THURSDAY, OCTOBER 19, 1911.

A VOLUME OF KOHLRAUSCH'S COLLECTED PAPERS.

Gesammelte Abhandlungen von Friedrich Kohlrausch. Erster Band, Elastizität, Wärme, Optik, absolute elektrische Messungen und Verschiedenes. Pp. xxxv+1108. (Leipzig: J. A. Barth, 1910.) Price 25 marks.

THE first paper contained in this collection is dated 1863, the last is dated 1909, less than six months before the author's death. Together they fill more than one thousand pages, and each of them has its own value and interest. When it is considered that the present volume contains none of the work on the conductivity of electrolytes and mobility of ions, in connection with which it is probable that the author's name is best known (the papers on these subjects being reserved for a second volume), it must be admitted that here is remarkable evidence of sustained and well-directed labour.

The half-century that was nearly covered by Kohlrausch's scientific activity was, in relation especially to magnetism and electricity, the subjects at which he chiefly worked, a period of systematising and setting in order, rather than, until near the end, of the discovery of new phenomena leading to essentially new conceptions. Even the reconstruction of electrical theory by Maxwell was based, not on new discoveries, but on a revised interpretation of well-known facts. To those whose personal memory of such things goes back to Kohlrausch's student days, the greatest and most far-reaching of the changes they have lived through must seem to be the universal recognition of the principle of the conservation of energy, and, as essential for the definite statement of this principle, the introduction of the conception of "absolute" units of measurement.

At the time of which we speak, these ideas had been formulated, but they were far from familiar, and the instrumental appliances needed for their practical application scarcely existed. Gauss's method of measuring the absolute intensity of the earth's magnetic field was beginning to find a place in German text-books, but it might be sought in vain in English or French books. A tangent-galvanometer of accurately known dimensions was a rarity. "Resistance-boxes" did not exist. Kirchhoff had, as long ago as 1849, published the experiments that are commonly cited as constituting the earliest actual measurement of a resistance in absolute measure, but no concrete embodiment of his results existed. Wilhelm Weber had distributed a certain number of coils of which he had measured the resistance, but very few physicists possessed a coil, or wire of any kind, of which they knew the resistance, otherwise than by comparison with some accidental arbitrary standard. Though the fundamental principles of absolute measurement are due undoubtedly to Gauss and Wilhelm Weber, the general spread of the conception and the introduction of practical methods founded thereon was, in a great degree, promoted by the Committee on Standards of Electrical Resistance first appointed by the British Association in 1861. The committee's first experimental determination of the "B.A. unit," $10^7 \frac{\text{metres}}{\text{second}}$, was published in 1863. At the same time, Maxwell and Jenkin's memorable paper "On the Elementary Relations between Electrical Measurements" appeared. As the first connected and comprehensive statement of the matter, this paper contributed greatly to promote a more general understanding of absolute measurements.

It is significant of the condition of the current teaching of theoretical physics at this time that, when Tyndall published his "Heat as a Mode of Motion" in 1863, he introduced it as an attempt "to bring the rudiments of a new philosophy within the reach of a person of ordinary intelligence and culture," but he and other popular writers so completely neglected to deal with one-half of the new philosophy that Macquorn Rankine felt called upon, in 1867, to publish a paper, "De la nécessité de vulgariser la seconde loi de la thermodynamique." There was no such thing in those days as a physical laboratory in the modern sense of the word. As Kohlrausch says, conditions were "pinched and patriarchal," and it was quite appropriately that the whole instrumental outfit of a university was called the "physical cabinet."

The state of electrical knowledge at the outset of Kohlrausch's career is well brought out by him in speaking of the conditions under which Gustav Wiedemann wrote his magnificent "Lehre vom Galvanismus und Elektromagnetismus," first published from 1861 to 1863:—

"It is only right that we should call to mind some of the inherent difficulties which beset the production of this classical work, difficulties which increased the labour of the exposition to an extent that we can understand only by a distinct effort of the imagination.

"The thermodynamic basis for the connecting links which now bind all together to a coherent whole was then in course of development, and had not by any means become common property; and in the case of electricity especially a consistent system of measurement was still wanting in a practically accessible shape. It is true that Ohm and Kirchhoff had laid down the laws of the strength of currents, and the foundations of a system of measurement for current, tension, and resistance had been settled by Gauss and Weber, but hitherto very few measurements in definite units had been actually carried out. It is hardly too much to say that the subject of absolute electrical measurement was as yet familiar to but few physicists. The Daniell's cell was almost the only standard of measurement that was commonly accessible. Measuring instruments that gave the strength of a current in intelligible units were not introduced till much later. The measurements of resistance then in use were inconvenient and untrustworthy. I remember my own not very successful struggles with file and plane to construct a rheostat. The statements given in published papers in reference to the units of resistance employed were often uncertain to the extent of 50 per cent. or more."

As was befitting in a son of Rudolf Kohlrausch and a pupil of Wilhelm Weber, our author took an effec-

tive part in remedying this state of things, and the present volume forms the first part of a record of what he accomplished.

The contents are arranged by the editors in sections, the first of which, extending to nearly 200 pages, is headed "Elasticity and Capillarity," and contains the author's earliest published papers. The two papers on capillarity, however, belong to the years 1906 and 1907. In the first of them, the author reproduces the substance of a paper by Lord Rayleigh, on the formation of drops, because, as he says, it had been treated "etwas stiefmütterlich" by German periodicals, and he directs attention to the value of the "method of dimensions" used by Lord Rayleigh.

The second section, nearly 100 pages, relating to "Heat, Thermoelectricity, and Gaseous Mechanics," contains almost the only exclusively theoretical paper in the volume. In this paper, Kohlrausch starts from the fact that differences of temperature between neighbouring parts of continuous pieces of metal are an essential condition of the action of a thermoelectric couple. He points out that a thermoelectric current is therefore necessarily accompanied by a current of heat, and, assuming a mutual convective action between these two currents—that an electric current conveys heat and that a current of heat conveys electricity—and assuming further that the quantity of electricity conveyed by a given flow of heat depends on the temperature of the conductor, he arrives at the ordinary formula, which represents the electromotive force of a thermoelectric couple as being proportional to the difference of temperature of the junctions multiplied by the difference between their mean temperature and a fixed temperature depending on the nature of the couple.

The third section, fifty pages, devoted to "Optics," deals chiefly with a method of measuring indices of refraction founded on the phenomenon of total reflection.

The fourth section, more than 650 pages, "Electrical and Magnetic (absolute) Measurements and Methods of Measurement," is the most important in the book. We may mention specially a paper on the "Absolute Value of Siemens's Unit of Resistance," which contains an acute and interesting criticism of the experiments of the British Association Committee. Unfortunately, in his own experiments, Kohlrausch adopted, without personally verifying them, the dimensions of a coil that had been wound by Weber, although he carefully determined every other quantity involved, with the consequence that he obtained an erroneous result. A later determination of the "Absolute Resistance of Mercury" led almost exactly to the value now adopted as the most accurate. The same may be said of a determination of the "Electrochemical Equivalent of Silver," which he carried out in conjunction with his brother Wilhelm. These two investigations seem to have been conducted with the utmost care, and they afford striking examples of the multitude of minute precautions that must be observed when great accuracy is aimed at in the determination of a physical constant. These two papers are the most elaborate in the volume, but all go to show the author's love of exact measurement and furnish evidence that he was pre-eminently in his right place when he was appointed president of the Reichsanstalt.

A final section, 100 pages, is headed "Miscellaneous and Books." It contains some interesting addresses and reports and biographical notices, and the preface to the last (eleventh) edition of the author's "Lehrbuch der praktischen Physik," first published in 1870, under the title "Leitfaden der praktischen Physik."

It only remains to add that the volume is excellently printed and very carefully edited.

G. C. F.

A MODERN HISTORY OF CHEMISTRY.

A Concise History of Chemistry. By T. P. Hilditch. Pp. ix+263. (London: Methuen and Co., Ltd., n.d.) Price 2*s.* 6*d.*

IN this book an attempt is made to trace the development of chemistry from the point of view of its present-day position—that is, from the point of view, say, of a traveller who, having reached his goal, seeks to retrace his route, and to survey, as if from an eminence, the devious and dimly indicated wanderings by which he has attained the coign of vantage he has gained. There are, of course, two ways of writing history. The first, which is by far the more difficult, inasmuch as it presupposes profound knowledge and extensive research, combined with imagination and the faculty of detachment, is for the historian to seek to project himself, as it were, into the particular period with which he is dealing at the moment, and to attempt to elucidate it from the contemporary point of view. In this way he becomes a faithful chronicler of the epoch, reflecting its spirit, correcting its errors, supplementing its truths, and making manifest the gradual evolution and enlargement of the special phase of intellectual, moral, social, or political development with which he may be concerned. Or he may, as in the present case, view the whole course retrospectively. This, no doubt, has certain advantages. But when applied to chemistry it is apt to do an injustice to one's predecessors by belittling their successive contributions to the general knowledge: there is apparently so much chaff to be winnowed, and the kernels of good grain would seem to be so few and so small in comparison with the harvest of to-day. It is apt, too, to give false impressions of the course of reasoning—the movement of the time—by which the early speculators were led to formulate their attempts at a chemical system. It is impossible to do full justice to their efforts unless the historian has that complete sympathy with them which comes from trying to put himself in their place, and so appreciating the motives by which they were guided or impelled.

In a volume of some 250 small octavo pages, which seeks to trace, in the broadest possible outline, the growth of chemistry from the earliest times to the present epoch, there is not much room for dwelling on the philosophy of its history. Mr. Hilditch is chiefly concerned more with results than with motives—with the ordering in historical sequence—of the significant facts of the science, and it is quite remarkable what a number of such facts he has contrived to

pack within the limited compass of his book. To the busy student who seeks to acquire merely an *aperçu* of the main current in the gradually broadening stream of chemical knowledge, and has but little interest in the personal aspects or human element in the story, the compilation, concise as it is, will be invaluable. Indeed, the author frankly confesses that his book "is designed more especially for those students whose interest in this aspect of the science is stimulated by the inclusion of 'historical chemistry' in the syllabus of examinations which concern them."

The examinee will certainly get a perfect plethora of the facts of chemical history if he steadily works his way through this volume. Even if he is unable to assimilate a moiety of them, he will at least have the satisfaction of knowing that he possesses in Mr. Hilditch's book a trustworthy and fairly comprehensive work of reference, and as such we warmly recommend it to every chemist, whether he be an examinee or not. The book is excellent in plan, and, in spite of its conciseness, eminently readable. Its arrangement readily enables the searcher to discover the origin and date of practically every fact of importance, even without the aid of the synoptical tables and very full index which are appended.

The book differs from all other works of the kind in its modernity. The author is more concerned, apparently, with the chemistry of our own times than with that of any preceding epoch. There are other works which deal more fully with the science of bygone ages, but there is certainly no book in our language which treats of the story of our own age with the same degree of fulness as the volume before us, and we hope that its sale will be such as to encourage the author to maintain it at its pretty high level of completeness.

THE ANOPHELINE MOSQUITOES OF INDIA.

A Monograph of the Anopheline Mosquitoes of India. By Dr. S. P. James and Dr. W. G. Liston. Second edition, rewritten and enlarged. Pp. viii + 128 + xv plates. (Calcutta: Thacker, Spink and Co.; London: W. Thacker and Co., 1911.) Price 16 rupees net (25*s.* net).

THE second edition of this work has been long looked for, and we now welcome it in much the same guise as before; for, although "enlarged," it has actually fewer pages than the first edition, the enlargement apparently referring to new plates, though the number of coloured plates remains the same as before. These coloured plates are so excellent that it is a pity that their number could not have been increased. In our opinion the outstanding merits of this book are the clearness of the descriptions and figures, and the provision of very good analytical tables.

We are glad in this edition to see Theobald's scale classification adopted as a first step in arranging the Indian anophelines in their proper zoological position. The authors are quite justified in their criticism of a good deal of scale nomenclature and their admirable plates of scales are a welcome addition, but their division of scales into "false" and "true" is hardly a happy one. In our opinion, "striate" and "non-striate" would have been better terms. In their attempts at revision of specific and generic names, the authors are a law unto themselves. It is not merely a question of nice judgment on the evidence for and against such a name, but there are violations of well-understood and accepted rules. We could give numerous examples of this, but one must suffice. Thus a certain African anopheline bears the name *Nyssorhynchus maculipalpis* (Giles). The authors accept Theobald's opinion that the so-called Indian *maculipalpis* is different; they therefore "change" the name of the Indian species to *maculipalpis* (James and Liston). This substitution of their name is, of course, no change at all, but it leaves us with two identical specific names in the same genus. A *new* name for the Indian species is imperative. We would appeal to the authors to consider this question of nomenclature, and to study carefully the laws governing it, and then publish a list of Indian anophelines with their synonyms. It is their duty to acquaint themselves with the matter fully, even down to the correct way of writing a specific name and its author.

We suppose the method advocated (p. 26) for mounting a collection of mosquitoes has advantages, or it would not have been adopted by the Central Malarial Bureau, but it certainly seems cumbersome, and to fasten nine different objects on to a board with *elastic bands* must sooner or later, in India of all places, spell certain disaster, *i.e.* loss of some of the objects.

Although the book contains an index of specific names, yet generic ones are omitted, and the general index of the first edition has disappeared—a distinct loss. We have noted several erroneous references to plates; *e.g.* three out of five on p. 7 are wrong. As is evident from reading the book, much work remains to be done on the male genitalia, larval stigmata, and eggs, and indeed on the whole bionomics of the Indian anophelines, but this will, we hope, now soon be remedied in India. The book has not, then, reached that ideal standard of excellence we had hoped for, but it must in justice be said, and this is a very practical point, that a worker with this book at his disposal will be able to find out with ease which of the some three dozen Indian anophelines his may be, although in several cases he will certainly be giving them erroneous names.

MINERALS OF RHODESIA.

The Mineral Industry of Rhodesia. By J. P. Johnson. Pp. iv + 90. (London: Longmans, Green and Co., 1911.) Price 8*s.* 6*d.* net.

THIS book is specially addressed to the prospector, and gives a good deal of information as to the occurrence of gold and minerals of economic value that have been worked in Rhodesia, the conditions under which they have been found, and mines of importance with their yields. It also gives an account of the occurrence of tin in other mines of South Africa outside Rhodesia, where minerals have been worked which the author thinks might reasonably be expected within the limits of the colony itself.

Gold has proved, up to now, the most important of

the metals mined, a value of 2,508,200*l.* having been recovered in 1910. It occurs chiefly as free gold, but alloyed with a varying quantity of silver, and is found disseminated through various rocks, *e.g.* granite syenite, granulite, various schists, ironstone, and quartzite; but quartz veins traversing various rocks are the dominant gold carriers, all situated close to the granite contact. These veins vary greatly in width, and also in yield, the average yield for 1910 being 30*s.* 9*d.* per ton milled.

Nearly all the mines are situated on old native workings, and the quantity of gold taken from these workings, which sometimes attain a depth of over 200 feet, must have been considerable.

The blunders of pioneer mining companies and resultant financial difficulties have furnished a rich harvest for tributers, who have made handsome profits.

In a large number of the reefs a serious falling off in values is encountered at the water level, their payability down to that point apparently being due to secondary enrichment.

The conditions of Rhodesia are not favourable to the formation of extensive alluvial deposits, and very little gold has been derived from that source.

Other metals than gold are coming increasingly into prominence. Chromite has been mined continuously and with a progressive output since 1905 from a hill of the mineral at Selukwe, the output in 1910 being 44,000 tons, of a value of 98,130*l.*, most of the mineral being shipped to America.

Wolfram and scheelite have been produced in the Buluwayo and Hartley districts of a total value of 10,930*l.*

Nickel and cobalt have not been found, but the author describes their mode of occurrence and the characters of the minerals at Sudbury and New Caledonia as a guide for prospectors.

Copper ores are very widespread in Rhodesia, and the author describes the Kansanshe, Bwana M'Kubwe, and Umkondo and Alaska deposits, on all of which there have been extensive old workings, those on the Alaska extending in an almost unbroken line for about 1700 feet with an extreme width of 660 feet, and have been proved to go down in some places to a depth of at least 70 feet. The copper so far exposed is mainly in the form of malachite, the sulphide zone not having yet been reached. It is disseminated through a crushed belt of limestone.

Lead and zinc are found as an enormous body in the well-known occurrence at Broken Hill, which is remarkable for the large development of phosphates of lead and zinc within the zone of oxidation. The Penhalonga Gold Mine has yielded lead as a by-product.

Molybdenite occurs on the farm Appingadam. Bismuth and antimony have only as yet been found in Rhodesia with the gold ores rendering them refractory. The output of silver is obtained mainly as a by-product in the treatment of gold ores, and partly from the argentiferous galena of the Penhalonga Mine, but no true silver minerals have as yet been found.

A chapter is also devoted to the non-metalliferous minerals of Rhodesia, which, while interesting, space does not permit us to notice, and the book concludes with a chapter giving hints to prospectors which they will find of interest.

Generally speaking, the book is clearly written, and contains a good deal of information; it should be in the hands of anyone who is devoting his attention to prospecting in Rhodesia.

