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A PIONEER IN APPLIED SCIENCE.

Collected Papers in Physics and Engineering. By Prof. James Thomson, F.R.S. Selected and arranged with unpublished material and brief annotations by Sir Joseph Larmor, Sec. R.S., and James Thomson. Pp. civ+484. (Cambridge: University Press, 1912.) Price 15s. net.)

WHEN Sir Joseph Larmor edited the scientific papers of Lord Kelvin and Prof. Fitzgerald he did work which nobody else could have done so perfectly; his time, however valuable, was spent to advantage. The editing of these papers of Lord Kelvin's brother might have been undertaken by many others, but now that the excellent result is before us we cannot regret it, and we must confess that we did not expect to find in the editor such a perfect sympathy with James Thomson's methods of study. He shares with Prof. Thomson's son the honour and credit of this publication. The book begins with about a hundred pages of biography and comment upon Thomson's works—excellent reading. Then we have 153 pages of papers relating to fluid motion, dating from 1852 to the Bakerian lecture of 1892; nearly eighty pages on congelation and liquefaction from 1849 to 1888; forty pages on the continuity of states in matter from 1869 to 1873; seventy pages on dynamics and elasticity from 1848 to 1887; and about eighty pages on geological and miscellaneous subjects from 1848 to 1892.

James Thomson was very exact in his use of language and in his ways of thinking. Even although in some of our studies we are quite exact, most of us are quite slipshod about other things that we think we know. If it were necessary to give examples the reader might be referred to paper 14 of this collection. Thomson there refers to the usual methods of study of the flow of water. He says: "The theoretical views so arrived at and very generally promulgated are in reality only utterly false theories based on suppositions of the flow of the water taking place in ways which are kinematically and dynamically impossible, and are at variance with observed facts of the flow, and even at variance with the facts as put forward by the advancers of those theories." After giving some examples, he says: "Now this method is pervaded by false conceptions and is thoroughly unscientific." Although Thomson constructed his famous turbine sixty years ago and put in simple language the principles on which nearly all modern water and steam turbines are now being constructed, these papers of his are so little known that nearly all books on hydraulics are still pervaded with the old false conceptions and unscientific methods.

He was free from the common fault of self-deception. There is no vagueness in any of his explanations of phenomena. When he explains such a thing as the tears of strong wine and refers to surface tension he is as exact as Prof. Boys or Lord Rayleigh, and he demands from his reader the same carefulness. When he is not perfectly sure of a thing he tells you so frankly. The results of Thomson's thought in so far as physics is concerned are known to all of us; they are to be found in all text-books; I wish we could say the same about his work in engineering. But both physicist and engineer will get much education in reading the original papers. They will come in contact with a true scientific mind, absolutely honest, intensely observant, afraid of self-deception, concentrative, persistent and tireless. I have no hesitation in saying that the hydraulic engineer who has not read these papers has a great deal to unlearn and learn.

Only the very simplest mathematical or scientific knowledge is needed by the reader, but he must have common sense and humour and the same inclination to laugh at pretentious, ignorant notions as the author himself. I think myself that in a few cases Thomson ought to have worked with higher mathematics. For example: water being supposed to be frictionless and to flow from two similar vessels with similar and similarly placed orifices, he thought it necessary to prove that the lines of flow are similar. If this is so, it is evident that if l and L are the dimensions, p and P the pressures, v and V the velocities at similar places, then $P/p = L/l$ and $V/v = \sqrt{L/l}$. His proof of the similarity is ingenious. Applied to the case of vessels moving through water it is Froude's law, but in this case, unlike Thomson's own, viscosity enters into the real phenomena in an all-important way, and the assumption that the proposition has been proved is very dangerous. Thomson used his proposition in getting a rational formula for the measurement of water by his triangular notch, and in proving that the empirical formula of Dr. Francis for rectangular notches is really a rational formula. It is curious that it should be necessary to tell engineers that the Francis formula is correct and that the usual formulæ of the text-books are quite incorrect.

Now that long proof given by Thomson in his 1876 paper (given by him to students in his classes for fifteen years previously) seems to me unnecessary. In one of his vessels A the flow is natural, and in the other B he guides the flow in stream

lines similar to those of A; he shows that there are no forces tending to deform the guides of B, and if we imagine them to disappear the flow is unchanged and remains similar to the flow in A. But since he proves so much, he ought to prove that there is no other way in which the flow can occur in B, and I am afraid that this cannot be done except by Kirchoff's use of higher mathematics. Indeed, Kelvin showed that there might be two answers to all such problems, one of them being unstable.

The first of these fluid motion papers (1852) deals with the free vortex. The example to which he most frequently referred his students was that of water leaving a basin by a central hole. The nearly circular motion of every particle is such that the speed is inversely proportional to distance from the axis, and he satisfied himself that our simple theory as to pressure, circular speed v, and height was correct. But he noticed that particles of dust on the lower surface of the basin moved in towards the hole nearly radially; he arrived at the conclusion that surface friction destroyed v, and therefore destroyed the centrifugal force, and therefore destroyed the balance of pressures, and therefore created a radial flow. This simple principle gave the key to the atmospheric phenomena of great forest fires; it enabled him to explain what occurs at river bends and why a river through alluvial ground tends to become more and more crooked; it enabled him to explain the phenomena of cyclones, and, most important of all, it enabled him in 1857 to give his simple explanation of what had puzzled many clever scientific men for two hundred years, the grand currents of atmospheric circulation. That short paper is easy to understand. The Bakerian lecture of the Royal Society with the same title, delivered in 1892 two months before his death, added nothing to that simple explanation, then thirty-five years old, but in it he gave at some length the history of the problem.

Hadley, in 1735, explained the trade winds in latitudes 30 S. to 30 N., but in all the numerous writings by distinguished men before and after Hadley until 1857 there was only slipshod reasoning and no explanation of the prevailing S.W. winds north of latitude 30 N. There is a whirl of the atmosphere there from the west which would produce no northerly flow of the air, only that there is friction against the earth; this diminishes the speed of the air and upsets the balance of pressures, producing a northerly flow close to the earth's surface—exactly the basin phenomenon! His proof, in 1849, that pressure lowers the melting point of ice consists in subjecting a mixture of ice and water to a Carnot cycle. He assumes with Carnot that no heat disappears when work is done, but he states quite clearly, as nobody else had ever done, what the third part of the cycle would be if Carnot were wrong and if less heat were given out than what had been received.

Using Regnault's experimental results for steam, Lord Kelvin had in 1848 calculated the value of Carnot's function, and James Thomson used the result, which was this:—"We find that the quantity of work developed by one of the same thermal units descending through one degree about the freezing-point is 4·97 foot-pounds." This enables him to find that the lowering of the melting-point is 0·00000355 p where p is the increase of pressure in pounds per square foot. This paper and Kelvin's paper and their connection with the vexed question, "Who discovered the second law?" are exceedingly interesting. Kelvin's paper of 1851 first established the second law on a logical basis irrespective of assumed properties of matter, and Kelvin was too generous in giving credit to Clausius and, indeed, to Rankine also. But these four men and Joule himself were all very close to the discovery in the three years 1848 to 1851. I know of no more interesting reading than what I find in Prof. Silvanus Thompson's life of Lord Kelvin during these years. No one of Plutarch's heroes "played the game" more nobly than the Thomsons.

James Thomson reasoned out from the above principle the cause of the flow of glaciers and the plasticity of ice and other curious ice phenomena, as well as the influence of stress on crystallisation generally, in a series of papers and letters until 1889. In 1862 he had made a model of a surface showing how p, v and t for carbonic acid vary, and had thought of conditions of instability. Dr. Andrews's Bakerian lecture of the Royal Society in 1869 caused him to revert to his previous study of the discontinuities of his surface, to complete his model and to write papers of 1871 on the abrupt changes at boiling and condensing. He reasoned out the existence of the triple point for ice, water and steam in 1872 and 1873 in the same way as that of his 1849 paper on ice. The one p, t curve for saturated steam drawn on copper by Regnault is really two curves the slopes of which at 0° C. are not the same, being in the ratio dp/dt for ice-steam $\div dp/dt$ for water-steam $= 1{\cdot}13$. These matters are familiar to all readers of Maxwell's book on heat, but the student will be interested in the letters and notes from 1862 which describe how Thomson was led to his results. He used to tell his students, with some glee, how his eye detected in Regnault's curve the discontinuity at 0° C. which nobody had noticed before.

His valuable papers on the strength and elas-

ticity of materials, the theory of springs, safety and dangers in structures and the testing of structures, on units, on dimensional equations, on absolute motion, on fatigue of materials are less well known, but students who read them will get a clear insight into subjects on which text-book reasoning is sometimes rather slipshod. His paper on the parallel roads of Lochaber is acknowledged to have cleared up a great geological puzzle. His paper on prismatic structure in basaltic rocks cleared up the Giant's Causeway puzzle.

In his paper of 1872 on atmospheric refraction of inclined rays and on the path of a level ray he solved another important problem. His integrating machine is now in use for tide-calculation. There are many papers on subjects of general interest to which I cannot refer because I have no space. Suffice it to say that on every subject about which he wrote he threw a new light, he gave fresh ideas, and he started students on new lines of thought. In reading one of his papers we instinctively feel sure that he has given long and careful consideration to the matter and has looked at it from many points of view; consequently he has exact and clear ideas, and he is able to state them in simple language, so that we at once accept his conclusions as correct.

JOHN PERRY.

TABLES OF THE WEIGHT OF AIR.

Tabellen der Luftgewichte γ_t^b, *der Druckäquivalente* β_t^b *und der Gravitation* g.

Tables des poids de l'air γ_t^b, *des équivalents barométriques* β_t^b *et de la gravité* g.

Tables of the Weight of Air γ_t^b, *of the Air-Pressure Equivalents* β_t^b *and of the Gravity* g. By Dr. S. Riefler. Pp. iv+101. (Berlin: Julius Springer, 1912.) Price 6 marks.

IN rough experiments, the density or the weight of the air may often be ignored; generally, however, it is allowed for with more or less completeness. But when it is desired, as in the author's work, to make a precise determination, so precise that the effect of moisture in reducing it, or carbonic acid gas in increasing it, must not be ignored, and when the local value of g has to be allowed for, then the investigator may find the calculation to be unduly tedious.

The author of these admirable tables has been brought face to face with the difficulty in connection with the disturbing effect of the density of the surrounding air on the period of the pendulum of the astronomical clock. For instance, the rate of such a pendulum is changed by 1/100 second per day, so he states, by a variation in weight of one milligram per litre in the air surrounding the pendulum. He has, therefore, calculated a series of tables, where they were not already in existence, whereby all the data required can be found with the maximum of directness and accuracy and the minimum of trouble. Every table has the formula on which it is based printed at the head, and a clear statement of the whole problem is printed in three parallel columns in German, French and English. In only one case is this departed from, where the names of the countries in which a large number of stations are situated for which g has been determined are printed in English only, "on account of the extended use of this language"—a compliment which an English paper should acknowledge.

The most important of the tables is calculated for every 10 mm. of barometric height from 380 to 680 mm., and then for every mm. up to 790 mm., and for every degree of temperature from −1° C. to +36° C. For all these conditions the weight of a litre of air free from CO_2, but both dry and half saturated with moisture, is calculated on the basis that at Paris the weight of dry air free from moisture and CO_2 is, under standard conditions, 1293·21 mg. Alongside the figure giving the weight is another, called by the author "the pressure equivalent of temperature," which shows the change in pressure in mm. of mercury due to a change of 1° C. in temperature. It is interesting to notice that this, in the case of half-saturated air at 760 mm., has a minimum value at about 17° C.

It would require more space than is available to discuss the tables fully. It is sufficient to say that the printing, the paper and the arrangement are all admirable, and that these tables should be found in every laboratory where exact work is done.

C. V. B.

ANTHROPOLOGY AND ARCHÆOLOGY.

(1) *The Annual of the British School at Athens.* No. xvii. Session 1910–11. Pp. liv+355+xxi plates. (London: Macmillan and Co., Ltd., 1912.) Price 25*s.* net.

(2) *The Cochin Tribes and Castes.* By L. K. Anantha K. Iyer. Vol. ii. Pp. xxiii+504. (Madras: Higginbotham and Co.; London: Luzac and Co., 1912.)

(3) *The Origin of Civilisation and the Primitive Condition of Man.* Mental and Social Condition of Savages. By the Right Hon. Lord Avebury. 7th edition. Pp. xxviii+454. (London: Longmans, Green and Co., 1912.) Price 7*s.* 6*d.* net.

(4) *Notes and Queries on Anthropology.* Edited

for the British Association for the Advancement of Science by Barbara Freire-Marreco and Prof. J. L. Myres. 4th edition. Pp. xii+288. (London: Royal Anthropological Institute, 1912.) Price 5*s*.

(5) *Rough Stone Monuments and their Builders*. By T. E. Peet. Pp. xii+172. (London and New York: Harper and Bros., 1912.) Price 2*s*. 6*d*. net.

(1) THE last issue of the Annual of the British School at Athens opens with an interesting review of the working of this institution since its foundation in 1883, prepared by the honorary secretary, Mr. G. A. Macmillan. In spite of its limited resources, the school, which deserves more active support from archæologists and students of classical literature in this country, has done most valuable work in the excavation of historical sites, and in the preparation of monographs on the archæology and anthropology of Greece and the eastern Ægean area. In the present volume, besides reports on the topography of the Troad, Thebes, Phylakopi, Phokis, and other places, Mr. W. R. Halliday has made an important contribution to the study of comparative religion in his article entitled "Cenotaphs and Sacred Localities," in which he deals with the stratification of local beliefs. It is interesting to read a description of a Thracian Tholos tomb at Kirk Kilisse, written before the recent campaign which has directed public attention to this place. The number, as usual, is provided with a fine series of maps and illustrations.

(2) Mr. L. K. Anantha Krishna Iyer, in the new volume of his survey of the people of the Cochin State in south-western India, passes from a description of the degraded forest and menial tribes to the higher castes, with whom he is much more personally familiar. He begins with an elaborate account of the Brahman classes, which display remarkable differences in beliefs and customs as compared with their brethren in northern India, from whom they form a comparatively recent offshoot. Then come the Nayars, with their strange marriage regulations and their unique association with the Nambutiri Brahmans. Equally interesting are the Mohammedan Mappillas, a race subject to occasional outbreaks of savage fanaticism which has from time to time nerved them to resist British troops. We have a full account of the remarkable colony of White and Black Jews, whose origin and history are still subjects of controversy. Finally, he describes the Syrian Church of Malabar, an institution of much interest to students of the history of Christianity. On all these varied races the author has collected a mass of valuable information. This book, for which anthropologists are indebted to the liberality of the State Government, is excellently produced, and supplied with admirable photographic illustrations. Thanks to the writer and Mr. Edgar Thurston, the ethnologist is now provided with a trustworthy account of the races of southern India. The survey will be completed by a third volume devoted to physical anthropology, the appearance of which will be awaited with much interest.

(3) Lord Avebury's work on primitive civilisation, first issued in 1870, now ranks as an anthropological classic. It is, however, much to be regretted that the author, in this new edition, has been unable to subject the work to a thorough revision and bring his authorities up to date. It is true that in his introduction he refers to some recent work, and discusses with admirable restraint the vivacious criticisms of the late Mr. Andrew Lang on the views expressed on savage religion; but, frankly speaking, his bibliography and references are not up to the level of modern research. A list of authorities on the beliefs and sociology of primitive man which ignores Sir E. Tylor's "Primitive Culture," and writers like Profs. Frazer and Westermarck, Messrs. Crawley, Hartland, and Lang, is clearly inadequate, and the authorities quoted in the notes, though good of their kind, are prehistoric, because they do not include recent surveys of savage life in Australia, India, America, Africa, or Melanesia. It may be hoped that in the next edition of this useful book Lord Avebury will take the opportunity of subjecting it to thorough revision, by bringing the bibliography up to date, and improving the notes by quotations from the works of modern travellers and ethnologists.

(4) The "Notes and Queries on Anthropology," issued by the Royal Anthropological Institute with the aid of a grant from the British Association, now appears in a thoroughly revised edition, prepared under the superintendence of Miss Freire-Marreco and Prof. J. L. Myres. Every chapter of the work bears the marks of careful and judicious reconsideration, and, as it stands, it should be in the hands of every traveller and official who has the chance of investigating savage races. In future editions of this valuable *questionnaire*, it might be advisable to extend the list of works recommended to the student, which only very imperfectly represents the best modern work. A section might also be added suggesting the precautions under which these elaborate interrogatories should be used in field work, with a suggestion, gathered from the experience of those familiar with savage races, of the best methods by which trustworthy information can be collected.

