THURSDAY, FEBRUARY 24, 1910.

A TEXT-BOOK OF BOTANY.

Warming-Johansen, Lehrbuch der algemeinen Botanik. Herausgegeben von Dr. E. Meinecke. Zweiter Theil (Schluss). Pp. iv+481–668. (Berlin: Gebrüder Bornträger, 1909.) Price 4.80 marks.

PROF. WARMING'S book, the concluding part of which has recently been issued, will be received with interest, whilst at the same time it cannot escape some criticism. But in the latter connection the circumstances of its publication must, in fairness to the author, be kept in mind. The first part was three years in the press, and even after its appearance an interval of two years elapsed before the second and final part was issued. Botanical thought has moved rapidly during the last decade, and any text-book must naturally suffer when produced under conditions so disadvantageous as those under which Prof. Warming's book has laboured.

The earlier chapters of the first volume contain a morphological treatment of the plant on interesting lines, the ecological factors due to physical environment, &c., being kept well in sight. Many excellent figures are given, and examples are drawn from plants which are not always utilised in these matters as they might be in modern works. Some topics strike us as having been somewhat inadequately discussed, however, and especially that of phyllotaxis. If this subject is to be introduced at all (and it can hardly be omitted in a treatise such as this) one looks for more than a somewhat perfunctory account of the Braun-Schimper views.

The chapter on abstract morphology appears to us rather to miss fire—either it is too long, or it is not long, or philosophical, enough. The cell also is treated perhaps somewhat dogmatically. This may be difficult to avoid in a treatise which, while aiming at being comprehensive, is limited in size. In any event, however, there is no excuse for the introduction of the old and long discredited figure of the lily cell showing large centrosomes. This figure is the more surprising since the author himself avows his disbelief in the centrosomes as there reproduced! The section dealing with the tissue systems is good; we would willingly have seen it enlarged. Many interesting observations are worked in with the general mass of information, and the whole is admirably handled and illustrated. The general classification of the tissue systems follows that employed by Haberlandt in his well-known treatise.

The structure of the wood is well described and figured, though the difficulties (*e.g.* sliding growth) presented by the differentiation of the elements are passed over. This is, however, evidently in keeping with the main plan which the author has kept before him, of making his book chiefly informational, rather than to introduce a discussion of the many doubtful and difficult problems. Similarly, the question as to the mode of formation of annual rings only occupies a few lines.

The latter part of the first volume contains an account of the physiology of nutrition, transpiration, growth, and irritability. The matter is connected up with the life of plants in the open, and although there may be differences of opinion as to the validity of the author's views on some matters—*e.g.* the ascent of sap—everyone will probably admit that the subject-matter is treated in an interesting way. This especially applies to the section on the regulation of functions.

The first part ends in the middle of an account of the reproductive structures, and this is continued in the second and final instalment of the work. The treatment is too short to enable anything like justice to be done to this important subject, the Florideæ, for example, being dismissed with rather less than a page of print.

The morphological discussion undoubtedly loses much on account of the omission of illustrations drawn from palæontological evidence; and, again, we find a figure (476) of the germination of the pollen grain of Lilium showing centrosomes, while in the legend we read that "the centrosomes are to be neglected." Why use such a figure when there are others to choose from? Or, better still, why not draw a new one?

The chapter dealing with the life-history of the plant and its relation to external conditions is, as one would anticipate, one of the most interesting in the book, and the pages devoted to the consideration of the occurrence and significance of rhythm and of the resting periods of plants will be found to be very suggestive. Rhythm is indeed one of the most striking of physiological phenomena, and the resting period is one of its remarkable phases.

The volume ends with a brief account of the general questions which centre around heredity, variability, and such like problems. The examples are well chosen, and the student will find the discussion helpful.

The book as a whole compares well with many text-books that have appeared in recent years. It also shares some of their inevitable defects. The subject is really too large to be treated within limits of space which twenty years ago were reasonably adequate. An author who attempts to do so is bound to incur adverse criticism, and we have given, perhaps, a somewhat candid expression of our own opinion of the present work in what has gone before. But we do not intend to convey the impression that Prof. Warming has not ably discharged his task, so far as it was possible for anyone to do it.

The book is really stimulating in many ways; indeed, any work by Prof. Warming, who has done so much to initiate ecological work, could not fail in this respect; and so we leave it, passing lightly over what may be looked on as unavoidable imperfections, and congratulating the author on the chapters of his work in which he has achieved unquestioned success.

J. B. F.

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THE AGRICULTURE OF MODERN EGYPT.

Text-Book of Egyptian Agriculture. Edited by G. P. Foaden and F. Fletcher. Vol. i. Pp. 320. (Cairo: Ministry of Education, 1908.) Price 30 P.T.

THE introduction of agricultural schools and colleges into countries where agriculture has hitherto been nothing more than a tradition must inevitably lead to the production of a number of text-books specially written for particular countries. Although the same broad principles hold everywhere, the factors coming into play are so numerous that the student cannot apply the principles to particular cases until he has had considerable experience in the analysis of agricultural problems. He must, indeed, learn his principles through the local practices, and no matter how sound a book may be, its usefulness is very limited unless it is well furnished with local applications.

The present volume is the first attempt yet made to teach agricultural science through Egyptian illustrations. The volume before us deals with soils, irrigation, land reclamation and manures. A second volume is promised dealing with crops, fungoid and insect pests, and animals. The services of several contributors have been enlisted.

The general result is distinctly satisfactory; the student gets the kind of information he wants, and probably forms a more intelligent appreciation of the principles of his subject than would otherwise be possible. The book is also useful to the non-technical reader interested in Egypt, because of its accounts of the land-development methods now in process of application.

The opening chapter deals with the Egyptian climate and its effect on crops. Then follows a long chapter on the composition and properties of soil in relation to plants, and afterwards we turn to the more special Egyptian part, which is very interesting. The valley of the Nile is bounded by high land said to be incapable of cultivation; the population is essentially agricultural and shows no sign of emigrating southwards to the Soudan; in consequence, the agriculture of Egypt must develop on intensive lines. The area of land is being increased by reclaiming the lakes and their margins and the waste lands of the interior; it is calculated that another 25 per cent. can still be added to the present cultivatable area. Drainage, reclamation, and irrigation of land are therefore described in considerable detail. The water is either pumped or syphoned out from the lake; then the canals and drains are completed, and next the land is washed with the Nile flood to remove salt, of which all but the last 1 or 2 per cent. can be readily removed. Finally, the land is levelled to facilitate irrigation; this is done by means of a scoop, but is very expensive and laborious. It is then ready for cultivation, but as it may contain 1 or 2 per cent. of salt a small millet ("dineba"), useful for fodder, and capable of withstanding salt, may be grown as a first crop, or, if the conditions are more favourable, rice. In the Wady Tumilat a reed known as samar, and used for making mats, &c., is largely cultivated for this purpose. If dineba or rice grow successfully, the second stage may be entered upon with a crop of berseem, or Egyptian clover, which enriches the land in nitrogen and organic matter, two defects from which it suffers. The process is now complete, and cotton or other crops can be taken; the land has not, however, attained its maximum productiveness, but will go on improving for several years. Bad spots must be improved by alterations in drainage, extra washing, or ploughing.

The composition of the solid matter brought down by the Nile naturally receives attention. On an average it contains 0·13 per cent. of nitrogen while the river is in flood, but five or six times as much in the months of low Nile. Speaking generally, Egyptian soils are said to be deficient in nitrogen and also in phosphoric acid, but only occasionally in potash.

The general chapter on soils reveals a defect from which this type of book must suffer. The subject-matter is in places rather out of date, while statements are often made on very slender evidence. Far too much is made of an alleged acid excretion from the plant root; there is really no evidence that anything except carbonic acid is given off. Sulphate of ammonia is incorrectly said to be of no value as manure unless nitrifying organisms are present. Salts are stated to diffuse upwards in the soil even when there is no upward movement of the soil water. The existence in the soil is assumed of waste products of plant life injurious to other plants. Other instances might be quoted. These things can, of course, be put right in subsequent editions, but it is in the direction of keeping the strictly general and scientific matter up to date that writers of local text-books will find their chief difficulty.

THE BINNENTHAL.

La Vallée de Binn (Valais). Étude géographique, géologique, mineralogique, et pittoresque. By Léon Desbuissons. Pp. viii+328 and map. (Lausanne: Georges Bridel et Cie., 1909.) Price 10 francs.

THE Binnenthal, a valley in the south of Switzerland on the Italian border, is little known to the many English people who yearly visit that delightful country. It was "discovered" more than twenty-five years ago by a well-known member of the Alpine Club. He loved the quiet and beauty of this valley, as well as the numerous walks and climbs; when his friends asked him to describe it, his answer was, "There is no glacier there and no alpine glow," and, thanks to his reply, the valley has remained unspoilt by the tourist crowd.

For the last ten years the Binnenthal has attracted the special attention of mineralogists on account of the discovery of more than twelve minerals new to science; some of these consist only of a few minute crystals of which there is not yet sufficient material for a chemical analysis.

M. Desbuisson has produced, with the able assistance of numerous men of science and writers, a very interesting account of the natural and local history of the Binnenthal. This book contains a number of beautiful photographs and drawings by the author; especially worthy of mention are the photographs of "Les Gorges des Twingen" and "Le Hamlau de Z'Binnen"; there are also excellent maps, in the execution of which his position as Géographe du Ministre des Affaires étrangères has given him exceptional facility.

The first chapter describes the streams and waterfalls, the contour of the surrounding mountains, the valleys and passes, taking the more important mountains in separate groups. Chapter ii. deals with the geology of the district, and is accompanied with some sections after Dr. Schardt and a geological map after Prof. Schmidt and Dr. Preiswerk. Until recently this district has presented one of the most difficult geological problems in Switzerland, but through the study of the arrangement of the rocks exposed in piercing Monte Leone for the Simplon tunnel, MM. Schardt, Schmidt, and Preiswerk have been enabled to elucidate the geological difficulties of the Binnenthal district. To geologists visiting this valley, this chapter and the numerous references to other authors will be of much assistance, even though M. Desbuisson's deductions may not be entirely accepted.

Chapter iii. is devoted to mineralogy, a subject occupying nearly half the book. The number of different minerals found in this district amounts to more than eighty; of these, fourteen are new minerals found in the Lengenbach quarry. The author gives a short description of the different minerals, with references to original papers. The arrangement is puzzling, as he mixes the carbonates, the sulphates, and the oxides together, and writes calcite $CaCO^3$, siderite CO^3Fe, anhydrite SO^4Ca, barytes $BaSO^4$. There are ten plates of various crystals photographed by the author from specimens in the collections of M. Gustave Seligmann, of Coblenz, the École des Mines, Paris, and from the author's own collection. They may be interesting as records of these specimens, but are of little assistance in helping the collector to recognise these rare minerals. Photographs of minerals are seldom satisfactory, except those in Miers's "Mineralogy," which have been outlined and shaded by Miss Miers. Chapter iv. describes the history and customs of the people. This is written in a very interesting manner, and gives a vivid picture of the development of the valley and the lives of the inhabitants. References are made to that very interesting book of M. Charles Biermann, "Vallée de Conches," and to Dr. Bernouilli's account of the prehistoric remains found when enlarging the hotel at Binn. The rings, brooches, and other objects found in the graves are now preserved in a case in the hotel.

Slight mention is made of the animals and birds of the district, but a complete list of the plants is given in an appendix by Dr. A. Binz; we should like also to have seen an equally complete list of the rare and beautiful butterflies and beetles for which the Binnenthal is remarkable, and which so greatly attract the notice of entomologists. The last chapter gives a clear and accurate description of the walks and climbs, but of the latter many are too difficult and hazardous to be attempted without a guide. We may conclude by saying that this artistically written and carefully compiled account will add much to the interest and enjoyment of those visiting the Binnenthal, and we think that an abridged edition in English would be most acceptable to the English and American visitors.

HYDRAULICS.

Text-book on Hydraulics. By G. E. Russell. Pp. vii+183. (New York: Henry Holt and Co., 1909.) Price 2.50 dollars.

WITH the advent of electricity, and in the first flush of its successful application to many purposes hitherto served by water, it was claimed that the days of hydraulic power were numbered, and that ere long the study of hydraulics would lose all except merely academical interest. That such has not proved to be the case is now a matter of common knowledge, and, in fact, the rivalry between the two motive agencies can only be said to have been stimulating alike to both of them. In regard to their industrial application, there are wide and distinct fields of usefulness for each, and, rightly understood, the two sciences are collaterally valuable, and even, to some degree, complementary. Altogether, far from the relegation of hydraulics to a background of obscurity and neglect, there has, of late years, been a decided recrudescence of interest in the science which engaged the attention of philosophers more than 2000 years ago, and has been dignified by the researches of Archimedes, Bernouilli and Pascal.

Many are the text-books which have been written for the benefit of the student, and the majority of them approach the subject from a practical point of view, or, at any rate, give a decided prominence to its more utilitarian aspects. Mr. Russell considers that there is still room for a text-book dealing with principles alone, and he has accordingly restricted his work to a discussion of the "more common and important problems." This programme does not, of course, afford much scope for originality of matter nor for novelty of treatment; moreover, it does not appear that either of these was the author's intention. The object aimed at, as a matter of fact, has been to produce a book "suited for use in a number of courses" (at the Massachusetts Institute of Technology) "where the amount of prescribed time and the ground to be covered varies in each course."

The volume is divided into ten chapters, dealing with hydrostatics; the laws of fluid motion; discharge from orifices; flow over weirs, through pipes and in open channels; and the dynamic action of jets and streams. Each chapter terminates with a number of problems, the solutions of which, however, are not given; and there are useful reference lists to other literature on the subject-matter. Most of these are American and English works, and one notes casually the omission of any mention of the studies of Boussinesq. Neither is there any account of stream-line flow, and the experimental researches in this connection of Reynolds and Hele-Shaw. But these omissions may be due to the restrictions imposed upon the author by the object he had in view.

For the rest, the book is written in carefully considered sequence, the type is clear, and the diagrams are excellent. There is a very useful warning in the introduction to the inexperienced student who is apt to attach exaggerated importance to the precision of numerical results obtained from data which, in themselves, are liable to errors of observation of no slight moment. The warning can hardly be over-emphasised, for the writer of this article has frequently noticed the tendency of students to pursue the solution of problems to the third and fourth decimal place when the integers alone cannot be depended upon to the extent of 10, 20, or even 50 per cent. Such fallacious exactitude is perhaps more characteristic of the study of hydraulics than of any other practical science.

B. C.

WORKS ON PHYSICS.

(1) *L'Électricité considérée comme Forme de l'Énergie.* Electrostatique. Première Partie. By Lieut.-Colonel E. Aries. Pp. 176. (Paris: A. Hermann et Fils, 1909.) Price 5 francs.

(2) *Lehrbuch der Physik.* By E. Grimsehl. Pp. xii+1052. (Leipzig: B. G. Teubner, 1909.) Price 15 marks.

(3) *Elements of Physics for Use in High Schools.* By H. Crew, revised by F. T. Jones. Pp. xiv+435. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1909.) Price 6*s*.

(4) *Light.* By Prof. R. C. Maclaurin. Pp. ix+251. (New York: The Columbia University Press, 1909.) Price 1.50 dollars, net.

(1) AS suggested by the title, the author in this pamphlet proposes to alter the present method of measuring electricity. Usually the terms "charge of electricity" and "quantity of electricity" are regarded as synonymous. Colonel Aries wishes to draw a distinction between them. The former he regards in the usual way, but defines the latter as proportional to the electrostatic energy, *i.e.* half the product of the charge and the potential. The consequence of this definition is to arrive at the result that the *quantity* of electricity associated with an insulated conductor is not constant, but varies with change of potential, although the charge is unaltered. This the author explains by assuming that the electricity (meaning the quantity—in reality the energy) streams to or fro, as the case may be, between the conductor and the surrounding dielectric.

To this change of nomenclature the objection may be raised that it leads to no useful result. But Colonel Aries suggests that in this passage of so-called electricity is to be found the explanation of the residual charge of condensers, and that it is identical with Maxwell's "displacement currents." Both suggestions are absurd. However, the treatment of the subject does not follow this point of view. Most of the ordinary theorems in electrostatics are proved by the ordinary methods, and it is a little difficult to see why the author makes the above suggestions at all. The volume is not absolutely confined to electrostatics, digressions being made into current electricity and magnetism.

(2) This book covers in some detail the whole ground usually taken in a systematic study of physics. It cannot be described as elementary, as generally understood. The standard is about that required for the pass degrees in the British universities. Were it in English it could be thoroughly recommended to students taking such courses. Recent experimental work, particularly that concerning radio-activity and electromagnetic radiations, finds a place in the section on electricity, and a number of useful tables of physical constants are given in the appendix. The notation of the calculus is used only occasionally, and in most cases, *e.g.* the estimation of certain moments of inertia, simple integrations are performed by laborious methods which avoid that notation. This, we think, is undesirable in a book of this type. If a knowledge of the calculus on the part of the student is assumed —as undoubtedly it should be in this work—it should be used consistently throughout the book.

It is gratifying to find several chapters in the beginning in which the fundamental principles of mechanics are thoroughly dealt with. The greatest difficulty encountered in the teaching of physics is insufficient training of the students in this respect. We take exception, however, to the somewhat illogical order of this section. Weight and specific gravity are defined before the questions of force and mass have been considered, and the definition of the unit of mass as "that which weighs one gram in the latitude 45°" is entirely misleading. The book is well printed, and possesses a profusion of diagrams illustrating the experiments described in the text.

(3) It is not often that we meet with a book which so admirably fulfils the purpose for which it is written as this one. It is intended for those who are just commencing the study of physics, and it is written in a way that must appeal to the student. The reason, probably, is that reference is so frequently made to those common occurrences and mechanical appliances in which the principles of physics are involved. Also, although the treatment is quite elementary, phenomena such as the diffraction and polarisation of light are not avoided, as is usually the case in text-books of this class. A further novel feature is the practice of frequently giving references to books by other authors, in cases where the student wishes for a more exhaustive treatment of a particular section of the subject. Numerous worked examples are given, and some four hundred questions are set at the end of the book.

There are only two faults we have to find. The first is connected with the question of gravitation. It is at least suggested, although not positively stated, that the value of "*g*" should be greater at the bottom of a mine than at the earth's surface. The second fault is by no means peculiar to this book. It is the erroneous view that a particle describing a circular path is in equilibrium, and subject to *two* forces, one centrifugal and the other equal and centripetal. One may ask, "How is a student to reconcile this with Newton's first law of motion?"

(4) This volume consists of ten lectures on light,

given last year by Prof. Maclaurin in the American Museum of Natural History. The subject undertaken was a difficult one, namely, to treat from a non-mathematical point of view, and in such a way as to be understood by non-physicists, the more advanced portions of the optical theory. Prof. Maclaurin has, however, successfully done this. The lectures are extremely clear and full of information. Among the subjects dealt with are colour vision and colour photography, dispersion and absorption, polarisation, interference and diffraction, and the connections between light and electricity, such as the Zeeman effect. The lectures make very good reading, and would be appreciated even by those for whom the exclusion of mathematics is unnecessary.

FUNCTIONAL PSYCHOLOGY.

(1) *Genetic Psychology. An Introduction to an Objective and Genetic View of Intelligence.* By E. A. Kirkpatrick. Pp. xv+373. (New York: The Macmillan Company, 1909.) Price 5*s*. net.

(2) *The Psychology of Thinking.* By Dr. J. E. Miller. Pp. xxv+303. (New York: The Macmillan Company, 1909.) Price 5*s*. net.

(1) THERE seems to be an ever-increasing tendency among psychologists at the present day to assimilate not only their methods of procedure, but also the schemes of description and explanation underlying their science to those employed by biology. In place of, or, more accurately, in supplementation of, the older "introspective" psychology—including "introspection under test conditions"—we now find a "functional" psychology which treats of the individual mind from the point of view, primarily, of its usefulness in adapting the individual to his environment. Both the books under consideration are written from this point of view. They are, both of them, excellent examples of the use of the biological method. Mr. Kirkpatrick tells us in his preface that all psychology must be founded on genetic principles, and studied in close relation to the facts and theories of the other sciences of life phenomena. He himself therefore commences his book with a clearly written and somewhat full account of the forms of behaviour of the lower animals, together with their structural bases, selecting types at different stages of evolution for detailed description. Not until the middle of the book does he reach the subject of consciousness "as such," and even here he deals first with its objective aspect, viz. its external effects and criteria, as exemplified by human adult consciousness. The account is excellent, and conducive to clear thinking on a difficult subject. Following this, there are chapters on "specific conscious states," "types of adaptive activity or intelligence," "types of learning activity," and "racial and individual development."

The book should prove of very considerable value to students, since it sums up a great deal of recent monograph work in most clear and interesting form.

(2) Dr. Miller's book is inspired throughout by what he aptly calls a clinical interest in the thinking process as it occurs in the child's mind, in concrete form, at the various stages of its education. The earlier chapters are devoted to a general explanation and justification of the biological point of view, and form an excellent propædeutic to the predominantly pedagogical account of thinking which follows. By those educationists—and they must surely be many—who have become dissatisfied with the quasi-logical, almost scholastic, account of the thinking process given by the older school of psychologists, the author's treatment of his subject will be found both stimulating and refreshing. Thinking is kept throughout in its correct and natural close relationship with other forms of mental activity and general organic behaviour. Not abstract schemes, but actual concrete bits of thinking, are to be found skilfully analysed and classified on every page. The continuity between the empirical thinking of animals and children and the reasoning of the trained adult mind is well brought out, together with their specific differences, and throughout the entire account the author never loses sight of the fundamental characteristic of the life process as expressed in terms of the satisfaction of needs, which is the central and controlling idea of his psychological system. The book breaks new ground in its treatment of a hitherto neglected department of psychology, and will undoubtedly be welcomed by psychologists and educationists alike. W. B.

OUR BOOK SHELF.

Das Kaninchen. Zugleich eine Einführung in die Organisation der Säugetiere. Monographien einheimischer Tiere. Vol. ii. Pp. vi+307. (Leipzig: Dr. Werner Klinkhardt, 1909.) Price 6 marks.

