THURSDAY, OCTOBER 30, 1913.

RADIATION THEORIES.

Vorlesungen über die Theorie der Wärmestrahlung. By Dr. Max Planck. Zweite Auflage. Pp. xii+206. (Leipzig: J. A. Barth, 1913.) Price 7 marks.

THE first edition of this book, which appeared in 1906, was reviewed in NATURE (October 11, 1906, Supplement iii.). The many and varied contributions to our knowledge of radiation phenomena that have been published in the ensuing seven years have made it necessary for Dr. Planck to rewrite and modify the book to a considerable extent, so that it now contains many novel features. As before, the object of the book is to apply the statistical methods previously used in the kinetic theory of gases to the phenomena of radiation, and full use is made of Boltzmann's views on the interpretation of entropy in connection with the theory of probability. But the present treatment is largely based on the remarkable assumption which the author designates as the "quantum-hypothesis."

The property thus assumed for the elementary electrical oscillators under consideration may perhaps best be explained by comparing them to the cisterns, of which many have been invented and which are so arranged that when the water in them reaches a certain level they overturn and empty themselves, then returning to their original position to be refilled. In other words, absorption takes place continuously, while emission occurs intermittently when the energy of the oscillator attains one or other of certain discrete values. This "quantum hypothesis," as the author points out, is analogous to the electron theory, which assigns a definite magnitude to the electron or "elementary quantum" of electricity. It accounts for Nernst's observed phenomena, and, further, it is in accordance with the view that every different radiation corresponds to a certain definite temperature, and it is already beginning to form an important element in present-day physical researches.

It need scarcely be pointed out that the quantum hypothesis entails irreversibility and thus overcomes a difficulty of the kinetic theory of gases, namely, that even statistical methods apparently fail to account for irreversible phenomena when applied to a system the elements of which are subject to the equations of reversible dynamics, unless some further assumption is made ("Assumption A" of the late Mr. Burbury). It will thus be seen that the present method does not pretend to afford a so-called "dynamical proof" of the phenomena of radiation, and in the preface Dr. Planck distinctly expresses the view that a new principle cannot in general be represented by a model working according to old laws. It will also be evident that brief indications of the new method, such as those contained in this notice, cannot be regarded as adequate descriptions of the real substance of Dr. Planck's investigations.

It was natural that a theory fraught with such far-reaching consequences should attract considerable attention at the recent meeting of the British Association, and the occasion was the more suitable as the presidency of Sir Oliver Lodge had attracted to the meeting a number of physicists all keenly interested in radiation theories. It would be undesirable to refer in greater length to these discussions, as they will be dealt with elsewhere. A popular account of modern radiation theories, including special reference to Dr. Plancks quantum hypothesis, was given by Dr. Max Born, of Gottingen, in *Die Naturwissenschaften* 21, for May 28, p. 499.

It does not appear to the present reviewer that the quantum hypothesis is necessarily irreconcilable with dynamical principles. If we take the equations of motion of a dynamical system and write down the expressions for the second differential coefficients of the squares and products of its velocities, we obtain formulæ which may be said to determine the energy accelerations of the system in the same way that the ordinary equations of motion determine the accelerations of the masses. If we assume conditions of statistical equilibrium we find a definite amount of energy associated with a definite system, and we further find that certain conditions must hold in order that energy equilibrium may be possible. Such a method establishes a kind of principle of duality between the properties of matter and the properties of energy, and is distinctly favourable to an atomic theory of energy. But the attempt to reduce everything to dynamics would of course land us in the old difficulty over the irreversibility.

G. H. B.

CHEMICAL TEXT-BOOKS.

(1) *Osmotic Pressure.* By Prof. A. Findlay. Pp. vi+84. (London: Longmans, Green & Co., 1913.) Price 2*s.* 6*d.* net.

(2) *The Organometallic Compounds of Zinc and Magnesium.* By Dr. Henry Wren. Pp. viii+100. (London: Gurney and Jackson, 1913.) Price 1*s.* 6*d.* net.

(3) *The Chemistry of Dyeing.* By Dr. J. K. Wood. Pp. vii+80. (London: Gurney and Jackson, 1913.) Price 1*s.* 6*d.* net.

(4) *V. v. Richter's Chemie der Kohlenstoffverbindungen oder organische Chemie.* Elfte Auflage. Zweiter Band. Carbocyclische und heterocyclische Verbindungen. Neu bearbeitet von Dr. Richard Anschutz. In Gemeinschaft mit Dr. Hans Meerwein. Pp xxii + 1048. (Bonn: Friedrich Cohen, 1913.) Price 26 marks.

(5) *Traité Complet d'Analyse Chimique Appliquée aux Essais Industriels.* By Prof. J. Post and Prof. B. Neumann. Deuxième Edition Française Entièrement Refondue par G. Chenu et M. Pellet. Tome Troisième. Second Fascicule. Pp. 465-903 + v. (Paris: A. Hermann et Fils, 1913.) Price 15 francs.

(6) *Traité de Chimie Minérale.* By H. Erdmann. Ouvrage traduit sur la 5e édition allemande par Prof. A. Corvisy. Tome Premier. Introduction à la Chimie et Métalloïdes. Pp. iv + 559. (Paris: A. Hermann et Fils, 1913.) Price 12 francs.

(7) *Laboratory Text-Book of Chemistry.* By V. Seymour Bryant. Part 1. Pp. vi + 246. (London: J. and A. Churchill, 1913.) Price 4*s.* net.

(1) THOSE who have read Dr. Findlay's book on the phase rule will have formed great expectations of his promised monograph on osmotic pressure, and we believe they will not be disappointed. The expression osmotic pressure of a solution has become a familiar one both to chemists and biologists, though, as Dr. Findlay is careful to point out, it is incorrect. A solution does not in itself have any osmotic pressure, the term being loosely used to denote the mechanical pressure *which would be produced* if the solution were separated from the pure solvent by a membrane which was permeable only to the solvent. The confusion of thought which has arisen in connection with the subject, especially amongst the biologists, is unfortunately very considerable, so that Dr. Findlay's clear treatise comes at an opportune moment and should be widely read. Although necessarily mathematical in parts, it is not unduly so, even for the biological reader.

The author shows himself to be no bigot in favour of the extreme views of the German physical-chemical school, and his chapter on the cause of osmosis and the action of the semipermeable membrane reaches a high standard. Regarded from the biological side, the subject of osmosis is one in which we are on the eve of important developments requiring interpretation in the broadest possible manner. In the past the tendency has been to give too little attention to the chemical meaning of the osmotic phenomena, but this error is avoided in the present work.

The work of Lord Berkeley in this country and that by Morse in America is described at length and its bearing on the general theory of ideal solutions discussed in a separate chapter. Emphasis is laid on the thermodynamic equation connecting the osmotic pressure with the vapour pressure of solutions.

(2), (3) Chemical monographs are evidently fashionable, and the success of the biochemical series edited by Dr. Plimmer and the inorganic series for which Dr. Findlay is responsible has inspired others to imitate them. The new series for which Dr. Cumming is sponsor are, however, of a different type and can scarcely lay claim to the title monograph—indeed, the use of the term is misleading. They are essentially summaries intended for advanced students with the examination bugbear in front of them, and though no doubt they will be very useful, they are in no way authoritative in the same sense as the other monographs to which reference has been made. However, they are well printed and convenient in size and price, and should prove very popular among students.

No. 1 in the series is Dr. Wren's essay on the organometallic compounds of zinc and magnesium. Though Grignard described the reaction which now bears his name so recently as 1900, the method has proved so fruitful in effecting organic syntheses that their number is already legion, and the subject forms, we fear, a very favourite examination question—hence, no doubt, the motive and form of the present summary. The mode of using the reagent is first described, but the bulk of the book is devoted to the description, with copious formulæ, of the products formed by its aid. A few pages are devoted to the theory of the reaction. The final section deals with Blaise's more recent applications of the organometallic derivatives of zinc, which afford reagents of less general activity and of greater ease of control.

Dr. Wood's summary of the chemistry of dyeing is simply and clearly written and devoid of technical terms, so that it should appeal to a wider public than the chemical student and, indeed, be in the hands of all practical dyers. The scheme followed is first to discuss the chemical composition and properties of the textile fibres, then to deal with the classification and properties of dyes, and lastly with the nature of the dyeing processes. A small bibliography and index is attached. The author is to be congratulated on the clear way in which he has dealt with the rival theories of dyeing within a short space.

(4) A new edition of Richter scarcely calls for criticism beyond the statement that the authors have maintained the standard of a work which has been indispensable to all students of organic

chemistry in the past and is likely to prove equally valuable to all in the future. No other text-book is so exhaustive and yet relatively still readable. We have taken the opportunity to test it somewhat severely and always found the desired information. The new edition does, however, afford an opportunity of noting the enormous increase in our knowledge of this part of organic chemistry—embracing the carbocyclic and heterocyclic compounds. Our former copy of the ninth edition, bearing the date 1901, is a modest little work of 809 pages, measuring 4×6 inches. The new edition requires 1048 pages, measuring $4\frac{1}{2} \times 7$ inches.

Even in 1900 the would-be chemist made some attempt to master the whole of Richter—to-day this is obviously impossible, and the student is forced to specialise at an early stage in his reading. Fortunately, chemical literature is now enriched by very many special monographs of a very readable character and free from too much elaboration of detail. When these are supplemented by Richter—the encyclopædia of chemistry—the student is indeed well armed. We have one suggestion only—namely, the author's name, as well as the journal reference, should be quoted in the references to the original literature. The omission of the author's name prevents reference to the abstracts of the original in the Journal of the Chemical Society or in the *Centralblatt* when the original paper itself is not available.

(5), (6) These translations of well-known standard German works testify to the rank taken by German science in other lands: they are already well known in this country. The second part of vol. iii. of Prof. Neumann's technical analysis contains Schultz's famous monograph on coal tar and artificial colouring matters, which already has a world-wide reputation and forms an appropriate complement to Germany's most famous chemical industry. This is the second French edition translated from the third German edition of the work.

Prof. Corvisy's book is a translation for the first time of the fifth German edition of the first volume of Erdmann's well-known work. The translator refers to the need of such a work in France, where no other book is available for students covering the ground in quite the same way.

(7) This book is intended to be actually used as a laboratory note-book in schools, the pupil having to write his answers in the spaces in the text left for the purpose. Precise instructions are given how to do everything and what to observe and infer, and in quantitative exercises only the actual figures have to be filled in by the schoolboy. The book is elaborately bound and somewhat expensive. We fear we do not agree with the author's interpretation of practical chemistry; indeed, we had hoped that books of this type had ceased to exist.

E. F. A.

PROBLEMS OF LIFE AND REALITY.

(1) *Essais de Synthèse Scientifique.* By E. Rignano. Pp. xxi+294. (Paris: F. Alcan, 1912.) Price 5 francs.

(2) *Contre la Métaphysique.* By F. Le Dantec. Pp. 255. (Paris: F. Alcan, 1912.) Price 3 francs 75 centimes.

(3) *Modern Science and the Illusions of Prof. Bergson.* By H. S. R. Elliot. With a preface by Sir Ray Lankester, K.C.B., F.R.S. Pp. xix+257. (London: Longmans, Green and Co., 1912.) Price 5*s*. net.

(4) *Wissenschaft und Wirklichkeit.* By Max Frischeisen-Köhler. Pp. viii+478. (Berlin: B. G. Teubner, 1912.) Price 8 marks.

(5) *The Young Nietzsche.* By Frau Förster-Nietzsche. Translated by A. M. Ludovici. Pp. viii+399. (London: W. Heinemann, 1912.) Price 15*s*. net.

THE first two of these volumes contain a curiously similar plea for the theorist in science. M. Rignano in his opening essay (1) maintains that there are a number of central problems in the biological sciences, in which there is almost a deadlock, due to the fact that they have been attacked exclusively by two opposite groups of specialists. One such problem, awaiting the synthetic view, is that of the nature of life and growth. Others are: the meaning of religion as viewed from the psychological and the sociological points of view; the economic and ideologic factors in history; the antithesis of socialism and liberal economics. These are dealt with in successive essays. In the first the various transformist theories are reviewed, in order to demonstrate how far-reaching may be the clarifying effects of a single piece of theorising. At the same time the *leit-motiv* of the whole volume is introduced—the mnemonic principle. The recapitulation of phylogenetic development in ontogenesis is essentially mnemonic, as is assimilation.

The same principle is next applied more in detail to the problem of growth, by means of a summary of the author's "centro-epigenetic" theory of development. This asserts that growth is determined by a nervous circulation, independent of a nervous system, consisting of discharges of specific nervous energy accumulated in the germ-plasm, each discharge depositing a substance apt in decomposing to regenerate the same specific nervous current. "Memory" in this wide sense is next applied to explain the affective tendencies (conations) which are regarded as strivings to regain physiological equilibrium. Thus one and the same explanation holds of all the finalism of life, namely, the mnemonic property of vital substance, that faculty of "specific accumulation" which belongs exclusively to nervous energy, itself the basis of life. The other essays reveal the same acuteness, fertility, and confidence in theorising.

(2) M. le Dantec, after a semi-serious demonstration that the philosopher is an artist, to be appreciated by those vibrating in harmony with him rather than understood by mankind at large, and a plea for more reasoning in natural science and less "kitchen-technique," proceeds also to consider the central problems of biology. All vital phenomena fall under the head of "functional assimilation." The organism assimilates *qua* organ of its function at the moment. Thus a mammal into whose peritoneum cow's milk is injected assimilates this, if it survives, *qua* organ of the struggle against cow's milk, but not absolutely, for it retains a trace or "memory" (cf. Rignano) in that its serum will henceforth give a precipitate with cow's milk. Thus it is impossible to separate "nature" and "nurture," though the part played by the latter must be relatively small "on pain of death." Like M. Rignano, a Neo-Lamarckian, M. le Dantec holds that among the transmissible acquisitions are the instincts, and logic, "the *résumé* of ancestral experience."

(3) Mr. Elliot's view of philosophy is, broadly, that it consists in making unfounded and untestable statements about the universe—mapping the back of the moon. Now this is surely a mistake; philosophy is not description, but explanation; and to explain is to bring unconnected or conflicting facts under one general law or notion. Sometimes it is merely a question of selecting the right familiar notion, but often a *new* "appropriate conception" has to be created, a process the difficulty and importance of which Mill so greatly underestimated; and philosophical explanation is evidently likely to be of this nature.

Thus while it is legitimate criticism of a philosophy to say that it is incomprehensible (a line pretty effectively worked by Schopenhauer) it is unreasonable to insist that it must be easily comprehensible, or use only everyday notions. Nor can one fairly complain if philosophers do not adduce specific facts for their theories. Negative evidence can disprove an explanatory hypothesis; positive evidence can only "verify" it cumulatively, and here the facts are broadly not in dispute. This, if correct, invalidates much that Mr. Elliot says about M. Bergson's "besetting fallacies," *e.g.*, the "mannikin fallacy." Again, his keen scent for "false analogy" often leads Mr. Elliot to take as demonstration what is clearly meant as "explication." While always acute and often touching on real difficulties, Mr. Elliot too often allows himself to be tempted, in sporting parlance, into smashes which find the net.

(4) Perhaps the least of the differences between the last work and Herr Frischeisen-Köhler's essay in critical realism is that in the latter M. Bergson is not so much as mentioned. The nineteenth century saw a movement of opposition to the intellectualism of the seventeenth and eighteenth centuries, and the book aims at helping to find a common point of view for the sciences typical of the two points of view—mathematics and history, the latter of which can never be based on pure thought. The method is a critical consideration of the conditions involved in consciousness, which themselves contain the bases of knowledge. Of the categories or modes of experiencing involved in consciousness, however, only that of reality is considered.

The closely-reasoned exposition is impossible to summarise here, but it involves the discussion of the two main modern attempts to derive all experience from the laws of pure thought—the logical idealism of the Marburg school and the philosophy of values developed by Windelband and Rickert. Finally, the empirical bases of our notion of reality are found, above all, in experiences of striving and resistance. Like fish in a glass bowl we are unable to go further in some directions, and since this experience always occurs in conjunction with certain sense-impressions, we recognise in these that which sets limits to our subjectivity. The real remains, indeed, always within the conditions of consciousness in general, but within consciousness the independence of the objective world from the self is assured. The book is a clearly-written, cautious, and eminently helpful discussion of the difficult problems with which it deals.