THE FOUNDATIONS OF SCIENCE.

Die logischen Grundlagen der exakten Wissenschaften. By Prof. Paul Natorp. Pp. xx+416. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 6.60 marks.

Probleme der Wissenschaft. By Federigo Enriques. Uebersetzt von Kurt Grelling. Erster Teil, Wirklichkeit und Logik. Pp. x+258+16. Price 4 marks. Zweiter Teil, Die Grundbegriffe. Pp. vi+259-599. Price 5 marks. (Leipzig and Berlin: B. G. Teubner, 1910.)

THE publication of these works, and, indeed, of the whole series to which they belong, furnishes further evidence for the revival of the interest in the ultimate problems of science, an interest which becomes very much alive so soon as an important branch of investigation reaches the borders of the knowable, and stands in danger of losing itself in unphilosophic disputations. Such an event is at present taking place in physics in connection with the relativity hypothesis, and before we reach the end of the controversy the logical foundations of science will have been thoroughly overhauled.

Prof. Natorp's work is practically a treatise on the fundamental principles of mathematics. It deals with such subjects as infinity and continuity, direction and dimension as determining pure number, time and space as mathematical structures, and the temporal and spatial arrangement of events. The treatment of the problems touched upon is detailed and thorough, and often leads to very decided (and, let us hope, decisive) pronouncements on present-day problems, as when the author declares it to be impossible to decide between the Euclidean or non-Euclidean structure of our space by means of any imaginable physical experiments. A brief summary of the new Principle of Relativity as formulated by Lorentz, Einstein, and Minkowski concludes a very informing and valuable work.

Prof. Enriques's two volumes are more practical and empirical, and will probably appeal to a wider circle of readers than Prof. Natorp's. The style is vigorous, and sometimes distinctly informal, and for that very reason the book is more readable than is the average work on these recondite subjects. His definition of "reality" is interesting. "Our belief in the reality of a thing," he says (p. 85), "supposes a totality of sensations which follow invariably upon certain conditions arbitrarily provided." This, as the author himself perceives, does not eliminate the possibility of a complex hallucination, unless we assume that the will is entirely in abeyance during hallucination. Those who prefer to regard reality as simply the "hallucination" common to the majority of mankind

will scarcely be won over by the author's attempt to attain a definition more flattering to our self-esteem. A terse definition of reality as "an invariant in the relation between volition and sensations" (p. 100) expresses very aptly the author's point of view. The chapter on the physiological bases of logic brings out clearly the author's ultra-modern methods, and his treatment of non-Euclidean geometry shows that he is not greatly out of sympathy with Poincaré's demand to regard all postulates, not as fundamental verities, but as mere mutual agreements among philosophers.

The last chapters of the book deal with the root laws of mechanics and physics in a brilliant and entertaining manner, including, of course, the Principle of Relativity. In the treatment of the latter, it is regrettable that the author stopped at the Fitzgerald-Lorentz contraction without going on to Einstein's all-important work. His final *tour de force* is to show that freedom and necessity are not incompatible, inasmuch as there is a necessity for freedom in biological processes. That, at all events, seems the most concise way of putting his argument.

OUR BOOK SHELF.

The Book of Buchan: a Scientific Treatise, in Six Sections, on the Natural History of Buchan, Prehistoric Man in Aberdeenshire, and the History of the North-east in Ancient, Medieval, and Modern Times. By Twenty-nine Contributors. Edited and arranged by J. F. Tocher. Pp. xxi+508. (Peterhead: The Buchan Club, 1910.) Price 10*s.* 6*d.*

THIS is a compendium of essays, somewhat on the lines of the Victoria County Histories, dealing with the natural history, archæology, and history of a district of north-east Aberdeenshire, known from ancient times by the name of Buchan. The essays, which are published by the local Field Club and edited by its secretary, are of varying degrees of merit. There are excellent essays on the geology of the district by Mr. A. W. Gibb and Dr. T. F. Jamieson. Prof. J. A. Thomson gives an admirable sketch of the fauna of the district and their origin. Prof. Trail deals with the flora in an essay which is chiefly concerned with pointing out the imperfections of the present knowledge of the subject, and urging the local botanists to complete the survey which he himself has so well begun. A valuable essay on "Stone Cists in Aberdeenshire" is contributed by Prof. R. W. Reid, to which are added tables of measurements of the skulls and limbs of the remarkable race which inhabited east Aberdeenshire in the late Neolithic and early Bronze age. Important contributions also bearing on the prehistory of the district at the same epoch are "The Prehistoric Pottery of Buchan," by the Hon. John Abercromby, and "Some Notes on the Stone Circles of Aberdeenshire," by Sir Norman Lockyer. These essays represent the latest views on these interesting archæological questions by acknowledged authorities.

The remainder of the volume deals with the history of Buchan from the beginning of history up to modern times. Some of these contributions show evidence of considerable research and mastery of the subject, notably that on "Life in the Northern Burghs before the Reformation," by Dr. P. Giles, of Cambridge.

Many of the contributions are, however, not up to the above high standard. We have an essay on Gaelic place-names of a type which usually is produced by the Celtic scholar with insufficient knowledge of philology, who relies chiefly on picking out words of similar sounds from a Gaelic dictionary. It is not surprising either that the editor, who writes with an air of great authority on nearly all the various subjects dealt with in the volume, should sometimes be caught tripping. We find him waxing enthusiastic about the maps of Ptolemy, evidently ignorant of the fact that there is no evidence that Ptolemy ever drew any maps, all the so-called maps of Ptolemy having been drawn by modern geographers from Ptolemy's descriptions. He also ascribes the writings of Bede to the seventh instead of to the eighth century.

On the whole, however, the volume is a credit to the science and scholarship of Aberdeenshire.

The Senior Botany. By Prof. F. Cavers. Pp. vii+484. (London: University Tutorial Press, Ltd., 1910.) Price 4*s.* 6*d.*

LIKE the three earlier text-books which Prof. Cavers has prepared for this series, the present work is admirably designed to portray the plant as a living entity, to indicate how structure is subservient to function, and to show that conditions and purpose underlie the manifold variations which plants assume. Much of the earlier chapters has appeared in one or other of the former books; the broad bean plant is selected as the introductory type, and the same satisfactory arrangement of information supplemented by experiment is adopted. Although a chapter is devoted to the microscope and cell structure, evidence requiring microscopic examination is generally avoided.

Photosynthesis is taken as the starting point for explaining metabolism, and the attractive theory, for which, however, further proof is required, of a conversion from light to electrical energy as the crucial operating factor is definitely formulated. Incidentally it is suggested that carbon assimilation is a more suitable expression than photosynthesis, but this depends upon the application of the term assimilation. Here, too, it seems desirable to raise a protest against the use of the word "stomate" on the grounds that "stoma" is more correct, and used generally, if not universally, by the best authorities. Among the various forms of transpiration measuring instruments, the best and simplest is not given; also it is observed that the interesting subject of soil physics is omitted except to advise reference to agricultural books.

There is an extensive chapter on ecology, which, with the chapters on flowers, classification, fruits and seeds, deserve special praise, as they are all explicit, stimulating, and copiously packed with detail; a few minor points of criticism arise, notably the description of monocotyledons as a lower class than the dicotyledons.

It should be understood that the qualification "senior" refers to the local examinations of Oxford and Cambridge. The book is well adapted for its purpose, although there is more information than most pupils in schools could assimilate; in addition, it can be strongly recommended to students in the polytechnics as a sound guide to the study of plant-life.

Praktikum der experimentellen Mineralogie mit Berücksichtigung der kristallographischen und chemischen Grenzgebiete. By Prof. E. Sommerfeldt. Pp. xi+192. (Berlin: Gebrüder Borntraeger, 1911.) Price 4.80 marks.

THIS little book is a veritable *multum in parvo*. It is astonishing how much information Prof. Sommerfeldt has succeeded in compressing into so small a compass; he has covered practically the whole range of physics and chemistry so far as these subjects may be applied

to the determination of the characters of minerals. He rightly believes that, while a careful study of the variety of specimens contained in a large mineral collection is most helpful towards acquiring facility in recognising mineral species, yet it is always desirable to be able to confirm a judgment by, or even to base it wholly upon, a few well-chosen tests, and this book is intended to assist students and others who may have occasion to identify mineral specimens in carrying out such tests.

The opening chapter deals with the goniometrical measurement and the perspective drawing of crystals, the calculation of the fundamental morphological data, and the measurement of refractive indices by the method of minimum deviation. In the next chapter the author passes on to the chemical examination by means of the blow-pipe, microchemical reactions, and the quantitative determination of the precious metals, coal, &c. The third chapter is concerned with crystal optics, and the fourth with the special application of these properties to use with the microscope. The last chapter includes the remaining physical characters, such as hardness, specific gravity, pyroelectricity, etching, melting point, and crystallisation, the phenomena presented by mixed crystals being considered at some length. In an appendix the author offers some hints on the kind of apparatus useful for prospectors and generally travellers interested in minerals, and considers the special case of precious stones.

The book has been carefully written, the hints given being evidently based upon the author's own experience, and it will be found to serve well the purpose for which it is intended.

Mikrographie des Holzes der auf Java vorkommenden Baumarten, im Auftrage des Kolonial-Ministeriums, unter Leitung von Prof. J. W. Moll, bearbeitet von H. H. Janssonius. Dritte Lieferung. Pp. 161–540. (Leiden: E. J. Brill, 1911.)

THIS is the third part of an extensive publication, designed to take advantage of a large number of Javanese wood specimens collected by Koorders with a view to the preparation of a forest flora for Buitenzorg. The collection is unique because corresponding herbarium material was gathered at the same time, so that the identity of each specimen can be accurately determined. The herbarium material was critically examined and described in the "Additamenta" noted in the title. The microscopic investigation is being conducted by Mr. H. H. Janssonius in great detail; a "topographical" or general description of the sections which would serve for most purposes is not considered sufficient, but copious details are supplied for each type of cell represented. Figures are only given for one species of each genus, and the scale of 1:25 is adopted; it would have expedited reference if a figure had been provided for each species on a scale of 1:10, enabling direct comparison to be made with illustrations provided in several standard works. The most valuable feature is the summary of anatomical characters drawn up for the analytical determination of genera and species. Prof. Moll suggested, in a notice of the earlier parts subscribed to the *Botanische Centralblatt* (vol. cxiii.), that it should be possible to determine not only the families but genera, and occasionally species, by the characters of the wood; the full consummation of this scheme is reserved for a final survey.

A book on these lines has long been a desideratum. Some estimation of the magnitude of the work can be formed when it is mentioned that this part completes a second volume of 540 pages, devoted entirely to the Discifloræ represented by 163 species or varieties.

When Should a Child Begin School? An Inquiry into the Relation between the Age of Entry and School Progress. By W. A. Winch. Pp. iii+98. (Baltimore: Warwick and York, Inc., 1911.)

MR. WINCH'S book is an admirable example of educational inquiry as it should be pursued. Instead of arguing on *a priori* grounds that children under five are better at home than at school, he shows by careful statistical methods what the actual effect of early entrance upon school courses is. His research shows in a thoroughly convincing way that those who begin school about five years of age do quite as well—often very much better—than those who begin at an earlier age. Stated quite moderately, it is clear that it makes no actual difference to the future school record whether a child begins at three or at five, though incidentally the figures suggest that delay beyond the fifth year is actually disadvantageous—a point in favour of English as opposed to German practice. Of course, many school authorities have already ceased to provide for children so young, not because of Mr. Winch's work, but because the State has withdrawn the grants. Yet it does not follow, of course, that the social value of the babies' classes in the infants' schools is nil. It is something that overworked wives are relieved for a few hours a day of the strain which young children in a small house commonly bring. But it is abundantly clear that formal school lessons of any kind before the fifth year is completed are quite unnecessary. Hygienic surroundings and playful occupations with abundant opportunities for sleep are chiefly wanted. Trained nurses rather than trained teachers, crèches rather than schools, would perhaps meet the situation. J. A. G.

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 Orientation of the Great Temple of Amen-Ra at Karnak.

IN 1891 Sir Norman Lockyer made a magnetic survey of the axis of the great Temple of Amen-Ra, at Karnak, with the view of determining an astronomical date for the original building.

Since that time a great deal has been done in excavating and exposing the foundations of the older work along the temple axis, chiefly under the personal supervision of M. Legrain, of the Department of Antiquities, who for sixteen years has been the director of the explorations at Karnak.

On my recent visit to Karnak, where I spent some weeks, M. Legrain gave me the greatest assistance to enable me to make a resurvey of the axis in the light of the many new discoveries, and particularly in pointing out the parts of the original buildings still *in situ*, many of which he had himself uncovered, and all of which I afterwards measured and centred up.

Unfortunately, I arrived at a very unlucky time for carrying out this work, as the place was crowded with Arab workmen hauling out great stones from the excavations, and gangs of boys carrying baskets of earth from the diggings, all making as much noise as possible, that the place was more like a busy ant-hill than the eternal calm which might be expected in an Egyptian temple. In addition to this, the tourist season was at its height, and personally conducted parties were continually passing up and down, and naturally made a highway of the axis where I had set up my instruments. One soon forgets small inconveniences; but the torment of the insects, when both hands were occupied, is brought to mind by a remark made to me by a passing gentleman from the far West when he said, "Mr. Surveyor, I guess you're having a bully time with them flies."

In the end I managed to peg out a line, down as much of the axis as I could get at, 523 feet long, from the columns in front of the sanctuary down to the lower end of the Hypostyle Hall; unfortunately, both the extremities of the line are blocked up. The sanctuary itself is completely filled up with the huge stones of the fallen roof, and the last columns of the Great Hall at the other end are at present built round with stones and bags of sand on account of the repairs being carried out to the neighbouring pylon, while the pylon itself is timbered up to prevent its falling, so that the two important points for a survey of this part of the axis cannot be used at present.

The line at this end of the axis had to be continued by the theodolite alone, as no measures for centring were possible, as it had to be carried through the Rameses Pylon into the Outer Court so far as the standing pillar of Tirhakah in order to get the true bearing of the central line by observations of the Pole Star, that star not being visible from any place on the axis inside the buildings.

The result of the survey in general quite confirms the data used by Sir Norman Lockyer in fixing the date at which the original axis was laid down, viz. about 3700 B.C. —a date which M. Legrain fully accepts on the results of his excavations, as the building of the upper end of the temple has been assigned on archæological grounds to about this period; indeed, two statues have been dug out by him, both now in the Cairo Museum, which give direct evidence as to the date. One is a seated figure of Cheops with his cartouche (of the fourth dynasty), the date of which is given in the lists as B.C. 3733, and the other is a headless figure which has been assigned to the work of the third dynasty. These figures were, of course, dug up long after Sir Norman Lockyer's survey; no older work has been found.

The height of the hills behind which the sun used to set at the summer solstice, to which the temple was oriented, was taken at 2° 30′. From the spot I was able to climb up to on the stones filling the sanctuary, to what I thought was about the height of an altar, I made it a little more; but as I had to see the hills through the timbering of the Rameses Pylon, between the struts, I could only measure the small part which was not covered; if this is the correct height, as I believe it to be, it would make the date of the foundation a little earlier, possibly to the time of the headless statue, which M. Legrain has assigned to B.C. 4000.

There are a great many difficulties just now in carrying out such an accurate survey as is required to arrive at an astronomical date of any value on account of great work that is being carried on. It must be remembered that the temple is about 1200 feet long, and stands on an area about five times that of St. Paul's, and is divided into numerous halls, corridors, and gateways; but all these are connected by the axis which runs through the whole building from east to west. This axis, when originally laid down, pointed to the place on the hill at which the sun disappeared behind it on the longest day, and the difference between the place where the sun set then and where it sets now gives the date of the foundation of the temple, the rate of the sun's change in declination being known.

M. Legrain tells me that in about two years' time he will have cleared out the fallen roof of the sanctuary, and that by that time he hopes the repairs to the Rameses Pylon will be completed and the timbering removed. In that case a unique opportunity will present itself for a survey of the whole of the axis at once from the court behind the opened-out sanctuary right down to the Ptolemaic Pylon at the west; and this Mr. Dowson, the Director-General of the survey in Cairo, has very kindly undertaken to have done by the survey officers so soon as the work is completed. HOWARD PAYN.

20 Hyde Park Place, W., October 11.

A Possible Relation between Uranium and Actinium.

IT is believed fairly generally that actinium has its source in the disintegration of uranium, although it is not a member of the direct line of descent through radium. This belief is based mainly on the fact that actinium and its products have a constant ratio to uranium in minerals, and since this ratio is very small actinium is supposed to be a branch-product.

In *The Philosophical Magazine* for September Mr. G. N. Antonoff describes some experiments in which a new product is obtained, called uranium Y, and gives strong reasons for the view that it is derived, not from uranium X, but directly from uranium. It is always in a small ratio to uranium X. Antonoff has shown that it is probably a branch-product, and a possible origin of the actinium series.

The following considerations may indicate how such a branch-product could be formed. They were not thought worthy of mention until the starting point of a branch-series had been found experimentally. If a single atom of uranium begins to disintegrate, it ordinarily leads to the whole radium series, without disturbance from other atoms. But the molecule of uranium will contain at least two atoms chemically combined, and perhaps a large number. An instability arising in one atom may frequently produce a similar instability in a contiguous atom, or even a projection of one atom into another, so that two atoms may break up together and form new combinations.