FOLLOWING upon an industriously compiled volume devoted to the frog, this series, edited by Prof. Ziegler, is now represented by a work on the rabbit, which we may confess at once is a disappointing one. It is little more than a new edition of Krause's well-known work, with a few additional illustrations. Indeed, though more elaborate in detail, the treatment is hardly so good as that of any of the elementary treatises in which this familiar animal has been described. There are no practical directions for actual dissection, and the figures are singularly devoid of explanatory lettering, an omission which becomes ludicrous in the case of complicated musculature. The editor has not exercised sufficient control in that important respect, nor in the treatment of the various sections, bones and muscles being allowed far too large a share in a purely descriptive work.

The book begins well, and, in fact, the introduction is its saving grace. The author treats in this opening section of the relation of the rabbit to its congeners, the differences between rabbits and hares, the various races, their habits, and history. Then follows a section upon diseases and parasites, but without any figures of the latter and without any mention of the two commonest cestodes, *Cysticercus pisiformis* and *Coenurus serialis*. Then follows an account of how to kill the creature, and, having done so, the author treats it for the whole of the rest of the work as dead. The book is a study in necrology. We are not told how the rabbit breathes or digests, or how it does anything. Are there sweat-glands? The index throws no light on the subject. What is the structure of the skin? A page near the end of the book, without a single figure to explain the heavy vocabulary, is all we are vouchsafed. The treatment of histological and embryological data is almost useless. A drawing of a sagittal section of the head raised hopes of a description of the course taken by the air in the act of breathing, but on examination the drawing itself is seen to be incomplete and to illustrate the tear-duct.

What is wanted in a modern monograph is no exclusively anatomical study of individual bones and muscles, expressed in a deterrent vocabulary, but a treatment seasoned with morphological and physiological "salt." This series is intended to help beginners, but a more strange method of doing so it would be hard to imagine. We trust that future volumes of this collection of monographs will be planned with a little more insight into the needs of biological students, and written with some feeling of the beauty as well as of the complexity of the subject.

The Irish Fairy Book. By Alfred Perceval Graves. Illustrated by George Denham. Pp. xv+355. (London: T. Fisher Unwin, n.d.) Price 6*s*.

There is a greater demand for fairy books than there is for works on folklore, and the readers differ greatly in taste and requirements. Some fairy books are worse than useless to the folklorist, books in which the authors treat their sources in a thoroughly irresponsible fashion. On the other hand, those who could handle such materials discreetly, learnedly, and reverently cannot be induced to write fairy books. But such books must be written, and Mr. Graves has produced one which is in every respect commendable.

Apart from a helpful preface and one short poem by the author or compiler, the book is a symposium by Irish writers of folk-tales, and a bare list of the writers' names shows the comprehensiveness of the work:—O'Grady, Kennedy, Allingham, Croker, Gregory, Zeats, O'Looney, Ewing, Ferguson, Joyce, McClintock, Carleton, Campbell, O'Kearney, Lover, Curtin, Wilde, Le Fann, Mangan, Hyde, Sigerson, Hull, Larminie, Boyd, Hopper, with Tennyson's "Voyage of Maeldune" as a fitting conclusion. The book is just what it was intended to be—delightful reading.

Many of the tales are in proper form for scientific examination, being evidently faithful records of oral traditions, which, with Mr. Denham's apt illustrations, are as "readable" as any in the collection. All the stories are replete with useful facts of folklore. The frequent identification of Druidism with magic is very impressive. As in Welsh folklore, the fairies are in high glee at the seasonal festivals. Puck, for instance, is definitely associated with November. Lugnassed, Lug's marriage—the old name for the August festival—survives in dialect as "Lunacy day in harvest." That the framework of the tale is the calendar is in most cases fairly obvious, and one regrets that the compiler offers the reader no clue to such an interpretation in a preface where other theories are mentioned. John Griffith.

Space and Spirit. A Commentary upon the Work of Sir Oliver Lodge entitled "Life and Matter." By R. A. Kennedy. Pp. 64. (London: C. Knight and Co., Ltd., 1909.) Price 1*s*. 6*d*. net.

This is a commentary on Sir Oliver Lodge's work, "Life and Matter," which was written primarily as a counterblast to Haeckel's "Riddle of the Universe." Its author agrees with Sir Oliver in regarding Spirit as the ultimate Reality, of which the Universe is a manifestation; but he differs on a few points of detail. Moreover, though Spirit is the "unknown reality," there is another irresolvable Absolute, viz. Space. There is a Spacial universe and a Spiritual universe. The former may only be a branch or out-leaking of the latter, but the two cannot be identified. Mr. Kennedy is, therefore, not a monist, even of the spiritual variety; he recognises two entities, and not merely two aspects of the same substance. (But is it not self-contradictory to speak of *two universes?*)

The most vital detail on which the author disagrees with Sir Oliver Lodge is that of the nature of Life. Sir Oliver, combating Haeckel's explanation of life (which gets out of the difficulty by attributing a kind of life to the atoms, in fine *petitio principii* style), Sir Oliver, we say, supposes life to flow into the carbohydrate molecule from a supernal life-reservoir, as soon as the molecule becomes sufficiently complex to accommodate it or to "let through" the properties which life can manifest. The materialist's view is that the complex aggregate has *generated* the life; he does not stop to ask what generated the complex aggregate; and Mr. Kennedy thinks that Sir Oliver is rather similarly inclined to leave the formation of the organism in its early stages to chance. "The right view surely is that life is in operation from first to last, and in fact generates the organism."

In discussions of these questions which lie on the borderland between science and philosophy, it is often apparent that divergences are verbal only. It is probably thus to some extent in the present instance. Certainly, life does not manifest itself except through complex molecules, but Sir Oliver does not leave the formation of those molecules to "chance." Rather, he would say that all matter allows intelligence and will to shine through—somewhat as taught by two men as different as Shelley and Prof. William James—from the spiritual sun which is Reality. But he is still right and consistent in denying Haeckel's assumption that atomic forces explain life, however aggregated.

The booklet is well written, and the argument is extremely acute and suggestive throughout.

Introduction to the Preparation of Organic Compounds. By Prof. Emil Fischer. Translated by Dr. R. V. Stanford. Pp. xix+175. (London: Williams and Norgate, 1909.) Price 4*s*. net.

Emil Fischer's "Anleitung zur Darstellung organischer Präparate" first appeared in 1883 in the form of autograph copies for the use of his students in the Erlangen Laboratory, and represents the first published introduction to the practical study of organic chemistry. The increasing demand led to its appearance in book form in 1887, and from it an English translation was made by A. Kling, which reached a second edition in 1895.

The book has apparently been more popular in Germany than here, for the present translation is made from the eighth German edition. This is no doubt due to the publication of more comprehensive and elaborate treatises on the same subject by English writers. But whatever the cause, the modest proportions of the volume before us do not diminish its practical value, as both teachers and students who have used it will readily admit. In this last English edition a second part is added, which is drawn from the author's researches on physiological chemistry, and is intended more especially for medical and biological students. The book is neatly bound, and printed in good type. J. B. C.

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 Meaning of "Ionisation."

I AM sorry that Prof. Walker (p. 458) has avoided my question. At present I am not concerned either with his position or with mine, with van der Waals or with Newton—I wish simply to know *what exactly he would have us understand by the word ionisation.* I hold that it is our duty, as scientific workers, if possible, to be exact in word as well as deed. It is a matter of reproach to us that we should be lectured, year after year, from the chair of the Royal Society, for our carelessness as writers. Now that the attempt is being made to standardise all sorts of things—from amperes and ohms to the members of iron bridges, even by means of international congresses—we might well devote some attention to our words and attempt to standardise our scientific nomenclature. *Ionisation* is a word used with increasing frequency in these days—unfortunately also with increasing ambiguity. I would appeal to Prof. Walker, as a leader among British physical-chemists, at least to tell us what he wished us to understand when using the word recently—as his meaning is in no way made clear in his article.

HENRY E. ARMSTRONG.

The Flow of Sand.

ON Friday, February 11, I had the pleasure of hearing Mr. C. E. S. Phillips deliver the discourse at the Royal Institution, illustrated by many experiments, a number of which showed that when sand escapes from an orifice at the bottom of a long vertical tube it does not do so perfectly uniformly, but in a series of pulses which are sufficiently rapid to produce audible sounds. Mr. Phillips did not offer any suggestion as to the reason why the flow is regularly intermittent, but two of his other experiments, and the laws of friction, suggest a possible cause.

One experiment showed sand forming a cone on being poured from a funnel. The sloping sides of the cone gave the angle of repose, and it was noticed that the sand at first did not flow steadily down the slopes, but intermittently. This, I think, may be due to a combination of the momentum of the sliding sand and the difference between the statical and dynamical friction between the particles of the sand. A little heap of sand collects, then the statical friction is overcome, and the momentum carries the sand slightly too far, thus making the angle of repose too small; consequently the on-coming sand is able to remain stationary on the slope until in turn its angle of repose becomes too great, the statical friction is overcome, and the cycle is repeated. The other experiment showed how sand is self-supporting in a tube except for the cone of sand at the base. Allow this cone of sand to pass through the orifice, and the rest will fall intermittently in the manner indicated.

If this theory is correct, one would expect sand with a comparatively large coefficient of statical friction to give fewer pulses per second than a sand having a smaller angle of repose.

A. S. E. ACKERMANN.

25 Victoria Street, Westminster, London, S.W., February 14.

I AGREE with the explanation offered by Mr. Ackermann in the first part of his letter, for it is evident that sand must slip down itself by a series of rushes.

The process, however, by which a mass of sand falling in a glass tube produces musical sounds is somewhat more complicated. The column must be regarded as consisting of two parts, the upper portion acting simply as an intermittently moving piston. It is the central region of the lower part which becomes less dense, owing to escape of sand through the orifice; the upper portion, being no longer supported, slips downward as a whole.

The rapidity of its intermittent motion depends upon the friction between the glass and sand. Hence the pitch of the note is raised if the grains are better packed. The action appears to resemble that of pushing a moist finger-tip along a polished table. The finger jumps rapidly and regularly.

As soon as the column so far lowers that the previously compact upper portion begins to fall away at its centre, all sound ceases. I showed at the Royal Institution that by coating the inner surface of the glass tube with oil, before filling it with sand, the column moved downward by slow, regular jerks, increasing in rapidity as the mass of the remaining sand in the tube grew less. Here all friction between the glass and the sand grains was eliminated, on account of the outer layer of particles adhering to the oil and remaining as a coating upon the tube.

The jerks became more rapid as the inertia diminished with the decreasing mass, which also explains why the pitch of the note given out by a tube rises somewhat as the sand column diminishes.

CHARLES E. S. PHILLIPS.

Castle House, Shooters Hill, Kent, February 15.

The Heredity of Sex.

CURRENT Mendelian theories of the heredity of sex are based on the assumption that gametes are pure with respect to sex characters; that is, that a gamete may carry the factor for maleness or the factor for femaleness, but not both. This view may be expressed thus:—a gamete carries M, the factor (or factors) for maleness, or F, the factor (or factors) for femaleness, but not both M and F.

The hypothesis proposed in this note suggests that the phenomena of sex are due, not to a single pair of allelomorphic characters, but to two independent pairs of characters, namely, maleness (M), with its allelomorph, absence of maleness (*m*), which constitute one pair, and femaleness (F), with its allelomorph (*f*), which constitute the other pair. On this hypothesis, since M*m*, F*f* are independent of one another, representatives of both pairs of characters occur in every gamete.

All gametes are therefore of one or other of the following sex constitutions, MF, M*f*, *m*F, *mf*. Hence all zygotes produced by the pairing of such gametes are of one or other of the following nine gametic constitutions:—

Dihybrid scheme	1 MMFF, 2 MMF*f*, 2 M*m*FF, 4 M*m*F*f*	9 MF
	1 MM*ff*, 2 M*mff*	3 M*f*
	1 *mm*FF, 2 *mm*F*f*	3 *m*F
	1 *mmff*	1 *mf*

In zygotes MMFF and M*m*F*f* it may be predicted that circumstances, nutrition, &c., determine which type (male or female) of sexual organs is produced.

Thus double begonias, which bear female flowers, may be induced by starvation to bear male flowers. Fern prothalli, which bear normally male and female organs, produce, when subjected to special treatment, male organs only, and so on.

In general, the numbers of "males" and "females" among MMFF and M*m*F*f*, zygotes, will be about equal, though wide departures from equality may occur in any species owing to the prevalence of conditions which favour the production of male or female organs.

The following types of zygotes will, it may be supposed, produce male sexual organs, MMF*f*, MM*ff*, M*mff*, and the following, female organs, M*m*FF, *mm*FF, *mm*F*f*; hence the number of males will equal the number of females produced by such zygotes.

The *mmff*, pure recessive type of zygote, if viable, is sterile. The origin of sexuality connotes an origin of sterility. To give examples of the application of the hypothesis to biological facts:—

A zygote of the MF type produces gametes of which all or some carry MF. Species which have MF gametes will be capable of exhibiting parthenogenesis (natural or induced). Certain of the lower algæ produce "gametes" which may fuse in pairs to form zygotes, or may develop directly into new individuals. Those which behave in the former fashion may be such as carry M*f* or *m*F, and those which develop directly may be the MF gametes.

Among moulds, certain species of Mucor exist as several races the individuals of each of which reproduce themselves asexually, but do not conjugate with one another. When, however, individuals of different races meet, they conjugate and produce zygospores. It may be supposed that one race is of such a type as MM*ff*, another of the *mm*FF type. In this case verification of the hypothesis is possible.

The absence of sexual reproduction in various groups of fungi is to be explained on the present hypothesis as due to the extinction (or effective separation) of all zygotes except those of one type, *e.g.* the M*f* or the *m*F types.

In homosporous ferns, the spores, produced after the reduction division, give rise each to a prothallus which bears male and female organs. If it be allowed that the reduction division is of fundamental significance with respect to the segregation of characters, it would appear to follow that current Mendelian theories of sex-heredity fail to account for the fact that a spore produced as a consequence of the reduction division may yet carry "male" and "female" factors.

The phenomena may be interpreted simply in terms of the new hypothesis. The fern plant is MMFF; the spore, and hence the prothallus, carries MF. Therefore male and female organs may be produced by the prothallus. The gametes formed and matured in the female organs are "female," those formed and matured in the male organs are "male."

In the heterosporous ferns the spores are of two kinds, macrospores, giving rise to "female" prothalli, and microspores, which give rise to "male" prothalli. In terms of our hypothesis the sporophyte (zygote) is M*m*F*f*, the megaspore *m*F, and the microspore M*f*.

Further, the high rate of mortality which accompanies spore-formation receives on this hypothesis an intelligible explanation. It is due to the inevitable reappearance of combinations of sex-characters which the heterosporous fern has ceased to tolerate.

In the light of the present hypothesis, homosporous ferns are homosporous because they are homozygous, and heterosporous ferns are heterosporous because they are heterozygous for the sex characters M and F.

The significant question arises, How far is the present limitation of characters presented by any great group of organisms determined by the fact that in this group the task of reproduction has come to be committed to some particular type or types of gametes?

The hypothesis would appear to throw light on large numbers of known facts, on prepotency, partial sterility—such, for example, as occurs in heterostylism—the apparently excessive production of pollen and ovules, and so forth.

Not only is it not repugnant to a reasonable explanation of many facts, but also the hypothesis does not seem to be inherently improbable. In that it is based on the presence and absence theory, it receives the sanction of Mendelism. It tempts the imagination to trace the origin of sexuality from the "self-contained" organisms of the MF type. Evolution in such types took, in some individuals, the form of a dropping out of the M, in others, of a dropping out of the F, factor. Such incomplete forms as M*f* and F*m* discovered in fusion the means of restoring their constitutions; but out of this fusion possibilities for novel constitutions arose, for the M*m*F*f* type of zygote was now in being. In reproducing by segregation the original MF type of gamete, the zygote was constrained to produce likewise the other possible combinations of M*m* and F*f*. Fusions between the several types resulted in different forms of zygote; evolution had its chance.

Among other types, the pure recessive, *mmff*, arose, and, with its advent, sterility, and, it may be, death, came on the scene as the sinister shadow of "sexual" reproduction.

It only remains to add to this note that—in case the hypothesis it proposes prove of value—though the responsibility for the hypothesis rests with the writer, the stimulus to which it owes its inception originated, in the first place, from a study of Bateson's work on heredity, and in the second place from discussions on the problems of heredity between the writer and his colleagues, Miss Rayner, Mr. Jones, and Miss Pellew, of the botanical laboratory, to whom certain of the foregoing illustrations are due.

University College, Reading. FREDERICK KEEBLE.

Geology and the Earth's Axis of Rotation.

FROM time to time the pages of NATURE contain references to the theory which would explain the occurrence of Ice ages by a hypothetical shifting of the earth's axis of rotation. On the face of it, the theory in question appears to be capable of explaining a good deal more than this.

In the first place, if the axis of rotation were to be shifted, it seems clear that the relations between the earth's hydrosphere (or hydrospheroid) and the lithosphere must undergo change. In the regions towards which the pole is approaching land will tend to emerge from the sea, and *vice versa.* If the effects of this supposition be traced out in detail, they will be found to furnish an explanation of such phenomena as raised beaches, submerged river valleys, varying continental connections, &c., without postulating violent alterations in the lithosphere itself. Speaking merely qualitatively, the hypothesis seems to fit the facts pretty closely, *e.g.* (*a*) the height of raised beaches tends to increase as one approaches the polar regions, as it ought; (*b*) a marine transgression is associated with a warm climate.

In the second place, a shifting of the polar axis will not be without effect on the lithosphere itself, although such effect would not, presumably, under present conditions, at all resemble the effect on the hydrosphere already alluded to. Even in a rough qualitative way this effect is not easily traced out, but it seems tolerably clear that it will account for those processes of folding, &c., whereby mountain chains are built up, and also for extensive local subsidences such as are believed to have occurred in geological time. These, and doubtless other phenomena, the hypothesis explains without having recourse to the supposition that the earth has been undergoing contraction through loss of heat.

I am not aware of the existence of any publications dealing with the matters referred to, but as the subject appears to be not without interest, perhaps some of your other readers will be able to refer me to papers, &c., treating of the subject with which they may be acquainted. I should be particularly glad to be referred to researches in which the subject is treated quantitatively.

HUGH BIRRELL.

Holyrood House, Bo'ness, Linlithgowshire, N.B., February 4.

Secondary Cells in Tropical Climates.

ALL who have used batteries of small secondary cells in the tropics will have experienced the difficulty of keeping their cells in efficient working order, and especially in preserving the junction of separate cells from rapid corrosion. The difficulty, appreciable in Europe, becomes very serious in a climate where the laboratory temperature lies between 30° and 40° C., and for this reason—it is probable that practically all accumulators sent to tropical countries by European manufacturers are filled by their recipients with dilute sulphuric acid of a density (1,190) which corresponds to a 20 per cent. mixture in north Europe at 15° to 20° C., but at a temperature of 30° to 35° C. indicates a mixture which is far too rich in acid for the health of the cells. Some simple experiments recently carried out in this laboratory exhibit quite clearly how large a deviation from the standard 20 per cent. mixture is caused by filling cells at 30° with dilute acid of density 1,190. It is found that a density of 1,190 at 30° corresponds to a composition of 23 per cent., whereas the value of the composition accepted as giving the best results with cells of this type is 20 per cent. The difference is as much as half the total change in composition due to chemical action during the process of charging the cell.

The conclusion reached from an examination of the density-temperature curves for dilute sulphuric acid points to the advisability of filling all secondary cells in localities where the average temperature is 30° or more with acid solution of density about 1.170. Densities as low even as 1,150 have been found satisfactory for small secondary cells in the hot weather in Calcutta.

In the case of large plants in power stations, the matter may be still more important, as a cell containing too strong an acid solution is likely, not only to live a shorter life, but to suffer sooner and more severely from sulphating and other diseases. E. P. HARRISON.

The Physical Laboratory, Presidency College, Calcutta, February 2.

The Invention of the Slide Rule.

DR. ALEXANDER RUSSELL's remarks on the invention of the slide rule (NATURE, January 13, p. 307) are of great interest, particularly his reference to Seth Partridge. There can be no doubt that Partridge deserves much credit for improving the rectilinear slide rule, but I see no escape from the conclusion that the real inventor of the rectilinear slide rule is the one who first made two Gunter's scales to slide together, for purposes of computation. The man who did this is Oughtred. In Mr. Sidney Lee's "Dic. of Nat. Biog.," article "Partridge, Seth," and in other publications, the incorrect statement is made that Partridge's book, "Description, &c., of the Double Scale of Proportion," first appeared in print in 1671 or 1672. I have a copy of the book bearing the date 1662. The manuscript was finished "Saturday night, August first 1657." In 1662 Partridge's rules were manufactured, not by Walter Hayes, but by "Anthony Thompson, living in Hosier-Lane near West Smithfield, in London."

There is another point of interest. The earliest account of the rectilinear slide rule, printed in Germany, is in Leupold's "Theatrum Arithmetico-Geometricum," Leipzig, 1727, p. 71. Leupold says that he had a manuscript of ten sheets, describing it, but that he did not know the name of the author or the inventor of the instrument. Leupold's description consists of translation, word for word, of extracts from Partridge's book. Thus a historic connection is established between the rectilinear slide rule in England and in Germany. FLORIAN CAJORI.

Colorado Springs, Colorado, February 7.

Aged Tadpoles.

THE experience of your correspondent Mr. John Don (February 17, p. 458) is no new one. More than twenty years ago we had in a small aquarium in the Charterhouse Museum a tadpole two years of age. To the best of my recollection this veteran never acquired any legs, either hind or front, but the head and body were extraordinarily large. At the present moment I have in my laboratory seven living tadpoles reared from spawn deposited last spring. Of these, three only have developed hind legs. These appendages appeared rather suddenly in December, a few days after I had supplied, for the first time, some fragments of hard-boiled egg.