(5) Having nothing in common with the other works except that it deals with a philosopher, the life of Nietzsche by his sister is an interesting and pleasing account of the first happy portion of that tragic existence. Strangely unlike a morose apostle of hardness is the almost painfully well-behaved child in the country parsonage, the brilliant schoolboy with all the German idealism and *schwärmerei*, the student shocked by the coarseness of university conviviality, the youthful professor of classics, the heroic but too sensitive ambulance volunteer in the Franco-Prussian war. The book takes us to the end of the friendship

with the Wagners, and it is its main weakness that it fails to make clear the reason either for the intensity or for the abrupt end of this devotion. The translation is quite satisfactory, and some excellent portraits add much to the book's effectiveness.

TEXT-BOOKS ON HEAT AND THERMODYNAMICS.

(1) *An Introduction to the Mathematical Theory of Heat Conduction.* With engineering and geological applications. By Prof. L. R. Ingersoll and O. J. Zobel. Pp. vi+171. (London and Boston: Ginn and Co., n.d.) Price 7*s.* 6*d.*

(2) *The Laws of Thermodynamics.* By W. H. Macaulay. Pp. viii+71. (Cambridge: University Press, 1913.) Price 3*s.* net.

(3) *A Text-book of Thermodynamics (with special reference to Chemistry).* By J. R. Partington. Pp. viii+544. (London: Constable and Co., Ltd., 1913.) Price 14*s.* net.

(4) *Lehrbuch der Thermodynamik.* Nach Vorlesungen von Dr. J. D. v. d. Waals. Bearbeitet von Dr. Ph. Kohnstamm. Zweiter Teil. Pp. xvi+646. (Leipzig: J. A. Barth, 1912.) Price 12 marks.

(5) *Leçons de Thermodynamique.* By Dr. Max Planck. Avec une conference du même à la Société chimique de Berlin sur Le Théorème de Nernst et L'Hypothèse des Quante. Ouvrage traduit sur la troisième édition allemande (augmentée). By R. Chevassus. Pp. 310. (Paris: A. Hermann et Fils, 1913.) Price 12 francs.

(1) THIS book is the outcome of the authors' teaching experience, and as one might expect, covers the ground usually required for a university degree. The subject-matter includes the Fourier equation, the steady flow of heat in one and more than one dimension, periodic flow in one dimension, Fourier's series applied to the linear flow of heat in the case of an infinite as well as semi-infinite solid, heat sources, slab and radiating rod, and in addition radial flow, instantaneous heat source at a point, sphere with surface at constant temperature, sphere cooled by radiation, and the general case of heat flow in an infinite medium. The concluding chapter deals with the formation of ice. The appendix contains a list of values for the thermal conductivities and emissivity factors, as well as the more commonly occurring integrals and miscellaneous formulæ. The striking feature about the book is the prominence which is given to the experimental applications of the expressions derived. These belong mainly to engineering, though the student of pure physics will find many of them of considerable interest. At the end of each chapter there are a number of problems to be worked out. As the work covers a relatively large field the authors have had to restrict themselves to typical cases. Full references are given, however, on particular points to larger works and original papers. The authors have compiled a very useful text-book of moderate size, which should appeal to a fairly wide circle of readers.

(2) This monograph contains a succinct account of the fundamental principles of thermodynamics. The writer has been singularly happy in combining precision and accuracy of statement with remarkable lucidity and readableness. Although he warns us in the preface that the tract should be read "in conjunction with other information," it ought to be found by no means beyond the grasp of the beginner. The subject is presented, in the first instance, from the engineer's point of view, though the nature of the publication is such as to preclude any very detailed illustrations of an applied character. This has the advantage, however, of making the work more interesting to the general reader. The author commences by explaining perfect differentials, and then passes on to the first and second laws and the four thermodynamic relations. In addition to the perfect gas, considerable space is devoted to the treatment of wet and dry steam, and a short account of the lead accumulator. The monograph as a whole forms a very excellent introduction to engineering thermodynamics.

(3) The first sixteen chapters of Mr. Partington's "Thermodynamics" represent a very full and detailed account of the classical theory along the usual lines. The two final chapters of the book deal rather briefly—considering the growing importance of the subject—with Nernst's heat theorem and the theory of energy quanta. The reader is assumed to be fairly well equipped as far as mathematics is concerned, and for chemists, at any rate, the book will in places make fairly severe reading. All the thermodynamic potentials (Gibbs' μ included) are freely employed, as well as the cycle method. Perhaps the least satisfactory is the chapter on electrochemistry. An English book dealing with thermodynamics from the chemical point of view is rather badly wanted, however, and Mr. Partington's deserves to meet with a good reception.

(4) As anyone familiar with van der Waals' writings will anticipate, the present work is by no means a text-book of thermodynamics in the ordinary sense of the term. This second volume, like the first (which appeared in 1908), is based upon Prof. van der Waals' lectures, the material being edited for the Press by Prof. Kohnstamm. As the sub-title expressly states, this volume deals

with the application of thermodynamics to liquid-gaseous systems containing more than one component. Although the phase rule and the theory of dilute solutions (from the osmotic point of view) are discussed at some length, the greater part deals with the problems of phase equilibrium from the points of view and by the methods with which one associates the name of van der Waals himself. The book is divided into two main parts, first, the consideration of systems in the absence of external forces, chemical or capillary effects, and secondly, the behaviour of systems when exposed to such forces. The work requires no introduction to English readers. The fundamental nature of the subject itself, and the fact that it emanates from the greatest living authority upon this subject, ought to provide a sufficient reason for every physicist and physical chemist becoming acquainted with it.

(5) Planck's thermodynamics is already so well known to readers in every country that it is only necessary in this place to direct attention to the appearance of the (enlarged) French translation of the third German edition. It would be utterly futile to attempt any worthy review of this book in the space of a few lines. A very interesting feature of this edition is the incorporation by the French translator of the lecture on Nernst's theorem and the energy quanta hypothesis delivered by Prof. Planck in December, 1911, before the German Chemical Society, and also a list of the papers on thermodynamics published by Prof. Planck with cross-references to the paragraphs of the book in which the same subjects are treated. The work is divided into four parts: the first deals with fundamental experiments and definitions, the second and third with the first and second laws, whilst the concluding part takes up the application of those laws to special physical chemical cases. The last chapter of this part is devoted to the discussion of the absolute value of entropy (Nernst's theorem). As an illustration of the place which Planck's "Thermodynamics" occupies, it may be mentioned that a fourth German edition has already appeared this year. It is high time that the English translation was brought up to date.

W. C. McC. L.

OUR BOOKSHELF.

The Annual of the British School at Athens. No. xviii. Session 1911–1912. Pp. viii+362+15 plates. (London: Macmillan and Co., Ltd., n.d.) Price 25*s.* net.

THE eighteenth volume of the Annual of the British School at Athens for the session 1911–12 is fully up to the level of this excellent series. The chief archæological article gives an account by Messrs. A. J. B. Wace and M. S. Thompson of the excavations at Halos, one of the smaller and less-known cities in Thessaly. A group of tombs at the foot of the acropolis was opened. Such cist graves formed of slabs are common in Thessaly, both in the fourth prehistoric period and in the Early Iron Age, to which the Halos tombs belong. Here there is no sign of cremation, simple inhumation being the only process. On the other hand, the excavation of a neighbouring tumulus proved that here corpses were burned. Thus in these two cemeteries we find two different methods of disposal of the dead. From an examination of the pottery and fibulæ it seems clear that the cremation tumulus is of a date later than that of the cist graves, and it may be referred to the middle of the so-called Geometric period, about the ninth century B.C. No exact parallel to this type of cremation burial has yet been found in Greece or elsewhere, and it differs from that of Halstatt and the rites described in the Homeric poems in some important particulars. The tumulus is clearly post-Homeric, and may be an Achæan burial in a degenerate or modified form.

Mr. M. N. Tod's paper on Greek numerical notation is of special importance. By a review of the epigraphical evidence he seeks to determine the numerical systems employed in the various Greek cities, and to state afresh some of the conclusions which we are entitled to draw from it. This paper is devoted only to the so-called "acrophonic" or "initial" class of numerical notation, the consideration of the other main type, in which the letters are used in their alphabetical order as numerical signs, being reserved for later treatment. The earliest example of this type appears to belong to the fifth century B.C., and the diversity of the systems employed in the various cities seems to be due to the modifications introduced into the pure numbers to make them capable of expressing money, weights, and measures. The detailed epigraphic evidence thus presented deserves the attentive study of students of the early history of mathematics.

The New Encyclopaedia. Edited by H. C. O'Neill. Pp. vii+1626. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 7*s.* 6*d.* net.

THIS encyclopædia is handy in shape and fairly light in weight, and considering the limits of size, it appears to be as complete and authoritative as can be expected. The expert in any branch of knowledge may note the omission of facts which he might think could have been included, but the general reader will find brief summaries on many topics. He will, therefore, find this volume useful, and will be able to continue his studies under the guidance of the bibliography which is appended to the more important articles. The information appears to be accurate and modern, but some of the less informative maps might have been omitted.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Reflection of γ Rays from Crystals.

IN some recent investigations Prof. Rutherford and Mr. H. Richardson have analysed the γ radiations emitted by a number of radio-active products. They have shown, for example, that radium B emits three distinct types of γ radiation, which are absorbed exponentially by aluminium with absorption coefficients $\mu=230$, 40, and 0·51 (cm.)$^{-1}$ respectively. On the other hand, radium C appears to emit essentially only one type of γ radiation, the absorption coefficient of which is $\mu=0{\cdot}115$ in aluminium.

Recently we have undertaken an examination of these types of radiation by the methods developed for X-rays by W. H. and W. L. Bragg, and by Moseley and Darwin, which consist in determining, either by the photographic or electric method, the intensity of the X-rays reflected from a crystal at different angles of incidence. In our experiments the source of γ radiation was a thin α-ray tube containing about 100 millicuries of emanation, the γ rays arising from the products of the emanation, radium B and radium C. A diverging cone of rays fell on a crystal of rock-salt, and the distribution of the reflected radiation was examined by the photographic method. The source and photographic plate were each about 10 cm. from the centre of the crystal. Suitable precautions were taken to reduce to a minimum the effect on the photographic plate of the primary and secondary β rays and penetrating γ rays. The source was first arranged so that the radiation made an average angle of about 9° with the face of the crystal.

It was calculated from the known data of the crystal that the radiation $\mu=40$ from the radium B, if homogeneous, should be strongly reflected at about this angle. A group of fine lines comprised between the angles 8° and 10° have been observed on the photographic plate in a number of experiments. Similar results have been observed with a crystal of potassium ferrocyanide, kindly loaned to us by Mr. Moseley. On examining the reflection for an angle of 2° another series of fine lines was obtained on the plate, probably resulting from the reflection of the more penetrating radiations from radium B and radium C.

The experiments indicate that the γ radiation for which $\mu=40$ is complex, and consists of several groups of rays of well-defined wave-length. Experiments are in progress to examine carefully the character of this reflected radiation, both by the photographic and electric method. It is hoped that in this way definite evidence will be obtained on the constitution and wave-length of each of the types of γ radiation which are emitted from radium B and radium C.

E. RUTHERFORD.
E. N. DA C. ANDRADE.
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The Piltdown Skull and Brain Cast.

Now that my friend Prof. Keith has explained (NATURE, October 16, pp. 197–99) so lucidly his reasons for making a big brain-case of the Piltdown fragments it is possible to define precisely the point at issue between us.

I should say at the outset that any anatomist, working with the plaster casts but without reference to the actual fragments from which they were moulded, might solve the extraordinarily difficult problem of reconstruction of the cranium in the way Prof. Keith has explained so plausibly. But the bones themselves present features which make such a solution altogether inadmissible. Anyone who examines the left parietal and temporal bones cannot fail to recognise that there is no room for any doubt as to the relative positions of these bones the one to the other, which is not that claimed for them by Prof. Keith.

The right parietal fragment and the occipital can be put into their proper positions and the symmetry of the two branches of the lambdoid suture be restored without producing "any marked asymmetry of another kind," such as troubled Prof. Keith, and without the necessity of making any such liberal additions to the capacity of the cranium as he demands (see his Fig. 2).

The "marked asymmetry of another kind" that he could overcome only by the adoption of the most drastic measures was created wholly by his refusal to admit the possibility that the middle line in the parietal region, as determined by Dr. Smith Woodward, was a close approximation to the truth.

The determination of the precise location of the middle line in the frontal and parietal regions is one of quite exceptional difficulty, but a number of facts and considerations make it certain that it is not where Prof. Keith would place it.

The crux of our difference, then, is the criteria which Prof. Keith uses for determining the middle line in the posterior parietal region. He writes (*op. cit.*, p. 198 *et seq.*):—"In the skulls of all the higher primates, the longitudinal sinus, near the hinder end of the adjacent margins of the right and left parietal bones, is marked by a narrow deep groove with distinct edges; on the margin of the upper angle of the Piltdown fragment the edge or margin of this groove can be clearly recognised."

It must be remembered that the area in question (the "upper angle" of the quotation) is immediately above the middle part of the lambdoid suture, which is preserved upon the larger parietal fragment. Prof. Keith does not seem to have realised this fact, for he represents the lambdoid suture (in his Fig. 2) as a large arch (A, B, A, B) crossing the middle line a short distance below the larger bone fragment. If a series of human and simian cranial casts be examined it will be found that, contrary to Prof. Keith's statement, in a considerable proportion of them there is no trace whatever (in the place just above the lambda corresponding to that preserved in the Piltdown specimen) of "the narrow deep groove with distinct edges" on which Prof. Keith relies as his guide for the determination of the middle line. This is especially the case in the casts of the more primitive human and the simian crania, as Profs. Boule and Anthony have pointed out in their discussion of the Chapelle-aux-Saints and La Quina brain-casts.

On these grounds Prof. Keith "moved the left parietal bone outwards or rather tilted [it] upwards and outwards until it assumes a more vertical position" (p. 199). But in order to do this he had to get rid of one of "the peculiar features of the original brain-cast—the sharp bending inwards or kinking of the temporal lobe of the brain" (p. 199). If Prof. Keith had not opened out the angle between the left temporal and parietal bones the aperture of the ear would have been made to look towards the neck, when he "tilted the left parietal upwards and outwards"! But the precise relationship of the left temporal and parietal bones is not a matter of argument but of fact; no one who examines the actual fragments and sees how precisely the edges of these bones fit one on to the other can refuse to admit that the parieto-temporal angle of Dr. Smith Woodward's restoration is a genuine peculiarity of this skull. If this is admitted it becomes impossible to tilt the upper margin of the parietal upwards and outwards. In other words, this peculiar articulation of the temporal bone affords confirmatory evidence of the proper location of the middle line.

It is a very interesting fact that the curious conformation of the temporal region of the brain, to the reality of which Prof. Keith objects, is quite analogous to that exhibited in the remarkable cranial cast of the Gibraltar skull, of which he is the custodian, and in some of the casts of primitive crania (negro, Australian, and Tasmanian) which he kindly obtained for me.

The greater part of Prof. Keith's letter deals with the lack of symmetry in the original reconstruction, which was due to a slight error in the positions assigned to the occipital and right parietal fragments. The need for this correction was realised before the meeting of the Geological Society last December; and this was taken into consideration when I was writing my preliminary note. G. ELLIOT SMITH.

The University of Manchester.

"Aëroplanes in Gusts."

I SHALL esteem it a favour if you will spare a little space in which to refer to the unsigned review of the first edition of my book, "Aëroplanes in Gusts," printed in NATURE of October 2.

It is not at all my intention to refer to or contest an adverse opinion standing alone, but there is associated with that opinion, in a way that might appear to justify it, a misstatement of fact that I can scarcely be expected to pass without an endeavour to correct.

Your readers are informed that I "measure the effect of a gust of wind by the accelerations of the air particles relative to the aëroplane." That I certainly do not do, and your reviewer has no excuse whatever, in anything I have written, for attributing to me so simple and foolish an error as the words imply. A most casual reading of my book, even in its first pages, shows, decisively, that I quite properly measure the gust—not "the effect of a gust," whatever that may mean—by the acceleration of headway, or acceleration of the velocity relative to the air, which, independently of that due to gravity and even of that due to the propeller, is being *impressed* upon the flying machine by the air.

