt, 1910.) Price 3.50 marks.

(2) *The Aims and Methods of Nature-Study. A Guide for Teachers.* By Dr. John Rennie. With an introduction by Prof. J. Arthur Thomson. Pp. xvi+352. (London: W. B. Clive, University Tutorial Press, Ltd., 1910.) Price 3*s.* 6*d.*

(1) PROF. CORI'S volume is not intended to give descriptions of the systematic characters and organisation of marine creatures, but rather to be a companion to direct the attention of the nature-student to the more commonly occurring marine organisms and to the chief phenomena associated with them. After a brief account of the past history of the Mediterranean and Adriatic, the author passes to the consideration of the animals of the beach—Arenicola, Sipunculus, Solen, Venus, Echinocardium, Synapta, Carcinus, &c.—the chief features and theoretical points of interest associated with many of which are indicated. While dealing with Annelids, the author directs attention to their relationship to the Crustacea and to the theory of the Annelid ancestry of vertebrates. Modifications of structure correlated with certain habitats, as illustrated, for example, by sessile molluscs, and the habits of animals, *e.g.* the shamming death and autotomy of crabs, are dealt with in an interesting manner. The description of the abundance of life on the beach leads up to remarks on the origin of life in shallow water, "die Geburtsstätte alles Seins." The lagoons and their flora and fauna—Mysidæ, Carcinus, Cardium, Labrax, Anguilla, &c.—and the Zostera meadows, with their extensive and characteristic fauna—Virbius, Spadella, Turbellaria, Cerianthus, Sepia, pipe-fish, sea-horses, &c.—are the subjects of two chapters.

The account of Sepia contains interesting references to the antiquity and former greater abundance of species of Cephalopods in the period when the Ammonites flourished, and to the power of colour change, owing to which "spiegelt sich sozusagen die Seele der Sepia auf ihrer Haut ab." Throughout the volume the author brings before the reader observations on the mode of life, the food and special points in the physiology of the animals under description; for instance, he points out that in Trachinus, the weever-fish, the spreading of the spines and the assumption of the defensive attitude are dependent chiefly on stimulation of the tail. The organisms of the rocks and rock-pools are then considered, attention being given to boring animals, *e.g.* Pholas, Paracentrotus, the former boring by chemical, the latter by mechanical means.

The concluding chapters give accounts of the larger organisms obtained by dredging, and in the plankton (Rhizostoma, some Siphonophores, Ctenophores, and Salps) and on the high sea (fishes, dolphins, &c.). The figures are for the most part excellent, but a few, for instance, those of Aphrodite, Arenicola, and Balanoglossus on Taf. vi., are capable of improvement. A few errors of spelling occur in the names of the animals figured, *e.g. pilleata* (for *pileata*), *forscalea, Litorina,* and *Echineis.* But these are only slight blemishes, and do not seriously detract from the value of this excellent work, which cannot fail to stimulate the interest and imagination of the nature-lovers for whom it is intended.

(2) Dr. Rennie aims at imparting a definite continuity of principle to the teaching of the subject of nature-study and to this end he outlines series of carefully graded courses. He holds rightly that the facts need to be carefully grouped or arranged in sequence, according to principle, in the mind of the teacher (although the principle need not always be enunciated to the pupils), for only in this way can the teaching be effective. Four school courses are suggested, namely, for pupils of seven or eight years, eight or nine years, nine to twelve years, and seniors, all of which are arranged on a seasonal plan and deal in turn with plants, animals, weather studies, calendars, and general considerations. Several chapters are devoted to excellent object-lessons on common living things, *e.g.* frogs and toads, birds and their eggs and feathers, the mole, shells, the snail, caterpillars and moths, earthworms, gnats, buttercups, common fruits and seeds, trees, ferns, &c. Then follow elementary studies of some common rocks, suggestions for a

school garden, studies on insects of economic importance, &c. The lessons are objective and practical, and from the stores of trustworthy information which they contain the teacher can select those topics most applicable to the locality and conditions under which he works. The volume is a plea for care and method, and we can recommend it to those teachers who desire to develop their work in this subject along sound lines. There are 178 illustrations, for the most part good, but several of those of insects might have been more carefully executed.

OUR BOOK SHELF.

An Introduction to Biology for Students in India. By Prof. R. E. Lloyd. Pp. xviii+298+15 plates. (London: Longmans, Green and Co., 1910.) Price 4 rupees (or 5*s*. 4*d*.)

THIS little book does not pretend to be a complete introduction to biology, and the title is perhaps somewhat misleading. It deals exclusively with certain invertebrate types and certain general principles, and appears to have been designed for the use more especially of Indian medical students. The author tells us in his preface that the book was written somewhat hurriedly, because it was urgently needed. The types dealt with have very properly been selected from the Indian fauna, and the work is evidently based very largely upon personal observations, for which the author deserves due credit. Some of the animals described, such as the fresh-water sponge, the scorpion, and the mosquito, are not usually dealt with in elementary text-books.

The work is of a strictly elementary character, but at the same time suffers somewhat from being rather too much up-to-date. Thus the chapter on heredity is practically confined to Mendelism. The author is not always happy in his definitions. He tells us that "the anterior end of an animal is that at which the mouth opens; the posterior end is where the anus is to be found. But difficulties sometimes arise in using these terms; for example, in a gasteropod mollusc, the mouth and anus open in the same direction." Surely it would be more correct to say that primarily the anterior end is carried foremost when the animal moves about, while the posterior end comes hindmost. It is difficult to excuse the spelling of the word "Foramenifera," and the statement that the shells of these animals are "always perforated by minute round apertures" is very misleading. Another misspelling against which we must protest is "chord," for "cord," in the case of the nerve-cord of Annelids. This is a mistake which is frequently made by elementary students, doubtless on the analogy of "notochord," which, of course, is really a Greek word.

It must not, however, be forgotten that this is a pioneer work written under great disadvantages. It shows a considerable amount of originality, both in scope and treatment, and should prove useful to those for whom it is intended. A. D.

Botany for High Schools. By Prof. G. F. Atkinson. Pp. xv+493. (New York: Henry Holt and Co., 1910.)

WHEN it is found that a school text-book of botany of average size contains, in addition to a course of morphology dealing with growth and work of parts of the flowering plant, a series of life-histories drawn from all the plant divisions and accessory chapters on ecology, economic plants and plant breeding, the question naturally arises whether careful exposition is not being sacrificed to variety. There are certainly objections to the inclusion of the life-histories from the lower cryptograms, as they are too sketchy to suffice for practical work; also the range and variation are too complex for the ordinary schoolboy or girl, while many teachers would prefer a good course of physiology or a grounding in the classification of vascular plants as an item in training.

Nearly half the book is devoted to the first part, in which the author presents a well-arranged account of the activities of the plant. The morphology of the vegetative organs is not so well ordered, and there are several unsatisfactory passages, such as the confusion between stem and shoot, unacceptable definitions of "decumbent" and parts of a leaf, and a misuse of cambium in describing the stem of the maize plant. The flowers, methods of pollination, and seed dispersal are treated at some length. The later chapters suffer from excess of generality or a tendency to the introduction of specialised topics, but it should be added that it is the author's intention to present outlines that are to be filled in by the teacher's lectures and practical work.

Proceedings of the Aristotelian Society. New series. Vol. x., 1909–10. Pp. 300. (London: Williams and Norgate, 1910.) Price 10*s*. 6*d*. net.

THE Aristotelian Society exists for the systematic study of philosophy, as to its historic development, and as to its methods and problems. It is an aristocratic body—intellectually speaking—consisting of about one hundred members, among whom are Mr. A. J. Balfour, Mr. Haldane, Prof. Sorley, Dr. Stout, Dr. Bernard Bosanquet, and Dr. Shadworth Hodgson.

In the latest volume of *Proceedings* there are papers on "Sensations and Images," by Prof. Alexander; "The Subject-matter of Psychology," by Mr. G. E. Moore; "Epistemological Difficulties in Psychology," by Dr. William Brown; "Kant's Account of Causation," by Mr. A. D. Lindsay; "Bergson's Theory of Instinct," by Mr. H. Wildon Carr; "Science and Logic," by Mr. E. C. Childs; "Some Philosophical Implications of Mr. Bertrand Russell's Logical Theory of Mathematics," by Mr. S. Waterlow; and two interesting papers on "Are Secondary Qualities Independent of Perception?" by Dr. Percy Nunn and Dr. F. C. S. Schiller respectively. The former takes up a position of vigorous realism, while the latter, with all his accustomed attractiveness of style—even when dealing with very technical matter—hopes to convince Dr. Nunn that philosophical salvation lies in humanism, for which the old terms idealist and realist have almost ceased to have meaning or interest. Dr. Nunn has a curious and rather novel argument in favour of there being possibly something really "there," in some hallucinations. He instances our old friend the "stick bent in a pool." To the eyes, it is bent, to the touch it is straight; in other words, its visual characters are not in the same position as its tactual. May we not therefore see a real thing which, to our other senses, is elsewhere? It is certainly a suggestive analogy, though risky.

Häusliche Blumenpflege. Eine Anleitung zur Pflege der dankbarsten Zimmer- und Balkon-Pflanzen. By Paul F. F. Schulz. Pp. vii+216. (Leipzig: Quelle and Meyer, n.d.) Price 1.80 marks.

ACCORDING to the author plant culture in the home is not sufficiently practised in Germany, and the object of the present work is to arouse more interest in the pursuit. Certainly if the plants for which instructions are given can be grown in the house, many having the time and taking a keen interest in flowers would be inclined to try their skill. The list includes Abutilon, Camellia, the Alpenrose, Bouvardia, Clivia, *Monstera deliciosa*, and *Odontoglossum grande*, in addition to the palms, geraniums, hydrangea, Cacta-

ceæ, and other plants that are generally recognised to be suitable for the purpose. The chief essentials to success are carefully prepared soil, good lighting, judicious watering, and, in many cases, an unheated room for winter storage; the good results observable in cottage rooms are quite in accord with the last condition.

The author first instructs in general processes, such as watering, potting, sowing, and the like, and then gives special directions for each plant or group of similar plants, arranging them according to habit. The instructions are full, clear and explanatory, so that anyone with an ambition for cultivating such plants as those named above without a greenhouse will be well advised to consult the book and work upon the lines indicated.

Flashes from the Orient, or a Thousand and One Mornings with Poesy. In four books, Spring, Summer, Autumn, and Winter. Book third, Autumn. By John Hazelhurst. Pp. x+280. (London and Aylesbury: Hazell, Watson and Viney, Ltd., 1910.) Price 1s. 6d. net.

READERS familiar with Mr. Hazelhurst's sonnets on summer will turn with interest to his verses dealing with subjects suggested by the phenomena and events connected with the fall of the year. His subjects range from "Enthusiasm" to "Misery," and from "The Sewing Machine" to "The Dome of Heaven"; and he finds music in them all.

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 Inheritance of Acquired Characters.

I AM rather disposed to think that Prof. Judd is right in saying that this "and similar problems were constantly present to Darwin's ever-open mind." They seem to me, indeed, to underlie the whole of the discussions in the second volume of the "Variation of Plants and Animals under Domestication"; and I believe it is generally considered that Darwin put forward his theory of "pangenesis" to account for the cases where some amount of direct influence of the environment appeared to be inherited.

The passage which Prof. Meldola quotes from the sixth edition of the "Origin" occurs word for word in the first (p. 44). It is interesting to note that in the interval between the two Darwin never saw any ground for altering the statement, though he modified others on the same page. I can have little doubt that, at any rate so far as plants are concerned, "the source of his . . . authority for" it is to be found in Alph. de Candolle's "great and admirable work," as Darwin calls it ("Origin," sixth edition, p. 89), "Géographie Botanique raisonnée." That appeared in 1855, and there is abundant internal evidence to show that it received from Darwin the most attentive study.

Great and admirable it certainly is, but it is impossible not to feel in reading it that, perhaps in the whole history of science, there has never been a more striking case of a *coup manqué*. For de Candolle had the same problem before him as Darwin, and he attacks it by the same method of patiently accumulating and sifting facts. He grasps the action of variation, heredity, and of cultural selection, but he fails to grasp the idea that nature might operate on the same lines as the cultivator, and natural selection constantly eludes him as it did Herbert Spencer.

It is true that de Candolle does not absolutely reject the effect of the environment, but he was led to the conclusion that it would act, if at all, with such extreme slowness as to be practically ineffective. It is difficult to give a brief quotation, but the following may suffice:—

"Toutes les fois qu'il a été question de l'influence du climat sur les végétaux, je me sais efforcé de combattre l'opinion d'une *acclimatation*, c'est à dire d'un changement dans la nature des espéces qui les rende, après quelques générations, plus aptes à résister aux influences défavorables d'un climat. J'ai applaudi au mot spirituel de du Petit—Thouars: 'L'acclimatation, cette douce chimère de la culture'" (pp. 1087–88).

It must I think be evident that, though he does not actually quote it, Darwin, from his use of the word "chimæra" ("Variation," ii., 313), has this passage in his mind. But he goes on to show that the problem is at once solved by natural selection. He states this, however, with his usual caution:—"Though habit does something towards acclimatisation, yet . . . the spontaneous appearance of constitutionally different individuals is a far more effective agent" (*loc. cit.*, 314), and though he appears, in the main, to have relied on de Candolle, he took some trouble to investigate the question for himself:—"Can we feel sure that our kidney-beans are not somewhat hardier? I have not been able, by searching old horticultural works, to answer this question satisfactorily."

I think, then, that it was upon de Candolle's conclusions, supported by his own investigations, that Darwin based the pregnant sentence which Prof. Meldola has quoted. And how pregnant every word in the book is can be little appreciated except by those who have more than a bowing acquaintance with its pages.

I cannot but agree with Prof. Judd that modern evolutionary theory had its root in Lyell. Nor do I think that in the cold light of history it will seem to "be going too far . . . to assert that if the Principles of Geology had not been written, we should never have had the Origin of Species." If the possession of Darwin is the glory of Cambridge, it is pleasant for a member of the sister university—though it says little about it—to know that it is secure in that of Lyell.

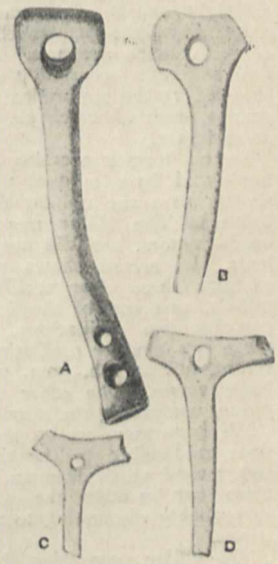
W. T. THISELTON-DYER.

Witcombe.

Palæolithic Shaft-straighteners.

IN a previous communication to NATURE (vol. lxxiv., p. 372, 1906) I directed attention to some Eskimos' arrow-straighteners which present a closer resemblance to the famous *bâtons de Commandement* of the Magdalenian age than any which had been previously described.

Last summer, when my friend Mr. Marrett and I were returning from Toulouse, where we had enjoyed the hospitality of the French Association, we stayed at Perigueux on our way to some of the painted caves of Les Eyzies. We were fortunate in our choice of an hotel, for our host, M. L. Didon, proved to be an enthusiastic investigator of the caves in the neighbourhood. His collection of Aurignacian bone implements, obtained by him from the Aurignacian station of Castelmeule, is the finest I have seen, and, I should think, unrivalled anywhere. M. Didon informs me that he has completed its description, which will be published in the course of the winter.



The number and variety of the bone implements obtained from this single locality, dating from a period so long anterior to the Magdalenian, greatly impressed us, but the objects which most aroused my interest were three shaft-straighteners (see Fig.). These, while presenting a general resemblance to the Magdalenian bâtons, make a still nearer approach to those of the Eskimos previously re-

ferred to. M. Didon was kind enough to allow me to make drawings of them for publication, and in the accompanying figure at B, C, D they are shown side by side with the Eskimos' shaft-straightener described by Dr. Boaz (Franz Boaz, Bull. Am. Mus. Nat. Hist., xv., p. 84, Fig. 117, 1901). They are all reduced to the same scale. The larger holes are no doubt intended to be used upon the shafts of javelins or lances; the smaller ones are of an appropriate size for arrows. The largest hole in A is 24 mm. in diameter, in B 21 mm.; the small hole in C is only 10 mm.

The most important feature in these implements is the obliquity of the holes; their axes are not perpendicular, but strongly inclined to the face of the implement. Singularly enough, in the more artistic *bâton de Commandement* of the Magdalenians this refinement is absent, and the hole goes straight through.

The ridges produced by the drill in boring these Aurignacian straighteners are still preserved, except on two opposite sides of the hole, where they have been worn away by use.

Whatever may be the ultimate verdict upon the Magdalenian "bâtons," there can be no question as to the nature of their Aurignacian homologues, since in no essential feature do these differ from the shaft-straighteners of the Baffin's Bay Eskimos described by Dr. Boas.

A similar straightener has been described and figured by Maška from the Kulna cave near Sloup, in Moravia.

Oxford, January 7. W. J. SOLLAS.

The Turkestan Earthquake of January 3-4.

SOME details of the seismographic and magnetographic records of the great earthquake of January 3 may be of interest to readers of NATURE. The three oscillation phases as seen on the seismogram are comparatively large. They commenced suddenly, each with a westward displacement, at 11h. 37m., 11h. 44·5m., and 11h. 48·5m. p.m. respectively. The large waves (third phase) then continued for 23·5 minutes, producing rapid oscillations of the boom at an average of 35 mm. double amplitude, indicating 14·4″ arc swing of the pillar. But these suffered an early interruption of 5 minutes by an apparent interference of two systems, reducing the amplitude to a minimum at 11h. 54m. p.m. The recovery was immediate and sharp, as if by the arrival of a second train of large waves, resembling closely the effect of the initial shock of the first large waves.

The maximum amplitude may have occurred between midnight and 8 minutes after, during which interval the registering light-spot travelled frequently beyond the limits of the camera aperture. But there is a probability that the maximum occurred precisely at midnight; and this is supplied by the mechanical effects upon the three magnetographs, each of which shows a clear maximum oscillation at midnight.

As on former occasions, the bifilar suspension of the horizontal force magnet was much more sensitive to the shakes than the unifilar declination or the vertical force balance. The bifilar responded to the first preliminary earth-tremors, and did not come to final rest for half an hour. Its record shows two groups of lines. The first contains three clear oscillations, marking the beginning, middle, and end of the first tremors. The second group contains five oscillations, including the maximum; and there is a smaller oscillation near the middle of the intervening lull at 11h. 50m. p.m., the commencement of the large waves. The other two curves show only the last group, containing the maximum.

We have therefore on the horizontal force curve oscillations responding to the three initial shocks of the first and second earth tremors, and of the large waves. To these may be added the maximum oscillation at midnight, as probably responding to a sudden increment of the large waves.

The bifilar suspension, being a torsion balance against the horizontal force, is naturally more sensitive to sudden vertical movements of its pillar than to horizontal or slower vertical displacements.

WALTER SIDGREAVES, S.J.

Stonyhurst College Observatory, January 11.

As given by the Milne-principle seismograph here, the commencement of the phases of this quake were as follows:—Preliminary: both N. and W. boom, 11.34 p.m. Second: N. boom. 11.40; W. boom, 11.39·5 Principal: N. boom, 11.52·9; W. boom, 11.52·8.

The actual maxima were:—N. boom, 110·8 mm. at 11.58·7; W. boom, 131·0 mm. at 11.55, and 127·6 mm. at 11.58·3.

There were 30 after-shocks on the N. boom, lasting until 5.11 a.m., and 37 on the W. boom, lasting until 5.26.

F. EDWARD NORRIS.

Woodbridge Hill, Guildford, January 17.

The Markings f Mars.

MAY I mention on behalf of my relative, Mr. J. H. Worthington, to whose previous letter M. Antoniadi has replied in NATURE of January 5, that he is at present away on an eclipse expedition to the Pacific Ocean, and out of reach of correspondence?

A. M. WORTHINGTON.

1 The Paragon, Blackheath, S.E., January 17.

Fireball of January 9.

THE Rev. W. F. A. Ellison, of Fethard Rectory, near Waterford, saw a splendid meteor on January 9 at 7h. 35m. G.M.T. The apparent path was near Aries and Cetus from 25°+3° to 27°−13°. Motion very slow, the whole duration being at least seven seconds.

The flight was directed from the radiant of the January Quadrantids, and it is possible that the fireball formed one of the larger fragments of that stream. But this is uncertain, and another observation is desirable to discover the true radiant. From Cornwall the meteor must have been a very fine object, and must have attracted the notice of many persons, though I have seen no published description of it.

W. F. DENNING.

THE ADMISSION OF WOMEN TO THE PARIS ACADEMY OF SCIENCES.

IN our last week's issue we gave an account of the action taken at the quarterly plenary meeting of the five academies of the Institute of France on January 5, in relation to the proposal of the Academy of Sciences to elect Madame Curie to the vacancy on the physical section of that body caused by the death of Monsieur Gernez.

A Paris correspondent has sent us a copy of the *Temps* containing a remarkable letter from M. Darboux, the permanent secretary of the Academy of Sciences, giving the reasons and motives of the academy for their decision. We have not space for the whole letter, which is admirable from start to finish, but M. Darboux insists upon a point missed in all the preceding polemic, which should have an important bearing upon the general question raised by it.

After referring to the magnificent work done by Madame Curie, and the honours which have been showered upon her, he points out that her proposed election as a working member of a busy academy is a matter of great importance, not so much to Madame Curie as to the academy itself.

"Tant de titres, tant de résultats mémorables obtenus dans un si court espace de temps donneraient certes à Mme. Curie le droit de réclamer comme une récompense méritée le siège occupé naguère par son mari. Mais un siège à notre Académie est plus et mieux qu'une récompense. S'il donne une satisfaction légitime et quelques droits, il impose aussi des

devoirs étendus. Pour examiner à ce point de vue la candidature de Mme. Curie, il est nécessaire que nous rappelions rapidement ici, pour le grand public qui l'ignore quelque peu, le rôle et le fonctionnement de l'Académie des sciences.