The secret of procuring these aged tadpoles is to keep the animals in a vessel with vertical sides, and to afford as little opportunity as possible for them to wriggle into shallow water. I maintain a depth of about 5 inches of water in the aquarium, and find that a subdued light favours the health of the tadpoles. Sexual maturity can hardly be expected until at least the normal period has elapsed, viz. in the third or even fourth year.

OSWALD H. LATTER.

Charterhouse, Godalming, February 18.

Title of the Natural History Museum.

IN NATURE of February 17 you say (p. 465):—"No one, so far as we know, has suggested a suitable and adequate title for the [museum] at South Kensington" (devoted to natural history). This is not a difficult question; I think "British Museum of Natural History" is both suitable and adequate. BERNARD HOBSON.

Tapton Elms, Sheffield, February 18.

THE NEW CANALS OF MARS.

THE word "new" when applied to a celestial phenomenon may be used in either of two senses. It may mean new to earthly observation, *i.e.* one which has never been seen by human beings before, or, secondly, new in itself, that is, one which has had no previous existence. New canals on Mars in the first sense, though always interesting, and at times highly important, are no novelty at this observatory, inasmuch as some four hundred have been discovered here in the last fifteen years. When Schiaparelli left his great work, he had mapped about 120 canals; with those detected here since, the number has now risen to between five and six hundred. Each of the four hundred thus added to the list, however rich an acquisition at the time it first came to be noticed, was not necessarily otherwise remarkable.

To observe, however, a canal new in the second meaning of the word, one, that is, that had never existed anteriorly, and to prove the fact, is an astronomical detection of far-reaching significance for the bearing it has upon the whole Martian question.

On September 30, 1909, when the region of the Syrtis Major came round again into view, after its periodic hiding of six weeks due to the unequal rotation periods of the earth and Mars, two striking canals were at once evident to the east of the Syrtis in places where no canals had ever previously been seen. Not only was their appearance unprecedented, but the canals themselves were the most conspicuous ones on that part of the disc. They ran one from the bottom of the Syrtis (lat. 20° N., long 285°), the other from a point part way up its eastern side (lat. 17° N., long 284°), and, curving slightly to the left as they proceeded south, converged to an oasis, itself new, on the Cocytus (lat. 5° N., long 265°), about two-thirds of the distance to where that canal meets the Amenthes. The Amenthes itself was not visible, except possibly as a suspicion. With the two main canals were associated several smaller ones, and at least two oases which had never been seen before, and from the interconnection of all of them these clearly made part of the new piece of Martian triangulation.

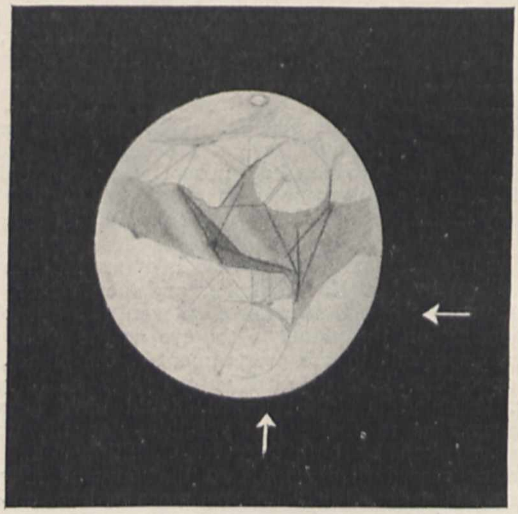
The phenomena were recorded in many independent drawings by Mr. E. C. Slipher and the director, and in the course of the next few days were photographed, appearing on the plates to the eye as the most conspicuous canals in the presentment of the planet. It is opportune that detailed photography of Mars in Mr. Lampland's skilful hands should have been so perfected as to make this possible; for the photographs taken by both Mr. E. C. Slipher and the director record these canals so that anyone may see them. There are thirty images, more or less, on each plate, and the canals appear on every image; on some more distinctly than on others, owing to the state of our air at the time, but recognisably on all; for each image had a pose of about two seconds and a half, and its definition varied according to the seeing at the time. Owing to the grain of the plate being much coarser than that of the eye, the two canals appear merged in one in the photographic images as a single line, its linear character, however, being quite distinct to one of good eyesight.

The photographs of this region taken in 1907 show no such feature.

No remembrance of ever having seen them before could be recalled by either observer, both being familiar with the planet, except that Mr. Slipher turned out to have drawn one of them the evening previous.

The record books were then examined, when it appeared that not a trace of them was to be found in the drawings of August, July, June, or May when this part of the planet was depicted. That they had not been observed in previous years was then conclusively ascertained by examination of the records of those years. The record of canals seen here is registered after each opposition in a fresh map of the planet's surface. This has been done since the beginning of the critical study of Mars at this observatory in 1894. Now, when these maps came to be scrutinised for the canals, each of them failed to show any such features. Nor had any observer previous to 1894 recorded them, as the observatory library of the subject bore witness. Schiaparelli had never seen them, nor had his predecessors or successors. This determined definitely that no human eye had ever looked upon them before. But, stirring as it is to know that one is the first to see a new geographical feature on another planet, akin to the thrill of finding unknown land in our own Antarctic regions, a much deeper scientific interest attaches to the question whether a phenomenon previously undiscovered was also previously non-existent. For in that case one has seen something come into being, with all that such origination implies.

It might seem to persons not versed in the subject that its absence on the charts was proof that a canal was itself new in the second sense because it was so in the first; but study of Mars has shown that this cannot be taken off-hand for granted. Several points must each be carefully considered. In the first place, one must be sure that the phenomenon could have been seen before, yet was not. It must be of a size which could not have escaped detection previously. Now, the great majority of canals discovered here were beyond the hope of detection elsewhere, owing to the character of the air, the improvement in instrumental means, and the long acquired knowledge of the observers. That they were not seen by Schiaparelli, therefore, by no means implies that they did not exist in his day—or even in the earlier days of observation here. We see to-day vastly more than we did in 1894, because of the experience acquired since. In the present case, however, this possibility of error was excluded by the size of the canals in question. They were not difficult detail of the order here mentioned, but, as I have said, the most conspicuous on the disc, canals which no observer of any standing whatever in good air could possibly pass by. They would strike any skilled observer of such matters the moment he looked at the planet. So far as this point went, then, they could not have existed before.



New Canals on Mars, November 4 (Prof. Percival Lowell).

The next point to be considered was whether they were results of a characteristic of the planet of vital import in its cartography—the annual seasonal change which affects all its features. For the world of Mars is as subject to recurrent seasonal change as our own, and more markedly so. This change stamps itself unmistakably upon all its features, obliterating some and bringing into prominence others according to the time of the Martian year. Examples of this occur in the study of Mars regularly at each opposition, the aspect of the disc varying according to a definite law dependent on the Martian season. To be sure, therefore, that a canal is itself new, the planet must have been previously carefully depicted at the same season of its year, and then when these earlier drawings are critically scanned the canal in question not found recorded on them. Now, the possibility of definite and conclusive intercomparison of the sort is not presented so frequently as one might think. Mars comes to opposition each time later and later by about two and a quarter of our own months. This means that we meet him in a different part of his orbit at each fresh approach, and so at a different season of his year. Now, until Schiaparelli's time, it was at or near opposition only that his face was studied. Schiaparelli extended the time greatly, but not until the subject was taken up at Flagstaff was the period of observation prolonged to six and eight months for each opposition epoch, thus enabling the same Martian season to be recurrently viewed by the seasonal overlapping of two or more observation periods.

But even so, the disc is not equally well presented in successive Martian years, because of the differing distances the two bodies are apart, and the difficulty of consequent comparison on the score of size. Still another difficulty in the way of parallelism is that of phase. Unless the two bodies be exactly opposite at the same season of the Martian year in the two cases, Mars will show a differing phase at each, and this means a different slant in the illumination. This is a very important distinction, because the disc shows very diversely when illuminated from above or from the side, so diversely that faintness of detail has often been attributed to intrinsic weakness of feature when illumination itself was the cause.

In consequence, the observer can never be quite sure that his data are comparable until he has himself seen the Martian disc under like conditions, or nearly such, which recurrent presentations demand a lapse of fifteen to seventeen years.

Furthermore, to be conclusive, the observations must all have been made by the same observer, working under like conditions, and grown, in consequence, familiar with every detail of the disc, since the personal equation, including by that term the site and the instrumental methods and equipment, is always a factor. A Martian cycle, that is, a round of about sixteen years, must have been gone through by the same observer before definite judgment can be pronounced. Such a cycle now stands complete at Flagstaff.

Examining the records here we find that Mars was observed four times previously at the same season of the Martian year as occurred during the epoch of the appearance of these two canals. The canals were seen at this opposition as follows:—

	1909	☉	In Martian relative chronology Northern Hemisphere	Hel. long. of planet	Opposition
First appearance	Sept. 30	277°	Jan. 6	4° 50′	Sept. 23, 1909
Last observed	Dec. 12	320°	Feb. 17	47° 43′	

The previous occasions on which the canals should have been visible, if their appearance or non-appearance were a consequence of the Martian season, were:—

	☉	Martian date	Opposition
1894 Sept. 8	277°	Jan. 6	Oct. 20, 1894
to			
Nov. 18	320°	Feb. 17	
1896 July 25	277°	Jan. 6	Dec. 10, 1896
to			
Aug. 23	320°	Feb. 17	
1898 July 12	295°	Feb. 9	Jan. 18, 1899
to			
Aug. 23	320°	Feb. 17	
1907 Nov. 12	276·5°	Jan. 6	July 5, 1907
to			
Jan. 25	320°	Feb. 17	

During all these periods the planet was kept under observation at Flagstaff, and during none of them were any such canals recorded. We are, therefore, sure that seasonal change cannot explain them, and that two years ago, and also eleven, thirteen, and fifteen years ago, no such canals existed. In Martian chronology this means that not only did they not exist in their present state during the previous Martian year, but also not four, five, and six Martian years before that. It is also fairly sure that they were not in existence thirty and thirty-two years ago, inasmuch as Schiaparelli never saw them.

Lastly, a further point disclosed by the Flagstaff observations must be reckoned with, a point of very singular significance. It was long ago discovered there that (see Bulletin No. 8 of the Lowell Observatory), while the great majority of the canals are quickened into conspicuousness alternately every six Martian months, first from the south and then from the north polar cap, certain ones respond only to one or the other cap, remaining inert to the action of its antipodal fellow. To be sure, therefore, that the new canals were really new to Mars, the old drawings had to be examined on this score too. Here again the records were decisive. No such canals had ever appeared before from the quickening of either cap at the time when, had they existed then, they should have showed.

The canals in question, therefore, proved to be, not simply new canals to us, but new canals to Mars. In the canal system they are *novae* in fact or function, and as such are the most important contribution to our knowledge of the planet of recent years. For let us see what they imply. In form they are like all the other canals, narrow, regular lines of even width throughout, running with geometric precision from definite points to another point where an oasis is located. This oasis resembles all the other oases, a small, round, dark spot. They partake, therefore, of all the peculiar features of the canal system, features which I have elsewhere shown make it impossible of natural creation, that is, of being the result of any purely physical forces of which we have cognisance. On the other hand, the system exactly resembles what life there would evolve under the conditions we know to exist. The present phenomena, then, show that the canals are still in process of creation, that we have actually seen some formed under our very eyes.

Thus, on every point which had to be considered, the records furnished conclusive evidence that the canals in question could not have existed in past Martian years in the condition in which we observe them to-day. Their previous non-visibility could not have been due to any of the causes which might possibly affect it, to wit:—(1) Want of size; (2) any personal equation of the observer; (3) improved instrumental or atmospheric means; (4) distance (all these are negatived by their striking conspicuousness); (5) phase; (6) regular seasonal change; and last (7) unihemispheric seasonal change.

It will be perceived that the proof that these canals are *novae* has been possible, and only possible, through the long systematic work done on the planet here for the last fifteen years. Without such a complete system of records the certainty that the canals in question were new canals *to Mars* could not have been reached.

PERCIVAL LOWELL.

Lowell Observatory, Flagstaff, A.T.

PROPERTIES OF POLONIUM.

THE statements regarding polonium which appeared in the report from Paris reprinted from the *Times* in NATURE of February 17, must have surprised many readers to whom polonium has been a familiar substance for the last ten years. It may be of interest to review briefly our present knowledge of polonium and the bearing of the recent work of Mme. Curie and Debierne upon it.

Polonium was the first of the active substances separated from pitchblende residues by Mme. Curie. Various methods of concentration were devised by her, with the result that preparations of polonium mixed with bismuth were early obtained many thousand times more active than uranium. Marckwald later separated from 15 tons of pitchblende about 3 milligrams of intensely active material which he called radio-tellurium, since it was separated initially with tellurium as an impurity. By dipping a copper plate into a solution of this substance, he obtained a deposit of weight not more than 1/100 milligram, which was far more active than an equal weight of radium. It was soon recognised that this preparation was identical with polonium, for it gave off the typical α radiation, and had the characteristic rate of decay of that substance. Unfortunately, Marckwald was not aware at the time of separation of the great importance of testing whether lead appeared as a product of transformation of polonium. Before such an experiment could be made, the polonium had to a large extent been transformed.

Polonium is one of the numerous transition elements produced during the transformation of the uranium-radium series. It is half-transformed in about 140 days, emitting α particles during the process. Rutherford showed in 1904 that polonium was in reality a transformation product of radium itself. Radium at first changes into the emanation, and then successively into radium A, B, C, D, E, F, radium F being identical in all respects with the polonium directly separated from a radio-active mineral. When the radium emanation is allowed to decay in a sealed glass tube, the walls of the tube are coated with an invisible deposit of pure radium D, radium E, and radium F, but the amount of the latter to be obtained in this way is far too small to be weighable.

The amount of polonium present in any radio-active mineral can easily be calculated. Since the radium and polonium (radium F) in a mineral are in radio-active equilibrium, the same number of α particles are expelled from each per second. Since polonium is half-transformed in 140 days and radium in 2000 years, the former breaks up 5000 times faster than the latter. The maximum amount of polonium to be obtained from a mineral is in consequence only 1/5000 of the amount of radium. In 1000 kilos. of pitchblende containing 50 per cent. of uranium, there are present 170 milligrams of radium. The weight of polonium is about 1/5000 of this, or about 1/30 milligram. It is thus obvious that to obtain 1/10 of a milligram of pure polonium, several tons of high-grade pitchblende must be worked up. The most natural source of polonium is radium D (radio-lead), which grows polonium and has a period of half-transformation of about twenty years. Since polonium breaks up about 5000 times faster than radium, its activity, weight for weight, should be about 5000 times greater than that of radium. There is nothing surprising in this, for the radium emanation has an activity about 200,000 times that of radium, while radium A (period three minutes) must have an activity 400 million times that of radium itself. Since the radiation from polonium is entirely in the form of α rays, it is to be expected that the radiation from it would show chemical and physical effects identical with those observed for pure emanation, the only difference being that the products of the latter emit β and γ rays as well.

Apart from the interest of obtaining a weighable quantity of polonium in a pure state, the real importance of the present investigations of Mme. Curie lies in the probable solution of the question of the nature of the substance into which the polonium is transformed. This problem has been much discussed in recent years. Since polonium emits α particles, one of its products of decomposition, as for all the other α-ray products, should be helium. The production of helium from a preparation of polonium has been observed by Rutherford and Boltwood (Manchester Lit. and Phil. Society, November 30, 1909), and also by Mme. Curie and Debierne in their present experiments. Boltwood several years ago suggested that the end product of the radium series was lead, and has collected strong evidence in support of this view by comparing the amount of helium and lead in old radioactive minerals. Since polonium is the last of the active products observed in the radium series, it is to be expected that polonium should be transformed into helium and lead, one atom of polonium producing one atom of helium and one atom of lead. This point of view receives additional weight from consideration of the atomic weight to be expected for the end product of radium. Since in the uranium-radium series, seven α particles, each of which is an atom of helium of atomic weight four, are successively expelled before radium F is reached, the atomic weight of polonium should be $7 \times 4 = 28$ units less than uranium (atomic weight 238·5). This gives an atomic weight of polonium of 210·5, and after the loss of an α particle, a final product of atomic weight 206·5—a value very close to the atomic weight of lead.

It is a matter of very great interest and importance to settle definitely whether polonium changes into lead. The evidence as a whole has long been in favour of that supposition. The outlook is very promising that the experiments of Mme. Curie and Debierne will settle this question conclusively. No doubt, an interval must elapse to allow the polonium to decay before the final examination of the residual substance can be made. E. RUTHERFORD.

THE DISCOVERY OF A SKELETON OF PALÆOLITHIC MAN.

DR. CAPITAN and M. Peyrony are to be congratulated on another important discovery of the remains of Palæolithic man on September 17, at Ferrassie, in Dordogne, a locality which has been made famous by the investigations of M. Peyrony during the past decade. Here he has discovered and studied five distinct layers, each containing the artifacts and animal remains of as many well-defined epochs. In ascending order these are:—(1) Acheulian, (2) Mousterian, (3) Lower Aurignacian, (4) Middle Aurignacian, and (5) Upper Aurignacian. The skeleton, which is described by Dr. Capitan in *La Nature* for December 25, 1909, was found between the layers 1 and 2, and as these and the three upper layers were absolutely intact, it is certain that the remains belong to the Mousterian epoch. The first bones seen were the ends of a tibia and femur, and before excavating further an invitation was sent to a number of French archæologists to witness the exhumation. With infinite care and precautions, an entire skeleton was revealed. It lay on its back, with the trunk turned slightly to the left; the legs were strongly flexed, the knees being turned to the right; the left arm was extended along the side, with the hand at the hip; the right arm was flexed, the hand being near the shoulder, and the head was turned to the left, the mouth being open.

The skeleton was photographed *in situ*. Around, above, and beneath were a large number of bones which had served as food for and had been broken by the Mousterians, as well as teeth of bisons, deer, goats and reindeer; the artifacts included points, knife-scrapers, disks, hammers, and bone-breakers of quartz of the Lower Mousterian type (that is, worked on one face only).

The long and small bones were carefully removed. The pelvis, thorax and skull were severally covered with tinfoil, and plaster was poured around each, so that when the plaster set they could be removed without injury. Thus protected, they were taken to Paris without further damage or loss. The restoration, mounting, and study of the skeleton are being undertaken by Dr. Capitan. As no anatomical details have as yet been given concerning the find, anthropologists will have to wait with what patience they can muster until the investigations are completed.

The attention of readers of NATURE has been directed at various times to the recent finds of Palæolithic man, but as this is the first whole skeleton which has been obtained of a Mousterian man, the discovery is one of prime importance.

There is no reason to doubt that the body was definitely placed where it was found; probably it was placed in a corner of a large rock shelter, and covered with earth, stones, and perhaps branches. The shelter was occupied later by generations of men of the Aurignacian epoch. Finally the overhanging chalk roof fell, and its débris subsequently became covered by a layer of stones and earth five feet in thickness. Thus protected, it has remained for 20,000 years. A. C. H.

TROPICAL AGRICULTURE.[1]

THIS work does not claim to be a handbook for the technical man, but to give information of value to students, administrators, and others on tropical crops, and at the same time to present the political and theoretical aspects of the subject.

Part i. (pp. 1–39) deals with the "Preliminaries to Agriculture." Such topics as soil, climate, labour, transport, capital, supply of water, tools, and plant acclimatisation are briefly discussed, frequently by drawing contrasts between the less known conditions of the tropics and the better known conditions of temperate regions.

Part ii. (pp. 40–141), approximately half the volume, is devoted to the "Principal Cultivations of the Tropics." This is, in our opinion, the least satisfactory portion of the book. The principal industries of Ceylon, with which the author is closely acquainted, are well done. The accounts of rice, coffee, tea, cocoanuts, and Para rubber, are admirable, although for a work dealing with the tropics as a whole Ceylon

[1] "Agriculture in the Tropics." An Elementary Treatise. By Dr. J. C Willis. Pp. xviii+222. (Cambridge: University Press, 1909.) Price 7s. 6d. net.

looms larger than it should, and there is a tendency to ignore methods not practised there. Thus, in a general account of coffee, the "dry" method of preparation should certainly be described, considering the extent to which it is employed in Brazil, by far the greatest coffee-producing country. The Brazilian method of preparing Para rubber is not referred to. Similarly, very scanty attention is given to crops, *e.g.* maize, Guinea corn or sorghum, and cassava, to confine attention to food-stuffs which are very important over large areas of the tropics, although, it is true, but little grown in Ceylon. In some cases condensation has been carried so far as to render the account quite inadequate, and sometimes even misleading. To give one instance, in the chapter on rubber we find: "Lagos rubber, *Funtumia elastica*, has been a little planted in some of the British West Indian and West African colonies, but as yet no rubber has been exported." From this, the sole reference to this plant, no one would realise that the tree is wild over wide areas of West Africa, and yields large quantities of exported rubber, and, moreover, that it is also wild in Uganda, whence a moderate quantity of excellent rubber has recently come on the market.

Making Copra in Samoa. From "Agriculture in the Tropics."

Striking examples of a lack of perspective are met with in the very brief notes on dyes and tans. In the former, after describing indigo and annatto, we find a list of "other dye stuffs of more or less local importance," in which occurs logwood! Cutch, from *Acacia Catechu*, is described as "perhaps the most important" of tanning substances, but why even in the brief list of other tans is there no mention of myrabolans (fruits of Terminalia, spp.)? Both are Indian tans, and in 1908, whilst the export of cutch was worth approximately 100,000*l*., that of myrabolans was nearly 400,000*l*. Several other similar instances might be quoted, and they detract considerably from what is otherwise a good, though somewhat restricted, survey of tropical agricultural industries.

Part iii., on "Agriculture in the Tropics (General)," and part iv., on the "Organisation of Agriculture," are distinctly interesting and valuable. They present the chief economic problems, including agricultural education and cooperative movements, with which the planters, administrative officers, and others have to deal, and suggest general lines along which the development of a tropical agricultural country should proceed to secure the best permanent advantage to both peasant and capitalist planter. These sections are well worth the careful study of all engaged in practically dealing with, or merely interested in, the broad administrative problems of the tropics. Such study should prevent much loss of time and money from misdirected efforts, and help to secure that continuity of policy without which even the best intentioned efforts come to naught. A book which presents these fundamental problems, and deals with them so well as Dr. Willis has done here, is a noteworthy addition to the literature of tropical agriculture.