The confusion made possible by not maintaining or exhibiting, as I have done in my book, the distinction between an actual acceleration and an impressed acceleration, and by not excluding the gravitational acceleration, scarcely needs enlarging upon or explaining in the columns of NATURE.

S. L. WALKDEN.

Muswell Hill, N., October 4.

I HAVE just received the second edition of "Aëroplanes in Gusts," and in reply to the author's criticism of my review, I cannot do better than quote the passage on p. 2 containing the definition :—

"Using therefore the term 'headway' in place of the cumbersome 'velocity relative to the air,' it will be taken for granted that the reader knows that :—

"(1) The instantaneous *strength* of gust at any point of the air as regards a given flying-machine flying at that point is measured by the acceleration of headway which any singularity of the air at that point is impressing upon the flying-machine, and the *direction* of the gust is opposite to the direction of the impressed acceleration.

"For example :—If the air is accelerating downwards at 40 ft. p.s. p.s., it is impressing upon the flying-machine an upward acceleration of headway of 40 ft. p.s. p.s., and this is the measure of the downward gust. In other words, the gust is of strength 40 ft. p.s. p.s., downwards. Simple velocity as distinguished from rate of change of velocity is, it will be noticed, completely ignored."

(The author then goes on to point out that accelerations may be represented by straight lines. Agreed.)

On p. 4 he says :—

"The general method of finding the impressed accelerations acting at a given instant upon a flying-machine consists in first answering the question :—

"If at any given instant the flying-machine could be suddenly transformed to a small smooth concentrated mass, how would it accelerate relative to the air?

"The acceleration answering the above question is the 'resultant relative gravity' of the following discussion, and when common gravity is subtracted *in vector sense* the result is the acceleration tendency or impressed acceleration due to the gusts. When from this result the impressed acceleration due to the absolute acceleration of the air at the place of the flying-machine is also subtracted *in vector sense* there will usually be found an impressed acceleration remaining. This is due to the air having what is called "velocity structure" at the point, and to the flying-machine in crossing that structure creating for itself a rate of change of headway."

If Mr. Walkden considers that he has received any injustice through the use of the term "effect of a gust" in substitution for his reference simply to "a gust," or the measure thereof, the reference to "effect" should certainly be withdrawn. But as regards his views on "impressed accelerations," the above quotations will probably appeal to readers of NATURE far more effectively than any criticism, however adverse. Yet several journals have reviewed the book favourably, and it has run into a second edition.

THE REVIEWER.

Mass as a Measure of Inertia.

CAN any of your readers enlighten me as to the authorship of the definition, "The mass of a body is the dynamical measure of its inertia"? I am under the impression that it is due to Clerk Maxwell, but have not been able to find where it occurs. I should be grateful for information as to where to look for it. W. C. BAKER.

School of Mining, Queen's University,
Kingston, Ont., October 13.

ENGINEERING RESEARCH AND ITS COORDINATION.

THE questions of the coordination and encouragement of research in engineering have been brought forward in various ways recently. In April Sir Frederick Donaldson, chief superintendent of Woolwich Arsenal and president of the Institution of Mechanical Engineers, referred to them in his presidential address. At the recent summer meeting of the same institution held in Cambridge, Mr. G. H. Roberts, of Woolwich, read an interesting paper entitled "A Few Notes on Engineering Research and its Coordination," while the matter was also touched upon by the president of the Institution of Water Engineers in his presidential address.

"I have long thought," he says, "and indeed it must be obvious to all who reflect upon the subject, that a great mass of experimental work is lost to the community because the results in many cases are not properly recorded, and even when complete records are kept, the results remain with the investigator," and after referring to the advantages of combining for research the experience and opportunities of a number of people, he continues:—"It occurs to me therefore to ask whether it is possible to make this institution"—the Institution of Water Engineers—"a clearing house for the handling of some at least of the many problems to which we devote time and thought."

Again, Sir Frederick Donaldson writes:—

Research in the hands of firms and engineering undertakings has already been advocated, and no one would wish to see such efforts in any way hampered, but if it were possible to coordinate the work more than is done at present, and also to place the results at the disposal of the profession more readily than is now the case, great advantage may be expected to result. Is it not worth considering whether inquiries should not be made to see if an Engineering Research Committee, the bounds of which should be much wider than membership of this institution alone [the Institution of Mechanical Engineers] could be got together with a view to organising, coordinating, and assisting research, more especially for engineering purposes?

Mr. Roberts's paper commences with the statement that

Although engineering as an applied science has now reached a high state of development, and has in many of its branches become highly specialised, it is somewhat remarkable that no definite and generally recognised system has been formulated for making known for the benefit of the profession as a whole the results of the numerous private researches and experiments which are continually being carried on.

The paper describes a few of the researches of general interest carried on at Woolwich Arsenal

with the hope that it may induce others to come forward and add to the stock of general knowledge and it may thus form the nucleus of a clearing house of engineering information.

Sir Frederick Donaldson goes farther than the formation of such a clearing-house; he suggests, as we have seen, in addition the organisation, coordination, and assistance of research: we will return to this point later.

To many readers of NATURE interested mainly in branches of science other than engineering, the need for a clearing-house may appear strange. A man after he has carried through a research in chemistry, physics, or one of the biological sciences, is not usually averse to giving his paper to the world. He communicates it to one of the scientific societies. In due time it appears in the journal, and is abstracted into one or more of the numerous and valuable periodicals which undertake such work for the great benefit of other investigators. But it is otherwise with much engineering or other technical research. The work is carried out for a special purpose: to determine the proper material to use in some structure; to see if some alloy which it would be convenient to employ for a certain machine will retain its properties under the conditions of temperature and stress to which it will be subject; to settle the form of bolt or screw-thread which for a given diameter offers the greatest resistance to shocks or impact and the like. Mr. Roberts's paper gives us examples. He records the results of tests on many specimens of timber used in the arsenal; of an investigation into the standard shapes and dimensions of tensile specimens; of numerous experiments on aluminium alloys. He describes a special instrument for indicating the yield-point of tensile specimens, and discusses the effect of the time-factor upon results of tensile testing and the unification of methods of reporting. Any of these investigations might have been carried out in some other works, and the result, when it had been utilised for the job in hand, forgotten and left to pass into oblivion.

Investigations of the kind, though of real value, may scarcely be of sufficient importance to be worked up as a paper for communication to one of the technical societies—always a somewhat elaborate business—and, indeed, results and methods sufficient for the purpose in view, and deserving of record, would be felt not unfrequently to be unsuitable for an evening's formal discussion. Again, there is the desire, sometimes the necessity, to keep the results private, and the disinclination to spend time in working them up for publication. Possibly some of these difficulties could be met by a committee guiding a staff of men whose business it would be to keep in intimate touch with works in which investigations of general interest were going on. The knowledge of these men would enable them to suggest to the committee what researches it was important should be secured for the public: they might assist the workers in preparing these for publication, or, where complete publication was not necessary or desired, in abstracting such parts as could usefully be placed on record. The committee, or the committee's records, would in time become a storehouse of information to be searched by a would-be investigator before he commenced his own experiments. Useful knowledge would be disseminated and overlapping prevented. The difficulties of the attempt are fairly obvious. Success, if it could be achieved on a sufficient scale, would be a real advantage to engineers.

But this is distinct from Sir Frederick Donaldson's suggestion of organising and advising as to research. To attempt this for the whole field of engineering science is a heavy task, and it may be questioned whether such work is not better done by a number of special committees, each working in a more limited field. Possibly a main committee like the main committee of the engineering standards committee is wanted to start the subordinate bodies and coordinate their work. Such special committees do exist at present. Prof. Hopkinson mentioned in the discussion on Mr.

Roberts's paper the gaseous explosions committee of the British Association. The alloys research committee of the Institute of Mechanical Engineers; the newly established research committee of the electrical engineers; the reinforced concrete committee of the civil engineers; or the Government Advisory Committee for Aëronautics, are all instances. For the success of such committees three things are needed—a man or men to carry out the research, a laboratory or works with proper equipment for the experiments, and funds to defray the expenses.

Prof. Hopkinson did well in the discussion at Cambridge to direct attention to the individuality of research. Much—everything—depends on the man, and he must have freedom. The committee may specify the objects of the inquiry, and indicate in general terms the methods to be followed, but no real result will ensue unless the investigator has ideas of his own, and, after the suggestions laid before the committee are approved, is free to carry them out.

The gaseous explosions committee owes its success to Dugald Clerk and Hopkinson; the alloys research committee to Roberts-Austin, Carpenter, and Rosenhain; while the work of the Advisory Committee for Aëronautics would lose nearly all its value were it not for the energy and devotion of the staff of the National Physical Laboratory.

Engineering research—technical research, indeed, of all kinds—differs, however, from much scientific research in that it can be organised. The problems proposed are usually fairly definite. What are the properties of a certain series of alloys? How are they modified by temperature, forging, annealing, and the like? Do the results of impact tests depend on the form and dimension of the specimen? What is the exact series of changes of temperature and pressure in the cylinder of a gas-engine? How are the forces and couples on an aëroplane related to its aspect to the wind? The problems may be difficult, the answers may elude inquiry; but, given the man, the laboratory, and the funds, a committee meeting at intervals to discuss the results of the experiments may reasonably hope in time to meet with success.

Sir Frederick Donaldson and his colleagues have raised questions of great interest and importance, well worth the careful consideration of those engaged in bringing the results of scientific inquiry to bear on the problems of manufacture and construction.

HIGHER EDUCATION AND THE STATE.

LORD HALDANE had something important to say upon the subject of provision for higher education in the course of his speech at the opening of the new buildings of the department of applied science of the University of Sheffield on Saturday last. An account of his address will be found elsewhere in this issue, but we are more particularly interested in a summary of the main points, communicated by him to representatives of the Press. Lord Haldane explained that he desired it to be realised fully that he was announcing the considered decisions of the Cabinet upon the subject of university education, and was indicating the policy to be followed. The substance of his remarks was expressed as follows:—

The main features of the Board of Education's scheme are a recognition of the great strides being made in university education by the United States and Germany, and an intention to maintain closely the connection between pure science and applied science and to check any tendency on the part of any of the younger universities to cultivate the latter at the expense of the former. Theory and practice must keep together. Men of business must remember that much of what is distinctive in the inventive and industrial genius of this country comes from theoretical sources.

Unless we wake up fully about this matter of education, and particularly higher education, I am a little nervous as to what the state of things with regard to our industrial supremacy will be fifteen or twenty years hence.

The nation will have to make up its mind to give considerably more out of central funds. The plans for these advances are now fashioned. I hate any idea of increasing expenditure, whether out of local or national sources, if it can be avoided. But this cannot be avoided. It is salvage money, and unless you spend it you will go back as a nation, and your revenues by which you keep up your fleets and your armies will begin to shrink, because you will not be holding your own in that great industrial position from which your power and your wealth have come.

We have now, therefore, a definite statement of the position which university work is to take in the national scheme of education adumbrated by various Ministers since the beginning of this year. There is a clear acknowledgment of the fact that in the matter of State provision for higher education we have not kept pace with other progressive nations; that scientific work which has no industrial interest is as important as that of which the direct application can be seen; that national advancement can be secured best by increase of scientific knowledge; and that all these things involve contributions from the national exchequer greatly in excess of those hitherto given.

Readers of NATURE scarcely need reminding that the policy thus broadly outlined has been urged consistently and persistently in these columns. Ten years ago, Sir Norman Lockyer, in his presidential address to the British Association at Southport, gave the evidence from which each one of the points mentioned by Lord Haldane could be justified; and since then, year by year, particulars have been given in the reports of the British Science Guild of the progress being made in the endowment of higher education and research abroad, in comparison with the position in this country. It was shown, for instance, in the last report of the Guild, that the total receipts of universities in the United States in the year 1910–1911 amounted to nearly nineteen million pounds, and the benefactions to four and a half millions. In the same year, the total receipts of those universities and university colleges in Great Britain in receipt of grants from the Board of Education was little more than 600,000*l.*, of which amount the total State grant was roughly one half. The State grants to universities in Prussia alone are more than twice as much as are contributed to our universities from the national exchequer.

Lord Haldane may therefore safely say that the United States and Germany have made far greater strides in university education than have been undertaken in this country. When he wrote the introduction to Sir Norman Lockyer's collection of addresses on education and national progress (1906), he suggested that the private donor should be encouraged, but that the motto of the Chancellor of the Exchequer as regards expenditure upon matters connected with higher education and research should be *Festina lente.* "I do not mean," he wrote, "that the Government ought not to spend public money generously upon the universities. I mean that it should not be spent unless and until a case for the necessity of such expenditure has been clearly made out."

We may be permitted to conclude from the address at Sheffield that Lord Haldane is now of the opinion that a case has been made out for increased national provision for our educational forces. He knows as well as anyone that the great advances being made in education in other countries constitute a formidable menace to ourselves, and that the State can wait no longer for like developments if it desires to maintain a leading position among progressive peoples. He has now stated authoritatively that the Cabinet realises our weakness, and accepts the only policy which will remedy it. We have read this pronouncement with lively satisfaction, and shall welcome any measure which will put the policy into effect.

DR. LUCAS-CHAMPIONNIERE.

THE sudden death of Dr. Just Lucas-Championnière has brought regret to many surgeons in this country, who knew the excellence of his character and of his work. He was seventy years old, surgeon to the Hôtel Dieu (the great hospital in Paris, founded by Saint Louis)—Commander of the Legion of Honour, and member of the French Academy. His father was the first editor of one of the chief medical journals of France; his grandfather had been a leader in the heroic war of La Vendée. From the Collége Rollin, Lucas-Championnière went to the Hôtel Dieu as a student, and was *interne* there in 1865. He became one of the most eminent of all French surgeons of his time, and received honours from many countries, including the Fellowship of the Royal Colleges of Surgeons of London and of Edinburgh. He was a great "all-round" surgeon; but he gave especial study to the operative treatment of hernia, and to the management of fractures. His best recreation—so far as he had time for it—he found in music.

To us over here—some of us may remember his genial presence in London during the 1881 International Medical Congress—he stands for the introduction into France of Lister's antiseptic method. He in France, and Saxtorph in Denmark, were the teachers of the new learning. He came to Glasgow in 1868, and Edinburgh in 1875, that he might learn for himself, watching Lister himself, every detail of the method. He so worshipped the work of Lister that, in the later years of his life, he resented the changes of method, the preference for things "aseptic" over things "antiseptic"; he hoped that surgery would return to "Lister's own method." There are few surgical books more pleasant to handle than his "Pratique de la Chirurgie Antiseptique"—with its portrait of Lister for a frontispiece, and the loyalty and devotion of the writing. It is pitiful to think how slow was the spread of the new learning; what misery was added, for want of the antiseptic method, to the misery of the Franco-German War; what unbelief, and worse than unbelief, delayed the universal recognition of Lister even in our own country.

NOTES.

A ROYAL Commission has been appointed to inquire into the subject of venereal diseases in the United Kingdom. The terms of reference are:—To inquire into the prevalence of venereal diseases in the United Kingdom, their effects upon the health of the community, and the means by which those effects can be alleviated or prevented, it being understood that no return to the policy or provisions of the Contagious Diseases Acts of 1864, 1866, 1869 is to be regarded as falling within the scope of the inquiry. The members of the Commission are:—Lord Sydenham of Combe, G.C.S.I., F.R.S. (chairman), the Right Hon. Sir David Brynmor Jones, K.C., M.P., Mr. Philip Snowden, Sir Kenelm E. Digby, G.C.B., K.C., Sir Almeric FitzRoy, K.C.B., Sir Malcolm Morris, K.C.V.O., Sir John Collie, Dr. A. Newsholme, Canon J. W. Horsley, the Rev. J. Scott Lidgett, Dr. F. W. Mott, Mr. J. E. Lane, Mrs. Scharlieb, Mrs. Creighton, and Mrs. Burgwin. The secretary to the Commission is Mr. E. R. Forber, of the Local Government Board, to whom any communications on the subject may be addressed.