"Des cinq Académies qui composent l'Institut de France, elle est peut-être celle qui a la tâche la plus active et la plus lourde. Certes, comme la nôtre, les autres Académies ont des prix à distribuer, moins nombreux et moins variés peut-être; mais le soin de juger des concours et de distribuer des récompenses est bien loin de former notre principale occupation. Dans ses séances hebdomadaires du lundi, l'Académie écoute avec intérêt les communications, souvent nombreuses, de ses propres membres; mais elle reçoit en outre une foule de travaux, venus de Paris, de la province, de nos colonies, de l'étranger. Il n'est pas rare qu'une de nos séances recueille une centaine de communications ayant les origines les plus diverses. Les comptes rendus de nos séances paraissent le samedi de chaque semaine, cinq jours seulement après la séance; ils contiennent presque toujours de 50 à 100 pages in-4°, où se trouvent exposées les recherches les plus neuves, les plus intéressantes. On peut affirmer, sans crainte d'être démenti, que cette publication si rapide, si soignée, constitue le moyen d'action le plus puissant dont dispose aujourd'hui une société savante. J'ajoute que depuis trois ans, notre confrère le prince Roland Bonaparte a confié à l'Académie des sommes importantes, destinées à provoquer et à subventionner les travaux scientifiques les plus méritants.

"Pour accomplir cette tâche féconde, pour distribuer tous ces prix, toutes ces subventions, pour apprécier si rapidement la valeur des communications qui lui parviennent, l'Académie a évidemment besoin de faire appel à toutes les compétences. Où trouvera-t-elle un savant plus autorisé que Mme. Curie pour lui donner un avis sur ces travaux relatifs à la radioactivité, dont le nombre grandit si rapidement?

"D'autre part, ces chercheurs qui peuplent le laboratoire si prospère de Mme. Curie, qui travaillent sous sa direction, devront-ils se résigner à voir leurs efforts et leurs travaux méconnus ou négligés? N'y a-t-il pas un intérêt évident à ce que le chef qui inspire leurs travaux soit admis, comme ses autres collègues de la Sorbonne à les présenter, à les défendre dans les commissions de prix, à les proposer pour des subventions; en un mot, à remplir dans toute son étendue la fonction d'un membre titulaire de l'Académie des sciences?"

* * * * *

"Nous nous contenterons de remarquer, en terminant, que, s'il arrive souvent à notre pays de marcher à l'avant-garde des nations, dans le cas actuel c'est l'étranger qui nous aura donné l'exemple. Ne parlons pas, si l'on veut, des distinctions qu'a reçues de ce côté Mme. Curie, bien qu'elle ait été nommée *membre actif* de quelques-unes des académies que nous avons énumérées plus haut. Mais nous sommes allé dernièrement à Rome, pour y assister aux séances de l'Association des académies, et nous y avons vu la comtesse Ersilia Lovatelli siéger, en qualité de doyenne de la section d'archéologie, à l'académie royale des Lincei, qui joue en Italie le rôle de notre Institut. De même, lorsque nous assistions en 1900 aux fêtes du second centenaire de l'académie des sciences de Berlin, une dame encore, Mme. Elise Wendel, assistait à toutes les cérémonies au titre de membre honoraire de l'académie. Nous pourrions ajouter d'autres exemples; ceux-là suffiront à prouver qu'à l'étranger, on n'éprouve pas les scrupules qui font hésiter quelques-uns de nos confrères."

THE SOLAR PHYSICS OBSERVATORY.

WE have received the following Memorial and accompanying signatures and documents from the hon. sec. of the British Science Guild, with a request that we should print it, together with the statement that the Memorial was handed to Mr. Asquith's private secretary by Sir David Gill, K.C.B., F.R.S., president of the Royal Astronomical Society, and vice-president of the British Science Guild, and Sir A. Pedler, C.I.E., F.R.S., hon. sec., and that the Prime Minister was pleased at once to grant the prayer of the memorialists:—

MEMORIAL

TO

THE RIGHT HON. THE PRIME MINISTER.

THE Memorial of the undersigned Fellows of the Royal Society and other bodies interested in the welfare of British Science to the Right Honourable H. H. Asquith, Prime Minister, and First Lord of the Treasury.

Sheweth

That in 1875 the Royal Commission on Scientific Instruction and the Advancement of Science strongly recommended the establishment by the State of an Observatory for Solar Physics.

That in 1879 this recommendation was acted upon by the Government.

That the accompanying letters from the Directors of the Chief Observatories and Meteorological Institutes in Europe and the United States show (1) that the work thus undertaken was of especial importance to the British Empire with its territory distributed all over the globe; (2) that the results already obtained are of high value, and promise eventually to lead to the better forecasting of droughts; (3) that the international character of the work makes it important that it should be carried on in close connection with a Government Department; (4) that a high-level site and free horizon are now essential.

That when a change of site of the Observatory became necessary, the Solar Physics Committee, a Consultative Committee appointed by the Government to advise them on such matters, selected a high-level site at Fosterdown on land purchased some years ago by the War Office, but no longer required by them. The Committee reported that this site fulfils the requirements of modern astronomical research.

And whereas, while we understand that the Solar Physics Committee have not withdrawn their recommendation, the site in question is now advertised for sale on December 13.

We, your Memorialists, therefore pray that the proposed sale of the selected site may be delayed until full inquiry has been made, and until a decision has been arrived at with full knowledge of the questions involved.

And your Memorialists will ever pray.

Lansdowne, Avebury, Rayleigh, Joseph D. Hooker, James Dewar, Iveagh, Lochee, R. B. Clifton, William Ramsay, J. A. Fleming, Fred T. Trouton, Arthur R. Cushny, F. W. Oliver, J. Norman Collie, L. N. G. Filon, E. C. C. Baly, Henry Miers, Augustus Waller, William White, Silvanus Thompson, A. Mostyn Field, J. Wolfe Barry, William Crookes, J. H. Poynting, William Turner, R. A. Sampson, Raphael Meldola, David Bruce, Lauder Brunton, Arthur H. Church, Charles Chree, Dugald Clerk, Wyndham Dunstan, E. H. Griffiths, J. Herschell, W. M. Hicks, Fletcher Moulton, H. E. Roscoe, E. T. Thorpe, William Tilden, E. Ray Lankester, W. H. Dines, G. T. Beilby, C. A. Parsons, John Murray, Arthur A. Rambaut, Blyth, Chichester, John Cockburn, Alfred Keogh, J. Herbert Warren, George Burt, George Reid, Baldwin Latham, W. F. Caborne, J. C. Bayard, E. Gold, H. N. Dickson, M. W. C. Hepworth, R. C. K. Lempfert, C. Theodore Williams, P. H. Cowell, Percy Davis, H. H. Walmesley, T. C. Hudson, William Fraser Doak, John A. Sprigge, Harold B. Dixon, James Crichton Browne, H. G. Lyons, George Hartley Bryan, E. Taylor Jones, John Perry, James Stirling, Hugh L. Callendar, P. A. MacMahon.

The letters appended to the memorial are from the following :—

(1) *Directors of Astronomical and Astrophysical Observatories.*

Sir David Gill, President of the Royal Astronomical Society, formerly Director of the Royal Observatory, Cape of Good Hope

Prof. Pickering, Director of the Harvard College Observatory, U.S.A.

Dr. Hale, Director of the Mount Wilson Observatory, U.S.A.

Dr. Backlund, Director of the Poulkovo Observatory, Russia.

Prof. Riccò, Director of the Royal Observatory of Catania and Etna, Italy.

Dr. Deslandres, Director of the Astrophysical Observatory, Meudon, Paris.

Prof. Max Wolf, Director of the Astrophysical Observatory, Heidelberg.

(2) *Directors of Meteorological and Physical Institutes.*

Dr. von Hann, formerly Director of the Meteorological Institute, Vienna.

Prof. Kayser, Director of the Physical Institute, Bonn.

Dr. Steen, Vice-President of the Meteorological Institute, Kristiania.

(*Copy.*)

34 De Vere Gardens,
Kensington,
London, W.,
November 14, 1910.

DEAR LOCKYER,—

At your request I have visited, in company with your son, the site at Caterham to which you propose that the instruments at present mounted at South Kensington should be transferred. As the result of this inspection I venture to express my earnest desire that advantage should be taken of this most favourable site.

It would be hard, in my opinion, to find a better one in England. It is about 800 feet above sea-level, and overlooks a wide and splendidly clear horizon. It is within half an hour's walk of a railway station, and thence within less than an hour's journey, by frequent trains, to Charing Cross. The site is completely protected from the glare of light from any neighbouring town, so that one great desideratum for stellar work, that of a dark sky, is secured. The contour of the neighbouring ground is such as to secure immunity from the danger of houses being built in the immediate neighbourhood. The surrounding slopes are covered by trees which protect the surface of the soil from the sun's heat, so that it is probable that the disturbance to good seeing, caused by convection currents, will probably be reduced to a minimum.

It is, I believe, a general experience in this country that the best definition for solar observation occurs in the early morning hours, and sometimes again in the late afternoon. This seems to be due to the comparative freedom from convection currents of air, in the morning before the soil is heated up, and in the evening when a condition of equilibrium is established, and it seems, so far as can be judged from inspection of the site, that the surroundings of the Caterham site are specially favourable from this point of view. There are other circumstances which point to the selection of the Caterham site :—

(1) The ground belongs to the Crown.

(2) It is distant from any roads, and therefore free from tremor.

(3) The atmosphere is free from smoke, and the site above low-lying mist.

(4) It is the site of a now disused Ordnance store for ammunition, provided with splendidly built and perfectly dry casemates, which would form rooms of nearly uniform temperature that could be used for spectroscopic research, dark-rooms, &c., and there are other existing buildings which could be utilised for observatory purposes, such as stores and working rooms.

(5) The casemates themselves would afford, on their upper surface, splendid foundations for instruments.

(6) There is excellent local material on the ground suitable for concrete.

Thus the expense of establishing the observatory would be greatly reduced by these pre-existing works and by the natural facilities afforded by the site.

I have no doubt that the Meteorological Office can furnish statistics as to the average amount of cloud and sunshine, and little doubt that in this respect the conditions are as favourable as any for the pursuit of Astrophysical and Solar research.

That it is the duty of our country to provide for the continuity of the work so well begun by you I think no man of science will dispute, and it would indeed be shame to us, in the face of what other nations are doing, if we are left behind in the race which was so well begun in this country by yourself, and which has been continued by you so successfully under conditions so unfavourable. In any change of site I venture to think it will be a great mistake if the best possible site is not chosen, and I do not think it is likely that a better site than that at Caterham will be found in these islands.

Yours sincerely,
(*Signed*) DAVID GILL.

(*Copy.*)

Harvard College Observatory,
Cambridge, Mass.,
November 4, 1910.

MY DEAR SIR NORMAN,—

Your letter of October 20 is received. I hear with great regret of the unfavourable changes which are proposed in the Solar Physics Observatory. The list of your publications and of the important results contained in them is very impressive. It seems to me that your persevering and long-continued work in astronomy, extending over nearly half a century, ought to be continued by you under favourable conditions, if possible. Moreover, it is obvious that the efficiency of the powerful instruments which you have collected will depend very largely on the location in which they are remounted. Every year this matter is receiving more attention among astronomers. The work of many instruments could easily be doubled by mounting them in more favourable locations. The most serious effect we have felt from the encroachment of the city of Boston has been the illumination of the sky by the electric light.

Yours very truly,
(*Signed*) EDWARD C. PICKERING.

The Athenæum,
November 7, 1910.

MY DEAR SIR NORMAN,—

You ask me for an opinion as to the value of the work done under your direction at South Kensington, and the importance of providing for its continuance under more favourable conditions. As you know, I have not always agreed with you as to methods of observation and the interpretation of results. But this has not prevented me from admiring your fertility and ingenuity in the formulation of hypotheses, and the activity of yourself and your assistants in testing them. The large amount of work done by your staff in the midst of London should encourage those who see in the establishment of large modern observatories a menace to smaller institutions.

The importance of providing for the Solar Physics Observatory in the future seems to me so obvious that I can hardly believe the Government will fail to do so. After permanence has been assured, the most vital point, in my opinion, is to discover a sufficiently able director to take up the work when you retire. Then come the exceedingly important questions of site and equipment. I cannot compare the merits of the two sites you mention, as I have not seen the one you prefer and you do not name the other. Other things being equal, high altitude, minimum cloudiness, a clear and transparent sky, absence of glare from street lights, and freedom from vibration are, of course, very important.

But the prime consideration is good definition of solar and stellar images, without which the most refined work cannot be done, in certain classes of observations.

You refer to the need of a clear eastern horizon. On Mount Wilson (altitude, 6000 feet) it is essential that the

sky should be clear within ten or fifteen degrees of the eastern and western horizons, as the best definition of the solar image is usually obtained from one to three hours after sunrise and before sunset. At the Yerkes Observatory (1200 feet) solar observations are not begun until about 9 a.m. I have seen the definition as perfect there at noon as at any hour of the day, though I believe the average early morning definition would be better than the average noon definition. I do not know what the corresponding conditions are in England, but at Catania, and on Mount Etna and Mount Hamilton, the early hours are the best. In general, I believe the superiority of the early morning and late afternoon hours to be most marked on mountain tops, and in hot countries where there is much convection.

Trusting that the Government will make ample provision for the observatory, and establish it on a favourable site,

I am,
Yours very truly,
(*Signed*) GEORGE E. HALE.

Sir Norman Lockyer, K.C.B., &c.,
Director of the Solar Physics Observatory,
South Kensington.

(*Copy.*)

Observatoire Central Nicolas,
Poulkovo Gouvernment de St. Petersbourg,
Cabinet du Directeur,
November 1, 1910.

DEAR SIR NORMAN,—

I am deeply touched by the sad news of the danger that threatens the continuity of your fruitful activity which is recognised by the scientific world as having most successfully contributed to the development of our knowledge of Solar Physics. Since the first foundation of chemical analysis of the sun was laid by Kirchhoff and Bunsen, your name has been intimately associated with the progress of Solar Physics. The memorable year 1868, when you and Janssen, independently of each other, taught us how to conduct solar observations, is the beginning of a new epoch in which the solar researches revealed the most wonderful facts.

The connection between periodical activities on the surface of the sun and terrestrial phenomena demands to be investigated so as to give a trustworthy base for a great part of the Meteorology. This investigation requires great endurance, experience, and self-sacrifice, as the results can be obtained only by means of continued co-operations. Your organisation of the Solar Commission to work on that line is just the way to realise the solution of this important question, and consequently it would be a great disappointment if a discontinuance should take place.

I am convinced that the continuation of the institution erected by you is an intense desideratum recognised by every astronomer. If your observatory is to be removed it should certainly be to a better place than it actually occupies. I am therefore not able to comprehend why an unfavourable position should be assigned to it. It seems to me that you have so legitimate a claim on every kind of support in your endeavour to promote science that such a case would be absurd, and that everyone who recognised the importance of the knowledge of Solar Physics and the connection between terrestrial phenomena and the sun would deeply deplore the interruption of your successful activity.

Yours very sincerely,
(*Signed*) O. BACKLUND.

(*Copy.*)

R. Osservatorio di Catania ed Etneo,
Direzione,
Catania, le 31 octobre, 1910.

MONSIEUR LE DIRECTEUR,—

J'ai appris avec une vraie peine que vous vous trouvez en des grandes difficultés à cause des changements qui vont avoir lieu pour le site de votre très important Observatoire.

Il serait vraiment déplorable que vous n'ayez pas la possibilité de continuer et même de porter encore plus en avant votre grande et splendide série de travaux qui est commencé avec l'application du spectroscope à l'étude des taches solaires et puis des protubérances, ce qui vous a conduit à la découverte de la méthode d'en faire l'observation en dehors des éclipses, si féconde en tous temps.

Et ensuite viennent vos importantes études sur l'enveloppe solaire, que vous avez appelé *chromosphère*, sur la substance alors inconnue, que vous avez nommée *helium*, et puis les observatoires des éclipses solaires, où vous et Respighi les premiers, vous avez fait usage du prisme objectif, qui a donné toujours des résultats de la plus grande importance pour la physique et la Chémie du Soleil.

Non content de tout cela vous avez porté vos recherches sur les spectres des métaux et autres substances, pour faire des comparaisons avec les phénomènes solaires.

Et ce qui est bien admirable, tout cela a été fait par vous seul et avec vos moyens privés.

Ensuite par votre inépuisable initiative et sur votre proposition, l'Angleterre a fondé des stations pour l'observation photographique du soleil en des climats plus favorables, dont le succès a été tout à fait complet pour donner la statistique de l'activité solaire. Et on vous doit aussi l'établissement à South Kensington des nouvelles et délicates observations spectrohéliographiques.

Et passant à l'application pratique des études solaires, vous avez entrepris de vastes recherches sur les relations entre les phénomènes solaires et les phénomènes météorologues terrestres d'où suivit la création de la *Commission internationale* pour l'étude de ces relations, dont vous avez été élu Président.

Et votre indomptable activité s'est portée aussi sur les météorites, sur les comètes, sur les étoiles, et ainsi vous avez été conduit à fonder une nouvelle classification et une nouvelle hypothèse sur l'origine des astres, très appréciée par les savants.

Et enfin il ne faut pas oublier vos intéressants recherches archéologiques qui ont des relations très importantes avec l'astronomie ancienne et la chronologie.

Tout cela est apparu en plus que 200 publications, et il paraît vraiment impossible que cette grande production scientifique soit l'œuvre d'un homme seulement, et même en tenant compte de la collaboration de vos vaillants élèves et aides. Et il faut ajouter que tout cela a été fait avec des moyens très limités, avec des difficultés de toutes sortes, en une installation excessivement modeste; je n'ai pas oublié ma surprise, lorsque j'ai eu le bonheur de visiter votre observatoire à South Kensington, qui a une si grande renommée dans la science, de trouver un ensemble des cabanes en bois et canevas, si modeste, et je dirai même si pauvre, pour l'Angleterre qui est si riche!

Mais j'espère que le changement que vous craignez vous donnera au contraire un établissement digne de vous, de votre grand Pays, de la science que vous cultivez d'après 40 ans avec tant d'ardeur et de succès, qui a suscité l'admiration de tout le monde scientifique; et je suis sûr que le nouvel observatoire sera encore mieux situé pour répondre aux besoins de vos études et au progrès de l'Astronomie physique moderne; c'est-à-dire qu'il sera construit sur une place élevée, avec une atmosphère plus pure et moins éclairée que celle de Londres.

Voilà mes vœux les plus sincères et les plus froides que je vous envoie avec mes salutations les plus distinguées et les plus cordiales.

Votre ancient admirateur,
(*Signed*) A. RICCO.

Catane le 20 novembre, 1910.

MONSIEUR LE PRÉSIDENT,—

En vous écrivant à propos de la translation de votre Observatoire j'ai manqué de remarquer une condition nécessaire et qui certainement ne vous est pas échappée. C'est la condition que votre nouvel observatoire domine bien l'horizon Est, à fin de pouvoir commencer les observations solaires le plus tôt que possible après le lever du soleil, de manière qu' elles puissent se rattacher à celles qui se font aux stations plus orientales que Londres, et

pour avoir devant vous toute la journée pour réussir à les accomplir lorsque le ciel n'est pas entièrement serein.

Je me permette d'attirer votre attention sur ce point important, parce que nous éprouvons à Catane l'inconvénient de ne pas avoir l'horizon Est tout à fait libre.

Agréez, M. le Directeur, mes sentiments de la plus grande considération.

Votre très dévoué,

A. Riccò.

(*Copy.*)

Observatoire d'Astronomie Physique de Paris,
Sis Parc de Meudon,
Seine-et-Oise,
Meudon, le 30 octobre, 1910.

Cher Monsieur Lockyer,—

J'apprends que votre observatoire de South Kensington doit être transféré en dehors de la ville, en pleine campagne, c'est-à-dire dans un lieu plus favorable aux études solaires. Je vous adresse à ce sujet mes vives félicitations, et je souhaite que le gouvernement anglais vous donne largement les subsides nécessaires, et vous permette de créer une organisation nouvelle qui soit bien en rapport avec l'importance toujours croissante des recherches solaires.

Votre observatoire actuel de South Kensington est bien mal pourvu; la plupart des instruments sont anciens, et tous les bâtiments sont en bois léger, cependant vous y avez fait de grandes choses, aussi bien sur les étoiles que sur le Soleil. La même remarque s'applique à vos premières observations de Wimbledon, et à votre grande découverte de 1868, qui nous a dévoilé l'atmosphère du Soleil, et a été le point de départ de toutes les recherches actuelles, si étendues, sur le Soleil. Vous opériez avec de petits instruments que dédaigneraient nos étudiants d'aujourd'hui.

Dans ces premières recherches qui ont fixé les méthodes, la valeur de l'homme pouvait suppléer à la faiblesse des appareils. Mais, pour appliquer les méthodes avec tout le développement qu'elles comportent, des installations largement conçues, des instruments de grande puissance sont nécessaires. On l'a bien compris en Amérique, où les observatoires solaires sont magnifiquement organisés et aussi quelque peu en France où le Parlement nous a accordé récemment des crédits extraordinaires. L'Allemagne, La Russie, l'Italie et même l'Espagne ont suivi le mouvement. Vous seuls, les Anglais, vous êtes actuellement en arrière, en retard, au moins en ce qui concerne les installations, car votre observatoire, en fait, a été le premier en date et l'initiateur des méthodes.

Heureusement, l'utilité et la nécessité d'une étude complète du Soleil apparaissent à tous de plus en plus évidentes, et vous avez contribué plus que personne à créer cet état des esprits par vos belles recherches récentes qui dévoilent une relation simple entre les protubérances solaires et le régime des vents et de la pluie à la surface de la terre. Certes tous les hommes, même les plus bornés, comprennent l'influence maîtresse du Soleil sur la terre, mais le lieu qui les nuit est beaucoup plus étroit qu'on ne le suppose au premier abord. Toutes les perturbations solaires ont leur répercussion sur la terre et son atmosphère, et si on veut démêler les causes des variations si complexes de notre atmosphère, il faut d'abord suivre avec le plus grand soin les variations du Soleil.