(5) The question of the origin of megalithic monuments and of the race by whom they were constructed has acquired fresh importance from the discussion, at the recent meeting of the British Association at Dundee, of the theories advanced by Prof. G. Elliot Smith, who attributes them to influence from Egypt, where he assumes that the invention of copper led to the use of carved stone. Mr. Peet's method in the present book is to give a summary account of megalithic monuments throughout the world, to which he adds some cautious, well-considered speculations on their origin and diffusion. He fully recognises the difficulty, in the present state of our knowledge, of deciding the centre from which they were derived. He suggests that the idea of the rock-tomb was brought into the megalithic area by the builders of the monuments, that it did not result from contact with the eastern Mediterranean, and that there is no direct connection between the corridor tombs of the megalithic countries and the great Tholoi of Crete and the Greek mainland. The book may be safely recommended as a cautious summary of a most difficult problem.

RECENT BOOKS ON PHYSICAL SUBJECTS.

(1) *Elements and Electrons.* By Sir W. Ramsay, K.C.B., F.R.S. Pp. ix+173. (London and New York: Harper and Brothers, 1912.) Price 2*s.* 6*d.* net. (Harper's Library of Living Thought.)

(2) *Radium and Radioactivity.* By A. T. Cameron. Pp. 185. (London: S.P.C.K., 1912.) Price 2*s.* 6*d.* (Romance of Science Series.)

(3) *A Handbook of Physics.* By W. H. White. Pp. xv+667. (London: Methuen and Co., Ltd., n.d.) Price 7*s.* 6*d.*

(4) *A Course of Physics, Practical and Theoretical.* By Dr. C. H. Draper. Pp. xi+413. (London: Blackie and Son, Ltd., 1912.) Price 4*s.* 6*d.* net.

(5) *La Théorie des Ions et l'Électrolyse.* Deuxième Édition. By A. Hollard. Pp. vii+220. (Paris: Gauthier-Villars, 1912.) Price 5 francs.

(6) *Lehrbuch der Optik.* Dritte erweiterte Auflage. By Dr. Paul Drude. Herausgegeben von Dr. E. Gehrcke. Pp. xvi+548. (Leipzig: S. Hirzel, 1912.) Price 12 marks.

(7) *Electricity and Its Practical Applications.* By Prof. M. Maclean. Pp. xiv+492. (London: Blackie and Son, Ltd., n.d.) Price 10*s.* 6*d.* net.

(1) IT need scarcely be stated that a popular treatise from the pen of Sir William Ramsay is sure to be of absorbing interest. This is particularly the case with the present volume, with the subject of which the author's name is so intimately associated. The various stages in the development of chemistry, and later of radioactivity, are sketched in a manner quite delightful, and although the treatment of the mechanics involved may be regarded by some as rather loose, it is only in a few instances that this objection can be raised, and it should be remembered that, after all, the readers will not all be strict mathematicians.

The principal chapters are those which deal with Dalton's atomic theory, molecular weights, the periodic table, molecules—invisible and visible—electrons, radioactivity and transmutation. Probably the last of these is that which will invoke the greatest interest. It is common knowledge that Sir William Ramsay's work in this field has been received in some quarters with scepticism, and, of course, all controversies are popular. The author draws a distinction between "transmutation" and "transformation," the former applying to controlled changes as distinct from natural changes. Among the reasons brought forward as indicating the probable effect of corpuscular bombardment in producing transmutation, it is suggested that it may be due to high temperature. The "temperature" of rapidly moving alpha particles is calculated upon the kinetic theory, and the number obtained is enormous.

With this view it is difficult to agree, for even if we admit the validity of this calculation as representing the temperature of the particles themselves, it cannot be claimed that it also measures the temperature of the body bombarded. But apart from this, the accumulated evidence of transmutation which is recorded in this chapter should not be lightly dismissed, especially coming as it does from the discoverer of the spontaneous production of helium from radium. It may be scarcely credible, because so extraordinary, but it may, nevertheless, be true.

(2) This is another little book on somewhat similar lines, although, in this case, radioactivity is the sole subject. The author takes the very reasonable view that some knowledge of physics and chemistry must be assumed in the reader, but the calls on this knowledge are neither great nor numerous, and will form no bar to the majority of students. A straightforward and interesting account of the main radioactive phenomena constitutes the contents of the book, and the novice who desires some acquaintance with this wonderful new subject could not do better than acquire a copy.

(3) It is not often that one comes across a text-book exhibiting so much originality as that which Mr. White has recently produced. To say that

it differs from the ordinary text-book scarcely expresses the truth of the matter. It is so often found that a new book on physics merely consists of previous works *plus* a few modifications and additions. Here, however, internal evidence makes it perfectly clear from page to page that the author is indeed the author.

The book is a very good one indeed, and should find a large sale among those students of physics who need in a single volume a treatment of the subject rather more than elementary. It is true that in many places the illustrations of physical principles used verge on the ludicrous, and that the mode of expression often seems out of place, but the redeeming feature is that the illustrations are excellent. It may be said, in fact, that by reason of the frequent recourse to everyday occurrences as constituting examples of various physical phenomena this book is chiefly noteworthy. A few of them, notably those connected with physiological processes, may, perhaps, be beyond the average student, but the author has evidently introduced them for the special benefit of students of medicine. One undesirable feature may be mentioned in conclusion, namely, the fact that the author has attempted in several places to conduct algebraic calculations in words instead of symbols, the result being that the reasoning, although correct, is very difficult to grasp.

(4) This is a combined theoretical and practical text-book intended for schools, and to be covered normally on a three-years' course. In most respects it resembles the usual school-book. It is, however, a good plan to describe in one volume the methods of doing experiments and the theoretical treatment of the principles involved.

(5) The author of this book has produced a useful record of much of the experimental work which has been done on electrolysis, and interprets the results upon the theory of ionisation. He claims that the simple theory, although admittedly inapplicable to concentrated solutions, yet may afford a basis to which modifications may be made, just as did Mariotte's and Gay-Lussac's laws for gases. The subject is divided into four sections, namely, the constitution of electrolytes, their conductivity, contact potential, and electrical energy. A considerable number of tables are given recording numerical values of such quantities as heats of ionisation and conductivities of acid solutions of various strengths.

(6) In a book having the reputation of the late Prof. Drude's "Optics," the chief interest in the appearance of the third edition is attached to the modifications and additions introduced. Such a book would be hard to improve, and might easily be spoilt. Prof. Gehrcke has wisely refrained from making any serious alterations, and the additions are few in number, the principal being a short description of Stokes's theory of aberration and a paragraph or so on the photochemical effect on gases. The treatise is still Drude's "Optics," and will continue to merit the high place it already holds in physical science.

(7) This volume has been written for the use of students of electrical engineering. It consists of the treatment of magnetism and electricity, first of all from the theoretical point of view, and then in connection with its various applications. The mathematical treatment is quite elementary—it is, in fact, based on Deschanel's "Natural Philosophy," so far as the purely theoretical part is concerned, many of the diagrams also being reproduced from that treatise. A series of tables of constants and various questions and exercises add to the value of the book, which appears to be well fitted for its purpose.

OUR BOOKSHELF.

La Cementazione dell' Acciaio. By Dr. Frederico Giolitti. Pp. xi+506. (Torino: Unione Tipografico-Editrice Torinese, 1912.)

IN the present work, Prof. Giolitti has collected together the important experimental results obtained by his fellow-workers during the last four years relative to the cementation of steel. At the same time, he has presented an exhaustive review of the subject from its scientific and technical aspects. The chemical nature of the process of cementation (in which term case-hardening is included) has been the subject of many controversies, and it cannot be said that the mechanism of the transport of carbon is even now understood. Prof. Giolitti subjects the extensive literature of the question to a critical review, which does not appear to omit any work of importance, English and German memoirs being examined as thoroughly as those in Italian and French. This part of the book might, perhaps, have been somewhat condensed by the omission of repetitions, but it forms an excellent source of reference for a class of facts of great importance for the general theory of metallic alloys. The chapter in which the results of previous investigations are summed up scarcely gives sufficient attention to the fact, now fully established, that carbon diffuses in the solid as a carbide, and not in the free state.

The author's own researches, which occupy the larger part of the book, deal mainly with the specific influences of carburising gases (hydrocarbons and carbon monoxide, alone or in the presence of solid carbon) in the process of cementation. Details are given of the experimental conditions employed, and of the technical processes based on the experiments. The methods are of great scientific as well as technical interest as examples of the application of a purely physico-chemical study of equilibrium to an industrial

operation. The work is an important and valuable contribution to the literature of metallurgy.

C. H. D.

Index Zoologicus No. II. Compiled (for the Zoological Society of London) by C. O. Waterhouse and edited by David Sharp, F.R.S. Pp. vi+324. (London: Printed for the Society, 1912.) Price 15*s*.

THE subtitle of this volume describes its scope; it runs: "An alphabetical list of names of genera and subgenera proposed for use in zoology as recorded in the 'Zoological Record,' vols. 38–47 inclusive (1901–1910), and the zoology volumes of the 'International Catalogue of Scientific Literature,' annual issues 1–10, together with other names not included in previous nomenclators." The first volume was published in 1902, and the primary object of the present work is to serve as an index to the intervening ten years, but it is also planned so as to be with Scudder's "Nomenclator" a complete register of the names of genera and subgenera proposed for use in zoology. The editor of this volume points out that 140,000 names have been, up to the present time, proposed for the genera and subgenera of zoological taxonomy.

Systèmes Cinématiques. By Prof. L. Crelier. Pp. 100. (Paris: Gauthier-Villars, 1911.) 2 francs. (*Scientia.* Janvier, 1911. Phys.-Mathématique. No. 31.)

UNDER the above title, the author investigates the motion of a right-angle one side of which passes through a fixed point, while the vertex describes a fixed right line or circle, that of a rod sliding between axes at right-angles, that of a crank connecting rod, and so forth; altogether, six methods of generation are investigated. The curves associated with these moving systems include the base and rolling centrodes or loci of the instantaneous centres, the envelope of the moving line and those of other lines associated with it, the trajectories of various points of the figure, and certain envelopes of their tangents. In this way a large number of curves are obtained, possessing interesting properties; of course, many of these are already well known. The figures in the book are rather complicated. The book contains a portrait of Col. Mannheim and a short bibliography.

Internal Secretion and the Ductless Glands. By Prof. Swale Vincent. With a preface by Prof. E. A. Schäfer, F.R.S. Pp. xx+464. (London: Edward Arnold, 1912.) Price 12*s*. 6*d*. net.

PROF. SWALE VINCENT is well known as an investigator who has devoted much attention to one of the most interesting chapters of physiology, namely, that which deals with the group of organs, formerly so mysterious, which are known as the ductless glands. The adrenal bodies, the thyroid and parathyroids, the thymus, the pituitary, pineal, carotid, and coccygeal bodies are the principal ones treated, but, as is well known, internal secretions are also formed by glands which possess ducts, and so we also have chapters on the pancreas, liver, kidney, and reproductive organs. The literature of the subject is enormous, and in presenting a lucid and terse account of the recent progress of science, and in ferreting out the 3000 or more references which deal with it, the author has, as Prof. Schäfer says in his preface, laid us under a deep debt of gratitude. W. D. H.

A Laboratory Manual of Agriculture for Secondary Schools. By Prof. L. E. Call and E. G. Schafer. Pp. xv+344. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1912.) Price 4*s*. net.

THIS book is issued to supply the demand that has arisen for laboratory exercises in the teaching of agriculture in the United States. Directly agriculture becomes a school subject (and it is for secondary schools that the book is intended), it becomes necessary that the teacher should be provided with a number of simple experiments within the capacity of the scholars and of the school equipment. Of course, the out-door observations must still remain the essential groundwork of the instruction, but a well-chosen course of laboratory experiments can be arranged to bring out the main principles and illustrate the working of the individual factors involved.

The lessons deal with soils, crops and animals. For convenience of working they are arranged in calendar form, beginning in September and continuing through to May, with an "extra" for Arbor Day. They have actually been carried out in schools, so that they are known to be workable.

The soil experiments deal mainly with the moisture relationships, which in Kansas play a large and sometimes a controlling part in soil fertility. The crops studied include the cereals, cowpeas, cloves, lucerne and potatoes: the exercises range over the germination of the seed, the development of the root and seed, and the examination of the harvest. The animal section is based on the score-card method, devised in America and found so useful that it has been introduced into this country.

Teachers of agriculture will find many useful and suggestive lessons in the book, and it will serve as an excellent example of the standard of instruction aimed at in the American schools.

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.*]

An Effect due to the Sudden Great Increase of Pressure.

IN the course of some experiments on the mapping of the lines of electric force between two charged conductors, a remarkable effect, due to the sudden very great rise in pressure in the oil separating them, occurred. The conditions of the experiment necessitated the use of two pointed strips of tinfoil, separated by an interval of 1/16 in., laid on a sheet of glass

with a drop of turpentine, to act as an insulator, between them. On this was laid a thin cover-glass, as used for covering objects when mounted for the microscope. Unintentionally the potential between the two tinfoil strips rose high enough to permit a spark to pass through the oil between them, and when this occurred a small piece was blown out of the centre of the cover-glass, being about 1/16 in. in diameter on the upper side and about half this on the lower, the piece of glass having the appearance of a small truncated cone. The cover-glass was only held down by the film of oil separating it from the strips of tinfoil; yet the fragment of glass was ejected with considerable force.

The cause of the effect may be explained as follows: the energy liberated from the spark was sufficient to cause the pressure to rise rapidly to a high value in the confined space, either by decomposing the oil and heating the liberated gas, or by forcing away the oil along its path, and so compressing it. (We are, however, not concerned here with the question as to whether the pressure on the glass cover had its seat in the oil alone or in the gas liberated from the oil, but only with the fact that the passage of the spark through the oil gave rise to a series of events which culminated in the forcing out of a plug of glass from the cover.) As the time during which the spark lasted was almost negligible, the rate at which the pressure rose near the spark was great enough to send out a pulse of pressure through the oil. This pulse striking the thin cover-glass had sufficient energy stored in it to cause the small piece of glass to be removed from it.

This effect is the converse of that noted by Mr. J. Y. Buchanan during the voyage of the *Challenger* in 1873, and repeated by him while on board the yacht of H.S.H. the Prince of Monaco, the *Princesse Alice*, in the summer of 1902 (see Proc. Roy. Soc., 1903, vol. lxxii., p. 88; or NATURE, 1903, vol. lxviii., p. 334). I will quote from Mr. Buchanan's paper:—"The brass tube (Figs. 1 and 2, plate i.) above referred to was the case for holding a piezometer which was accidentally broken. With it I repeated the experiment which I had made in the *Challenger*, with this difference, that I used only one sealed glass tube. It was an ordinary pipette of 50 c.c., sealed up at both ends close to the body. It was wrapped in a piece of muslin and loosely packed with cotton waste so as to occupy the middle of the brass tube.

"The length of the brass tube was 33 cm., and its diameter 4·13 cm. Its weight without the cover was 350 grams. Both the top and the bottom are pierced with many holes so as to allow passage to the water.

"Thus charged, it descended on the sounding line to a depth of 3000 metres, and when it came up it was evident from its appearance that the experiment had succeeded. As in the experiment on board the *Challenger*, the glass had been converted into a snow-white powder. The external effect also was confined entirely to that part of the brass tube which had been occupied by the sealed glass tube. Above and below it there was no disfiguration."

In this case it was easier for the water outside to distort the brass tube than to flow through the perforated caps covering the ends, and so fill the space lately occupied by the glass bulb. In the case of the punctured cover-glass the pressure rose so suddenly on the spark passing through the oil that there was not sufficient time to raise the glass as a whole, or to push away the film of oil lying between it and the glass slide, with the result that a minute piece of glass was forcibly blown out. Had the cover-glass possessed the ductility of brass, there would perhaps have been a bulge formed instead of a piece being bodily removed.

On another occasion I had a practical demonstration of the power given out by a spark. It was in the early days of wireless telegraphy, and I had constructed an oscillator of a simple type, consisting of a pair of brass balls immersed in paraffin oil, the oil and balls being contained in an inverted bottle from which the bottom had been removed. The bottle was about 2½ in. in diameter, and about 4 in. deep, and the balls were situated at the centre, one above the other, and ⅛ in. apart. I had not passed more than about a dozen sparks between the balls when suddenly the glass was shattered. The large end of the bottle was open, and the free surface of the oil was about 2½ in. in diameter. We have in this case direct evidence of a pressure being transmitted in the form of a pulse, or single wave, to the glass containing vessel of an intensity sufficient to cause it to break. The cause of this pressure was the spark passing from ball to ball through the oil, and while passing pushing away the oil on all sides with a rapidity which gave rise to a pulse of pressure. This pulse travelled outwards with great velocity, and contained such a store of energy that on striking the sides of the vessel it was sufficient to rupture the glass. The potential energy of the original electric charge was converted into the kinetic energy of the spark, and this in turn was transformed into the energy of the pulse, which was finally transferred to the glass. As the amount of energy was too great for the glass to hold, it found an outlet in shattering the vessel.

The "pressure in an electric spark" is a term by no means uncommon in scientific literature, yet but little attention is paid to the effects which this pressure exerts on surrounding objects, as, for example, when a tree or house is struck by lightning. They all belong to the type mentioned above.

In conclusion, I would recommend a careful study of the paper by Mr. J. Y. Buchanan referred to above to those interested in the subject of the sudden *relief* of great pressure.