The scheduled atomic weight of uranium is 238·5. Two such atoms have a weight 477. If they break up together and form only one substance, it might have a molecular weight equal to that of uranium, or $\frac{1}{2}$, $\frac{1}{3}$, . . . of that of the combined atoms. On the assumption that three atoms of a substance are formed, its atomic or molecular weight is 159.

The experiments of Russ appear to give the most trustworthy value of the atomic weight of actinium emanation. They showed that the thorium emanation is 1·42 times as heavy as that of actinium. If thorium emits two α particles, both helium atoms, its emanation should have an atomic weight about 224. The atomic weight of actinium emanation thus becomes about 156.

On a theory of the constitution of the elements given to the British Association by the writer at Portsmouth, it is more likely that the emanation from thorium has the same atomic weight as that from radium, and that actinium emanation has an atomic weight of 152·5. Russ's experiments would then lead to a value very close to this for actinium emanation. It is, of course, difficult in most cases to obtain satisfactory conclusions from such experiments on diffusion, but there are strong grounds for thinking that in this special case the usual sources of error have been minimised.

If uranium Y be formed in this way, with an atomic weight 159, it may well be the parent of actinium, whether the suggested atomic weight of the emanation be correct or not, and it is not unlikely that at certain stages in the radium series a similar series of branch-products of low atomic weight may be produced. There is evidence of this in the complex product radium C.

J. W. NICHOLSON.

Trinity College, Cambridge, October 11.

Hot Days in 1911.

MR. MACDOWALL'S letter in NATURE of October 12 (p. 485), in which he directs attention to certain features in the sequence of annual number of hot days at Greenwich, is interesting. Nevertheless, I think he himself will acknowledge that his example, viz. the summer of 1911, is a happy one. What his diagram would lead one to expect if one were making a forecast, and not a retrospect, is that the number of hot days in 1911 would lie between his lower limit of 90 days and an upper limit of about 90+130, or 220 days; the value half-way between the two, *i.e.* 155 days, being the "most probable." Clearly in this case the upper limit, and also the most probable value, may be disregarded, and the lower limit is sufficiently high to be worthy of note.

The fact is that the dot for 1909, the ordinate of which is sought, lies on the lower edge of the boundary of the area of dots, so that in this case the lower limit gives a close approximation to the truth. If a dot happens to lie near the upper edge of the area of dots, the upper limit of its range along the vertical of the diagram becomes a close approximation. But since the difference between the upper and lower limits is no fewer than about 130 days,

that is, 53 days more than the average number of hot days per year, it is evident that the method will seldom give results that are useful.

I think the most striking fact brought out by the diagram is that a distinct relationship exists between the total number of hot days in five consecutive years and the difference between that number and the corresponding one for the next five years. I have used the diagram to find the coefficient of correlation between these quantities, and I find that its value is as high as -0.725 ± 0.059.

Five hot years are thus usually followed by five cold years, and *vice versa*. This may be accounted for by supposing that the number of hot days at Greenwich is subject to a regular fluctuation with period not far from 10 years. If the period were exactly 10 years the coefficient of correlation would be nearly -1, and all the dots would practically lie on a straight line passing through the origin of the diagram. The fact that they do not lie on a straight line means either that there is another period or periods superposed, or that 10 years is nearly, but not quite, the true period.

It would be interesting to learn whether the directions of the lines joining successive points (chronologically) on the diagram show any sort of regularity. If they proceed generally in a clockwise direction they indicate that the period is slightly greater than 10 years; if in a counter-clockwise direction the period is less than 10 years. The whole arrangement is similar in some respects to Dr. Schuster's well-known periodogram. R. CORLESS.

October 14.

Insects Feeding on "Slime Flux" of Trees.

MY attention has been directed to three elm trees at Ettington, near Stratford-on-Avon, which it is said have been "killed by wasps." It appears that the wasps were attracted by the sweetness of the sap, and attacked the trees in such swarms, and so drained them of sap, that the death of the trees seems imminent, all the leaves having gone yellow long before the usual time.

I should be glad to know if others have noticed similar attacks on elm trees, and whether the averred sweetness of the sap is due to some previous degenerative change in the tissues of the tree, or whether wasps would attack a normal tree if they could get access to the sap.

The elms are all three comparatively young trees, and belong to the common variety. My informant tells me that he has previously noticed the same thing happen with an elm tree in one of his fields, which died the next winter.

JOSEPH A. GILLETT.

Woodgreen, Banbury, October 9.

A SIMILAR phenomenon may be seen at the present time in the collection of elms at Kew. The trunk of a fine specimen of *Ulmus parvifolia* has for some weeks past—but more especially during August and September—been the daily rendezvous of hundreds of wasps and bluebottles. As is the case with the trees at Ettington, the attraction is the sweet sap that exudes from the trunk. It is a mistake, however, to blame the wasps for the damage that is being done to the trees. They do not cause the outflow of sap, but are merely there feeding on it. A piece of bark has been removed from the tree at Kew and microscopically examined. It was found to be suffering from what is commonly known as "slime flux," the bark being saturated with sugary moisture. The primary cause of this somewhat obscure disease appears to be a yeast, which finds its way to the cambium layer by means of a wound. Often, as in the Kew instance, ingress has been facilitated by the borings of an elm beetle. The yeast sets up a decomposition of the cells, and starchy, ultimately sugary, products are formed, which exude from the trunk in solution. It is this which attracts the multitude of wasps, bluebottles, and other insects. It is evident from the odour of the bark that a certain amount of fermentation is going on, and the presence of alcohol is further indicated by the behaviour of the wasps, which, after feeding for some time, become stupid and lethargic.

Although "slime flux" is not an uncommon disease of trees in Britain (it is much more prevalent on the Continent), it is not one of the most troublesome. Still, where it attacks it is nearly always ultimately fatal. The Kew tree is evidently suffering from severe debility. Unfortunately, the disease, as a rule, has become firmly established before there are any outward indications of its existence. When noticed on a branch the part attacked can be removed, but when the trunk is badly affected there seems to be no means of curing it. W. J. B.

Meteor Showers.

THE following meteor showers become due about the time when the Orionids may be expected to put in an appearance:—

Epoch October 18 22h. (G.M.T.), approximately twenty-ninth order of magnitude. Principal maximum, October 20 12h. 45m.; secondary maxima, October 20 11h. 15m. and October 22 8h. 10m.

Epoch October 20 9h. 30m., approximately fifth order of magnitude. Principal maximum, October 21 11h. 15m.; secondary maxima, October 20 9h. 30m. and October 22 10h. 35m.

From the foregoing it may be seen that there is likely to be a considerable amount of meteoric activity on the nights of October 20–22. These three nights seem well favoured as regards maxima, which occur at times very suitable for observations.

Other radiants besides that in Orion may be found active on the nights mentioned, but Orionids ought to prove most numerous on the night of October 20, as it is on this night that the general Orionid maximum becomes due. JOHN R. HENRY.

October 16.

The Possible Identity of the Kiess Comet.

IT is well known that the aphelia of many comets are grouped at distances which are nearly the same as those of the larger planets, and astronomers have sometimes attempted to use this fact to demonstrate the existence of a planet beyond Neptune. M. Flammarion mentions two cases—a comet which appeared in 1532 and 1661, and Tuttle's 1862 comet, which is related to the Perseid meteors, and has a period of 121½ years. These are taken as indications of a planet at a mean distance of about 48 astronomical units. The evidence is obviously insufficient; and special interest therefore attaches to the statement that the Kiess comet (1911*b*) is possibly the same as 1790 I. If the identity can be established, this comet must belong to the same group as the other two, and may be regarded as strengthening their evidence as to the hypothetical planet. P. H. LING.

7 Chandos Road, Redland, Bristol, October 2.

Standard Time in New Zealand.

I NOTE that in NATURE of March 16, in an article headed "Standard Time in France," it is stated on the authority of "Hazell's Annual" that the standard time adopted in New Zealand is 11 hours fast on Greenwich.

This is not correct. New Zealand standard time is the time of the meridian 172½° E., that is, 11½ hours in advance of Greenwich civil time. This is correctly stated in "Whitaker's Almanac," 1911, p. 89.

G. HOGBEN.

Seismological Observatory, Wellington, New Zealand, September 4.

Habits of Dogs.

MR. VENABLES'S reference to formic acid (NATURE, September 21, p. 382) reminds me that once, in the pine-woods at Potsdam, I came upon a forester performing some curious evolutions, apparently patting something on the ground and then holding his hands to his face. He explained that it was an ant-hill, and the smell was "very good for the nerves." A. EVERETT.

ARCHÆOLOGY IN EGYPT AND GREECE.

NO great discovery has marked the progress of archæological excavation in the Near East during the past season. The fierce heat of summer has now, at the time of writing (August), stopped all excavation by us northerners in the lands of the eastern Mediterranean, and probably only the Cretan archæologists at Tylissos (and possibly the Italians, also in Crete) are still in the field. The work of winter and spring is over, and we may now sum up the more important results of it.

In the Nile-basin the most sensational find has been that of Profs. Garstang and Sayce, working for the Sudan Excavations Committee of the University of Liverpool, at Meroë, in the Sudan, the ancient seat of the kingdom of the Kandake queens. The splendid bronze head (Fig. 1) of an imperial Roman of the first century A.D. (no doubt Augustus himself), which was on view in June in the rooms of the Society of Antiquaries at Burlington House, and has now been acquired by the British Museum, was alone sufficient to "make the fortune" of any excavator; while the nuggets and cakes of gold which a lucky chance revealed to Prof. Garstang's spade are no doubt a very unusual sensation in archæology. To the Sudani, and not less to the Egyptian and the Nilote Greek, it must have seemed that one antika-hunter, at any rate, had at last obtained what all must really be seeking—gold.

Gold, far more than iron nowadays, "doth of itself attract a man"; and for its gold alone the Meroë excavation would be remarkable to the vulgar, while the head of Augustus renders it remarkable to the *cognoscenti*. But we cannot dignify either the finding of a heap of ancient dross, though intrinsically valuable and useful on account of its value, or that of a fine Roman bronze head, as a great discovery. The great discovery was made last year, when the Meroë of the Kandakes was found, and the temple of Amen mentioned by Herodotus was identified. The smaller finds this year are less interesting than those of last year. There is more of the remarkable African-looking, hand-made pottery which to our eyes unmistakably stamps the Meroïtes as pure negroes of central Africa, Nilotes perhaps, but certainly negroes; as, indeed, we see in their rude pseudo-Egyptian representations of themselves and of the Egyptian gods whose worship they caricatured.

Of the history of the Roman head and how it got to Meroë, we can only conjecture that in some raid northwards into Upper Egypt the head of an imperial statue of heroic size, set up possibly at Syene, was struck off and carried by the barbarians back to Meroë. Though in the reign of Augustus the Roman general Petronius took Napata (Gebel Barkal) from one of the Kandakes (in punishment for just such an incursion as has been postulated), the place was not retained, and there is no likely place for a big public statue of an emperor anywhere south of Syene: it is not at all probable that so fine a figure as this must have been would be set up at the southern frontier station of Primis (Ibrîm). From Syene then we must suppose that the head originally came, and it is most like a young Augustus, of all the imperial family: perhaps one may almost call it an Octavian. Germanicus it certainly is not, nor is a statue of Germanicus in Egypt in any way probable, or even possible, in spite of the honour with which he was received: he was there illegally, in violation of the law of Augustus which forbade those of senatorial rank to visit that country. The head has now been placed in the British Museum through the generosity of the Sudan Excavations Committee, in consideration of a gift of a thousand guineas towards the committee's further excavations by the National Art Collections Fund. The photograph here shown was kindly lent by Prof. Bosanquet.

As for the gold, one might well wish that it could be coined into sovereigns, each with the word Meroë stamped upon it in the manner of the Vigo money, coined of the silver captured out of Spanish galleons at Vigo, of Queen Anne. But it is to be feared that the "Meroë" sovereigns would as soon pass out of circulation as did those of President Kruger!

Generally speaking, the Liverpool excavations have been of great interest as showing us more of the life of this curious Egyptianised negro kingdom of Meroë, whose Queen Kandake sent the eunuch to Jerusalem who was converted to Christianity and baptised by St. Philip on the way to Gaza (Acts viii. 27). There is no proof that he perpetuated his new religion at Meroë, though long afterwards the Ethiopians were strong Christians and handed their faith on to the non-negro Abyssinians, who (absurdly) like to call themselves "Ethiopians" to-day.

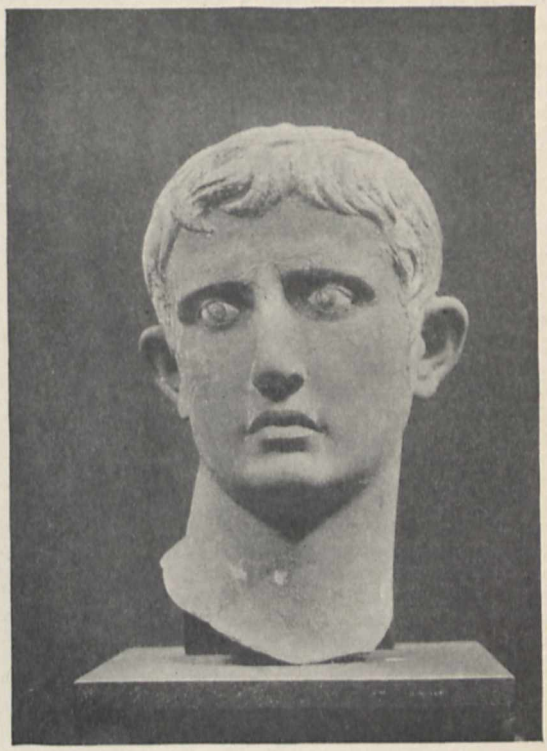

FIG. 1.—The Meroë Head of Augustus.

Passing northward to the modern border of Egypt and the Sudan, the scene of many an Ethiopian foray in old Roman days and many an Egyptian razzia in days then ancient, we find that at Farrâs, north of Wadi Halfa and just on Sudanese territory, Mr. F. Ll. Griffith, reader of Egyptology in the University of Oxford, has, assisted by Mr. Blackman, excavated a large number of tombs of late period, ranging from Ptolemaic to Christian days. Very interesting pottery has been found, linking up that of Meroë with that of Nubia exemplified by Mr. Randall-MacIver's finds at Areïka (see NATURE, April 28, 1910), but at the same time presenting constant points of difference and originality. Additions have also been made to our store of inscriptions in the

"Meroïtic" demotic script, of which Mr. Griffith is the first to begin the decipherment.

One cannot describe in detail all the various excavations, some regular, others ephemeral, that are set on foot every year in Egypt. The season has not been remarkable for discoveries. The Egypt Exploration Fund, premier and pioneer of modern scientific excavation-societies in Egypt, has dug with success at Atfih in Middle Egypt (this work was carried out by Mr. de M. Johnson), and has steadily gone on with the thorough exploration of Abydos which it resumed two years ago. The Fund's expedition at Abydos was directed by Prof. Naville, assisted by Mr. T. E. Peet and Mr. James Dixon. The work of supplementing Prof. Petrie's former excavations of the royal tombs of the first dynasty at Umm el-Qa'ab by further investigations has been brought, at any rate temporarily, to a conclusion, the previously unexplored portion of the Mound having been thoroughly excavated. Last year interesting discoveries had been made, including a fragment of a crystal bowl with the name of an early king (well known from the former discoveries of Amélineau on the same site), which has been the subject of scientific discussion and is now in the British Museum.

The results of this year's work from the tombs explored in the necropolis of Abydos (not Umm el-Qa'ab) have been exhibited, not in England, but at Boston. The Egypt Exploration Fund is an Anglo-American society, and it is fitting that the yearly exhibition should occasionally, at least, be held in the United States.

Next year Prof. Naville proposes to proceed to the complete exploration of the "Osireion," an extraordinary subterranean (or apparently subterranean) sanctuary of Osiris, close to the great temple of Seti I. This Osireion has already been attacked by the Egyptian Research Account, several years ago, and the results of this work were published by Miss M. A. Murray. But various reasons did not allow of the heavy work of emptying this tunnel being concluded, and it now remains for the excavators of the Exploration Fund, directed by a veteran whose speciality has always been precisely this kind of work, to discover the hidden secrets of the Osireion. But for a big work of this kind money is necessary. Subscriptions for the Fund are urgently required, and the office of the secretary is 37 Great Russell Street, W.C. Among recent subscribers to this work may be mentioned, as an instance of Japanese interest in all branches of science, the University of Kyoto, which has already received from the Fund many interesting relics of ancient Egypt to be studied by the youth of new Japan.

The other British society at work in Egypt, the Egyptian Research Account, has, under the direction of Prof. Flinders Petrie, continued its work at Memphis and elsewhere. An interesting series of Græco-Roman portraits from Hawara, similar to those discovered by Prof. Petrie at the same place many years ago, has been exhibited at University College, Gower Street, this summer, together with sculptures from the Egyptian Labyrinth and from Memphis, and prehistoric vases and flints from a site explored during the season's work.