Ces dernières raisons, et leur côté utilitaire, ont frappé tout particulièrement les membres du Parlement et du Sénat français qui m'ont accordé des crédits pour le Soleil. Je leur ai parlé aussi de vos recherches sur la comparaison avec les étoiles, et sur la place du Soleil dans la nature, recherches qui ont un intérêt surtout philosophique.

Tels sont les renseignements que je puis vous fournir sur les conditions faites en France à l'astronomie physique, et solaire. Je puis les compléter d'autres détails, si vous le jugez utile.

Je vous souhaite le meilleur succès dans l'œuvre que vous poursuivez pour le plus grand bien de la science, et je vous prie d'agréer l'expression de mes sentiments respectueuses et dévoués.

(*Signed*) H. Deslandres.

(*Translation.*)

The South Kensington Solar Physics Observatory under the direction of Sir Norman Lockyer.

The discoveries and work of the South Kensington Solar Observatory under the direction of Lockyer have been so unusually fruitful and numerous that it is quite impossible to mention here even all of the most important. Some of them are arbitrarily selected.

The discovery which brought Sir Norman Lockyer the first great reputation was certainly that which enabled us to observe the prominences of the sun even without an eclipse if his spectroscopic method were used. Another discovery of undying renown was the finding of helium in the sun, which twenty-seven years later Sir William Ramsay proved to exist in the nitrogen of the earth's atmosphere.

That the absorption in sun-spots is increased was discovered by Lockyer, and thereby the path was laid for the only possible comprehension of the constitution of the solar globe.

The exact proof of a great number of terrestrial elements existing in the sun was of fundamental importance.

Doppler's principle was first applied by Lockyer to the processes of movement in the sun's atmosphere. By this means it became possible to recognise and investigate the ascending and descending currents in the sun's atmosphere. It was thus shown that in the sun similar meteorological movements occur to those on our earth, but they are much more powerful.

The use of the objective-prism without slit in solar eclipses by Lockyer first rendered possible the exact investigation of the constitution of the chromosphere and solar corona.

The investigations of the variability of the spectra of the elements in the sun and in sun-spots with the spot-period had great influence upon the scientific development of the last decades. They went hand in hand with the development of Lockyer's bold hypotheses of the dissociation of the elements. The great discovery that different parts of the electric arc give different spectra for one and the same element would alone have been of the greatest influence.

Although the hypotheses have changed with time, the substance of them has been accepted directly through the most recent advances of physics and the cognisance of electrons, and there is no doubt that they have been directly of invaluable importance to the progress of science through the objections to which they have given rise.

Quite as fruitful, contested and defended, are the views put forth by Lockyer and South Kensington respecting the formation of the universe from meteoric dust and gases. The detailed studies respecting the emission lines of metals under the application of the highest electric energy could hardly have been made without them, and the numerous excellent studies in detail of the different kinds of suns found in the firmament in a different stage of development, which we owe in recent years to South Kensington, have all sprung from this leading point of view.

Even if those investigators are right who vehemently contest many points of the hypothetical construction of the development of the stars, a valuable core will still remain. The full utility of the enormous materials collected respecting the spectra of the elements, of the stars, and the sun will remain of lasting value.

The numerous ingenious improvements and inventions in spectroscopic methods, spectroscopes, telescopes, and apparatus which have emanated from South Kensington are of the greatest utility.

The statistical investigations of the influence of the sun upon terrestrial weather conditions proceeded hand in hand with these astrophysical labours. After South Kensington had shown that the higher radiation energy of the sun occurred at the time of sun-spot maximum, and not at the time of the minimum, the problem was attacked in many different ways in order to show the influence of the solar period upon terrestrial magnetism, pressure, and temperature conditions of the earth's atmosphere, and amount of rainfall. It was seen that success could only be obtained if the conditions over the earth as a whole were taken into account. The establishment of the Solar Commission of the International Meteorological Committee

and the collection of observations from all stations round the earth was the next step, and South Kensington became the headquarters for this collective work, the results of which have already began to bear the most interesting fruits.

Although this short *résumé* has only touched upon the most striking pieces of work, it must, however, show beyond doubt that the institution directed by Lockyer at South Kensington has played a universally stimulating and leading part in the scientific world.

Solar physics, and also astrophysics, are in England closely connected with South Kensington Observatory—as in France with Meudon, in America with Mount Wilson, and in Germany with Potsdam. It forms for the scientific reputation of England an essential part, and if during recent years it has not been able to keep pace in many things with the largest institutions of other countries, it was owing to the abnormally unfavourable position in the smoke of the metropolis London and the relatively small funds which have inconceivably been placed at its disposal.

(*Signed*) DR. MAX WOLF.

Heidelberg, October, 1910.

(*Translation.*)

Vienna,
November 1, 1910.

MY DEAR SIR,—

I have learned with the greatest regret that the activity of the Solar Physics Observatory will be interrupted, and that, generally speaking, by the removal of the observatory to an unsuitable place, with unfavourable atmospheric conditions, there is danger of the continuance of the work being hampered, the success of which, so far, has been acknowledged in the widest circles.

Just at the present time, when all the larger countries are about to take up the solar investigation inaugurated in England through them specially, or are thinking of doing so, when, especially in America, large sums are expended upon it, it seems inconceivable that injury should be contemplated to an observatory devoted to this investigation, which can look back upon thirty-eight years of such successful work, notwithstanding the small funds at its disposal. Should England wish to put itself even partially out of action in the cooperation in such a promising field of inquiry? An Empire which extends over the whole earth should at least support a work that has done so much that is surprising and practically important in the discovery of intimate relations between atmospheric conditions of the remotest parts of the earth.

Your very numerous works and publications in the domain of stellar and solar physics, which have long since received the appreciation of distinguished astronomers, have also placed investigators of terrestrial magnetism and meteorologists under the greatest obligation. They have shown us new methods and new aims. Especially is this so in the indication of a short period in the solar and meteorological variations on the earth; the extension of the Bombay-Cordoba "see-saw" of the variations of atmospheric pressure over the whole earth; the variations in temperature and rainfall with solar changes in the neighbourhood of the Indian Ocean (pulses in Indian rainfall at spot maximum and minimum); solar activity, 1833 to 1900, and the discovery of a period of about thirty-five years in the same, with which magnetic and meteorological periods (Brückner's cycle) correspond; the relations between solar protuberances and the manifestations of terrestrial magnetism, &c.

Meteorologists and investigators of terrestrial magnetism must therefore express the most earnest desire that the activity of the Solar Physics Observatory heretofore may not suffer retrenchment in any direction, but, on the other hand, that it may be extended.

With great respect, &c.,
(*Signed*) J. HANN.

Bonn,
Humboldstrasse 2,
October 25, 1910.

DEAR SIR NORMAN,—

I am sure that to everyone who knows something of spectroscopy and astrophysics the name of yourself and of the South Kensington Observatory are most familiar. These names are so intimately connected with the progress we have made in the last forty years, that even the beginner must know them. I think it is impossible to overestimate the services you have rendered to astrophysics and astronomy.

When I first had the opportunity of seeing your observatory—it is a long time ago, I think twenty years—I admired that you have been able to do all this work in such a place and under such poor conditions. Some years ago, when I first heard that the place of your observatory was needed for other purposes and that you should get a new observatory, I was very glad, because I was sure that the English Government would be happy of the opportunity to give you the best available place and good buildings, and so promote the most needed continuation of your work in a better site. I was sure that the English Government is aware of the high importance of astrophysics for human knowledge and culture, and full of gratitude to you who has spent a successful life to the promotion of this science under such difficult conditions.

You can imagine how astonished I am to hear that your Government will give you a site quite unfit for the purposes of astrophysics. I can only suppose that such a plan has been taken into consideration without full knowledge of the importance and the needs of astrophysical work. So I hope surely that the Government, when better instructed, will change its mind and give you the site you need.

In the last meeting of the International Union for Solar Research, held this year in California, the Union resolved to send messages to the Governments of Japan and Australia asking the erection of astrophysical observatories. I am sure that every member of the Union would second your claim for a well-situated new observatory. I hope the English Government will hear the wish of all the civilised nations not to interrupt, but to promote, the work of yourself and of your observatory.

Please make any use you like of this letter.

I am, dear Sir Norman,
Yours most truly,
(*Signed*) H. KAYSER.
Director of the Physical Institute of the University.

Det Norske Meteorologiske Institut,
Kristiania,
October 29, 1910.

DEAR SIR,—

I am much obliged to you for the good opinion shown by the value which you attach to a declaration from me concerning the work of the Solar Physics Observatory.

After my return from Cambridge and London in 1904 I wrote an article in the Norwegian newspaper *Aftenposten* expressing my admiration of your celebrated observatory, and my opinion of the importance of its splendid work for the future of meteorology. I venture to give here subjoined a translation of that part of the article which concerns the subject in hand.

"The man who has taken the initiative in the first organisation of the new lines in meteorology is, as already mentioned, Sir Norman Lockyer, one of England's most eminent men of science. He was born in 1836, and from his earliest youth has worked at the study of what takes place in the sun. In 1868 he discovered in the sun's chromosphere a then unknown substance, helium, which is now thought to be a gaseous modification of the now famous radium. Lockyer has been an observer of almost all the total eclipses of the sun during the last forty years, and in 1868 he found—simultaneously with, but independently of, the French astronomer, Janssen—a method of observing the sun's prominences at any time by the aid of the spectroscope—a very great step in advance, as formerly this phenomenon could only be observed during the rare, brief moments of a total eclipse.

"It was mainly due to Lockyer's perseverance that as early as the 'seventies of last century an observatory, exclusively for solar observation, was erected in India, whose tropical position is especially favourable to that kind of observations. At the same time a small physical-chemical laboratory in South Kensington was given up to him, and turned into the now so celebrated Solar Physics Observatory, which, under Sir Norman's management, has gradually risen to be a first-class scientific institution.

"The observatory, however, is not very easy to find in the labyrinth of the world-city. It is well concealed behind the great South Kensington Museum, in a back-yard of the museum, with access to it through an insignificant-looking side entrance in the Exhibition Road. The observatory buildings themselves, five or six in number, also present a very plain appearance, giving the impression, when seen from a distance, of being part of a travelling menagerie or circus.

"But on passing within these wooden walls and tent-doors one is deeply impressed by the wonderful instruments and apparatus with which Sir Norman Lockyer and his son, Dr. William Lockyer, aided by a staff of assistants, draw forth the sun's secrets by astronomical, spectroscopic, and photographic means. The instrumental equipment of the observatory is probably unique of its kind, and in the meteorology of the future the Lockyers' Solar Physics Observatory in South Kensington will rank among the first to be counted with."

Since that time I have followed the publications from the observatory with much interest, observing the great progress in all branches of solar inquiry and its relations to meteorological and other terrestrial phenomena. It is my sincere hope that the new position of your observatory may be such that you, dear Sir, and your admirable scientific staff, may carry on your work on the same lines as before, untroubled by difficulties arising from local disturbances.

I am, dear Sir,
Sincerely yours,
AKSEL S. STEEN.

Vice-Director of the Norwegian Meteorological Institute.
President of the Norwegian Geographical Society.

SOLWAY BIRDS.[1]

COUNTY histories of birds have followed each other in such rapid succession during the past few years that the majority of those the geographical situation of which gives them special importance, have found historians. This the latest addition deals with the avifauna of Dumfriesshire and the Solway area, which is to say that the neighbouring counties of Kirkcudbright and Wigton are included in the author's purview. Mr. Gladstone's survey, therefore, covers the whole of the very interesting south-west corner of Scotland along the shores of which the Solway ebbs and flows.

The region is indeed very fortunate in its historian. He has supplied all that the ornithologist can wish to know concerning the occurrence of its birds. His book is also a meritorious production from the publishers' and bookbinders' point of view. It is light to hold and very attractive on account of its excellent paper, bold, clear type, and the beauty of its illustrations. Messrs. Witherby, the publishers, one of whom is a well-known ornithologist, now appear as the worthy rivals in London of the distinguished place which the house of Douglas in Edinburgh has so long held for the production of ornate books on natural history.

Mr. Gladstone has added interest to his work by placing on record the names, with a short biography, of each of the ornithologists of the county, of whom from about 1650 there appear to have been a goodly number. Among them occur such well-known or distinguished names as Captain Clark Kennedy, Robert Gray, Dr. Grierson, Sir William Jardine, William Laidlaw (Sir Walter Scott's amanuensis), the Rev. Hugh Macpherson, and Sir John Richardson, naturalist to the Franklin Arctic expedition, and the discoverer of Huxley.

Short eared Owl on the Nest, photographed by Mr. F. Barber-Starkey. From "The Birds of Dumfriesshire," by Hugh S. Gladstone.

The physical features of the county, which embraces an area of a little more than 686,000 acres of land surface and 21,000 of water and foreshore, are very varied. The northern part is mountainous, rising into hills more than 2000 feet, "intersected by glens and valleys"; the southern "breaks into three great 'dales,' named from the Nith, the Annan, and the Esk." The wide Solway firth is an area of special importance to the natural history of the district, for

[1] "The Birds of Dumfriesshire—a Contribution to the Fauna of the Solway Area." By Hugh S. Gladstone. Pp. xcix+482. (London: Witherby and Co., 1910.) Price 25s. net.

it provides vast feeding grounds for shore birds, although, in the absence of cliffs, rock-breeding species are scarce or absent. Dumfriesshire has been reafforested to a wide extent since the earlier parts of the last century. Consequently suitable habitats have been provided for many species which would not otherwise be included in its register, while "hedge enclosures with rows, belts, or clumps of ornamental or 'wind-breaking' trees have greatly encouraged the increase of passerine birds." The firth opens its arms also to welcome home-coming immigrants and birds of passage. "There is no doubt," as Mr. Gladstone remarks, "that in comparatively recent geologic times the Irish Channel was a great tidal river, of which the Solway streams were its northernmost tributaries, and that this ancient river valley was the route by which the birds went and came in long by-past ages—a route which has left so strong an impression on posterity that the birds travel along what is now a broad sea-way."

The number of species recorded from Dumfries is of residents, 70; summer visitants, 31; winter visitants, 31; occasional visitors, 30; very rare or accidental visitors, 56; or, in all, 218. One reads with regret that eagles and harriers have ceased to nest; that martins, barn-owls, and swallows are scarer; but, on the other hand, it is pleasant to know that pied flycatchers, tufted ducks, great spotted woodpeckers, jays, woodcock, and peregrine falcons have become more numerous. The author's biographies—all of them just what they should be—of the different species, abound with interesting observations. In speaking of the dipper, by the way, Mr. Gladstone records that there has been a nest in a certain stream for 123 years in succession. There are a score of heronries in the county, and the list of rookeries is a long one, the site of some of them dating back for more than 600 years. Notwithstanding that 36,000 rooks have been killed in the last three years, the stock shows few signs of decimation. Incursions of sandgrouse and of continental crossbills are recorded, the latter species nesting apparently only for a few seasons after such visitations.

We commend heartily "The Birds of Dumfriesshire" to all British ornithologists, and especially to those north of the Solway. The volume is provided with what is too often forgotten in faunistic books, an excellent map, and, with a good index, a *sine quâ non* of a book of reference, if it is to be fully useful. By the courtesy of the publishers we are able to exemplify its illustrations by a specimen of the twenty-four full-page pictures which adorn it.

NOTES.

On Monday next, January 23, an important development in Oceanographical Science will take place by the inauguration of the Oceanographical Institute in Paris, which has been founded and endowed by the Prince of Monaco. In NATURE of April 14 and November 3, 1910, notices appeared of the opening of the Oceanographical Museum founded by the Prince at Monaco, and a description of the museum and its objects was given by Mr. J. Y. Buchanan. With the opening of the Institute next week, a further development will take place; for the Institute will now be composed of, first, the Institute at Paris; secondly, the Museum at Monaco. The Prince has described the Museum at Monaco as the workshop, and the Institute in Paris as the retail house. The Institute is French and international—French because its seat is in Paris, directed by a French administrative committee consisting of M. Emile Loubet, M. W. Darboux, M. Cailletet, Dr. P. Regnard, Mr. Georges Kohn, and Mr. Louis Mayer; international because the scientific and technical direction is in the hands of what is termed the "Comité de Perfectionnement," of which the president is the Prince of Monaco, and the vice-president Mr. J. Y. Buchanan, while the other British members are Sir John Murray, K.C.B., and Dr. W. S. Bruce. The committee also includes the names of many eminent French, German, Scandinavian, and other oceanographers. While the Museum is under the direction of Dr. Jules Richard, the Institute in Paris is under the administration of Dr. P. Regnard. Three professors are connected with the Institute—M. Joubin for biological oceanography, M. Berget for physical oceanography, and M. Portier for the physiology of marine creatures. After the opening of the Institute on January 23 the Comite de Perfectionnement will meet, and future arrangements for the development of the Institute will be duly considered.

Sir David Gill, K.C.B., F.R.S., has been elected a foreign member of the Swedish Royal Academy of Sciences, Stockholm.

A Reuter message from St. Petersburg announces that the Russian Academy of Sciences has conferred honorary membership on Prince Albert of Monaco, and has elected the following as corresponding members:—Mr. Bryce, British Ambassador to the United States; Prof. Lorentz, Leyden; Prof. Strasburger, Bonn; and Prof. Lewes, Albany.

At the meeting of the Paris Academy of Sciences on January 3, the incoming president, M. Armand Gautier, comparing the practice of the Academy with that of the Royal Society, mentioned the fact that during the half-hour preceding the formal opening of each meeting of the latter, the fellows meet in the ante-room for informal conversation, and he expressed the hope that a similar arrangement could be organised for the Academy. This would avoid the necessity for private conversations being carried on during the actual meeting.

It is reported from Sydney that the Science Congress—which, we suppose, is the Australasian Association for the Advancement of Science—has voted 1000*l.* for Dr. Mawson's Australian Antarctic expedition, which is starting in November for the purpose of exploring the regions between Cape Adare and the Kaiser Wilhelm II. Land. Three Australian citizens are each contributing 1000*l.* to the expedition, and other generous help has been promised.

The report referred to in a paragraph last week (p. 342), that the town of Prjevalsk in Turkestan was destroyed by waves of the Issil-Kul Lake during the Vyernyi earthquake of January 3–4, proves to have been incorrect. The towns along the northern shore of the lake, however, suffered severely, and fifty persons were killed. It will be noticed that the position of the epicentre as given in Dr. W. N. Shaw's letter (p. 335) is in the immediate neighbourhood of the lake.

According to a Press message from Winnipeg, information has reached there from Fort Churchill, on Hudson's Bay, that the schooner *Jeanie*, with fifteen geological surveyors on board, was wrecked on September 9, 1910, in a gale near Wagner inlet. After suffering great hardships the party reached Fort Churchill on December 1, and is now on its way to Winnipeg by dog train. The party left Ottawa last spring to investigate the flora and fauna in the Hudson's Bay district.

A Reuter message from Washington states that the members of the U.S. Geodetic Survey who have been examining Commander Peary's Arctic observations

declared, during the hearing of his request for retirement from the Navy, that the explorer went within sixteen to ten miles of the North Pole. It is also announced from Washington that the House Committee on Naval Affairs has reported favourably on the Bill retiring Commander Peary with the rank of Rear-Admiral "on account of his Polar attainment."

A REUTER message from Berlin states that, under the presidency of the Minister of Public Worship, a meeting was held there on January 11 to draw up a foundation scheme for the Emperor William Society for the Encouragement of Science. According to the resolutions adopted, membership will entail an entrance fee of 1000*l.* and a yearly subscription of 50*l.* The society will be governed by a general assembly, a senate, and an executive committee. The senate will consist of ten members elected by the society, but the power to appoint additional senators is reserved by the Emperor, as protector.

WE learn from the *Revue scientifique* that the French Budget for 1911 provides various grants to learned societies in France. Among these may be mentioned 1400 francs to the mathematical society; 1000 francs each to the societies of anthropology, zoology, biology, and botany, the prehistoric society, the Bordeaux society of sciences, and the Rennes society of sciences; 600 francs to each of the societies of meteorology, mineralogy, and the Nantes society of sciences. Grants of 500 francs are made to three societies, of 400 francs to three societies, and 240 francs to one society. A grant of 25,000 francs is included for the fund available to assist scientific research.

THE director of the Meteorological Office announces that the series of meetings commenced in 1905 for the informal discussion of important contributions to meteorological literature, particularly those by colonial and foreign meteorologists, will be continued this year. The meetings will be held on the following Mondays, at 5 p.m.:—January 23, February 6 and 20, March 6 and 20. At the opening meeting on Monday next, Prof. Grossmann will open a discussion on the relation between the temperatures of the North Atlantic Ocean, and of North-West and Central Europe. The subjects suggested for discussion at subsequent meetings are as follows:—Meteorologische Optik, J. M. Pernter; Cloud Report, Part ii., H. H. Hildebrandsson; scientific results of the *Scotia*, 1902–4, R. C. Mossman; Einfluss des Windes auf die Fahrt von Dämpfern, P. Heidke; on the influence of the earth's rotation on ocean currents, W. Ekman; on the influence of forests on rainfall and the probable effect of *déboisement* in agriculture in Mauritius, A. Walter; climatological diagrams, John Ball; on the double diurnal variations of the velocity of the wind at Nagasaki, Y. Tsuiji; the amount of radium emanation in the atmosphere, J. Satterly.

A CIRCULAR letter has been issued by the British Executive Committee of the International Hygiene Exhibition, to be held in Dresden this year, directing attention to the fact that the British Government has declined the invitation to participate in the exhibition. All the chief States of the world, with the single exception of Great Britain, have accepted the invitation, and have voted substantial sums in aid thereof. The British committee is therefore appealing for 10,000*l.*, which is necessary if Britain is to be represented at the exhibition. Contributions, or promises thereof, should be sent immediately to the secretary, 47, Victoria Street, S.W.