W. G. ROYAL-DAWSON.
17 Pembridge Gardens, London, W.
January 8.

The Halo in the Ricefield and the Spectre of the Brocken.

IN connection with the curious Japanese phenomenon of the halo seen around the head of the shadow of a person standing in a ricefield in early morning (NATURE, p. 419, December 12, 1912), it may be of interest to recall that some recent balloon voyagers have reported observations of a bright halo surrounding the shadow of the car thrown upon a horizontal cloudfield by oblique solar rays. Coloured diffraction rings are sometimes seen surrounding the head of the "spectre of the Brocken," but for these to be visible theory requires that the drops constituting the mist should be of uniform size. In an article in the *Meteorologische Zeitschrift* (p. 282, June, 1912; see also *Science Abstracts*, p. 574, December, 1912), by Prof. F. Richarz, discussing the theory of the subject, reference is made to an observation by Dr. Bieber from the balloon *Marburg* of a halo around the shadow, and also to other verbal communications of a similar character. Prof. Richarz's article is followed by another describing a photograph taken by Dr. Wegener of a series of three diffraction rings seen around the shadow of the same balloon, the *Marburg*, on another voyage. The centre of the rings was the point corresponding to the shadow of the eye, or of the camera objective. On calculating the

radius r of the cloud drops from the angular radius of a ring, a divergence from theory was found on this, and other, occasions. Theoretically all the rings should give the same value for r, but the calculated value of r was found to diminish with the order of the ring outwards.

The Japanese observers are stated in the note to attribute the halo to reflected light from sun-images formed on the green blades by rays refracted through dewdrops. In the case of the cloud observations it seems necessary to assume reflection from portions of the cloud itself.

The difficult point, however, is to explain why the light thus reflected should be maximum in the direction of the sun, or, what is the same thing, in the direction of the observer. The fact that the ring surrounds the shadow of the observer's head seems to render such an assumption necessary. A single drop, as Prof. Richarz points out, does not give maximum intensity of reflection in the direction of the incident light. Dr. Richarz's explanation why the cloud as a whole should do so is simple and ingenious, and is applicable whether the sun's rays fall normally or obliquely to the surface of the cloud. Direct light only penetrates into the cloud (or assemblage of drops) when it finds a clear path, for if it strikes any drops on the way it will be scattered or diverted by refraction and reflection at their walls. If light which has so penetrated should then fall on the surface of a drop in the interior, it will be reflected in various directions, but only that portion of the reflected beam which returns the same way it came can find a clear path out again. Portions of the beam reflected in other directions will generally find their way blocked by intervening drops and be scattered. Hence the intensity of the reflected light will be maximum in the direction of the source of light, and the intensity will fall off rapidly with departure from that direction. The observer's head (or the balloon) cuts off the central portion of the sheaf of rays which he would see most brightly reflected, leaving only the peripheral portion visible.

To digress, I have a vivid recollection of one very foggy winter evening when I was wintering in a cottage on a wild part of the Cornish coast. Chancing to throw open the casement window of the sitting-room, I was for the moment quite taken aback to find myself confronted by a tall sinister figure looming up before the window. It was my own shadow thrown on the fog by a lamp left unshaded on a table in the room.

Perhaps I may take this opportunity to record another little optical observation of different character. Once—I think it was towards the close of the hot summer of 1908—watching, from the top of a cliff some 800 ft. high, the sun setting over the sea, I saw the upper half of the disc look like a double staircase; there were three or four distinct, almost rectangular, steps cut out of the limb symmetrically on either side. When most of the disc had sunk out of sight, the small portion remaining was suggestive of the lid of a teapot with a knob on top. Some lines of light cloud about the horizon showed the existence of horizontal stratification in the atmosphere, and the strange distortion of the solar limb was evidently due to refraction through horizontal strata with extraordinary sharpness of boundary and difference of density. ALICE EVERETT.

Milbourne Lane, Esher, January 6.

"Rosa stellata."

IN 1898 Prof. E. O. Wooton described a remarkable new rose from southern New Mexico, giving it the name *Rosa stellata* on account of the stellate trichomes. The peculiar, mostly trifoliolate leaves, the leaflets with cuneiform bases and more or less truncate, sharply toothed apices, gave the plant an unusual appearance; while even the flowers, described as "large and showy . . . deep rose-purple," were not at all like those of the ordinary wild roses of the Rocky Mountains. Through the kindness of my friend, Prof. Fabian Garcia, I obtained some living plants of *R. stellata* from the original locality in the Organ Mountains. Some of these were sent to Dr. A. R. Wallace, who has grown them in England successfully; the others have been growing in Boulder, Colorado. Last year the plants in my garden grew exceedingly well, and were most attractive. Certainly if *R. stellata* can be generally used in gardens, it will be a valuable addition to horticulture, but it probably will do its best only in relatively dry climates. My wife attempted crosses with several other roses, and in one case was successful in getting good seed; what will result remains to be seen.

The fruit of *R. stellata*, as indicated by Wooton, is large, beset with strong slender prickles. Quite unlike the usual types of rose fruits, its walls are dense, not at all fleshy or brilliantly coloured, but corky. The orifice is very broad, with a diameter of 8 mm. The bright chestnut-red seeds, about 4 mm. long, are long-oval, not compressed, and therefore not at all angular. All this differs conspicuously from the fruit of typical Rosa.

R. stellata, however, is not the only plant of this type. Years before, Engelmann described *R. minutifolia* from Lower California, a plant with the same general characters. In recent times, Dr. Greene has separated part of Wooton's *R. stellata* as *R. mirifica*, and has added a fourth species, *R. vernonii*. Thus we have a compact group, which should, I think, form a distinct subgenus or genus Hesperhodos, with *stellata* as the type. All the species are of extremely restricted distribution, which may probably be explained by the fact that the fruits are not adapted to be eaten by birds.

The wide-open prickly fruit suggests that this may be a primitive form, as compared with true Rosa; but it is to be noted that the roses found fossil in the Miocene beds of Florissant, Colorado, belong to the true genus Rosa, not at all to Hesperhodos.

T. D. A. COCKERELL.

Boulder, Colorado, December 30, 1912.

A Lens or a Burning Glass?

IN the latest edition of Carpenter on the microscope at p. 119 occurs the following, evidently from the pen of the late Dr. Dallinger:—"There is in the British Museum a remarkable piece of rock crystal, which is oval in shape and ground to a plano-convex form, which was found by Mr. Layard during the excavations of Sargon's Palace at Nimroud, and which Sir David Brewster believed was a lens designed for the purpose of magnifying. If this could be established it would, of course, be of great interest, for it has been found possible to fix the date of its production with great probability as not later than 721–705 B.C. . . . we spent some hours in the careful examination of this piece of worked rock crystal, which, by the courtesy of the officials, we were permitted to photograph in various positions, and we are convinced that its lenticular character as a dioptric instrument cannot be made out. There are cloudy striæ in it, which would prove fatal for optical purposes, but would be even sought for if it had been intended as a decorative boss; while the grinding of the 'convex' surface is

not smooth but produced by a large number of irregular facets, making the curvature quite unfit for optical purposes. In truth it may be fairly taken as established that there is no evidence of any kind to justify us in believing that lenses for optical purposes were known or used before the invention of spectacles."

While studying the evolution of fire-getting it occurred to me that this lens might have been used for obtaining fire from the sun; in other words, as a burning glass. It is well known that when the fires on the ancient altars happened by some accident to go out they had to be renewed by "pure" fire, obtained either by rubbing two sticks together or by concentrating the rays of the sun.

It would be an interesting investigation to see if this lens could be thus used. Of course, in the dull climate of England it might not work so well as in the sunny latitude of Nimroud, but the experiment would be worth trying, and by noting the extent to which the temperature was raised a good guess might be made as to its efficiency. JOHN PHIN.

Paterson, N.J., U.S.A., December 25, 1912.

"Primeval Man."

YOUR brief review of "Primeval Man" (NATURE, January 9, p. 512) devotes rather more than half of its space to the flat contradiction of two statements contained in a footnote. Your reviewer writes:—"That there was no connection between the Druids and the megaliths is absolutely unsupported by evidence. The idea is certainly older than the eighteenth century."

It is now commonly held that the Druids were an institution peculiar to the Celts, and there is no reason for tracing their origin to the pre-Celtic inhabitants of our islands. As the first wave of Goidelic or Brythonic invaders cannot have reached Britain much before 600 B.C., a gap of many centuries separates the Druids from the builders of the megalithic structures, which, by common consent, belong mainly to the end of the Neolithic or beginning of the Bronze age.

With regard to the popular notion connecting the Druids with the megaliths, the earliest printed reference appears in the enlarged edition of Camden's "Britannia," 1695. Here seven theories as to the origin of Stonehenge, &c., are cited, and the Druidic theory is quoted as being derived from a MS. paper of Aubrey. It is interesting to note in this connection that there is no instance of the words *druidic*, *druidical*, recorded in the "New English Dictionary" before 1755.

I am able to take a somewhat impartial view of the objections raised by your reviewer, as the footnote in question was written for me by the author of the articles, "Druidism," "Celt," and "Early Ireland," in the "Encyclopædia Britannica."

A. HINGSTON QUIGGIN.

88 Hartington Grove, Cambridge, January 14.

THE origin of the footnote is satisfactorily explained. Sir John Rhys's papers in the Transactions of the British Academy are strongly recommended. For literary information about the British Druids Welsh and Irish sources should be consulted. The material evidence bearing on primeval man, which was omitted from Mrs. Quiggin's book, is the astronomical testimony of the monuments, as interpretative both of Neolithic culture and of the real avocation of the Druid, whose nationality or race should be regarded as a secondary matter. Mrs. Quiggin's Celtic chronology should be revised. Mr. Common Consent, *alias* Commonly Held, is very apt to ignore evidence which he cannot quite follow, and what he follows generally is the angle of least resistance. He is very hard on astronomers and Druids—ancient astronomers.

Mediæval Welsh bards speak of bardic prophets as *derwyton*, modern Welsh *derwyddon*, "Druids." The traditional regulations for the erection of a stone circle for bardic purposes are prefaced with the statement that the regulations had been handed down from the time of the Welsh princes—that is, before the subjugation of Wales by Edward I. (see the section, "Voice of Gorsedd," in Welsh and English, in the printed collection called "Iolo MSS.," which may be consulted in most large libraries). Efforts have been made to show that such bardic documents are forgeries, with what motive is not stated. It has been proved, on the other hand, that the "forgers" did not understand their own alleged productions, and that their traducers are still more unaware of the meaning of the architectural principles involved in the traditional account (see NATURE for the last twenty years, and the second edition of Sir Norman Lockyer's "Stonehenge"). JOHN GRIFFITH.

X-rays and Crystals.

IT is not at all difficult to measure the ionisation produced by the radiation reflected by crystals, as indeed Prof. Barkla has already suggested. Using a sheet of mica and a pencil of a few millimetres diameter, I find it possible to follow with an ionisation chamber the movement of the reflected spot while the mirror is rotated. W. H BRAGG.

Leeds, January 17

ANTARCTIC BIOLOGY AND THE ROCKS OF WESTERN WILKES LAND.[1]

THE three last publications on the results of the Antarctic expeditions of the *Discovery*, *Scotia* and *Gauss* show that these works are approaching completion. The new contribution to the scientific results of the *Scotia* includes all the botanical reports except that on the phytoplankton, which may prove the most important. Of the ten memoirs in this volume, two deal with localities, Ascension and Gough Islands (lat. 50° S.), which are outside the Antarctic area. Seven of the memoirs are republished from various journals, while that by Mr. and Mrs. Gipp on the marine algæ is a compilation of their three papers with a rediscussion of some of the results. It is a great convenience to have these valuable memoirs collected into one volume; but it is unfortunate that the species founded in them are described in this work as "new species." Much trouble may be thus caused by the annual biological records again cataloguing these species, or by their being subsequently assigned to wrong dates.

[1] "National Antarctic Expedition, 1901–4." Natural History. Vol. vi. "Zoology and Botany." Pp. xvi+9+32+63+plates in text. (London: Printed by Order of the Trustees of the British Museum, and sold by Longmans and Co.; Bernard Quaritch; Dulau and Co., Ltd.; and at the British Museum (Natural History), 1912.) Price 16*s*.

"Scottish National Antarctic Expedition." Report on the Scientific Results of the Voyage of the S.Y. *Scotia* during the years 1902, 1903, and 1904. Under the leadership of Dr. W. S. Bruce. Vol. iii., "Botany." Parts i.–xi. Pp. ix+153+plates in text. (Edinburgh: The Scottish Oceanographical Laboratory; Edinburgh and London: Oliver and Boyd; Glasgow: James MacLehose and Sons, 1912.) Price 23*s*. 6*d*.

"Deutsche Südpolar-Expedition, 1901–3." In Auftrage des Reichsamtes des Innern. Herausgegeben von Erich von Drygalski. ii Band, "Geographie und Geologie." Heft vii. Pp. viii+617–662+2 plates. (Berlin: Georg Reimer, 1912.) Price 7.50 marks (Subscription price 6.20 marks.)

The first of the two new contributions in this volume is an interesting essay by Dr. Rudmose Brown on the problems of Antarctic botany. He agrees with Dr. Skottsberg in limiting the Antarctic area to south of 60° S. He retains Dougherty Island as existing, in spite of the failure of the latest attempt to find it. Dr. Brown refers to the striking poverty of the Antarctic in land plants. In the South Orkneys (lat. 61° S.) the expedition did not find a single flowering plant, whereas in 79° N. in Spitsbergen some of the land is carpeted with flowers of a hundred species. Dr. Brown attributes the poverty of the Antarctic flora to the mean temperature in the summer being below freezing point and to the flocks of penguins, which, in the absence of carnivorous animals, overrun the land. In his discussion of the origin of the Antarctic land flora, Dr. Brown remarks that the presence of an Arctic element in the mosses might appear to support the doctrine of bipolarity, which, he agrees with Dr. Skottsberg, has no botanical support. That most of the zoological evidence is also opposed to the theory is remarked by Mr. F. Jeffrey Bell in his interesting introduction to the last volume on the collections of the National Antarctic Expedition. Mr. Rudmose Brown explains the presence of the Arctic mosses by their transmission by sea birds, of which some species range almost from pole to pole. Some plants may have been introduced to Antarctica by wind; for Dr. Fritsch found in material from the South Orkneys the pollen of Podocarpus, which must have been blown from South America. Dr. Brown regards the whole Antarctic land flora as derived from South America, a conclusion which is supported by the absence of New Zealand plants from eastern Antarctica.

The second new memoir is by Dr. J. H. Harvey Pirie on Antarctic bacteriology. Levin has shown that many Arctic birds and seals are free from bacteria. Dr. Pirie, however, found that three out of the four species of seals examined and ten of the fifteen species of birds contained bacteria. His general results agree with those of Gazert, Ekelof and Charcot of the German, Swedish and French expeditions respectively, that Antarctic animals usually contain bacteria but may be sterile. Dr. Pirie found that the air, when carefully collected from the crow's-nest and the deep sea samples, was always sterile. In seven out of ten cases the surface water of the sea yielded bacteria. Denitrifying bacteria are, however, very scarce, and Dr. Pirie points out that the nitrogen so continuously added to the sea is eliminated by the action of these bacteria. Owing to the slight bacterial denitrification in the polar seas, plant and animal life is more abundant there than in the tropics.

Hence is explained the extraordinary abundance of individuals in the polar seas in spite of the relative poverty in species, a fact which is referred to by Mr. Jeffrey Bell in the new volume of the reports on the collections of the National Antarctic Expedition. He quotes Mr. Hodgson's remark that it was usual to take from ten to thirty thousand amphipods at a single haul, and Mr. Bell estimates that the collection included nearly ten thousand specimens of one schizopod. Mr. Bell refers to the two new species of Cephalodiscus and Mr. Hodgson's rediscovery of the ten-legged Pycnogonid as perhaps the most interesting of the biological results of the expedition. The volume includes three memoirs, a report on some young holothurians by Prof. MacBride, in which he suggests that these animals were derived from primitive echinoids, a hypothesis which appears less probable since Walcott's discovery of a Cambrian holothurian, which is much more ancient than any known echinoid. The second memoir is by Prof. Ehlers on the polychaets, and the last is by Prof. Fritsch on the freshwater algæ. This memoir is perhaps of less interest than the same author's report on the algæ collected by the *Scotia*, for Messrs W. and G. S. West have previously described the collection from South Victoria Land brought back by the Shackleton expedition. In the South Orkneys, in addition to the red snow which is familiar in Polar and Alpine regions, there is a yellow snow, due to a mixture of eighteen species of algæ and two of fungi. The colour is due to the numerous globules of fat. The general affinities of this flora are planktonic, and Dr. Fritsch suggested that it was carried ashore by the wind.