BY Order in Council dated October 14 new denominations of standards of the metric carat of 200 milligrams and its multiples and submultiples have been legalised for use in trade in the United Kingdom on and after April 1, 1914. The permissible abbreviation of the denomination "metric carat" is "C.M." The weights legalised range from 500 C.M. to 0·005 C.M., the series being 5, 2, 1 throughout. The legalisation of the metric carat has been undertaken by the Board of Trade after consulting representatives of the trade in diamonds and precious stones, and is the outcome of a resolution passed at the General Conference on Weights and Measures, held in Paris in 1907, advocating the adoption of an international standard carat. Diamond dealers in this country were at first opposed to any change, and it is only quite recently that they have found it necessary to reconsider their views on the subject, owing to the progress made on the Continent in enforcing the adoption of the metric carat. The new standards are intended to displace the old English carat weight, which has never had legal sanction, but has long been in use in this country, and is recognised by the trade as defined by the relation $151\frac{1}{2}$ carats = 1 oz. troy, so that it is equivalent to 3·168$\dot{3}$ grains, or to 205·3 milligrams nearly.

BY the death of Mr. William Hunting, on October 24, the veterinary profession has lost one of its most brilliant members, and the public in general one of its most strenuous workers in the cause of public health, especially in relation to the prevention of diseases transmissible from animals to man. Mr. William Hunting was born in 1844, receiving his early education at the Edinburgh Academy, and his professional training at the New Veterinary College, Edinburgh. He obtained his diploma of membership of the Royal College of Veterinary Surgeons in 1865, and became a fellow in 1877. His former teacher, Prof. Gamgee, established a veterinary college in London, and selected him to teach anatomy and physiology, and after a while Mr. Hunting was appointed professor of veterinary science at the Royal Agricultural College, Cirencester. He did not retain this chair for long, and eventually he settled in general practice in London, where he was brought into daily contact with glanders in horses, a disease with which his name will always be associated. He was later elected to the council of the Royal College of Veterinary Surgeons, and became its president, the highest honour his profession could bestow on him, in 1894–5. Mr. Hunting was acknowledged to be the greatest authority on clinical glanders, and it was mainly owing to his efforts that the London County Council instituted its campaign against this disease which was so easily communicable to man, and almost invariably fatal. For this purpose the L.C.C. appointed him as its chief inspector, from which post he retired under the age limit. He lived, however, to see the disease got well under control with every prospect of its being completely eradicated in a comparatively few years. He published an illustrated monograph on glanders in the horse and in man, the best work in existence on the disease, and he has also contributed the chapter on this affection in Hoare's "System of Veterinary Medicine." He had only recently been invited to provide a paper on the same subject for the International Veterinary Congress, which will meet in London in 1914. He founded and edited *The Veterinary Record*, and published a standard work on horse-shoeing, and was also a prolific writer to the veterinary Press. Amongst the many offices he held at the time of his death, Mr. Hunting was president of the National Veterinary Association, examiner for the membership and fellowship of the Royal College of Veterinary Surgeons, examiner for the membership of the Royal Agricultural College, and for the meat inspector's certificate of the Royal Sanitary Institute. He was also a member of the board of studies in veterinary science in the University of London, and a governor of the Royal Veterinary College.

DR. F. H. HATCH has been elected president of the Institution of Mining and Metallurgy for the forthcoming year.

MR. STEPHEN REYNOLDS, a member of the Departmental Committee inquiring into the condition of the inshore fisheries, has been appointed adviser on these fisheries to the Development Commission.

DR. H. R. MILL, director of the British Rainfall Organisation, has been compelled to take a complete rest for a time on account of his eyes, which have been affected by the continual strain of his work. He will leave next month for a voyage to New Zealand, and is advised not to attempt to take up for at least a year any work which involves close attention. It is hoped that the rest and change will have a decidedly beneficial effect upon Dr. Mill's eyesight and general health.

THE young Malay elephant at the Zoological Gardens, which had been ailing for some time, died in the latter part of last week. The skin has been consigned to Messrs. Rowland Ward, Ltd., by whom it will be mounted for the Natural History Museum. At the time of its death the animal, although about three years old, still retained the hairy coat of new-born Asiatic elephant calves.

IN *The Field* of October 25 Mr. R. I. Pocock records the acquisition by the Zoological Society of the second known example of the South American short-eared dog, or fox (*Canis sclateri*). The first specimen was acquired by the society in 1882, and described by Dr. Sclater under the preoccupied name of *C. microtis*. In neither case is the precise habitat known, but Mr. Pocock, who also refers to the peculiarity of the association of short ears with small bodily size, considers that the species is probably a forest animal.

AN exhibition of "Nature Photographs," organised by the Nature Photographic Society, is now being held at the house of the Royal Photographic Society, 35 Russell Square. It consists of 132 photographs of birds, animals, flowers, fungi, insects, &c., generally of a high order of merit, and many of them by workers who have earned a considerable reputation for work of this kind. Admission to the exhibition is by presentation of visiting card, between 11 and 5, until November 15. The photographs shown are just of the kind that must appeal to those interested in nature-study.

THE annual dinner of the London School of Tropical Medicine was held at Prince's Restaurant on October 24, Dr. F. M. Sandwith presiding, and among those present were Lord Milner, Mr. Percival Nairne, Sir Charles Lukis, Sir J. West Ridgeway, Sir John Anderson, Surgeon-General May, Sir Patrick Manson, and many others. Mr. Austin Chamberlain, proposing the toast of the school, referred to the progress which tropical medicine has made during the last twenty-five years, and said that it is a matter of national pride that in so beneficent a movement our countrymen stand in the forefront in regard to the new learning which is being acquired. The London School has appealed for a sum of 100,000*l.* for endowment, research, and endowment of beds for certain tropical cases, of which about 70,000*l.* has been obtained. A pleasing event of the evening was the presentation to Sir Patrick Manson, the *doyen* of tropical research, of two portraits of himself on behalf of the subscribers, by Mr. Cantlie and Dr. Prout, representing the London and Liverpool Schools respectively.

A VIOLENT wind-storm passed over part of Wales on Monday night, October 27, causing damage roughly estimated at between 30,000*l.* and 50,000*l.*, and the loss of two lives, as well as injuries to many people. Two men named Woolford and Breeze were walking arm-in-arm when they were caught by the wind and blown a distance of thirty yards. Woolford fell on his head and was killed, and Breeze had two ribs fractured. From the position in which the dead body of a man named Harries was found in a field near Abercynon it is believed that the man must have been carried 300 or 400 yards by the force of the gale. Along the whole Taff Valley, from Treforest past Cilfynydd and by Quakers Yard to Treharris wrecked structures and up-rooted trees mark the path of the storm. It was first felt at Treforest, and it seemed to gather force as it entered the valley at Cilfynydd. Along the whole way the storm was confined to a path about 200 yards wide.

AT the annual public meeting of the Five Academies, held last week at Paris, a paper on the subject of prehistoric trepanning was read, by the late Dr. Lucas Championnière; it dealt with instances of the operation, beginning with the first discovery of such a skull by M. Prunières under a dolmen in the Lozère, among the cave men, the ancient Gauls, and the pre-Columbian Americans. These people performed trepanning by means of flints, and the writer had succeeded in piercing the skull of an adult in the dissecting-room in thirty-five minutes by means of a flint, which was not specially sharpened. He attributed the skill of these early surgeons to the now lost art of rotating instruments in fire-making. The operation was performed in the case of serious skull wounds, and also to relieve headache and epilepsy, by releasing the spirit to which the attacks were attributed. He himself had seen a native at Biskra, in Algeria, whose head showed four perforations, and he and his brothers asserted that they had trepanned their own father twelve times. It is remarkable that the operation was not practised among highly civilised races, like Greeks, Egyptians, Arabs, Hindus, and Chinese, or among some peoples of low culture, like African negroes.

AT the annual general meeting of the Royal Society of Edinburgh, held on October 27, the following office-bearers and councillors were elected:—*President:* Prof. James Geikie, F.R.S. *Vice-Presidents:* Dr. J. Burgess, Prof. T. Hudson Beare, Prof. F. O. Bower, F.R.S., Sir Thomas R. Fraser, F.R.S., Dr. B. N. Peach, F.R.S., and Sir E. A. Schäfer, F.R.S. *General Secretary:* Dr. C. G. Knott. *Secretaries to Ordinary Meetings:* Dr. R. Kidston, F.R.S., and Prof. A. Robinson. *Treasurer:* Mr. J. Currie. *Curator of Library and Museum:* Dr. J. S. Black. *Councillors:* Prof. T. H. Bryce, Mr. W. A. Carter, Mr. A. Watt, Dr. J. H. Ashworth, Dr. J. G. Gray, Prof. R. A. Sampson, F.R.S., Prof. D'Arcy W. Thompson, C.B., Prof. E. T. Whittaker, F.R.S., Principal A. P. Laurie, Prof. J. Graham Kerr, F.R.S., Dr. L. Dobbin, Mr. E. M. Wedderburn. It is worthy of note that the presidents of the Royal Societies of London and of Edinburgh are brothers, natives of Edinburgh, and both geologists.

AT the annual general meeting of the Cambridge Philosophical Society, held on October 27, the following officers and council were elected:—*President:* The Master of Christ's. *Vice-Presidents:* Prof. Pope, Dr. Barnes, and Prof. Seward. *Treasurer:* Prof. Hobson. *Secretaries:* Mr. A. Wood, Mr. F. A. Potts, and Mr. G. H. Hardy. *Other Members of Council:* Sir J. J. Thomson, Mr. J. E. Purvis, Mr. R. P. Gregory, Dr. Cobbett, Mr. J. Mercer, Dr. Marshall, Mr. G. R. Mines, Mr. F. J. M. Stratton, Prof. Woodhead, Mr. C. Forster Cooper, Mr. C. E. Inglis, and Dr. Duckworth.

AT the annual meeting of the Prehistoric Society of East Anglia, the honorary secretary made an announcement, which will be welcome to archæologists, that the society proposes to undertake a survey of Grime's Graves, at Weeting. A few of these constructions were superficially studied in 1852, and one was carefully examined by Canon Greenwell in 1870. But much still remains to be done, and the importance of flint implements of the Cissbury type found in the caves has been greatly increased by the suggestion of Mr. Reginald Smith that they are analogous to those of the Aurignacian age found on the Continent. Contributions are invited for the prosecution of this undertaking by Mr. W. G. Clarke, 12 St. Philip's Road, Norwich. The president, Mr. J. Reid Moir, discussed the fractured flints found in the Eocene "Bullhead" bed at Coe's Pit, Bramford, near Ipswich, with special reference to the views of M. Breuil, who is inclined to regard the fractures as the result of natural pressure. The Ipswich bed is now overlaid by some 40 ft. of deposits, partly sand, and it is difficult to imagine how pressure on the lower strata could have been exercised through such a medium. Mr. Reid Moir concludes, from experiments, that pressure may account for the fractures. If this be the case, it must have been exercised before the deposition of the present overlying strata. In later beds the "human touch" is sufficiently obvious, and it is thus possible to differentiate one type from the other with some confidence.

The Eugenics Review for October (v., No. 3) contains matter of much interest for the citizen. The Chancellor of Stanford University, U.S.A., writes on the eugenics of war, pointing out that it is the best part of the population that becomes the military, and that a country, therefore, by the ravages of war, suffers not only at the time but for generations afterwards. "Wars are not paid for in war-time; the bill comes later," as Benjamin Franklin said. Mr. Sören Hansen marshals evidence on the inferior quality of the first-born children, and a State not only loses citizens by the limitation of families, but is also penalised thereby by a deterioration in racial quality.

THE monograph published by Prof. P. N. Ure, and issued by the Oxford University Press, on black glaze pottery from Rhitsona in Bœotia (pp. 63+xix plates, price 7*s*. 6*d*. net) is a useful contribution to our knowledge of Greek ceramics. Our information on the history of the Bœotian federation from literary sources is confined to Thebes; that of the minor members must be discovered by the spade. If this pottery could be accurately dated it would supply much useful evidence. The present monograph has established the leading facts, which must be supplemented by further excavation and examination of the material.

THE Danysz rat virus, consisting of a cultivation of a microbe which produces a fatal infectious disease among rats, has been used with considerable success for the extermination of rats in many districts. The accompanying illustration shows the preparation of

Saturating crushed oats with Danysz virus at Kaltern, Austrian Tyrol.

the "bait," made by impregnating crushed oats with the virus, for use in Kaltern, a village in the Austrian Tyrol, which had suffered severely from an invasion of field rats.

THE age of the earth has long been a favourite topic for discussion, and conclusions have been arrived at from time to time remarkable mainly for their variety. This variety is likely to characterise for a long time to come other conclusions that may follow, for the simple reason that at present we lack the data for dealing with the subject in a comprehensive way. Estimates of geologic time, founded upon one set of facts and assumptions, are found to be difficult to square with those based upon other and equally trustworthy sets. Mr. H. S. Shelton considers some methods of attacking the problem in the October number of *Science Progress*. He points out the absence of sufficiently good data for the average rate of erosion of rocks, and suggests that further information could be obtained if we possessed fuller details concerning the extent of particular local formations. Of the geochemical methods he thinks the best is probably that based on calculations concerning the amount of limestone in the rocks of the earth; and from Mellard Reade's deductions he believes it is "possible to assess a probable minimum of the order of 500,000,000 of years." Respecting the estimates of Strutt, based on the study of helium and radioactive minerals, he says: "The most we can now infer is a moderate minimum of time, a result that is given equally well by other data if properly handled." Concerning biological evidence, he says: "The biologist has no independent standard of time. Vague as are the data of the geologist, those of the biologist are still more uncertain." Finally: "What we are entitled to say on the evidence before us—biological, geological, and physical—is this: It would be absurd to attempt, on very insufficient data, to give an estimate of the probable lapse of geologic time. But there is, at the present day, no reason whatever why it should not be a thousand million of years or a time even greater." This does not carry us very far, and Mr. Shelton's suggestions for further study of the problem are somewhat trite.

THE October number of *The Entomologists' Monthly Magazine* contains a memoir and portrait of the late Dr. O. M. Reuter, the celebrated hemipterist, who died on September 2, in his native town of Abo, at the age of sixty-three.

THE report of the Entomological Society of Ontario for 1912 mainly deals with the infestations of injurious insects in the Dominion and the best means of keeping them in check. Great aid in this work has been afforded by the establishment of field laboratories in various districts, which have enabled investigations to be carried on over much wider areas than was previously possible. Another feature of the year's work has been an increased importation of parasitic enemies of some of the most noxious insects, notably the introduction of cocoons of the larch-sawfly infected with an ichneumon-fly from the English Lake District.

THE beautiful colours of thin films observable with Mr. C. V. Boys's scientific toy, "The Rainbow Cup," were referred to in a Note in our issue of January 23 of this year (vol. xc., p. 579). A cheap form of the instrument is now available from Messrs. J. J. Griffin and Sons, Ltd., the price being 2*s*. 6*d*. only instead of 25*s*. Though the new form is, of course, not so good as the more expensive instrument, it shows the changing colour patterns in a very pleasing way, and should interest a large section of the general public. An explanatory pamphlet is included in the box containing the instrument and the soap solution.

THE Royal Meteorological Institute of the Netherlands has issued a useful paper on the rainfall of that country (*Mededeelingen en Verhandelingen*, 15), with maps and tables showing the annual and seasonal distribution. The work is a continuation prepared by Dr. Hartman of one published by Engelenburg in 1891, since which time the number of stations has greatly increased, and is the first instalment of a general climatology of the Netherlands. In addition to the annual means for the whole period, which differs for each station, all the means for the twenty-five years, 1881–1905, have been calculated, as this period has been adopted as a normal time for comparison by the Solar Commission of the International Meteorological Committee. The extreme annual values for this series vary from 828 mm. (32·6 in.)

at Leeghwater (South Holland) to 596 mm. (23·5 in.) at Kampen (E. Zuider Zee). The rainfall diminishes considerably near the coasts; at some distance from these it increases, and afterwards the diminution becomes progressive and general with distance from the sea. The maximum values occur in July, August, and October; the minimum values occur generally in February and April. In July the increased rainfall is due chiefly to thunderstorms.