IN a letter to the *Times*, January 11, the chairman (the Bishop of Ripon) and the executive committee of the National League for Physical Education and Improvement direct attention to three leaflets issued by the league dealing with the question of a pure milk supply. These have been prepared by Sir John McFadyean, Prof. Simpson, Mr. F. E. Freemantle, and Dr. J. F. Sykes. One leaflet, intended for "farmers and other milk producers," contains advice upon the care of cows, the precautions to be observed by the milkers, the treatment of the cowsheds, the cleansing of utensils, storage, and the danger of human infection. In a second leaflet, "distributors and retailers" are informed of the steps which they should take with regard to dairies and milk shops, infection, contamination, and souring, storage, and sale, utensils, and cleanliness during delivery. The third leaflet contains a number of hints for the benefit of "housewives and all consumers of milk."

AN interesting observation, dealing with a very obscure phenomenon of alcoholic fermentation, was communicated at a meeting of the Institute of Brewing on January 9 by Mr. O. Overbeck. In endeavouring to prepare a non-alcoholic beer by removing the alcohol from ordinary beer by a stream of carbon dioxide, Mr. Overbeck states that he found that the beer after this treatment recovered a part of its alcohol content when cooled and aërated with carbon dioxide. Thus, beers which after the removal of alcohol contained only 0·2 per cent. of this substance were found after treatment with carbon dioxide in the cold to contain as much as 1 to 1·5 and even 2 per cent. As the liquids were in all cases practically free from yeast, this remarkable production of alcohol cannot easily be explained in the light of our present knowledge. It may be due to some purely chemical effect or to the presence of some unsuspected ferment in the beer, the action of which becomes noticeable under the conditions of the experiment. Confirmation of the observations and further experiments on the nature of the phenomenon will be awaited with great interest.

THE scientific career of Col. George Strahan, who died last week at seventy-one years of age, is described in *The Times* of January 16, as follows: "After serving for a short time in the Irrigation Branch of the Public Works Department in India he was appointed to the Survey Department, in which he continued for the rest of his service. The early portion of his survey career was passed in the Topographical Branch, and many thousand square miles of country in Rajputana and Mysore, as well as in other parts, were surveyed by him and the officers under him. In later years he was employed in the electric determination of longitudes in India and between India and Greenwich, for which work he was specially suited. He rose to be Superintendent of the Great Trigonometrical Survey, and also acted for a short time as Surveyor-General."

TIME was when the expression "the tsetse-fly" was understood to mean simply the species *Glossina morsitans*, Westwood. Indeed, the name is still often used in this sense by many writers; not long ago Prof. Kleine created a sensation in the daily Press by the statement that "the tsetse" did not transmit sleeping sickness, meaning, thereby, *G. morsitans*, but producing the mistaken impression that he had proved *G. palpalis* to be innocent in the matter of spreading the disease. One newspaper even went so far as to state that Kleine had disproved any connection between *G. palpalis* and sleeping sickness. Austen, in his standard monograph of the genus Glossina, recognised seven species of tsetses, and acknowledged, subsequently, the validity of an eighth, *G. tachinoides*, Westw. In a paper noticed recently in NATURE (December 29, 1910, p. 279), Mr. Newstead brings the number of

species up to eleven, and proposes to distribute them amongst three distinct genera. The problems involved are by no means of purely academic interest, but have the utmost practical importance from the known fact that different species of tsetses are instrumental in transmitting the different species of trypanosomes that produce diseases in man and animals, and it is a matter of urgent necessity to determine exactly the various species of these flies and the limits of their distribution.

In its issue of January 6, the *Times* announces the grant by the Treasury of 40,000*l.* to the Board of Agriculture and Fisheries for the encouragement of light horse breeding in Great Britain. In administering the grant, the Board will have the assistance of a special Advisory Council. The purposes of the grant are five in number, namely:—(1) the award of premiums to stallions; (2) awards for the purchase of half-bred working broodmares for location in specified districts; (3) free nominations for suitable mares for service by premium or approved stallions; (4) the purchase—for re-sale—of stallions; (5) the voluntary registration of stallions. The awards to stallions will be of two classes, viz. King's premiums and the Board's premiums, the former to be given to stallions at the ensuing spring show in London, and the latter to animals exhibited at other spring shows or selected by the Board. In an article on the grant in the *Daily Telegraph* of January 11, it is stated that certain authorities consider that it will increase the supply of hunters, cobs, &c., and ask what means are provided to create a demand for this increased stock. Owing to the steady development of motor traction, the demand for light horses is not increasing, and will probably become still smaller, so that unless the War Office is prepared to increase largely its purchases, it is difficult to see where breeders are to find a market.

Part ix. of the fifth volume of the Annals of the South African Museum is devoted to a revised list of the local reptiles and amphibians, with descriptions of new species, by Mr. G. A. Boulenger. In connection with this may be mentioned a list of East African reptiles and amphibians, by Mr. S. E. Meek, published by the Field Museum at Chicago (Zool. Ser., vol. vii., No. 11), based on a collection made from 1905 to 1907.

According to the *Egyptian Morning News* of December 20, 1910, Captain Stanley Flower has been unusually successful in his eleventh collecting trip to the Sudan, from which he returned with no fewer than 170 live animals for the zoological gardens at Giza, together with a number of museum specimens. The rarities include a Sudani galago (*Galago teng*), a white-tailed mongoose in which the whole tail is (abnormally) black, and a cow buffalo from the Blue Nile, the last-mentioned race being already represented in the gardens by a bull.

In our own Zoological Gardens it is intended to display a special exhibition of African animals during the coming summer. Some out of a series of birds collected for the King were received at the gardens a few months ago, and it is announced in the *Field* of January 7 that half a dozen mammals brought home by H.R.H. the Duke of Connaught. These include a couple of meerkets, two specimens of the Cape zorille, or muishund, as the animal is called by the Boers, a Sykes's guenon, and a Malagasy ring-tailed lemur. These animals were presented to Princess Patricia of Connaught by the Chief Lewanika.

In *British Birds* for January, Messrs. Witherby and Hartert, after referring to the distinctness of the English jay (*Garrulus glandarius rufitergum*) from the typical Continental representative of the species, announce that, in their opinion, the Irish jay is likewise entitled to rank as a local race. Compared with British specimens, the Irish jay (*G. g. hibernicus*) has the feathers of the sides of the head and ear-crests markedly darker and more rufous, while there is a tendency to a similar darkening all over the under-parts, and the crest is conspicuously darker. The Irish jay is mainly restricted to Leinster and the adjacent districts of Munster, although of late years it has spread into the south of Ulster. The Irish representatives of two other birds—the water ouzel and the coal titmouse—have recently been described as local forms. Whether we are any the forwarder for such splitting-up of species may be a question.

We are indebted to Mr. W. H. Shrubsole for a copy of an unpublished article on the contrast between the protection accorded to useful birds in Hungary and Great Britain. The Hungarian Government employs the services of an ornithological expert, and from the results thereby attained has been enabled to draw up a series of enactments which appear admirably adapted for the protection of all species beneficial to the agriculturist. Heavy fines are enacted on the conviction of offenders against these Acts, while rewards are offered to the writers of the best essays on bird-protection. Other paragraphs in the Acts prohibit the possession or transport of scheduled birds or their nests and eggs. On the other hand, the British Acts for the protection of wild birds are, in the author's opinion, altogether inadequate. Attention is also directed to the use in Italy of huge nets—some half a mile in length and of great height—for the capture of swallows and other migratory birds.

In the issue of Nature of October 6 last (vol. lxxxiv., p. 428) a letter was published from Prof. T. D. A. Cockerell containing some interesting information concerning the fur trade. Prof. Cockerell gave extracts from a detailed synonymy contained in the retail catalogue of an important American firm dealing in furs, which showed how far the furs bought from shops may be identified from the names under which they are sold. A letter to the *Morning Post* of January 12, from Mr. E. M. Kirwan, raises the same point, and offers a warning to the public in the form of a list showing the proper names of the various furs and the permissible descriptions sanctioned by the Fur and Skin Section of the London Chamber of Commerce and the London Drapers' Chamber of Trade. Mr. Kirwan's list is as follows:—

Name of Fur.	*Permissible Description.*
American sable	Canadian sable or real sable.
Fitch dyed	Sable fitch.
Goats dyed	Bear goat.
Hare dyed	Sable hare or fox hare.
Kids	Caracul kids.
Marmot dyed	Sable marmot, mink marmot, or skunk marmot.
Mink dyed	Sable mink.
Musquash dyed	Mink musquash or sable musquash.
Musquash pulled and dyed	Seal musquash.
Nutria pulled and dyed ...	Seal nutria.
Nutria pulled, natural	Beaver nutria or otter nutria.
Opossum sheared and dyed	Beaver opossum.
Otter pulled and dyed	Seal otter.
Rabbit dyed	Sable coney.
Rabbit sheared and dyed ...	Seal coney or musquash coney.
Rabbit, white	Mock ermine.
Rabbit, white, dyed	Chinchilla coney.
Wallaby sheared and dyed	Skunk wallaby.
White hare	Imitation fox or mock fox.
White hairs inserted in foxes and sables	Pointed.

IN a recent number (December, 1910) which has reached us of the Leipzig *Neue Weltanschauung* Prof. Max Kassowitz, of Vienna, criticises the views of those biologists who consider that the main cause of the origin of species is to be found in natural selection. His objections are all tolerably familiar. He points out, for example, that the analogy from artificial selection is not complete. The breeder selects characters from motives of curiosity and the like, not because they are useful to the form dealt with, but because they are useful or interesting to himself. Moreover, in order to maintain his artificially produced race, he has to exercise a far more rigid selection than can take place in nature. When left to themselves, such strains rapidly revert. The Lamarckian explanation must be resorted to, not merely for the atrophy and disappearance of disused organs, but also for the enhanced development of frequently used parts. Evidence of this is afforded by Darwin's comparison of the wing and leg bones of tame and wild ducks. If it is once admitted, the author remarks, that the changes produced by use or disuse can pass over to the offspring by means of the germ-plasm, there is no further reason for doubting the general transmissibility of acquired characters or the influence of this principle on every change that takes place in the course of the development of species. Natural selection, he declares, has not hindered the peculiar susceptibility of mankind to certain forms of disease. In these cases the working of a Lamarckian factor can be traced, not of the nature of Darwin's pangenesis, to which there are obvious objections, but more probably a circulation of specific atom-complexes derived from the disintegration of protoplasmic molecules. Prof. Kassowitz's contentions have been heard before, and abundantly answered. Had he taken into account the results of Mendelian research, it is plain that some of them would never have been advanced. The concluding argument of his paper, on the subject of disease toxins, is ingenious, but unconvincing.

A REVIEW of the development of the Ligulatæ, *i.e.* the genera Selaginella and Isoetes, communicated by Dr. G. Ritter to *Naturwissenschaftliche Wochenschrift* (December 11, 1910), traverses the investigations by Bruchmann into the various modifications of the prothalli and embryo in Selaginella, and describes similar stages in Isoetes.

THE list of seeds of hardy herbaceous plants, shrubs, and trees available for exchange with botanic gardens and regular correspondents, annually published by the director of Kew Gardens, has lately been issued in the usual form as Appendix 1 to the *Kew Bulletin*, 1911. The list is a short one, presumably reflecting the past unfavourable season, during which the gentians and cotoneasters have yielded the best results.

A SKETCH of the flora of the Samoa Islands is contributed by Dr. F. Vaupel to Engler's *Botanische Jahrbücher* (Beiblatt, No. cii.), with reference to his collections of plants gathered chiefly on the island of Savaii. The flora falls into the Melanesian division of the Malayan region while showing affinities with the floras of Australia and New Zealand. In common with other insular floras cryptogams are abundant, and the ferns supply 200 species as compared with 600 flowering plants. Two of the most typical are *Angiopteris evecta* and the small tree-fern *Todea Fraseri*; *Tmesipteris tannensis*, two species of Psilotum, and *Botrychium daucifolium* are reckoned among the rarer pteridophyta. A unique feature of some of the lagoons is the thick growth of *Acrostichum aureum* alongside the brackish water, and a peculiar vegetation, consisting of a tangle of *Gleichenia dichotoma*, *Pteris heterophylla*, and *Imperata arundinacea* penetrated by masses of *Lycopodium cernuum*, covers the tufa soil on the plateaux. Among phanerogams, the orchids are well developed, also the dicotyledonous genera Psychotria, Cyrtandra, and Elatostemma.

BULLETIN 124 of the West Virginia Experiment Station deals with factors influencing the vigour of incubated chickens. Incubators operated without moisture gave rather better results than those where moisture was supplied, but the author is not prepared to assert that the difference is real. Indeed, this old controversy whether a moist or a dry atmosphere should be maintained in an incubator has not yet been satisfactorily settled. It has been suggested that the chick embryos have a certain power of adapting themselves to different degrees of humidity during their development.

THE *Bulletin de la Société d'Encouragement pour l'Industrie nationale* (No. 9) contains an interesting report, by M. Maurice Alfassa, on economic imperialism in Great Britain, in which he deals fully with the efforts now being made to promote cotton growing within the British Empire and to study the problems to which it gives rise. He advises that our African experiments should be closely watched, as some of the conditions are not dissimilar to those obtaining in the French African possessions, and considers that if it is worth our while to try to raise our own cotton it is equally worth while for France.

THE current number of the *Agricultural Journal of India* (vol. v., part iv.) is up to its usual level of interest, and contains several well-illustrated articles dealing with native agricultural practices, and with possible improvements on them. Mr. Keatinge gives a well-written account of the rural economy of the Bombay Deccan, both in its western part, where there is a moderate rainfall and a certain amount of irrigation, and where, consequently, good garden crops can be grown, and in its eastern portion, where a heavy black soil occurs, but rainfall and irrigation are both deficient; here the typical crops are *jowari* and cotton. The population naturally follows the water supply; in the western part it is not uncommon to find the cultivator living on his holding and working industriously at it; in the eastern part, however, the cultivators' houses are confined to the villages on account of the public wells, and much less work is done on the fields. A description is given in another article of the new agricultural college at Coimbatore, Madras, and Mr. Gammie reproduces the paper on cotton cultivation in India that he presented to the Brussels Congress last May.

THE monthly meteorological chart of the North Atlantic Ocean for January, issued by the *Deutsche Seewarte*, explains the good use made of radiotelegraphy for disseminating weather and storm-warning notices to vessels and small craft in the North and Baltic Seas. (1) The wireless station at Norddeich follows its time signal at 1h. p.m. by a short summary received from the Seewarte of the weather conditions over Europe at 8h. a.m., with forecasts for the above-mentioned localities. (2) When necessary, storm-warnings are sent to the same station, and are received by vessels having wireless apparatus and repeated by them by means of day and night signals. (3) Storm-warnings are also sent by the Seewarte to the fishery cruiser in the North Sea, and repeated by ordinary signals by day, and at night by searchlight, for the benefit of fishing-boats. (4) Storm-warnings intended only for the Baltic coast are disseminated in a similar manner by the wireless station at Bülk.

THE descent of a sphere in a viscous liquid was studied by Basset in 1887, but the equation of motion was only integrated by successive approximation. Since that time the subject has been discussed in the *Atti dei Lincei* for 1907 by Prof. Picciati and Dr. Tommaso Boggio. In the *Quarterly Journal of Pure and Applied Mathematics*, No. 164 (1910), Mr. Basset gives a general investigation of the problem, based on the work of the two Italian writers. One notable feature of the work is that the viscosity enters into the Stokes' current-function solution in a way that it did not enter in the earlier solutions of the problems.

IN a paper on the imaginary in geometry, contributed to the University Studies, Lincoln, Nebraska, x., 1., Prof. Ellery W. Davis discusses geometrical properties connected with a mode of representing points in two-dimensional space the coordinates of which are both complex variables. He takes a so-called "black" point P′ the coordinates of which are the real parts of the variables, and from it draws a "red vector" the compounds of which are the imaginary parts, the extremity being a "blue" point P″ the coordinates of which measure the real parts *plus* the imaginary coefficients.

THE *Revue scientifique* for December 31, 1910, contains the address delivered by M. H. Le Chatelier at the Collège de France on December 18 in connection with the ceremonies commemorating the centenary of the birth of Regnault. In the course of his address M. Le Chatelier referred to several facts in the early life of Regnault not generally known. An orphan without means, he spent his youth as an assistant in a fancy bazaar, and at the age of twenty-two entered as a student at the Ecole des Mines. He rose immediately to a prominent position as one of the most promising pupils, and at the qualifying examinations in May, 1834, after two years only of study, he passed brilliantly. For some strange reason the Government refused to nominate him student engineer along with his successful fellow-students, but insisted on a further two years' course at the Ecole. During this period he raised himself by his chemical researches to the front rank of chemists, and it was only on the appointment of a Government commission on the steam engine in 1843 that he commenced that series of measurements in the domain of physics which for accuracy remained unique for half a century.

IN NATURE for August, 11, 1910, we directed the attention of our readers to a communication to the Vienna Academy of Sciences, which appeared in the *Physikalische Zeitschrift* for July 15, and gave a preliminary account of the measurements of quantities of electricity less than the electron or "atom of electricity," by Dr. F. Ehrenhaft, of the University of Vienna. The complete account of the measurements is now available in the *Sitzungsberichte* of the academy for May, 1910. Since our previous note, Prof. Millikan has published in *Science* for September, 1910, an account of his measurements of the charges on drops of oil produced by an "atomiser" or sprayer. He concludes from them that the atomic charge of electricity is $4{\cdot}9\times10^{-10}$ electrostatic units. Dr. Ehrenhaft points out in his complete paper that many of Prof. Millikin's results do not fit in with his conclusion. The June (1910) number of the *Sitzungsberichte* contains Dr. K. Przibram's measurements of the charges on the fine particles of mists produced by electrolysis of a solution of potassium hydrate, by the spark discharge in moist air, by hydrochloric acid, or by phosphorus in moist air. His results confirm those of Dr. Ehrenhaft, so that there is a serious difference of opinion between the Viennese and other observers on the fundamental question of the existence of atomic charges of electricity.

THE paper read by Major O'Meara, C.M.G., on submarine cables for long-distance telephone circuits, at the Institution of Electrical Engineers on January 12, when Mr. Herbert Samuel, the Postmaster-General, was present, will be welcomed by electrical engineers. The paper gave in the first place a brief description of the first telephone cable of notable length; and after touching shortly on the differences in subsequent cables laid across the Channel—which varied very little from the original—proceeded to describe the latest telephone cable laid last year between Dover and Cape Gris Nez. This cable was specially designed to improve the clearness of speech over the line, and also to enable more distant parts of the Continent to be in direct communication with England. To overcome the indistinctness, to which all long-distance telephone cables are liable, small induction coils are inserted in the cable. The theory of this was first propounded by Messrs. Heaviside and Pupin, and is embodied in the present "coil loaded" cable. Two double coils are required for the four conductors and are inserted at a distance of one knot (1·153 miles) apart, each coil being just under six ohms resistance. The two coils nearest the ends of the cable are only half a knot from the terminal instruments, this having been found to give the best results. It is essential, having regard to the maintenance of these cables, that the coils should be evenly distributed, as in repairing cables intermediate lengths have to be inserted. So long as the coil spacing is not altered beyond five per cent. on either side, no noticeable impairment to speech will take place. The importance of this fact will be appreciated when the list of repairs on existing telephone cables is taken into account. It was doubtful when the cable was designed as to how the mechanical difficulty of securing the coils in the cable would be overcome, owing to the increase of size at the points where the coils are inserted, and also the difficulty of the increased thicknesses passing over the drums when laying the cable. These difficulties were successfully overcome and a special paying-out drum was employed, the cable being payed out without passing it under the dynamometer wheel. The paper gives a full description of the laying of the cable; and the complete specification of the cable is contained in one of the many appendices attached thereto. Under the previous existing conditions, conversation could be carried on over a distance of 250 miles, but with the new "coil-loaded" cable a distance of 850 miles is possible.

THE current number (January 10) of the *Comptes rendus* of the Paris Academy contains an account of a new general method of preparing anhydrous metallic chlorides, by Ed. Chauvenet. The method recently proposed by Matignon and Bourion, based on the use of a mixture of chlorine and sulphur chloride, is efficient, but the method now proposed is simpler in that phosgene is used, a substance commercially obtainable in the liquid form in bombs. The oxide of the metal is placed in a boat, and heated in a slow stream of the carbonyl chloride; the metallic chloride, if it is volatile, sublimes a little in advance of the boat in crystals, the temperature required varying between 350° C. and 650° C. Of the numerous oxides tried only silica was unacted upon, a fact which will be of service in separating siilca from other metallic oxides, such as the oxides of tungsten, tantalum, or titanium. Titanium and tungsten furnished oxychlorides, but in all the other cases examined the pure anhydrous chloride was obtained.

AT the students' meeting of the Institution of Civil Engineers, held on January 6, Mr. G. F. Davidson read a

paper entitled "The Measurement of Boiler Deformations." The author described a novel and ingenious method of ascertaining the deformation and corresponding stress by means of a mirror attached to the point on the shell to be examined and a telescope sighted on to the mirror, the reflected reading of a graduated scale being observed and the angular deflection thereby ascertained.

We learn from a note in the *Builder* for January 13 that M. Knauth, in reporting on the settlement in Strassburg Cathedral, states that the chief cause is the defective condition of the foundations beneath the north tower. The foundations consist of two walls running north to south and east to west, and are constructed of rubble and cement on argillaceous soil, in which some timber piles had been driven. The piles are badly decayed, and the interior pillar of the tower is said to be virtually unsupported for a length of 2 metres, as a layer of vegetable earth is interposed between the foundations and the base of the pillar. Like many fabrics of the same class in this and other countries, Strassburg Cathedral was built in different epochs, one result being that the foundations have now to carry loads greater than those contemplated by the original designer. This point is illustrated by the statement that the present foundation load is upwards of 25 tons per square foot. The remedy proposed is the underpinning of all defective foundations.