Turning to Crete, we find a sterility of results this year comparable to that in Egypt. Sir Arthur Evans (whom we congratulate most heartily on his richly deserved knighthood) has not put spade to earth at Knossos this year, or continued the works of conservation which he carried out in the "Queen's Megaron" last year. Nor has Mr. Seager dug in the country round the Isthmus of Hierapetra, which he has earmarked as his own special hunting-ground. But he has located, and reserved for future excavation, possibly next year, an extraordinary village-site of the Geometric period, on a ledge, almost inaccessible to all but Cretans and Mr. Seager, high up on the vertical side of the great cleft in the mountains above the village of Monasteraki, near Kavousi (Fig. 2). This ledge, at first barely three feet wide, turns the corner of the cleft, and there, well within the gorge, broadens into a platform some ten feet across, on which people of the Geometrical period had found a hidden and secure refuge from the attacks of the Ægean pirates of their degenerate and barbarous times. The cliff rises sheer above, and falls sheer below for hundreds of feet to the untrodden floor of the gorge. Another work reserved by Mr. Seager until next year is the continued exploration of the hill-village of Vrokastro, begun last year by Miss Edith Hall, which yielded interesting antiquities of the transition period from Geometric to classical times.

FIG. 2.—The great Cleft of Kavousi.

The Italian work of recent years has resulted in the addition of a pillared "agora" to the palace of Agia Triada (Fig. 3): the results of this year's explorations, which were not yet begun when the writer visited Phaistos and Agia Triada in May, have not yet come to hand.

An interesting feature of Cretan work is now the participation in it of the Cretans themselves, who are keenly interested in the antiquities and past history of their splendid but sorely tried and oppressed island. In Drs. Hatzidakis and Xanthoudidis, Crete possesses archæologists of whom England, France,

Germany, or any other country might be proud. Dr. Xanthoudidis has for several years past made important discoveries, and now Dr. Hatzidakis has discovered and is excavating an important Minoan palace at Tylissos, not far from Knossos, at the base of Ida. Great brazen bowls, the largest vase of obsidian (a single piece twelve inches high) yet discovered, and a remarkably bold and fine bronze statuette of a man in the Minoan saluting attitude of adoration, are only a few of the fine trophies that have come from Tylissos to the shelves of the really magnificent museum of Candia. The work at Tylissos continues under the direction of Dr. Hatzidakis.

The Museum of Candia may be described as the Mecca of students of the Greek Bronze age, though the Ashmolean at Oxford, thanks to the unremitting care of Sir Arthur Evans, is a very good second to it, so far as Cretan antiquities are concerned, and the first vase room at the British Museum now contains a "Mycenæan" collection which, thanks chiefly to the results of past excavations of Minoan tombs in Cyprus, makes the British Museum by no means a bad third, while its Cretan collection also has now become quite important. The Museum of Athens proudly exhibits its trophies from "golden" Mycenæ and elsewhere in Greece, but of Cretan and Cypriote antiquities it has none.

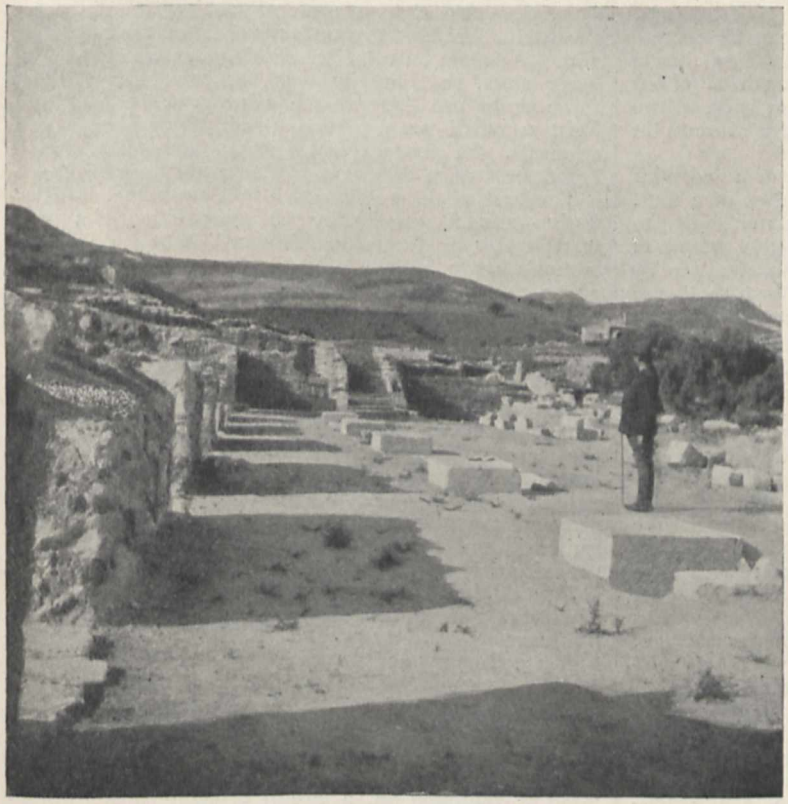

FIG. 3.—Agia Triada: the new Agora.

The British School at Athens has again turned its attention to a Mycenæan site this year, having resumed its interrupted excavations at Phylakopi in the island of Melos. Interesting discoveries, especially of pottery, have been made. The German work at Tiryns last year produced most important results, especially remarkable being the remains of a fresco depicting a boar-hunt, in which figure two women (or, more probably, in the writer's view, noble youths) riding to the hunt in a chariot. A fine representation of a woman in splendid robes has also been found. Reproductions of this fresco, from the accomplished hand of M. Gilliéron, junr., will soon be given to the world.

Elsewhere in Greece, though interesting results have been obtained by the French at Delos, the most remarkable discovery has been made this year at Corfu, where the Greek Archæological Society has discovered an archaic temple, with sculptures resembling the metopes of Selinus in Sicily. In view of the fact that ancient Kerkyra was a colony of Corinth, and Selinus of the neighbouring Megara, this resemblance is interesting. At the time of the discovery the German Emperor was in residence at his Corfiote palace of the Achilleion, and, thanks to his active interest in it, the excavation is to be continued under the distinguished direction of the leader of German archæology in the Levant, Prof. Dörpfeld (see NATURE, vol. lxxxvii., p. 149).

I bring this account to an end with a mention of the explorations of Messrs. Wace and Thompson for the English Macedonian Exploration Fund in the Elassona district of Turkish Thessaly, which will no doubt add much to our knowledge of the remarkable Neolithic culture of northern Greece, which has upset so many preconceived notions of the early history of Greek civilisation. It may be noted, in this connection, that Mr. F. W. Hasluck has just discovered a Minoan "bee-hive" tomb at Kirk-kilisse in the vilayet of Adrianople.

H. R. HALL.

PROGRESS IN ELECTRIC LIGHTING, HEATING AND COOKING.

ELECTRICAL engineers are claiming—and are claiming with justice—that great advances from the industrial and commercial point of view have been made during the last year or two in electric lighting, heating and cooking; but the average man of science, who probably concerns himself more with general principles than with the detailed applications of physics, may wonder in what these great advantages really consist. He will remember that the employment of tungsten in place of carbon for the filaments of incandescent lamps, and the consequent improvement in efficiency from 4 to 1¼ watts per candle-power, dates back to five years ago, and will point out that in the present form of this lamp a tungsten filament is still used, heated to the same temperature, and consequently having the same light efficiency. As to electric heating, he may even be still more sceptical, for, when at school or college, he may have learnt that the energy of an electric current flowing continuously through a resistance is transformed into heat, and that no invention can make the heat generated greater than is represented by the square of the current multiplied by the resistance of the wire. It will, therefore, not be out of place to pass in review

the actual improvements in detail which enable the electrical engineer to substantiate his claim that great progress has been made.

Taking the case of electric lighting first. The efficiency of the incandescent lamp depends entirely upon the temperature of the filament, if we neglect for our present purpose the hypothesis of selective emissivity of certain substances, which, although advanced from time to time, has never been completely established, and in any case would only slightly affect the accuracy of the above general statement. Tungsten, being more refractory than carbon, can be kept continuously at a higher temperature without volatilising, and a tungsten filament would give three times the light of a carbon filament for the same consumption of power and the same life. But as the specific resistance of tungsten is lower than that of carbon it was necessary to produce a finer filament than the carbon one, and to find a means of supporting a greater length of this fine filament in the lamp. These difficulties were at first only partly overcome. The filament of a 25-c.p. 220-volt carbon lamp has a diameter of about 0·16 mm., and a length of about 350 mm., while the filament of a tungsten lamp of the same candle-power and voltage is about 0·02 mm. in diameter and 830 mm. long.

To produce pure tungsten in the form of a rod with a diameter in the order of a few hundredths of a mm. it was necessary to mix it with other materials, to press or "squirt" a filament of the required diameter, and to eliminate the foreign substances by various processes, at the same time "forming" and strengthening the pure tungsten filament which was left. This resultant filament was exceedingly brittle, especially when cold, and it could only be made in short lengths, so that several separate loops had to be independently supported and joined in series in each lamp; obviously a delicate operation in view of the fragility of the filament and the difficulty of welding tungsten to other metals.

At first, therefore, the filament could only be made of small enough diameter and high enough resistance for comparatively high candle-powers, and for voltages not greater than 110 volts; and, in fact, when the first tungsten lamps were put on the market as articles of commerce only one diameter of filament was used, and the length varied according to the voltage, so that the buyer had to be satisfied with one particular candle-power of lamp suited to his voltage. Month by month and year by year, however, the manufacturing processes were improved, the filaments were made stronger, finer filaments were pressed and formed, and the methods of mounting them were bettered. The range of sizes and voltages was gradually increased, and during the first half of 1909 16-c.p. 100-volt lamps and 32-c.p. 200-volt lamps with tungsten filaments were placed on the market, followed in the autumn of that year by a 25-c.p. 200-volt 32-watt lamp.

With this, the limiting size of a squirted filament seemed to have been reached, but in the meantime painstaking research work had been carried on in the laboratories of the chief lamp manufacturers, with the object of finding a process for actually drawing tungsten in the form of a wire. This has now been finally accomplished on a commercial scale, and during the last two months three of the leading incandescent lamp manufacturers in this country have already practically "scrapped" their comparatively new filament presses used for the squirting process, and are making their lamps with filaments of tungsten wires. The new wire filament has an enormously greater strength, and as in addition it can be used in the lamps in one continuous length without joints, the robustness of the lamp has been so improved that it is as great as that of one with an ordinary carbon filament. Finally, it has been already found possible to produce finer filaments of drawn wire than by the squirting process, and, as has already been announced in our columns (September 28, p. 420), at the opening of the Electrical Exhibition at Olympia on September 23, a 16-c.p. 220-volt 20-watt Osram lamp was shown, as an article of commerce, with a filament only about 0·015 mm. in diameter.

During the various stages of the introduction of the metal filament lamp, the electrical engineer set himself the task of making the utmost use of the economy which it occasioned in the consumption of electrical energy. For equal light, one-third of the energy was being consumed as with the carbon filament lamp, and the consequent cheapening of electric light opened a much wider field, and brought it within reach of the smaller householder. There were, however, two obstacles to overcome: first, the fact that the metal filament lamps for the usual town-lighting voltages were only to be obtained in comparatively large sizes, so that although the consumer obtained three times the light at the same cost, he could not light a small room at one-third of the cost; and, secondly, the expense of wiring a house for electric light acted as a deterrent to the small householder.

The first of these difficulties was overcome, in alternating-current systems, by the interposition of a small transformer or "auto-transformer" between the consumer's main switch and his lamps. A voltage of 25 or 50 could thus be obtained, for which pressures metal filament lamps down to the smallest candle-powers have been obtainable during the past four years. A wastage of electrical energy is, however, liable to occur when no lamps are on, unless the consumer then turns off the supply at his main switch, for otherwise magnetising current is passing through the primary of the transformer all day long, whether lamps are switched on or not. To prevent this waste automatic switches have sometimes been employed to disconnect the transformer when all lamps are extinguished, and to reconnect it as soon as a lamp is turned on.

One of the latest types of these (made by Messrs. Muirhead and Co.) is shown in Figs. 1 and 2. In this case an auto-transformer is employed; that is to say, a coil connected across the mains with a tapping at a point corresponding to the pressure required for the secondary circuit. The construction of the switch is clear from the general view and diagram. When no lights are on, the main circuit of the auto-transformer is open at the mercury cup 1. As soon as one lamp is switched on, a circuit is established through the coil marked starting coil, and the "auxiliary" coil and "main" coil in series, and the core seen in the two illustrations is sucked into the coil, making contacts 1 and 2. This connects the auto-transformer to the mains at contact 1, and also short-circuits the starting coil at contact 2. When a few more lamps are in circuit, bringing the current up to 2·2 amperes, the core has been sucked in further, and contact 3 is made, short-circuiting the "auxiliary" coil and leaving the main or retaining coil only in circuit. The object of successively short-circuiting the first two coils is to diminish the voltage drop. On the lamps all being switched off, the arm falls by gravity, and the auto-transformer is out of circuit.

One of the largest items in the wiring of houses is the cost of fixing the steel tubing or wooden casing in which the wires are placed. In those houses where surface work is not objected to, use is now frequently made of metal-encased wires, which are simply fixed on the walls by metal saddles. The metal casing is

in the form of a tube of thin tinned copper or a lead alloy pressed round the insulated wire, and forming an integral part of it. When low-voltage wiring is supplied through a double-wound transformer, the outer metal sheathing of the wire is used as a return conductor; in the case of the lead-covered wire there is a thin copper tape under the lead to improve the conductance. For continuous current and houses supplied through an auto-transformer, a twin wire is usually employed, the two wires being under one sheath. In both cases it is essential that the outer sheath shall be mechanically continuous; in the concentric system this is obvious, and in the twin system the continuity of the casing, which is then earthed at one end, is necessary to secure immunity from shock or fire in case of leakage. The necessary "bonding" of the sheathing, therefore, forms part of the "system," and various simple arrangements are used for connecting the wires to the fittings, which effectually prevent this bonding from being omitted.

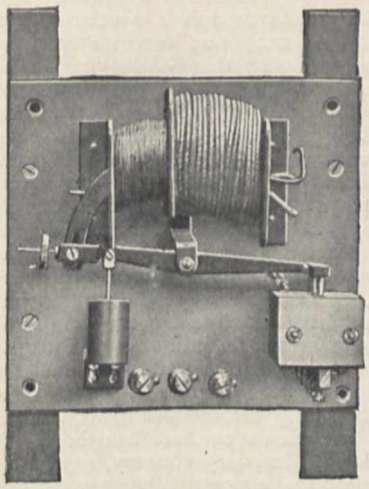

FIG. 1.—Automatic Transformer Switch (cover removed).

In comparison with the triumphs that have been accomplished in the laboratory and works in connection with lamp manufacture, the improvements in heating and cooking apparatus will appear slight. They are largely pure improvements in constructional details. The success of electric cooking has been

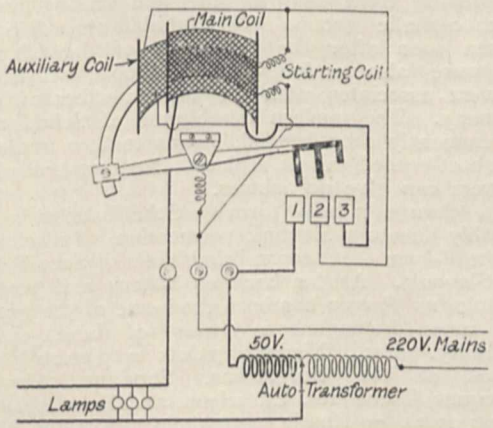

FIG. 2.—Diagram of Automatic Transformer Switch.

almost entirely due to the possibility of bringing the actual heating element in the closest possible proximity to the object to be heated, so as to heat nothing else than the actual surfaces required for the cooking operation; this is, of course, not possible to such a degree either with coal or gas cooking. To illustrate this two of the simplest examples may be taken. Fig. 3 is a "table toaster" shown open. The heating element is a ribbon of high-resistance alloy wound spirally on strips of mica. This glows with a dull-red heat when current is turned on. The bread is placed in the removable sides (one only is seen in the illustration), a piece on either side of the heater, and these are closed up so that the bread is held vertically, and parallel to the surface of the heater, with only a very short space between. As a result the bread is toasted absolutely evenly, and with no loss of heat at all. Fig. 4 is a section of the lower part of an electric kettle, and it is seen that the

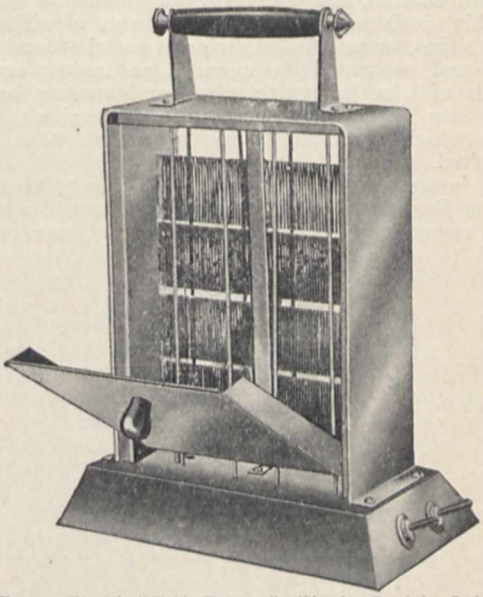

FIG. 3.—Electric "Table Toaster." (Simplex Conduits, Ltd.)

heating element projects into the bottom of the kettle, and is practically surrounded by the water.