THE present autumn has many meteorological features of especial interest. Only one-third of the autumn now remains, and although there is ample time for a thorough change to set in, there are at present no indications of generally colder conditions. The weekly reports issued by the Meteorological Office show an excess of temperature since the close of summer at the end of August, in all parts of the British Isles, and over England and Ireland the excess amounts to 3° for the period embraced by September and October. The absence of low temperatures is very pronounced, and at Greenwich the lowest shade temperature for October is 36°, while to October 28 there were nine nights with the thermometer above 50°. In October last year sharp frost was experienced on October 5 and 6, but it is not altogether uncommon to escape frost throughout the month, and in 1910 the lowest temperature at Greenwich for October was 39·6°. On twenty-one days out of the first twenty-eight days in October this year the shade temperature at Greenwich had exceeded 60°, and even towards the close of the month such high temperatures were fairly common. The autumn rains have so far been in excess of the average over the midland and eastern districts of England, but there is generally a deficiency in the western districts.

IN his remarks on Dr. Bohr's letter on the spectra of helium and hydrogen, in NATURE of October 23, p. 232, Prof. Fowler referred to certain corrections required in the wave-lengths calculated for the lines near Hβ, Hγ, &c., as given in the original submitted to him. Dr. Bohr, however, corrected these wave-lengths in the proof, thus rendering Prof. Fowler's corrections unnecessary. We are asked to mention this in order to remove any ambiguity to which the reference to corrected wave-lengths may have given rise.

THE September number of *Terrestrial Magnetism and Atmospheric Electricity* devotes twenty pages to an account of the magnetic work of the Astronomer Royal, Edmund Halley. In 1698 he was placed in command of the *Paramour Pink* in order "to improve the knowledge of the longitude and the variations of the compasse." He spent two years taking observations in the Atlantic between latitudes 50° N. and 52° S., and published his results in a "General Chart of the Variations of the Compass" in 1701. The journal in which he entered all his observations is reprinted under the editorship of Messrs. Ault and Wallis, of the department of terrestrial magnetism, and Dr. Bauer has collected together the references to Halley's magnetic work in the journals of the Royal Society, and gives reprints of the letterpress which accompanied the sea charts of the western and southern oceans, and of the whole world.

SOME interesting results are recorded by Messrs. F. A. Sannino and A. Tosatti in the *Atti R. Accad. Lincei* (vol. xxii., ii., No. 5) of the effect of manuring grape vines with manganese sulphate. The result of the application is considerably to increase the yield of grapes per hectare, but the must obtained in the vintage is poorer in glucose, and higher in acidity than with the control, carried out on the same land, but without the addition of manganese. The wine obtained after fermentation shows a quite characteristic odour and flavour, and tends to resemble Marsala or Madeira. At the same time a tendency to develop turbidity is shown which is also found in wines when too rich in oxydases. The proportion of manganese present in the ash of the wine is at the same time markedly increased.

COMMENTING on the loss of the German naval airship *Zeppelin L2*, *The Engineer* for October 24 does not consider that present constructive methods will ever render available the tactical superiority of airships. No dirigible balloon has yet been constructed which has fulfilled its function otherwise than by dodging the forces of nature. It is held that both commercially and constructionally, the dirigible balloon of to-day appears to be an absurdity. Further, there is little reason to hope that conditions will change, and that new materials and methods of construction will be made available.

THE "James Forrest" lecture for 1913 was delivered by Mr. Alexander Gracie, in the new buildings of the Institution of Civil Engineers on October 23, the subject being twenty years' progress in marine construction. Increase in size of vessel is undoubtedly the most valuable resource of the naval architect, as it leads directly towards the attainment of greater comfort, speed, and economy. Twenty years ago, the premier Atlantic vessel was the *Campania,* 600 ft. in length, 65 ft. in beam, and 41 ft. 6 in. in depth. To-day the largest vessel afloat is the *Imperator,* 880 ft. by 90 ft. by 63 ft. The Cunard liners *Lusitania* and *Mauretania* have been surpassed in size, but still hold their supremacy in speed unchallenged; these vessels maintain an ocean speed of between 25 and 26 knots. The advance has been greatly facilitated by the introduction and development of the steam turbine, which has provided the way to further progress in economy, lightness, and the construction of very large units, while at the same time eliminating vibration troubles and relieving the difficulties of engine-room management. Twenty years ago, the majority of cross-Channel vessels were paddle-steamers. Typical vessels were the paddle-steamer *Calais Douvres* and the twin-screw *Ibex.* The former vessel had a displacement of 1065 gross tons, and engines of 6000 indicated horse-power gave a speed of 20·64 knots. The corresponding dimensions of the latter vessel were 1062 gross tons, 4200 indicated horse-power, and 19·37 knots. The introduction in 1911 of geared-turbines in the *Normannia* and *Hantonia* has led to a great economy in fuel, these vessels using but 43 tons of coal per trip, as compared with 70 tons used by their immediate predecessors of the same capacity, but propelled by direct-driven three-screw turbines. Last summer, the Channel steamer *Paris*, fitted with geared turbines, attained the remarkable speed of 25·07 knots—a result which has only been surpassed by torpedo craft. Hydraulic transmission has lately been developed in Germany, and electrical transmission has also been applied to several vessels. Cargo steamers have advanced from 6400 to 9600 tons dead-weight, at practically constant speed of 11 knots. There are many attractive possibilities in the problem of producing a trustworthy internal-combustion engine able to compete successfully with the steam-engine and geared turbine.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR NOVEMBER:—

Nov. 1. 16h. 0m. Mercury at greatest elongation east of the Sun.
2. 21h. 18m. Jupiter in conjunction with the Moon (Jupiter 4° 35′ N.).
4. 11h. 32m. Uranus in conjunction with the Moon (Uranus 3° 26′ N.).
5. 8h. 0m. Venus at greatest heliocentric latitude N.
12. 13h. 0m. Mercury stationary.
15. 12h. 25m. Saturn in conjunction with the Moon (Saturn 6° 49′ S.).
18. 7h. 6m. Mars in conjunction with the Moon (Mars 2° 23′ S.).
,, 13h. 21m. Neptune in conjunction with the Moon (Neptune 4° 40′ S.).
22. 18h. 0m. Mercury in inferior conjunction with the Sun.
26. 7h. 33m. Venus in conjunction with the Moon (Venus 5° 41′ N.).
,, 23h. 32m. Mercury in conjunction with the Moon (Mercury 6° 43′ N.).
27. 0h. 0m. Mars stationary.
30. 16h. 5m. Jupiter in conjunction with the Moon (Jupiter 4° 12′ N.).

A NEW COMET.—A Kiel telegram, dated October 24, distributes the information communicated by Prof. Hartwig that on October 23 Dr. Zinner discovered a comet of the 10th magnitude at 7h. 58·8m. M.T. Bamberg. Its position is given as R.A. 18h. 40m. 1s., and declination −4° 32′ 38″, and the object was observed to have a tail. The comet is thus situated in the constellation of Aquila, a little less than half-way between λ Aquilæ and η Serpentis.

COMET METCALF 1913*b*.—The following is the ephemeris for Metcalf's comet as calculated by Herr A. Kobold, and published in *Astronomische Nachrichten*, No. 4686:—

12h. M.T. Berlin.

	R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
Oct. 30	20 46 53	+4 25·8	
31	46 31	3 13·9	
Nov. 1	46 13	2 6·1	
2	45 58	1 2·0	9·7
3	45 47	+0 1·5	
4	45 39	−0 55·9	
5	45 33	1 50·1	
6	45 31	2 41·4	9·9

This faint comet is now just moving into the constellation of Aquarius, and is only a suitable object for telescopes of large aperture.

COMET WESTPHAL (1913*d*).—Comet Westphal is becoming a faint object, being now a little fainter than 8·5 magnitude. The following is a portion of the ephemeris published by Hermann Kobold in *Astronomische Nachrichten*, No. 4687:—

12h. M.T. Berlin.

	R.A. (true) h. m. s	Dec. (true) ° ′	Mag.
Oct. 30	20 40 35	+23 16·8	
31	39 38	23 53·8	
Nov. 1	38 46	24 30·4	8·6
2	37 56	25 6·5	
3	37 11	25 42·3	
4	36 30	26 17·7	
5	35 51	26 52·8	8·6
6	35 17	27 27·5	

The comet is moving in the constellation of Vulpecula, and is in a good position for observation.

ELEMENTS AND NUMBERS OF MINOR PLANETS.—The growth in the number of the minor planets discovered is clearly brought out in the two interesting communications by Dr. Cohn in *Astronomische Nachrichten*, No. 4688. In the first paper he refers to the elements and numbering of these bodies, and points out that in the interval, July 1, 1912, to June 30, 1913, sixty-seven objects have been given provisionary numbers. Five of these have been identified as old members of the group. Of the sixty-two remaining, nineteen hail from Heidelberg, seven from Johannesburg, nine from Neuchâtel, eleven from Simeïs, three from Vienna, and thirteen from Winchester. Of this number twenty-one have had their elliptical orbits checked and numbers assigned to them.

In the second communication Dr. Cohn points out the unsatisfactory state, and possibility of mistakes, in the present system of lettering the planets, owing to their great number, and suggests, with the help of other astronomers, a set of names for the planets from No. 570 to 727. As an example, it may be stated that 697 has been named "Galileo," as it was discovered on the day of the three hundredth anniversary of the discovery of Jupiter's satellites. 727 is termed "Nipponia," as the planet was discovered twice by Herr Hirayama in Tokio.

THEORETICAL ASTRONOMICAL RESEARCH.—A circular regarding a plan for an institute for theoretical astronomical research has reached us from Lund, Sweden. It is a timely plea for financial support for a neglected part of astronomy. The work suggested as specially suitable to be undertaken by the institute is in the first place the investigations of the orbits of the asteroids, work which it is confidently anticipated will lead to the solution of "the problem of three bodies," and perhaps also solve the enigma of the evolution of the heavenly bodies. This work would be undertaken by three of a proposed staff of eight "theoretical astronomers." Two more would work at the problem of three bodies; to another couple would be assigned various cosmological problems, such as the figure of the heavenly bodies, tides, and related problems. The remaining astronomer would be required to deal with stellar statistics. These men would be of the standing of university professors, and have rather better pay. Each astronomer would have one algebraical computer and two numerical computers at his personal disposal, and should the necessity arise additional computers would be available. The project is conceived in a princely manner, the proposed yearly budget being 200,000 marks (German) (10,000*l.*), and the complete scheme requires a capital sum of 5,600,000 marks (280,000*l.*). Calculating machines, worked by lady computers, would be employed for the numerical calculations, and no fewer than 100,000 marks (5000*l.*) is proposed to be spent on machines.

COMMITTEES ON RADIO-TELEGRAPHIC INVESTIGATIONS.

Organisation of an International Commission.

A MEETING was held in Brussels at the commencement of last month at which the question of organising an international commission to carry out wireless experiments was further discussed. At the International Time Conference in Paris last October a series of resolutions was passed with reference to the formation of an international organisation for the scientific study of Hertzian waves and their relationship to the medium through which they travel. At this conference Mr. Goldschmidt, of Brussels, placed his high-power station at Brussels and the sum of 1000*l*. for preliminary studies at the disposal of the proposed international commission.

Arising out of these resolutions the representatives of the different countries who were present at Brussels last month drafted a provisional constitution for the international commission and a scheme for its work.

The objects of the commission are:—(1) To carry out experiments on the propagation of electric waves. (2) To make wireless telegraph measurements and the study of the problems related therto.

The provisional programme of the work of the commission will consist in making measurements in different countries and at different distances and in different directions of the strength of signals sent out from the station at Brussels. These measurements will be repeated from day to day or hour to hour as necessary in order to determine the variation of the strength of the signals both with time, with distance, and with direction, and later the effect of wave-length and decrement will be studied.

It is proposed to set up a receiving station near the transmitting station in Brussels in order accurately to control the strength of the waves sent out so that an allowance can be made for any unavoidable variation in reducing the final results.

The organisation consists of a number of national committees, one in each of the countries taking part. The national committees will send delegates to the international commission, and these delegates, together with the officers, will constitute the international commission. It is proposed that the international commission should meet once a year, or more often if the work is sufficiently advanced.

The Institution of Electrical Engineers has decided to undertake the formation of the national committee for Great Britain, under the scheme for the organisation and encouragement of electrical research which was announced at the institution meeting on December 12, 1912.

The British Association Committee.

The British Association Committee has now inaugurated an extensive scheme for the making of observations of natural electric waves by means of wireless telegraph receiving apparatus, and is addressing to wireless telegraph experimenters an invitation to cooperate in the making of observations. The records will be collected by the committee and compared and reduced by it.

These natural electric wave trains produce troublesome noises in the telephone receivers of wireless telegraph stations. Some proportion of them are due to lightning strokes within a few hundred miles of the receiving station; but even when there is no thunder weather recorded over the whole continent of Europe and the adjacent seas, they are received continuously by an antenna adjusted to a great wave-length. It has been suggested that some of these wave trains may be due to extraterrestrial causes, and it does not seen unreasonable to suppose that electrical discharges may occur in the sun and may be the source of a proportion of the natural electric wave trains we receive. There is little likelihood of our gaining a knowledge of the causes at work until organised observations are carried out simultaneously at numerous points of the globe and collated at a single centre, such as the committee now affords.

Another and distinct inquiry which urgently needs pursuing is the action of the earth's atmosphere in causing variations of the electric waves used in transmitting messages over long distances. The laws of these variations, especially in respect of their connection with weather conditions, with position on the earth's surface, and with the time of day would, if unravelled, probably throw light on the electrical conditions of the highest parts of our atmosphere. The committee has undertaken this inquiry also.

In carrying on the work the committee looks very largely to private experimenters for the collection of data. But it has been a matter of extreme gratification to find that the Imperial Navy and the British Post Office were willing to help. The Marconi Company also has, with commendable public spirit, promised to give its powerful assistance to the committee. Thus the committee can already make sure that data will be collected on its behalf in all parts of the world. Meanwhile private experimenters who are willing to assist the committee by making observations should communicate with the secretary, Dr. W. Eccles, University College, Gower Street, London, England.

APPLIED SCIENCE IN THE UNIVERSITY OF SHEFFIELD.

ON October 25 the completed buildings of the applied science department of Sheffield University were opened by Lord Haldane. These buildings have the largest frontage in Sheffield, being 350 ft. long, the architecture being of the Hampton Court Palace type. The cost of the additions has been approximately 45,000*l*. The central administrative block contains a very fine assembly-room, called the "Mappin Hall," after the late Sir Frederick Thorpe Mappin, first chairman of the applied science committee of Sheffield University, and a handsome departmental library which will house books having reference to applied science and pure science data more immediately bearing upon this subject. There are staff common-rooms, and the metallurgical record office included in this central block, and the department of pure geology is also housed here.

The south-east wing, a considerable portion of the cost of which was defrayed by the Drapers' Company of London, contains four floors; the two lower floors are devoted to non-ferrous metallurgy, the third floor to mining, and the fourth floor to applied chemistry which has particular reference to mining. The new non-ferrous department, which has been organised so as not in any way to overlap the metallurgy of the Royal School of Mines, has been designed to develop scientifically the silver industries of Sheffield. The course here is divided into two sections: first, the basis metal section, in which are produced on a works' scale ingots of German silver, Britannia metal, brass, and bronze, white metals, and other non-ferrous metals in use in Sheffield manufactures (for working these metals into the finished articles, the department has secured the friendly cooperation of silver manufacturers in Sheffield); secondly, the electroplating department, in which all classes of plating operations are carried on on a manufacturing scale. Each student's bench is fitted with a specially combined ammeter and voltmeter, so that the student may make his preliminary studies under exactly known conditions. There are two large laboratories for the preparatory and advanced stages of this special study of non-ferrous metals as used in the Sheffield trades. The lecture-rooms are two in number, one seating 150 and the other fifty students, both being provided with up-to-date electric lantern arrangements.

The micrographic laboratory has been made to a specially thought out design, each block of the polishing battery being run by a separate electric motor of one-seventh h.p., revolving at 1400 revolutions per minute. Adjacent to the polishing and etching-room is a photomicrographic department complete with dark-room. The photomicrographic apparatus is by Zeiss, and is fitted with the new arc lamp of this firm. There is a large staff and research laboratory, one side of which is devoted to calorimetric work.

From the point of view of pure science the most important installation in the new metallurgical wing is a specially devised recalescence laboratory for observing with great accuracy the critical points of iron and steel, the freezing points of metals, and the phenomena of solid solution in metals. There are coke-fired and electric vacuum furnaces in which a complete vacuum can be obtained in about one minute by means of the "Fleuss" pump. The recalescence apparatus comprises an astronomical clock by the Synchronome Company, a chronographic recorder reading to a quarter of a second, and a delicate galvanometer reading direct or in connection with a potentiometer. This installation, which has been made to specification by the Cambridge Scientific Instrument Co., has cost about 400*l*., and is the most complete extant.