W. G. F.

REFORM OF THE CALENDAR.

SEÑOR C. A. HESSE, of Iquique, Peru, sends us an ingenious scheme for what he calls the reform of the calendar. It has, however, nothing to do with the Julian or Gregorian styles, or any modification of the latter, now used in all Christian countries except those of the Oriental Church, which still follow the Julian usage. But it is a plan, similar to one put forth in England a year or two ago, for making the days of the week and month correspond throughout the year. This he does by dividing the year into 13 months of 28 days (or 4 weeks) each; and as that would reduce the whole year to 364 days, he proposes two intercalations, one of a zero day, and another of what he calls a double zero day.

Plans of this kind would, if adopted, cause more trouble than they would save, besides interfering with the perpetual succession of the seventh day of the week. In endeavouring to adjust the ecclesiastical calendar according to his system, Señor Hesse gives at the end a table of the dates of the feasts in 1912 as now regulated and as proposed by him. They are, indeed, inadmissible. As to taking Easter a week later, that is of less consequence; but he puts Pentecost (Whit Sunday) 54 days after Easter and 13 days after Ascension Day!

It is to be hoped that some day the whole Christian church will come to an agreement to take Easter always on the first or second Sunday in April, adjusting the other movable feasts thereby. But as regards the days of the week and year, it would be a great mistake to tinker with them; and so-called zero days would produce most serious confusion.

It is a remarkable thing that the apocalyptic book of Enoch makes the year contain only 364 days, though it must have been known, according to any probable date of the composition of even its first part, that the integral number was 365. That, not being a multiple of 52, we must adjust the days of the week as we can. To increase the number of the months would be deplorable from many points of view. It would have been better if Julius Cæsar's first proposal about the respective lengths of the twelve months had been retained rather than the subsequent modification of Augustus; but to alter this now would give much more trouble than it would save. W. T. LYNN.

NOTES.

THE paper by Captain Tilho on the French mission to Lake Chad, which was read before the Royal Geographical Society on Monday evening, February 21, contained much interesting information about the hydrography of the Chad region. On arriving in the vicinity of the lake in 1908, the mission learned that caravans were crossing on dry land the northern portion of the lake-bed, where in 1904 Captain Tilho had navigated an open expanse of water; that the central portion was merely a marsh; but that in the southern portion channels which had formerly been closed to navigation had again become practicable. Summing up the results of the mission's investigations, Captain Tilho described Lake Chad as a closed depression about four-fifths the size of Belgium, entirely independent of the rivers that flow into the Atlantic and the Mediterranean. The average depth of the lake is 5 feet. Its shores are ill-defined, the slope being so slight that small variations in the level suffice either to submerge or to leave bare large areas of the lake-bed. Even the wind may produce these results. The waters of the lake are renewed for about a tenth part by the rainfall, and for about nine-tenths by the rivers that drain into the lake, principally the Shari and the Komadugu. Losses are due to evaporation and infiltration. In the present state of knowledge it is impossible to formulate a law governing the rise and fall of the lake, but there is no reason to suppose that it is likely to disappear. A problem which has exercised the minds of geographers is whether Lake Chad occupies the lowest part of the immense plain of which it is approximately the centre. The observations of the French mission show that to the north-east of the lake there is a series of plains of considerably lower altitude. The country falls about 200 feet in a distance of less than 250 miles.

THE Rev. G. F. Whidborne, who died on February 14, aged sixty-four, was an enthusiastic amateur geologist who endeared himself to a large circle of friends. Since 1876 he had been a Fellow of the Geological Society, and for many years, as a member of council, he took an active interest in the society's affairs. He was also a member of council of the Palæontographical Society, and was several times elected a vice-president. He was interested in many lines of geological research, but devoted himself especially to the study of fossil Invertebrata. In 1883 he contributed to the Geological Society's Journal a paper on new Mollusca from the Inferior Oolite, and between the years 1888 and 1898 he published three volumes on the Devonian fauna of the south of England, included in the monographs of the Palæontographical Society. In later years he was also attracted to more general questions, and became an active member of the Victoria Institute, to the journal of which he contributed two papers. Mr. Whidborne's genial presence was always welcomed at the scientific meetings he attended, and his memory will be cherished by all who had the good fortune to be associated with him.

THE late Mr. R. Marcus Gunn, the eminent ophthalmic surgeon, devoted much of the leisure of his vacations to making a collection of fossils, which he left to the British Museum (Natural History). He worked especially in the Jurassic formations of Sutherland, and at the time of his death was engaged in the preparation of a memoir on the Jurassic flora of Brora, in collaboration with Prof. A. C. Seward, who is now completing the undertaking. He obtained many fish-remains, Mollusca, and other fossils, which form a valuable addition to the national collection. Mr. Gunn also collected from the Old Red Sandstone of Caithness, and will always be remembered for his discovery of the problematical fossil fish *Palaeospondylus gunni*, which was named after him by Dr. Traquair.

THE following awards of the Mary Kingsley medal have been made by the Liverpool School of Tropical Medicine:—Mrs. Pinnock, in recognition of the services rendered to the cause of tropical medicine and sanitation by her brother, the late Sir Alfred Jones, founder and first chairman of the school; Mr. W. Adamson and Prof. W. Carter, for assistance rendered in the foundation of the school; Prince Auguste d'Arenberg, president of the Suez Canal Company, for his campaign against malaria at Ismailia; Sir William Macgregor, Governor of Queensland, for his services to sanitation and tropical medicine while Governor of Lagos; Surgeon-General Walter Wyman, head of the Marine Hospital Service of the United States, for the organisation which he has given to the service under him and for the manner in which he has always supported scientific principles in public sanitation; Sir Alfred Keogh, recently Director-General of the Royal Army Medical Corps, for the organisation which he has given to the service under him and for the manner in which he has always supported scientific principles in public sanitation. The medal for valuable contributions to the scientific and educational side of tropical medicine has been awarded to Prof. R. Blanchard, Paris; Dr. A. Breinl, director of the Tropical Diseases Institute in Queensland; Prof. A. Celli, Rome; Dr. C. W. Daniels, director of the London School of Tropical Medicine; Surgeon-Colonel King, Indian Medical Service; Prof. Nocht, director of the Hamburg School of Tropical Medicine; Prof. G. H. F. Nuttall, Quick professor of parasitology at Cambridge University; Major L. Rogers, Indian Medical Service; Prof. J. L. Todd, associate professor of parasitology at McGill University.

BY Colonel C. R. Conder's all too early death on February 16, science and geography have suffered a great loss. When still a young subaltern of engineers he was selected to continue the survey of the Holy Land under the auspices of the Palestine Exploration Fund, and he amply justified the selection. He had a natural aptitude for surveying, and he and his assistants made an excellent survey of a large area of the Holy Land. The difficulties he had to encounter were not confined to those incident to the survey of a rugged and unmapped country; to these were added troubles with Turkish officials and with the inhabitants; but his tact and genial nature, combined with the knowledge of the people and language he soon acquired, his energy and enthusiasm, triumphed over all obstacles, and enabled him to carry out the work in a manner which reflected credit on him and on his country. His service in Palestine affected the rest of Conder's life. A man of his ability and energy naturally did not confine himself to his technical survey work and to the identification of Biblical sites. He threw himself wholeheartedly into the many questions which arose in connection with this work, and applied to them a keen and ingenious intellect and an unbounded industry. The interests and studies which Conder first took up in Palestine were pursued by him to the end of a hard-working life. While in the army his official duties were often important and arduous, but he spent almost the whole of his spare time in study and literary work connected with the Holy Land, and after his retirement he devoted himself entirely to this work. Conder spent a good many years on the congenial work of the Ordnance Survey; he did good work on some of the other varied duties of the Royal Engineers, and later on under the Irish Government, but his name will be remembered mainly through his survey, his numerous books, and memoirs on the Holy Land. The views he propounded do not command universal acceptance, but they were based on hard and conscientious work, on deep study, and on intimate personal knowledge of the Holy Land, and his works have added largely to our knowledge.

CYCLONIC disturbances have for some time past continued to arrive from the Atlantic with more than usual frequency, and since the commencement of February the British Islands have been constantly under the influence of boisterous, warm, and moist south-westerly winds, which have blown from off the open ocean. Barometrical pressure has been uniformly lower in the northern part of our area than in the south. The central areas of the disturbances have passed either to the north of Iceland or between Iceland and Scotland. The storm systems became more thoroughly developed from about February 17, when a fairly severe gale was experienced in our northern and western districts. On Saturday, February 19, another important disturbance arrived from the Atlantic, and the barometer fell considerably below 29 inches over the greater part of the kingdom, accompanied by strong gales in many places. This disturbance was passing away to the north-eastward when a fresh fall of the barometer set in on our west coasts, resulting in a very severe storm over the whole country on Sunday. The barometer at 6 p.m. was as low as 28·1 inches in the north-west of Ireland, and the mercury was below 29 inches over nearly the whole of the British Islands. The barometrical gradient was very steep in Ireland and over the southern portion of England, and the heaviest winds were probably experienced in the English Channel and over the North Sea, where, from the estimated strength of the wind, the rate attained fully 70 or 80 miles an hour. The wind reached its maximum strength on Sunday afternoon and evening, and the gale was particularly gusty. At Greenwich the anemometer registered 30·7 lb. on the square foot at 8.55 p.m.; but this force was not of long duration, the maximum force at other times during the gale being only about 23 lb. on the square foot. The gale was, however, one of the strongest experienced in recent years, and much damage was done both on land and at sea, accompanied by serious loss of life. Thunderstorms occurred on the night of February 20 in parts of England, and the whole character of the weather was extremely unsettled. Detailed accounts of the absolute wind velocity for various parts of the United Kingdom have not yet been received at the Meteorological Office, but the records when to hand will prove both valuable and interesting.

THE following officers have been elected for 1910 in connection with the Paris Bureau des Longitudes: President, Prof. H. Poincaré; vice-president, M. G. Bigourdan; secretary, M. H. Deslandres.

AT the annual general meeting of the Physical Society, held on February 11, Prof. H. L. Callendar, F.R.S., was elected president for the ensuing year; and Prof. S. Arrhenius, Madame Curie, and Prof. G. E. Hale were elected honorary fellows of the society.

SIR WILLIAM PREECE, K.C.B., Sir Joseph Swan, and Prof. G. Vernon Harcourt have been elected the first honorary members of the Illuminating Engineering Society. The first anniversary dinner of the society was held on Thursday, February 10.

AT 6.38 a.m. on February 18 a sharp earthquake was felt at Canea (Crete). The shock was accompanied by a subterranean sound and an undulating movement lasting about fourteen seconds. Several buildings were damaged in Canea and the neighbouring country. Two slight shocks were felt at Malta on the same date shortly after 6.0 a.m.

MR. A. D. HALL, F.R.S., delivered, on February 22, the first "Masters" lectures, established by the Royal Horticultural Society in memory of the late Dr. M. T. Masters. His subject was the adaptation of the soil to the plant; and he described the factors which induce a particular plant to confine itself in nature to one special type of soil, or cause a given plant to flourish in one garden while failing in another.

WE learn from the *Times* that the inhabitants of Gross-Lichterfelde, the native place of Otto Lilienthal, have decided to erect a monument to the memory of their countryman, who was amongst the earliest practical pioneers in aviation, and met his death in 1896 while making a flight at Gömberg, in the province of Brandenburg. The monument will be erected either on the hill on the slopes of which Lilienthal made his early experiments, or in the square on the bank of the Teltour Canal.

THE anniversary meeting of the Geological Society was held on Friday, February 18, when the officers were elected as follows:—*President:* Prof. W. W. Watts, F.R.S. *Vice-presidents:* Dr. C. W. Andrews, F.R.S., Mr. A. Harker, F.R.S., Mr. W. Monckton, and Prof. W. J. Sollas, F.R.S. *Secretaries:* Prof. E. J. Garwood and Dr. A. Smith Woodward, F.R.S. *Foreign Secretary:* Sir Archibald Geikie, K.C.B., Pres.R.S. *Treasurer:* Dr. Aubrey Strahan, F.R.S. The following medals and funds were presented:—Wollaston medal to Prof. W. B. Scott; Murchison medal to Prof.

A. P. Coleman; Lyell medal to Dr. A. Vaughan; Wollaston fund to Mr. E. B. Bailey; Murchison fund to Mr. J. W. Stather; Lyell fund to Mr. F. R. Cowper Reed and Dr. Robert Broom. The president delivered his anniversary address, which dealt with the antiquity of man.

THE report of the council was presented at the annual general meeting of the Institution of Mechanical Engineers on February 18. Among other matters of interest dealt with we notice that a grant of 200*l*. was made towards the cost of depositing at the National Physical Laboratory a set of British standard Whitworth- and fine-thread hardened plug screw-gauges, with other screw-gauges and measuring machines. An exhaustive research into the properties of some alloys of copper, aluminium, and manganese was completed at the National Physical Laboratory in May by Dr. W. Rosenhain, in conjunction with Mr. F. C. A. H. Lantsberry. This forms the ninth report of the Alloys Research Committee, and is now before the Institution for discussion. In view of the extremely heavy task of completely investigating a ternary system of alloys, the committee, under the chairmanship of Sir William H. White, is now limiting its researches at the National Physical Laboratory to the study of light alloys of aluminium, and is dealing, in the first place, with those containing zinc or nickel. Prof. H. C. H. Carpenter is continuing at the University of Manchester his research, referred to in the last annual report, on the production of castings to withstand high hydraulic, steam, and gas pressure. A report is expected towards the end of 1910. The summer meeting of 1910 of the institution will take the form of a joint meeting in Birmingham and London with the American Society of Mechanical Engineers. This occasion will afford members an opportunity of reciprocating the hospitality extended to them in the United States during the joint meeting of 1904.

DR. A. M. McALDOWIE read a paper before the Cotteswold Field Club on February 15 on field-notes on certain prehistoric remains near Cheltenham. The object of the paper was to show that many of the camps and barrows on the Cotteswold Hills, such as those of Leckhampton, Crickley, Coopers Hill, and others, were used in prehistoric times for observations of the rising and setting sun at the solstices and equinoxes. By the use of a series of diagrams he showed that the position of these monuments was in many cases in remarkable agreement with the solstitial lines. In the discussion which followed, the remarkable character of these coincidences was recognised, but the opinion was expressed that the suggestion that these camps and barrows were used for solar observations before they were utilised for purposes of protection and interment of the dead was improbable. The author referred to the curious custom of planting trees on barrows, possibly as homes for the spirits of the dead, and to the fact that a right of way very commonly was found to exist leading to the more important barrows, suggesting that they were scenes of assemblages for some religious purpose in early times.

WE have to welcome the first part of a new Yorkshire natural-history journal, in the form of the Proceedings, &c., of the Hull Junior Field Naturalists' Society. It contains a reprint of Mr. J. Ritchie's paper on the occurrence of the Arctic hydroid *Selaginopsis mirabilis* in British waters, and likewise of Mr. T. Sheppard's account of a specimen of the crustacean *Eryon antiquus* from the Yorkshire Lias.

To the February number of Witherby's *British Birds* Mr. C. E. Fagan, secretary of the natural-history branch of the British Museum, communicates a full memoir, accompanied by an excellent portrait, of the late Dr. R. B. Sharpe. In the same issue Dr. N. F. Ticehurst records the occurrence of a pair of black wheatears, or black chats (*Saxicola leucura*), at Rye Harbour between August 31 and September 16, 1909, both of which were killed. This is the first record in Britain of this south European and north African bird.

WE have received a copy of the report of the Yorkshire Naturalists' Union for 1909, reprinted from the January number of the *Yorkshire Naturalist*, from which it may be gathered that the work of that body is being carried on as energetically as ever. We have been struck by the statement that Mr. J. F. Musham "sent a brood of young pipistrelles taken in a bedroom in the Northallerton district," since this would seem to imply (although it may bear another interpretation) that the pipistrelle may produce several young at a time. Information on this point would be of interest.

IN vol. iii., part iv., of Records of the Indian Museum, Dr. N. Annandale describes and figures, under the name of *Alaptus magnanimus*, what is apparently the smallest known insect, the length of the type-specimen being only 0·21 mm. and the wing-expanse 0·85 mm. The only known specimen made its appearance in the field of vision while its describer was engaged in observing under the microscope certain organisms in oil-of-cloves. It proved to belong to the hymenopterous family Myrmaridæ, and to be nearly allied to Westwood's *Alaptus excisus*. As the insect was unlikely to be met with by any professed student of the Hymenoptera, Dr. Annandale considered that he was not justified in neglecting the opportunity of publishing a description.

Two articles in the February number of the *Popular Science Monthly* are devoted to an account of modern work on marine biology and oceanography. In the first of these Prof. C. L. Edwards gives an illustrated description of the Swedish marine zoological station at Kristineberg, near the village of Fiskebäckshil, on the west coast. Fiskebäckshil was first brought into prominence as a promising situation for the study of marine biology in 1835, and four years later Sven Lovén and others joined the colony of naturalists who were then working with the meagre resources afforded by the place. In 1877 the Kristineberg station was founded by the Danish Royal Academy of Science at the initiation of Lovén, who became director, and held the post until 1892, when he was succeeded by his friend Hjalmar Théel. The second article, by Prof. C. A. Kofoid, is devoted to the Museum für Meereskunde at Berlin, which was opened in 1906, and is designed to illustrate everything connected with the sea and its products.

THE perennial discussion as to the homology of the columella auris in Amphibia is renewed in a lengthy memoir by Messrs. B. F. Kingsbury and H. D. Reed in the *Journal of Morphology* (vol. xx., No. 4, November, 1909). This memoir constitutes the second contribution of the authors' work on the columella auris in Amphibia, and deals with the Urodela, of which a large number of types have been studied by means of serial sections. It will probably be long before unanimity of opinion is arrived at on this difficult question, but it is satisfactory to those who have been brought up in the old faith that the columella auris of amphibians is homologous with the hyomandibular of fishes to learn that this view is supported by the present detailed investigation.

APROPOS of the article on colour-blindness in NATURE of January 27, Mr. C. R. Gibson has forwarded us a reprint on "An Occasional Peculiarity in My Own Colour Vision" (Royal Philosophical Society of Glasgow, 1908). On three occasions he has failed to distinguish brilliant red objects or light until the colour has been accidentally brought to his notice, when the colour appears immediately to flash into his consciousness, and he experiences a feeling of amazement that he could have been oblivious to it. There is every reason to believe that, as a rule, his colour vision is normal. If this is the case, we must conclude that there is a temporary block in the transmission of the nervous impulses from the periphery to the cortex of the brain, and that the position of the block is in the higher cerebral portion of the visual path. Bordley and Cushing have recently brought forward evidence of alterations in the field of vision for colours in cases of increased intracranial pressure due to cerebral tumours. The existence of a special cortical "centre" for the perception of colours is the subject of dispute. That there must be cortical representation of the impulses engendering colour perception is a point which need not be laboured. The problem is rather that of the dissociation, or the nature of the association, of the mechanism of colour perception with that of light and form perception in the higher levels of the brain. Evidence such as that brought to our notice by Mr. Gibson helps to elucidate this problem, though more definite evidence is obtained from cases such as one admirably reported by Dr. Edwin Bramwell in the *Review of Neurology and Psychiatry* for this month (vol. viii., February). Here a cerebral abscess secondary to bronchiectasis involved the cortex of the occipital lobe, and was accompanied by fits with a visual aura and by hemi-achromatopsia.

THE production of rhizoid-like processes from cells of Spirogyra filaments when growing under unnatural conditions has been recorded by several observers from De Bary onwards. Evidence has tended towards the conclusion that these are malformations, and this opinion receives confirmation in a paper, by Dr. Z. Woycicki, which appears in the *Bulletin International de l'Académie des Sciences*, Cracow (October, 1909). In this case the ill effects are attributed to the gaseous atmosphere in the laboratory. A similar formation of rhizoids was induced in cultures of *Mougeotia genuflexa*, while the injection of gas into cultures of *Cladophora fracta* produced a crop of resting spores.

IT is a debated point whether modifications in plants induced by special physiological conditions can be inherited or not, and a number of experimental investigations, chiefly with lower organisms, have been made with varying results. An account of experiments with *Aspergillus niger*, carried out by Mr. K. Kominami, is published as vol. xxvii., art. 5, of the Journal of the College of Science, Tokyo University. The fungus was grown for several generations in a strong (6 per cent.) solution of common salt, and the cultures so obtained were compared with the cultures raised in normal media. With regard to germination, the conidia of the modified stock started more rapidly and strongly than those from the normal plants, and this superiority was maintained throughout ten generations. On the contrary, modifications of the organism produced in poisonous solutions did not appear to be transmitted to succeeding generations.

IN connection with a variety of plants which have been found to irritate the skin when handled by gardeners and others, Mr. J. H. Maiden, Government botanist for New South Wales, has commenced to collect and summarise evidence of authentic cases. In the *Agricultural Gazette of New South Wales* (December 2, 1909) Mr. Maiden deals with a number of plants—*Oenothera biennis*, L., *Hedera helix*, L., various Primulas, *Hyacinthus orientalis*, L., and varieties, *Thuja Douglasii*, *Agave americana*, and others—quoting specific instances of the irritation caused. He states that he has found literature relating to plants which irritate the skin—other than Rhus and Primula, which he dealt with in an earlier issue of the gazette referred to—exceedingly scarce or even wanting. Mr. Maiden would be glad of references or authoritative statements as to irritation or "poisoning" caused by any wild or cultivated plants.

IN the *Bulletin International de l'Académie des Sciences de Cracovie* for November, 1909, appears a paper on the mineral alstonite, by Dr. Stefan Kreutz, in which he discusses the vexed question whether this substance is a double salt or an isomorphous mixture of the three members of the group, aragonite, witherite, and strontianite. From a careful consideration of his own and earlier observations he concludes that the second view is probably correct, but acknowledges some as yet inexplicable discrepancies. He explains the complex twinning either as simultaneous twinning about both {110} and {130} or as repeated twinning about {110}, as in the case of alexandrite.