In the larger cooking apparatus similar means are taken to bring the heating elements exactly where they are wanted, and to reduce the amount of heat lost by radiation and convection to a minimum. For instance, in most forms of electric oven at least three of the sides contain heating elements quite close to the interior surface; in nearly all makes the lagging is very thoroughly carried out, while others rely to some extent on giving the outside of the apparatus a bright surface to reduce radiation. It has also been proved by experiment that in roasting a joint in an electric

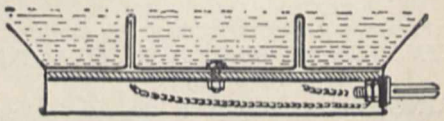

FIG. 4.—Arrangements of heating elements in Kettle. (Simplex Conduits, Ltd.)

oven, owing to the more even distribution of the heat there is less shrinkage of the meat, so that it retains its gravy; it appears that the smallest possible diminution of weight in a joint during cooking is an object aimed at by cooks and housewives, and that in this respect the electric oven has the same superiority over the gas oven as the gas oven has over the ordinary coal-fired kitchen range. The precision with which the heat can be regulated by switching on or off the heating elements as required is also a great advantage both as regards good cooking and absence of waste, and several makers adopt a series-parallel arrangement of connections and switching, so that all the elements are utilised, whether at full, half, or quarter heat, and there is absolute uniformity of temperature over the whole of the heating surface.

Great improvements have also been effected in the heating elements themselves. In the earlier apparatus it was customary to use coils of wire coated with or embedded in enamel, but trouble was experienced owing to the different coefficients of expansion of the wire and the enamel, and consequent cracking and gradual disintegration of the latter, due to unequal expansion. Enamel insulation has been considerably improved in this respect now, and some makers employ it with success, but the favourite method is to wind the high-resistance metal in the form of ribbon on mica strips, or to use flat strips of metal wound edgewise and separated by mica. One maker employs spirals of wire in quartz tubes, and another has for long been particularly successful with strips of mica upon which very thin films of metal have been deposited.

An interesting attachment to a water-boiler (made by the Bastian Electric Heating Syndicate) is shown diagrammatically in Fig. 5. Above the chamber containing the heater is a light, hinged metal flap, upon which bears the end of a rod connected to a catch lever holding the switch in the "on" position. The bubbling of the water when boiling causes the flap to rise, releasing the switch and thus turning off the current.

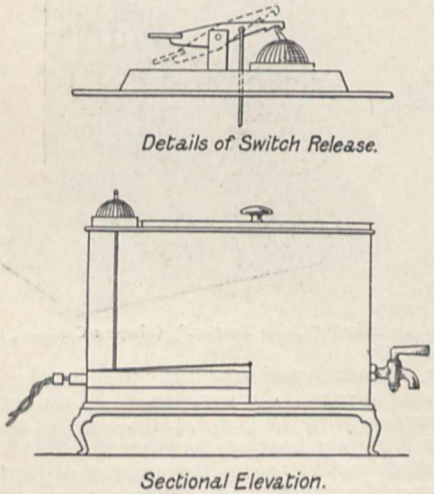

FIG. 5.—Water Heater with Automatic Switch.

MANKIND—FROM THE PLIOCENE TO THE PRESENT.[1]

DURING the last forty years the opening period of mankind has receded further and further into the past. At first we were content to count the years in thousands, then in tens of thousands, and now nothing less than hundreds of thousands is regarded as sufficient to cover the known period of man's existence on the earth.

The three works noticed here cover the whole of the human period so far as it is yet known. Dr. H. v. Buttel-Reepen deals with the Europeans of the Pleistocene or Glacial period, to which, following the teaching of Dr. A. Penck, he assigns a round half-million of years. Dr. Franz Schwerz takes up the story where Dr. H. v. Buttel-Reepen leaves off, and describes the various races which have inhabited his native canton of Schaffhausen since the Neolithic period began—one which he regards as commencing about 25,000 years ago. The third work, by Prof. Niederle, of the University (Tchéque) of Prague, is concerned with events which lie within the Christian period—the expansion and fate of the Slavonic race into south and central Europe and into Asia.

The three works are very different in nature; Dr. v. Buttel-Reepen's small monograph is a concise and excellent summary of the facts and theories relating to mankind in Europe during the Glacial period; it is the best of the many books that have lately appeared in Germany to supply a popular demand for information concerning early man, and is richly illustrated. Dr. Scherwz's monograph represents the results of personal research, and reflects the exact, elaborate, and painstaking methods of the Zurich school of anthropologists. Prof. Niederle's book is a stock-taking of the Slavonic race; he estimates that there were 139,000,000 Slavs at the commencement of the present century, more than 20,000,000 of whom occupy territories outside Russia, and are a continual cause of political unrest in central and eastern Europe.

It is the anthropological rather than the political data of Prof. Niederle's writings which interest us here. He appears to supply the answer to a problem which has puzzled Dr. Schwerz and has been an enigma to anthropologists in every country, especially in England. The problem concerns the source and supply of the brachycephalic races of central Europe and their sporadic appearance in Britain. The oldest human remains yet found in Schaffhausen—a canton almost surrounded by German territory—are those of Schweizersbild—remains which supplied Prof. Kollman, of Basle, with the basis for his famous theory of a pygmy prehistoric race in Europe. There can be absolutely no doubt that the Schweizersbild Neolithic men are identical with the Neolithic English described by Huxley as the "river-bed type"—people of rather low stature and with small heads, somewhat compressed from side to side and falling in the dolichocephalic group. The inhabitants of Schaffhausen soon after the beginning of the Christian era were also a long-headed people, which Dr. Schwerz associates with the Reihengräber of south Germany. The modern inhabitants of Schaffhausen are eminently short-headed, but as to how and when the short-headed people replaced the long-headed Dr. Schwerz can give no answer.

The change in head form in Schaffhausen is most probably due to a Slavonic permeation. In colouring and head-form the modern inhabitants of Schaffhausen are Slavonic. As far back as history and tradition can take us Russia has been the home of the greatest and most homogeneous mass of brachycephalic humanity. Prof. Niederle paints a picture of the exodus of the Bulgarians, Servians, Slovenes, Slovoques, Tschéques, Lusaciens, and Poles, from the parent stock in Russia, and their absorption in the German-speaking peoples.

We may be certain that what has taken place in historical times—a continuous exodus and absorption of the round-headed Slavonic stock—had been at work during the greater part of the Neolithic period, if not earlier. A round-headed race is not known to occur in western Europe until the latter part of the Paleolithic period. There is every reason to regard the short-headed races of mankind as comparatively recent products of evolution; every known example of Glacial and early post-Glacial man, with the possible exception of some Krapina people, is of the long-headed

1 "Aus dem Werdegang der Menschheit. Der Urmensch vor und während der Eiszeit in Europa." Von Dr. H. v. Buttel-Reepen. Pp. vi+139+109 figures in text+3 tables. (Jena: Gustav Fischer, 1911.)
"Versuch einer anthropologischen Monographie des Kantons Schaffhausen speziell des Klettgaues." Von Franz Schwerz. Neue Denkschriften der schweizerischen naturforschenden Gesellschaft, Bd. xlv., pp. 83-292+80 figures+1 map+87 tables. (Zürich: Zürcher & Furrer, 1910.)
"La Race Slave, Statistique, Démographie, Anthropologie." Par Prof. Lubos Niederle. Traduit du Tchéque par Louis Léger. Pp. xii+231+1 map. Paris: Félix Alcan, 1911.) Price 3.50 francs.

type. From the present distribution of the short-headed races we may regard Russia as the most probable cradle of this race. The brachycephalic fair-haired European may be regarded as the latest and perhaps highest product in evolving humanity. Time will show that the brachycephalic peoples of Europe are essentially of Slavonic origin, and that brachycephaly will prove to be a Mendelian dominant in the fusion of long- and short-headed peoples.

Dr. v. Buttel-Reepen adopts Dr. Penck's three intermissions of the Glacial period—a first, second, and third; and in the tentative condition of our knowledge that division is as good as another. To the beginning of this period he assigns *Homo Heidelbergensis*, known from his mandible only and by the Eoliths ascribed to him. A minute study of this mandible leaves no doubt that *Homo Heidelbergensis* must be assigned to the Neanderthal race. Remains of this race are also ascribed to the second interval and the third succeeding Ice age—a period estimated at 200,000 to 400,000 years. If such a period is approximately correct, then it is wonderful that the type remained so constant throughout such a vast interval of time. We know of only nine crania of the race, and the limb bones of only five or six individuals, and in all of them the state of preservation is incomplete.

The rarity of such specimens probably explains the extraordinary sum paid by the Museum für Völkerkunde, in Berlin, for the skeleton discovered by Herr O. Hauser near Le Moustier in 1908—a price, according to Dr. Buttel-Reepen, amounting to 160,000 marks. The skull of this skeleton, like that found at Chapelle-aux-Saints, was so broken that in neither case has an approximately accurate reconstruction been made. Indeed, the only cranium which is nearly complete and intact is that found at Gibraltar so long ago as 1848—nine years before the discovery of the Neanderthal calvaria. This cranium, which Dr. Buttel-Reepen regards as of little scientific value, is, in the opinion of the writer, the most primitive and therefore probably the oldest of all the remains yet found of the remarkable Neanderthal race. It is the only one which shows a cranial capacity decidedly below the average of modern Europeans; the palate, and especially the teeth, are of the most primitive form known in this race. In such a long period of time as that ascribed to the Ice age, there must have been a succession of many races, and in the remains found at Krapina (Croatia), and at Spy (Belgium), we see what is apparently a mixture of older and more recent forms.

In the third interval of the Ice age the Neanderthal race apparently disappeared; his successor at present is supposed to be the type of man found at Gally Hill in Kent, and at Brünn in Moravia—a long- and narrow-headed race, so unlike the Neanderthal that Prof. Klaatch propounded the theory of a multiple simian origin for human races—a theory which Dr. v. Buttel-Reepen says must be taken *cum grano salis*. The remains found in the Grimaldi cave, near Mentone, and the Cro-Magnon race are also assigned to the close of the Glacial period. The Cro-Magnon race, which thus early appeared in Europe, is from a physical point of view, and also as regards the cranial capacity, one of the finest races of mankind ever evolved. The bearing of all recent discoveries of ancient man in Europe, both as regards his physical structure and his culture, is to remove the beginning of humanity into a more remote past—one which reaches into the Pliocene period at least.

Dr. Buttel-Reepen, like of many of his German colleagues, is inclined to assign the skull discovered in Gough's cavern, Cheddar, and described by Mr. H. N. Davies in 1904, to the Palæolithic period. There can be no doubt this is an error, for the cranium in question is an example of the "river-bed" type—the characteristic form in England during the early Neolithic period. The Tilbury skull, and one recently found in a Derbyshire cave by the Rev. E. H. Mullins, are also of this type. A. KEITH.

COAL DISCOVERIES IN BRITISH COLUMBIA.

THE announcement, made in a special article in *The Times* of October 14, on "Coal in British Columbia," that an "immense body of anthracite coal exists at the head-waters of the Skeena . . ." to quote the words used in the telegram from the Minister of Mines of that province, need cause no surprise when it is considered how little is yet known about the mineral resources of the vast territories comprised within the Dominion of Canada. If the figures given by Reuter may be taken as trustworthy, 2100 square miles and 43,000,000 tons per square mile, the estimated coal resources of the province leap up in a single bound from 40,225,000,000 tons, as estimated in 1910, to 130,525,000,000 tons, the addition amounting to about three times the quantity estimated to be contained in our own South Wales coalfield.

Very little information appears to have been allowed to leak out regarding this immense coalfield almost up to the moment when publicity was given to the foregoing statements. All that is said about it in the annual report of the Minister of Mines for the year ending December 31, 1910, is that "the anthracite district around the head-waters of the Skeena continues to attract attention" (p. K88). Again, on p. K176 of the same document a summary is given in the form of a table of the estimated coal-content of the various known coal areas in British Columbia, extracted from a paper read by Mr. D. W. Dowling, of the Geological Survey, before the Canadian Mining Institute at the Quebec meeting in March, 1911, in which the Skeena River is credited with sixteen square miles and 61,000,000 tons of anthracite. Lastly, when the present writer had the pleasure of meeting Mr. McEvoy (mentioned in the telegram of the Minister of Mines) in Toronto on March 7 last, nothing that he can recollect was said to give him any clue to the vastness of the coalfield which Mr. McEvoy was then about to re-visit.

In the table referred to above the names of twelve separate coalfields are given, probably all of Cretaceous age, containing 39,674 million tons of bituminous coal; three, probably of Tertiary age, containing 490 million tons of lignite; and one, the Skeena River coalfield, the geological age of which is not mentioned, containing sixty-one million tons of anthracite. The largest areas are those of Comox, 300 squares miles; Nanaimo, 350; Elk River, 230; Elk River north, 140; Graham Island, 60, all containing bituminous coal; and Graham Island, 100, lignite. Although the areas of Comox and Nanaimo fields are the greatest, the assumed thickness of coal in each, namely, six feet, puts their estimated reserves far behind those of the two Elk River fields, each with 100 feet of coal distributed in a number of separate seams. As stated in the article in *The Times*, the two first are in Vancouver Island. The seams of coal, Douglas and Wellington, with a rider from two to three feet thick under the first, and a similar rider from two to four feet thick above the second, crop out at a greater or less distance from the shore, not exceeding six or seven miles perhaps at most, and dip under the sea in the Strait of Georgia and under the small islands near the shore. The two last, Elk River and Elk River north, are cut through by the defiles in, and not far from, the watershed of the Rocky Mountains, and

consequently many of the seams of coal are accessible by means of day-levels. The present writer would have thought that a greater thickness than six feet of coal could have been attributed, at any rate to the seams in the Nanaimo coalfield, as the Douglas seam occurs in the form of lenticular masses, the maximum thickness of which attains as much as twenty-six and twenty-eight feet at some points, and as the Wellington seam, which underlies it at a depth of seven hundred to one thousand feet, is from three to six feet thick.

The following analyses will serve to show the character of the bituminous coals referred to above :—

	Comox per cent.	Nanaimo per cent.	Elk River per cent.
Moisture	1·47	4·60	0·87
Volatile combustible matter	28·19	33·70	23·11
Fixed carbon	64·05	54·70	70·70
Ash	6·29	7·00	5·32

The proportions of all these constituents vary in each of the coalfields, the moisture attaining in some cases as much as 7 per cent., volatile combustible matter more than 40 per cent., and ash 10 per cent. and more. Some of the seams make good coke, when the proportion of moisture is low enough (not exceeding 2 per cent.).

The produce of the Vancouver Island Collieries is in demand along the western coast of America; that of the Elk River Collieries supplies smelting works in the United States, railways, and so on.

The produce of the Skeena River Collieries will have about 180 miles to travel to the coast at Prince Rupert, and will thereafter have to compete with the bituminous coals of Vancouver and some of the other islands along the coast, which can ship their coal directly into the holds of the ships which use it.

It is to be hoped that in the great field the existence of which has been foreshadowed, some of the supposed anthracite will be found to contain at least 12 per cent. volatile combustible matter, as "drier" coals and true anthracites, containing from 3 per cent. to 6 per cent., are not considered suitable for steam-raising purposes in European countries, on account of their slow rate of combustion, although Pennsylvanian anthracite seems to be quite acceptable in some parts of the United States.

DR. HUGHLINGS JACKSON, F.R.S.

THE recent death of Dr. Hughlings Jackson has called forth that widespread recognition amongst men of science which his modesty and retiring nature rendered impossible during his lifetime. To many, and particularly to workers in scientific fields remote from medicine, his name is unknown, and yet, although he never performed an experiment, no one man has so profoundly influenced the growth of our knowledge of the functions of the nervous system.

John Hughlings Jackson was born in 1835, at Green Hamerton, in Yorkshire, and began the study of medicine at York. After a short period as a student at St. Bartholomew's Hospital, he became qualified to practise medicine in 1856, and then returned to York for two years as house-surgeon to the dispensary. In 1862 he was appointed assistant physician to the National Hospital for the Paralysed and Epileptic, and in 1863 he became assistant physician to the London Hospital. These are the material facts in Dr. Jackson's outwardly uneventful life.