The melting-shop for non-ferrous metal will register the comparative melting efficiencies of coke, oil, gas, and electricity, each method being capable of making ingots of about 90 lb. weight. The static and dynamic testing of non-ferrous metals will be made in the ferrous department, which is provided with a single-lever Buckton machine on two centres, so that the machine may be arranged to read off the stress either in 3-in. ton moments or 12-in. ton moments. For more delicate work there is a two-ton static machine. The dynamic testing will be carried out on Arnold's standard stress-strain machine, on which it is hoped to obtain important results on the adherence of silverplating of different thicknesses on different basis metals.

In declaring the building open, Lord Haldane insisted most strongly that the industrial success of this country in the future depends upon the cordial cooperation of pure and applied science, which are practically indivisible. He said :—"Without a Kelvin or a Clerk Maxwell, or a Lister, or a man, to go further back, like Sir Isaac Newton, many of the things which we do to-day, and do so well, would not be done, but we have also to remember that unless other men of a similar type are produced in the future we cannot keep up to the level we are now at, but we should be at a disadvantage compared with other countries. You have done a very practical thing in founding this great new department of applied science; you have done the right thing in keeping applied science and pure science in close relation, and bringing both into intimate organic relation with the spirit of the University, that great permeating spirit without which they cannot be on a high level.

"What will be done in the department of applied science will be to go still further than has been possible in the past in bringing the application of science to bear on the problems of industry. It will not be practical work merely; it will be work in the course of which the student will be trained in the highest knowledge. He also will be told that he must not stop short at the conclusions to which science leads him, but must show his capacity to apply the conclusions at which he has arrived to the actual and practical solution of the difficulties which confront the industrial world. In the old days pure science appeared to be something no one was interested in from the point of view of practical education. Now the greatest commercial discoveries depend upon new ideas, new conceptions being developed by men who have genius which makes them devoted to their work, even though they have to starve to do it. It is only in universities and technical schools that we find these men, and if British industry is to hold its own in the future, we shall have to realise the necessity there is, not only to turn to science, but to see that pure science has an opportunity of developing itself and being brought in contact with daily work."

Lord Haldane went on to contrast the rapid strides that are being made in the development of universities in America with what is being done in this country. He has, he said, great faith in the capacity of the British nation, but unless we wake up thoroughly in the matter of education, and particularly higher education, he is a little nervous as to what we may find the state of things concerning our industrial supremacy some fifteen or twenty years hence.

"Nowadays not only Governments, but Government Departments are waking up about these things. For the last twelve months there has been a great deal of activity about the business of national education. Mr. Pease is carrying out what I believe to be a right line of policy. He is trusting the very highly expert officials at the Board of Education and consulting the education committees throughout the country. The local education committees have done splendid work, but the burden on them has been very heavy. The nation will have to make up its mind to give considerably more out of the taxes for this work. The plans are now fashioned. The Government knows exactly what to do to make advance if only it has the nation at its back. I hate any idea of increasing expenditure, whether it is out of local or national resources, if it can be avoided. This expenditure, however, cannot be avoided. Unless we spend it we shall go back as a nation. Our revenues, by which we keep up our fleets and armies, will shrink, because we shall not be holding our own with the industrial nations. What Sheffield has done will have to be done right through the country."

Lord Haldane also referred to the report of the Advisory Committee on University Grants, and mentioned that this Committee, amongst other matters, has practically decided recently to deal with a pension fund for professors (see NATURE, March 6, 1913, p. 21), which, he said, "meant that instead of a man having to cling on to his post as the alternative to starving when he felt himself old, he could retire, and let a young man take his place, and go on with the development still further of the teaching which the professor had carried so far."

THE BRITISH ASSOCIATION AT BIRMINGHAM.

SECTION M.

AGRICULTURE.

OPENING ADDRESS BY PROF. T. B. WOOD, PRESIDENT OF THE SECTION.

I PROPOSE to follow the example of my predecessor of last year, in that the remarks I wish to make to-day have to deal with the history of agriculture. Unlike Mr. Middleton, however, whose survey of the subject went back almost to prehistoric times, I propose to confine myself to the last quarter of a century—a period which covers what I may perhaps be permitted to call the revival of agricultural science.

Twenty-five years ago institutions concerned with the teaching of agriculture or the investigation of agricultural problems were few and far between. I do not propose to waste time in giving an exhaustive list, nor would such a list help me in developing the argument I wish to lay before the section. It will serve my purpose to mention that organised instruction in agriculture and the allied sciences was already at that date being given at the University of Edinburgh and at the Royal Agricultural College, whilst, in addition, one or more old endowments at other universities provided courses of lectures from time to time on subjects related to rural economy. Agricultural research had been in progress for fifty years at the Rothamsted Experimental Station, where the work of Lawes and Gilbert had settled for all time the fundamental principles of crop production. Investigations of a more practical nature had also been commenced by the leading agricultural societies and by more than one private landowner.

In these few sentences I have endeavoured to give a rough, but for my purpose sufficient, outline of the facilities for the study of agricultural science twenty-five years ago, at the time when the county councils were created. Their creation was followed almost immediately by what can only be called a stroke of luck for agriculture. The Chancellor of the Exchequer found himself with a considerable sum of money at his disposal, and this was voted by Parliament to the newly created county councils for the provision of technical instruction in agriculture and other industries.

Farmers were at that time struggling with the bad times following the wet seasons and low prices of the 'seventies and 'eighties, and some of the technical instruction grant was devoted to their assistance by the county councils, who provided technical instruction in agriculture. Thus, for the first time considerable sums provided by the Government were available for the furtherance of agricultural science; and, although at first there was no general plan of working and every county was a law unto itself, the result has been a great increase of facilities for agricultural education and research.

Almost every county has taken some part. The larger and richer counties have founded agricultural institutions of their own. In some cases groups of counties have joined together and federated themselves with established teaching institutions. For my purpose it suffices to state, without going into detail, that in practically every county, in one way or other, attempts have been made to carry out investigations of problems related to agriculture.

Twenty years after the voting of the technical instruction grant to the county councils, Parliament has again subsidised agriculture, in the shape of the Development Fund, by means of which large sums of money have been devoted to what may be broadly called agricultural science. It seems to me that the advent of this second subsidy is an occasion when this section may well pause to take stock of the results which have been achieved by the expenditure of the technical education grant. I do not propose to discuss the results achieved in the way of education, although most of the technical instruction grant has been spent in that direction. It will be more to the point in addressing the Agricultural Section to discuss the results obtained by research.

The subject, then, of my address is the result of the last twenty years of agricultural research, and I propose to discuss both successes and failures, in the hope of arriving at conclusions which may be of use in the future.

Agricultural science embraces a variety of subjects. I propose to consider first the results which have been obtained by the numerous practical field experiments which have been carried out in almost every county. I suppose that the most striking result of these during the last twenty years is the demonstration that in certain cases phosphates are capable of making a very great increase in the crop of hay, and a still greater increase in the feeding value of pastures. This increase is not yielded in all cases, but the subject has been widely investigated, and the advisory staffs of the colleges are in a position to give inquirers trustworthy information as to the probability of success in almost any case which may be submitted to them. This is a satisfactory state of things, and the question naturally arises: How has it come about?

On looking through the figures of the numerous reports which have been published on this subject, it appears at once that in many cases the increase in live-weight of sheep fed on plots manured with a suitable dressing of phosphate has been twice as great as the increase in weight of similar animals fed on plots to which phosphate has not been applied. Now about a difference of this magnitude between two plots there can be no mistake. It has been shown by more than one experimenter that two plots treated similarly in every way are as likely as not to differ in production from their mean by 5 per cent. of their produce, and this may be taken as the probable error of a single plot. Where, as in the case of many of the phosphate experiments, a difference of 100 per cent. is recorded, a difference of twenty times the probable error, the chances amount to a certainty that the difference is not an accidental variation, but a real effect of the different treatment of the two plots. The single-plot method of conducting field trials, which is the one most commonly used, is evidently a satisfactory method of measuring the effects of manures which are capable of producing 100 per cent. increases. It was good enough to demonstrate with certainty the effects of phosphatic manuring on many kinds of grass land, and it is to this fact that we owe one of the most notable achievements of agricultural science in recent years.

Another notable achievement is the discovery that in the case of most of the large-cropping varieties of potatoes the use of seed from certain districts in Scotland or the northern counties of Ireland is profitable. This is another instance of an increase large enough to be measured accurately by the single-plot method. Reports on the subject show that seed brought recently from Scotland or Ireland gives increased yields of from 30 to 50 per cent. over the yields produced by seed grown locally for three or more years.

That the single-plot method fails to give definite results in many cases where it has been used for manurial trials is a matter of common knowledge. Half the reports of such trials consist of explanations of the discrepancies between the results obtained and the results which ought to have been obtained. The moral is obvious. The single-plot method, which suffices to demonstrate results as striking as those given by phosphates on some kinds of pasture land, signally fails when the subject of investigation is concerned with differences of 10 per cent. or thereabouts.

Before suggesting a remedy for this state of things it will be well to consider the allied subject of variety testing, which has been brought into great prominence recently by the introduction of new varieties of many kinds of farm crops. In testing a new variety it is necessary to measure two properties—its quality and its yielding capacity—for money-return per acre is obviously determined by the product of yielding capacity and quality as expressed by market price. I propose here to deal only with the determination of yielding capacity. The determination of quality is not allied to manurial trials.

In attempting to determine yielding capacity there has always been a strong temptation to rely on the measurement of obvious structural characters. For instance, in the case of cereals many farmers like large ears, no doubt with the idea that they are an indication of high-yielding capacity. Many very elaborate series of selections have been carried out, on the assumption that large grains, or large ears, or many ears per plant implied high yield.

We may take it as definitely settled that none of these characters is trustworthy, and that the determination of yielding capacity resolves itself into the measurement of the yield given by a definite area. The actual measurement, therefore, is the same as that made in manurial trials, and is, of course, subject to the same probable error of about 5 per cent.

It follows, therefore, that it is subject to the same limitations. Variety trials on single plots, and that is the method commonly used, will serve to measure variations in yielding capacity of 30 per cent., or more, but are totally inadequate to distinguish between varieties the yielding capacities of which are within 10 per cent. of each other.

Numbers of such single-plot trials have been carried out, with the result that many varieties with yielding capacities much below normal have almost disappeared from cultivation, and those commonly grown do not differ greatly from one another—probably not more than 10 per cent.

Ten per cent. in yielding capacity, however, in cereals means a return of something like 15*s.* to 20*s.* per acre—a sum which may make the difference between profit and loss; and if progress is to be made in manuring and variety testing, some method must be adopted which is capable of measuring accurately differences in yield per unit area of the order of 10 per cent.

The only way of decreasing the probable error is to increase the number of plots, and to arrange them so that plots between which direct comparison is necessary are placed side by side, so as to reduce as much as possible variations due to differences in soil. Thus it has been shown that with ten plots in five pairs the probable error on the average can be reduced to about 1 per cent., in which case a difference of from 5 to 10 per cent. can be measured with considerable certainty.

Such a method involves, of course, a great deal of trouble; but agricultural science has now reached that stage of development at which the obvious facts which can be demonstrated without considerable effort have been demonstrated, and further knowledge can only be acquired by the expenditure of continually increasing effort. In fact, the law of diminishing return holds here, as elsewhere.

It appears, then, that for questions involving measurements of yield per unit area, such, for instance, as manurial or variety trials, further advance is not likely to be made without the expenditure of much more care than has been given to such work in the past. The question naturally arises: Is it worth while? I think the following instance shows that it is:—

Some years ago an extensive series of variety trials was carried out in Norfolk, in which several of the more popular varieties of barley were grown side by side at several stations for several seasons. In all, the trial was repeated eleven times. As a final result it was found that Archer's stiff-straw barley gave 10 per cent. greater yield than any other variety included in the trials, and by repetition of the experiment the probable error was reduced to $1\frac{1}{2}$ per cent. The greater yield of 10 per cent., being over six times the probable error of the experiment, indicates practical certainty that Archer barley may be relied on to give a larger crop than any of the other varieties with which it was compared. One difficulty still remained. It was almost impossible to obtain anything like a pure strain of Archer barley. Samples of Archer sold for seed commonly contained 25 per cent. of other varieties. This difficulty was removed by Mr. Beaven, who selected, again with enormous trouble, a pure high-yielding strain of Archer barley. Since this strain was introduced into the Eastern Counties the demand for it has always exceeded the supply which could be grown at Cambridge and at the Norfolk Agricultural Station, and it is regarded by farmers generally as a very great success.

The conclusion, therefore, is that a 10 per cent. difference is well worth measuring, that it cannot be measured with certainty by the single-plot method, and that it behoves those of us who are concerned with field trials to look to our methods, and to avoid printing figures for single-plot experiments which may very well be misleading. Almost everyone thinks himself competent to criticise the farmer, who is commonly described as too self-satisfied to acquaint himself with new discoveries, and too conservative to try them when they are brought to his notice. Let us examine the real facts of the case. Does the farmer ignore new discoveries? The largely increasing practice of consulting the staffs of the agricultural colleges, which has arisen among farmers during the last few years, conclusively shows that he does not; that he is, in fact, perfectly ready to avail himself of sound advice whenever he can. Is he too conservative to try new discoveries when brought to his notice? The extraordinary demand for seed of the new Archer barley quoted above, and for seed of new varieties generally, the continuous advance in the prices of phosphatic manures, as the result of increased demand by farmers, the trade in Scotch and Irish seed potatoes, all show how ready the farmer is to try new things. The chief danger seems to be that he tries new things simply because they are new, and he may be disappointed if those who are responsible for the new things in question have not taken pains to ascertain with certainty that they are not only new but good. Farmers are nowadays in what may be called a very receptive condition. Witness the avidity with which they paid extravagant prices for single tubers of so-called new, but inadequately tested, varieties of potatoes some years ago, and in a less degree the extraordinary demand for seed of the much-boomed French wheats, and the excitement about nitragin for soil or seed inoculation. Witness, too, the almost universal failure of the new potatoes and French wheats introduced during the boom, and the few cases in which nitragin gave any appreciable result. The farmer who was disappointed with his ten-guinea tuber, his expensive French wheat, or his culture of nitragin cannot but be disillusioned. Once bitten, twice shy. He does not readily take advice again.

Let us, therefore, recognise that the farmers of the country are ready to listen to us, and to try our recommendations, and let that very fact bring home to us a sense of our responsibility. All that is new is not, therefore, necessarily good. Before we recommend a new thing let us take pains to assure ourselves of its goodness. To do so we must find not only that the new thing produces a greater return per acre, but that the increased return is worth more than it costs to produce, and we must also define the area or the type of soil to which this result is applicable. This implies in practice that each field trial should confine itself to the investigation of only one, or, at most, two, definite points, since five pairs of plots will be required to settle each point; that the experimental results should be reviewed in the light of a thorough knowledge of farm book-keeping, and that accurate notes should be taken of the type of the soil, and the area to which it extends, and of the various meteorological factors which make up the local climate. At present we are not in possession of a sufficient knowledge of farm accountancy, but there is hope that this deficiency will be removed by the work of the Institute for Research in Agricultural Economics, which has recently been founded at Oxford by the Board of Agriculture and the Development Commission. The excellent example set by Hall and Russell in their "Survey of the Soils and Agriculture of the South-Eastern Counties," an example which is being followed in Cambridge and elsewhere, seems likely to result in the near future in a complete survey of the soils of England which will make a sound scientific basis for delimiting the areas over which the results of manurial or variety trials are applicable.

Reviewing this branch of agricultural science, the outlook is distinctly hopeful. New fertilisers are coming into the market, as, for instance, the various products made from atmospheric nitrogen. New varieties of farm crops are being produced by the Plant-breeding Institute at Cambridge, and elsewhere. It is to be hoped that the work of the Agricultural Economics Institute at Oxford will throw new light on the interpretation of experimental results from the accountancy standpoint. Finally, the soil surveys on which the colleges have seriously embarked will assist in defining the areas over which such results are applicable. It only remains for those of us who are responsible for the conduct of field trials to increase the accuracy of our results, and the steady accumulation of a mass of systematic and scientific knowledge is assured. It will be the business of the advisory staffs with which the colleges have recently been equipped by the Board of Agriculture and the Development Commission to disseminate this knowledge in practicable form to the farmers of this country.