PROF. A. WOEIKOF contributes an extremely interesting and suggestive study of the sources of human food-supply to *La Géographie* (vol. xx., Nos. 4 and 5, pp. 225 and 281). After pointing out that the substitution of any manufactured substance for vegetable food is extremely improbable, inasmuch as plant life is capable of storing solar energy in a much more economical manner than any machine, the author emphasises the facts that scarcely any one kind of food is universally regarded as a necessary of life, while many kinds which are now regarded as necessaries by certain peoples were almost unknown to them a few generations ago. From an examination of the geographical and economic conditions, Prof. Woeikof concludes that meat will in the future become so expensive as to be practically unavailable as an ordinary food, and that the supply must sooner or later be drawn wholly from the vegetable kingdom. He is of opinion that the application of scientific methods will increase the productiveness of the agricultural land of the world to an almost unlimited extent.

IN the *Atti dei Lincei* (xix., 1), Dr. Umberto gives a short note on the solution of the hydrodynamical equations for two-dimensional steady motion in a region bounded by free stream lines, the remaining spaces being occupied by fluid at rest.

UNDER the title of "L'Énergie," a French translation of Prof. Ostwald's classical work has been added to the new scientific series published by M. Félix Alcan, Paris, under the editorship of Prof. Borel. The translator is M. E. Philippi, and the price is 3.50 francs.

FROM the *Annual Register* we learn that the American Mathematical Society now consists of 618 members, as against 601 at the beginning of last year. The library now contains nearly 3300 volumes, as against between one and two hundred nine years ago. The books can be borrowed through the post by members, and one of the aims of the library is to preserve as complete a record as possible of the growth of mathematics in America.

THE *Revue générale des Sciences* (xx., 23) contains a second article, by Prof. Frédéric Houssay, on the form and stability of fishes. The author has now made models representing different kinds of fish, tapering to the tail end in the form of circular or elliptic cones, and fitted with fins and tails similar to those on the actual fishes. He finds that the short conical forms are the most stable, that stability is in every case secured by means of the fins, and that for certain limits of velocity an elongated conical form becomes unstable under the conditions existing in nature.

Many who have had experience of magnetic survey work on land, but have never attempted observations at sea, will be interested in an article, by Dr. L. A. Bauer, in the December (1909) number of *Terrestrial Magnetism and Atmospheric Electricity* on some problems of ocean magnetic work. It deals with the arrangements adopted on board the United States survey ship *Carnegie* by Dr. Bauer. Each of the three instrments in use is arranged to determine two of the magnetic elements, and the reductions are made within a few minutes of the observations being taken, so that if there is any disagreement repeat observations may be taken at once. Recording and reducing are in every way facilitated by the use of printed forms, and results are to be published rapidly. Thus Dr. Bauer intends to give a summary of the voyage ending January, 1910, in the March number of *Terrestrial Magnetism*, and future work is to be dealt with in the same prompt fashion.

We have received a separate copy of a paper on two mercury manometers for small pressures, by Drs. Karl Scheel and Wilhelm Heuse, of the Physikalisch-Technische Reichsanstalt, which appeared recently in the *Zeitschrift für Instrumentenkunde*. The first of the two manometers is a slight modification of the instrument described by Lord Rayleigh in 1901. A U-tube provided with a bulb on each limb is filled with mercury up to the middle of the bulbs. Just above each mercury surface is a fine glass point, an image of which can be seen in the mercury. The tube is attached to a support, which can be tilted about an axis perpendicular to the plane of the tube by means of a screw, while the angle of tilt is determined by the mirror and scale method, the mirror being attached to the support. The glass points and their images are observed through a microscope. To increase the range of the instrument, in the second form of it one of the bulbs can also be moved up or down on the support by means of a screw, and the movement measured by means of a second mirror supported partly on the fixed, partly on the moving, bulb. By means of the two instruments the authors have determined the vapour pressure of water at low temperatures to a high order of accuracy.

The existence of a negative coefficient of expansion for silver iodide, first demonstrated by Fizeau, and confirmed by Rodwell, has not yet been explained by any satisfactory hypothesis. Grinnell Jones (*Zeitschrift für physikalische Chemie*, January 25) suggests that Richard's hypothesis of compressible atoms may have a bearing on this point. From this point of view the volume change of a substance owing to a rise of temperature is the algebraical sum of the volume changes, the increase of the intramolecular space owing to the increased molecular vibration, the increase due to the diminution of cohesion, and a positive or negative volume change owing to an alteration in the mutual chemical attraction of the atoms. In the present paper it is shown that the affinity of silver and iodine increases with the temperature, and it is suggested that it is the resulting contraction which causes the negative expansion coefficient of silver iodide.

In view of the extreme fewness of the insoluble salts of sodium, exceptional interest attaches to the observations of Mr. W. C. Ball, as described in the Journal of the Chemical Society (December, 1909), to the effect that the nitrite $5Bi(NO_2)_3,9CsNO_2,6NaNO_2$ is substantially insoluble in water, whilst the corresponding potassium salt is soluble. The use of bismuth-cæsium-potassium nitrite provides a reagent by means of which small amounts of sodium may be detected and estimated in the presence of large quantities of potassium—a great advance on the indirect methods that have usually been employed. The reagent is made by dissolving 50 grams KNO_2 in 100 c.c. of water, neutralising with nitric acid, and adding 10 grams of powdered bismuth nitrate. To this liquid a 10 per cent. solution of cæsium nitrate is added until the sodium present in the KNO_2 has been precipitated; the solution is then filtered, and the cæsium salt added to a total of 2·5 grams. The method may be varied to detect cæsium by the use of bismuth sodium nitrite as a reagent, the precipitate having the same composition as in the previous case; rubidium may also be detected, but the test is less sensitive.

The problem of the best method of dumping stone, dirt, or other spoil into water is of particular interest in Stockholm, where rock-blasting and removal is being carried out continually for extensions to the harbour or to the streets. We learn from a note in *Engineering* for February 18 that a new form of automatic dumping apparatus has been designed and constructed by Mr. A. F. Wiking, of Stockholm. This self-dumping barge is built with a flush deck having low bulwarks on three sides, the fourth side being either left open or provided with doors which are opened by the pressure of the load on deck when the barge tilts over for dumping. The self-tilting of the barge is obtained by forcing water, by means of compressed air, into a cylindrical tank, which is carried on tripods at a height of about 16 feet above the deck. The admission of water to this tank upsets the stability of the barge, with the result that it tilts over and discharges its load. Arrangements are also provided for returning the water from the elevated tank after dumping is completed, so as to enable the barge to return to an even keel.

The large ice-making plant recently set to work at Grimsby by the Linde British Refrigerating Company, Ltd., is described in the *Engineer* for February 18. The plant is on the ammonia compression system, and consists of two steam-driven ammonia compressors, two belt-driven treble-ram water pumps, two ammonia condensers, two can ice-making tanks and brine refrigerators, centrifugal brine-circulating pumps, electrically driven cranes, ice crushers, and elevator. There is an insulated cold store of about 13,000 cubic feet capacity, and an ice store capable of holding 1100 tons of ice, both stores being cooled by means of pipes, through which cold brine is circulated by rotary pumps. The compression plant is driven by a Morley's patent cross-compound steam engine, designed to use highly superheated steam, and is provided with exceptionally large bearing surfaces, as it has to run six or seven months at a stretch without stopping. The results of trials show 9·56 lb. weight of steam per indicated horse-power per hour when producing 208 tons of ice per day of twenty-four hours; 5·12 lb. of ice were made per pound weight of steam The ice-making performance of the plant is about 41 tons of ice per ton of coal, a very creditable performance, which has not been approached by any other type of refrigerating machinery.

Messrs. Friedländer, of Berlin, have sent us copies of seven catalogues of scientific publications, devoted, respectively, to various branches of palæontology, geography, and physiography.

MESSRS. MACMILLAN AND CO., LTD., have published the mathematical papers for admission into the Royal Military Academy and the Royal Military College for the years 1900–9 in a single volume, the price of which is 6*s*. The book has been edited by Messrs. E. J. Brooksmith and R. M. Milne, who have supplied answers to the questions.

A SECOND edition of "Acetylene: the Principles of its Generation and Use," by Messrs. F. H. Leeds and W. J. Atkinson Butterfield, has been published by Messrs. Charles Griffin and Co., Ltd. The original issue of the work was reviewed fully in NATURE of December 10, 1903 (vol. lxix., p. 122), and it will suffice to say that the book has been revised and enlarged, an appendix including descriptions of representative acetylene generators having been added.

THE second part of "A Catalogue of Books on Natural History" has been issued by Mr. Bernard Quaritch, of Grafton Street, London, W. The present part completes the general works, and this section includes scientific voyages and transactions of learned societies; and the works on zoology are also begun. We notice that the section of the catalogue concerned with entomology includes two important libraries brought together by authorities on the subject. It is expected that the catalogue will be completed in ten parts.

THE St. Catherine Press, Ltd., has published a handbook to the Scandinavian winter health resorts, written by Dr. T. N. Kelynack. The substance of the book originally appeared as a series of articles in the *Lancet*. The descriptions of places are written in a bright, interesting style, and indicate that Dr. Kelynack speaks from personal knowledge derived from direct inquiry and observation. Numerous illustrations add greatly to the attractiveness of the guide, which altogether should prove of value both to physicians and patients and to holiday seekers. The price of the book is 1*s*. net.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A NEW COMET, 1910*b*.—A telegram from the Kiel Centralstelle announces the discovery of a new comet by M. Pidoux at the Geneva Observatory. The position of the comet on February 20, at 7h. 10m. (Geneva M.T.), was R.A.=0h. 46m. 22·1s., dec. $=+7^\circ\ 50'\ 41''$, and the daily motion was −2·4 m. in R.A. and $-24'$ in declination.

This position is in the constellation Pisces, the comet at the time of discovery being slightly east of north from δ, and a little north of west from ϵ, Piscium. Reference to the ephemeris for Halley's comet will show that, when discovered, this new object was apparently less than $1\frac{1}{2}^\circ$ away from Halley's.

COMET 1910*a*.—The story of the discovery of comet 1910*a* is now exactly recorded, by Mr. Innes, in No. 4387 of the *Astronomische Nachrichten* (p. 311, February 12). It appears that the first intimation received by Mr. Innes arrived by a telephone message on January 15 from the *Leader*, a Johannesburg newspaper. This message stated that "Halley's comet was seen by Foreman Bourke, Driver Tricker and Guard Marais at 4h. 45m. rising in front of the sun. It was visible for about twenty minutes."

The next morning, Sunday, Messrs. Innes and Worssell kept watch, but clouds prevented an observation. The morning of January 17 was also cloudy, but there was a break just above the place of sunrise, and the comet was seen, at 5h. 29m. (standard time), by both observers independently, but by Mr. Worssell a few seconds the earlier; the telegram to Kiel was then dispatched.

Mr. Innes asks that, if seen by no one else earlier, it may be placed on record that this comet was first seen by railway officials at Kopjes, Orange Free State.

In the same number of the *Astronomische Nachrichten* Dr. Kobold gives the daily ephemeris, based on the improved elements, extended to March 12; the following is an extract:—

Ephemeris for 12h. (Berlin M.T.).

1910	α (1910·0) h. m.	δ (1910·0) ° ′	log *r*	log Δ	Mag.
Feb. 24	22 10·9	+11 55·6	0·05563	0·29959	5·4
28	22 14·6	+12 53·8	0·08681	0·31812	5·6
Mar. 4	22 18·1	+13 48·5	0·11505	0·33461	5·8
8	22 21·3	+14 40·5	0·14086	0·34936	6·0
12	22 24·3	+15 31·0	0·16463	0·36238	6·2

The magnitudes are based on the observation made by Prof. Hartwig on January 27 that the magnitude was then about 2·0, and by calculation the magnitude at perihelion becomes about −1·4. Observations made at Arcetri on February 7 gave corrections of +2s. and $+0{\cdot}4'$ to the ephemeris places.

From this ephemeris we see that the comet is now apparently travelling, very slowly and in a direction slightly east of north, through Pegasus, and when it rises on the morning of March 3 it will be about 100′ north of 31 Pegasi, a fifth-magnitude star; but observations will be difficult owing to the apparent proximity of the sun.

The ephemeris also shows that the comet is retreating from the earth and sun at the rate of about two million miles per day, approximately in the direction of the earth-sun line; the present distances (February 24) are about 185 and 106 million miles respectively.

In No. 7 of the *Comptes rendus* (February 14, p. 369) M. E. Esclangon describes some remarkable transformations which he observed to take place in comet 1910*a* between January 22 and 30. On the former date the nucleus was about $15''$ in diameter and very bright, and from each side of it, normally to the general direction of the tail, there appeared two currents of matter, nearly rectilinear near the source, but curving rapidly at some distance from it to form the tail. On January 30, however, the aspect was entirely changed, the nucleus being only $3''$ or $4''$ in diameter, and very sharply defined. The two currents of bright matter had been replaced by a circular nebulosity eccentric in regard to the nucleus; on February 9 no tail was visible. M. J. Comas Sola also communicates a paper dealing with the form of the comet, to which we hope to refer later. In a brief note M. Borrelly reports that on February 7 the comet was very faint, appearing fainter than stars of the eighth magnitude; on February 10 the magnitude was estimated as 8·5, and the comet was nearly circular, with a diameter of $2{\cdot}5'$.

HALLEY'S COMET.—The following is a further extract from Mr. Crommelin's ephemeris as published in No. 4379 of the *Astronomische Nachrichten*:—

Ephemeris for Greenwich noon.

1910	R.A. h. m.	Decl. ° ′	log *r*	log Δ
March 1	0 34·0	+7 55	—	0·2774
6	0 30·2	+7 57	0·0397	0·2779
11	0 26·4	+8 0	—	0·2761
16	0 22·6	+8 2	9·9744	0·2711
21	0 18·5	+8 4	—	0·2623
26	0 14·2	+8 5	9·9017	0·2492
31	0 9·7	+8 4	—	0·2311
April 5	0 4·9	+8 1	9·8297	0·2069

These positions will be found plotted on the chart we gave in our issue of January 13 (No. 2098, p. 320), and during the greater part of April the comet will probably be unobservable. At present (February 24) the distances of the comet from the sun and from the earth are 116 and 175 million miles respectively, and the latter is increasing; but during the first week in March the earth and comet will again approach each other, until on March 31 the distance separating them will be but about 158 million miles.

In No. 419 of the *Observatory* (p. 105) Mr. Crommelin directs attention to the following parallelism of the election results of 1835 and 1910—both comet years—which is sufficiently remarkable to quote here:—

Parliaments of	1832	1906	1835	1910
Liberals	514	513	385	396
Opposition	144	157	273	274

THE QUESTION OF "ABSORBING MATTER" IN SPACE.—In the January number of the *Astrophysical Journal* (vol. xxxi., No. 1, p. 8) Prof. Barnard discusses some of the "dark lanes," seen on a number of his beautiful photographs of nebulæ, from the point of view of their representing masses of actual absorbing matter. A nebulous region involving ν Scorpii is shown to be nearer than the general background of stars, and is at least partially transparent, but the absorption of the light of the stars behind it must be considerable, for it seems to show a distinct veiling tendency in certain regions. In the case of ρ Ophiuchi nebula, also, there are dark lanes which tempt Prof. Barnard to believe in the existence of opaque matter in the sky, although, if there is, it must be there, as shown on the photographs, on a gigantic scale. If it does exist, it is probably in connection, in some way, with nebulæ, for it is in nebulous regions that it is found. A magnificent photograph of the ρ Ophiuchi region is reproduced with the article, and Prof. Barnard believes that better photographs will show the nebulous region which he has photographed near π and δ Scorpii to be connected with the ν Scorpii and ρ Ophiuchi nebulosities.

PHOTOGRAPHIC OBSERVATIONS OF η AQUILÆ.—In No. 4385 of the *Astronomische Nachrichten* Herr A. Kohlschütter discusses a number of photographic observations of η Aquilæ made at Göttingen during 1906–7, and compares the results with those obtained from visual observations. This comparison shows that, essentially, the variability is the same photographically as visually, but the amplitude of the photographic variation is about 0·42 magnitude the greater.

EPHEMERIS FOR DANIEL'S COMET, 1909e.—A revised ephemeris for Daniel's comet (1909e) is given in No. 4387 of the *Astronomische Nachrichten*. Dr. Ebell, having been informed by Mr. Crommelin that the previous ephemeris, to which we directed attention last week, was incorrect, has calculated another, which he now publishes.

PRESENTATION TO SIR EDWARD THORPE, F.R.S.

AT the Government Laboratory on Friday, February 18, Sir Edward Thorpe was presented with a silver tea and coffee service and silver cigarette box subscribed for by former colleagues on the staff of the laboratory, and by members of other public departments intimately connected with the laboratory. Among the company present, besides Sir Edward and Lady Thorpe, were Sir George Murray, G.C.B., permanent secretary to the Treasury; Sir Thomas Elliott, K.C.B., secretary to the Board of Agriculture; Sir Nathaniel Highmore, Board of Customs and Excise; Mr. Middleton, Board of Agriculture; and Dr. J. J. Dobbie, principal of the Government Laboratory.

In making the presentation, Sir George Murray said he remembered being present at the opening of the Government Laboratory, and he had had ample opportunities of watching the progress of the department and the working out of what seemed in its inception to be a very novel and perhaps rather hazardous experiment. That experiment arose from a conviction that the demands of the Government on chemical science, as applied to the administrative business of government, could best be satisfied by a great central institution with an adequate equipment, and placed under the control of the most eminent man of science the Treasury could procure. The opposite idea was always dear to the hearts of departmental chiefs. They preferred a series of independent laboratories under their own control. From the moment of Sir Edward Thorpe's appointment, however, the laboratory gained the confidence of all the departments concerned, as well as of the public and the scientific world. He thought that the imposing variety of the work which was done in the laboratory could not fail to strike even the most uninstructed observer. The excellence of that work could be appreciated by only a very few.

Sir Thomas Elliott took this occasion of thanking Sir Edward Thorpe for the assistance, and more than the assistance, for the friendly advice and help that he had always shown himself ready to tender to the Board of Agriculture and Fisheries. Sir George Murray had referred to the relations between various departments, likening them to water-tight compartments. He, however, would compare them with so many foreign Powers treating with one another through the ordinary channels of diplomacy. He was sure that in overcoming such obstacles Sir Edward Thorpe showed the qualities of a statesman as well as those of a public official.

Mr. H. W. Davis, deputy principal, Mr. H. J. Helm, I.S.O., former deputy principal, and Mr. J. Connah, of the Customs branch of the laboratory, all referred to the excellent relations which had existed between Sir Edward and his colleagues, and to the great interest which Sir Edward had always taken in everything affecting the welfare of the laboratory staff.

Sir Edward Thorpe, in reply, said there was a large number of those present who could have very little conception of the difference between the old state of affairs at Somerset House and the new state in the Government Laboratory. The stars were favourable when he planned the new building, and he was glad to acknowledge the great assistance he received from individual members of his own department. The laboratory was planned, as all laboratories should be, from the inside outwards. He at once recognised that the removal from Somerset House to the new building was the opportunity for making new departures quite impossible to achieve under the old conditions. With the improvements possible in the new building, economies had been effected which practically repaid the cost of the building several times over. Sir Edward said that, apart from the routine work, several very important matters had devolved upon the laboratory which had taxed its energies to the utmost. One of the earliest arose out of the imposition of the sugar duties. The laboratory was obliged to carry out experiments upon the thermal expansion and specific gravities of glucose solutions of varying qualities, and to weld the results into tabular form. The arsenic poison scare, too, resulted in the elaboration of an apparatus for the rapid and accurate determination of infinitesimal quantities of arsenic. This apparatus had since come into official use in several countries besides our own. Further, at the present time the laboratory was, in amicable conjunction with the Brewers' Institute, engaged in a series of experiments with a view to the reconstruction and amendment of the tables upon which the method for determining the original gravity of beer is based.

A vote of thanks to Sir George Murray was proposed by Dr. Dobbie, and carried with acclamation.

BRILLIANT METEOR OF FEBRUARY 17.

ON February 17, at 6.8 p.m., a brilliant fireball was observed from various parts of the country. The evening twilight was strong, but the object created a very luminous effect; one observer, situated fully 250 miles from the meteor, estimated its light as quite three times as bright as Venus, and the streak or trail was visible for seven minutes.

Observations have come from the Thames near Sheerness, Guildford, Cardiff, and other places, and the radiant point appears to have been near Capella, from which a fine shower of February meteors is directed. The meteor was situated over Lundy Island or that region, and its height was probably from 88 to 46 miles, and velocity about 15 miles per second. As seen from Guildford, the streak remained on view nine minutes, when a cloud obscured it. It drifted far to the S.W. during its visibility, and it will be possible to compute the motion and direction of the drift very exactly.

More observations are required to define the real path with greater certainty, and amongst the large number of persons who saw the meteor it is hoped that some good records were obtained. The writer would be much interested in hearing some further particulars about the object, and especially with regard to its path in the heavens and place of the drifting streak. The meteor was probably the most brilliant observed in the British Isles hitherto this year.

W. F. DENNING.

THE HYDROGRAPHY OF THE NORTH SEA AND ADJACENT WATERS.

THE fourth report of the North Sea Fisheries Investigation Committee contains a number of papers on hydrographical researches in the northern part of the North Sea and the Færöe-Shetland channel which are of special interest, inasmuch as they provide a *résumé* of the work done since the committee began its labours, and a statement of certain results and conclusions which may now be accepted as definitely established and used as standards for comparison with future observations. These papers are:—(1) and (6) on hydrographical investigations in the North Sea and Færöe-Shetland channel during the years 1906–7–8, by Dr. A. J. Robertson; (2) on the temperature of the surface waters of the North Sea during the years 1906 and 1907, by Mr. Frank G. Young; (3) on the salinity of the North Sea, and (4) on surface-temperature observations between Hull and Hamburg during the years 1877–83, by Prof. D'Arcy Thompson; and (5) on the deep currents of the North Sea as ascertained by experiments with drift bottles, by Captain C. H. Brown. Dr. Robertson discusses the observations made during the periodic cruises executed by the SS. *Goldseeker* on lines laid down by the International Council. Mr. Young subjects to harmonic analysis temperature observations made by captains of passenger steamers and officers in charge of certain lightships and lighthouses. Prof. D'Arcy Thompson reviews in his first paper a long record of surface-temperature observations made between Hull and Hamburg by Captain W. Barron, and examines the relation of the sea temperature in the southern part of the North Sea to the air temperature of the adjacent coasts, and in his second paper gives an account of the mean values of salinity in the waters of the North Sea—the general distribution of salinity, its mean periodic variation, and the epochs of maximal and minimal salinity. Captain Brown reports upon experiments with the drift bottle devised by Mr. G. P. Bidder, which is so constructed as to float a few inches above the sea bottom, being carried along by the bottom current, and in the course of time scooped up by a trawl-net or found stranded on a beach.