At the National Hospital he came in contact with two men who influenced the direction of his thoughts, Brown-Séquard, from whom he acquired a knowledge of the recent work of French physiologists, and Lockhart Clarke, whose beautiful microscopic preparations taught him the minute anatomy of the nervous system. But in his early lectures, delivered between 1864 and 1868, he showed how quickly he had found that path which was to lead him by consecutive steps to his greatest generalisations. In 1864 he had already shown that paralysis of the right half of the body was associated, in most cases, with loss of speech, and characteristically gave the whole credit to Broca, whose work had appeared shortly before his lecture. Broca's observations were essentially anatomical, and are still the subject of dispute, but Jackson described forms of disturbed speech associated with hemiplegia, which stand untouched to-day. In 1866, he formulated the condition now known as apraxia, and repeatedly demonstrated cases of this disturbance to his pupils in the wards of the hospital. But he was forty years before his time, and apraxia was not generally recognised until its rediscovery by Continental observers.

At that time all work on the functions of the nervous system was dominated by the brilliant discoveries of the French School of Physiology, and Jackson's idea that convulsions arose from some change in the cerebrum and usually from a focus within the territory of the Sylvian artery was passed over in contemptuous silence. But when Hitzig and Fritsch showed, in 1870, that stimulation of the cortex could produce movements, Jackson's views came to the front, and local convulsions are now called by his name.

Step by step we can watch the growth of his great generalisation put forward in the Croonian lectures of 1884 on "Evolution and Dissolution of the Nervous System." He showed that in hemiplegia movements and not muscles were affected, for the brain is not dealing with tools but with functions. Thence he passed to the idea of "levels" in the nervous system, each of which represented a higher evolution; passage from one level to that above it was always from the general to the special in function, and from the simple to the complex in structure. Dissolution produced by disease or by experiment occurred in the inverse order, and the removal of the highest level set free the activities of those below. To this view Jackson gave the widest application, and explained the rigidity of limbs paralysed from cerebral disease by the over-action of uncontrolled centres in the cerebellum and spinal cord. So far back as 1877, he laid down that "the cerebellum is the centre for continuous movements and the cerebrum for changing movements," and so formulated the modern doctrine of the tonic nature of cerebellar activity.

These wide-reaching generalisations have not yet received their full application, but they permeate modern neurology; and the position of the English School is due largely to Dr. Jackson's stimulating influence and generous self-effacement. H. H.

AUGUSTE MICHEL LÉVY.

ON September 25, Auguste Michel Lévy, director of the Geological Survey of France, and Inspector-General of Mines, died in his sixty-eighth year. His work, which has had so wide an influence, covered the whole period of the rise of modern petrology. The systematic grouping of rocks was largely a French study at the opening of the nineteenth century; Michel Lévy carried on the tradition into far broader fields by concerning himself with their natural relationships and modes of origin. The great memoir entitled "Minéralogie micrographique; Roches éruptives françaises," in which he was associated with his master Fouqué, appeared in 1879, and showed how the methods of Sorby had been appreciated in

France, simultaneously with their development by Vogelsang, von Lasaulx, and Rosenbusch in Germany. A dual nomenclature, indeed, grew up, for certain structures in igneous rocks, of which traces are still clear when we compare works produced on opposite banks of that great factor in literature, the Rhine.

Lévy, in his desire to understand, and not merely to describe, set himself to construct igneous rocks by fusion in the laboratory, as Ste.-Claire Deville and others had constructed rock-forming minerals. In the domain of lavas the results, produced in collaboration with A. Lacroix, were especially successful, and surpassed the expectations of petrologists, who had previously been content with glassy slags. Carrying the study of the optical properties of minerals in thin sections to a high degree of refinement, Lévy and Lacroix issued their book on "Les Minéraux des Roches" in 1888, and the details there given have formed the basis for a long series of researches by their followers in many lands.

The separation of the members of the felspar family, those halting-points in the continuous series indicated, on chemical grounds, by Tschermak, received special attention in Lévy's memoir on the "Détermination des Feldspaths" in 1894. But those who have watched the development of the French Geological Survey will also recognise how much is due to Lévy as an organiser in the field. The gneisses of the Morvan occupied his attention twenty-four years ago, and in 1887, in a modest paper entitled "Sur l'origine des Terrains cristallins primitifs," published by the Socété géologique de France, he set forth his belief that dynamic metamorphism had been overrated as a cause of the crystallisation of minerals in schists. His official memoir on the "Granite de Flamanville" (1893) shows how far he was prepared to go in urging the potency of contact metamorphism and mutual absorption in the production of types of crystalline rock; and his views, associated as they were with the parallel work of Barrois, laid the foundation for many later observations, such as those of Lacroix, Sederholm, and Daly.

Lévy's official work extended to an investigation of the water supply of his country, a research of immense public importance, which is still in progress. His secure position as one of the foremost of scientific men earned him his election as a member of the Institute of France. For those who wish to have before them, and for future generations of their students, the record of the firm and noble features of Lévy as he lived, it may be well to mention the fine photogravure portrait now included in the series by Eckstein, of Berlin.

DR. F. AMEGHINO.

A CIRCULAR letter recently received at the British Museum (Natural History) from the president of the Sociedad Cientifica Argentina, Buenos Aires, announces the death of Dr. Florentino Ameghino, the well-known palæontologist, as having taken place at La Plata, on August 6. We believe that the cause of death was neglect of a limb that had been wounded in an accident, the deceased refusing to call in medical assistance. For many years Dr. Ameghino kept a small stationer's shop in La Plata, and it was there that much of his palæontological work was carried on. When and how his attention was first directed to this subject we have no information, but it must evidently have been during the 'seventies, as he published a paper entitled "L'homme préhistorique dans la Plata" in the second volume of the *Revue d'Anthropologie*, 1879. This was followed by a number of papers in various local journals on the Tertiary mammals of Patagonia, the materials of which were collected by his brother, Carlos Ameghino, who for many years afterwards continued to make collecting journeys to that country; but whether on his own account or at the instance of others we are unaware.

Figures and fuller descriptions of the, frequently fragmentary, specimens upon which scores of species and genera were founded in these preliminary papers were given in a quarto two-volume work, published at Buenos Aires in 1889, under the title of "Contribucion al conocimento de los Mamiferos fosiles de la República Argentina." This was followed by a perfect stream of memoirs and papers on the fossil mammals and birds of Patagonia and other parts of the Argentine Republic, in all of which the author insisted that the Santa Cruz beds are Lower Eocene, and some of the other mammaliferous horizons of Patagonia Cretaceous, whereas most palæontologists consider them to be not older than Oligocene.

In 1895 Dr. Ameghino published in Buenos Aires an important memoir entitled "Sur les Oiseaux fossiles de Patagonie," in which appeared a full account of the gigantic seriema-like Phororhachis. The discovery and description of this wonderful bird were alone quite sufficient to have made Ameghino's name celebrated in palæontological annals; another great discovery being that of the development of a monodactyle type of foot in an animal far below the grade of the horse. That Ameghino, out of the redundance of his material, should have been profuse in naming species and genera, is, although a matter for regret, scarcely to be wondered at, and must not be allowed to obscure our view of the value of his work in bringing to notice the marvels of the ancient fauna of Patagonia.

On the death of Dr. Carlos Berg, Dr. Ameghino was appointed director of the Museum at Buenos Aires, a post he held until his death.

NOTES.

REUTER'S agency states that the British Government is sending out a further commission to Central Africa in connection with sleeping sickness. This will be in charge of Colonel Sir David Bruce, who will be accompanied by Lady Bruce, and assisted by Captain Hamerton, R.A.M.C., Prof. Newstead, of the Liverpool School of Tropical Medicine, Major Harvey, R.A.M.C., Staff-Sergeant Gibbons, and Mr. James Wilson. The work of the commission will on this occasion be confined to Nyasaland, where more than forty cases of sleeping sickness have occurred since 1909. The commission, which is also under the auspices of the Royal Society, is expected to be absent from England for three years. Sir David and Lady Bruce will leave Marseilles on November 10, and will proceed up the Zambezi and the Shire Rivers to Blantyre and Zomba, the capital of Nyasaland. One of the principal objects of the commission is to endeavour to ascertain whether the existence of the fly supposed to be responsible for sleeping sickness in Nyasaland depends upon the presence of big game.

ALL artists and chemists will learn with regret that Sir Arthur Church has decided to retire from his position as professor of chemistry to the Royal Academy, where he has for so many years not only acted as guide to the young art student through the intricate subject of chemistry as applied to the painting of pictures, but has also performed invaluable services both in advising and assisting artists in their work, and on many occasions helping the Government in the preservation of works of art. His careful

investigations and restorations of the frescoes in the Houses of Parliament, and his invaluable work in the preservation of ancient stone buildings, such as Westminster Abbey, are well known to all who are acquainted with these subjects. While on one hand Sir Arthur Church was for many years professor of chemistry at the Royal Agricultural College at Cirencester, and has done invaluable work in connection with the application of chemistry to agriculture, on the other hand he may be said to be one of the few living chemists who have applied their scientific knowledge to the problems connected with the applied arts; and he has done this not only in the department of chemistry, but also in the scientific theory of colour as applied to decoration. He is also known as an authority on precious stones, porcelain, and earthenware, and has shown all his life that interesting combination of the scientific and artistic temperament which is rarely found. It is to be hoped that his retirement from the professorship will mean merely that he will have greater leisure to continue his many researches on the application of chemistry to painting, researches upon which the permanency of some of our greatest works of art must ultimately depend.

REUTER reports that a slight earthquake shock was felt at Catania on October 15. The shock was more severe at Giarre, Macchia, Guardia, Rondinella, and Santa Venerina.

THE South African Branch of the Royal Sanitary Institute is arranging to hold a congress in Cape Town on November 9–11. This is the first sanitary congress to be held in British South Africa.

THE death is announced, on October 10, of Dr. W. R. Huggard, the British Consul at Davos, Switzerland. Dr. Huggard was an authority on mental diseases and tuberculosis. He was not a prolific writer, but was known as the author of a "Handbook of Climatic Treatment, including Balneology," and a few papers in medical periodicals. Dr. Huggard had been a resident at Davos for twenty-five years.

THE death is announced of the Rev. Mariam Balcells, S.J., professor of mathematics at Boston College, Mass. A native of Tarragona, he was for a time connected with the Spanish Geological Survey. He became director of the Ebro Observatory of Cosmical Physics, which he had himself built during his earlier career as an engineer. He introduced into Spain the study of the solar chromosphere by means of the spectroheliograph, and in collaboration with Father Cirera, now the director of the observatory, made various investigations of the relation between solar activity and terrestrial magnetism.

FROM the Abor expedition, which is about to start, we have a good prospect of learning more about this little-known region. Besides the surveying work which is always carried out on such mountain expeditions, the Government of India has arranged for as much scientific investigation to be carried out as the circumstances will admit. According to *The Morning Post*, Mr. J. H. Burkill will be the botanist, and Mr. S. Kamps and Mr. R. Hodgirt will take charge of zoology and anthropology respectively. A geologist will accompany the expedition, but the definite appointment has not been announced. Captain Trenchard and Lieut. Oakes are in charge of the survey operations. An interesting experiment is being made with various forms of rations, and especially with compressed tea, which has been made up into small cases of 45 lb. each for handy transport.

AT the present time Mr. Chas. Urban, who has done so much to correct our geographical impressions, is exhibiting at the Scala Theatre a "kinemacolor" representation of the recent eruption of Etna. It is not an exciting show, though possibly the photographer got uncomfortably hot, for the most interesting feature of the film is the portion depicting the slowly advancing front of a lava stream. This is well worth seeing by any geologist who has not actually witnessed this type of flow. There is a peculiar fascination in watching the deliberate fragmentation of the cooling lava-crust, with the continuous detachment of solidified blocks, each with its attendant puff of white steam. Sitting in the comfortable seats of the Scala, the visitor would like more of this portion; but no doubt there were difficulties.

THE eighteenth International Congress of Americanists is to be held in London from May 27 to June 1, 1912. This will be the first time the congress will have visited Great Britain. The main subjects to be considered at next year's meeting are:—(*a*) the aboriginal races of America, their origin, distribution, history, physical characteristics, languages, customs, and religions; (*b*) the monuments and archæology of America; and (*c*) the history of the discovery and occupation of the New World. H.R.H. the Duke of Connaught is the patron and Sir Clements Markham president. The organising committee includes Sir Richard Martin, Sir T. Holland, Dr. C. H. Read, Profs. Gowland and J. L. Myres, Mr. H. Balfour, and others, with Mr. Alfred Maudslay as chairman. Titles of papers to be presented at the meeting of the congress should be sent immediately to the secretary, c/o the Royal Anthropological Institute, 50 Great Russell Street, London, W.C.; and it is further requested that synopses of the papers may be sent in by March 31, 1912. Communications may be oral or written, and the languages admitted are English, German, French, Italian, and Spanish.

MR. E. A. GAIT, Census Commissioner for India, has collected into a single volume the detailed instructions issued to the provincial superintendents describing the subjects on which it is desired that information should be collected and embodied in their reports now in course of preparation. Of particular interest are the inquiries into the internal working of the caste system and the extent to which the rulers of independent States exercise their traditional prerogative of interfering in such matters; the investigation whether the existence of the Mendelian law can be traced in the crosses between different races; birth and marriage customs; and numerous other subjects which have been discussed only in a summary way during the last and previous enumerations of the people. If the provincial superintendents, in addition to the task of compiling and explaining the statistics, can find time and opportunity for undertaking this investigation, the forthcoming reports of the census of 1911 are sure to furnish materials of much interest to students of anthropology and sociology.

THE committee appointed to investigate ancient earthworks and fortified enclosures has prepared a report for presentation to the Congress of Archæological Societies. The committee reports steady progress in the investigation of these monuments, in particular in Hampshire, where Dr. J. P. Williams is engaged in cataloguing the barrows of that county after the completion of his list of earthworks. Measures of preservation have been adopted in the case of the Stokeleigh Camp in Somerset, the Scambridge Dykes in Yorkshire, and at Skipsea in the

same county. The committee regrets to announce grievous destruction at the earthworks of Willington in Bedfordshire, Penmaenmawr in Carnarvonshire, Uley Bury in Gloucestershire, Stainton in Westmorland, and of the ditch round the top of Windmill Hill at Avebury, in Wilts. Excavations have been carried out on several sites, the most important being those at Avebury under the control of Mr. St. George Gray, and some preliminary investigations of Stokeleigh Camp, in Somersetshire, by Prof. C. Lloyd Morgan and Mr. A. E. Hudd, but nothing was found to throw further light on the origin and construction of the camp. At Old Sarum the work of the Society of Antiquaries was practically confined to the uncovering of masonry structures.

In 1878 ("Cat. Chiroptera Brit. Mus.") Dr. Dobson gave the name *Kerivoula brunnea* to a bat collected by Sir Andrew Smith years previously, leaving it open whether the habitat was South Africa or Madras. Until a short time ago that specimen remained the only known representative of the species; but it is announced in the Annals of the Transvaal Museum for April that a second example has been obtained in Portuguese East Africa, thus fixing the habitat.

In an article on a new species of Hipparion (*H. proboscideum*) from the Upper Tertiary of Samos, published in *Verh. Deutsch. Zool. Ges.*, 1910–11, p. 192, Prof. Studer expresses the opinion that the preorbital depression or pit found in the skull of many members of the horse group is not for the reception of a lacrymal gland, but is for the purpose of muscular attachment, and attains its maximum development in species like Onohippidium and *Hipparion proboscideum*, which were probably furnished with a proboscis. The position of the pit, it is stated, differs somewhat from that of a true larmier, and the inframaxillary foramen is always some distance from the pit. This accords, in some degree, with the views of Mr. R. I. Pocock, who has pointed out that in Onohippidium the pit is divided into two moieties, one of which may have contained a gland, and that the pit in Hipparion is probably also glandular. From the fact that a preorbital pit occurs in Merychippus, as well as in the above-mentioned genera, Dr. Studer is inclined to think that a proboscis may have been developed in most or all of the forerunners of the horse group.

A third part of the publication "Illustrations of New South Wales Plants," for which Mr. J. H. Maiden is responsible, contains descriptions of seven species of Callistemon, the bottle-brushes, and four species of Swainsona; all except *Callistemon lanceolatus* are illustrated. A key to the species of Callistemon, prepared by Mr. E. Cheel, separates a large section having anthers with free filaments from a small section displaying coherent filaments. Certain species are cultivated, notably *C. rigidus* and *C. pinifolius*, here described. Swainsona, belonging to the Papilionatæ, includes some fodder plants and a few that are poisonous to stock.

A puzzling fossil organism, named Traquairia by Mr. Carruthers, forms the subject of a short article contributed by Mrs. D. H. Scott to the *Annals of Botany* (April), a separate copy of which has just reached us. The chief feature in the organism is the complicated structure of the outer envelope, with an elaborate system of anastomosing tubes connected with prominent spines. It was originally referred by Mr. Carruthers to the radiolarians, but subsequent botanical investigators have regarded it as a possible reproductive organ of a cryptogamic plant. Without expressing a definite opinion, the author inclines towards the original suggestion. The chief object of the paper is to identify and describe four species that differ primarily in the nature of the spines.

Arising out of an investigation into the sources of the Ignatius beans of commerce, furnished by species of Strychnos, Mr. A. W. Hill has prepared a revision of East Indian and Philippine species of the genus, and it is published in *The Kew Bulletin* (No. 7). The section, characterised by long corolla tubes and large fruits containing strychnine, forms a very natural group, ranging in distribution throughout the area, although the individual species conform to the general rule of localised distribution. Types of seven new species are described. Another systematic article is provided by the list of new African plants, which includes two new genera, Discoglypremna and Sclerodactylon. Also a new genus, Dipentodon, showing unique floral characters, is discussed by Mr. S. T. Dunn, who places it provisionally in the Celastraceæ.