One more point, and I have finished this section of my address. I have perhaps inveighed rather strongly against the publication of the results of single-plot trials. I quite recognise that the publication of such results was to a great extent forced upon those experimenters who were financed by annually renewed grants of public money. Nowadays, however, agricultural science is in a stronger position, and I venture to hope that most public authorities which subsidise such work are sufficiently alive to the evils attendant on the publication of inconclusive results to agree to continue their grants for such periods as may suffice for the complete working out of the problem under investigation, and to allow the final conclusions to be published in some properly accredited agricultural journal, where they would be readily and permanently available to all concerned. This would in no wise prevent their subsequent incorporation in bulletins specially written for the use of the practical farmer.

So far I have confined my remarks to subjects of which I presume that every member of the section has practical experience, subjects which depend on the measurement of the yield per unit area. These subjects, however, although they have received far more general attention than anything else, by no means comprise the whole of agricultural science. Certain scientific workers have confined their efforts to the thorough solution of specific and circumscribed problems. I propose now to ask the section to direct its attention to some typical results which have been thus achieved during the last twenty years.

The first of these is the development of what I may call soil science. Twenty years ago the bacteriology of nitrification had just been worked out by Warington and by Winogradski. The phenomena of ammoniacal fermentation of organic matter in the soil were also fairly well established. The fixation of atmospheric nitrogen by organisms symbiotic on the leguminosæ had been definitely demonstrated. Fixation of nitrogen by free-living organisms had been suggested, but was still strenuously denied by most soil investigators. No suggestion had yet been made of the presence in normal soils of any factor which inhibited crop production. The last twenty years have seen a wonderful advance in soil science. Our knowledge of nitrification and ammoniacal fermentation has been much extended. The part played by the nodule organisms of the leguminosæ has been well worked out, has seen a newspaper boom, and a subsequent collapse, from which it has not yet recovered. But the greatest advance has been the discovery of the part played by protozoa in the inhibition of fertility.

The suggestion that ordinary soils contained a factor which limited their fertility emanated in the first instance from the American Bureau of Soils. The factor was at first thought to be chemical, and its presence was tentatively attributed to root excretion. Certain organic substances, presumably having this origin, have been isolated from sterile soils, and found to retard plant growth in water-culture. It is claimed, too, that the retardation they cause is prevented by the presence of many ordinary manurial salts with which they are supposed to form some kind of combination.

Contributions to the subject have come from several quarters, but whilst the suggested presence of an inhibitory factor has been generally confirmed, its origin as a root-excretion and its prevention by manurial salts has not received general confirmation outside American official circles. The matter has been strikingly cleared up by the work of Russell and Hutchinson at Rothamsted, who observed that the fertility of certain soils which had become sterile was at once restored by partial sterilisation, either by heating to a temperature below 100° C., or by the use of volatile antiseptics such as toluene. This observation suggested that the factor causing sterility in these cases was biological in nature, that it consisted, in fact, of some kind of organism inimical to the useful fermentation bacteria, and more easily killed than they by heat or antiseptics. After a long series of admirable scientific investigations these workers and their colleagues have shown that soils contain many species of protozoa, which prey upon the soil bacteria, whose numbers they keep within definite limits. In certain circumstances, such, for instance, as those existing in the soil of sewage farms, and in the artificial soils used for the cultivation of cucumbers, tomatoes, &c., under glass, the protozoa increase so that the bacteria are reduced below the numbers requisite to decompose the organic matter in the soil into substances suitable for absorption by the roots of the crop. Practical trials of heating such soils, or subjecting them to the action of toluene, or other volatile antiseptics, have shown that their lost efficiency can thus be easily restored, and the method is now rapidly spreading among the market gardeners of the Lea Valley.

I have attempted to sketch the chief points of this subject with some detail in order to show that strictly scientific work, quite outside the scope of what some people still regard as "practical," may result in discoveries which, apart from their great academic interest, may at once be turned to account by the cultivator. The constant renewal of expensively prepared soil which becomes "sick" in the course of a year or so is a serious item in the cost of growing cucumbers and tomatoes. It can now be restored to fertility by partial sterilisation at a fraction of the cost of renewal, and considerable sums are thus saved by the Lea Valley growers.

For my second instance of scientific work which has given results of direct value to farmers, I must ask to be allowed to give a short outline of the wheat-breeding investigations of my colleague Prof. Biffen. Even as late as fifteen years ago plant-breeding was in the purely empirical haphazard stage. Then came the rediscovery of Mendel's laws of heredity, which put in the hands of breeders an entirely new weapon. About the same time the Millers' Association created the Home-grown Wheat Committee, of which Biffen was a member. Through this committee he was able to define his problem as far as the improvement of English wheat was concerned. There appeared to be two desiderata: (1) The production of a wheat which would crop as well as the best standard home-grown varieties, at the same time yielding strong grain, *i.e.* grain of good milling and baking quality; and (2) the production of varieties of wheat resistant to yellow rust, a disease which has been computed to decrease the wheat crop of the world by about one-third.

The problem having been defined, samples of wheat were collected from every part of the world and sown on small plots. From the first year's crop single ears were picked out and grown on again. Thus several hundred pure strains were obtained. Many were obviously worthless. A few possessed one or more valuable characteristics: strong grain, freedom from rust, sturdy straw, and so on. These were used as parents for crossing, and from the progeny two new varieties have been grown on, thoroughly tested, and finally put on the market. Both have succeeded, but both have their limitations. Burgoyne's Fife, which came from a cross between strains isolated respectively from Canadian Red Fife and Rough Chaff, was distributed by the Millers' Association after a series of about forty tests, in which it gave an average crop of forty bushels per acre of grain, which milled and baked practically as well as the best imported Canadian wheat. It is an early-ripening variety which may even be sown as a spring wheat. It has repeatedly been awarded prizes for the best sample of wheat at shows, but it only succeeds in certain districts. It is widely and successfully grown in Bedfordshire and Dorset, but has not done well in Norfolk. The other variety, Little Joss, succeeds much more generally. In a series of twenty-nine trials scattered between Norfolk and Shropshire, Kent and Scotland, it gave an average of forty-four bushels per acre, as compared with forty bushels given by adjoining plots of Square Head's Master. It originated from a cross between Square Head's Master and a strain isolated from a Russian graded wheat known as Ghirka. Its grain is the quality of ordinary English wheat. It tillers exceptionally well in spring, and is practically rust-proof. Its one drawback is its slow growth during the winter if sown at all late. It has met with its greatest success in the Fen districts, where rust is more than usually virulent.

The importance of this work is not to be measured only by the readiness with which the seed of the new varieties has been tried by farmers and the extent to which it has succeeded. The demonstration of the inheritance of immunity to the disease known as yellow rust, the first really accurate contribution to the inheritance of resistance to any kind of disease, inspires hope that a new method has appeared for the prevention of diseases in general.

Biffen's work too shows the enormous value of co-operation between the investigator and the buyer in defining problems connected with the improvement of agricultural produce. It is open to doubt if a committee of farmers would have been able to define the problems of English wheat production as was done by the Millers' Committee, and in the solution of any problem its exact definition is half the battle. Mackenzie and Marshall in their work on the "Pigmentation of Bacon Fat" and on the spaying of sows for fattening, have found the great value of consultation with the staffs of several large bacon factories. There seems to be in this a general lesson that before taking up any problem one should get into touch not only with the producers but with the buyers, from whom much useful information can be obtained.

I feel that Biffen's work has borne fruit in still another direction, for which perhaps he is not alone responsible. Twenty years ago agricultural botany took a very subsidiary position in such agricultural examinations as then existed. In some of the agricultural teaching institutions there was no botanist, in others the botanist was only a junior assistant. It is largely due to the work of Biffen and the botanists at other agricultural centres that botany is now regarded as perhaps the most important science allied to agriculture.

I must here repeat that I am not attempting to make a complete survey of all the results obtained in the last twenty years. My object is only to pick out some of the typical successes and failures and to endeavour to draw from their consideration useful lessons for the future. So far I have not referred to the work which has been done in the nutrition of animals, and I now propose to conclude with a short discussion of that subject. The work on that subject which has been carried out in Great Britain during the last twenty years has been almost entirely confined to practical feeding trials of various foods or mixtures of foods, trials which have been for the most part inconclusive.

It has been shown recently that if a number of animals in store condition are put on a fattening diet, at the end of a feeding period of twelve to twenty weeks about half of them will show live-weight increases differing by about 14 per cent. from the average live-weight increase of the whole lot. In other words, the probable error of the live-weight increase of a single fattening ox or sheep is 14 per cent. of the live-weight increase. This being so, it is obvious that very large numbers of animals must be employed in any feeding experiment which is designed to compare the feeding value of two rations with reasonable accuracy. For instance, to measure a difference of 10 per cent. it is necessary to reduce the probable error to 3 per cent. in order that the 10 per cent. difference may have a certainty of thirty to one. To achieve this, twenty-five animals must be fed on each ration. Those conversant with the numerous reports of feeding trials which have been published in the last twenty years will agree that in very few cases have such numbers been used. We must admit then that many of the feeding trials which have been carried out can lay no claim to accuracy. Nevertheless, they have served a very useful purpose. From time to time new articles of food come on the market, and are viewed with suspicion by the farmers. These have been included in feeding trials and found to be safe or otherwise, a piece of most useful information. Thus, for instance, Bombay cotton cake, when first put on the market, was thought to be dangerous on account of its woolly appearance. It was tried, however, by several of the agricultural colleges and found to be quite harmless to cattle. Its composition is practically the same as that of Egyptian cotton cake, and it now makes on the market practically the same price.

Soya-bean cake is another instance of a new food which has been similarly tested, and found to be safe for cattle if used in rather small quantities and mixed with cotton cake. The price is now rapidly rising to that indicated by its analysis. Work of this kind is, and always will be, most useful. Trials with few animals, whilst they cannot measure accurately the feeding value of a new food, are quite good enough to demonstrate its general properties, and its price will then gradually settle itself as the food gets known.

Turning to the more strictly scientific aspects of animal nutrition, entirely new ideas have arisen during the last twenty years. I propose to discuss these shortly, beginning with the proteins. Twenty years ago the generally accepted view of the *rôle* of proteins in nutrition was that the proteins ingested were transformed in the stomach and gut into peptones, and absorbed as such without further change. Splitting into crystalline products, such as leucin and tyrosin, was thought only to take place when the supply of ingested protein exceeded the demand, and peptones remained in the gut for some time unabsorbed. It is now generally agreed that ingested protein is normally split into crystalline products which are separately absorbed from the gut, and built up again into the various proteins required by the animal. If the ingested protein does not yield a mixture of crystalline products in the right proportions to build up the proteins required, those crystalline products which are in excess are further changed and excreted. If the mixture contains none of one of the products required by the animal, then life cannot be maintained. This has been actually demonstrated in the case of zein, one of the proteins of maize, which contains no tryptophane. The addition of a trace of tryptophane to a diet, in which zein was the only protein, markedly increased the survival period of mice.

The adoption of this view emphasises the importance of a knowledge of the composition of the proteins, and especially of a quantitative knowledge of their splitting products, and much work is being directed to this subject in Germany, in America, and more recently in Cambridge as a result of the creation there of an institute for research in animal nutrition by the Board of Agriculture and the Development Commission. This work is expected ultimately to provide a scientific basis for the compounding of rations, the idea being to combine foods the proteins of which are, so to speak, complementary to each other, one giving on digestion much of the products of which the other gives little. Meantime, it is desirable that information should be collected as to mixtures of foods which are particularly successful or the reverse.

Here the question arises, for what purpose does the animal require a peculiarly complicated substance like tryptophane? The natural suggestion seems to be that the tryptophane grouping is required for the building up of animal proteins. It has also been suggested that such substances are required for the formation of hormones, the active principles of the internal secretions the importance of which in the animal economy has received such ample demonstration in recent years. The importance of even mere traces of various substances in the animal economy is another quite recent conception. Thus it has been shown, both in Cambridge and in America, that young animals fail to grow on a diet of carefully purified casein, starch, fat, and ash, although they will remain alive for long periods. In animals on such a diet, however, normal growth is at once started by the addition of a few drops of milk or meat juice, or a trace of yeast, or other fresh animal or vegetable matter. The amount added is far too small to affect the actual nutritive value of the diet. Its effect can only be due to the presence of a trace of some substance which acts, so to speak, as the hormone of growth. The search for such a substance is now being actively prosecuted. Its discovery will be of the greatest scientific and practical interest.

Evidently new ideas are not lacking amongst those who are engaged in investigating the *rôle* of the proteins and their splitting products in the animal economy. But of more immediate practical interest is the question of the amount of protein required by animals under various conditions. It is obviously impossible to fix this amount with any great accuracy, since proteins differ so widely in composition, but from many experiments, in which a nitrogen balance between the ingesta and the excreta was made, it appears that oxen remain in nitrogenous equilibrium on a ration containing about one pound of protein per 1000 lb. live-weight per day. All the British experiments of a more practical nature have been recalculated on a systematic basis by Ingle, and tabulated in the Journal of the Highland and Agricultural Society. From them it appears that increase of protein in the ration, beyond somewhere between one and a half and two pounds per 1000 lb. live-weight per day of digestible protein, ceases to have any direct influence on increase in live-weight.

We may fairly conclude, then, that about two pounds of proteins per 1000 lb. live-weight per day is sufficient for a fattening ox. This amount is repeatedly exceeded in most of the districts where beef production is a staple industry, the idea being to produce farmyard manure rich in nitrogen. The economy of this method of augmenting the fertility of the land is very doubtful. The question is one of those for the solution of which a combination of accurate experiment and modern accountancy is required. Protein is the most expensive constituent of an animal's dietary. If the scientific investigator, from a study of the quantitative composition of the proteins of the common farm foods, and the economist, from careful dissection of farm accounts, can fix an authoritative standard for the amounts of protein required per 1000 lb. live-weight per day for various types of animals, a great step will have been made towards making mutton and beef production profitable apart from corn-growing.

For many years it has been recognised that an animal requires not only so much protein per day, but a certain quota of energy, and many attempts have been made to express this fact in intelligible terms. Most of them have taken as basis the expression of the value of all the constituents of the diet in terms of starch, the sum of all the values being called the starch equivalent. This term is used by various writers in so many different senses that confusion has often arisen, and this has militated against its general acceptance. Perhaps the most usual sense in which the term is used is that in which it means the sum of the digestible protein multiplied by a factor (usually 94) plus the digestible fat multiplied by a factor (usually 2·3), plus the digestible carbohydrates. This, however, gives misleading values which are too high in concentrated foods and too low in bulky foods, the discrepancy being due to the larger proportion of the energy of the bulky foods which is used up in the much greater work of digestion which they require. Kellner and his school have devised a method which measures the starch equivalent by experiment, a much more satisfactory and practical method than any system which depends purely on calculation.

An animal or a number of animals are kept on a maintenance diet so that their weight remains constant. To this diet is added a known weight of starch, and the increase in weight observed. The animal or animals are then placed again on the same maintenance diet for some time, and then a known weight of the food to be tested is added, and the increase in weight again observed. The data thus obtained indicate that so many pounds of starch produce as much increase in live-weight as so many pounds of the food under experiment, from which it is easy to calculate how many pounds of starch are actually required to produce as much increase in live-weight as 100 lb. of the food under experiment. The starch equivalent thus found expresses an experimentally determined fact which is of immediate practical value in arranging a dietary, its value, however, depending on the accuracy with which it has been determined. Kellner and his colleagues have thus determined the starch equivalents of all the commonly used foods. Their values for concentrated foods, and other foods commonly used in Germany, have been determined with considerable accuracy, and with the method which has also been devised for defining the relation between the experimentally determined equivalent and the equivalent calculated from the analysis by means of a formula, they form by far the most trustworthy basis for arranging a feeding ration including such kinds of foods.

But roots, which form the staple of the diet of fattening animals in Great Britain, are not used on the same scale in Germany, and Kellner's starch equivalents for roots have not been determined with sufficient accuracy or under suitable conditions to warrant their use for arranging diets under our conditions.