A Blue-book has just been issued giving account of the engine trials at the National Physical Laboratory for the award of the prize of 1000*l.* offered by Mr. Patrick Y. Alexander. These trials form the subject of an article in *Engineering* for January 13, from which we gather that six engines were entered, but only three arrived before the date fixed. These were:—(1) the Wolseley Tool and Motor-car Company, Birmingham; (2) Messrs. Humber; and (3) the Aster Engineering Company, Wembley Park (entered by Green's Motor Patents Syndicate). Not one of these engines was able to fulfil the conditions of the test fully. The first was pulled up by a leak in the copper oil pipe leading from the pump to the oil well, a defect which led to other mishaps. The Humber motor ran steadily at 37 brake-horse-power at 1224 revolutions per minute for 11¼ hours, and then stopped suddenly with one of the cylinders broken off and two connecting rods buckled. The Green engine was more fortunate. It had to stop for a new sparking plug, and then ran, making approximately 31·5 brake-horse-power at 1213 revolutions per minute, until the completion of the twenty-four hours' run. In a special test of seven minutes, the motor developed 36·4 brake-horse-power at 1390 revolutions per minute. The prize has not been awarded, but we understand that the donor has generously presented a cheque for 200*l.* to the makers of the Green engine, which came nearest to the conditions of award.

Messrs. J. and A. Churchill have just ready for publication a new edition of another volume of "Allen's Commercial Organic Analysis." It is vol. iv. under the new arrangement, and has been rewritten under the editorship of Mr. W. A. Davis and Mr. S. S. Sadtler.

Messrs. Williams and Norgate announce for early publication a translation into English of Prof. Wilhelm Ostwald's work entitled "Natural Philosophy." This work, the translation of which will be revised by the author, gives a *résumé* of modern natural philosophy, based not upon metaphysics, but upon the sciences; and it aims at providing a complete synthesis of the results of the specialisation of last century.

OUR ASTRONOMICAL COLUMN.

Nova Lacertæ.—A brief note in No. 4464 of the *Astronomische Nachrichten* announces that Prof. Max Wolf has found a twelfth- or thirteenth-magnitude star in the position of Nova Lacertæ on plates taken some years ago at the Königstuhl Observatory. The previous presence of a faint object does not, of course, necessarily preclude the star discovered by Mr. Espin from being of the "novæ" type, although in most cases the pre-existence of matter in the identical position is assumed rather than demonstrated; before the catastrophe which produces the extraordinary outburst of light, the object is usually too faint to be detected on our photographs.

More precise spectrum observations than those yet published will permit us to determine whether the outburst was of the catastrophic nature which produces typical "novæ" or whether it is simply a case of a peculiar variable; up to the present, the unfavourable English skies, combined with the faintness of the object, have prevented definitive observations. Seven or eight bright lines have been observed at the Cambridge Observatory, and it is worthy of note that they have not the broad appearance of lines seen in the spectra of novæ.

It is to be regretted that the "nova" was not discovered earlier, for we understand that Prof. Pickering has found images of it, on plates taken about the end of November, 1910, showing it to be of approximately the same photographic magnitude (about 5·0) as the star 9 Lacertæ shown on the chart which we gave in last week's issue; on December 30, 1910, its magnitude was about 7·0. Referring to these facts, at the Newcastle Astronomical Society, Mr. Espin pointed out that for some three weeks the star was visible to the naked eye, yet no one observed it. It was not visible on the Harvard plates on November 19, so that its rise to the fifth magnitude must have been rapid. Mr. Espin suggests that these observations conclusively prove the object to be a real nova. A plate taken at Harvard in December, 1887, although it shows faint stars, shows no trace of the nova.

Mr. Bellamy estimated the visual magnitude on January 2 as 7·5, and recorded the colour as orange. It will probably be found, as with other novæ, that there is a certain difference between the photographic and visual magnitudes, due to the presence of radiations visually inert, and this is suggested by the fact, stated by the Astronomer Royal, that the photographs taken at Greenwich show the image of the nova to be different in appearance from the other star images shown on the same plates.

The Orbits of Several Spectroscopic Binaries.—Nos. 5–8, vol. ii., of the Publications of the Allegheny Observatory contain the discussions of the orbits of various spectroscopic binaries under investigation at the observatory.

In No. 5 Mr. R. H. Baker discusses the measures of the spectrum of 30 H. Ursæ Majoris as shown on fifty plates taken with the Mellon spectrograph in 1908–10. He finds that the observations are not so well satisfied by the preliminary curve computed on the assumption of simple elliptic motion, but the agreement is improved by the introduction of a secondary oscillation. As there is no trace of the secondary component on any of the plates, the resulting orbit must be accepted as preliminary; the period is 11·5832 days.

Thirty spectrograms of 57 Cygni are discussed by the same observer in No. 6 of the Publications. These were taken in 1909, and a comparison of the results with earlier ones secured in 1903 establishes the period as 2·8546 days. The orbits of both primary and secondary components are given separately and then combined, and it appears that the masses are not very different.

Mr. Baker also reverts to the discussion of θ Aquilæ, in No. 7, which, from a comparison of observations made by M. Deslandres in 1901–2 with later ones made in 1907–8 by Mr. Baker, appeared to have a variable period. The latter observer now finds that the two observations of 1901 are probably erroneous, and that the period of θ Aquilæ (17·1245 days) is constant. The orbit as published is derived from single-prism plates, where the lines are confused, and can be only an approximation to the true elements; the star is bright enough, however, for

three-prism spectrographs, which would separate the lines and enable better elements to be derived.

In No. 8 Mr. F. C. Jordan discusses the orbit of π Andromedæ from measures of 111 plates taken with the Mellon spectrograph between August, 1907, and October, 1909, and derives a period of 143·67 days. A point of special interest is that this binary is a helium star with a long period, and it has been shown that helium binaries are sharply divided into long and short periods. The latter are generally less than one month, whilst the shortest of the former class is 116 days. The increase of eccentricity with period is also notable, the mean periods for the two groups being 8·38 and 147·1 days, whilst the corresponding mean eccentricities are 0·19 and 0·41 respectively. π Andromedæ is a notable example, the eccentricity of its orbit being 0·58. The point is a very striking one, but the data are, as yet, too meagre to warrant speculation concerning its possible significance.

THE DISCOVERY OF KEPLER'S LAWS.—The history of Kepler's labours in working out his three laws of planetary motions is interestingly told by M. Bigourdan in No. 23 of the *Revue générale des Sciences*. Refused as a divine, Kepler pursued his study of mathematics, and was appointed professor at Gratz in 1594, then being twenty-three years of age. But in 1599 he was, as a Protestant, expelled from Styria, and accepted a post under Tycho Brahe. For a number of years he endeavoured to fit Tycho Brahe's wonderfully accurate observations into the geocentric system which the latter upheld, but without success, for there was always a residual error in latitude of 8′ or 9′, and this amount Kepler believed to be impossible in such careful observations. Then, after the master's death, he worked away at the heliocentric idea, and succeeded, eventually, in discovering the laws which are the basis of our knowledge of orbital motions. In his paper M. Bigourdan introduces many other points of interest concerning Kepler's life and methods.

BRIGHT BOLIDES.—The apparitions of several bright bolides during the latter part of 1910 are recorded in Nos. 37–38 of the *Gazette astronomique* by M. Birkenstock, director of the Bureau Central Météorique. One, recorded by several observers at different stations, appeared about 8.45 (C.E.T.) on August 19, and, as seen at Novi, was about three-quarters the size of the full moon; it then split into two parts, each half the size of the moon, and, leaving a train, disappeared after a flight which lasted three seconds. Other bolides were recorded on September 9 and 23, and October 8.

THE ASTROGRAPHIC CATALOGUE, CATANIA ZONES.—We have received part i., vol. vii., of the Catania astrographic catalogue, giving the positions of 8855 stars. These have been determined from fifteen plates covering the region oh. to 3h. in R.A., and +52° to +54° in declination; excluding repetitions, the net number of new positions is 7872. Tables for the geometrical corrections for zone +53°, with their arguments, and ten-year precession constants up to the year 2000, are also given.

CONFERENCES OF MATHEMATICAL TEACHERS AND OF PUBLIC SCHOOL SCIENCE MASTERS.

THE annual meeting of the Mathematical Association was held at the London Day Training College on January 11, and the science masters met in the same building on January 11 and 12. The officials of the college and of the respective associations made admirable arrangements, which conduced to the success of the gatherings both from the working and the social aspects.

Prof. H. H. Turner presided at the mathematical meetings, and in his address gave a historical *résumé* of the recent advance of "the astronomical regiment" under the leadership of Pickering, Stratton, Perrine, Melotte, and Cowell. He described the discoveries of the new satellites of Saturn and Jupiter, and the revelations into the past of planets which resulted from an examination of the orbits of these satellites. The members present, mostly teachers in schools, were greatly interested in the "news from the front" of the mathematical army. The annual report showed a large increase in membership and an expansion of the *Mathematical Gazette*.

Mr. G. Goodwill read a paper on the teaching of elementary mechanics, in which he recommended that dynamics should precede statics, and that the idea of change of velocity should be treated as a basal concept necessary for a proper approach to the subject. He showed an extremely simple ballistic pendulum used for measurements of change of momentum. By abandoning the usual uniplanar arrangement, he has at once simplified the exercises and tangibly increased their didactic value.

Canon J. M. Wilson described two fragments of ancient geometrical treatises found in the Worcester Cathedral Library. The first was written by Gerbert, who became Pope Sylvester II. in 979. At that time Euclid was known only to the Moors, and Gerbert failed in his attempt to enter the University of Granada. The second fragment dated from the early part of the twelfth century, and was written by a monk of Bath named Adelhard or Æthelhard. He succeeded in learning Arabic and entering the Universities of Granada, Cordova, and Seville by professing to be a Mohammedan. The fragment discovered by Canon Wilson proved to be part of a translation of Euclid from the Arabic into Latin. This translation was used in all the schools of Europe until 1583, when Euclid's own Greek text became known.

Mr. A. W. Siddons presented an important report by the Mathematical Association Committee "On the Teaching of Algebra and Trigonometry" (published by Bell and Sons, price 3*d*.). The report dealt with the function of algebra in the school curriculum for boys who were not likely to specialise in mathematics, and aimed particularly at giving teachers opportunity to develop with their pupils mathematical ideas of great educational value—ideas drawn from mechanics, mensuration, solid geometry, infinitesimal calculus, and more especially from numerical trigonometry. Mr. F. W. Dobbs (Eton) thought the recommendations went too far, whereas Mr. Barnard said that the Rugby masters thought the suggested syllabus was inadequate. Other speakers supported the views of the authors, and the general effect of the discussion was to strengthen the hands of the committee and to endorse their conclusions. The meeting referred to the committee a paper read by Mr. C. V. Durell, who urged that much commercial arithmetic should be omitted in order to find time for work more productive of mathematical intelligence.

Among interesting exhibits were a projection of the earth's surface on a cube, shown by Prof. Turner, a celestial cylinder by Dr. T. P. Nunn, and apparatus illustrating Mr. Goodwill's paper. Prof. E. W. Hobson has accepted the office of president for the coming year.

Sir E. Ray Lankester opened the science masters' meeting with an address upon "Compulsory Science *versus* Compulsory Greek." The main question he desired to raise was whether the right choice of subjects for study was made in our public schools, and whether it was right and proper, as he should suggest, to cease altogether the cumbrous efforts to teach the Greek language to schoolboys and to substitute for it as a regular and necessary part of the curriculum a well-considered, duly adapted, and skilfully designed course of instruction in natural science—using that term in the most comprehensive sense. The results of education were not transmitted by physiological heredity. Every individual born had to begin its education on a blank sheet. But man had created for himself a gigantic and overpowering possession, a sort of physical envelope of customs, taboos, traditions, laws and knowledge, which, though not transmitted to new individuals at birth as part of their structure, was yet a heritage by which man was educated. This heritage was put into his possession by gesture; by word spoken, written, or printed; by law; by the training given in the nursery and school; and by the experience of life. Individuals did not start equal, and it was the business of the educator to ascertain the various degrees of educability in the young and to adapt the course of education administered to them to their varying aptitudes. The well-educated man was he who had been enabled most fully to benefit by the accumulated inheritance of human knowledge and experience, and to enter on manhood as the heir of all the ages. The true Greek spirit was

realised, was, in fact, reborn, and existed in our present phase of civilisation in the splendid creations and the self-reliant, hopeful, and sober enthusiasm of the men of science of the nineteenth century. The Greeks, were they able to visit us now, would have nothing but contempt for our Greek compulsionists. At the conclusion of his address he proposed a possible and desirable course of school education when compulsory science had banished the usurper—compulsory Greek.

Sir William Tilden, in proposing a vote of thanks, pointed out the advances made in the schools during recent years, and mentioned that the boys who were compelled to learn Greek were fewer than those obliged to study science.

Sir J. J. Thomson was elected president for the coming year.

Mr. A. Vassall read a paper on the education of medical students, and explained the powers which the General Medical Council actually possess, and referred to further powers to which the General Medical Council appear to lay claim. He deprecated any attempt on the part of the Medical Council to dictate a syllabus of general, as distinct from technical, education. Prof. Osler, in the course of the discussion, supported the view that the early scientific training of medical students could be undertaken by public schools.

In his paper on the experimental determination of the equivalent of magnesium, Mr. W. M. Hooton explained the complex reactions which actually occur when magnesium is heated in a porcelain crucible. As usually performed, the products include, in addition to the oxide of the metal, magnesium nitride and silicide, carbon, and possibly silicon. We should like to see more papers of this type, for there are many text-book exercises in vogue, both in class and in examinations, which call for careful revision. Mr. Hooton did not only succeed in the analytical investigation—he further developed a revised and satisfactory manner of performing this quantitative exercise which is of considerable value in an elementary course.

A good discussion was evoked by Mr. Eggar's paper on teaching English in connection with science lessons. The opener and Mr. Lewis, who followed, dwelt mainly on the faults prevalent in boys' notes, but subsequent speakers offered constructive suggestions for improvement. Prof. R. A. Gregory asked that more prominence be given to the romance of science. Scientific work of the last ten years had been concentrated on the drudgery of the laboratory, and the inspiration of early days had been neglected. This neglect was detrimental to scientific progress, and he wished schools more effectually to cultivate interest in the higher aspects of science. Dr. Gow (Westminster) said that the difficulty in regard to accurate language was felt in every branch of school teaching. After a long and interesting debate, the chairman suggested the possibility of a correlation report, to be drawn up in association with teachers of English.

Another useful debate arose on the question of "Wave Theory *versus* Rays" in the teaching of light, the respective protagonists being Mr. J. Talbot and Mr. C. F. Mott. Dr. T. P. Nunn uttered a needed *caveat* against dogmatic exposition of ideas relating to the æther, and showed how simply some of the most useful formulæ of optics could be obtained by heuristic lessons without unverified assumptions. The outcome of the discussion appeared to us to be that it was possible to secure the presentation of useful concepts of the wave theory to a class of boys of age sixteen, and that the process was valuable educationally.

Mr. R. W. Sloley contributed a paper on teaching concepts of energy and potential.

The exhibition of scientific apparatus and books was of large extent and good quality. Twelve of the best known firms in the trade had arranged extensive exhibits, which included not a few novelties. There were also about forty pieces of apparatus contributed by the members of the association, in some instances the handiwork of pupils. Half a dozen leading publishers sent their latest books on science subjects, and it was satisfactory to note the large proportion of advanced books which were shown. Most of the members and guests devoted a considerable time to the examination of the exhibits, which were well displayed, and suggested many practical aids to work in laboratory and lecture-room.

In promoting social intercourse among science and mathematical masters from various parts of the country, this year's congress was even more successful than its predecessors. Much of the credit for this must be given to Mr. D. J. P. Berridge, who is retiring from the office of honorary secretary after giving to the Public School Science Masters' Association several years of hard, successful work. G. F. D.

GEOLOGY OF THE BRITISH ISLES.

AMONG the later memoirs of the Geological Survey of Great Britain, for which Mr. T. Fisher Unwin is wholesale agent, is that accompanying Sheet 142 of the 1-inch map, on "The Geology of the Melton Mowbray District and South-east Nottinghamshire," by Messrs. Lamplugh, Gibson, Wedd, Sherlock, and Smith (price 2*s*. 3*d*.). The map (price 1*s*. 6*d*.) is a good one for showing the irregular distribution of boulder-clay across the ridge of Middle Lias, and its cessation in the Vale of Belvoir. Rhætic beds are recognised above the "tea-green marls" of the Keuper in the north and west. In the memoir it is pointed out that the Vale of Belvoir must have lain in the glaciated region, but was an area of stripping rather than of accumulation. Melton Mowbray probably stands over a concealed coalfield, which has been proved by borings to the north-west, and which may extend far to the south-east.

The tenth part of "The Geology of the South Wales Coalfield" has also been issued by the Survey, and is written by Messrs. Strahan, Cantrill, Dixon, and Thomas (price 2*s*.). It accompanies Sheet 229 of the map, which appears both in "solid" and drift editions. Part of the area was surveyed by Mr. B. S. N. Wilkinson, now senior geologist on the Irish Survey. The features of economic importance are dealt with in the description of the coalfield, which appears in the south-east of the map, and in chapter xv., on metallic ores, building stones, &c. The subdivisions of the Ordovician strata, including the Llanvirn series, are now shown in considerable detail on the colour-printed map, and Upper Tremadoc beds are also recognised in a band south of Carmarthen town. The Old Red Sandstone makes distinctly hilly country along the coast, and is cut across its strike by the main streams. The journey westward from Kidwelly thus involves two picturesque but sometimes breezy ferries, while the railway runs in milder Ordovician country to the north. The drift map shows patchy remnants of a sheet of boulder-clay, deposited by ice moving westward and southward down the Towy Valley, but disregarding its local windings. In the extreme west of the area ice probably came in from the north-west. It is suggested (p. 147) that the chalk-flints which are fairly common in the glacial gravels were derived from Cainozoic deposits which have been swept away.

Messrs. Lamplugh and Gibson have described "The Geology of the Country around Nottingham" (1910, price 2*s*.), with an accompanying map, specially composed of parts of four sheets (price 1*s*. 6*d*.). Attention is directed to points where local research is still required, a feature of the memoir that will be welcomed in a district famous for its amateur geologists. This official work has, indeed, been undertaken in an educational spirit, and is certain to meet with a gratifying response.

Mr. H. J. Osborne White writes on "The Geology of the Country around Alresford" (1910, price 2*s*.), and a colour-printed reproduction (price 1*s*. 6*d*.) is now issued of the drift-sheet No. 300, first published in 1898. The district lies on the edge of the chalk of Salisbury Plain, which is followed so picturesquely on the east by the high commons of the Lower Greensand beyond Lyss and Kingsley. A memoir describing the country that includes the village of Selborne, nestling in its vale at the foot of the Lower Chalk escarpment, will appeal to many naturalists. Mr. O. White pays special attention to the zoning of the Chalk. Types of soil and questions of water supply are dealt with in the concluding pages, and there are some interesting notes on river-capture (pp. 74 and 75).

The valuable series of memoirs on water supply is continued by one on Oxfordshire, by Mr. R. H. Tiddeman (1910, price 2*s*. 3*d*.), and one on Hampshire and the Isle of Wight, by Mr. W. Whitaker (1910, price 5*s*.). Dr. H. R. Mill contributes the chapters on the rainfall of the areas.

The Survey's "Summary of Progress" for 1909 (1910, price 1*s*.) contains, as usual, a record of new observations, of which further details may be expected later. A number of Devonian inliers have been found in the Culm-measure area west of Dartmoor. Mr. Clement Reid is prepared to correlate the well-known Bovey beds, with which even Playfair was acquainted, with the lignites of the Rhine, and to assign them to the Upper Oligocene. They thus fill a gap in British geology above the Hamstead beds of the Hampshire basin. "The Bovey flora . . . seems to be essentially the flora of the granite-ravines, with the admixture of a very few aquatic forms. . . . Marsh-plants are exceedingly rare" (p. 18). The additions to our knowledge of the Isle of Mull are conspicuous (pp. 26–38). Upper Lias and Middle Jurassic beds have now been discovered on Loch Don, thus filling part of the gap that occurs at Carsaig between the representatives of the Jurassic and the Cretaceous (see also p. 57). "Cornstones" in the Trias of Morvern (p. 35) indicate arid conditions; and Mr. Maufe's tropical experiences are here used to advantage. Detailed analyses of Devonshire clays, derived from granite, are given on p. 59. The titanium dioxide is usually more than 1 per cent., while zirconia and vanadium sesquioxide are each about 0·03 per cent.

Mr. L. Richardson contributes an elaborate and well-illustrated paper on "The Inferior Oolite and contiguous Deposits of the South Cotteswolds" to the Proceedings of the Cotteswold Naturalists' Field Club, vol. xvii., 1910, p. 63. He also discusses some of the hollows on the Cotteswold scarp in a paper on glacial features (*ibid*., p. 40), and shows how the Ice age has probably left its traces in the land-forms here, as in North Wales. Mr. Richardson read his paper in 1909, and about the same time Prof. W. M. Davis, to whose work on Snowdon he refers, contributed a short paper on "The Valleys of the Cotswold Hills" to the Proceedings of the Geologists' Association (vol. xxi., p. 150). He points out that "when the curves of a stream are too small for the curves of its valley, a diminution of stream volume is to be inferred." The Evenlode and other valleys on the back of the Cotteswolds are too large for their present streams, and this may be due to their beheading by the recession of the escarpment. But the author suggests that they may formerly have been occupied by water escaping from small lakes between an ice-front in the Liassic lowland and the face of the Cotteswold cuesta. Such water would select the pre-glacial valleys, and would enlarge them.

In the same journal (vol. xxi., p. 333) Messrs. C. R. Bower and J. R. Farmery add to our knowledge of "The Zones of the Lower Chalk of Lincolnshire," working upwards from the top of the Red Chalk or Hunstanton Limestone. They see cause to differ as to the selection of zone-fossils made by previous writers, and choose, going upwards, *Holaster subglobosus*, *Terebratulina ornata*, and *Holaster trecensis*. Forty-three species are added to the records from these beds, and a plate is given to show the range of form in *Discoidea cylindrica*, from a pentagonal type in the lower zone to a flattened one, with a circular base, in the upper zone. Messrs. J. G. Hamling and T. Rogers (*ibid*., 1910, p. 451) furnish a new coloured geological map of North Devon, on the scale of three-quarters of an inch to one mile.