The United States Geological Survey has published ten bulletins (Nos. 457–464, 469, 472, 473) dealing with the results of spirit-levelling during the last ten or fifteen years in various parts of the country. A plate showing the form of bench-mark used is now included to facilitate recognition of the bronze or aluminium plate on which the altitude to the nearest foot, before the final corrections are applied in the office, is stamped.

The Canadian Department of Mines has published a summary of the triangulation and spirit-levelling carried out in Vancouver Island, B.C., in 1909. Descriptions of the stations are given, and the azimuths, back-azimuths, and distances of points observed from each station are tabulated; but the method of observing is not stated, nor is the accuracy attained anywhere indicated. An 8-inch theodolite, with two micrometer microscopes reading to two seconds, was used. The levelling was carried out with a 14-inch Dampy level, each line being run at least twice; altitudes are tabulated to 0·001 foot, but here again there is no indication of the precision aimed at or attained.

The mining town of Burketown is in the north-western corner of Queensland. Its ore deposits were first discovered by Mr. F. H. Hann in 1887, but mining was only begun in 1897; since then several of the ore deposits have been worked, and concentrates carted to the coast at Burketown, one hundred miles distant. The leading mining company of the district, the Queensland Silver Lead Mines, Ltd., recently arranged for an inspection of the field by one of the officers of the Queensland Geological Survey. The work was entrusted to Mr. Lionel C. Ball, whose report, illustrated by five maps, twenty-three plates, and forty plans, has now been issued by the Geological Survey of Queensland (Publication No. 232). Mr. Ball is impressed by the widespread distribution of the ores; but the quantity of high grade is small, and the success of the field will depend upon the large low-grade ore bodies. The ore deposits are mainly brecciated lodes in a series of silicified sandstones and indurated shales. The report contains not only a precise account of the chief mineral deposits, but includes some important contributions to the geology of north-western Queensland.

The U.S. Weather Bureau has issued a special bulletin relating to the destructive hurricane which visited the South Carolina-Georgia coast on August 27–28. Synoptic weather charts are drawn for the Atlantic Ocean for August 25–28, giving the position of the hurricane; reports from vessels show that the storm was in process of forma-

tion on August 23 in about latitude 24° and longitude 67° 30′. Its course was far north of the normal path of tropical disturbances at this season of the year, and its influence was not felt at any stations in the West Indies; the first signs of its approach were felt at the land stations that suffered most, viz. Charleston and Savannah, on the morning of August 27, and warnings of its approach were fortunately sent by the Central Bureau to both those stations and to shipping at various ports, thus minimising the danger so far as possible. The centre of the hurricane reached the coast near Savannah at 8h. a.m. of August 28, passed through eastern Georgia, recurved over North Carolina to E.N.E., and passed to sea off the New Jersey coast. Immense damage was wrought, both to houses and shipping, the velocity of the wind at places exceeding 100 miles an hour (factor 3?). Prof. Moore remarks that, had wireless reports been at hand, it would have been possible to give warning of the approach of the storm several days previously; but this would not have saved the hundreds of houses unroofed, the destruction of telegraph wires, and the like.

As stated in NATURE of September 28 (p. 417), at the Turin meeting of the International Electrochemical Commission the committee on international symbols agreed provisionally to the proposals made at the Brussels meeting. These were to represent mass, length, and time by M*m*, L*l*, and T*t*; electric current, electromotive force, and resistance by I, E, and R; quantity of electricity by *Qq*; magnetic field and induction by H and B; inductance by L; the last three symbols to be printed in special type not yet settled. The maximum value of any quantity to be indicated by the subscript *m*.

THE *Verhandlungen* of the German Physical Society for September 15 contains a paper by Dr. A. R. Meyer, of the University of Greifswald, on the change of the electrical resistivity of pure iron from 0° to 1000° C. The iron is in the form of a wire, and is enclosed in an evacuated glass bulb. Its resistance is measured by the fall of potential down the central portion of it, due to the passage of the heating current. Its temperature is measured thermoelectrically by means of a fine platinum platinum-rhodium junction in contact with it, or by means of a radiation pyrometer. For each of three specimens of iron the resistance increases more rapidly with temperature as the temperature rises until 700° C. is reached. Above this temperature the rate of increase is smaller and more nearly uniform. Up to 700° C. the watts spent in the wire, the current through it, the electromotive force at its ends, and its resistance are all proportional to powers of the absolute temperature.

THE September issue of the Journal of the Chemical Society contains obituary notices of Profs. Beilstein, Erlenmeyer, Fittig, Landolt, and Menschutkin. In addition to the biographic and scientific narrative, an admirable series of portraits is given. In the case of Prof. Beilstein, the notice is signed by Prof. Otto N. Witt.

THE forty-second volume of the *Sitzungsberichte* of the Physikalisch-medizinischen Sozietät in Erlangen has recently come to hand. In addition to five papers by Prof. E. Wiedemann on the history of science, the volume includes chemical papers on the halogenaurates of ethylene- and propylene-diammonium, by A. Gutbier and C. J. Obermaier on the copper salts of ferro- and ferri-cyanic acid, and by L. Hovermann on the atomic weight of iridium. The values deduced for this atomic weight by four different methods from the analysis of the salt K_2IrCl_6, were 192·942, 192·881, 192·956, and 193·116, whilst the analysis of the salt $(NH_4)_2IrCl_6$ gave the value 193·403.

The Scientific American of September 16 is devoted specially to industrial chemistry. It contains articles on "How Electricity is Aiding the Chemist," by Prof. W. H. Walker, of Massachusetts; on "Artificial Rubber," by Prof. Ira Remsen; on "Testing before Buying," by Dr. C. F. McKenna; on "Catalysis," by A. J. Lotka; on "The Industrial Chemist," by Prof. R. K. Duncan; and on "The Technically Trained Foreman," by Dr. Allen Rogers. The magazine is attractively produced, and contains a number of interesting and unfamiliar illustrations, but suffers from the disagreeable characteristic of American journalism whereby each article is interrupted at the conclusion of its first or second page and continued in fragments amongst the advertisements.

DEALING with the destruction of the Austin dam, Pennsylvania, *The Engineer* for October 13 states that, shortly before the actual disaster, the condition of the structure had aroused fears among the residents of the towns below, and that these, being expressed, had the effect of inducing the owners to undertake certain minor protective measures. It is questionable whether anything short of complete reconstruction could have saved the dam. Owing to the upward overturning pressures caused by leakages below the foundations, the alignment of the upper edge had last summer already become a slight arc. That this was the real cause of the disaster is the opinion of the engineer who designed the dam, and reported on the defects discovered in January, 1910. He and another engineer reported the dam to be safe, notwithstanding these defects, but made certain recommendations for the repair and reinforcement of the structure. These, however, he was not engaged to supervise, and he has no knowledge that they were ever carried out. That Austin will be rebuilt, or the lumber industry of the district survive the calamity, seem improbable. The local timber supply was rapidly nearing exhaustion, and at the best could have held out but five years longer. To these circumstances, perhaps, in some degree, may be attributed the comparatively few and ineffectual measures taken to safeguard public interests.

Engineering for October 13 contains an account of the demolition of the Bridlington railway bridge on the North-Eastern Railway, an operation which was carried out by the Ammonal Explosives, Ltd., of London. The bridge was composed of five arches, each arch having a span of 18 feet, with a width of 37½ feet. The arches were built of four courses of hard ringing bricks set in cement, forming a hard, tenacious mass of masonry requiring to be pulverised completely and instantaneously. To facilitate the operation, the surface of the bridge had been stripped, leaving simply the crowns of the arches and the buttresses to be blown down. As the bridge was separated from the station and buildings by only about 8 or 10 feet, the crowns of the arches only were blown down at the first operation. The total quantity of ammonal No. 5 explosive used was 39·5 lb., distributed in 139 holes. A feature of the operation rendering it more than usually interesting was the employment, for the first time in England, of an entirely new kind of detonating fuse, called Bickford's toluene fuse or "Cordeau" detonant. With this fuse, detonators in each cartridge are dispensed with. The fuse may be either laid alongside or simply inserted into each cartridge, and one detonator, attached to the firing end of the fuse, alone is necessary to cause the instantaneous detonation of the whole mined structure. The whole operation was conducted in a most successful manner.

MESSRS. H. F. ANGUS AND CO., of Wigmore Street, London, W., have issued their second catalogue of second-hand scientific apparatus and accessories. All the instruments listed have been tested, adjusted where necessary, and, unless otherwise stated, are capable of work of equal precision as when new. The catalogue gives particulars of microscopes and accessories, various other optical instruments, and sundry apparatus.

THE second part of vol. iv. of the Proceedings of the University of Durham Philosophical Society can now be obtained from Messrs. A. Reid and Co., Ltd., of Newcastle-upon-Tyne. It includes a selection of the papers read to the society between December 8, 1910, and May 11, 1911. These papers include a description of a new steam trap, by Mr. E. M. Eden; one by Prof. Henry Louis on the mutual development of metallurgy and engineering; and others by Dr. T. H. Havelock, on the displacement of the particles in a case of fluid motion; by Dr. J. A. Smythe, on benzyl-orthothioformate; and by Dr. A. A. Hall, on the relationship between the chemical composition and the position of some North Country clays. In addition there is a report of the Boulders Committee on the boulders and pebbles collected or determined since the last report of the committee.

ERRATUM.—In line 9 of Mr. Rollo Appleyard's letter in NATURE of October 12, for $A=e$ read $A=e^{U}$. The expression was correctly given by Mr. Appleyard in his letter, and the ^{U} was in place in the page passed for press, but it fell out in the course of printing last week's issue.

OUR ASTRONOMICAL COLUMN.

CHANGES ON MARS.—An observation made by M. Jarry Desloges at the Massegros Observatory, and published in Circular No. 133 from the Kiel Centralstelle, records a change on the Martian feature Libya. Previous observations had shown this area to be of a dull greyish hue, but on October 12 it was seen to be very bright; changes in the intensity of these white areas are by no means uncommon, and Libya, for example, was recorded as intensely white by the Rev. T. E. R. Phillips on May 22, 1903.

COLOUR PHOTOGRAPHY OF MARS.—In No. 42 of the *Mitteilungen der Nikolai-Hauptsternwarte zu Pulkowo* M. Tikhoff describes some results he has secured by taking photographs of Mars through coloured screens. These screens transmitted light of wave-lengths 690–655 $\mu\mu$ (red), 680–600 $\mu\mu$ (red and orange), 620–545 $\mu\mu$ (orange and yellow) and 550–495 $\mu\mu$ (green), respectively, and were used in conjunction with the 30-inch equatorial telescope. Taken at the focus, the images of Mars were about 1·5 mm. diameter.

Excellent photographs of Mars were secured, and a comparison of those taken with the red and with the green filters shows some remarkable differences. For example, on the "red" photographs the "continents" (Hellas, Elysium, Ausonia, &c.) are very bright, much brighter than the south polar cap; the latter is the most intense feature on the "green" photographs.

The seas are very dark on the "red" plates and greyish on the "green"; the canals (such as Xanthus, Scamander, Cerberus, &c.) are best seen on the "red" and "orange-red" photographs, their colour apparently resembling that of the seas.

The study of the polar cap led to the conclusion that it was of a greenish colour rather than white, and this suggested ice rather than snow, so experiments on the absorption spectrum of ice were carried out. These, and photographic experiments on sand, snow, and ice made by M. Kalitine, confirmed the conclusion that during August 4–30, 1909, the south polar cap of Mars exhibited the optical properties of ice rather than of snow.

BROOKS'S COMET, 1911*c*.—Below we give a further extract from the ephemeris for comet 1911*c*, published by Dr. Ebell in No. 4528 of the *Astronomische Nachrichten*. The cloudy and hazy skies of the past week have rendered observations difficult, and, apart from these local conditions, the difficulty will now increase owing to the decreasing northerly declination and magnitude.

Ephemeris 12h. M.T. Berlin.

1911	α (true) h. m.	δ (true) ° ′	log *r*	log Δ	mag.
Oct. 19	12 43·9	+18 15·5	9·7241	9·8498	2·8
,, 21	12 39·7	+15 13·1			
,, 23	12 36·5	+12 10·4	9·7000	9·8850	2·9
,, 25	12 34·4	+ 9 8·8			
,, 27	12 33·3	+ 6 9·6	9·6904	9·9219	3·0
,, 29	12 33·2	+ 3 14·3			
,, 31	12 33·9	+ 0 24·0	9·6978	9·9587	3·2
Nov. 2	12 35·5	− 2 20·0			

This path lies nearly due south through Coma and Virgo, and the comet will be quite near to γ Virginis on November 1.

THE SOLAR ECLIPSE OF APRIL 17, 1912.—From the *Gazette Astronomique* (Nos. 45–46) we learn that preparations are to be made by the Uccle Observatory to organise two stations for the observation of the solar eclipse of April next. According to the *Connaissance des Temps* data, the eclipse should be total for six seconds in Spain, for two seconds in the neighbourhood north of Paris, and should cease to be total in Belgium. But the Nautical Almanac data would make it not a total eclipse anywhere in Europe, although the greatest duration of annular eclipse, six seconds, would then take place in Belgium.

AN ENORMOUS BOLIDE.—On April 10 a great noise was heard at Catania following, by about three minutes, a brilliant flash of bluish-green light; the microseismograph also registered slight movements. These phenomena and their relation to a bolide are discussed very fully by Prof. Ricco in No. 7, vol. xl., of the *Memorie di Astrofisica ed Astronomia*, who finds that the meteor probably exploded at a height of 30 km. above a point some 52 km. N.N.E. of Catania. A careful search in the indicated region has, however, revealed no traces of the fragments as yet. From the tabulated summary of communicated observations it would appear that a most extraordinary phenomenon was very generally observed.

MICROMETER MEASURES OF ENGELHARDT-STUMPE STARS.—During the winter of 1910–11 Dr. Lau employed the 10-inch refractor of the Urania Observatory for micrometer measures of faint stars measured by Engelhardt in the neighbourhood of stars given in Stumpe's catalogue. From these measures and Engelhardt's he has derived the proper motions, which he now publishes in No. 4523 of the *Astronomische Nachrichten*, with notes as to the colour and magnitudes of the pairs; of the fifty-four systems given, about two-thirds are optical, and one-third physical, systems.

PHOTOGRAPHS OF THE 1898 TOTAL SOLAR ECLIPSE.—From the Tokio Observatory we have received a copy of the report of their 1898 eclipse observations, published in 1910. The volume contains some excellent reproductions of photographs of the corona, which were taken at Jeur, in western India, and are described and discussed by Mr. H. Terao and Prof. S. Hirayama.

COOPERATION IN OBSERVING VARIABLE STARS.—The observation of variable stars is one that calls for only a modest equipment, and so can readily be undertaken by amateurs. In No. 166 of the Harvard College Observatory Circulars Prof. Pickering prints a list of 372 variables of long period, and asks for cooperation in the observation of them. Many are already being regularly observed, but more help is required, and, if desired, the results would be incorporated in the Harvard publications.

THE SCIENCE SECTION OF THE TURIN INTERNATIONAL EXHIBITION.

WHEN the scope of the Franco-British Exhibition was under consideration, the British Science Guild approached the organisers and suggested that a science section should be arranged. The suggestion was agreed to; and it will be remembered how successful the exhibit was, and what a large amount of interest it aroused. Since then similar exhibits have been arranged at the Japan-British Exhibition and the present Coronation Exhibition, and still continue to attract attention.

The Exhibitions Branch of the Board of Trade has, at the instance of the Physical Instruments and the Chemical Committees of the Royal Commission appointed to deal with the exhibitions at Brussels, Rome, and Turin, organised an exhibit on somewhat similar lines. It was realised that at international and other exhibitions physical and chemical instruments and apparatus are not shown to advantage. The facilities for examination of the instruments are inadequate, owing to the fact that they are usually shut up in cases. Generally speaking, also, there is no one there to take them out and explain them to those who may be interested. It was therefore decided to instal working chemical and physical laboratories, in which exhibitors would have, for the first time in international exhibitions, an opportunity of having their instruments explained and demonstrated. The educational value of such a system of exhibiting is obvious, not only from the point of view of the manufacturers, but also to the public. The average person has no idea of what goes on in a physical or chemical laboratory, or what the apparatus, generally seen in a case, is employed for. In these laboratories actual experimental work can be seen in operation, and the demonstrators are there to give explanations to those seeking information. It should be mentioned here that professors and students from the universities and polytechnics on the Continent have taken great interest in the laboratories, in many cases spending several hours, and coming not once, but several times.

A Joint Committee of Mathematical and Scientific Instruments and Chemical Industries Committees was appointed to deal with the matter and to appoint competent scientific representatives to act as demonstrators in the laboratories.

The laboratory fittings were constructed by Messrs. Baird and Tatlock, Ltd., under the directions of the joint committee and personal supervision of Dr. F. Mollwo Perkin.