In the summary which concludes his report on the observations of 1906, Dr. Robertson makes use of the results obtained by the other investigators, and lays down certain general rules. Tidal action is sufficiently active in the southern part of the North Sea to effect a thorough mixing of waters from surface to bottom; hence over this area, the northern boundary of which, by the way, seems somewhat uncertain in position, surface observations alone will henceforth be deemed sufficient. In the northern section the conditions are altogether different, and no uniformity exists in the surface to bottom distribution. Over the North Sea area the temperature decreases from the shore to the open sea in summer and increases in winter. In summer the warmest water (15° to 18° C.) occurs along the Belgian and Dutch coasts, and the coldest in the deep channel off Norway, while in winter the coldest water is, as a rule, along the Danish coast (2° to 3° C.), and the warmest between Scotland and Shetland (7° C.). The greatest annual variation at the surface occurs along the Belgian, Dutch, and German coasts, where it amounts to 13°, while between Scotland and Shetland it is some 9° less. In the deeper layers over the northern area of the North Sea the value is only 1°, while the smallest variation of all takes place in the deepest parts of the Skagerak, where it amounts to only 0·2°.

Mixing by tidal currents is so strong that water of less salinity than 33 per mille is rarely found more than a few miles from shore; over the North Sea area the variations in salinity are greatest at the surface, and the greatest mean deviation from the average occurs where salinity is lowest. In the northern area the variation seldom exceeds 0·2 per mille. The changes in salinity are thus too small to have any direct effect upon the occurrence or wanderings of food-fishes; they are mainly of interest as a guide in studying the movements of the waters.

Much information has been acquired with regard to the general circulation of the waters within the area, and the extent to which this undergoes changes of periodic and irregular kinds. Large volumes of Atlantic water are normally streaming northward as a surface current through the Færöe-Shetland channel into the Norwegian Sea, comparatively little entering the Norwegian Sea between Færöe and Iceland, where the east Iceland current comes southwards. Under exceptional conditions Polar water extends far enough south to enter the regions of the channel. (Dr. Robertson cites 1908 as one in which this occurrence was very well marked, and it was observed in 1902, as appears from Dr. Wolfenden's observations [*Geographical Journal*, April, 1903] and Dr. Robertson's report to the North Sea Committee, 1902–3 [p. 11]. The conditions observed by H.M.S. *Jackal* in 1893 were also probably somewhat similar.) The deeper layer north of the Wyville Thomson ridge is normally flooded with cold water of salinity 34·9 per mille, which is in direct connection with the bottom area of the Norwegian Sea, but in the southern parts of the channel at least these bottom layers are occasionally displaced by warmer and salter water, showing that marked changes may occur even at the greatest depths. (This also appears, from Dr. Wolfenden's observations, in the summer of 1900.)

Between the Færöes and Fair Isle the centre of the Atlantic stream is situated between 3° and 5° west longitude, where the mean annual temperature is 9·5° C. and salinity 35·29 per mille. Within the regions of the channel its direction of flow varies from north-east to east, and the speed of the surface waters apparently averages about fourteen miles in twenty-four hours. Branches are thrown off which enter the North Sea round the north and south of Shetland, and of these the latter is certainly subject to seasonal variation. A scanty winter salt-water distribution is normally followed by more vigorous inflow during early spring, increasing to a maximum in the beginning of summer, and gradually decreasing again on the approach of the following winter. As exceptional seasons, Dr. Robertson quotes (1) the winter 1905–6, when an unusually powerful Atlantic inflow took place; (2) the summer of 1907, when the maximum inflow was unduly delayed; and (3) the whole of 1908, when the inflow was very scanty.

The greater proportion of the Atlantic water entering the northern part of the North Sea area bends eastward before reaching the 57th parallel of latitude, and after throwing off a branch which enters the Skagerak as an undercurrent is carried back northwards. This rotational movement, due to the configuration of the bottom, gives rise to a cold, deep-water area, an area with a great temperature phase delay over which the maximum value in the bottom layers is not reached until near the close of the year. (This layer appears in the *Jackal* observations, 1893.) A fresh-water current continually streams northward along the Norwegian coast, being exclusively confined to the in-shore regions during the winter months, but extending in summer far out to sea as a thin surface layer; similar movements occur in summer off the Scottish coast.

From the above summary of Dr. Robertson's conclusions it appears that the normal distribution and circulation of the waters in the North Sea area may now be regarded as definitely known. The departures from the normal are, as was supposed, very considerable, but it would seem that the years 1905–6 and 1908 may be taken as representing the nature of the extreme variations which are likely to occur, and it is noteworthy that the older observations of H.M.S. *Jackal* and other vessels indicate conditions which, while showing some abnormal features for the years to which they refer, agree satisfactorily with the more recent and more adequate work as regards the type of distribution and general movement, and fall within the limits of departure from that type which they have themselves recorded.

H. N. DICKSON.

THE THOMSEN MEMORIAL LECTURE.[1]

AMONG the Danes whose names are inscribed as men of science on the eternal bead-roll of fame, that of Julius Thomsen stands pre-eminent—linked indeed with that of Oersted. It is significant of the position which Thomsen acquired in physical science, and of the respect which that position secured for him in the eyes of his countrymen, that his statue should have been erected during his lifetime

[1] Delivered before the Chemical Society on February 17, by Sir Edward Thorpe, C.B., F.R.S., past-president of the Society.

and placed in the vicinity of that of Oersted in the court-yard of the Polytechnic High School of Copenhagen. Thomsen, in fact, played many parts in the intellectual, industrial, and social development of Denmark. To Europe in general he was mainly known as a distinguished man of science. By his fellow-citizens he was further recognised as an educationist of high ideals, actuated by a strong common sense and a stern devotion to duty; as an able and sagacious administrator; as a successful technologist and the creator of an important and lucrative industry based upon his own discoveries; and as a man of forceful character, who brought his authority, skill, and knowledge of men and affairs to the service of the communal life of Copenhagen.

Thomsen was a municipal councillor of that city for more than a third of a century. He occupied a commanding position on the Council, and was invariably listened to with respect. The gas, water, and sewage works of Copenhagen are among the monuments to his civic activity. From 1882 up to the time of his death he was a member of the Harbour Board of the port. In these respects Thomsen sought to realise Priestley's ideal of the perfect man—that he should be a good citizen first and a man of science afterwards.

Hans Peter Jürgen Julius Thomsen was born in Copenhagen on February 16, 1826. He was educated at the church school of St. Peter in that city, and subsequently at von Westens Institute. In 1843 he commenced his studies at the Polytechnic, and in 1846 graduated there in applied science, and became an assistant to Prof. E. A. Scharling. Of his earliest years comparatively little is known. Thomsen, always a reserved and taciturn man, talked little about himself even to his intimate friends—and least of all about the days of his youth. It was known to a few that these days had not been smooth. Those who were best informed were conscious that to these early struggles much of that dour and resolute nature which formed a distinguishing trait in his character was due. Thomsen, indeed, began life as a fighter, and a fighter he remained to the end of his four-score years.

In 1847, he became assistant to Forchhammer, passing rich, like Goldsmith's pedagogue, on 40*l.* a year. Georg Forchhammer, whose earliest work dates back to the period when Berzelius was in his prime, was an active and industrious investigator of the old school, mainly in inorganic chemistry, and more particularly on problems of chemical geology and physiography. He was a frequent visitor to this country, and was well known to early members of the British Association. Although doubtless influenced, in common with all teachers in northern Europe, by the example and methods of Berzelius, such influence as he himself was able to exert died with him. Forchhammer attracted few pupils, and created no school, and Thomsen probably derived no inspiration or acquired any stimulus from this association. For a time Thomsen supplemented his scanty income by teaching agricultural chemistry at the Polytechnic. In 1853 he obtained a travelling scholarship, and spent a year in visiting German and French laboratories. He probably owed this scholarship in great measure to his first contribution to the literature of chemistry, namely, his memoir, "Bidrag til en Thermochemisk System" (contributions to a thermochemical system), communicated to the Royal Society of Sciences of Copenhagen in 1852, and for which he received the silver medal of the society and a sum of ten guineas to enable him to procure a more accurate apparatus. In this memoir he sought to develop the chemical side of the mechanical theory of heat, doubtless under the influence of Ludwig Augustus Colding, an engineer in the service of the Municipality of Copenhagen, and a pioneer, like Mayer, in the development of that theory. Indeed, the Danes now claim for Colding, who had made experiments on the relation between work and heat as far back as 1842, but whose labours were practically ignored by his contemporaries, the position which the Germans assign to Mayer (see Mach's "Development of the Theory of Heat"). In 1861 Thomsen further developed his ideas in a memoir on the "General Nature of Chemical Processes, and on a Theory of Affinity Based Thereon," published in the Transactions of the Danish Academy of Sciences. In this paper he laid the foundations of the chief scientific work of his life.

In 1853 Thomsen patented a method of obtaining soda from cryolite, so-called "Greenland," or ice-spar, a naturally occurring fluoride of sodium and aluminium, $Al_2F_6,6NaF$, found largely, indeed, almost exclusively, in Greenland, and particularly at Ivigtut. It derives its mineralogical name from its ice-like appearance and ready fusibility even in the flame of a candle. It seems to have been first brought to Europe in 1794, and to have been described by Schumacher in the following year. Klaproth first showed that it contained soda, and its composition was further established by Vauquelin, Berzelius, and Deville.

Thomsen's process consists in heating a finely divided mixture of cryolite and chalk in a reverberatory furnace, whereby carbon dioxide is expelled and calcium fluoride and sodium aluminate are formed. The roasted mass is lixiviated with water, so as to dissolve out the sodium aluminate, which is then treated with carbon dioxide. Alumina is precipitated, and sodium carbonate remains in solution. The alumina is either sold as such or converted into sulphate (co-called "concentrated alum" or "alum-cake"), and the sodium carbonate is separated by crystallisation. Both products are obtained in a remarkably pure condition, and the cryolite-soda yields excellent "caustic."

Thomsen's process, although simple enough in principle, requires considerable skill and pains in its practical execution, and most of the manufacturing details were worked out by him, or under his direction. Success largely depends upon the maintenance of a proper temperature; the decomposition begins below a red-heat, but requires to be finished at that temperature, and care must be taken to avoid fusion or even sintering of the mass. In 1854 Thomsen obtained the exclusive right of mining for cryolite and of working up the mineral in Denmark for soda and alumina. Actual manufacturing operations were begun on a small scale in 1857, and in the following year Thomsen planned the present large factory at Oeresund, near Copenhagen, which was opened on his thirty-fourth birthday. The importance of this industry to Denmark may be seen from the circumstance that during the fifty years of its existence the firm have paid the Danish Government nearly 300,000*l.* for the concession. Other factories were started in Germany, Bohemia, and Poland, but met with little success. The Pennsylvania Salt-manufacturing Company at Natrona, near Pittsburg, eventually obtained the right to work up two-thirds of all the cryolite mined in Greenland. From the start Thomsen took a large share in the management of the Oeresund works, and by his energy, foresight, and skill placed the undertaking on a sound commercial basis.

Although Thomsen died a rich man, mainly as the result of the industry he created, in the outset of his career as a teacher and a technologist his means were very straitened. He came of poor parents, of no social position or influence, and they were unable to further his inclinations towards an academical career. In 1854 he applied unsuccessfully for a position as teacher of chemistry at the Military High School in Copenhagen. During three years—from 1856 to 1859—while still engaged in developing his cryolite process, he acted as an adjuster of weights and measures to the Municipality of Copenhagen. It was a poorly paid position, but it kept the wolf from the door. At about this period he betook himself to literature, and published a popular book on general subjects connected with physics and chemistry—somewhat in the style of Helmholtz's well-known work—entitled "Travels in Scientific Regions," which had a considerable measure of success. He was, however, not altogether unknown even at this time as an author, since in 1853 he had collaborated with his friend Colding in producing a memoir on the causes of the spread of cholera and on the methods of prevention, which attracted much attention at the time of its appearance.

In 1859, whilst engaged in the Oeresund factory, he again applied to the authorities for a position as teacher at the Military High School, and succeeded in obtaining an appointment to a lectureship in physics, which he held until 1866. During his tenure of this office he devised his polarisation battery, which received many awards at international exhibitions and was used for a time in the Danish telegraph service.

In 1859–60 he was "vicarius" for Scharling at the University, and in 1865 became a teacher, and in the following year professor of chemistry and director of the

Chemical Laboratory, a position which he retained—active to the last—until 1901, when he retired in his seventy-fifth year of age.

Before his connection with the University, he founded and edited, from 1862 to 1878, in association with his brother, August Thomsen, the *Journal of Chemistry and Physics*, one of the principal organs of scientific literature in Denmark.

In 1863 he was elected a member of the Commission of Weights and Measures, and was instrumental in bringing about the adoption of the metric system and the assimilation of the Danish system to that of the Scandinavian Kingdom.

In 1883 Thomsen became Chancellor of the Polytechnic High School of Copenhagen—a position which he held for about nine years. During this period he entirely changed the character and spirit of the school, and stamped it with the impress of his earnestness and industry. Under his direction, new buildings were erected and arranged in accordance with the best Continental and American models. Thomsen's administration was in marked contrast to that of his somewhat easy-going predecessor, but it is doubtful if it brought him popularity in the school. The students respected and even feared him, but his cold and unsympathetic nature evoked no warmer feeling. It was said of him by one who knew him intimately that he never learned to draw the young to him, to create in them an interest for his work, to form a school. Thomsen was a homely man, but not even in his home, says the same authority, was it possible for him to change his active, earnest, strenuous disposition—what his friends called his fighting character. But if he was always the serious master of the house, he was also its obedient servant. In reality he was a man of deep feeling, and was not without power to give that feeling expression in words, sometimes in verse, and occasionally even in music.

It was while occupying the position of director of the chemical laboratory of the University that Thomsen executed the thermochemical investigations which constitute the experimental development of the ideas he had formulated in his memoir of 1861. The results of these inquiries were first made known in a series of papers published from 1869 to 1873 in the Transactions of the Royal Danish Society of Sciences, and from 1873 onwards by the *Journal für Praktische Chemie*. The papers were republished in collected form in four volumes (1882–1886) by a Leipzig house under the title of "Thermochemische Untersuchungen." A summary of this experimental labour, which extended over a third of a century, was subsequently prepared by Thomsen, and published in 1905 in Danish under the title of "Thermokemiske Resultater."

In this work he reviewed the whole of the numerical and theoretical results, to the exclusion of the greater portion of the experimental details. A translation of this volume by Miss Katharine A. Burke, entitled "Thermochemistry," renders it readily accessible to English readers. Miss Burke has supplemented the original work by a short account, taken from the "Thermochemische Untersuchungen," of the experimental methods employed, thereby rendering the whole more intelligible to the student. Moreover, in the English edition a partial attempt has been made to translate Thomsen's deductions into the language of modern theory based on the conception of ionisation, which, of course, was not known to science at the time the "Thermochemische Untersuchungen" was published.

It is impossible within the limits of such a notice as this to deal in detail with the immense mass of experimental material which this work embodies, and I shall not attempt, therefore, to do more than to offer a generalised statement, based mainly upon the admirable account of Thomsen's work given by Prof. Brönsted to the Chemical Society of Copenhagen on the occasion of the meeting held on March 2, 1909, to commemorate Thomsen's services to science.

The conception of affinity as a cause and determining condition of chemical change is traceable in some of the earliest efforts to coordinate and explain chemical phenomena. It certainly existed long prior to the time of Boyle, and was at the basis of every philosophical system after his period. We need only mention the names of Bergman, Wenzel, and Berthollet to indicate this fact. But to Thomsen belongs the credit of being the first to make the attempt to measure the relative value or strength of affinity quantitatively, and to express it numerically in definite terms which admitted of exact comparison. Thomsen's theory of affinity, as enunciated by him in his 1851 paper, was based upon his conviction that affinity could be measured quantitatively by estimating the amount of heat evolved in the chemical process. We are not immediately concerned to show whether the theory is right or wrong, or in what respect it fails. The point is that the enunciation of this principle upwards of half a century ago constituted an important step forward, inasmuch as it sought to estimate affinity in relation to a quantity which can be fixed by experiment, and is capable of expression by numbers. In this and in the subsequent paper of which mention has been made already, he thus defines his conception of thermochemistry, and discusses, for the first time, its laws.

"The force which unites the component parts of a chemical compound is called affinity. If a compound is split up, whether by the influence of electricity, heat, or light, or by the addition of another substance, this affinity must be overcome. A certain force is required the amount of which depends on the strength of the affinity.

"If we imagine, on the one side, a compound split up into its component parts, and on the other side these parts again united to form the original compound, then we have two opposite processes the beginning and end of which are alike. It is therefore evident that the amount of the force required to split up a certain compound must be the same as that which is evolved if the compound in question is again formed from its component parts.

"The amount of force evolved by the formation of a compound can be measured in absolute terms; it is equal to the amount of heat evolved by the formation of the compound.

"Every simple or complex action of a purely chemical nature is accompanied by evolution of heat.

"By considering the amount of heat evolved by the formation of a chemical compound as a measure of the affinity, as a measrue of the work required to again resolve the compound into its component parts, it must be possible to deduce general laws for the chemical processes, and to exchange the old theory of affinity, resting on an uncertain foundation, for a new one, resting on the sure foundation of numerical values."

As has been proved by later theoretical and experimental investigations, the theory of thermochemical affinity is not absolutely correct at ordinary temperatures. But, on the other hand, it has been shown that a comparatively large number of processes are approximately in unison with it. Not only do they agree qualitatively, that is to say, that heat is evolved during the process, but also in the fact that the results which newer and more exact methods for estimating affinity have produced agree numerically with what would be required by the thermochemical theory. We meet here with a fundamental phenomenon which Thomsen deserves great credit for having first pointed out, but the explanation of which could not be given at the time he indicated it. It can be demonstrated theoretically that the lower we reduce the temperature and the nearer we get to the absolute zero, the more nearly is the condition for the theory fulfilled, so that at the absolute zero the theory would be found to be an exact law of nature. If it were possible to work at such low temperatures it would be found that the evolution of heat, or the evolution of energy by the chemical process, would be an exact measure of the affinity of the process and that under this condition the theory of Thomsen would be the accurate expression of a natural law.

But under ordinary conditions this is not so, for in reality an ever-increasing number of endothermic processes are found to occur, that is, processes which proceed with the absorption of heat. Thomsen tried at first to explain these phenomena in such a way as to keep them within his system, and he drew a distinction between a purely chemical process running conformably to his theory and a physico-chemical process which did not fall within the law. But he was gradually convinced that his theory could not be maintained in its entirety. It is to his credit that he did not seek to uphold an untenable principle, or try to defend it as did Berthelot, who almost to his dying day maintained the validity of the principle in spite of all facts.

These ideas have, in the words of Ostwald, been the scientific confession of faith of chemists throughout half a century. They have had the greatest influence on scientific thought in every branch of chemistry. It is on the basis of them that we have arrived at a theory of affinity which at the present moment is being developed into one of the most perfect chemical theories. Lastly, it is due to these ideas that the experimental material has been produced which during all time will place the name of Julius Thomsen in the first rank of men of science.

To go through this material in detail is, as I have said, impossible here. It may be stated generally that practically every simple inorganic process has been investigated calorimetrically by Thomsen, or can be calculated by means of the calorimetric data furnished by him. In the case of organic substances, data have been given for estimating the heat of combustion of a large number of compounds. All these estimations were made by Thomsen personally, according to a pre-arranged plan, and in systematic succession during a period of more than thirty years. They comprise more than 3500 calorimetrical estimations. It has been truly said that this work is unique in the chemical history of any country.

Among the results of Thomsen's thermochemical inquiries which have special value for physical chemistry is his investigation of the phenomena of neutralisation, in which he shows that the basicity of acids can be estimated thermochemically, and that it can in this way be proved whether or not a point of neutrality exists. His observation that the heat of neutralisation is the same for a long series of inorganic acids, such as hydrochloric acid, hydrobromic acid, hydriodic acid, chloric acid, nitric acid, &c., supports the theory of electrical dissociation, inasmuch as this requires that the heat of neutralisation of the strong acids must in all cases be independent of the nature of the acid, because the process of neutralisation for all of them is the combination of the ion of hydrogen in the acid with the ion of hydroxyl of the base to form water. These investigations also led to the important thermochemical result that the heat of neutralisation of acids (or the heat of their dissociation) cannot be considered as a measure of the strength of the acids.

Another important result is the proof by experiment of the connection which exists between the changes of the heat-effect with the temperature and the specific heat of the reacting substances. The first law of thermodynamics requires the relation indicated by Kirchhoff: $dU/dT = C_1 - C_2$, where U is the heat-effect, T the temperature, and C_1 and C_2 are the heat capacities of the two systems before and after the reaction, and Thomsen showed by investigation of the heat of neutralisation, the heat of solution, and the heat of dilution, that this relation was satisfied. For the purpose of his inquiry, the specific heats of a large number of solutions of salts were estimated by an ingenious method, and with an exactness hitherto unattained.