In the same volume of the Proceedings of the Geologists' Association, p. 489, Mr. M. A. C. Hinton summarises his work on the British fossil voles and lemmings, and makes some very interesting remarks on the climatic conditions accompanying the maximum extension of ice in our islands. He regards the "Great Ice Age" in Britain as due to "glaciers formed in the mountainous districts," though it is not clear why Britain in this respect should differ so widely from Ireland or Scandinavia. His views are in happy agreement with those of Dr. Scharff as to the survival of Lusitanian members of our fauna through the alleged destructive epoch of maximum glaciation.

Dr. R. F. Scharff (Proc. Royal Irish Academy, vol. xxviii., sect. B, No. 1, price 1*s*.) writes on "The Evidences of a Former Land-bridge between Northern Europe and North America." His paper has a special bearing on the origin of the present flora and fauna of Ireland. The author holds that land-bridges afford the only means by which terrestrial species are permanently transferred to a new habitat. He makes out a good case for the existence of a connection between our islands and America in late Pliocene times, and for the pre-Glacial origin of our flora and fauna. Incidentally, there is much that will interest workers on glacial climate, though the view (p. 5) that "the Glacial period was primarily due to the diversion of oceanic currents" will not explain the simultaneous glaciation of Europe, North America, and the central Andes. The only way out of this difficulty, if we rely on ocean-currents, is to accept, with M. Stanislas Meunier (*Revue des Idées*, September 15, 1910, p. 219), the still more difficult proposition that post-Pliocene glacial phenomena were separated, in various regions, by intervals of several thousands of years.

The Transactions of the Hull Geological Society for 1906–9 (1910, price 2*s*. 6*d*.) show how local observation may be aptly stimulated. Mr. Sheppard most usefully summarises, with numerous illustrations, recent publications bearing on the district. Mr. F. M. Burton has issued a paper on "The Witham and the Ancaster 'Gap'" as a separate publication (London and Hull: Brown and Sons, price 1*s*.). Surely this would have found better circulation through one of the northern scientific journals. Something seems omitted in a critical passage on p. 12, where the "clays of the Upper Lias and beds of Marlstone" are said to have extended eastwards, "cutting through the Lower Oolite at Ancaster, and forming the 'Gap' there."

In the Quarterly Journal of the Geological Society of London, vol. lxvi., part iii., issued in August, 1910, Mr. L. Moysey discusses (p. 329) Brongniart's genus Palæoxyris, as abundantly revealed in the Derbyshire and Nottinghamshire coalfield. The similarly problematic organisms Vetacapsula and Favolia are also found, the former being known only from England. All three genera are believed by the author to be egg-cases of fishes. The society, as is well known, publishes abstracts of the discussions on its papers, a practice that should be universally followed under careful editing. We gather that the types of fish that would produce such egg-cases are practically absent from the beds where the three genera are found, and that botanists may still rise up to claim these quaint elongated bodies.

Miss H. Drew and Miss T. Slater (*ibid*., p. 402) describe the "Geology of the District around Llansawel (Carmarthenshire)," where little has been done since Sedgwick wrote in 1854. The beds described are Gotlandian, and include the whole Birkhill series, followed by Lower Gala beds.

Mr. T. O. Bosworth's work on the metamorphism round the Ross of Mull granite is referred to in the Summary of Progress of the Geological Survey for 1909. He now (Quart. Journ. Geol. Soc., 1910, p. 376) describes the beautiful phenomena of injection of granite along the foliation-flexures and other planes of weakness in the surrounding garnetiferous mica-schists. The latter belong to the Moine series of the Highlands. Groups of well-bounded prisms of sillimanite occur as contact-products in the schists, in addition to the ordinary fibrolitic type. There are some indications in the long and interesting discussion that the views of many Continental observers as to the potency of metamorphism by injection are spreading among workers in the British Isles.

Mr. G. W. Tyrrell, of Glasgow University, has published several papers on the characters of igneous rocks in southern Scotland. Writing on the "Intrusions of the Kilsyth-Croy District, Dumbartonshire" (*Geological Magazine*, 1909, pp. 299 and 359), he points out that the feeders of the laccolite of diabase in this district "appear to cut" the Linlithgowshire intrusive rocks, which have been regarded as of Cainozoic age. Since there is much evidence that the Kilsyth Croy rocks are of post-Carboniferous, but still Palæozoic, date, the Linlithgowshire series to the south must also be late Palæozoic. Micropegmatite veins occur through the diabases, and give cause for an interesting discussion (p. 362) as to their origin in

this and other cases, based on the suggestion of Daly that igneous magmas are essentially basic at the outset. In a paper on "The Classification of the Post-Carboniferous Intrusive Igneous Rocks of the West of Scotland" (Transactions of the Geol. Soc. of Glasgow, vol. xiii., p. 298), Mr. Tyrrell gives a useful account of the distribution of the various types. In cooperation with Mr. N. Martin, he describes the geology of the Auchineden district in the Kilpatrick Hills (*ibid.*, p. 322), and continues (p. 337) with an account of the igneous rocks of the vents and lava-flows. These prove to be olivine-basalts, though the sills were previously thought to be trachytic, on account of their fluidal structure and pale crusts. They belong to the late Palæozoic series. In a notice of rocks near Ballantrae (*ibid.*, p. 283), Mr. Tyrrell points to a granulitic diorite as a dolerite or gabbro metamorphosed by a later intrusion of serpentine. There is a pleasing sense of original outlook in these papers.

The Geological Survey of Ireland has issued a memoir by Messrs. Kilroe, Hallissy, and Seymour on the soils of the agricultural station at Ballyhaise (price 1*s.* 6*d.*), accompanied by a map showing types of soil and the underlying rocks, on the scale of eight inches to one mile. The methods adopted by this Survey for the examination of soils are fully stated. Another memoir, by Messrs. G. A. J. Cole and T. Crook (price 1*s.* 6*d.*), describes the submarine geology of the west coast of Ireland, so far as it can be known from the numerous rock-specimens dredged up by the official Fishery Survey. The amount of mingling of material by glacial drift-action appears to be very small on the west coast. Areas of Upper Cretaceous and Cainozoic limestone are indicated off the Kerry coast. As in the Ballyhaise memoir, a coloured map is included in the publication.

Prof. Cole describes (Proc. R. Irish Acad., vol. xxviii., sect. B, 1910, p. 113, price 6*d.*) the phenomena of weathering on the surface of a sheet of fine-grained diorite near Rathmullan, in Donegal, which is known as the "picture rock" or "scribed rock." The residual spheroids lie in box-like enclosures, the walls of which result from the toughening of the rock by the development of amphibole inward from its joint-planes.

In the *Irish Naturalist* for September, 1910, the Rosapenna area in northern Donegal is systematically described. Among the papers on its natural history is an excellent one on the geological structure, by Mr. J. de W. Hinch. G. A. J. C.

RUSSIAN MAGNETIC OBSERVATIONS.

UNDER the title "Die Variationen des Erdmagnetismus" Prof. Ernst Leyst has written a paper, occupying 250 pages and four plates, in the *Bulletin de la Société Impériale des Naturalistes de Moscou* for 1909. It deals with magnetic data from the Russian observatories at Pavlovsk (St. Petersburg), Irkutsk, and Katharinenburg, and with some corresponding data from Potsdam and Greenwich. The paper contains valuable statistical data for Pavlovsk, such as the secular changes of all the magnetic elements from 1873 to 1906, and diurnal inequalities derived from a 33-year period. Its main object, however, is to investigate the relations borne to terrestrial magnetism by sun-spot frequency and barometric pressure. A number of the data bearing on the sun-spot connection should be useful, such as diurnal inequalities in years of sun-spot maximum and minimum at the several stations. But their utility would have been greater if the numerical relationships between magnetic and solar phenomena had been gone into more critically. A good deal has been already done on these lines, even for some of the stations considered by Dr. Leyst, of which he seems unaware.

The parts of the memoir having a chief claim to novelty relate to the influence of sun-spot frequency on secular change and on the annual inequality, and to the relation between barometric pressure and the diurnal variations. Dr. Leyst finds secular change of declination to be more rapid near sun-spot maximum than near sun-spot minimum at all the stations included in his research except Katharinenburg. For the ratio borne by the rate of secular change at sun-spot maximum to that at sun-spot minimum he finds nearly 2 : 1 at Greenwich and more than 3 : 1 at Irkutsk. In the case of the annual inequality—*i.e.* the variation shown in the mean monthly values after elimination of the secular change—he concludes in pp. 206–7 that the range is increased at sun-spot maximum for declination and inclination, but diminished for total force. As regards barometric pressure, Dr. Leyst finds the range of the magnetic daily oscillations, both regular and irregular, at Pavlovsk to be larger on days of highest barometric pressure than on those of lowest pressure, the phenomenon being specially conspicuous near sun-spot maximum.

The author's zeal, as evidenced by the great amount of labour expended in his investigations, merits warm appreciation. One's confidence, however, in his conclusions would have been greater if the work had shown more distinct evidence of critical insight.

Lines of no secular change seem to traverse continents with continuous velocity. Their passage must occur at some stations in sun-spot maximum, and at others in sun-spot minimum, and must mark in either case a time when secular change numerically considered is a minimum. In short, secular change, while seldom varying rapidly with the geographical coordinates, is essentially a local phenomenon, whereas sun-spot frequency is not. The secular change results assigned by Dr. Leyst to Greenwich are certainly not fairly representative of sun-spot maximum and minimum there. They show not the least resemblance to some which the present writer has deduced for Kew from the longer period 1860–1909. If a difference of the kind supposed by Dr. Leyst does exist, it is in England, at least, of a comparatively trifling character. As to the annual inequality, that of declination—the element which ought to possess least uncertainty—presents the suspicious features that the ranges obtained have usually diminished as the number of years included was lengthened, while the types obtained at comparatively near stations have differed. In Dr. Leyst's case the results are derived from only two or three groups of three-year periods at either sun-spot maximum or sun-spot minimum, so that more than usual uncertainty attaches to the elimination of the secular change. Of all Dr. Leyst's conclusions, that as to the relations between the diurnal variations and the barometric pressure is undoubtedly the most remarkable. The figures which he gives for declination and horizontal force show during summer, not a small, but a large difference between the ranges of the diurnal inequality and the absolute ranges (absolute maximum less absolute minimum) on days of highest and on days of lowest barometer at Pavlovsk. In winter the phenomenon is much less apparent, which leads the author to regard the case as one of association and not of direct cause and effect.

If confirmed, the result, it need hardly be said, would be of great theoretical importance. A matured opinion on the question could be attained only by a minute study of observational data. Thus an independent investigation of data from some second observatory by a competent critic is to be desired. Several theoretical considerations naturally present themselves. Large absolute magnetic ranges are intimately associated with highly disturbed conditions, and such conditions are normally, at least, not local. High or low barometric pressure, on the other hand, is an essentially local phenomenon. A high at St. Petersburg means a low somewhere else, often even within the confines of Europe. If there is any such general association as Dr. Leyst supposes, a high barometer at Pavlovsk must be a symptom of a special set of conditions affecting an area much larger than that the barometric pressure of which is above the average. C. CHREE.

THE MICHAEL SARS *NORTH ATLANTIC DEEP-SEA EXPEDITION*, 1910.[1]

IN August, 1910, Sir John Murray offered to defray the expenses of an expedition to the North Atlantic with the Norwegian research steamer *Michael Sars*. The Norwegian Government, too, showed itself very indulgent towards the enterprise, and placed the vessel entirely at our disposition; and my colleagues, who have so long

[1] From a paper read before the Royal Geographical Society on January 16 by Dr. Johan Hjort.

taken part in these researches, Prof. H. H. Gran, Dr. Helland-Hansen, Mr. E. Koefoed, and Captain Thor Iversen, all signified their utmost willingness to join the expedition.

On completing our preparations, we started off from Plymouth in the beginning of April, 1910, after being joined by Sir John Murray at that port.

During the four months that the cruise lasted, a great deal was accomplished. For oceanographic science it cannot but be interesting to learn that a little steamer, of only 226 tons, could carry out so many and such multifarious researches right across one of the mighty oceans, and I will accordingly give a few figures to illustrate what was done.

In the case of hydrographical material, we collected 2400 water-samples, more than 900 of which were from below the surface. At 110 stations we took 937 temperature observations from below the surface, while as many as 1625 observations of the surface temperature were recorded during the cruise. In addition, we obtained 258 measurements of currents and seven measurements of light. For the study of vegetable plankton we made 140 vertical hauls, and took 38 water-samples for filtering and 58 samples for examining with the centrifuge. For the larger plankton there were 95 vertical hauls with nets of different sizes, 193 horizontal hauls with silk nets, 80 horizontal hauls with pelagic trawls, and 18 hauls with a very large tow-net. Trawlings were undertaken on twenty-four occasions at different depths.

Our being able to carry out so many investigations, in spite of the fact that the ship traversed a distance of about 11,000 miles during the four months the cruise lasted, shows that oceanographic expeditions can be undertaken in small craft and for a relatively moderate expenditure; and this will most likely be a matter for consideration when future expeditions are planned.

Hydrographical Investigations.

At 110 stations we collected material for determining the temperature and salinity of the sea water. The temperature observations have now been corrected, the water-samples have been titrated, and the results are set down in vertical sections and charts showing the distribution of temperatures and salinities at the different depths. The distribution of temperatures and salinities in the sea between Newfoundland and Ireland in the month of July, 1910, can be shown in a diagram. Throughout nearly the whole section there is a layer with salinities of 35·5 per mille in the uppermost 150–200 metres. Both salinities and temperatures decrease in fairly regular proportion as we descend, until we reach a uniform layer termed "bottom water," in which the temperature is slightly below 2½° C., and the salinity is about 34·9 per mille. It is noteworthy that this salinity is exactly the same as has been found in the bottom water of the Norwegian sea during the previous investigations. During the cruise of the *Michael Sars* in the Atlantic, this same salinity has been discovered both between the Canary Islands and the Azores, and between the Azores and Newfoundland, and also outside the Bay of Biscay.

This uniform bottom water lies deeper in the eastern portion of the North Atlantic, off the south coast of Europe and the north coast of Africa, than in the western or north-western portion of the coast of America. East of Newfoundland it attains a comparatively high level. This would seem to indicate that the bottom water of the North Atlantic comes from the north-western portion of that ocean.

A chart shows clearly the influence of the Mediterranean; very salt and comparatively warm water streams out of the Mediterranean and sinks deeper down; outside Spain it mainly flows northwards, owing to the effect of the earth's rotation; another portion seems to follow the ordinary stream towards the south-west. Between the comparatively fresh cold water in the north-west and the relatively warm salt water outside Spain a belt extends from west of the Azores as far as the Faröes and Iceland, with fairly uniform salinities of 35 to 35·5 per mille, and temperatures of 6° to 8° C.

When we compare our temperatures with those of the *Challenger*, we find that they agree most satisfactorily, so far as the deep layers are concerned, and the temperature observations of the *Challenger* seem to have been very good. When we look at all the stations from the cruise of the *Challenger* in the summer of 1873, which are situated in the neighbourhood of the *Michael Sars'* stations of a summer thirty-seven years later, we find everywhere that the water in the mid-layers was much warmer in 1873 than in 1910. The differences of temperature go up to about 5° in the mid water-layers, but sink to 0·1° and 0·4°, respectively, in deep water. This seems to indicate that there are such very great fluctuations from year to year in the degree of warmth in these mid-layers that they even exceed the fluctuations in the seasons.

It is obvious that fluctuations of this kind in the degree of warmth of the Atlantic Ocean are most important, and need further investigation. In the Norwegian Sea such fluctuations in water flowing in from the Atlantic have been already previously investigated by the *Michael Sars*.

These determinations of the temperatures and salinities of salt water will subsequently be utilised for dynamic calculations. It will thus be possible to draw conclusions as to the movements of the different water-layers. These movements the expedition endeavoured also to investigate by means of direct-current measurements with the propeller current-meter which Ekman has constructed.

In the Strait of Gibraltar we tried first to anchor one of the lifeboats fore and aft, as had often been done previously in Norwegian waters. However, the strong current broke the lines repeatedly. We accordingly anchored the ship itself, with 1½-inch steel wire and a warp anchor, in about 200 fathoms. The ship lay thus on April 30 from 2.30 a.m. until 5 p.m. During this time we took seventy measurements at eight different depths.

A comparison of diagrams representing the conditions at 9 a.m., when the inflow into the Mediterranean was at its height, and at 2 o'clock in the morning and 3 o'clock in the afternoon, shows that the effects of the tidal water are very great throughout the whole mass of water from the surface to the bottom. During the inflow, the velocity in the upper instreaming layer was about 1 metre per second, while in the lowest west-flowing layer it did not exceed one-third metre. During the outflow from the Mediterranean to the Atlantic there was hardly any surface current, whereas the outward current at depth had a velocity of up to 2 metres per second. The real velocities were actually greater, as the current generally ran in a slightly oblique direction to the axis of the strait.

During our experiments with the large otter trawl on the bank south of the Azores on June 12, our trawl stuck fast on the bottom. Instead of immediately getting it clear, this otherwise unfortunate circumstance was made use of for taking current measurements. The ship was thus anchored to the trawl at a depth of 668 fathoms (1235 metres). In all, we took ninety measurements at various depths down to 800 metres. On a diagram showing the current from hour to hour at a depth of 10 metres, the tidal movements can be distinctly seen. The actual main current ran southwards with a velocity of 8–9 cm. per second. Another diagram shows the currents in the different layers at three intervals of time:—(1) at 3.30 a.m.; (2) at 7 a.m.; (3) at 10.45 a.m. A comparison of the three figures shows that at all the depths down so far as 800 metres there were tidal movements. On the whole, the currents in the deeper layers flowed in a contrary direction to the movements in the upper ones. There was an astonishingly strong current at 800 metres at 3.30 a.m., but otherwise we found, as a rule, that the current was strongest close to the surface, while at 100 metres there was a tendency to a minimum, and a tendency to a maximum at 200 metres.

The measurements show, accordingly, that there can be very considerable tidal currents even down so low as 800 metres. The reason why they were so strong south of the Azores is probably to a great extent that the bottom there forms a large shoal, which the water presses up against.

Similar investigations with modern methods have never been undertaken before either in deep water or in the Strait of Gibraltar.

That there are tidal movements in the open sea and such strong currents, even at depths above 400 fathoms (800 metres), is interesting for many reasons, as it assists us in understanding the ocean currents, the tide-wave, the

distribution of living organisms, and the deposits along the bottom of the sea.

It has long been a puzzle to find that at great depths in the sea there are stones which are not covered by deposits, though they must undoubtedly have lain at the bottom for a long period of time. On the slopes of the coast banks south-west of Ireland, we shot our trawl in about 1000 fathoms (1797 metres), and found, *inter alia*, numbers of stones.

Sir John Murray has given them to Dr. Peach for examination. As mentioned in Sir John Murray's lecture to the Royal Geographical Society in Edinburgh on November 11, 1910, Dr. Peach "reports that fully 20 per cent. are glaciated fragments. They consist of granite, gneiss, shales, sandstones, chalks, limestones, and flints, and some of these contain fossil remains. The condition of these fragments shows that in many instances they projected above the surface of the deposit in which they were embedded. Dr. Peach has no doubt that these stones were carried by ice during the later phases of the Glacial period to the position in which they were found. They almost all belong to the series of sedimentary, metamorphosed, and erupted rocks now found *in situ* in this country and in Ireland. But the interesting question is, Why have these fragments not been completely covered up by the shells which are continually falling from the surface? Telegraph engineers give reasons for believing that in some localities and depths the rate of accumulation is at least 1 inch in ten years; at this rate all rock fragments deposited during the Glacial period should have been buried in the ooze far beyond the reach of the trawl. Most probably the tidal currents, which our observations showed to exist in deep water, extend right down to the bottom and remove the small Globigerina shells from any ridges. Still, there may be other explanations of the facts" (*Scottish Geographical Magazine*, December, 1910).

Phytoplankton.

The phytoplankton of the Atlantic Ocean, in so far as it can be collected with tow-nets, we know from Hensen's expedition in 1889, the results of which, by the way, have not yet been fully treated; further, from the extensive researches of Cleve. We have also received a valuable contribution from G. Murray and Whitting; the *Valdivia* expedition, carried out by the greater part of its investigations in the Antarctic and Indian Oceans, the researches in the Atlantic being comparatively few. Our knowledge regarding the distribution of species in the Atlantic is, notwithstanding, still very incomplete.

The samples taken by tow-nets in the open sea could not, any of them, compare in quantity with what can be obtained in the coastal waters in the Norwegian Sea. The only exceptions are the series taken to the west of Ireland and in the Bay of Biscay during April (stations 2, 3, 4, 7, 9, 10), where we met with large quantities of diatoms, even down to depths of more than 100 metres.

The oceanic samples are, however, very rich in species, there being, as a rule, at least fifty species in every single sample from the upper layers down to a depth of 100 metres. Many of the species are so sparsely represented that it has only been possible to find a few individuals, but the majority of them have, in spite of their scanty numbers, a wide distribution throughout the warm seas, and they have also been found in the Indian Ocean (*Valdivia*) and the Pacific (Kofoid). A few of them have not yet been described, though most of them are known from previous investigations. It will be a difficult matter to characterise the groups of species according to their geographical distribution within the area investigated; it can perhaps be done when our material has been fully treated, but certainly not as yet. All we can do at present is to distinguish the subtropical species from those which belong to temperate waters, and the oceanic species from the ones which have their centre of distribution along the coasts.

[The lecturer mentioned some instances of the occurrence of interesting forms belonging to the most important plankton-algæ, and then described more particularly the most important botanical discovery of the expedition, that by centrifuging the sea-water large numbers of very small algæ, mostly Coccolithophoridæ, were found. These go through the meshes of the tow-nets, and have therefore not been considered by previous expeditions which only used tow-nets, notwithstanding that Sir John Murray, during the *Challenger* expedition, had directed attention to their importance.]