The last part of the volume on the geographical and geological results of the German south polar expedition contains a posthumous memoir by E. Philippi, the geologist of the expedition, on the intra-glacial material found near the winter quarters of the *Gauss*. The icebergs examined came from the east, and contained fragments of granite, gabbro, gneiss, crystalline schists, and a red quartzite, but no fossiliferous rock or representative of the "young volcanic" series. Icebergs were also examined eight miles west of the Gaussberg, and they contained similar rocks. Philippi concludes from the characters of the ice that it must have flowed over an irregular undulating land. The erratics collected by the expedition have been identified by Dr. Reinisch and include a similar but more varied series of rocks. They include granite and aplite, gabbro and gabbro porphyrite, many varieties of gneisses and hornblende schists, some of which are rich in pyrites, marble, quartzite, calc-silicate rock and sandstone. There is no true mica schist or phyllite. This association of rocks supports the view that western Wilkes Land is geologically a southern continuation of Western Australia. The third memoir in this part is a valuable study by Reinisch of the rocks collected in various Atlantic islands from the Azores to St. Helena. His report and analyses confirm the conclusion that the volcanic rocks of these islands mainly belong to the alkaline series, though, as Reinisch remarks, some of the basaltic rocks are intimately related to augite andesites.

J. W. G.

MODERN PUMPS FOR HIGH VACUA.

THE widespread researches on the phenomena in electrical discharge tubes, which form so important a feature of modern physics, directed much attention to the question of obtaining high vacua. In 1888, as Lenard tells us,[1] an efficient vacuum pump was by no means an essential part of the equipment of a physical laboratory: at the present time it emphatically is so. In the following a brief account will be given of the modern forms of the different types of pumps, especial reference being made, however, to a pump recently invented by Dr. Gaede, as it depends on a principle never before applied, and seems from present information more efficient than any of its predecessors.

All vacuum pumps except this latest one of Gaede's make use of the principle employed by Otto von Guericke in the first air-pump—that is, the intermittent separation and discharge of a fraction of the gas from the reservoir to be exhausted by means of a piston, which in the mercury pumps takes a liquid form. We can, in reviewing the modern forms, divide these pumps into three classes: the solid piston pump, the hand mercury pump, and the automatic mercury pump.

The solid piston pump has preserved much of its original arrangement of valves, but has been modified in the Geryk pump, which may be taken as a modern example, by the use of layers of a particular oil in the place of packing. The valves are always covered by the oil, which takes up all clearance, and hence leakage is largely avoided, but the vapour pressure of the oil, though very small, prevents the highest vacuum being produced; however, 0·0002 mm. of mercury can be attained. In a still more recent pattern, the "Rose" pump manufactured by Messrs. Cosser, there is no piston rod, the piston being of iron and moved by electro-magnets oscillating outside the pump cylinder.

The forms of hand mercury pump now used are all modifications of the well-known Toepler pump. One of the simplest and most successful is that devised by Antropoff, in which the usual bulb is replaced by one of cylindrical form arranged obliquely instead of vertically.

The desire to reduce the time and labour attaching to the hand pump has led to the construction of a large number of mercury pumps which can be operated mechanically; in experiments such as those of Prof. Wien on canal rays such a continuously running pump is a necessity. The most convenient of these are the various rotary pumps, of which the first was devised by Schulze-Berge, and of which Kaufmann in 1905 brought out a pattern which has been considerably used. The essential of this is an inclined spiral tube which rotates continuously; a thread of mercury running in it cuts off and forces out a fraction of the air at every rotation. There are two such tubes; the pump, though efficient, is somewhat fragile and complicated.

[1] Nobel discourse, 1906, p. 3.

The rotary mercury pump most in use at the present time is that of Dr. Gaede. It consists of an outer closed drum half filled with mercury, in which a second drum rotates. This drum is divided into chambers, which in turn become connected to the vessel to be exhausted; by the rotation they are filled alternately with gas and mercury, the gas being displaced into the outer space between the two drums and cut off from return by the mercury. The system is similar to the gas meter, only in this the moving gas effects the rotation, while in the Gaede pump the rotation sets the gas in motion. With this pump the pressure must first be reduced to a few millimetres of mercury by any rough preliminary pump, as otherwise the difference of pressure between the outside and inside of the rotating drum will become sufficient to drive the gas back into the drum again.

In the past year, however, Dr. Gaede described an air-pump depending on a new principle, which he calls the molecular air-pump. Maxwell assumed, and Knudsen has recently verified experimentally, that if a gas be in contact with a solid surface, the gas molecules are reflected from it in all directions independently of the angle of incidence, or "diffusely reflected." This is due to molecular irregularities of the surface. Gaede has shown that for pressures above 0·001 mm. of mercury the above assumption is not experimentally verified, and he attributes this to the formation of a film of adsorbed gas on the solid surface, which covers and conceals the molecular irregularities. The surface then presents only mechanical irregularities, and the result is that if a gas be travelling over a surface the molecules are preferentially thrown back in the direction from which they came, as they fall in general on small slopes of the irregularities facing their direction of drift. In both this case and that of diffuse reflection the new pump is effective, but the point is of interest in considering the theory of the pump, and it was considerations of this kind which led Gaede to its construction.

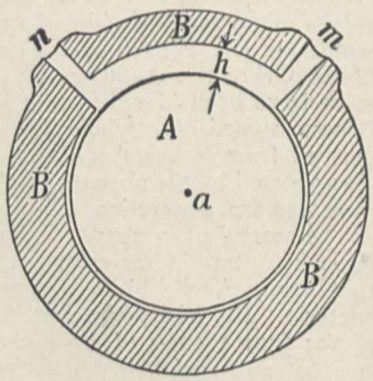

FIG. 1.—Principle of molecular air pump.

The new pump depends for its action on the dragging of the gas by a rapidly moving surface.[2] Consider a cylinder *A* rotating in a clockwise direction in a case *B*; in *B* there are two openings *n* and *m* connected by a slot (Fig. 1). The gas will be dragged by the cylinder from *n* to *m*, and in

[2] For the illustrations which accompany this article, we are indebted to the makers of the new pump—E. Leybold's Nachfolger, Cöln.

consequence a difference of pressure will be established between n and m which is proportional to the speed of rotation and the internal friction of the gas; the latter being independent of the pressure, the difference of pressure produced should be independent of the pressure. This is true when the pressure is relatively high; if it continued to be true down to the lowest pressures we should be able to create an absolute vacuum by exhausting initially with another pump at n to a pressure lower than the (constant) difference of pressure between m and n. When, however, we come to pressures below 0·001 millimetre of mercury this is no longer the case; the molecules are then diffusely reflected, and fly from one wall to the other without meeting other molecules. If the surface of the cylinder moved with a velocity greater than the molecular velocity we would obtain an absolute vacuum; such speeds are impossible in practice. However, at these low pressures the ratio of the pressures at m and n remains constant independent of the pressure, and it has been found that attainable speeds of revolution (8000–12,000 revolutions per minute) are sufficient to give a vacuum better than any hitherto obtained.

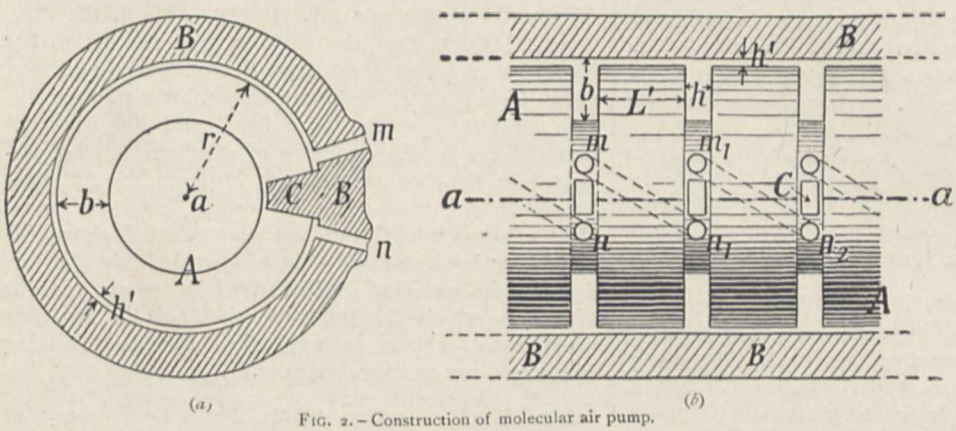

FIG. 2.—Construction of molecular air pump.

In practice the pump is constructed as indicated in Fig. 2 (*a*) and (*b*). Instead of cutting the slot in the case, the cylinder is grooved, and a tongue C from the case projects into the groove; this is equivalent to a very long slot in the case. For increased efficiency several parallel grooves are cut, and connected with one another so that the low pressure side of one is the high pressure side of the next (Fig. 2, *b*). The complete pump is shown in Fig. 3. A preliminary pump is needed to reduce the pressure to a few millimetres of mercury initially.

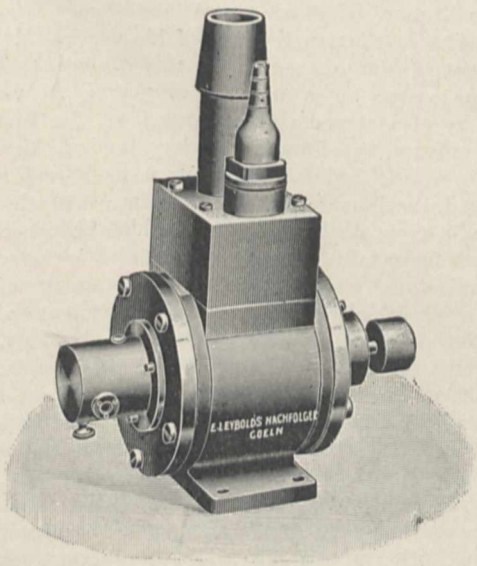

FIG. 3.—Molecular air pump.

A great advantage of this form of pump is that it deals with vapours as well as gases, as the low pressure part of the pump remains at low pressure. In other forms of pump the gases are compressed while being removed, and in consequence vapours condense which are afterwards brought back into the vacuum again. Without drying agents the new pump has produced a vacuum lower than any hitherto measured, 0·0000002 millimetre of mercury; this pressure was calculated by observing the ratio of the pressures in different grooves.

Very interesting are the measurements made by Gaede of the kinetic heat effect. Owing to the increased velocity of the molecules the temperature of the gas should be higher near the upper surface of the tongue C (Fig. 2) than near the lower surface, and by arranging a thermocouple in place of the tongue C Gaede has detected such an effect as soon as the pressure is low enough to allow the mean free path of the molecules to be larger than the dimensions of the groove.

A table of the exhaustion attainable with various selected pumps is appended.

Pump.	Pressure in millimetres of mercury.
Water pump	10
Ordinary piston pump	1
*Older Geissler pump	0·1
*Newer Geissler pump	0·01
*Sprengel pump	0·001
*Modified Toepler pump	0.00001
*Kahlbaum's automatic mercury pump	0·000002
Geryk oil-filled pump	0·0002
Gaede rotary mercury pump	0·00001
Gaede molecular pump	0·0000002

* Taken from Winkelmann's "Handbuch der Physik," I. The numbers must only be taken as very rough; for instance, it is very doubtful whether Kahlbaum's pump can give a better vacuum than Gaede's mercury pump (the figure for which is given by the Physikalisch-Technische Reichsanstalt).

E. N. DA C. ANDRADE.

NOTES.

We regret to see the announcement of the death on January 10, in his sixty-first year, of Dr. F. Teller, chief geologist at the K. K. Geologische Reichsanstalt at Vienna, and member of the Vienna Academy of Sciences.

Prof. A. Keith has been elected president of the Royal Anthropological Institute of Great Britain and Ireland, in succession to Mr. A. P. Maudslay. Mr. T. C. Hodson has been elected secretary of the institute, in succession to Mr. T. A. Joyce, who has become a vice-president.

M. B. Baillaud, director of the Paris Observatory, has been elected president, and M. H. Deslandres, director of the Meudon Observatory, vice-president, of the Paris Bureau des Longitudes for 1913.

The death is announced, in his fifty-ninth year, of Dr. G. A. Gibson, of Edinburgh, who was a well-known authority on diseases of the heart. His work on "Diseases of the Heart and Aorta," published in 1898, established his reputation as a specialist.

The Copenhagen correspondent of *The Daily Chronicle* reports that at a special audience on January 20 King Christian decorated Dr. V. Poulsen and Prof. P. O. Pedersen with the Medal of Merit in gold on account of the honour they have brought to Denmark by their work in connection with wireless telegraphy and telegraphones.

Dr. E. M. Kindle, for many years attached to the palæontological staff of the United States Geological Survey, at Washington, has accepted a similar position on the Geological Survey of Canada. Mr. Burling, for many years assistant to Dr. Walcott in the palæontology of the Cambrian rocks of North America, has also joined the technical staff of the Canadian Survey at Ottawa.

Extensive preparations are being made for the forthcoming meeting of the International Congress of Zoology to be held in the museum of the Oceanographic Institute at Monaco, March 25–30. Numerous collections from various expeditions and countries are being exhibited in the spacious halls of the institute. The aquarium at Monaco and the Russian Biological Station, Villefranche, are also expected to furnish interesting material for discussion during the congress.

A special general meeting of the Royal Geographical Society was held on January 15 to consider, among other matters, the proposal to admit women as fellows of the society. The president (Lord Curzon of Kedleston) moved the resolution: "That the society approve of the election of women as fellows," and it was carried by 130 votes to 51. In future, therefore, women will be eligible for admission as fellows on the same basis as men.

On Thursday next, January 30, Prof. B. Hopkinson will deliver the first of two lectures at the Royal Institution on recent research on the gas engine, and on Saturday, February 8, Sir J. J. Thomson will begin a course of six lectures on the properties and constitution of the atom. The Friday evening discourse on January 31 will be delivered by Mr. George M. Trevelyan, on the poetry and philosophy of George Meredith, and on February 7 by Sir John Murray, on life in the great oceans.

The will of the late Mr. Rowland Ward, the taxidermist, directs that the trustees with respect to his charitable bequests shall expend 500*l.* per annum out of the income of his residuary estate, after the legacies and annuities specified have been paid, for a period of ten years in the purchase of specimens to be presented to the Natural History Museum, South Kensington. The residue of his estate is left in equal shares to such eight of fourteen selected charitable and other institutions as his widow shall choose. In default of his widow's selection within twelve months of the testator's decease, the whole of the fourteen institutions—which include the Natural History Museum—are to share equally.

Mr. A. C. Claudet, whose death on January 17 will be widely regretted, was born on June 9, 1855, and was the eldest son of the late Mr. Frederick Claudet, of London and Cannes, the founder of the well-known firm of assayers and metallurgists. He was educated privately and at the Royal School of Mines, where he took the associateship in metallurgy in 1878. He was one of the best-known and most universally respected members of the mining and metallurgical community, and had been treasurer of the Institution of Mining and Metallurgy from its foundation in 1892 to the day of his death. He was president of the institution in 1906–7, and had also been a trustee for a number of years. At various times he also served on the council of the Institute of Chemistry, the Faraday Society, and on those of other scientific bodies. He took a keen and active interest in various educational movements to which he devoted a great deal of time, and which he generously assisted financially. These movements included the reorganisation, rebuilding, and equipment of the Royal School of Mines, the establishment of the Imperial College of Science and Technology, the Imperial College Union, &c., and he served on several committees connected therewith. He was an active member of the executive committee of the Bessemer Memorial Fund, from which the Bessemer Laboratory at South Kensington was equipped. He and Mr. Hennen Jennings, of Washington, D.C., established a "post-graduate grants fund," under the auspices of the Institution of Mining and Metallurgy to supplement the scholarships given by the institution to assist graduates to take practical courses in mines and works in the chief mining centres of the world, and many young engineers have been assisted in this way to bridge the period between college and their actual professional career with excellent results. His noble qualities of heart and mind are not so common as to make his death anything but a real loss to an unusually large number of friends, both personal and professional.

THE Home Secretary has appointed a committee to inquire and report as to the conditions necessary for the adequate and suitable lighting (natural and artificial) of factories and workshops, having regard to the nature of the work carried on, the protection of the eyesight of the persons employed, and the various forms of illumination. The committee consists of the following members:—Dr. R. T. Glazebrook, C.B., F.R.S. (chairman), Mr. Leon Gaster, Prof. F. Gotch, F.R.S., Dr. J. Herbert Parsons, Mr. W. C. D. Whetham, F.R.S., and Sir Arthur Whitelegge, K.C.B. The secretaries of the committee are Mr. D. R. Wilson and Mr. C. G. Paterson. Any communications regarding the inquiry may be addressed to Mr. D. R. Wilson at the Home Office.

THE committee which has been formed from representatives of several of the principal agricultural institutions of this country for the purpose of securing adequate British representation at the tenth International Congress of Agriculture, to be held at Ghent, Belgium, on June 8–13 next, is making an appeal for adherents to this important congress, and also for the contribution of papers on agricultural subjects. The subscription for members, who will receive the publications of the congress gratuitously, and have the right of taking part in the discussions, has been fixed at 20 francs (16*s*.) Subscriptions should be sent to the secretary, British committee (Mr. H. Chambers), Craven House, Northumberland Avenue, W.C., with whom those desirous of reading papers at the congress should communicate.