Of no less importance are Thomsen's thermochemical investigations on the influence of mass. In the year 1867 Guldberg and Waage published their theory of the chemical effect of mass. But they had only verified the theory to a small extent and in particularly simple cases. They had not investigated the complete homogeneous equilibrium, because at that time no method existed for experimental investigation of such homogeneous equilibrium. Thomsen showed that the estimation could be made thermochemically. By allowing, for instance, an acid to act on a salt of another acid in an aqueous solution, the latter acid will be partly replaced by the first, which will form a salt. By mixing, for instance, a solution of sodium sulphate and nitric acid, there is formed sodium nitrate and sulphuric acid, but the process will not proceed to completion. If we have estimated the heat of neutralisation of the two acids with sodium hydroxide, the difference between these two heat-phenomena will give the amount of heat corresponding to the total decomposition of the sodium sulphate, and the heat found experimentally by mixing the two solutions will therefore show to what degree the transformation has taken place. It would be possible to estimate thermochemically the amount of the four substances in solution, and thereby, by varying the concentration or the proportion between the initial quantities of substances, to calculate whether the Guldberg-Waage theory on the effect of mass was confirmed in this case.

Thomsen applied this method to a large number of different acids and bases, and was enabled thereby to prove the agreement with the law of the influence of mass in all the cases which he examined. He found particularly that the proportion of the one acid which remained combined with the base was constant with mixtures of constant proportion. On this basis he propounded the term *avidity*, which he defined as the tendency of the acid to unite with the base, and he showed that the avidity was independent of the concentration, and only to a small extent varied with the temperature. The term avidity has since acquired great importance, particularly since other and more exact methods for its estimation have been found. Concurrently with this, its meaning has been made clear by the theory of electrolytic dissociation.

On the basis of these estimations, Thomsen drew up the first table, based on experiments, of the relative strength of the acids, and the numbers in this table have been found to agree with the results obtained by examining the electrical conductivity of the acids.

It is worth noting that Thomsen not only produced the experimental proof of the correctness of the Guldberg-Waage theory of the effect of mass soon after the appearance of this theory, but also that he was the first to acknowledge and adopt it. It is remarkable that this work of Thomsen received so little attention, although it appeared in a widely circulated German journal, and it was not until ten years later that the law of the effect of mass was generally recognised, as the result of the work of Ostwald and van 't Hoff.

Although Thomsen's title to scientific fame rests mainly upon his thermochemical work, his interests extended beyond this particular department of physical chemistry. He worked on chloral hydrate, selenic acid on ammoniacal platinum compounds, and on glucinum platinum chloride, on iodic acid and periodic acid, on hydrogen peroxide, hypophosphorous acid, and hydrogenium. He early recognised the importance of Mendeléeff's great generalisation, and contributed to the abundant literature it produced. His paper of 1895, "On the Probability of the Existence of a Group of Inactive Elements," may be said to have foreshadowed the discovery of the congeners of argon. He pointed out that in periodic functions the change from negative to positive value, or the reverse, can only take place by a passage through zero or through infinity; in the first case, the change is gradual, and in the second case it is sudden. The first case corresponds with the gradual change in electrical character with rising atomic weight in the separate series of the periodic system, and the second case corresponds with a passage from one series to the next. It therefore appears that the passage from one series to the next in the periodic system should take place through an element which is electrically indifferent. The valency of such an element would be zero, and therefore in this respect also it would represent a transitional stage in the passage from the univalent electronegative elements of the seventh to the univalent electropositive elements of the first group. This indicates the possible existence of a group of inactive elements with the atomic weights 4, 20, 36, 84, 132, the first five numbers corresponding fairly closely with the atomic weights respectively of helium, neon, argon, krypton, and xenon (*Zeitsch. anorg. Chem.*, 1895, ix., 283; Journ. Chem. Soc., 1896, lxx., ii., 16). He subsequently made known the existence of helium in the red fluorite from Ivigtut.

As evidence of Thomsen's manipulative ability and his power of accurate work may be mentioned his determination of the atomic weights of oxygen and hydrogen, and incidentally of aluminium. For the atomic weight of hydrogen he obtained the value 1·00825 when O = 16, which is practically identical with that of Morley and Noyes. He further made most accurate estimations of the relative densities of these gases, and of the volumetric ratios in which they enter into the composition of water. His value for the atomic weight of aluminium is nearly identical with that adopted in the last Report of the International Committee on Atomic Weights.

Thomsen maintained his interest in thermochemical problems up to the end, and was a keen and clear-sighted critic of the work which appeared from time to time during the later years of his life. This interest occasionally gave rise to controversy, and some of his latest papers were wholly polemical.

Thomsen was a pronounced atomist, and to him a chemical process was a change in the internal structure of a molecule, and the chief aim of chemistry was to investigate the laws which control the union of atoms and molecules during the chemical process. He considered that chemistry should be treated mathematically as a branch of rational mechanics. But no one insisted more strongly than he how little we really know of these questions. In summarising his theoretical ideas in the *Thermokemische Resultater,* he says, "An almost impenetrable darkness hides from us the inner structure of molecules and the true nature of atoms. We know only the relative number of atoms within the molecule, their mass, and the existence of certain groups of atoms or radicles in the molecule, but with regard to the forces acting within the molecules and causing their formation or destruction our knowledge is still exceedingly limited." He fully realised that his own work was only the foundation on which the future elucidation of these questions must rest. "He worked," says Brönsted, "in the conviction that what we somewhat vaguely call the affinity of the atoms—their interaction, their attraction, and varying effect, &c.—follows the general laws of mechanics, and that, as he worded it, the principle that 'might is right,' holds good in chemistry as in mechanics. On this foundation he hoped to be able to evolve the laws for the statics and dynamics of chemical phenomena, even although the true nature of the action is unknown."

Thomsen's merits as an investigator received formal recognition from nearly every country in the civilised world. So far back as 1860 he was elected one of the thirty-five members of the Danish Royal Society of Sciences of Copenhagen, and from 1888 until his death he was its president. In 1876 he became an honorary foreign member of the Chemical Society of London. On the occasion of the fourth centenary of the foundation of the University of Upsala (created in 1477), he received the degree of Doctor of Philosophy *honoris causa.* In 1879 he was made an honorary M.D. of the University of Copenhagen. Two years later he was made a foreign member of the Physiographical Society of Lund, and in 1888 he was elected a member of the Society of Science and Literature of Gothenburg. In 1885 he became a member of the Royal Society of Sciences of Upsala, and in 1886 of the Stockholm Academy of Sciences.

In 1883 he and Berthelot were together awarded the Davy Medal of the Royal Society—a fitting and impartial recognition on the part of the society of the manner in which the two investigators, whose work not infrequently brought them into active opposition, had jointly and severally contributed to lay the foundations of thermochemistry.

In the same year Thomsen was made a member of the Accademia dei Lincei of Rome, and in the following year he was elected into the American Academy of Arts and Sciences in Boston, and of the Royal Academy of Sciences of Turin. In 1887 he was made a member of the Royal Belgian Academy.

In 1886–7, and again in 1891–2, he was rector of the University of Copenhagen. In 1888 he became Commander of the Dannebrog, and in 1896, and on his seventieth birthday, he was made Grand Commander of the same order. On the same occasion the Danish chemists caused a gold medal to be struck in his honour. In 1902 he became a Privy Councillor (Geheime Konferenz raad). In the same year he was elected a foreign member of the Royal Society of London.

He died on February 13, 1908, full of years as of honours, and was buried on the eighty-third anniversary of his birth and on the jubilee of the opening of the Oeresund factory. His wife, Elmine Hansen—the daughter of a farmer on Langeland—predeceased him in 1890.

I desire to express my acknowledgments to Director G. A. Hagemann, of Copenhagen, and to Prof. Arrhenius, of Stockholm, for their assistance in obtaining information concerning Thomsen's personal history. I am also much indebted to our fellow, Mr. Harald Faber, for his kindness in making for me a translation of Prof. Brönsted's account of Thomsen's scientific work, on which my own *résumé* is mainly based.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Sir J. J. Thomson has been nominated to represent the University at the celebration next October of the centenary of the University of Berlin.

Mr. S. Brodetsky, bracketted senior wrangler in 1908, has been elected to the Isaac Newton studentship, tenable for three years.

The adjudicators of the Smith's prizes and Rayleigh prizes are of opinion that the following essay sent in by a candidate is of distinction, "Discontinuous Motion in Gases," by Mr. G. I. Taylor. A Smith's prize is awarded to Mr. Taylor for this essay. The second Smith's prize is not awarded.

In response to an appeal for funds for the purpose of purchasing a site and for building, equipping, and conducting a field laboratory on the outskirts of Cambridge, mainly for the study of protozoal and parasitic diseases, donations amounting to 988*l.* 17*s.* have been received. A donation of 1000*l.* has been promised, anonymously, when the fund has reached 6000*l.* In addition to the foregoing, the Government of Cape Colony has placed the sum of 500*l.* at the disposal of Prof. Nuttall for the purpose of investigating East Coast fever. By permission of the Government, a part of this sum will be utilised for the construction of the laboratory.

OXFORD.—The fact that Halley occupied the Savilian chair of astronomy at Oxford gives this University a special interest in Halley's comet. This interest the University proposes to mark by conferring the honorary degree of Doctor of Science on Mr. P. H. Cowell, F.R.S., chief assistant, and Mr. A. C. D. Crommelin, assistant, at the Royal Observatory, Greenwich, by whose joint calculations the exact determination of the re-appearance of Halley's comet was successfully accomplished. The actual ceremony of conferring the degree will probably take place in May, at the time when the comet is expected to be at its brightest. It has further been arranged that the first discourse given on the new foundation of the Halley lecture shall be delivered by the founder himself, Dr. Henry Wilde, F.R.S., and it is hoped that this may take place at the same time as the conferring of degrees on the two Greenwich astronomers.

ST. ANDREWS.—Besides the munificent gifts to the chemical department of the University already noted, Dr. Purdie recently handed 2000*l.* to the University Court to aid in paying a chemical assistant.

Prof. Percy Herring (physiology) has been appointed dean of the faculty of science, and he enters on his duties at the end of the winter session, the pro-dean (Prof. Butler) meanwhile officiating during the enforced retirement of Prof. Musgrove from illness.

The spacious new Pettigrew Museum of Natural History (the gift of Mrs. Pettigrew) is approaching completion, and the hothouses and conservatories in connection with the botanical department, to which Mrs. Pettigrew also liberally contributed, are well advanced.

A JOINT conference of members of the Geographical Association and of the Federated Associations of London Non-primary Teachers will be held at 3 p.m. on Saturday, March 12, at the Polytechnic, Regent Street, W., when an address will be given by Mr. H. J. Mackinder on "The Regional Method in Geography." Tickets may be obtained from the honorary secretary of the Federated Associations, Miss R. F. Shove, 26 Blessington Road, Lee, S.E.

EDUCATIONAL and charitable institutions, says *Science,* have received 32,400*l.* by the will of the late Mrs. Frances E. Curtiss, of Chicago. Among the institutions which have benefited is Williams College, Williamstown, Mass., 5000*l.* Cooper Medical College, San Francisco, has received a bequest of 1000*l.* by the will of the late Mrs. Myrick. In connection with these bequests to higher education, it is interesting to note that our contemporary reports President Schurman, of Cornell University, as having said in a recent address: "I should like most to see at Cornell a score of research professorships with salaries, say 1500*l.* each, which would call for a capital of some 600,000*l.* or 800,000*l.*, a really small amount in this age of American multi-millionaires."

The issue of "The Public Schools Year Book" for 1910, which is now available, is the twenty-first, and the coming of age of this useful annual publication is marked fittingly by its adoption by the Headmasters' Conference as their official book of reference. The first part of the work is devoted to the proceedings of the Headmasters' Conference and to full information relative to the public schools. The second part deals with entrance scholarships at the public schools, entrance examinations to the universities, and the conditions of admission to the Navy, Army, Civil Service, and other professions, including engineering and chemistry. A general list of preparatory schools where young boys may be prepared for admission to a public school is also included. To parents proposing to send a boy to one of the public schools, the year book will prove invaluable, since the information respecting the organisation and instruction, fees and other charges, and so on, is just what they will require.

A recent table prepared for the London County Council Education Committee provides instructive particulars as to the ages of the boys and girls in the London secondary schools aided by grants from the Council. During the educational year 1909–10 there were in attendance in these schools 9244 boys and 5468 girls. Of the 9244 boys, 2131 were under 12 years of age, 1589 between 12 and 13 years, 1786 between 13 and 14 years, 1767 between 14 and 15 years, 1191 between 15 and 16 years, 465 between 16 and 17 years, 224 between 17 and 18 years, and 91 were more than 18 years. As regards the 5468 girls, 1467 were under 12 years of age, 896 were between 12 and 13 years, 863 between 13 and 14 years, 922 between 14 and 15 years, 805 between 15 and 16 years, 327 between 16 and 17 years, 154 between 17 and 18 years, and 34 above 18 years. In other words, only 780 of the total number of boys in the London secondary schools aided by the Council, or only 8·4 per cent., are above 16 years of age, and only 515 of the total number of girls in the schools, or 9·4 per cent., are above 16 years of age. It must be remembered that, with the exception of the greater public schools, the majority of the public secondary schools in London receive aid from the rates, and consequently it has to be admitted that the number of boys and girls receiving what may be called a complete secondary education is very small.

The London County Council aids upwards of fifty secondary schools in London. The grants are paid partly with the view of enabling the schools to accommodate a larger number of pupils than would otherwise be possible, and partly with a view of increasing the efficiency of the work. The income of the "aided" schools is derived from four main sources—endowment, Board of Education grant, fees, and grant from the London County Council. The total amounts of these sources of income for the educational year 1908–9 were as follows:—Endowment, 52,533*l.*; Board of Education grant, 49,818*l.*; fees, including fees of London County Council scholars, 114,334*l.*; and the Council's grant, excluding the fees of scholars, 41,415*l.*; making a total of 258,100*l.* It is estimated that during the present educational year the amounts will be:—Endowment, 53,190*l.*; Board of Education grants, 57,678*l.*; fees, 120,963*l.*; and Council's grant, 40,346*l.*; bringing the total up to 272,177*l.* In the case of each "aided" school, the Council requests the governors to submit a statement of receipts and expenditure for the completed year, and also an estimate of the receipts and expenditure for the coming year, and the grant made by the Council is estimated to be sufficient, together with endowments, fees, and Board of Education grant, to admit of the efficient carrying on of the school, and to provide a reasonable working balance throughout the educational year.

The prospectus for the current session of the Pusa Agricultural Research Institute gives particulars of the courses available for students in agricultural chemistry, economic botany, economic entomology, mycology, agricultural bacteriology, and agriculture proper. The work in each of these departments is respectively under the supervision of the Imperial agricultural chemist, economic botanist, entomologist, mycologist, agricultural bacteriologist, and agriculturist, who act under the principal as chiefs of the teaching staff. In the absence of experience of the class of student likely to be received, it has been found impossible to lay down a permanent syllabus of the training in each subject. The syllabuses are, for the present, tentative, and subject to the condition that time will not be wasted in taking students over ground that is already familiar to them. It may be remembered that the Pusa Agricultural Research Institute owes its inception to the generosity of Mr. Henry Phipps, who in 1903 placed at the disposal of Lord Curzon, then Viceroy of India, a donation of 20,000*l.* (which he afterwards raised to 30,000*l.*) with the request that it might be devoted to some object of public utility in India, preferably in the direction of scientific research. Part of this donation was devoted to the construction of a Pasteur institute at Coonoor, in southern India, and it was decided that the balance should be utilised in erecting a laboratory of agricultural research to form a centre of economic science in connection with that occupation on which the people of India mainly depend. This conception was subsequently enlarged, and the Government of India has now constructed a college and research institute, to which a farm of some 1300 acres is attached, for purposes of experimental cultivation and demonstration. The Pusa Institute is consequently in a position to enable students who have passed with distinction through a course at a provincial college, by means of a post-graduate course in one of the specialised branches of agricultural science, to qualify for the higher branches of agricultural work.

Replying to the toast of his health at the annual dinner of the Bristol University Colston Society on February 17, Sir William Ramsay, K.C.B., spoke of the administration of British universities. Professors should not, he said, be paid less than the average income obtainable in kindred professions. If a professor is paid at a much lower rate than he would obtain by entering some corresponding profession, it means that persons of one of three classes will occupy chairs. First a few men, from love of teaching or research, will carry on work on a pittance. Secondly, there are the men with a competence, who will take professional work for the love of it. They are few. The third result of underpayment is that professorial chairs will be filled with men of mediocre talent and capacity; students will suffer, and generations, as they succeed one another, will deteriorate. Scholarships, he continued, are mostly a waste of money. The bestowal of scholarships is not always a failure; but if granted as loans on the evidence of the power of application and good conduct, the money can, in most cases, be bestowed more profitably. What the public wants to buy, or should want to buy, is the educated brains of one who will in future prove useful to the State. The present method is one by which the article is uncertain and the price paid incommensurably high, owing to the high percentage of failures in attaining the standard of mind which the public has a right to demand. If the money distributed in scholarships were applied to the development of universities, England's universities would be rich.—The question of adequate remuneration for professors is to some extent a question of ways and means; until more money is forthcoming in this country for the purposes of university and higher education generally, there seems little possibility that the emoluments of men engaged in teaching and research will be increased. British universities seem unable to arouse the generosity of our men of wealth to the same extent as has been done in the United States, for instance. We notice in *Science* for February 11 that in one week donations were announced of 50,000*l.* to the Sheffield Scientific School of Yale University, 200,000*l.* for the establishment of a teachers' college, and 90,000*l.* for the general purposes of higher education. A few gifts on this scale would soon make it possible to remedy the defect to which Sir William Ramsay directs attention.

New science laboratories at St. Leonard's School, St. Andrews, N.B., were opened by Sir Ernest Shackleton on February 1. The building comprises two large laboratories each 34 feet by 30 feet, a lecture theatre to seat sixty pupils, a room for the preparation of experiments by the science mistresses, a dark-room for work in optics, a conservatory for botanical experiments, a cloak-room, and a spacious corridor, to be fitted with dust-proof museum cases. The chemical laboratory, which is also to be used for practical work in geography, is fitted with six benches, at each of which four girls work. The tops of the benches have been kept as clear as possible, carrying only Bunsen burners and two movable trays, each of which can hold ten reagent bottles. These trays, with the bottles they contain, fit into cavities in the sides of the benches, so that the tops can be cleared in a moment when required for practical geographical work. The reagent bottles are double-labelled, so that they can be used by two pupils working opposite each other. Attached to the front of the demonstrator's bench is a shelf, which hangs vertically when not in use. This has been designed for the purpose of holding the apparatus required for the lesson, and two girls from each bench come to this dispensing shelf and take from it all they require for their experimental work. The laboratories are both supplied with many light trays of varying sizes, each capable of holding a dozen beakers, flasks, burettes or pipettes, &c. These trays fit into the bench cupboards. Neither cupboards nor drawers have been set apart, as is usual, for the individual use of the pupils except in the case of the more advanced students, as experience has shown that they are apt to become receptacles for burnt matches, corks, soiled filter papers, &c. Placed in each stool recess is a shelf which holds a trough, test-tube rack, tripod, and retort-stand. The same principle has been observed in the fittings of the physical and botanical laboratory. The fume cupboards, of which there are four—two in the chemical laboratory, one in the physical laboratory, and one between the lecture theatre and the preparation room—are all supplied with both gas and water. The building is fitted throughout with electric light. In the lecture theatre there is an electric lantern, and a part of the cream-coloured wall acts as the screen, and allows a picture 10 feet square. This room is fitted with dark blinds, and ventilated, when these are in use, by means of an electric fan. In the conservatory are benches at which the pupils work when fitting up apparatus for botanical experiments. The usual precautions have been taken against accident by fire, and Minimax fire extinguishers stand in prominent positions.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 13.—D. P. **Phillips**: Re-combination of ions at different temperatures. The ionisation was produced in a layer of air of uniform thickness by means of a single discharge through a Röntgen bulb. The layer of air ionised was situated midway between two parallel electrodes, and was separated from each by a layer of un-ionised air. The quantity received by each electrode depends upon the field established between them, and from the variation of the quantity with the field the coefficient of re-combination can be calculated. By placing the pair of electrodes in a double-walled jacket the temperature was varied, and the coefficient of re-combination found at different temperatures. The values which were found are:—

Temp. Centigrade ...	16°	100°	155°	176°	273°
Coeff. of Re-combination	1·00	0·50	0·399	0·36	0·178

The value at the temperature of the room, *i.e.* at 16°, was taken as unity, and the other values were compared with this. The object of having the layer of ionised air separated from the electrodes by un-ionised air was to decrease the number of ions reaching the electrodes by diffusion, and so causing an apparent increase in the re-combination. With this arrangement the effect of diffusion would be to decrease the apparent re-combination. In order to test the magnitude of the error introduced by diffusion, the thickness of the ionised layer of air was altered, and the coefficient of re-combination determined for each thickness. At each temperature it was found that the coefficient of re-combination apparently falls off when the thickness of the layer is reduced below a certain value. Thus it was shown that in this experiment the diffusion was negligible up to 176° C., but that at 273° C. it probably caused a serious reduction in the apparent value of the re-combination.

Sir Edward **Thorpe** and A. G. **Francis**: The atomic weight of strontium. The principle of the methods employed consisted in determining the ratios of the weights of strontium bromide and chloride and of pure silver and of the silver halides respectively. The strontium salts, $SrBr_2$ and $SrCl_2$, purified by fractional crystallisation and precipitation, were fused in a stream of dry halogen acid and allowed to solidify in dry nitrogen. While the halides were still warm the nitrogen was replaced by dry air and the salts transferred to the weighing flasks. The fused salts were ice-like in appearance, and yielded perfectly clear neutral solutions in water. The silver needed to precipitate completely the halogen was dissolved in a specially devised burette, so contrived that the solution could be delivered without loss to the strontium solution. After eighteen hours the slight excess silver left in solution was titrated with a solution of strontium halide of known strength. Finally, the silver halide was dried, fused, and weighed. The apparatus was so devised that these operations could be done without removing the silver salts from the vessel in which it was formed. As an independent check, the ratios of $SrBr_2$ and $SrCl_2$ to $SrSO_4$ were also determined by converting the strontium halides into strontium sulphate by direct treatment with sulphuric acid. The possible sources of error are discussed, and all known corrections were applied. In all, six series of observations were made. The mean results are as follows:—

Series A.	$2Ag : SrBr_2$ (6 exp's.) ...	... 87·645 ± 0·0037
,, B.	$2AgBr : SrBr_2$ (5 expts.)...	... 87·653 ± 0·0045
,, C.	$2Ag : SrCl_2$ (6 expts.) ...	... 87·642 ± 0·0017
,, D.	$2AgCl : SrCl_2$ (5 expts.)...	... 87·645 ± 0·0020
,, E.	$SrBr_2 : SrSO_4$ (3 expts.)...	... 87·629 ± 0·021
,, F.	$SrCl_2 : SrSO_4$ (4 expts.)...	... 87·661 ± 0·0078
Mean of	A, B, C, D	... 87·646 ± 0·0016
,,	E, F	... 87·645 ± 0·0107
,,	A, B, C, D, E, F	... 87·646 ± 0·0029

The authors adopt 87·65 as the definite value for the atomic weight of strontium—a number only 0·03 in excess of Richards's final value as given in the last report of the International Committee on Atomic Weights.