This, and the fact that the term starch equivalent is so widely misunderstood, is no doubt the reason why the Kellner equivalent has not been more generally accepted in Great Britain. An advance will be made in the practice of feeding as soon as the starch equivalent of roots has been accurately determined under our conditions, when the Kellner equivalents will no doubt come into general use.

I have now reached the end of my survey. I recognise that it is very incomplete, and that I have been compelled to neglect whole subjects in which important work has been done. I venture to hope, however, that my words have not been altogether unprofitable. It is somewhat difficult to summarise what is in itself really nothing but a summary. Perhaps, however, I may be allowed to point out once more what appears to me to be the moral of the last twenty years of work in agricultural science.

The many practical field and feeding tests carried out all over the country have demonstrated several very striking results; but, if they are to be continued with profit, more trouble must be taken to insure accuracy. Farmers are ready to listen. It behoves us more than ever to found what we tell them on accurate results.

Besides such practical trials, however, much has been done in the way of individual scientific work. The results thus obtained, as, for instance, Russell and Hutchinson's partial sterilisation of soils, Biffen's new wheats, and Beaven's pure Archer barley, are of practical value to the farmer as immediate as the most practical field trial, and of far wider application.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Herbert Spencer lecture will be delivered by Prof. C. Lloyd Morgan, F.R.S., professor of psychology in the University of Bristol, on Friday, November 7. The subject of the lecture will be:—"Spencer's Philosophy of Science."

DR. O. W. RICHARDSON, F.R.S., professor of physics in Princeton University, New Jersey, has been appointed as from January 1 next to the Wheatstone chair of physics at King's College, London, in succession to Prof. C. G. Barkla, F.R.S.

MRS. W. BAYARD CUTTING and her children have (says *Science*) given 40,000*l.* to Columbia University for a fund in memory of the late W. Bayard Cutting, who served as trustee of the University from 1880 until his death, in 1912. The income of this fund is to be applied to the maintenance of travelling fellowships, open to graduate students of distinction in letters, science, law, and medicine or engineering.

STUDENTS who are working privately with the object of graduating in the University of London will welcome the "London University Guide and University Correspondence College Calendar, 1914," published by the University Correspondence College, London, and distributed gratuitously. The first part of the volume constitutes the guide, and contains the regulations for the examinations leading to the various degrees to be held by the University of London in 1914 and 1915. The calendar, 1913–14, which completes the volume, gives particulars of the facilities offered by the University Correspondence College to students who desire assistance in their work through the post.

A VERY useful form of pocket diary, which covers the academic year beginning with October, 1913, instead of commencing with January in the usual way, has been published by the Cambridge University Press. Though concerned more particularly with events in the work of the University of Cambridge, the diary will appeal to all whose work is in connection with colleges or schools. The diary is published in three forms, at 1*s.* net, 2*s.* net, and 2*s.* 6*d.* net respectively. From the same source we have received "The Cambridge Diary for the Academical Year 1913–14," in block form. Each sheet contains seven days, and ample space is provided for manuscript notes of engagements. The price of this diary is 1*s.* net.

THE establishment of new universities in Germany was one of the chief topics of discussion at the recent congress of German university teachers held at Strasburg. The movement was strongly opposed in a report presented by Prof. Bücher, of Leipzig. According to this, many corporations, with the encouragement of the Ministry are endeavouring to raise the status of existing institutions to that of university rank. The preponderance of government in such institutions would be municipal, and consequently university independence would be endangered, and, in addition, a high academic standard would not be maintained. Overcrowding of the existing universities was advanced as an argument in favour of the creation of new institutions, but the organisation of such universities as those of Berlin and Leipzig enabled them to deal with large numbers without any detriment to the teaching. Prof. Kaufmann, of Breslau, remarked that quite 40 per cent. of the students were unsuited for an academic training, and the creation of new institutions would in no way relieve overcrowding at the older universities, but simply increase the total number of students. Many teachers, however, were strongly in favour of the movement, contending that the establishment of universities in the large industrial and commercial centres was an essential and necessary element in modern conditions of life. It was a movement which should be strenuously supported. Side by side with this question arose that of the standard required for the doctorate. The congress considered it should be made imperative for all universities to demand a thesis embodying independent and original research work from the candidate.

THE second annual report of the King Edward VII. British-German Foundation states that there is an increase in the expenditure, due to a larger number of cases assisted, and to the fact that several of the permanent allowances have been raised. We learn from *The Times* that in accordance with the terms of the trust deed, which provides for an annual joint sitting of the two sections of the foundation, alternately in England and Germany, the first joint conference was held last September, at Sir Ernest Cassel's residence in London. The question of the best way of employing the surplus funds was discussed, and it was agreed finally to adopt the following resolution:—"That a certain proportion of the surplus funds of the German section be employed in enabling British subjects to attend or visit universities, schools, institutes, or business establishments in Germany, or to reside in Germany, and that a certain proportion of the surplus funds of the British section be employed in enabling Germans to attend or visit universities, schools, institutes, or business establishments in the United Kingdom, or to reside in the United Kingdom." It is hoped that this scheme will serve to assist students who are not possessed of the necessary means in pursuing a course of studies abroad, and give them an insight into the customs and character of the German people, affording them an opportunity of making lasting friendships with Germans, and thus help in promoting a good understanding between the two nations. The second joint conference of the two sections was held in Berlin on October 25. Its main object was to discuss the merits of the scheme of studentships and the desirability of continuing it.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 20.—M. F. Guyon in the chair.—Pierre **Termier**: The A1 excursion of the twelfth International Geological Congress: the Appalachian region of Canada.—R. **Lépine** and M. **Boulud**: The presence, in the vascular walls, of a ferment setting free a reducing sugar at the expense of the virtual sugar of the blood, and capable of hydrolysing phloridzin. These experiments show that the vascular walls possess a new function, hitherto ascribed to the liver alone.—Léon **Lichtenstein**: Some applications of the notions of functions of an infinity of variables in the calculus of variations.—François **Lukács**: Laplace's series.—Pierre **Idrac**: Experimental researches on the *vol plané*. Photographic experiments with small balloons show that in places where birds are capable of hovering flight there is an ascending current of air with velocities of the order of 3 to 4 metres per second. This corresponds to the magnitude of the velocity of air currents in the *vol plané* of an aëroplane.—R. **Fortrat**: An abnormal Zeeman phenomenon with the sodium doublet, $\lambda = 2853$. The use of a ferro-cobalt electromagnet, made according to the indications of P. Weiss, enabled the author to place an ordinary spark in a field of 49400 Gauss. The experimental results obtained agree closely with the theory of Voigt.—Raoul **Dupuy**: Functional arterial hypertensions. Pseudo-arterio-sclerosis. A discussion of the means of differentiating arterio-sclerosis from functional hypertension.—P. **Chaussé**: The path of penetration of the tuberculous virus in the calf and the tuberculigenic power of cow's milk. Inhalation is the usual mode of tuberculous infection in the young calf; intra-uterine infection must also be taken into consideration, since the latter furnishes an important proportion of the graver cases. Although the calf is much more exposed than the adult animal to infection through the alimentary canal, this is relatively the least important mode of infection. The milk of the cow is not the cause of infection of the calf to any great extent.—J. **Danysz**: The use of some new medicinal combinations in the treatment of trypanosomiasis. A compound obtained by the action of silver nitrate upon arsenobenzene, was found capable of sterilising the blood of rabbits infected with Surra by a single injection. *Trypanosoma rhodesiense* was more resistant but succumbed to a mixture of the above reagent with trypan red.—Jules **Amar**: The physiological effects of work and the degree of fatigue.—R. **Anthony**: The experimental study of the factors determining the cranial morphology of mammals deprived of teeth.—J. **Chaine**: The *îlots* of the Termites.—M. **Lemoigne**: The butylene-glycollic fermentation of glucose by staphylococci.—Lucien **Mayet** and Jean **Pissot**: The discovery of the engraved bone of a mammoth showing a human figure, in the upper Aurignacian layer of La Colombière, near Poncin. The drawing described would appear to be the first engraving of man of the middle Quaternary epoch.—Jean **Boussac**: The geological constitution of Haute-Tarentaise.—F. **Dienert**: Remarks concerning some experiments with fluorescein.

BOOKS RECEIVED.

Records of the Indian Museum. Vol. viii., Zoological Results of the Abor Expedition, 1911–12. Part 3. September. Pp. 191–231 + plates. (Calcutta.) 2 rupees.

Memoirs of the Indian Museum. Vol iv., No. 1, An Account of the Crustacea Stomatopoda of the Indo-Pacific Region, based on the Collection in the Indian Museum. By S. Kemp. Pp. 217 + plates. (Calcutta.) 15 rupees.

Über Natronzellstoff: seine Herstellung und chemischen Eigenschaften. By Dr. C. Christiansen. Pp. v + 154. (Berlin: Gebrüder Borntraeger.) 5 marks.

Einführung in die Mykologie der Gebrauchs- und Abwässer. By Dr. A. Kossowicz. Pp. vi + 222. (Berlin: Gebrüder Borntraeger.) 6.60 marks.

Handbuch der Morphologie der Wirbellosen Tiere. Edited by A. Lang. Zweite Begw. Dritte Auflage. 4 Band, 3 Lief. (Jena: G. Fischer.) 5 marks.

A Text-Book of Quantitative Chemical Analysis. By Dr. A. C. Cumming and Dr. S. A. Kay. Pp. xi + 382. (London: Gurney and Jackson.) 7*s*. 6*d*. net.

Elementares Praktikum der Entwicklungsgeschichte der Wirbeltiere mit Einführung in die Entwicklungsmechanik. By Dr. O. Levy. Pp. viii + 183. (Berlin: Gebrüder Borntraeger.) 5.60 marks.

Conseil Permanent International pour L'Exploration de la Mer. Investigations on the Plaice. General Report. By Dr. F. Heincke. I., The Plaice Fishery and Protective Regulations. First part. Pp. 153 + xxxv + iv plates. Rapports et Procés-Verbaux des Réunions. Vol. xv. Juillet 1911–Juillet 1912. Pp. viii + 167. (Copenhague: A. F. Host et Fils.)

Technological Museum, Sydney. Technical Education Series. No. 18, Cabinet Timbers of Australia. By B. F. Baker. Pp. 186 + lxviii plates. (Sydney.)

Les Lois Empiriques du Système Solaire et les Harmoniques Tourbillonnaires. By F. Butavand. Pp. 43. (Paris: Gauthier-Villars.) 2 francs.

Les Progrès de la Chimie en 1912. Pp. xiv+411. (Paris: A. Hermann et Fils.) 7.50 francs.

Traité de Chimie Minérale. By H. Erdmann. Translated by Prof. A. Corvisy. Tome ii., Etude des Métaux. Pp. 331. (Paris: A. Hermann et Fils.) 10 francs.

Traité de Physique. By Prof. O. D. Chwolson. Translated by E. Davaux. Enlarged edition. By E. and F. Cosserat. Tome iv. Deux Fasc. Pp. 431 to 1162. (Paris: A. Hermann et Fils.) 22 francs.

L'Etude Physico-Chimique des Sels Chromiques. By A. Sénéchal. Pp. 28. (Paris: A. Hermann et Fils.) 2 francs.

L'Additivité des Propriétés Diamagnétiques et son Utilisation dans la Recherche des Constitutions. By M. P. Pascal. Pp. 26. (Paris: A. Hermann et Fils.) 1 franc.

Smithsonian Institution. U.S. National Museum. Report on the Progress and Condition of the U.S. National Museum for the Year ending June 30, 1912. Pp. 165. (Washington: Government Printing Office.)

Leeds Astronomical Society. No. 20, Journal and Transactions for the Year 1912. Pp. 91. (Leeds: R. Jackson and Son.) 2*s*.

Maryland Geological Survey. Middle and Upper Devonian. Text, pp. 720+vi plates. Lower Devonian. Text, pp. 560+vi plates. Devonian. Plates xvii–lxxiii. (Baltimore: Johns Hopkins Press.)

The British Rust Fungi (Uredinales): their Biology and Classification. By W. B. Grove. Pp. xii+412. (Cambridge University Press.) 14*s*. net.

Rubber and Rubber Planting. By Dr. R. H. Lock. Pp. xiii+245+x plates. (Cambridge University Press.) 5*s*. net.

Plane Geometry. By Prof. W. B. Ford and C. Ammerman. Edited by E. R. Hedrick. Pp. ix+213+xxxi. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*. net.

Recent Physical Research. By D. Owen. Pp. 156. (London: *The Electrician* Printing and Publishing Co., Ltd.) 3*s*. 6*d*. net.

The Principles of the Application of Power to Road Transport. By H. E. Wimperis. Pp. xiv+130. (London: Constable and Co., Ltd.) 4*s*. 6*d*. net.

Selektionsprinzip und Probleme der Artbildung: ein Handbuch des Darwinismus. By Dr. L. Plate. Vierte Auflage. Pp. xv+650. (Leipzig and Berlin: W. Engelmann.) 16 marks.

The Hope Reports. Edited by Prof. E. B. Poulton. Vol. viii. Appendix 1890–1910, including Five Subfamilies of the Blattidæ. By R. Shelford. Vol. viii., 1910–13, with a Separate Appendix. Vol. ix. 1911–13, The Natural History and Description of African Insects, especially the Acraeine Butterflies. (Oxford.)

The Cambridge Diary for the Academical Year 1913–14. (Cambridge University Press.) 1*s*. net.

The Cambridge Pocket Diary, 1913–14. (Cambridge University Press.) 1*s*., 2*s*., 2*s*. 6*d*. net.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 31.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—The Difference between a Drain and a Sewer: R. Kelsey Jones.

MONDAY, NOVEMBER 3.

SOCIETY OF ENGINEERS, at 7.30.—Accretion at Estuary Harbours on the South Coast of England: G. O Case.

ARISTOTELIAN SOCIETY, at 8.—President's Address: Appearance and Real Existence: Prof. G. Dawes Hicks.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Studies in Oxidation. IV. The Production of Oxygen by Electrolysis. Peroxidation as Determined by Platinum and other Catalysts: Prof. H. E. Armstrong.—Analysis of Crude Glycerine by the International Standard Methods 1911. Determination of Organic Residue: R. G. Grimwood.—Observations on the Abel Heat Test: Bertram J. Smart.

TUESDAY, NOVEMBER 4.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Striation of Flint Surfaces: J. R. Moir.

RÖNTGEN SOCIETY, at 8.15.—Presidential Address: Prof. A. W. Porter.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Presidential Address: A. G. Lyster.

WEDNESDAY, NOVEMBER 5.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Preparation of Rubber for Analysis: L. Archbutt.—The Examination of Commercial Gelatines in Reference to their Suitability for Paper Making: R. W. Sindall and W. Bacon.—Some Experiments on Chlorine Compounds of Ethane and Ethylene, with Special Reference to their Applications to Analytical Chemistry: L. Gowing-Scopes.—The Detection and Estimation of Benzoic Acid in Milk and Cream: E. Hinks.

ENTOMOLOGICAL SOCIETY, at 8.—New or Little Known Heterocera from Madagascar: Sir Geo. H. Kenrick.

GEOLOGICAL SOCIETY, at 8.—Geological Sections through the Andes of Peru and Bolivia: Dr. J. A. Douglas.

THURSDAY, NOVEMBER 6.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Soil Solution and the Mineral Constituents of the Soil: A. D. Hall, W. E. Brenchley, and L. M. Underwood.—Studies in Heredity. II. Further Experiments in Crossing British Species of Sea Urchins: Prof. E. W. MacBride.—Synthesis by Sunlight in Relationship to the Origin of Life; Synthesis of Formaldehyde from Carbon Dioxide and Water by Inorganic Colloids acting as Transformers of Light Energy.—Prof. B. Moore and T. A. Webster.—The Trypanosomes causing Dourine (Mal de Coit or Beschälseuche): Dr. B. Blacklock and Dr. W. Yorke.—Postural and Non-Postural Activities of the Mid Brain: T. G. Brown.—The Nature of the Coagulent of the Venom of *Echis carinatus*: J. O. W. Barratt.

FRIDAY, NOVEMBER 7.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Experience in the Design and Working on Different Kinds of Fuel for Gas Producers: G. E. Lygo.

GEOLOGISTS' ASSOCIATION, at 8.—Annual Conversazione.

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