ACCORDING to an article in *The Times* of January 16, the council of the Zoological Society has received, and accepted, an offer from Mr. J. N. Mappin, head of the firm of Messrs. Mappin and Webb, Ltd., to install in the gardens a series of terraces in rockwork for the better display of certain groups of the larger animals. In tendering a vote of thanks to Mr. Mappin for this munificent offer, the council intimated that the proposed structures are to be known as the Mappin Terraces. The site on which they are to be erected is the one where the special Malay and Nepalese collections were exhibited last summer; work is to be commenced at the earliest possible date, and it is hoped that the whole installation will be completed within a twelvemonth. That it will enhance the attractions of the ever-popular menagerie cannot be doubted, and it is expected that it will also conduce to the well-being and health of the animals. In making his offer Mr. Mappin expressed the hope that the council might see its way to allow shop-assistants to enter the gardens at a reduced payment on certain days, a suggestion which was favourably received by that body. The council has also accepted a gift of 1000*l*. from Sir J. Key Caird, Bart., for the erection of a new insect-house.

WE regret to have to record the sudden death of Dr. O. T. Williams, hon. assistant-physician, Royal Infirmary, Liverpool, and lecturer on pharmacology and demonstrator of biochemistry in the University. Dr. Williams was cut off in the early prime of a life of great promise. He was only thirty-five years of age, and succumbed to an attack of acute pancreatitis after a few days' illness. During the past ten years he had published many important papers on the biochemical problems related to disease. His work was concerned chiefly with the biochemical problems of digestion and metabolism, such as the nature and constitution of the lipoids of tissues and organs, the lipoids of diabetic blood, the nature of the protein in albumosuria, abnormal fat assimilation associated with some diseases of the intestine, and certain biochemical changes associated with appendicitis. An account of Dr. Williams's published papers alone gives but little idea of the influence he was beginning to exert upon the progress of research in medical science in Liverpool, and in forming high ideals of the work of the physician as a scientific worker in the minds of the younger men in the city. His early death will be long lamented by many whose minds he influenced.

THE death of Colonel F. Bailey, R.E. (retired), at Edinburgh on January 21, will come as a shock to foresters in many parts of the world. Colonel Bailey was one of the early pioneers when, forty years ago, the modern science of forestry was taken over by Englishmen from the Continent. He is best known as having for many years conducted the course of forestry at Edinburgh University. Several of his pupils now fill the most important forest appointments in the Empire. When a Captain in the Royal Engineers, Colonel Bailey was selected, so far back as 1871, to take charge of the survey branch of the Indian Forest Department. He held this important post until 1884. Latterly he also had charge of the Indian School of Forests at Dehra Dun. In 1884 he was appointed by the Secretary of State for India to take charge of the English students following the course of instruction at the Nancy Forest School. In 1887 he was decorated by the French Government in recognition of his forest services. He returned to India, temporarily, in 1887, and for some time acted as Inspector-General of Forests for that country. In 1907 failing health compelled the resignation of the Edinburgh lectureship; in July last the Senatus of the University conferred upon him the honorary degree of LL.D. Until his death he was hon. editor of the half-yearly forestry publication of the Royal Scottish Arboricultural Society, of which he was president in 1898. He was the author of papers on forestry far too numerous to mention here. As to his work in the field, he will be remembered as the framer of "working plans" for two important forest estates in Scotland, the first of their kind. The best known of these, that for Novar, is held to be well fulfilling his calculations and anticipations. He also helped Lord Lovat and Captain Stirling of Keir in the preparation of that most detailed and practical working plan of last year for the Glen Mor area on the Caledonian Canal.

THE Horace Dobell lectures of the Royal College of Physicians were delivered by Dr. C. J. Martin, F.R.S., the subject being "Insect Porters of Bacterial Infections." The lectures form a very complete summary of our knowledge of the conveyance of typhoid

fever and diarrhœa by house-flies, of plague by fleas, and of relapsing fever by ticks; lice and bugs are also referred to. Many details are given of the anatomy of the insects, and a full bibliography is appended.

THE January number of *Bedrock* (No. 4, 1913) contains the full text of Dr. Metchnikoff's Priestley lecture, "The Warfare against Tuberculosis," delivered before the National Health Society, an abstract of which was published in these columns. Dr. Eric Pritchard writes on "the milk problem," dealing with the question of the effect of heat as applied in pasteurisation and sterilisation of milk. He is satisfied that infants may be satisfactorily reared on freshly boiled milk and also on dried milk.

A PARASITIC fungus (*Empusa muscae*) of the house-fly has long been known, and its use has been suggested as a means of destroying flies. Hitherto the fungus has not been artificially cultivated, but Mr. Edgar Hesse now claims to have done this, and with his cultures to have infected and destroyed flies. The fungus attacks the house-fly (*Musca domestica*), the lesser house-fly (*Fannia canicularis*), and the stable-fly (*Stomoxys calcitrans*). It was formerly believed that the fungus attacks the fly from without, but Mr. Hesse finds that the spores are swallowed and probably germinate in the crop, and thence invade the tissues of the fly. The matter has been brought to the notice of the Local Government Board, by which it is being considered and examined. The evidence of the conveyance of disease germs by flies is complete, and the fungus might, therefore, be employed to destroy flies.

SIR RONALD ROSS delivered a lecture on medical science and the tropics at a meeting of the Royal Colonial Institute on January 14. He said that he cannot but feel that the reason why tropical Africa has not become civilised is due to the fact that the great tropical diseases affect not only immigrant Europeans but are almost equally disastrous to the natives. The ravages of malaria, yellow fever, kala-azar, dysentery, plague, and cholera were reviewed. The death-rate fell remarkably between 1903 and 1911, owing to knowledge accumulated by a band of enthusiastic investigators, who, however, are most inadequately remunerated. Sir Ronald Ross said that Britain gives probably less than 50,000*l.* per annum throughout the Empire for medical research, and yet medical research benefits some fifty millions of white subjects of the Empire. Mr. Austen Chamberlain, who presided, instanced as an example of the value of tropical medical research the fall in the invaliding rate of European officials between 1904 and 1911 from 63 to 25 per 1000. He made an earnest appeal for funds on behalf of the schools of tropical medicine.

THE University of California, in No. 4, vol. x., of its ethnological series, publishes an elaborate monograph on the tribe of Salinan Indians, which has been prepared by Mr. J. Alden Mason. The task of inquiry has been difficult owing to the lack of information regarding the stock itself, and the existence of similar conditions among the adjacent tribes. The Salinans occupy a position between the typically central culture of the northern groups and that of the Chamash to the south. Their general characteristics are a dependence primarily on vegetable food, chiefly acorns, a great stability of population, absence of gentile organisation, a weak development of the arts, of war, and of ritualism. In spite of these drawbacks, the present monograph, with its abundant details of their ethnology and culture, shows a considerable advance on our knowledge of the natives of California.

THE Queensland Museum has issued the first volume of a series of memoirs which promises to supply a valuable addition to our knowledge of the natural sciences and ethnology of Australia. The present issue opens with a paper on Papuan mummification by the director, Dr. R. Hamlyn-Harris, in which he describes two specimens from Torres Straits. The body was placed on a platform with a fire beside it, partly for the comfort of the spirit, and partly to assist in dispelling the noxious fumes arising during the process of desiccation. The corpse was then removed to the sea and cleaned, the interior being filled with pieces of the dried sago-palm. It was hung up to dry, and adorned by the insertion of pieces of Nautilus shell for eyes, the body was smeared with ochre and oil, and various ornaments were attached to it. When dried, it was fixed to the central pole of the hut, and after some years the head was made over to the widow, and the mummified corpse was taken to one of the gardens of the deceased and allowed to decay, or in some cases it was buried inside the hut.

IT is announced in the January number of *The Entomologist's Monthly Magazine* that, in consequence of having taken up his residence abroad, Lord Walsingham has felt compelled to resign his joint editorship of that journal.

FROM a distributional point of view considerable interest attaches to the identification by Dr. C. R. Eastman (Ann. Carnegie Mus., vol. viii., No. 2, 1912) of remains of doubly-armed fresh-water herrings of the genus Diplomystus in Tertiary deposits in Guinea. For the genus—in addition to several other localities—also occurs in a Tertiary formation on the Brazilian coast, and thus seems to indicate the prevalence of similar conditions during Tertiary times on the two sides of the Atlantic. The author discusses the bearing of the new fact on the theory of a former land connection between western Africa and eastern North America by means of an hypothetical "Helenis."

A COMPACT summary of the knowledge we now possess concerning the structure, origin, and economics of pearls and mother-of-pearl is given in a paper on "Perlen" contributed by Prof. E. Korschelt to *Fortschritte d. naturwissenschaftlichen Forschung* (Band vii., 1913). In sixteen short sections Prof. Korschelt gives an impartial account of the most important work of the last ten years. In connection with the origin of pearls, it is becoming quite clear from the work of Rubbell, Dubois, and Jameson that

by far the greater number of pearls are formed around particles that are closely related to certain kinds of shell substance. We might, in fact, divide the causes of pearls into internal and external causes. The external causes include worm and other parasites and sand grains, and both are actually proved causes. The internal causes appear to be more interesting, and, so far as the pearls in the fresh-water mussel (*Margaritana margaritifera*) and possibly the Ceylon pearl oyster (*Margaritifera vulgaris*) are concerned, seem to be the more important. The paper is well illustrated, and as a short summary is admirable, though many sections undoubtedly require more detailed treatment.

DR. W. C. STURGIS has forwarded a copy of his recently published "Guide to the Botanical Literature of the Myxomycetes." This bibliography of an extensive and important group of Protista, which has been claimed alike by the botanist and the zoologist, gives the titles of a very large number of publications between the years 1875 and 1912, and though the compiler has confined his attention somewhat closely to citations from botanical writers, thus omitting a certain amount of valuable material in the fields of cytology and physiology especially, it will prove extremely useful to students of these organisms, whether botanical or zoological. The guide is issued by the Colorado College, as Science Publication, vol. xii., No. 11.

THE annual report of the Director of Agriculture for the Federated Malay States deals mainly with rubber, and shows an astonishing development of this crop. No fewer than 107,200 acres of land were opened during the year, while the total output of rubber was but little short of twenty-two million pounds, against twelve and a half million of the previous year; prices were also well maintained. Insect pests occur, but not to a serious extent; according to the entomologist, white ants (*Termes gestroi*) are decreasing, and the other pests can now be controlled. Fungoid diseases cause some trouble, especially that brought about by *Fomes semitostus*, but this is now amenable to treatment.

THE Meteorological Committee has recently issued the seventh edition of "A Barometer Manual for the Use of Seamen." The work was originally issued by the Meteorological Council in 1884, as a revise of the "Barometer Manual" prepared by Admiral FitzRoy, which had then been long out of print. Both these manuals attained great popularity; altogether about 25,000 copies of the revised editions were disposed of, this large supply being partly due to the adoption of the work as a text-book for mercantile marine examinations. The manual now under report (83 pp., large 8vo) was prepared in the marine division of the Meteorological Office under the superintendence of Commander Campbell Hepworth, C.B. (marine superintendent). It differs from the last edition mainly by the addition of certain paragraphs in the text, temperature conversion tables, and other minor details, and, like some of its predecessors (which have been referred to in our columns), is well illustrated by figures and by plates compiled from material in the possession of the office. The sections dealing with barometric pressure and its variations, with gales of the temperate zones, and tropical storms are very interesting and instructive, both for seamen and others, and, as stated in the title, the work is really "a text-book of marine meteorology."

IN the Proceedings of the Tokyo Mathematico-Physical Society, vi., 17, Mr. T. Terada considers the experimental fact that the velocities of earthquake waves fall short of the values calculated by hydrodynamical methods. His analytical work is devoted to examining whether this discrepancy can be accounted for by the yielding of the earth's crust, regarding the latter as a flexible bed resting on an inner fluid magma. The results show that the explanation is a plausible one, though the analysis involves a number of assumptions not realised in practice.

FOR some time past, the belief that Newton's law of gravitation is only approximate, and that the influence of a gravitative field depends on the time during which it has existed, has received increasing attention from physicists and astronomers. In a paper contributed to the *Wiener Sitzungsberichte* (cxxi., 1) Prof. G. Jaumann builds up a theory of gravitation based on a modification of Laplace's and Poisson's differential equations. This modification consists in the addition of an extra term proportional to the time-flux of the potential, and it leads to the result that in empty space the potential is propagated according to the same law as temperature in the diffusion of heat. The theory is applied to planetary motion, variation of latitude, and conditions of stability of the solar system.

WE have had an opportunity of experimenting with the "Rainbow Cup," which Mr. C. V. Boys showed a few months ago at the Royal Society soirée, and find it an interesting piece of apparatus. The cup has its lip horizontal, and can be spun about a vertical axis. When a soap film is placed on the top of the cup and the cup then spun, the film thins rapidly in the middle, and in a good light the display of colours is brilliant. By altering the direction of rotation coloured patterns can be produced which might be used as the basis of decorative designs. By continuing the rotation or by tilting the film a black spot can be obtained and a study of its motions under different conditions soon shows that it is thinner than any other part of the film. The makers of the "Rainbow Cup" are Messrs. J. J. Griffin and Sons, Ltd., Kingsway, W.C.

WE have received a copy of the second annual report of the work of the Radiological Institute attached to the University of Heidelberg, a report which appeared in part 43 of the *Elektrotechnische Zeitschrift* for 1912. The institute was founded in 1910, has Prof. Lenard for director, and a further staff of three assistant lecturers and demonstrators in addition to an instrument-maker and attendant. In the two years it has been in operation it has pro-

duced a long series of researches published in scientific journals in this country, as well as in Germany. These may be grouped under the following heads:—Absorption and secondary radiation of kathode rays, photoelectric effects, electrical conductivity of gases and of flames, phosphorescence and radio-activity, including its application to medical work. We wish every success to this active and progressive institute.

THE receipt of the notification of the Metropolitan Gas Referees for the current year serves as a reminder that the quality of the gas supplied to the County of London is subject to severe control. The threat of a monopoly caused by the amalgamation of various gas companies led to increased Parliamentary control, and commencing with the City of London Gas Act, 1868, there are several Acts dealing with the London gas supply, the latest being the London Gas Act, 1905. Subject to these Acts, the details of the methods to be used in gas-testing are left to three gas referees, who have to prescribe and certify the situation and number of the testing places, the apparatus and materials for testing the illuminating power, calorific power, purity and pressure of the gas provided by the companies. The notification of the gas referees gives the methods prescribed in detail. The controlling authorities (the London County Council and Corporation of the City of London) have also certain discretionary powers as to the times of testing, and these authorities also appoint the gas examiners.

MESSRS. CHARLES GRIFFIN AND CO., LTD., have published a tenth edition of an "Elementary Manual on Applied Mechanics," by Mr. A. Jamieson. Many new examination questions have been added, and the symbols agreed to by the International Electrotechnical Commission, held in Turin in 1911, have been included.

MESSRS. J. WHELDON AND CO., 38 Great Queen Street, Kingsway, W.C., have just issued a catalogue (No. 60) of books and papers on microscopical science in most of its branches. The catalogue includes a number of valuable works, both ancient and modern, and the classification makes it easy to find the works available in the various departments of microscopy.

OUR ASTRONOMICAL COLUMN.

NOVA GEMINORUM, No. 2.—The photometric and spectroscopic observations of Nova Geminorum, No. 2, made at the Harvard and Arequipa Observatories, are discussed in Circulars 175 and 176 of the Harvard College Observatory.

Prof. Wendell's magnitude observations show several fluctuations, with maxima on March 14, 17, 23, 30, and April 5; the magnitude increased considerably during the night of March 14.

The spectra were taken between March 13 and June 5, 1912, inclusive, and are discussed by Miss Cannon; some are reproduced in the second circular. On March 13 the spectrum was not of the usual nova type, *i.e.* bright lines accompanied by dark lines; but was of the class F_5 (Procyonian) type, with slight variations, having dark lines only; a reproduction of the spectrum of Procyon is placed above the nova spectrum on the plate accompanying the circular, and shows the similarity very strikingly. Miss Cannon remarks on the fact that the earliest spectrum of Nova Persei (2) also lacked bright lines, and that these are the only two novæ of which the spectrum has been secured while the star's light was still rising to its primary maximum. The spectrograms taken on March 14 show the spectrum in a transitional state, the characteristic "nova spectrum" being fully developed on March 16. The bright band at K, faint on March 20, had disappeared by March 22, only a narrow dark line remaining; on March 27 a brightening in the region of the spectrum near λ4640 was noticeable, the continuous spectrum was faint, and the dark hydrogen lines not clearly seen, but on March 30 both the continuous spectrum and the dark hydrogen lines were again more intense, the latter being distinctly double. A spectrum taken on May 10 is stated by Miss Cannon to show increased intensities for bands at λλ4640 and 5016, while a bright band appears on the less refrangible edge of Hγ; this probably represents the appearance of the nebula line 5008 and the line which appeared during the nebula stage of previous novæ at 4365.