February 17.—Sir Archibald Geikie, K.C.B., president, in the chair.—E. **Marsden**: Phosphorescence produced by α- and β-rays.—Prof. E. **Rutherford**: Theory of the luminosity produced in certain substances by α-rays.—Dr. H. **Geiger**: The scattering of the α-particles by matter. In a previous note on the same subject experiments have been described which gave direct evidence of the scattering of the α-particles in passing through matter. These experiments have been continued with the object of determining quantitatively the amount of scattering under various conditions. In particular the influence of the thickness and nature of the scattering material and of the velocity of the α-particles has been studied in detail. With the exception of a few modifications, the experimental arrangement was the same as that employed in the preliminary experiments. A strong source of homogeneous α-radiation was placed at one end of a long tube, and the α-particles, after passing through a narrow circular opening, fell upon a zinc sulphide screen sealed to the other end of the tube. When the pressure inside the tube was very low the scintillations produced by the impact of the α-particles on the screen were confined to a very small area. When, however, the α-particles were intercepted by a thin sheet of metal, the scintillations were spread out over a much greater area, this being due to the scattering of the α-particles when passing through the metal sheet. The distribution of the scintillations over the screen was determined by counting them at different parts of the screen. From the distribution curve the most probable angle through which the α-particles were turned in passing through the metal sheet under investigation could be found. In all experiments the scattering was measured by this angle, and the following results were obtained:—(1) The most probable angle of scattering increases for small thicknesses approximately proportional to the square root of the thickness of matter traversed by the α-particle. For greater thicknesses the scattering angle increases more rapidly. (2) The most probable angle of scattering is proportional to the atomic weight of the scattering material. (3) The most probable angle of scattering increases rapidly with decreasing velocity of the α-particles.—Dr. H. **Geiger**: The ionisation produced by an α-particle. Part ii., Relation between ionisation and absorption. Experiments are described which were undertaken to measure the velocity of the α-particles after passing through various sheets of mica of known stopping power. A thin wire, which was made highly active by the deposit from radium emanation, served as source of radiation. The α-particles emitted from it passed through a narrow slit and produced a small line of scintillations on a zinc sulphide screen. The deflection of the line in the magnetic field amounted to 1 cm. and more, and could be accurately measured by means of a travelling microscope. The relative velocities found in this way when different sheets of mica were interposed were up to 6 cms. of the range in good agreement with those previously obtained by Prof. Rutherford by a photographic method. Great difficulties were experienced in observing the scintillations when the α-particles had to pass through a thickness of mica nearly equivalent to the range. It could, however, be shown that the velocity decreased rapidly towards the end of the range. The lowest velocity which was measured corresponded to 0·27 of the initial velocity. The α-particles had in this case to pass through a thickness of mica equivalent to 6·8 cm. of air. The experimental results could be represented with good approximation by the equation $v^3 = a\ (R-x)$, where a and R are constants, R denoting the maximum range of the α-particles. The curve indicates that the velocity becomes zero at the end of the range. In the course of the experiments an investigation was carried out to see whether all the α-particles from radium C are emitted with identical velocities. The experiment showed that the variation in the initial speed, if any, was certainly less than 0·5 per cent., but that the α-particles acquired a slight difference in velocity in passing through air. Assuming that the ionisation produced by an α-particle is proportional to the expenditure of energy, the equation representing the ionisation at any point of the path can be deduced from the above equation for the velocity. Taking into account the slight variation of velocity in a pencil of α-particles at the end of the path, the theoretical ionisation curve agrees fairly well with the experimental.—H. C. **Greenwood**: The influence of pressure on the boiling points of metals. The present research is a continuation of a previous paper dealing with the boiling points of metals under atmospheric pressure. Previous work at reduced pressures has been strictly limited by the lack of any material capable of maintaining a vacuum at high temperature, being, in fact, confined, except for a few metals of relatively low boiling point like zinc, to some observations in a very high vacuum. For similar reasons nothing has been done on the effect of high positive pressures. The difficulties here indicated were avoided by arranging the whole furnace inside an enclosure in which the desired changes of pressure could be produced. Heating was effected electrically, and the temperatures were measured optically, while the actual boiling point determinations were made by a method of visual observation similar to that before used. Observations were taken at pressures ranging from 100 mm. of mercury to 50 atmospheres. The order of magnitude of the effects produced is shown by the following example:—The boiling point of bismuth under 102 mm. of mercury is 1200° C., and under 16·5 atmospheres 2060° C., a variation of 860° being thus produced. The boiling points of all the metals studied (bismuth, copper, lead, silver, tin, zinc) were found to show a closely similar dependence on the pressure.—A. O. **Rankine**: The viscosities of the gases of the argon group. The viscosities of the five gases—helium, neon, argon, krypton, and xenon—have been compared with that of air. The method used was that described in a paper recently communicated to the society. The principal advantage of this method is that it enables the viscosity of quite a small quantity of gas to be determined with considerable accuracy. The total volume of the apparatus used in this case was rather less than 6 c.c. The values found for the viscosities of helium and argon are in close agreement with those obtained by previous observers. The results for the remaining three gases admit of no comparisons, these being the first determinations. All five gases are more viscous than air, the ratios η/η air being as follows:—

He	Ne	A	Kr	X
1·086	1·721	1·220	1·361	1·234

The viscosity of neon at ordinary temperature is far higher than that of any other gas hitherto experimented upon, and krypton is next in order of magnitude. As the atomic weight increases the viscosity alternately rises and falls. If, however, the mean free paths are calculated by using Maxwell's equation, they are found to decrease regularly with increase in atomic weight. The paper also contains estimates of the relative sizes of the atoms and their densities, the calculations being based upon the kinetic theory of gases. The conclusions arrived at are that the densities of the atoms of neon, krypton, and xenon are the same, and three times as great as that of helium. The argon atom is nearly twice as dense as the helium atom.

Physical Society, February 11.—Dr. C. Chree, F.R.S., president, in the chair.—Prof. H. L. **Callendar**: *Presidential address.* The application of resistance thermometers to the recording of clinical temperatures. The objections to thermocouples are twofold. The E.M.F.'s developed are so small that the recording instruments must be very sensitive and therefore unsuitable for ordinary use. Serious difficulties arise with regard to the thermostat necessary to maintain one of the junctions of the thermocouple at a constant temperature. The chief difficulty in connection with the use of resistance thermometers lies in the heating effect of the current. It was pointed out that in platinum thermometry, to obtain accurate compensation for the resistance of the leads, it is necessary that the ratio arms of the Wheatstone bridge should be equal, and it was shown that this condition reduced the sensitiveness to be obtained by suitably varying the resistances by about 30 per cent. In joining up a bridge in work with resistance thermometers, Maxwell's rule for the positions of the battery and galvanometer which give maximum sensitiveness is seldom applicable. While Maxwell's arrangement actually gives the greatest sensitiveness, the heating effect of the current is so much greater that this more than counterbalances the increased sensitiveness. The problem to be solved in designing a suitable thermometer for clinical work is, with a given galvanometer and resistance-box, to find the resistance of the thermometer which will give the most accurate results for a given heating effect of the current. This is given by the equation $R = 2G + S$, where G is the resistance of the galvanometer and S that of one of the ratio arms. It is important in the construction of a thermometer for clinical work to secure quickness of action and to reduce the heating effect of the current. An ordinary tube-form of thermometer is good for laboratory work with sensitive galvanometers, but it is unsuitable for use with recorders. The pattern of the thermometer must be suited to the purpose for which it is intended. Three types were shown, designed for mouth, rectal, and surface work. Continuous records obtained from a patient with a normal temperature were shown. The temperature is generally very steady if the thermometer does not shift or the patient get wholly or partly out of bed. The effects of external changes of temperature were also shown, and simultaneous records taken on different parts of the body illustrated the fact that the temperature does not vary in the same way at all places.

Royal Meteorological Society, February 16.—Mr. H. Mellish, president, in the chair.—E. **Mawley**: Report on the phenological observations for 1909. During the whole year wild plants came into blossom behind their usual time, the departures from the average being greatest in March and April. Such early spring immigrants as the swallow, cuckoo, and nightingale made their appearance rather earlier than usual. The only deficient farm crops were beans, peas, and hay. On the other hand, the yield of wheat, barley, oats, turnips, mangolds, and potatoes was well above the average, and more particularly barley and turnips. The crop of apples, pears, and plums was under average, whereas that of raspberries, gooseberries, currants, and strawberries, taken together, was fairly good. As regards the farm crops, this was the fourth year in succession in which the yield has been above average.—Colonel H. E. **Rawson**: The North Atlantic anticyclone. The author has examined the "Synchronous Weather Charts of the North Atlantic" published by the Meteorological Office for the months of September, 1882, to August, 1883, and has analysed the tracks of the centres of high-pressure areas during that period. He finds that it is very rare for an individual system which has traversed the American continent to cross the ocean from land to land. In every month centres of high areas which have drifted across America and have travelled out on to the ocean are found coalescing there with one another or with the centres of the persistent Atlantic anticyclone. From mid-February to mid-September the charts indicate that on arrival on our coasts systems extend westwards, and their centres reverse their easterly movement and drift to the west, while in June and July the centres of high areas form over the ocean within the Atlantic anticyclone rather than drift into it from the American continent.

Institution of Mining and Metallurgy, February 17.—Mr. Edgar Taylor, president, in the chair.—Bede **Collingridge**: Errors due to the presence of potassium iodide in testing cyanide solutions for protective alkalinity. The results of experiments made by the author show that potassium iodide exercises an important influence on cyanide solutions, especially on solutions which contain no protective alkali, since in testing these in the presence of potassium iodide they show protective alkalinity. This fact is of considerable interest in cyanide plants, because cyanide decomposes more rapidly in solutions deficient in protective alkalinity than in those protected by an alkali, and the method adopted by the author for testing without potassium iodide would therefore imply a marked saving of cyanide in the case of large plants.—A. R. **Andrew**: The detection of minute traces of gold in country rock. In the course of investigations made for the purpose of determining the presence, or otherwise, of minute traces of gold in the shales and greenstone of Merionethshire, the author found that he was unable to believe in the trustworthiness of the methods usually adopted for that purpose, particularly as regards the possibility of obtaining litharge or any sort of lead absolutely free from gold and silver. On that account he claims that no credence should be given to any alleged detection of minute traces of gold in country rock unless accompanied by a full account of the means by which the purity of the litharge is assured.—W. A. **MacLeod**: The surface condenser in mining power plant. The author conducted a number of tests on the winding engines of a mine with which he was connected, the results of which are embodied in this paper, together with a vast amount of other information concerning the relative consumptions and efficiencies of condensing and non-condensing engines. He found that the employment of condensers was distinctly beneficial in both respects, even under the intermittent conditions attaching to most mining power plants, and the results of his investigation have enabled him to determine with some exactness the leading features to be emphasised in the laying down of a condensing plant suitable for work of a more or less intermittent nature, as is the case of winding engines.

CAMBRIDGE.

Philosophical Society, January 24.—Dr. Hobson, vice-president, in the chair.—R. R. **Mines**: The relative velocities of diffusion in solution of rubidium and cæsium chlorides. The rates of diffusion of salts into a gelatine jelly were compared by measurement of the progressive changes in the electrical conductivity at a fixed distance below the surface of the jelly when in contact with decinormal solutions of the salts. The concentration of salt corresponding to each reading was obtained from Kohlrausch's tables. Experiments carried out with lithium, sodium, and potassium chlorides gave results which agree with the values found by previous observers for the relative rates of diffusion of these salts in aqueous solution. This was considered to justify the extension of the method to rubidium and cæsium chlorides, as to the rates of diffusion of which no data were available. Rubidium chloride was found to diffuse slightly faster than potassium chloride, and cæsium chloride slightly faster than rubidium chloride.—L. **Southerns**: Experimental investigation as to dependence of the weight of a body on its state of electrification.—Miss D. B. **Pearson**: Note on an attempt to detect a difference in the magnetic properties of the two kinds of ions of oxygen.

PARIS.

Academy of Sciences, February 14.—M. Émile Picard in the chair.—G. **Lippmann**: A seismograph with a liquid column. A T-tube, full of water, is connected at each end with two basins of the same liquid. The changes of level in the arm of the T-tube are indicated by a thin disc of mica, connected through a suitable mechanism to a mobile mirror. To avoid friction, the disc does not touch the sides of the tube. Owing to this, slow changes of the vertical are not recorded by the instrument. The apparatus has the advantage that its period is invariable, depending only on the dimensions originally chosen, and the preliminary adjustments are much simpler than in the ordinary form of seismograph.—The perpetual secretary read a telegram from Dr. Charcot, summarising the work achieved by the Antarctic expedition.—Ernest **Esclangon**: The transformations of the Innes comet (1910*a*). Two diagrams of this comet are given, showing its appearance on January 22 and 30. Although there is no doubt that real transformations of considerable magnitude took place in this comet between the above dates, it is shown that an important part of the modifications observed, especially as regards the shape, is to be attributed to the changes in the angle at which it was observed. Observations of position are given for January 22 and 30, the conditions being especially good, and for February 9.—J. **Comas Solá**: The figure of the comet 1910*a*. Photographs were taken daily commencing January 20, and the resulting negatives discussed.—M. **Borrelly**: Observations of the comet 1910*a*, made at the observatory of Marseilles with the comet finder of 16 cm. free aperture. Positions are given for February 4, 5, 7, 8, 10, and 11.—Émile **Borel**: The definition of the definite integral.—J. **Le Roux**: Positive quadratic forms and the principle of Dirichlet.—Farid **Boulad**: The disjunction of the variables of equations nomographically rational of superior order.—Carlo **Bourlet**: The resistance of the air.—Mme. P. **Curie** and A. **Debierne**: Polonium. Starting with several tons of uranium mineral residues a preliminary treatment with hydrochloric acid furnished about 200 grams of material with an activity about 3500 times that of uranium, this activity being due to polonium. The hydrochloric acid solution was treated with ammonia to eliminate copper, the hydrates boiled with soda to dissolve lead, and then further treated with ammonium carbonate to dissolve uranium. The final residue of insoluble carbonates, obtained after several repetitions of these processes, were dissolved in hydrochloric acid and treated with stannous chloride. The original activity was concentrated in the final precipitate, which weighed about 1 gram. This was re-dissolved in hydrochloric acid, precipitated with hydrogen sulphide, the sulphides washed with sodium sulphide, and re-dissolved and again precipitated with stannous chloride. The final product of this lengthy series of operations weighed some milligrams, and was shown by spectrum analysis to contain mercury, silver, tin, gold, palladium, rhodium, platinum, lead, zinc, barium, calcium, and aluminium. The further purification presented great difficulties, but by electrolysis the activity was concentrated into about 2 milligrams of material. Activity measurements proved this to contain about 0·1 mgr. of polonium, and this is the quantity which ought to be found according to theory in two tons of a good pitchblende. Some lines in the spectrum are given which are probably due to polonium. The production of helium was proved, amounting to 1·3 cubic millimetres after 100 days, the theory requiring 1·6. An abundant disengagement of ozone was generally found near the substance.—L. **Décombe**: The measurement of the index of refraction by means of the microscope. A modification of Brewster's method. The liquid is placed between a plane and a plano-convex lens. In monochromatic light the refractive index can be determined to about 0·001.—P. Roger **Jourdain**: The alumina arising from the oxidation of aluminium amalgam in air.—Marcel **Delépine**: The dimeric aldehyde of crotonic aldehyde and the corresponding acid. A method of obtaining this substance with fair yields has been worked out, and the corresponding acid prepared and described.—J. **Bougault**: The action of nascent hypoiodous acid on the unsaturated acids: α-cyclogeranic acid.—Frédéric **Reverdin**: The action of concentrated sulphuric acid on some aromatic nitramines.—L. **Barthe**: The action of sulphosalicylic acid on trisodium phosphate.—Aug. **Chevalier**: The forest resources of the Ivory Coast: the results of the scientific expedition to western Africa. Wood, rubber and oils.—L. **Blaringhem**: A new form obtained after mutilation, *Nigella damascena polycephala*.—J. B. **Gèze**: The agricultural development in the Bouches-du-Rhône of a spontaneous species of Typha (*T. angustata*) not previously noted in France.—L. **Léger** and Ed. **Hesse**: Cnidosporidia and the larvæ of Ephemera.—L. **Joubin**: A young Spirula.—Mme. **Phisalix**: The physiological action of the mucus of batrachians on these animals themselves and on snakes. This action is the same as that of snake poison.—L. **Jammes** and A. **Martin**: The adaptation of parasitic nematodes to the temperature of their hosts.—E. **Grynfeltt**: The tensor muscle of the choroid in teleosteans.—J. **Thoulet**: The genesis of the submarine rocks known under the names of *mattes*.—André **Brochet**: The relation between the radio-activity and richness in dry extract of the thermal waters of Plombières.—Louis **Besson**: A sort of white rainbow observed at Paris.

DIARY OF SOCIETIES.

THURSDAY, February 24.

Royal Society, at 4.30.—Colour-blindness and the Trichromatic Theory of Colour Vision: Sir William Abney, K.C.B., F.R.S.—Contributions to the Biochemistry of Growth: (*a*) The Total Nitrogen Metabolism of Rats bearing Malignant New Growths; (*b*) Distribution of Nitrogenous Substances in Tumour and Somatic Tissues: W. Cramer and H. Pringle.—The Alcoholic Ferment of Yeast Juice: Part V., The Function of Phosphates in Alcoholic Fermentation: Dr. A. Harden, F.R.S., and W. J. Young.

Royal Institution, at 3.—Illumination, Natural and Artificial: Prof. S. P. Thompson, F.R.S.

Institution of Electrical Engineers, at 8.

FRIDAY, February 25.

Royal Institution, at 9.—Colours of Sea and Sky: Lord Rayleigh, O.M., F.R.S.

Physical Society, at 5.—Telephone Circuits: Prof. J. Perry, F.R.S.—On the Laws regarding the Direction of Thermo-electric Currents enunciated by M. Thomas: Prof. C. H. Lees, F.R.S.—A New Method of Determining Thermal Conductivity: H. R. Nettleton.

Institution of Civil Engineers, at 8.—Irrigation Works: Sir R. Hanbury Brown, K.C.M.G.

SATURDAY, February 26.

Royal Institution, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

MONDAY, February 28.

Royal Society of Arts, at 8.—The Petrol Motor: Prof. W. Watson, F.R.S. (Lecture IV.)

Institute of Actuaries, at 5.—Some Notes on the Establishment of the Office of Public Trustee in England: W. C. Sharman.

TUESDAY, March 1.

Royal Institution, at 3.—The E otions and their Expression: Prof. F. W. Mott, F.R.S.

Zoological Society, at 8.30.—On the Varieties of *Mus rattus* in Egypt, with General Notes on the Species having reference to Variation and Heredity: J. Lewis Bonhote.—Zoological Collections from Northern Rhodesia and Adjacent Territories: Lepidoptera Heterocera: Sir George F. Hampson, Bart.—The Urogenital Organs of *Chimaera monstrosa*: T. H. Burlend.

Institution of Civil Engineers, at 8.—*Further discussion*: The Hudson River Tunnels of the Hudson and Manhattan Railroad Company: C. M. Jacobs.

Royal Society of Arts, at 4.30.—Fruit Production in the British Empire: Dr. John McCall.

WEDNESDAY, March 2.

Society of Public Analysts, at 8.—The Composition of Painters' Driers: J. H. Coste and E. R. Andrews.—Note on the Analysis of Ultramarine Blue: E. R. Andrews.—The Colorimetric Estimation of Small Quantities of Bromine in the Presence of Large Quantities of Chlorine and Small Quantities of Iodine: W. J. Dibdin and Leonard H. Cooper.—Note on the Kjeldahl Estimation of Nitrogen in Fatty Substances: J. A. Brown.

Royal Society of Arts, at 8.—The Teaching of Design: E. Cooke.

Entomological Society, at 8.—Descriptions of New Algerian Hymenoptera (Sphegidæ): the late Edward Saunders.—On the Tetriginæ (Orthoptera) in the Oxford University Museum (Third Paper): J. L. Hancock.

THURSDAY, March 3.

Royal Society, at 4.30.—*Probable Papers*: The Depression of Freezing Point in very Dilute Aqueous Solutions: T. G. Bedford.—Sturm-Liouville Series of Normal Functions in the Theory of Integral Equations: J. Mercer.—The Solubility of Xenon, Krypton, Argon, Neon, and Helium in Water: A. von Antropoff.

Royal Institution, at 3.—Illumination, Natural and Artificial (Experimentally Illustrated): Prof. S. P. Thompson, F.R.S.

Röntgen Society, at 8.15.—Dental X-ray Technique: C. A. Clark.

Linnean Society, at 8.—Our British Nesting Terns: W. Bickerton.

FRIDAY, March 4.

Royal Institution, at 9.—Magnetic Storms: Dr. C. Chree, F.R.S.

Institution of Civil Engineers, at 8.—Reinforced Concrete as applied to Retaining-walls, Reservoirs, and Dams: A. J. Hart.

SATURDAY, March 5.

Royal Institution, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

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