To sum up, the chief results are as follows:—

(1) The quantity of plankton in the open Atlantic is far less abundant than what is found in coastal seas.

(2) At most of the stations where investigations took place, the maximum of plant-substance was found at about 50 metres' depth; it was, as a rule, scanty in the immediate neighbourhood of the surface, but appeared to be almost as abundant at 10 metres as at 50 metres. There was thus about the same quantity of plants all the way down from 10 metres to 50 metres.

At 75 metres the quantity was, as a rule, not more than half what we met with at 50 metres, and at 100 metres there was only about a tenth part.

This was the case with oceanic water. Where there was an admixture of coastal water, and an evident distinction between the surface layer at depth, the surface layer was comparatively richer in plants, and all the limits had an upward tendency.

(3) The different species are distributed, each in its own characteristic fashion, in regard to depth. The Peridinea keep comparatively near the surface, the diatoms prefer the deepest layers, while the Coccolithophoridæ affect an intermediate position.

(4) The number of living plant cells in the open Atlantic throughout the most densely populated water-layers (10–50 metres) varies, as a rule, between 3000 and 12,000 cells per litre sea water. Of these, about half are Coccolithophoridæ, the rest being Peridinea cells with a few naked flagellates and a sprinkling of diatoms.

The Larger Organisms.

Deep-sea Fishes and Crustaceans.

Since the *Challenger* expedition laid the first foundation of our knowledge regarding the animal world of the deep sea, many succeeding expeditions have bountifully added to our store. As an instance, I may mention that we now know one thousand different species of deep-sea fishes, and that the German *Valdivia* expedition alone discovered no fewer than sixty-three new species.

Regarding these many species, however, only very little is known. In the case of quite a number of them we are acquainted merely with one, or at most a few specimens, while we are in almost complete ignorance as to their biology, their propagation, development history, growth, and outward conditions of life.

The view which generally prevails in literature nowadays is that the sea contains a motley abundance of forms either along its bottom or floating within its waters, subject to a uniformity of outward conditions of existence—that is to say, passing their lives in absolute darkness—and in a medium with constant temperatures and other physical surroundings.

To biologists, this view concerning the animal life of the deep sea has presented many difficulties. How is it that in a constant medium of the kind conceived there exist side by side so many distinct forms? And how, again, can animals with large eyes manage to live alongside blind forms? Why are some species furnished with numerous highly developed light-organs, while in the case of others these are entirely wanting? And how, too, comes it that within the same groups of animals, nay, often in closely affinitive species, the colours vary so remarkably, although the outer medium is the same?

These questions have become all the more pressing now that biological ocean research has discovered instances where in the same area of the sea there occur many different animal forms, each possessed of its own peculiarities in mode of life, habitat, and other respects, so that each species has its own characteristic area of distribution, even though it may occasionally be found together with its neighbours in the same catch. Our study of the spawning-grounds of the cod family (Gadidæ) in the North Sea and Norwegian Sea has shown us, for instance, that each of seventeen species has its particular spawning area, each species during the spawning period seeking out distinct characteristic depths, temperatures, and salinities,

so that, just as from a morphological point of view the species may be characterised by a definite form or structure, so, too, it is possible to characterise it by certain well-defined conditions of existence. These conditions characterise a given species quite as much as any morphological description, and, in fact, for a proper conception of the species both methods of investigation are supplementary.

Now, if we wish to investigate the conditions of existence under which animals live, we must naturally first of all ascertain where they live, which, in the sea, will be tantamount to discovering the depth where they reside. This alone can enlighten us regarding the conditions of light, the temperatures, and the salinities which are requisite for their existence.

Our knowledge regarding the haunts of the smaller organisms has advanced greatly in recent years owing to the fact that we have made use of small closing nets. But, with regard to the larger animals, especially fishes, we still possess little knowledge, despite the great exertions made in this direction, above all others, by the Prince of Monaco and the *Valdivia* expedition.

When fitting out the *Michael Sars* expedition, I kept ever in mind that one of the most important of all our aims should be to try and develop a method which would yield more information regarding the vertical distribution of deep-sea fishes.

The ideal instrument for capturing the larger pelagic organisms would be a big tow-net or pelagic trawl which could be sunk closed to the requisite depth, then opened and towed at a carefully ascertained depth, and finally closed again and hauled in. Such an instrument would be capable of capturing many of the larger animals, and it would secure them, too, at known depths. However, an instrument of this kind would naturally be extremely complicated, too much so, in fact, to prove trustworthy under our present system of working, and it would further entail a great expenditure of time. It would not be possible to operate many of these tow-nets simultaneously (amongst other reasons, because of the slip-leads), and consequently it would be necessary to undertake a series of hauls at the different depths.

This being the case, I gave up the idea of trying to construct any such instrument. A more practical plan seemed to be to try and tow a number of instruments simultaneously at different depths, and to compare the catches thus made with each other.

Thanks to a practical arrangement, we succeeded in towing ten different instruments from two wire lines. The arrangement generally adopted was as follows:—

At the surface	1 silk net of 1 metre diameter
,, 50 metres... ...	1 ,, ,, ,,
,, 100 ,, ...	1 ,, ,, ,,
,, 150 ,, ...	1 young-fish trawl
,, 300 ,, ...	1 silk net of ¾ metres diameter
,, 500 ,, ...	1 young-fish trawl
,, 750 ,, ...	1 silk net of ¾ metres diameter
,, 1000 ,, ...	1 young-fish trawl
,, 1250 ,, ...	1 silk net of ¾ metres diameter
,, 1500 ,, ...	1 large tow-net of 3 metres diameter (made of shrimp-net) or a young-fish trawl

With this, or a corresponding arrangement, we carried out some long hauls at about thirty stations, as well as from the Canary Islands to the Sargasso Sea, and from Newfoundland to Ireland. Some hauls were made in the daytime and others at night.

In this manner we collected a very large material, consisting of many kinds of pelagic organisms—fishes, cephalopods, crustaceans, medusæ, &c. I will here merely mention a few instances of the evidences our material affords as to the occurrence of these animals at different depths. To illustrate the method employed, I will begin with the remarkable and well-known Sternoptychid *Argyropelecus hemigymnus*. Of this species we caught 286 individuals at the different stations. The bulk occurred at depths between 150 and 500 metres; no individuals were caught above 150 metres, and only about 7 per cent. were taken at depths lower than 500 metres. If we assume, then, that these 7 per cent. were captured during the process of hauling in the appliances, and that none of them live at depths below 500 metres, we will have an idea of the accuracy of our method. By far the greater part were caught at a depth of 300 metres, where we generally had out a ¾-metre silk net, whereas at 150 metres and at 500 metres the appliance used was, as a rule, a young-fish trawl, that would have had a far greater capacity for catching these fish. It seems, accordingly, that the preponderating majority of the individuals of this species is very strictly limited to an "intermediary" layer, situated at a depth of about 300 metres. A closer investigation of the individuals captured at a depth of 150 metres shows that they were all caught at night. This may be due either to an upward nocturnal wandering or to chance, though on this question the smallness of our material makes it unsafe to hazard an opinion; in subsequent investigations, however, it will be worth while taking this fact into consideration. Among the individuals captured in 500-metres water there must, at any rate, be a few that were taken in the process of hauling in the young-fish trawl through the intermediary layer above; still, there were far fewer found in the young-fish trawl, which was towed in 1000-metres water—it seems evident that there must also have been some individuals swimming at the 500-metres depth.

This instance gives us a good illustration of our method, with its deficiencies and advantages. It is obvious that the greater the number of individuals we have to deal with, the greater is the probability of obtaining trustworthy information, and the safer are the conclusions we can deduce from our results. When, therefore, in what follows, I proceed to give some instances of the distribution in depth of different kinds of fish, I will begin by mentioning the commonest, or, at any rate, the most numerously captured forms belonging to the species *Cyclothone microdon* and *C. signata*.

Of these two species we caught altogether more than 7500 individuals, which were all measured and arranged according to their length and the instrument in which they were captured, so as also to obtain information regarding the occurrence of the different sizes at different depths.

C. microdon was found during the cruise of the *Michael Sars* in the northern Atlantic at every station where an appliance was towed in depth below 500 metres. Above 500 metres it was only met with occasionally. A table shows how, at a depth of 300 metres, we only came across one individual (in the southern section). In depths from 500 metres down to 1500 metres its quantitative occurrence appears to be fairly uniform.

In our northern as well as in our southern section we found approximately the same number of individuals in each of the three young-fish trawls, which we towed simultaneously, viz. at depths of 500 metres, 1000 metres, and 1500 metres.

When we next examine the size-distribution at the different depths, we see that it is perfectly clear that the smaller sizes are met with much higher up than the larger ones, which latter are mainly to be found at a depth of 1500 metres. In the northern section we find that at a depth of 500 metres the greatest number of individuals were 30 mm. in length, whereas at 1500 metres the majority were 60 mm. At a depth of 500 metres we only came across two that were more than 50 mm. in length.

The smaller and younger individuals, of a length of 20–30 mm., live, accordingly, to a preponderating extent, 1000 metres higher up in the water-layers than the majority of the largest and oldest individuals.

Another remarkable fact which strikes us when we study the table is that the average size of individuals is much smaller at the same depth in the southern than in the northern section.

C. signata resides in an intermediary layer, with maximum in the number of individuals at about 500 metres. In the case of this species, too, we note that the younger individuals are mainly to be found high up in the water (notice particularly the southern stations), and that the same size is to be found deeper in the southern section than in the northern.

We have a remarkable parallel to the areas of vertical distribution of these two fish species in the case of the red-prawn species. These latter unite with the black fishes in forming a populous and characteristic "com-

munity." We have come across no fewer than twenty-six species of prawns, of which we shall here refer to *Acanthephyra multispina* and *A. purpurea*.

A. multispina shared with Cyclothone the peculiarity of the largest and oldest individuals, being found in the nets towed at greatest depths, say at 1000–1500 metres. *A. purpurea* resembles *Cyclothone signata* in that its distribution is chiefly confined to an intermediary layer between 500 metres and 750 metres in depth.

The instances I have given show the utility and exactness of our method of working. Where we have to deal with catches of great numbers of individuals, our errors and inaccuracies will undoubtedly be very small. The catches which the *Michael Sars* made of such forms as Cyclothone and Acanthephyra were certainly most satisfactory in this respect. But when we come to the catches which the expedition made of scarce forms, or forms more difficult to capture, then we are bound to own that the method of working even of the *Michael Sars* is not sufficiently effective. Still, it is interesting to examine a few of the results yielded by the method we employed with the object of discovering some conformity, or some general rule, for the peculiar distribution of the different organisms at different depths.

I will commence with the view I formed during the cruise itself from the appearance of the catches on board, which view I find has also, to a certain extent, forced itself upon other observers, chief amongst whom I may mention Prof. A. Brauer, to whom was confided the treatment of the fishes of the *Valdivia* expedition. I found on examining the catches from great depths that the black and dark-red forms were the all prevailing ones among animals from the greatest depths.

Black-coloured pelagic fishes are few in number, though they might be termed numerous if we take into account what was previously known concerning "scarce" forms. *Gastrostomus bairdii*, Cyemaatrum, and *Gonostoma grande* were only caught at depths from 750 metres downwards. The two species *Gonostoma elongatum* and *Ptotostomias guernei* were caught at great as well as small depths, even in some cases so high up as 150 metres below the surface. The rule, then, that the black forms are only to be found at great depths, cannot be said to hold good universally.

The question accordingly arises whether among the black forms there may not be said to be groups or different types. In common with several previous observers, I have been struck by the fact that even the anatomical structure of the black fishes points to different modes of living. When we compare, for instance, pictures of the above-mentioned five species of fish, we see that, of the three species which were only found at great depths, *Gastrostomus bairdii* and Cyemaatrum are quite without light organs, and *Gonostroma grande* has but small ones, as is also the case with *Cythotlone microdon*. In *Gonostoma elongatum* and *Ptotostomias guernei*, the light organs are much more developed (as is also the case with *Cyclothone signata*). It is an interesting fact now to notice that every single individual of these two species which was captured higher up than 500 metres was caught at night, which coincides with previous observations regarding black forms, such as Idiacanthus and Astronesthes, which have been caught at night right close up to the surface. We may assume, accordingly, that among the black deep-sea fishes there are several different modes of life, that is to say, several different "biological types."

With the view of a better understanding of the occurrence of these black and red types in the sea, I have endeavoured to compare their vertical distribution with the intensity of the sunlight in different depths and at different parts of the ocean.

We have seen that the upper limit for *Cyclothone microdon* and the red crustaceans in the northern section from Newfoundland to Ireland, or about 50° N. lat., was approximately 500 metres below the surface, and we have also noticed that the limit of depth for the same forms at the southernmost stations, or about 33° N. lat., was some 200–300 metres deeper. In the Norwegian Sea I have already previously investigated the intermediary pelagic fauna, and found pelagic red prawns as well as the dark-red fish *Sebastes norvegicus* at depths of about 200 metres below the surface. Sebastes was taken, for instance, with floating long lines in considerable quantities on a course Jan Mayen-Lofoten—that is to say, in about 67° N. lat., at a depth of 200 metres—and it was even found, though in decreasing quantities, higher up. Along the Norwegian coast, in the fjords and sounds, we have a particularly rich fauna of red crustaceans (especially *Pandalus borealis*) residing at depths the maximum of which in the north, at any rate, may be put at about 200 metres. Now, if we calculate the depth to which the rays of the sun penetrate, after passing through the same distance in the water, assuming always that the rays are direct, and that the rate of absorption is the same, we find that the rays will have passed through the same distance to reach a depth of 500 metres in 50° N. lat., that they will pass through to reach 650 metres in 33° N. lat., or 300 metres in 67° N. lat.

However, the transparency of the water varies greatly in different regions. If we take the results of previous observations during different expeditions, we may set down the visible depth in the open sea as being, roughly, 50 metres in 33° N. lat., 40 metres in 50° N. lat., and 25 metres at the outside in the Norwegian Sea in 67° N. lat. Taking this into consideration, we find that there will be the same intensity from the retilinear rays

In 33° N. lat., at about	800	metres'	depth		
,, 50°	,,	,,	500	,,	,,
,, 67°	,,	,,	200	,,	,,

The red and black animal forms, as has been found in the investigations I have just described, have an upper limit in the different waters which corresponds everywhere with the same intensity of light.

During the Atlantic cruise of the *Michael Sars* we undertook a series of measurements of the intensity of light with a photometer constructed by Dr. Helland-Hansen; to determine the intensity of the different colour rays, Dr. Helland-Hansen made use of panchromatic plates and gelatin colour-filters. The observation south and west of the Azores (that is to say, at the southern stations) showed that the rays of light strongly affected the plate at a depth of 100 metres. The red rays were weakest here, while the blue and ultra-violet rays were strongest. At a depth of 500 metres the blue and ultra-violet rays were still distinctly visible, and at a depth of 1000 metres the ultra-violet rays were yet perceptible. In 1700 metres, however, there was not the faintest trace of light, even after the plates had been exposed for two hours in broad daylight.

In the above-mentioned deep, which denotes the upper limit for the black and red forms during the daytime, we may after this, no doubt, assume that there are only to be found chemically effective rays from the violet portion of the spectrum. Now, seeing that the coefficient of absorption for the red rays, as compared with the violet, is about in the proportion of 30 to 1, and that our observations failed to trace any red rays at a depth of 500 metres, it follows that the red animals at this depth must be quite as invisible as the black ones. It is interesting to note, in this connection, that it is only at night that the black fish with large light organs are found high up in the water, and that red crustaceans in the Arctic regions, as was noticed by Scoresby in the case of *Hymerodora glacialis*, are to be found right up to the edge of the ice at the surface of the sea.

Above the region I have hitherto been describing, with its black and red forms, our parallel hauls have shown us an equally characteristic, though very different, group of pelagic fishes. Their peculiarity is that their body is always more or less compressed from one side to the other. In colour they are dark along the back and silvery or shining, with a bluish-violet gleam along the sides, their eyes are large and often telescopic, and most characteristic of all, I suppose, are their strongly developed light organs; characteristic forms are especially to be met with among the families Sternoptychidæ and Stomiatidæ. From a table showing the depth at which a number of these forms occur, it can be seen that 500 metres may be taken as their lower limit, and that the greatest number of individuals reside at a depth of 300 metres; above 150 metres there were only a few found, and even those that

were met with in 150 metres, or higher up, were with very few exceptions taken at night.

Cyclothone signata may be said to approximate to this group so far as distribution is concerned, and this form also has large, well-developed light organs. A closer analysis of the occurrence of these forms in different latitudes would probably reveal much of interest, though this must be reserved for subsequent investigations.

It is important to lay stress upon the fact that these shining colours, remarkable light organs, and peculiar telescopic eyes do not belong to the dark region in the sea where the sunlight never penetrates, but, on the contrary, to a region where there are, at any rate, large quantities of the rays which are nearest to the blue, violet, and ultra-violet portion of the spectrum.

There has been a good deal of disputing as to whether the light emitted by the light organs was entirely produced by the vital energy of the organisms, or whether the organisms had the power of transforming the ultra-violet rays of the sunlight into rays of lesser wave-length. The observations I have described here cannot, of course, decide questions of this kind, but they show, at any rate, that the light-emitting organisms live in a medium in which there are quantities of rays from the sunlight; and we recognise, further, in these forms a new biological type of organisms, a separate group with quite characteristic outward conditions of existence.

The higher we ascend towards the surface of the sea, the more varied become the forms and colours of the organisms, and the more diversified become also, probably, their conditions of life. I have up to now only been able to examine a portion of the large material from the uppermost water-layers, and will merely mention a single group from this region, namely, the larvæ and young fish forms. Of these we have collected a very large quantity, amounting to thousands. It has been impossible to determine them all, as this will be a long and laborious task.

A table shows how, out of 3600 transparent large and young fishes, 90 per cent. were secured in the appliances operated from the surface down to a depth of 150 metres. These forms are young stages of many different kinds of fishes.

A very interesting and important question is the quantity of animals in the different depths. This question has not been much studied yet. I believe myself that the upper limit of the red and dark-coloured forms is particularly rich. In the Norwegian Sea I found that the occurrences of a rich intermediate pelagic life corresponded to a great rise in the density of the sea water, and I explained this thus, that the food of the animals, sinking down from the upper layers, might accumulate there. The closer study of our material may give more information about this interesting question.

In my preceding remarks I have given a number of instances of the observations we were able to make regarding the depth distribution of fishes when we examine material collected by means of parallel hauls. But it is obvious, too, that this material can equally well be used for ascertaining their horizontal or geographical distribution, and it is only after studying simultaneously as well their vertical and horizontal distribution that we can characterise the outward conditions under which they live. If we look at the horizontal distribution as found by the *Michael Sars* and compare it with previous observations in the northern Atlantic, we shall get some idea of how little knowledge we possess concerning the most ordinary forms inhabiting the ocean between Europe and the coast of the United States. I will base my comparison entirely on Brauer's valuable summary of what was previously known, and on the same instances that I have employed when discussing the vertical distribution.

Black fishes and red crustaceans were caught at all the stations during the cruise of the *Michael Sars* in the Atlantic wherever we lowered our appliances to a depth of 500 metres.

Transparent young fish were captured over the whole area of investigations, though in very varying quantities.

In the open sea over the greatest depths, the Scopelidæ are undoubtedly the most numerous group among the young fish. We find also many extremely interesting forms with stalk eyes, telescope eyes, and so on. Amongst those with telescope eyes there are many of a perfectly transparent new form, which may in all probability be assigned to the genus Dysomma. They were mostly caught in the uppermost 150 metres.

When we have succeeded in determining these young stages, we will be able to throw much light upon the life-history of many important species of fish. The numerous forms of the group Leptocephalidæ will by no means be the least interesting among them. The 195 individuals that were found are believed to belong to no fewer than twenty species, of which a good many are entirely new.

I have previously (in NATURE of October 24, 1910) published a short description of a number of these Leptocephalidæ, which we were able to prove to be the larvæ of the European eel. These larvæ (forty-four specimens in all) have this much of interest in them as compared with previous finds, that they were met with right out in the Atlantic Ocean, far away from the slopes where they previously had been discovered.

Trawlings.

To operate the big trawl at the greatest depths of the North Atlantic, about 2500 or 3000 fathoms, proved a very difficult task. However, two of our hauls were quite successful. The first was in the Bay of Biscay, at a depth of 2500 fathoms. Our catch contained a number of invertebrates, including holothurians of the genus *Elpidia alcyondae*, sponges, and ascidians, and two fishes belonging to the genus Macrurus.

The second haul, between the Canary Islands and the Azores, at a depth of 3000 fathoms, yielded only a very few living organisms. In the half-barrel of mud brought up by the trawl we found thirty pumice-stones overgrown with Stephanocylis and Limopsis, and there were also two holothurians (*Laetmogone violacea* and Elpidia, sp.), sertulariæ, fragments of an umbellularia, an antipathes, a spike of a cidaris, fragments of shell of argonauta, as well as one Bulla tympanica of a whale, and two shark's teeth, of which the first belonged to a carcharodon and the second to an exyrhina. Of fishes there were one Malacosteus, one Alepocephalus, one Leptocephalus, one Argyropelecus, and a form not yet determined. All these I believe to have been pelagic, and to have been taken during the process of hauling in. Regarding one form alone, there was doubt whether to class it as a bottom fish or as pelagic, namely, an unquestionably new species much resembling *Ipnops murrayi*.

Judging from the appearance of the trawl when being lowered and when being afterwards hauled in, I consider this haul to have been, technically speaking, a success, and I cannot explain the catch otherwise than by supposing that at those profound depths there was an absolute poverty of animal life. It remains a question whether all these great ocean floors are equally barren in regard to animals, and especially fishes. So far as I know, the literature on the subject only records the capture of a few Macruridæ from the greatest ocean deeps, this being all the evidence that there is to favour belief in the occurrence of larger fish there. But is it perfectly certain that even those are not also pelagic? On several occasions during the cruise our tow-nets captured over the greatest ocean depths pelagic specimens of Alepocephalus, which is generally brought up by the trawl. In any case, the animal life there must be extremely scanty; and this is borne out by the vertical hauls with our big net below 1500 metres, which I have referred to when discussing *Cyclothone microdon*.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The professor of mineralogy has, with the consent of the Vice-Chancellor, reappointed Mr. A. Hutchinson to be demonstrator in mineralogy and assistant curator for five years from January 1.