THE VARIABLE STAR 87, 1911.—From time to time we have referred in these columns to Mr. D'Esterre's notes describing a possible nova in the constellation Perseus. The star was conspicuous on plates taken by Mr. D'Esterre on November 13 and 21, 1911, but did not appear on three previous dates. Prof. E. C. Pickering now states, in Circular 176, that from an examination of the Harvard photographs, Miss Cannon finds that the star was of the eleventh magnitude on October 30, 1896, September 17, 1899, and January 28, 1902, but was not visible on sixty-eight other plates, including one taken, with sixty minutes' exposure, on November 3, 1885, which shows faint stars.

Prof. Pickering concludes that this object is certainly not a nova, but appears to be a variable star with a large range which is bright during a relatively short portion of its variations; the period does not appear to be uniform, and he suggests that the object possibly belongs to the U Geminorum and SS Cygni class of variable stars.

THE TRANSIT OF MERCURY, NOVEMBER 14, 1907.—Prof. Donitch observed the transit of Mercury which took place on November 14, 1907, from a special station established at Assuan. The chief observations were spectroscopic, the spectra being taken with a special spectrograph, at the times of internal contacts, the slit coinciding with the sun's limb. The resulting spectra show no lines other than those of the solar spectrum, and lead Prof. Donitch to the conclusion that the planet does not possess an atmosphere extending beyond 15 km. from its surface; but for the present he hesitates to consider this conclusion as rigidly established. (*Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg*, No. 17.)

ASTRONOMICAL ANNUALS.—We have received M. Flammarion's "Annuaire Astronomique," for 1913, and the "Anuario" of the Madrid Observatory. In addition to its usual complete series of tables and ephemerides, the former contains useful illustrated reviews of the progress of astronomy and meteorology during 1912, several special articles, and a frontispiece showing six untouched photographs of the annular solar eclipse of April 17, 1912.

The "Anuario," besides the ordinary tables and ephemerides, has a popular article on new stars, a long article on the determination of azimuths in the field, an interesting review of solar physics, with special reference to the development of the spectroheliograph, and a *résumé* of the solar and meteorological observations of 1911 and 1912.

THE CLEVELAND MEETING OF THE AMERICAN ASSOCIATION.

THE sixty-fourth meeting of the American Association for the Advancement of Science was held in Cleveland, Ohio, from December 30, 1912, to January 4, 1913, under the presidency of Prof. E. C. Pickering, director of the Harvard College Observatory. The meetings of the association were accompanied, as usual, by the meetings of a large number of affiliated societies of national scope but of specific object. Twenty-five such societies met this year in Cleveland at the same time, and, in part, in close cooperation with the eleven sections of the American Association.

The meetings were held in the buildings of the Western Reserve University and of the Case School of Applied Science, which, with the exception of the Medical College of the Western Reserve University, stand upon the same campus in the eastern part of the city. The facilities for the meetings were admirable, and have seldom been excelled in the history of such meetings. There were about one thousand scientific men and women in attendance, or about one-half the attendance of the Washington meeting of last year, which is accounted for by the fact that while Cleveland is a large city and a manufacturing and commercial centre, it has not the large museums and scientific organisations of Washington. Nevertheless, some of the meetings were more largely attended than last year. The physicists, for example, and the psychologists, as well, held the largest sessions in their history, and most of the meetings were marked by exceptionally full programmes of great interest.

The growing tendency of the past few years to emphasise the work of the affiliated societies, more or less at the expense of the sections themselves, was in evidence, and the recent movement was continued whereby it has been arranged that when a national scientific society corresponding in its subject with a given section meets with the association, the sectional programme is abandoned except for a session of general interest, other papers offered to the section being transferred to the corresponding society. It is an interesting movement, and quite different from the general tendency in the British Association.

The titles of the addresses of the retiring vice-presidents of the different sections were as follows:—*Section A*, Mathematics and Astronomy, "The Spectroscopic Determination of Stellar Velocities, considered Practically," by Dr. E. B. Frost, Yerkes Observatory, Williams Bay, Wisconsin; *Section B*, Physics, "Unitary Theories in Physics," by Dr. R. A. Millikan, University of Chicago, Chicago, Illinois; *Section E*, Geology and Geography, "The Significance of the Pleistocene Molluscs," by Dr. B. Shimek, State University of Iowa, Iowa City, Iowa; *Section F*, Zoology, "Is it Worth While?" by Dr. H. F. Nachtrieb, University of Minnesota, Minneapolis, Minnesota; *Section G*, Botany, "The Scope of State Natural History Surveys," by Dr. F. C. Newcombe, University of Michigan, Ann Arbor, Michigan; *Section H*, Anthropology and Psychology, "The Study of Man," by Dr. G. T. Ladd, Yale University, New Haven, Conn.; *Section I*, Social and Economic Science, "The Comparative Measurements of the Changing Cost of Living," by Dr. J. P. Norton, Yale University, New Haven, Conn.; *Section K*, Physiology and Experimental Medicine, "The Function of Individual Cells in Nerve Centres," by Dr. W. T. Porter, Harvard Medical School, Boston, Mass.; *Section L*, Education, "Educational Diagnosis," by Dr. E. L. Thorndike, Columbia University.

In a number of instances, the meetings for the delivery of the vice-presidential addresses were arranged with following symposia often in joint session between one or more societies and sections on subjects closely related to the subjects of the vice-presidential addresses. In Section G (Botany), an interesting symposium was held on permeability and osmotic pressure, the leading paper on this title being presented by Dr. Jacques Loeb, now of Columbia University. To this discussion, Dr. H. C. Jones contributed a paper on the bearing of osmotic pressure on the development of physical or general chemistry; Dr. W. J. V. Osterhout discussed the permeability of plant cells; and Dr. B. E. Livingston discussed the part played by osmotic pressure and related forces as environmental factors.

Section B (Physics) and the American Physical Society presented as a joint interest programme papers on photographing and analysing sound waves, by Dr. D. C. Miller, of the Case School of Applied Science, Cleveland, Ohio; the reaction of the room on the source of sound, by Dr. W. C. Sabine, Harvard University, Cambridge, Mass.; and some points concerning absolute measurements of sound, by Dr. A. G. Webster, Clark University, Worcester, Mass.

The programme of Section I (Social and Economic Science) was largely devoted to conservation topics, one day being given to a symposium on the conservation of human life and health. The American Association of Anatomists and the American Physiological Society had especially long and interesting programmes. The American Society of Zoologists divided its programme into sections on the following topics: ecology and behaviour; comparative anatomy; comparative physiology; embryology and development; cytology; and genetics.

The American Chemical Society, an organisation of great strength, this year for the first time in many years has decided not to meet at the same time and place with the American Association. This is a new policy which will be given a trial. The Chemical Section of the association (Section C) will, it is hoped, continue its activities, but at the present meeting the address of the vice-president was not given. Owing to the absence, on account of ill-health, of the vice-president of Section D (Mechanical Science and Engineering), no address was delivered before this section.

At the opening meeting, the retiring president, Dr. C. E. Bessey, of the University of Nebraska, Lincoln, Nebraska, introduced the president-elect, Prof. E. C. Pickering, and addresses of welcome were delivered by Mayor Baker, of Cleveland, by President C. F. Thwing, of the Western Reserve University, and by Acting-President Comstock, of the Case School of Applied Science. President Pickering responded to these addresses of welcome, and was followed by Dr. Bessey with his address as the retiring vice-president, the title of the address being "Some of the Next Steps in Botany." This opening session was held in the large ball-room of the Hotel Statler, and was followed by a reception tendered by the local committee.

At the meeting of the general committee, Atlanta, Georgia, was chosen as the place of the next meeting during Convocation Week, 1913–14 (the week in which the first day of January falls), and Philadelphia was recommended as the place of meeting for the following year. Arrangements were made to make an earnest effort to bring about a large and important meeting in the summer of 1915 on the Pacific coast during the International Exposition to be held at San Francisco to celebrate the opening of the Panama Canal.

The following officers were elected for the year 1913:—President, Dr. E. B. Wilson, Columbia University, New York, N.Y.; vice-presidents: *Section A*,

F. Schlesinger, Allegheny Observatory, Allegheny, Pa.; *Section B*, A. D. Cole, Ohio State University, Columbus, Ohio; *Section C*, A. A. Noyes, Massachusetts Institute of Technology, Boston, Mass.; *Section D*, O. P. Hood, U.S. Bureau of Mines, Washington, D.C.; *Section E*, J. S. Diller, U.S. Geological Survey, Washington, D.C.; *Section F*, A. G. Mayer, Carnegie Institution of Washington, Washington, D.C.; *Section G*, H. C. Cowles, University of Chicago, Chicago, Illinois; *Section H*, W. B. Pillsbury, University of Michigan, Ann Arbor, Michigan; *Section I* (no election); *Section K* (no election); *Section L*, P. P. Claxton, U.S. Commissioner of Education, Washington, D.C. General secretary, H. W. Springsteen, Western Reserve University, Cleveland, Ohio; secretary of the council, W. A. Worsham, jun., University of Georgia, Athens, Georgia.

The following are the new secretaries of the sections elected for five-year terms:—*Section A*, F. R. Moulton, University of Chicago, Chicago, Illinois; *Section B*, W. J. Humphreys, Weather Bureau, U.S. Department of Agriculture, Washington, D.C.; *Section C* (no election); *Section D*, A. H. Blanchard, Columbia University, New York, N.Y.; *Section E*, G. F. Kay, Iowa State University, Iowa City, Iowa; *Section F*, H. V. Neal, Knox College, Galesbury, Illinois; *Section G*, W. J. V. Osterhout, Harvard University, Cambridge, Mass.; *Section H*, G. G. MacCurdy, Yale University, New Haven, Conn.; *Section I*, S. C. Loomis, New Haven, Conn.; *Section K* (no election); *Section L*, S. A. Courtis, Home and Day School, Detroit, Michigan.

SCIENCE AT RECENT EDUCATIONAL CONFERENCES.

TWENTY conferences were held in London during the first fortnight of this month, but we need only refer to the proceedings of the Public School Science-masters, the Teachers' Guild, the Assistant-mistresses, the Domestic Science Teachers, and the London County Council Conference of Teachers. It is true that the Headmasters' Conference met in December; but it is a remarkable fact that although individually the members are men of great force directed with earnestness, the vectorial addition of their forces when combined in conference yields a resultant which tends to zero. As their proceedings have no direct bearing upon science teaching, no further reference need be made to them here.

The usual meetings of the Association of Public School Science-masters (A.P.S.S.M.) were held at the London Day Training College, and were preluded by four lectures given by Dr. T. P. Nunn on the theory of science teaching, with special reference to the conditions in boys' schools. Dr. Nunn held that the aim of science teaching was to take the pupil along one of the main roads of human progress. The disciplinary value of science teaching was that they were treading the pathways of great minds, the function of the school being to bring the pupil into sympathetic relation with the character of human effort. He went on to deal with the characteristics of scientific method at different stages of its development; with the nature of induction and deduction, postulate, hypothesis, law and principle. The correlation of science with mathematics and other branches of the school curriculum was illustrated by applying the principles advocated to particular topics, and the skill and ingenuity of the applications were warmly applauded by an audience composed of experienced science-masters.

The main meeting opened with a presidential address by Sir Archibald Geikie, Pres.R.S., who gave a retrospect based on his personal observation of the progress of science in public schools during the last sixty years. An abridgment of the address was published in NATURE of January 16.

The first afternoon was devoted to the discussion of the aims and uses of school science societies, and the topics were assigned to opening speakers, who gave in each case a very useful account of the practical management on which success largely depends. General principles and methods were discussed, and next the subjects of field work in zoology and geology. The possibilities of a school astronomical society were brought forward by Mr. G. Hewlett (Rugby), and the Dulwich College Photographic Society was described with reference to details of organisation. It is a striking indication of the spirit animating members of the A.P.S.S.M. that no mention was made of the large amount of voluntary work which these societies place on the shoulders of the busy science-master; this voluntary burden is accepted as a matter of course, and nothing said. One who is merely an onlooker may direct attention to this spirit.

The discussion on practical examinations in science was unsatisfying. Mr. Berridge made some good points in his censure of the weaknesses of examiners; but the objections to abolishing practical examinations of matriculation (or lower) standard lacked a spokesman. Probably some profit would accrue to the crammer—at the expense of the schools. Mr. Berridge's suggestion that "a certificate from some responsible person, stating that a given number of hours have been spent in practical work, should be exacted from all candidates before they are allowed to sit for a paper in science," may be intended as a safeguard, but its operation is uncertain. It would be much easier for examining authorities merely to drop practical examinations, and there is a danger that this may be done without requiring Mr. Berridge's certificate. No resolution was put before the meeting, and the time for discussion was too short.

Valuable papers were submitted on the teaching of mechanics by Mr. A. W. Siddons (Harrow), Mr. C. E. Ashford (Dartmouth), and Mr. W. J. Dobbs. All advocated procedure from experiment and intuition to theory of increasing rigour; from concrete to abstract. The outcome of the discussions during recent years at the A.P.S.S.M. and the Mathematical Association will be, we hope, that the experimental and logical treatment will be unified. Formerly boys learnt "mechanics" in the mathematical class-room under one teacher, and another subject, also called "mechanics," in the physical laboratory, without correlation. We have got as far as correlation, and are now hoping for unity. Mr. G. F. Daniell urged that the teaching of density should be put into the background, and that specific volume should be given priority. He proposed the term "roomage" (already used in the Navy) in place of specific volume. The suggestions were favourably received. The value of the historical sequence in teaching chemistry was urged by the Rev. T. J. Kirkland. Mr. W. D. Eggar drew an amusing sketch of the historical sequence in electricity, but put in a strong plea for employing the method in leading the student to understand the work of Galileo, Paschal, and Newton. He claimed that to trace the development of ideas which culminated in Newton's discoveries was to open a new vista in the intellectual outlook, and ought to form part of any liberal education.

The association continues to increase in membership, and has just originated a useful piece of work by publishing a selected list of science books suitable for school libraries. There was the usual admirable exhibition of apparatus, the influence of which extends

beyond the limits of the meeting and of the association. The Mathematical Association met in the same building, and it was unfortunate that arrangements were not made so that the two presidential addresses at least could be attended by members of both associations. Good service has been done by the Teachers' Guild, on the initiative of which thirteen associations met by agreement in the University of London and had a kind of British Association week of meetings. At one of the guild meetings Miss Sheavyn directed attention to the mode of entry into the higher grades of the Civil Service. Of the first hundred in the last competition fifty-nine scored chiefly in classics, twenty-nine in mathematics, and twelve in other subjects. (One gathers that science is not wanted or that proficiency in science is not esteemed as evidence of mental culture.) Miss Sheavyn regretted that in technical posts requiring qualifications in science, *e.g.* posts at the British Museum, the question of opening them to suitable women should not be considered, notwithstanding the difficulty experienced at times in getting applicants.

Miss L. M. Drummond, in her presidential address to the Assistant-mistresses in Public Secondary Schools, discussed "the scientific study of living things as an element in education." She said that they were urged by social reformers to teach girls certain definite biological facts, notably those of human physiology and reproduction; but there was too little appeal for real training in biological thought. In this age people did not set as high a value as they should on the energising power of ideas. Some knowledge of a living body was valuable, but she did not think it followed that a course of human physiology should always be introduced. If the school course included animal anatomy, more definite physiological teaching would find a natural place, and on such a foundation she would base teaching in hygiene. Training in scientific biology was a real and helpful preparation for entering sympathetically into the thought-life of the time.

A somewhat different line of argument was taken by Prof. Starling at the L.C.C. Conference. We hope to refer to this in a future article, to which also we postpone consideration of the discussion at the Association of Teachers in Domestic Subjects.

G. F. DANIELL.

PRIZES PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1914.

GEOMETRY.—The Francœur prize (1000 francs), for discoveries or works useful to the progress of pure and applied mathematics; grand prize of the mathematical sciences (3000 francs), for an improvement in the theory of functions of one variable which are susceptible of representations by trigonometrical series of several arguments, linear functions of this variable; Poncelet prize (2000 francs), for work in pure mathematics.

Mechanics.—Montyon prize (700 francs), for the invention or improvement of instruments useful to the progress of agriculture, the mechanical arts, or sciences; Henri de Garville prize (1500 francs), for original work in mechanics; Fourneyron prize (1000 francs), for a theoretical and experimental study of the question of combustion of explosion turbines.

Navigation.—The extraordinary prize of 6000 francs, as a recompense for work increasing the efficiency of the French naval forces; Plumey prize (4000 francs), for improvements or inventions contributing to the progress of steam navigation.

Astronomy.—The Lalande prize (540 francs), for the most interesting observation, memoir or work useful to the progress of astronomy; the Valz prize (460 francs), for the most interesting astronomical observation during the year; the Janssen prize (a gold medal), for a discovery or work representing an important advance in physical astronomy; the Damoiseau prize (2000 francs), for an improvement in Le Verrier's tables of Jupiter.

Geography.—The Tchihatchef prize (3000 francs), for the encouragement of naturalists of any nationality who have made explorations in the lesser-known parts of Asia; the Gay prize (1500 francs), for a study of the distribution of hydraulic forces in a mountainous region, with a description of the methods and instruments employed in this research; the Binoux prize (2000 francs), for work on geography; the Delalande Guérineau prize (1000 francs).

Physics.—The Hébert prize (1000 francs), for a treatise or discovery extending the practical use of electricity; the Hughes prize (2500 francs), for work contributing to the progress of physics; the Victor Raulin prize (1500 francs), for facilitating the publication of works relating to meteorology and physics of the globe; the La Caze prize (10,000 francs), to the author of works or memoirs contributing to the progress of physics.

Chemistry.—The Jecker prize (10,000 francs), for work in organic chemistry; the Cahours prize (3000 francs), for the encouragement of young workers in chemistry; the Montyon prize (unhealthy trades, a prize of 2500 francs and a mention of 1500 francs), for work rendering an art or trade less unhealthy; the L. La Caze prize (10,000 francs), for work in the field of chemistry.

Mineralogy and Geology.—The Fontannes prize (2000 francs), for a palæontological publication.

Botany.—The Desmazières prize (1600 francs), for a work on Cryptogams; the Montagne prize (1500 francs), for researches on the anatomy, physiology, development, and description of the lower Cryptogams; the De Coincy prize (900 francs), for a work on Phanerogams.

Anatomy and Zoology.—The Savigny prize (1500 francs), for the assistance of young travelling zoologists, not receiving Government aid, who occupy themselves with the invertebrates of Egypt and Syria; the Thore prize (200 francs), for the best work on the habits and anatomy of a species of European insect; the Cuvier prize (1500 francs), for a work on zoological palæontology, comparative anatomy, or zoology.

Medicine and Surgery.—The Montyon prize (2500 francs, mentions of 1500 francs); the Barbier prize (2000 francs), for a valuable discovery in surgical, medical, or pharmaceutical science, or in botany having relation to medicine; the Bréant prize (100,000 francs), for a means of curing Asiatic cholera; the Godard prize (1000 francs), for a memoir on the anatomy, physiology, and pathology of the genito-urinary organs; the Baron Larrey prize (750 francs), to a naval or army surgeon or doctor, for a work dealing with military medicine, surgery, or hygiene; the Bellion prize (1400 francs); the Mège prize (10,000 francs).

Physiology.—The Montyon prize (750 francs), for work in experimental physiology; the Philipeaux prize (900 francs), for the same; the Lallemand prize (1800 francs), for work relative to the nervous system; the Pourat prize (1000 francs), for a memoir on the origin of the anti-ferments; the L. La Caze prize (10,000 francs), for a work on physiology; the Martin-Damourette prize (1400 francs), for a work on therapeutic physiology.

Statistics.—The Montyon prize (1000 francs, two mentions of 500 francs).

History of Science.—The Binoux prize (2000 francs).

General Prizes.—The Arago, Lavoisier, and Berthelot medals; the Henri Becquerel prize (3000 francs); the Gegner prize (3800 francs); the Lannelongue prize (2000 francs), for men of science or their relatives in need of assistance; the Gustave Roux prize (1000 francs); the Trémont prize (1100 francs); the Wilde prize (4000 francs, or two of 2000 francs), for discoveries in astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; the Lonchampt prize (4000 francs); the Saintour prize (3000 francs), for researches in the physical sciences; Henri de Parville (2500 francs); the Victor Raulin prize (1500 francs), for facilitating the publication of works relating to meteorology; the Houllevigue prize (5000 francs); the Caméré prize (4000 francs); the Jerome Ponti prize (3500 francs); the Bordin prize (3000 francs), for a study of the nature and origin of the gases and emanations from the terrestrial globe; the Serres prize (7500 francs), for works on general embryology applied to physiology and medicine; the Jean Jacques Berger prize (15,000 francs); the prize founded by Mme. la Marquise de Laplace; the Félix Rivot prize (2500 francs).

BRITISH MEDICAL SCIENCE AT THE GHENT INTERNATIONAL EXHIBITION.

ONE of the most important sections of the British exhibit at the forthcoming International Exhibition at Ghent will be an organised demonstration of the progress that has been made in this country in the scientific investigation of tropical diseases and of their prevention and cure. The exhibit has been carefully planned by a committee composed of members of the various schools of tropical medicine, and each school deals specially with certain diseases. The London School, represented on the committee by Dr. H. B. Newham, is dealing with beri-beri, cholera, filariasis, and guinea-worm. The exhibit of the Liverpool School, prepared by Dr. J. W. W. Stephens and Prof. Newstead, will be devoted to the subjects of malaria, sleeping sickness, yellow fever, and ankylostomiasis.

The Royal Army Medical College, under the direction of Lieut.-Col. Sir William Leishman, is undertaking exhibits of enteric fever and leishmaniasis, the former arranged in five sections to illustrate respectively the causation, diagnosis, dissemination, pathology, and vaccine treatment, the latter in three sections dealing with Indian kala-azar, infantile kala-azar, and Oriental sore. Malta fever is allotted to the Admiralty under the direction of Fleet-Surgeon P. W. Bassett-Smith, and plague to the India Office, represented by Sir A. M. Branfoot. Dr. Andrew Balfour, of Khartum, is preparing the exhibit relating to leprosy. In addition to the work of the schools, an exhibit will be sent by the Natural History Museum to illustrate the problems of natural history, such as life-cycles of the parasites, structure and life-histories of their insect-carriers, &c., specially connected with the study of tropical diseases.

In each case the disease will be considered, so far as possible, from the various points of view of distribution, cause, pathological effects, dissemination, treatment, and prophylaxis. The exhibits will comprise specimens, models, coloured drawings, or photographs of the parasites that cause the disease, and of the insects that transmit them, illustrating their structure and life-histories; charts, maps, and statistics showing the distribution and incidence of the disease, results of treatment, &c.; and specimens or models of apparatus used in treatment or prevention, such as, for example, models of mosquito-proof portholes and cabins on ships. In the case of beri-beri specimens of rice will be shown illustrating the causation of the disease, and in the case of sleeping sickness heads and skins will be exhibited of the species of antelope and other wild game which harbour the trypanosome.

The entire exhibit, the details of which are now practically complete, will be, it is hoped, a striking testimony to the wide range and great importance of the investigations upon tropical diseases that are being carried on in this country.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The prize of 50*l.* from the Gordon Wigan fund for a research in chemistry was awarded in the year 1912 to Mr. D. H. Peacock, for investigations on hydroxyhydrindenehydrazine and its resolution, 1 : 2 : 4-triketopentamethylene, the theory of molecular volumes.

The Senate authorised some time ago the erection of the eastern half of the forestry building, as soon as adequate funds have been provided. More than 4500*l.* has now been privately subscribed, and a grant from the Development Fund will enable the erection of the building to be taken in hand immediately. The cost of the contemplated building will exceed 5000*l.*, and the grant will therefore amount to 2500*l.* The forestry committee recommends that the grant by the Treasury of a sum of 2500*l.*, which is required to defray half the cost of the eastern portion of the forestry building, be accepted, and that the Vice-Chancellor be authorised to convey to the Development Commissioners the thanks of the University for the grant now authorised, and for their promise of a future grant when an extension of the forestry building will be required.

It is proposed to confer the degree of master of arts, *honoris causa*, upon Mr. G. Udny Yule, University lecturer in statistics.

OXFORD.—The Herbert Spencer lecture this year will be delivered by Dr. D'Arcy Wentworth Thompson, C.B., professor of natural history, University College, Dundee, at the Examination Schools, on Thursday, February 13, at 5.30. The subject of the lecture, which will be illustrated by lantern-slides, is "Growth and Form."

On January 28 Convocation will vote on a proposal to assign a plot of land in the University Park, to the east of the plot lately assigned for the erection of a new chemical laboratory, for the purpose of an engineering laboratory. It will be remembered that last term Convocation declined to sanction the allocation of a site for the latter purpose at the north-west corner of the park. A movement has been set on foot for acquiring land in various parts of the city for the future extension of University departments, and in particular for securing a site for the proposed engineering laboratory in the neighbourhood of Museum Road. It is understood that a sum of more than 1000*l.* has already been promised for this object, including a donation of 50*l.* from the Chancellor, Lord Curzon. On the other hand, it is urged, in a paper signed by many of the teachers of science in the University, that the Museum Road site is very unsuitable for the proposed laboratory, and it appears to be extremely doubtful whether, if the park site be refused, the other proposal will be accepted as an alternative.

ACCORDING to a recent regulation issued by the Minister of Public Instruction in France all students of foreign nationality who wish to pursue their studies

in French universities with a view to obtain the licence or doctorate in law, the licence in science or in letters, or the doctorate of the university in medicine must produce (in the original) diplomas or certificates awarded to them by the universities or other institutions where they have pursued their studies and passed their examinations. These documents, which must be accompanied by a translation by a certified translator (*traducteur juré*), will be viséd and certified either by the Consul-General of France in the student's native country or by one of the representatives of that country accredited to France.

THE following lectures will be delivered at the Lister Institute of Preventive Medicine on various dates from February 4 to March 18:—"The Early Bacteriological Work of Lord Lister," Prof. C. J. Martin, F.R.S.; "Various Products of the Tubercle Bacillus used in Diagnosis and Treatment and Current Views upon their Mode of Action," Dr. G. H. K. Macalister; "Some Recent Work on the Agglutination of Bacteria with Special Reference to Agglutination with Acids," Dr. J. A. Arkwright; (1) "Recent Work on Hæmolysis," (2) "Serum-fast Bacteria," Dr. J. Henderson Smith; "Lipoids," Dr. H. Maclean; "The Laws Governing Disinfection by Various Agencies," Dr. H. Chick; "The Chemical Action of Bacteria," Prof. A. Harden, F.R.S. The lectures are addressed to advanced students and others interested in the subjects discussed. Students of the University are admitted free, and others can obtain a card of admission on application to the secretary of the institute.

IN the issue of *Science* for December 27 last, Prof. Rudolf Tombo, jun., examines the registration returns for November 1, 1912, of twenty-nine of the leading universities in the United States. Five universities show a decrease in the total enrolment, namely Cornell, Illinois, Iowa, Johns Hopkins, and Pennsylvania, while four institutions showed a loss in the total enrolment in the previous year. The largest gains were registered by Columbia (1069), California (733), Minnesota (515), New York University (488), Texas (475), Nebraska (391), and Harvard (303). In the previous year there were four institutions that showed a gain of more than three hundred students, namely California, Columbia, Cornell, and Ohio State. For 1912 ten institutions exhibited an increase of more than two hundred students in the autumn attendance, as against four in 1911. Of these institutions four are in the east, five in the west, and one is in the south. Of the universities dealt with the six with the highest total attendance are as follows:—Columbia, 9007; California, 6457; Chicago, 6351; Harvard, 5729; Michigan, 5620; and Cornell, 5412. As regards the number of students in pure science, Cornell continues to maintain its lead in this branch, enrolling 1419 students, as against Michigan's 1284, Yale's 1139, and Illinois's 965.

MR. JAMES GRAHAM, secretary for education in Leeds, delivered on January 17, at the University of Leeds, a lecture on methods of preparation for the future life of our industrial army. In elementary education in this country, he said, we are not at present getting full value for the money spent, and this is to be attributed to the early age of leaving school and to local by-laws which allow the brightest pupils to leave before they have obtained full benefit from the education provided. The Government should, he said, take steps to raise the school-leaving age to fourteen years for urban districts throughout the country. This would make it possible to organise at the top of the elementary schools a special course of work, thoroughly practical in character, and likely to help in the production of the intelligent and adaptable type of boy now required in industry. He described an interesting educational experiment which is being made in Leeds in the establishment of day preparatory trades schools. These schools combine a preliminary practical training in trades with a continued general education for boys who have passed through the elementary school. The course covers a period of two years and aims at an all-round development of the boy's faculties in a practical manner. For such schools it is important, Mr. Graham insisted, to secure a teaching staff with practical experience of the workshop. For boys who enter some trade or industry directly they leave the elementary schools, a corresponding course of study is required between the ages of twelve and fourteen. The ultimate success of such a scheme lies to a large extent with the employer, and the Leeds employers are beginning to appreciate the value of the training given in the preparatory trades schools. During the years of youth and adolescence, he continued, supervision and guidance are needed, especially in regard to blind-alley occupations where comparatively high wages are paid for unskilled employment, often leading to the premature development of a spirit of independence in the boy and to the withdrawal of discipline and guidance on the part of the parent.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, January 15.—Annual general meeting.—Dr. H. N. Dickson, president, in the chair.—Mr. C. J. P. Cave was elected president and Mr. F. Druce treasurer for the ensuing year.—Ordinary meeting.—C. F. **Brooks**: The snowfall of the United States. The author has collected the data available from more than 2000 stations for the fifteen years 1895–1910, and from the results thus obtained he has prepared a map showing the annual snowfall. The effects of topography, prevailing winds, storm frequency, and the location of the great lakes and oceans in and about the United States on snowfall are very apparent. In the first place, the western coast ranges, the Sierra Nevadas and Cascade ranges, lying in the path of the prevailing westerlies blowing from the Pacific Ocean, bring excessive snowfall (in many places exceeding 400 in. per year) on their western flanks. The dry interior basin just to leeward of these mountains has very little snowfall, except where mountains rise above the general level. The great Rocky Mountain chain again brings copious snowfall (exceeding 100 in. per year in a great many places, from Idaho and Montana south to northern New Mexico, and in some places in Colorado as high as 400 in. a year, and 300 in. per year in southern Wyoming). Again, in the lee of these mountains, the dry western prairies suffer deficient snowfall. On nearing the Great Lakes, snowfall increases, and on the south-east shores of each of the lakes, 80 to more than 100 in. of snow falls annually. The Appalachian Mountain chain brings the lines of equal snowfall far south, there being 50–100 in. in the mountains from Maryland to Maine. In northern New England frequent storms in winter cause a snowfall of more than 100 in. annually. In south-eastern United States snowfall occurs practically everywhere, except in extreme southern and eastern Florida and southern Texas. The Gulf Stream shows its influence as far as Cape Hatteras by bending the lines of equal snowfall far to the north.

Institution of Mining and Metallurgy, January 16.—Mr. Edward Hooper, president, in the chair.—L. H.

Cooke: (1) Some considerations on the specification of theodolites for mines. (2) Specification for a precision-theodolite. Having found in the course of a long experience that the greater number of theodolites catalogued by British makers, while not unsuitable for the purposes of the civil engineer and surface surveying in general, are not well adapted for underground work, more particularly in inclined deposits, the author has attempted to draw up a specification for a precision-theodolite specially suited for the requirements of the mining engineer. The outcome of successive endeavours in that direction was embodied in the two papers presented to the institution, the intention being to provoke discussion from mining men with a view to the ultimate drafting of a specification which should standardise the vital features and quality of a mine-theodolite suitable for working on lodes of no great thickness or inclination. As a preliminary, Mr. Cooke has formulated a series of twenty-four conditions which he regards as more or less essential to the production of a really useful instrument for the purpose required, his chief points being portability and readiness for immediate use, protection of the vernier plates and other vital parts from dust and dirt, absolute accuracy in reading, and all possible simplicity of construction and operation.—S. C. **Bullock**: Description of a modern lead concentrating mill, Broken Hill Junction North Mine, New South Wales. While not desiring to hold up the plant described in his paper as a model, the author showed how by pursuing a series of experiments, it was possible to improve a mill's output to a marked degree. The mill feed, which was originally treated as one class of ore, was divided into two sections, rhodonite and quartz, to undergo separate treatment in accordance with their respective physical characteristics, after the preliminary crushing and sorting. This system was devised as the outcome of exhaustive tests in sizing, screening, and concentrating, and the result of the new working has been a considerable increase in recovery. A further development alluded to in an addendum to the paper is the installation of a minerals-separation plant, which is intended to treat the crude zinc-lead ore after the jig lead has been extracted.—J. H. **Levings**: The blast-roasting of sulphide ores. This paper related the practical experience of a working metallurgist in Tasmania, when the first smelter at which the Huntington-Heberlein process was used outside Europe was installed, in 1900, the Carmichael-Bradford process following a year later. A chief point of interest in the paper deals with the shape of the pots or roasting vessels, various experiments ultimately deciding the form which gave the most uniformly satisfactory results.

MANCHESTER.

Literary and Philosophical Society, January 7.—Mr. Francis Jones, vice-president, in the chair.—Dr. G. **Hickling**: A remarkable band-like cloud, observed on the night of December 24, 1912. It was suggested that the object observed was possibly due to cloud formation on the trail of dust in the track of a meteorite.—Dr. H. F. **Coward** and F. **Brinsley**: Vortex rings of flame in a hydrogen-air mixture.—R. F. **Gwyther**: The specification of the elements of stress. Part ii., simplification of the specifications already given (*vide* Manchester Memoirs, vol. lvi., No. 10); and part iii., an essay towards the reconstruction of the fundamental equations. Part ii. dealt with a general mode of reducing the number of arbitrary functions or the general stresses within a body from six to three. Part iii. dealt with the physical basis of the fundamental equations, and proposed a scheme differing from that generally accepted.