Dr. Hobson has been appointed chairman of the moderators and examiners for the Mathematical Tripos, Part ii., 1911.

Mr. C. E. Inglis has been appointed chairman of the examiners for the Mechanical Sciences Tripos, 1911.

DURHAM.—Mr. P. J. Heawood, mathematical lecturer, has been appointed to the professorship of mathematics in succession to Prof. R. A. Sampson, F.R.S., who was recently appointed Astronomer Royal of Scotland.

DR. FREDERIC S. LEE has been appointed head of the department of physiology at Columbia University, New York, on the retirement of Prof. J. G. Curtis. He has been connected with the University since 1891, having successively held the posts of demonstrator, adjunct professor, and research professor.

BY the will of the late Mr. W. S. Steel, of Philiphaugh, Selkirkshire, the sum of 5000*l.* is to be set aside for the establishment of "The Strang Steel Fund," the income of which is to be applied for the advancement of education in Selkirkshire, including the burgh of Selkirk. Mr. Steel also bequeathed 5000*l.* to Glasgow University to found a scholarship for promoting research in any department of science the University may consider desirable, and the income of 2000*l.* for the purchase of books for the library of the University.

THE Regent Street Polytechnic, London, is being rebuilt this year at a cost of 90,000*l.* The rebuilding fund was inaugurated by a grant of 20,000*l.* from the London County Council and a loan of 20,000*l.* from the City Parochial Foundation. The 50,000*l.* needed to complete the fund has been subscribed and promised with the exception of 2500*l.*, which has been reserved so that as many old members, scholars, students, &c., of the polytechnic may have the opportunity of participating in the scheme. Donations of 1*l.* to 100*l.* may be sent to the secretary of the polytechnic, 309 Regent Street. Among donations to the rebuilding fund may be mentioned Lord Leith of Fyvie, 30,000*l.*; Mr. Howard Morley, 5000*l.*; and Lord Howard de Walden, 3500*l.*

THE report of the principal of the Huddersfield Technical College, read at the recent distribution of prizes to students of the institution, is a record of steady progress. Not only was there during last session a substantial increase in the number of both day and evening students, but also in the fees paid and the grants received from the Board of Education. In addition to the strictly technical part of the work of the colleges, courses of instruction are provided which enable students to graduate at the University of London. At the conclusion of his report the principal suggested an enlargement of the sphere of usefulness of the institution during the daytime, and consideration is being given to the possibility of expanding the work of the college in the following directions:—the more vigorous conduct and better organisation of the day commercial department; the establishment of day classes for apprentices in various trades; day classes in mining for workers employed on night shifts; trade schools of dressmaking, millinery, or cloth mending; and the opening of a home-making centre, to be worked in conjunction with the department of domestic economy.

AT the convocation of the University of Chicago on December 20, 1910, a letter from Mr. John D. Rockefeller to the president and trustees was read. In the letter, which is printed in *Science* for December 30, Mr. Rockefeller announces that he has had 2,000,000*l.* set aside for the University of Chicago, and that it is to be delivered to the University in ten equal annual instalments, which began on January 1 of this year. Each instalment is to bear income to the University from the date of such delivery only. The letter goes on to point out that Mr. Rockefeller believes that it is better for a university to be supported and enlarged by the gifts of many rather than by those of a single donor, and he states that the University of Chicago has received in addition to his own gifts more than 1,400,000*l.* from citizens of Chicago and the West. With his latest generous gift, Mr. Rockefeller says he has completed the task he set before himself as regards the University; and his letter contains his resignation from the board of trustees, and the announcement of the resignations of his personal representatives. "I am acting," the letter says, "on an early and permanent conviction that this great institution, being the property of the people, should be controlled, conducted, and supported by the people in whose generous efforts for its upbuilding I have been permitted simply to cooperate." A resolution of appreciation of Mr. Rockefeller's generosity, adopted by the trustees, states that altogether the sums received from him amount to 7,000,000*l.* The trustees, too, are able to say in their resolution:—"Mr. Rockefeller has never permitted the University to bear his name, and consented to be called its founder only at the urgent request of the board of trustees. He has never suggested the appointment or removal of any professor. Whatever views may have been expressed by members of the faculty, he has never indicated either assent or dissent. He has never interfered directly or indirectly with that freedom of opinion and expression which is the vital breath of a university, but has adhered without deviation to the principle that while it is important that university professors in their conclusions be correct, it is more important that in their teaching they be free."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 12.—Sir A. Geikie, K.C.B., president, in the chair.—Prof. H. L. **Callendar** and H. **Moss**: The absolute expansion of mercury.—Dr. R. W. **Gray** and Sir W. **Ramsay**: The density of niton (radium emanation) and the disintegration theory.—Prof. J. S. **Townsend**: The charges on ions in gases, and some effects that influence the motion of negative ions. The experiments on charges on ions in gases which had previously been made with air only have been extended to oxygen, hydrogen, and carbonic acid. The value of the quantity Ne for the negative ions is in all cases very near the value $1{\cdot}22 \times 10^{10}$, which corresponds to a charge, e, equal to the charge on a monovalent atom. The ions were produced by secondary Röntgen rays, and it was found that when non-penetrating rays were used the value of Ne for the positive ions was practically the same as for negative ions, but is much larger when the penetrating rays are used, showing that in this case some of the positive ions have double charges. The motion of the negative ions is considerably changed by carefully drying the gases, and the results of the experiments may be used, in conjunction with the determinations of the velocities made by Mr. Lattey, to determine the apparent mass of the negative ion, which diminishes at low pressures as the electric force is increased. For a given force, the pressures at which the effect of drying becomes appreciable is higher in hydrogen than in oxygen, and much less in carbonic acid than in the other gases.—F. W. **Aston**: The distribution of electric force in the Crookes dark space. The method used in the investigation is one due to J. J. Thomson, and consists in shooting a beam of homogeneous kathode rays transversally through the discharge, and observing the deflection of the beam at various points. The results so obtained are free from the very serious objections which may be urged against the "sounding-point" methods used by previous observers. The electric force in the negative glow is found to be negligibly small, while within the Crookes dark space it is satisfied within experimental error by the simple formula $\mu(D-x)$, where D is the length of the dark space, x the distance from the kathode, and μ a constant. This result indicates the presence of a uniform charge of positive electrification within that region. The distribution is the same for all gases, pressures, and currents used. By integrating the forces so obtained, the potential fall across the dark space is calculated, and is found in all cases to agree within experimental error with the actual potential between the electrodes. The large and abrupt fall of potential at the surface of the kathode found by other investigators is probably a result of faulty methods, an explanation of which is suggested.—Dr. P. E. **Shaw**: The measurement of end-standards of length. A continuation of work published in Roy. Soc. Proc. (December 1, 1905). In recent years the authorities at the National Physical Laboratory have been required to measure and test end-standards with unprecedented accuracy. As a result, the faults of the standards and of the measuring machines have come to light. In this

paper an account is given (1) of improvements in the planeness and parallelism of the standards; (2) of changes introduced in the author's measuring machine to cope with the more accurate standards. It is easy to get consistent readings of length provided the standard is not moved; but if, as is required, the standard is moved, it is a difficult mechanical problem to provide a movement so nearly parallel that the readings before and after movement shall be consistent. Curves and tables are given showing the degree of accuracy at present obtained. A great advance in refinement is expected on the present lines of work.

Linnean Society, December 15, 1910.—Dr. D. H. Scott, F.R.S., president, in the chair.—Dr. O. **Stapf**: Report on the International Botanical Congress, held at Brussels on May 14–22, 1910. The Linnean Society appointed five delegates for the congress with the view of having the different departments concerned in the discussion on taxonomic nomenclature so far as possible represented. The delegates were Messrs. Arber (fossil plants), Cotton (algæ, lichens, and fungi), Gepp (Musci and Hepaticæ), Henry Groves and Dr. Stapf (phanerogams and vascular cryptogams, and Mr. H. Groves also Charceæ). Phytogeography was not taken especially into account, as Mr. Tansley, the delegate of the Cambridge Philosophical Society, joined Section iii.—R. W. H. **Row**: Non-calcareous sponges from the Red Sea, collected by Mr. Cyril Crossland. The present report contains descriptions of seventy-seven species, belonging to forty-four genera, of which thirty-one species and four genera are new to science. The total sponge fauna of the Red Sea now includes no fewer than 187 species, but this includes certain forms only found in the Gulf of Aden. The Red Sea sponge fauna shows a very great similarity to that of the Indian Ocean, no fewer than eighty species being found common to the two regions. Of these eighty species, sixteen occur along the coasts of East Africa or on the islands near by, twenty-five occur in Ceylon, and no fewer than thirty-one in the East Indies and Australia. As a result, the Indo-Australian region, as defined in the report on the Monaxonia of the *Challenger* expedition, has been enlarged to include the whole of the Indian Ocean and the adjacent seas, and it is suggested in this report that a division into western and eastern areas can be made along the sixty-fifth meridian of east longitude. The fauna of the Red Sea, not only as regards sponges, but in general also, shows a very close relationship both in character and species with that of East Africa, and that of Ceylon with the Australian fauna. Another interesting feature of Mr. Crossland's collection is the presence of three species previously only known from the Mediterranean area, or, at any rate, the North Atlantic. It is suggested that these forms have migrated thence into the Red Sea through the Suez Canal.—R. S. **Adamson**: Notes on the comparative anatomy of the leaves of certain species of Veronica. Thirty-eight species of the genus, natives of New Zealand, have been examined, which show great variation of form. All are more or less xerophilous and evergreen. One of the most noticeable features is the formation at the leaf-insertion of a patch of cork-cells which completely cuts off the continuity of tissues except for the bundle; these cells are formed by a phellogen, and may appear in the first year of the three during which the leaf persists. The species show, in general, a series of increasingly xerophilous types of leaf structure, from forms with large leaves with normally differentiated mesophyll, through those with quite homogeneous structure, to forms with scale-like leaves with corresponding anatomical modifications. The less xerophilous species have hydathodes at the leaf-apex that may be modified in various ways; these are absent in the more xerophilous forms. Stomata are protected in various ways, especially by cuticular expansions over the pore, and by depression of the guard-cells below the surface. The xerophilous nature of the leaves can be correlated to some extent with the climatic conditions in the native habitats.

Mathematical Society, January 12.—Dr. H. F. Baker, president, in the chair.—T. C. **Lewis**: A property of the number 7.—Prof. E. W. **Hobson**: The fundamental theorem relating to the Fourier constants for given functions.—Prof. H. M. **Macdonald**: The integration of the equations of propagation of electric waves.—Dr. W. H. **Young**: The fundamental theorem in the theory of functions of a complex variable.—Miss H. P. **Hudson**: The 3-3 birational transformation in three dimensions (second paper).

PARIS.

Academy of Sciences, January 9.—M. Armand Gautier in the chair.—Emile **Picard**: A singular integral equation.—A. **Laveran**: The resistance of goats and sheep to trypanosomiases: the long duration of acquired immunity following these diseases. Both sheep and goats are susceptible to most of the trypanosomiases, but the attack is usually slight and followed by cure, whilst in most other animals the termination is fatal. The serum of a sheep two and a half years after cure from an attack of *T. dimorphon* is active, and protects mice against the attack of the same organism. Similar results were obtained from the serum of the goat.—M. **de Forcrand**: Some probable chemical properties of radium and its combinations. From thermochemical data for the metals of the alkalis and the alkaline earths, and the position of radium in this series, thermochemical data are calculated for radium and its compounds. From these data it is reasonable to assume that the hydroxide will be a little more stable than baryta, but a little more easily dissociable than sodium hydroxide; the oxide RaO should be easily converted into the peroxide RaO_2 at a red heat, and radium carbonate should be decomposed with some difficulty at a red heat. The existence of a hydride (RaH_2) is also predicted.—M. **Luizet**: The variable brightness of certain stars of the type of δ Cephei. On the basis of certain assumptions, the changes in brightness are calculated, and the curves thus obtained compared with the experimental data, with satisfactory agreement.—Charles **Nordmann**: The effective diameters of the stars. Starting with the effective star temperatures determined by the author's stellar photometer, the effective diameters of ten stars are calculated. It is found that stars the effective temperature of which are higher than that of the sun have the smallest diameters, the contrary holding for stars cooler than the sun.—M. **Le Fort**: An interpolation formula established with a view to some practical applications.—M. **Ziembinski**: The relation existing between the thrust of a propulsive helix when fixed and when attached to a body in motion in the air.—Pierre **Weiss**: A new property of the magnetic molecule. If the molecule Fe_3O_4 in magnetite possesses four degrees of freedom of rotation, the value of the specific magnetisation at the absolute zero will be 97·7, very near to the value 95·9 obtained by Kamerlingh Onnes at the temperature of liquid hydrogen. From the experiments described, it is found that at certain temperatures the magnetic moment of the molecule increases suddenly by quantities bearing a simple numerical relation to the magnetic moment of the molecule at low temperatures.—L. **Décombe**: The definition of entropy and of temperature. Monocyclic systems.—J. **de Kowalski** and J. **de Dzierzbicki**: The influence of functional groups on the spectrum of progressive phosphorescence. The substances studied were examined in alcoholic solutions (concentration 0·05 normal) at about −190° C. The acids examined included benzoic, the three toluic, three amidobenzoic, three oxybenzoic acids, and also benzonitrile and *p*-tolunitrile.—Witold **Broniewski**: The electrical properties of the aluminium-magnesium alloys. The experiments included measurements of the electrical resistance, thermo-electric power (against lead), and the variation of the thermo-electric power with temperature, the data obtained being given in the form of curves with the percentage of magnesium as abscissæ. The probable existence of the compounds AlMg and Al_2Mg_3 is indicated, but the existence of Al_4Mg and $AlMg_4$, described by earlier workers on the same subject, could not be confirmed.—Ed. **Chauvenet**: A general method for the preparation of anhydrous chlorides (see p. 383).—J. B. **Senderens**: Ketones derived from the three isomeric toluic acids. The method for preparing ketones, based on the catalytic action of thoria, described by the author in a previous paper, has been applied to the preparation of fifteen cresyl-alkyl-ketones. The density, boiling point, and melting point of the semicarbazone are given for each ketone.—M.

Lanfry: A new thiophene compound, $C_{10}H_6S_2$, and some of its derivatives. The new compound was isolated from the products of the reaction of sulphur and naphthalene vapour when passed through an iron tube at a red heat. Its composition is probably either phenothiophene or phenodithiophene. An account is given of the behaviour of the new compound on oxidation.—A. **Wahl**: The condensation of acetic ester with its higher homologues. Contrary to the views held up to the present, the condensation of acetic ester with its homologues by means of sodium is possible in certain cases. Details are given of the preparation of butyrylacetic ester by this reaction.—Jean **Dybowski**: A new source of natural indiarubber. A method of utilising Jeloutong, resulting from the coagulation of the latex of *Dyera costulata*.—L. **Blaringhem**: The rules of Naudin and the laws of Mendel relating to hybrids. The examples described are not in accord with Mendel's laws, but fully agree with the rules given by Naudin in 1861.—Jules **Laurent**: The physical conditions for the resistance of the vine to mildew.—René **Maire** and Adrien **Tison**: Researches on some Cladochytriaceæ.—P. **Chausé** and L. **Pissot**: The process of caseification in human tuberculosis.—Ch. **Janet**: The existence of a chordotonal organ and of a pulsatile antennary vesicule in the bee, and on the morphology of the head of this species.—Alfred **Angot**: The value of the magnetic elements at the Val-Joyeux Observatory on January 1, 1911.—Alfred **Angot**: The earthquake of January 3–4, 1911. The earthquake, the epicentre of which appeared to be in Central Asia, was recorded on the seismograph of the Parc Saint-Maur Observatory, and was the most violent hitherto recorded, the amplitude being outside the range of the recorder for about six minutes. The vibrations of the ground were sufficient to disturb the magnetographs.—Louis **Fabry**: The earthquake of January 3, 1911. Details of the records of the seismograph at the Observatory of Marseilles.—Henri **Bourget**: Remarks on the preceding communication.

CALCUTTA.

Asiatic Society of Bengal, December 7, 1910.—P. C. **Rây** and Jitendra Nath **Rakshit**: Methylamine nitrite. When mercuric nitrite solution is treated with dilute ammonia, a precipitate of dimercurammonium nitrite is formed, and ammonium nitrite remains in solution (Trans., 1902, lxxxi., 644). Recently a solution of mercuric nitrite was similarly treated with dilute methylamine. The precipitate which was thus obtained proved on analysis to be dimercurammonium nitrite, pure and simple. The filtrate, amounting to about 25 c.c., was distilled in a vacuum at temperatures gradually raised from 45° to 50°.—Hem Chandra **Das-Gupta**: The occurrence of Maestrichtien fossils at Kacch Station (in British Baluchistan).

DIARY OF SOCIETIES.

THURSDAY, JANUARY 19.

ROYAL SOCIETY, at 4.30.—The Action of *B. lactis aerogenes* on Glucose and Mannitol. Part II.: G. S. Walpole.—The Pharmacological Action of South African Boxwood (*Gonioma Kamassi*): Dr. W. E. Dixon.—Autoagglutination of Red Blood Cells in Trypanosomiasis: Dr. W. Yorke.—The Transformation of Proteids into Fats during the Ripening of Cheese (Preliminary Communication): M. Nierenstein.—The Action of X-rays on the Developing Chick: J. F. Gaskell.—(1) Experiments to ascertain if Antelope may act as a Reservoir of the Virus of Sleeping Sickness (*Trypanosoma gambiense*); (2) Experiments to ascertain if the Domestic Fowl of Uganda may act as a Reservoir of the Virus of Sleeping Sickness (*Trypanosoma gambiense*): Colonel Sir D. Bruce, F.R.S., and others.

ROYAL INSTITUTION, at 3.—Recent Progress in Astronomy: F. W. Dyson, F.R.S., Astronomer Royal.

LINNEAN SOCIETY, at 8.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Neolithic Villages in Thessaly: Messrs. Wace and Thompson.

FRIDAY, JANUARY 20.

ROYAL INSTITUTION, at 9.—Chemical and Physical Change at Low Temperatures: Sir James Dewar, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Modern Electrical Dock-equipment, with Special Reference to Electrically-operated Coal-hoists: W. Dixon and G. H. Baxter.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Reinforced-concrete Arches: G. F. Walton.

TUESDAY, JANUARY 24.

ROYAL INSTITUTION, at 3.—Heredity: Prof. F. W. Mott, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Anniversary Meeting.

MINERALOGICAL SOCIETY, at 5.30.—On Kaolin: F. H. Butler.—On Schwartzembergite: Dr. G. F. H. Smith and Dr. G. T. Prior.—An Improved Form of Total Refractometer: A. Hutchinson.—A Case of Electrostatic Separation: T. Crook.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Sand-movements at Newcastle Entrance, N.S.W.: C. W. King.—Fremantle Harbour-works, Western Australia: C. S. R. Palmer.—The Bar Harbours of New South Wales: G. H. Halligan.

WEDNESDAY, JANUARY 25.

ROYAL SOCIETY OF ARTS, at 8.—Motor Transport in Great Britain and the Colonies: H. M. Wyatt.

INSTITUTION OF MINING AND METALLURGY, at 8.—*Adjourned discussion*: Notes on Chilian Mills in Russia: H. C. Bayldon.—Notes on Placer Mining, with Special Reference to Hydraulic Sluicing: N. A. Loggin.

GEOLOGICAL SOCIETY, at 8.—The Skomer Volcanic Series (Pembrokeshire): H. H. Thomas.—Some African Evidence for the Planetismal Hypothesis: E. H. L. Schwarz.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, JANUARY 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Memoir on the Theory of the Partitions of Numbers. Part V. Partitions in Two-dimensionals Space: Major P. A. MacMahon, F.R.S.—The Origin of Magnetic Storms: Dr. A. Schuster, F.R.S.—On the Fourier Constants of a Function: Dr. W. H. Young, F.R.S.—On the Energy and Distribution of Scattered Röntgen Radiation: J. A. Crowther.—On some new Facts connected with the Motion of Oscillating Water: Mrs. H. Ayrton.

ROYAL INSTITUTION, at 3.—Recent Progress in Astronomy: F. W. Dyson, F.R.S., Astronomer Royal.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Long Distance Transmission of Electrical Energy: W. T. Taylor.—Extra High Pressure Transmission Lines: R. Boriase Matthews and C. T. Wilkinson.

FRIDAY, JANUARY 27.

ROYAL INSTITUTION, at 9.—Radioactivity as a Kinetic Theory of a Fourth State of Matter: Prof. W. H. Bragg, F.R.S.

PHYSICAL SOCIETY, at 5 (at University College).—A Demonstration of Phase Difference between the Primary and Secondary Currents of a Transformer by means of a Simple Apparatus: Prof. F. T. Trouton, F.R.S.—A Note on the Experimental Measurement of the High Frequency Resistance of Wires: Prof. J. A. Fleming, F.R.S.—(1) The Measurement of Energy Losses in Condensers traversed by High Frequency Oscillations; (2) Some Resonance Curves taken with Impact and Spark Discharges: Prof. J. A. Fleming, F.R.S., and G. B. Dyke.—Council Meeting at 4 30 p.m.

SATURDAY, JANUARY 28.

ESSEX FIELD CLUB, at 6 (at Essex Museum of Natural History, Stratford).—Exhibition of Coloured Photographs of Alpine Flowering Plants: Somerville Hastings.—Note on the Occurrence of Stony Beds underlying Harwich Harbour: Percy Thompson.—On a Pre-historic Interment found near Walton-on-Naze: Hazzledine Warren.

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