PARIS.

Academy of Sciences, January 6.—M. F. Guyon in the chair.—The president announced the death of M. Teisserenc de Bort and of M. Cailletet.—L. E. **Bertin**: Calculation of the increase of load or of speed obtained by increasing the dimensions of a steamer.—E. **Bouty**: The dielectric polarisation of the wall and measurements of dielectric cohesion; the retardation of the silent discharge.—L. **Maquenne** and E. **Demoussy**: The influence of the preceding conditions on the value of the respiratory coefficient in green leaves. The theory developed by the authors regards two stages as essential in normal plant respiration, introducing a new factor, the solubility of carbon dioxide in the cell juices.—A. **Calmette** and C. **Guérin**: A new contribution to the pathogeny of tuberculous infection. Healthy and tuberculous cattle were kept in the same shed for a period of eleven months, under conditions preventing infection by the lungs. All the healthy animals became tuberculous, and responded to the tuberculin test, although only half of them showed definite tuberculous lesions.—P. **Stroobant**: The distribution of spectroscopic double stars on the celestial sphere. Spectroscopic double stars are relatively much more numerous in the galactic zone than in the whole of the stars of the same magnitude, and this is due to the high proportion of helium stars among the binaries.—A. **Demoulin**: A general property of lines traced on a surface.—A. **Rosenblatt**: Irregular surfaces satisfying the inequality $p_\theta \geq 2(p_\alpha + 2)$.—Ch. **Müntz**: The direct solution of the secular equation and some analogous transcendental problems.—Georges **Giraud**: A class of transcendentals having a theorem of multiplication.—M. **Nörlund**: Linear equations of finite differences.—G. **Kœnigs**: The construction of the centres of curvature and principal planes of the envelope of a surface of a cylinder which rolls without slipping on another.—Jules **Andrade**: Experimental researches on the double cylindrical spiral.—Henri **Villat**: The flow of heavy fluids.—J. de **Boissoudy**: The equilibrium of a gas in a state of binary dissociation.—A. **Leduc**: Guldberg's law and the law of corresponding states.—O. **Dony-Henault**: The use of resistances of granulated metallic chromium for electrical heating. Powdered chromium, compressed between carbon plates, can be conveniently used as a resistance furnace, and permits of the use of low voltages. Temperatures above the melting point of quartz can be maintained.—Daniel **Berthelot** and Henri **Gaudechon**: The commencement of photolysis of ethyl alcohol, acetaldehyde, and acetic acid.—H. **Copaux**: The basicity of the tungsto-acids.—P. J. **Tarbouriech**: 2.2-Dimethyl*cyclo*heptanone.—A. **Fernbach**: The acidification of musts by yeast in the course of the alcoholic fermentation.—Marcel **Baudouin**: The lumbar vertebral canal in the anthropoid apes and in prehistoric man.—Pierre **Teissier**, Pierre **Gastinel**, and P. L. **Marie**: The passive vaccine immunity conferred by intravenous injections of variolic serum.—F. **Bordas**: The use of low temperatures in cryotherapy. A freezing mixture of solid carbon dioxide in alcohol or acetone is recommended for therapeutic work instead of pencils of solid carbon dioxide.—A. **Magnan**: The relations between feeding and the dimensions of the cæcum in ducks.—Pierre **Kennel**: Contribution to the study of the functions of the large tentacles in *Arion rufus*.—Jacques **Liouville**: The polymorphism of *Delphinus Cruciger*.—M. **Desgrez** and M. **Dorléans**: The influence of the constitution of the purin bodies on their action towards arterial pressure.—A. **Railliet**, G. **Moussu**, and A. **Henry**: Experimental researches on the development of *Fasciola hepatica*.—Ch.

Pussenot: The lower Stephanian (Cevennes zone) in the axial Alpine zone. An attempt at the coordination of the various levels of the coal strata in the western Alps.—De Montessus de **Ballore**: Earthquakes and the phases of the moon. These appear to be unrelated.

January 13.—M. F. Guyon in the chair.—G. **Bigourdan**: Description of an apparatus for sending time signals automatically. A diagram is given of the time signal agreed upon by the recent International Conference, and form of commutator described by means of which such a signal may be sent automatically with high accuracy.—Lord **Rayleigh**: The resistance of spheres in air in motion. Referring to some experimental results published in a recent number of the *Comptes rendus* (December 30) by M. Eiffel, it is pointed out that the law of dynamical similitude as developed by Stokes and Reynolds for viscous liquids is applicable, at least as a first approximation.—R. **Lépine** and M. **Boulud**: Feebly combined sugar in the blood.—Jules **Baillaud**: An integrating opacimeter for stellar photographs. The Hartmann microphotometer is based on the assumption of a homogeneous photographic plate; a new form of photometer is described which is independent of this condition.—P. E. **Gau**: The most general transformations of partial differential equations of the second order.—Maurice **Janet**: The characteristics of systems of partial differential equations.—M. **Schwartz** and M. **Villatte**: The application of an optical method of coincidences to the transmission of time. The apparatus used consists of two optical telegraphs of the military type using acetylene, a Leroy electromagnetic pendulum with variable contact, and chronometers beating half-seconds. Two methods have been devised, one optical, the other partly optical and partly auditory. Results are given for distances between 6 and 45 kilometres, with an accuracy of 0·05 second.—Marcel **Brillouin**: The theory of black radiation.—M. **Costanzo**: The occlusion of the products of radium. Palladium occludes the products of the disintegration of radium. These phenomena can be applied to the estimation of radium.—Adrien **Guébhard**: The theoretical possibility of a reversible arrangement for the automatic reconstitution of the natural colours by projection.—E. **Mathias**, H. Kamerlingh **Onnes**, and C. A. **Crommelin**: The rectilinear diameter of argon. The densities of the liquid and saturated vapour at the same temperature of argon are given for eight temperatures ranging from −125·17° to −183·15°. Argon follows the law of the rectilinear diameter approximately, but the deviations, although small, are too systematic to be assigned to experimental error.—A. **Perot**: The movement of the luminous centres in hydrogen tubes.—Ch. **Boulanger** and G. **Urbain**: Theory of the efflorescence of saline hydrates. The influence of temperature.—Marcel **Boll**: The relation between the velocity of a photochemical reaction and the incident radiant energy. The velocity coefficient of a photochemical reaction is proportional to the incident radiant energy, even if the reaction is bimolecular.—Nicolas **Czako**: The alloys of aluminium with vanadium alloys were prepared, containing from 1 to 80 per cent. of vanadium, and these were studied by the metallographic method. Crystals of Al_4V and AlV were identified, and indications of the existence of AlV_2 were obtained.—Jacques **Duclaux**: The elements of energy.—P. **Lebeau** and A. **Damiens**: A method of analysis of mixtures of hydrogen and gaseous saturated hydrocarbons, hydrogen, methane, ethane and propane. The method is based on the fractional distillation of the liquefied gases. Hydrogen and methane cannot be separated in this way, but a good separation of hydrogen from ethane and propane was obtained.—Ed. **Lasausse**: The fixation of the alkaline bisulphites on the salts and ester salts of the acetylenic acids. One or two molecules of sodium sulphite are fixed, giving mono- or di-sulphonates. The reaction has been studied with phenylpropiolic acid, methyl phenylpropiolate, and methyl amylpropiolate.—Paul **Gaubert**: Some compounds of cholesterol giving liquid crystals.—Lucien **Daniel**: New researches on grafting of Brassica.—J. **Stoklasa**: The influence of uranium and lead on vegetation. Minute proportions of nitrates of lead and uranium in the soil cause a distinct increase in plant growth.—M. **Marage**: The action of complex and intermittent sound vibrations on the auditive centres.—J. **Mawas**: The form, direction, and mode of action of the ciliary muscle in some mammals.—R. **Anthony** and I. **Bortnowsky**: A pleuropatagium of peculiar type in *Microcebus minor minor*.—H. **Agulhon** and R. **Sazerac**: The action of uranium salts and of metallic uranium upon the pyocyanic bacillus.—P. **Becquerel**: The influence of uranium salts and of thorium salts on the development of the bacillus of tuberculosis.—Ph. **Lasseur** and G. **Thiry**: Coloured cultures of bacteria considered up to the present as achromogens.—Em. **Bourquelot**, H. **Hérissey**, and M. **Bridel**: The biochemical synthesis of glucosides of alcohols with the aid of a ferment (α-glucosidase) contained in air-dried low yeast. α-Ethylglucoside has been obtained in a pure crystallised state biochemically.—Robert **Douvillé**: The influence of the mode of life on the sutural line of the Ammonites belonging to the family of the Cosmoceratideæ.—Alfred **Angot**: Value of the magnetic elements at the Val Joyeux Observatory on January 1, 1913.

BOOKS RECEIVED.

An Elementary Course of Magnetism and Electricity. By Dr. C. H. Draper. Pp. vii+86. (London: Blackie and Son, Ltd.) 2*s*.

Safety in Coal Mines. By Prof. D. Burns. Pp. 158. (London: Blackie and Son, Ltd.) 2*s*. 6*d*. net.

The Principles of Stock-breeding. By Prof. J. Wilson. Pp. vii+146 (London: Vinton and Co., Ltd.) 5*s*. net.

Journal of the Institute of Metals. Vol. viii., No. 2. Edited by G. Shaw Scott. Pp. ix+378+plates 32. (London: Caxton House.)

Die neuere Entwicklung der Kolloidchemie. By Dr. W. Ostwald. Pp. 23. (Dresden and Leipzig: T. Steinkopff.) 1 mark.

A New Geometry. Parts i. and ii. By S. Barnard and J. M. Child. Pp. xviii+315. (London: Macmillan and Co., Ltd.) 2*s*. 6*d*.

A Vertebrate Fauna of the Malay Peninsula from the Isthmus of Kra to Singapore, including the Adjacent Islands. Reptilia and Batrachia. By Dr. G. A. Boulenger. Pp. xiii+294. (London: Taylor and Francis.) 15*s*.

The Electron Theory. By Prof. T. Mizuno. Pp. 336. *In Japanese*. (Tokyo: Z. P. Maruya and Co., Ltd.)

Notions de Mathématiques. By Prof. A. Sainte-Lague. Pp. vii+512. (Paris: A. Hermann et Fils.) 7 francs.

Explosives. By Dr. H. Brunswig, translated and annotated by Drs. C. E. Munroe and A. L. Kibler. Pp. xv+350. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 12*s*. 6*d*. net.

Building Stones and Clay-products. By Dr. H. Ries. Pp. xv+415+lix. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 12*s*. 6*d*. net.

Human Physiology. By Prof. L. Luciani. Translated by F. A. Welby. Edited by Dr. M. Camis. Vol. ii. Pp. viii+558. (London: Macmillan and Co., Ltd.) 18s. net.

Achievements of Chemical Science. By Dr. J. C. Philip. Pp. vii+217. (London: Macmillan and Co., Ltd.) 1s. 6d.

A Medical and Surgical Help. By W. J. Smith. Revised by Dr. A. Chaplin. Fourth edition, revised. Pp. xviii+355. (London: C. Griffin and Co., Ltd.) 5s. net.

Elementary Manual on Applied Mechanics. By Prof. A. Jamieson. Tenth edition, revised and enlarged. Pp. xix+452. (London: C. Griffin and Co., Ltd.) 3s. 6d.

The Theory of Measurements. By Dr. A. de Forest Palmer. Pp. xi+248. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 10s. 6d. net.

Handbuch der Morphologie der wirbellosen Tiere. Edited by A. Lang. Band iv., Lief. 1. (Jena: G. Fischer.) 5 marks.

A Handbook of Wireless Telegraphy. By Dr. J. Erskine-Murray. Fourth edition, revised and enlarged. Pp. xvi+442. (London: Crosby Lockwood and Son.) 10s. 6d. net.

The Manufacture of Iron and Steel. By H. R. Hearson. Pp. xi+103. (London: E. and F. N. Spon, Ltd.) 4s. 6d. net.

Le Problème Physiologique du Sommeil. By H. Piéron. Pp. xv+520. (Paris: Masson et Cie.) 10 francs.

Les Merveilles du Monde Sidéral. By M. G. Raymond. Fasc. ii. (Paris: G. Thomas.)

Die sanitarisch-pathologische Bedeutung der Insekten und verwandten Gliedertiere, &c. By Prof. E. A. Göldi. Pp. 155. (Berlin: R. Friedländer und Sohn.) 9 marks.

High School Ethics. Book One. By J. H. Moore. Pp. xiv+182. (London: G. Bell and Sons, Ltd.) 2s. 6d. net.

Mécanique appliquée. By Prof. J. Perry. Translated by E. Davaux, with additions, &c., by E. and F. Cosserat. Tome I. L'Energie Mécanique. Pp. vii+398. (Paris: A Hermann et Fils.)

Practical Agricultural Chemistry. By Prof. S. J. M. Auld and D. R. Edwardes-Ker. Pp. xxiv+243. (London: J. Murray.) 5s. net.

Elementary Physical Optics. By W. E. Cross. Pp. 312. (Oxford: Clarendon Press.) 3s. 6d.

Lost in the Arctic. By E. Mikkelsen. Pp. xviii+395+illustrations+map. (London: W. Heinemann.) 18s. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 23.

ROYAL SOCIETY, at 4.30.—The Metabolism of Lactating Women: E. Mellanby.—(1) Colour Adaptation; (2) Trichromic Vision and Anomalous Trichromatism: Dr. F. W. Edridge-Green.—Transmission of Environmental Effects from Parent to Offspring in Simocephalus: W. E. Agar.—The Relation of the Islets of Langerhans to the Pancreatic Acini under Various Conditions of Secretory Activity: Dr. J. Homans.—Contributions to the Histo-chemistry of Nerve; the Nature of Wallerian Degeneration: H. O. Feiss and W. Cramer.—Onychaster, a Carboniferous Brittle-star: I. B. J. Sollas.—Herbage Studies. II. Variation in *Lotus Corniculatus* and *Trifolium repens* (Cyanophoric plants): Prof. H. E. Armstrong, F.R.S., E. F. Armstrong and E. Horton.

ROYAL INSTITUTION, at 3.—Birds of the Hill Country: Seton Gordon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Use of a Large Lighting Battery in connection with Central Station Supply: F. H. Whysall.

FRIDAY, JANUARY 24.

ROYAL INSTITUTION, at 9.—Recent Advances in Scientific Steel Metallurgy: Prof. J. O. Arnold.

PHYSICAL SOCIETY, at 5.—The Electrical Conductivity and Fluidity of Strong Solutions: W. S. Tucker.—The Resistance of Electrolytes: S. W. J. Smith and H. Moss.—The Recalescence of Iron Carbide: S. W. J. Smith and J. Guild.

MONDAY, JANUARY 27.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Morocco: Alan G. Ogilvie.

ROYAL SOCIETY OF ARTS, at 8.—Liquid Fuel: Prof. Vivian B. Lewes.

INSTITUTE OF ACTUARIES, at 5.—Some Aspects of the National Insurance Act, 1911. Part I. National Health Insurance: R. C. Simmonds.

TUESDAY, JANUARY 28.

ROYAL INSTITUTION, at 3.—The Heredity of Sex and Some Cognate Problems: Prof. W. Bateson.

ROYAL SOCIETY OF ARTS, at 4.30.—The Wood Industry in the British Dominions: C. E. W. Bean.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Canton-Kowloon Railway (Chinese Section): F. Grove and B. T. B. Boothby.—The Canton-Kowloon Railway (British Section): G. W. Eves.

WEDNESDAY, JANUARY 29.

AËRONAUTICAL SOCIETY, at 8.30.—Stability Devices for Aëroplanes: Mervyn O'Gorman.

ROYAL SOCIETY OF ARTS, at 8.—Co-partnership: Aneurin Williams.

THURSDAY, JANUARY 30.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Formation of Usually Convergent Fourier Series: Prof. W. H. Young.—The General Theory of Elastic Stability: R. V. Southwell.—A Spectro-photometric Comparison of the Emissivity of Solid and Liquid Copper and of Liquid Silver at High Temperatures with that of a Full Radiator: C. M. Stubbs.—A New Analytical Expression for the Representation of the Components of Diurnal Variation of Terrestial Magnetism: G. W. Walker.—An Investigation into the Magnetic Behaviour of Iron and some other Metals under the Oscillatory Discharge from a Condenser: Prof. E. W. Marchant.

ROYAL INSTITUTION, at 3.—Recent Research on the Gas Engine: Prof. B. Hopkinson, F.R.S.

CONCRETE INSTITUTE, at 7.30.—The Settlement of Solids in Water and its Bearing on Concrete Work: Dr. J. S. Owens.

SOCIETY OF DYERS AND COLOURISTS, at 8.—The Possibilities of a Standard Light and Colour Unit: J. W. Lovibond.—A Simple Method for Detecting Silk, Cotton and Wool Fibres in Admixture in Textiles: W. P. Dreaper.

FRIDAY, JANUARY 31.

ROYAL INSTITUTION, at 9.—The Poetry and Philosophy of George Meredith: G. M. Trevelyan.

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