In the physical laboratory a dark-room has been set apart, where demonstrations are given with the well-known optical lantern of Messrs. Reynolds and Branson. The lantern employed is a special one fitted with a movable stage, so that it can be used for ordinary optical work and for illustrating practical experiments in science teaching. It is also fitted with a polariser, which, by moving the stage, can be brought into position, and by a further movement of the stage a microscope of special design can be used. Thus bacteriological, physiological, and natural-history specimens can be shown.

On the bench adjoining the dark-room Messrs. Reynolds and Branson exhibit other types of lanterns, and the Barr and Stroud lantern-slide apparatus. This very convenient piece of apparatus is fitted with graduated scales, which enable the operator without calculations or focussing on the screen, rapidly to prepare a lantern-slide.

Beyond this is an interesting exhibit by Robert Paul of electrical apparatus, including the Irwin oscillograph, on which are shown both the current and pressure curves of the alternating current, supplied by a small alternator of the Crypto Electrical Company, and complete apparatus for making measurements of self-induction by means of the Campbell variable mutual inductance, the alternating current being obtained by a microphone hummer.

On the next bench Messrs. J. J. Griffin and Sons show Sand's apparatus for the electro-deposition of metals, and their separation by means of an auxiliary electrode, the potentiometer box containing a capillary electrometer of special design. On the opposite bench Messrs. Townson and Mercer exhibit apparatus for the demonstration of the laws of mechanics, and also certain laboratory electrical instruments.

Messrs. Adam Hilger show their wave-length spectroscope. Other apparatus on this bench consists of a collection of electrical and magnetic testing instruments by Messrs. Baird and Tatlock, Negretti and Zambra, the well-known "Tintometer" for colour estimation, two mathematical models in plaster by Prof. Crum Brown, F.R.S., and a "Geryk" vacuum pump by the Pulsometer Engineering Co., Ltd.

On a separate bench Messrs. T. Oertling have a splendid collection of assay and chemical balances and accessories.

The central bench contains some interesting examples of modern electrical instruments made by the Cambridge Scientific Instrument Company, amongst which are the "Duddell" oscillograph, with camera outfit, for use on circuits up to 50,000 volts, shown in operation; a "Callendar" recorder connected to an open-wound thermometer, by means of which a continuous record of the laboratory air temperature is obtained; the "Thread" recorder, connected to a copper couple, arranged so that its extreme sensibility can be shown; a laboratory type pyrometer with a platinum platinum-iridium couple (this is used for showing the temperature of an electrically heated laboratory furnace).

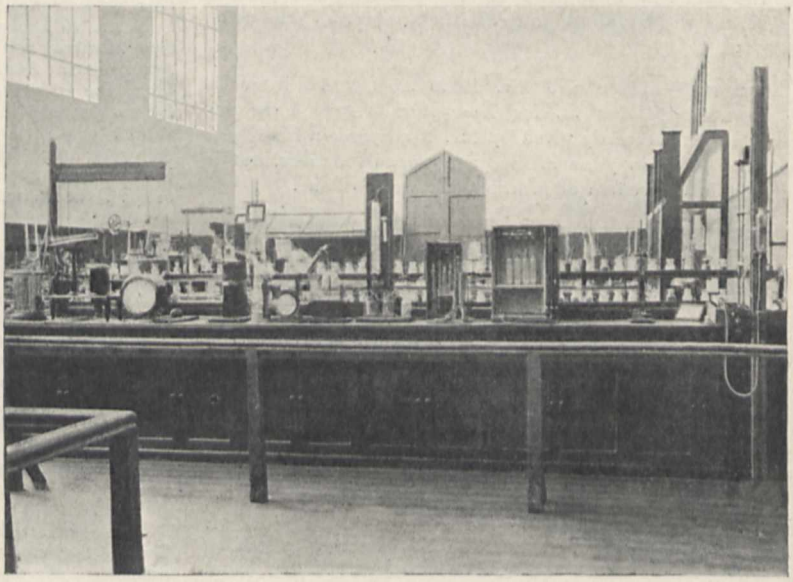

FIG. 1.—General View of Chemical Laboratory.

Most of the firms showing in the laboratory also have good exhibits in the Physical Instruments Court.

On entering the chemical laboratory, the first bench on the left-hand side is a furnace bench of Yorkshire stone with a uralite hood. On this bench various furnaces by Messrs. Fletcher Russell and Co., Ltd., are exhibited, such as are employed in metallurgical and assay work; also laboratory burners of various design.

On the opposite side is a bench which is in part fitted up for electrochemical analysis, and here actual analytical operations are from time to time carried out by the laboratory demonstrator. On another part of the same bench

the method of assaying gold in order to test its fineness is illustrated in a series of twelve operations by Messrs. Johnson and Matthey, who have also supplied the platinum electrodes for analysis. First a gold link taken from a watch chain is shown, (2) the hammered gold, (3) the rolled gold, (4) a weighed quantity ready for assay, (5) the gold with a piece of silver wrapped in lead, (6) the same in a cupel, (7) the gold-silver alloy hammered and rolled after cupelation, (9) the rolled and coiled alloy in the parting flask, (10) the gold after parting with nitric acid, (11) the gold annealed, (12) the assayist's report. The assay balance and muffle employed in such operations are also shown. In still another part of the same bench various crucibles and other apparatus used in assay work are shown by the Morgan Crucible Co.

At another bench Messrs. Townson and Mercer show a large assortment of apparatus employed in various operations. Thus there is a centrifuge operated by means of an electromotor which is shown in operation. There is also apparatus for the analysis of explosives, and general apparatus, such as the Lewis Thompson calorimeter, hot-air ovens, vacuum drying apparatus, &c. A portion of this bench, which is provided with water and electrical heating, is reserved for general demonstrations, such as operations of filtration, crystallisation, precipitation, and

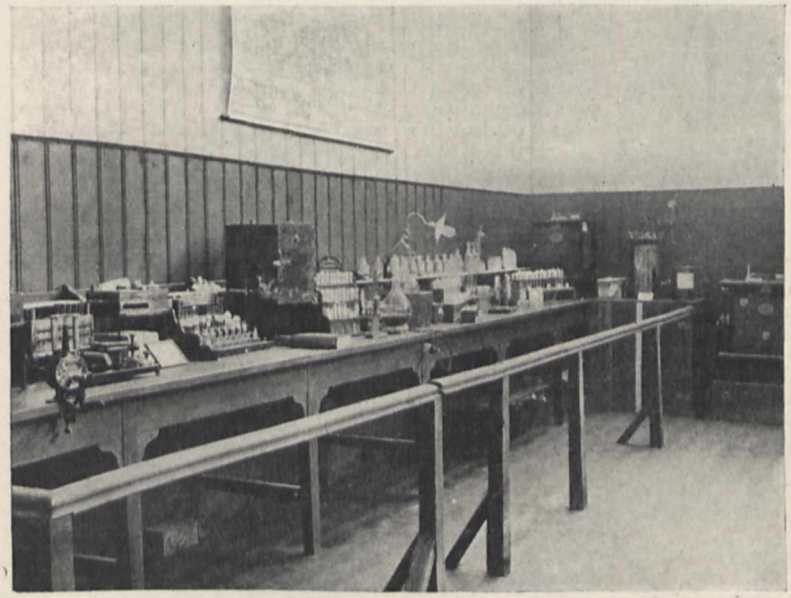

FIG. 2.—Bacteriological Bench where demonstrations were given.

so on. Demonstrations in dyeing are also given here, and the action of dyes on mordanted and unmordanted cotton, silk, &c., illustrated. The apparatus for dyeing and material for these experiments are supplied by Messrs. Read Holliday, of Huddersfield.

Following this bench is a draught cupboard, which contains apparatus for the generation of sulphuretted hydrogen, carbon dioxide, and so on.

On the next bench the various apparatus employed in the analysis and examination of mineral oils is exhibited; for example, the method of estimating the viscosity by means of the viscometer is shown in operation, and also the taking of flash-points. Most of this apparatus is exhibited by Messrs. Baird and Tatlock, but the Mahler-Cook bomb calorimeter is shown by Messrs. J. J. Griffin and Sons, Ltd. There is also on the shelves a fine display of reagents and pharmaceutical products exhibited by Messrs. T. Morson and Son. On the opposite side of the bench the various apparatus employed in gas analysis is shown. There is also a good display of silica apparatus by the Silica Syndicate and the Thermal Syndicate. This apparatus has attracted a very great amount of attention, as in Italy it was generally not known that silica apparatus was manufactured in England.

At the end of the laboratory a long bench is devoted to bacteriology, where Messrs. Baird and Tatlock make a display of the various apparatus used in bacteriological work, and also show cultures on solmedia, a powdered form of bacteriological culture. At another portion of the demonstration bench Messrs. Edward Cook and Co., the well-known soap-makers, have a demonstrator who shows the methods employed in the standardisation of disinfectants by the Rideal-Walker method and by the Lancet method.

On the next bench there is a working laboratory apparatus exhibited by Ozonair, Ltd., showing the formation of ozone. On another part of the bench there is a most interesting exhibit of old chemical apparatus used in the eighteenth century, kindly lent by the Society of Apothecaries, London.

In the centre of one side of the room Messrs. Burroughs, Wellcome and Co. have an exhibit showing the results obtained by the firm in research work, and in the manufacture of substances of pharmacological importance. Thus the formation of ernutin from ergot is graphically displayed. Investigations in the Wellcome Physiological Research Laboratories have shown that ergot contains at least three active principles, and the exhibit is intended to show the production of these. This exhibit is of great interest, and demonstrates the high value of chemical research in technical operations.

There is also a lead-covered distillation bench, on which are shown the processes of distillation, fractionation, and extraction in operation.

This part of the British exhibit has attracted great attention, and the Board of Trade has been highly commended by other nations upon the new departure. At the same time, it must be mentioned that the whole of the British Section is most creditable to the Exhibitions Branch of the Board of Trade, without which it would not have been possible. Thus there is a splendid exhibit of textiles, and the exhibit of British motor-cars has attracted a large amount of interest. There is also a good exhibit of agricultural machinery and implements.

Most excellent catalogues have been drawn up to explain the various exhibits. The catalogue for the Mathematical and Scientific Instrument Section is in French and is splendidly illustrated. The apparatus is most carefully and fully described both from the theoretical and practical aspect, and Mr. E. H. Rayner, who edited the catalogue, is to be congratulated upon its excellence.

The Catalogue of Chemical Industries, of which there is an English and French edition, commences with articles descriptive of the following industries, which have been written or revised by the persons whose names accompany the articles:—The alkali industry, J. F. L. Brunner and J. I. Watts; sulphuric acid and nitric acid, Dr. F. Mollwo Perkin; the gas industry and coal-tar products, Prof. Vivian Lewes; cyanides and prussiates, A. Gordon Salamon and Dr. G. T. Beilby; electricity, Dr. G. T. Beilby; explosives, Walter F. Reid; nickel, J. F. L. Brunner; oils, fats and waxes, soaps and candles, Dr. J. Lewowitsch; petroleum and shale oil, Sir Boverton Redwood, Bart.; pharmacy, Thomas Tyrer and N. H. Martin; salt, J. F. L. Brunner and J. I. Watts; disinfectants and antiseptics, Dr. D. Somerville; rare metals, Dr. F. Mollwo Perkin. The catalogue is thus a small treatise on technical chemistry. The second part of the catalogue deals with the actual exhibits.

THE FOURTH INTERNATIONAL CONFERENCE ON GENETICS.

THE fourth International Conference on Genetics is the latest of a series of conferences which was inaugurated with the "Conference on Hybridisation" convened in 1899 by the Royal Horticultural Society. The Horticultural Society of New York undertook the organisation of the second conference, held in that city in 1902; the third "Conference on Plant-breeding" took place in London in 1906, again under the auspices of the Royal Horticultural Society; the fourth conference of the series, and the first to receive the title of "Conference on Genetics," has recently been held in Paris under the control of the Société Nationale d'Horticulture de France, which is to be very heartily congratulated on the success which attended all its arrangements.

As M. Ph. de Vilmorin has pointed out, genetics, though born of the studies provoked by the rediscovery of Mendelism, is itself of wider scope, and includes all that appertains to the physiology of heredity, the problems of fluctuating variation, selection, mutation, the transmission of acquired characters, cytology, &c. Most of the subjects were represented among the communications brought before the recent conference. There were, indeed, no papers dealing purely with cytology, though Dr. Swingle brought forward the tentative suggestion that the diverse types encountered in certain F_1 families might be due to different groupings within the cell of a given set of determinants; but the absence of cytological papers no more than reflects the present difficulty of producing any satisfactory cytological "explanation" of the phenomena of heredity, and we can only hope for better things in the future. Appended are short notes on a few of the communications made to the conference.

Messrs. Bateson and Punnett described some results of very great interest in regard to the special relations which have been found to exist in certain cases between distinct factors. Those who have followed recent progress in this work will remember that in not a few crosses, between plants differing from one another in respect of two characters, the phenomenon known as "partial coupling" between the factors for these characters has been exhibited; that is to say, the F_1 produces the four possible types of gamete, not in the approximately equal numbers which would result from a chance distribution of the factors, but in proportions represented by the general expression

$$(n-1)\mathrm{AB} : 1\mathrm{A}b : 1a\mathrm{B} : (n-1)ab,$$

where n is any power of 2 and is equal to one-half the total number of gametes produced.

Other crosses, on the other hand, gave results which suggested that, in certain circumstances, the same two factors were repelled from one another in gametogenesis. Unlike the phenomena of coupling, the repulsion appeared to be complete, so that no germ-cell received both factors, and consequently no germ-cell was without one of them.

This year, however, Punnett has discovered a case in which repulsion is not complete, but the gametes containing one or other of the two factors (but not both) are produced in greater numbers than the other types of gamete. That is to say, the middle terms of the gametic series are large, the end terms small—the converse to what occurs in "partial coupling"—and the gametic series is represented by the expression

$$1\mathrm{AB} : (n-1)\mathrm{A}b : (n-1)a\mathrm{B} : 1ab.$$

In Punnett's case the gametic series was of the form 1 : 3 : 3 : 1; even in this case, where n has its lowest value, only one plant having both recessive characters is to be expected in every sixty-four F_2 plants. With higher values of n, the proportion of double-recessives in F_2 will be smaller still, and it can scarcely be doubted that this is the explanation of the cases hitherto regarded as representing complete repulsion; at the same time, the isolated occurrence of double-recessives in families exhibiting repulsion is explained.

The di-hybrid F_1 may therefore produce the four types of gametes in proportions ranging from

$$\begin{array}{lccccc} & (n-1) & : & 1 & : & 1 & : (n-1) \\ \text{through} & 1 & : & 1 & : & 1 & : 1 \\ \text{to} & 1 & : (n-1) & : & (n-1) & : & 1 \end{array}$$

Bateson and Punnett point out that the conception underlying the terms "partial coupling" and "repulsion" is no longer justified, and they substitute the phrase "reduplication of terms" in a series of gametes.

Profs. Baür and Lotsy described experiments in crossing different species of snap-dragon. *Antirrhinum majus* (in the normal and peloric forms) was crossed reciprocally with *A. molle*, with *A. latifolium*, *A. sempervivum*, &c. The characters of the hybrids and of the very numerous forms obtained in F_2 were illustrated by means of coloured drawings. The experiments showed conclusively that segregation takes place in these species-crosses; how numerous are the factors to be considered may be judged from the fact that, of the 500 F_2 plants raised, scarcely any two were alike. Among these plants there appeared an interesting new type resembling the flowers of the yellow-rattle (Rhinanthus) in the shape of the corolla.

Several papers dealing with cereals were presented, some of them of no little importance from the economic point of view. Dr. Nilsson-Ehle described experiments indicating that precocity and resistance to cold depend upon combinations of Mendelian factors. Dr. Surface described the results of selection for such characters as protein-content, &c. He showed that in one case of successful selection for high protein-content, the plants raised after the ninth generation were all the descendants of a single progenitor, that is to say, selection had resulted in the isolation of a pure line possessing the desired quality. This result agrees with much that has been done since Johannsen first clearly presented the idea of pure lines, and agrees, too, with the new results which Prof. Boeuf communicated on the present occasion.

Dr. Orton described some work of the highest economic importance in the raising of varieties of agricultural plants resistant to the attacks of disease. Many varieties of cotton, the cow-pea (Vigna), and the water-melon are susceptible to the attacks of species of Fusarium; the cow-pea, in addition, is liable to the attacks of the nematode *Heterodora radicicola*. Immune or highly resistant varieties of all these plants have now been obtained, in the case of the water-melon, however, only after crossing with a non-edible but resistant wild type.

At the session devoted to papers dealing with animals, Prof. Federley described an interesting case in Pygæra of the transmission of a disease through females, themselves unaffected by the disease, to their male offspring, all of which died of the disease. Dr. Walther, of Vienna, gave an account of his investigations into the inheritance of coat-colour in horses, a subject with regard to which he has secured a great wealth of material.

Finally, mention must be made of a new case of brachydactyly in man, described by Dr. Drinkwater. This case differs from the previous one in that there is no ankylosis of the short median phalange with the terminal phalange, and the fingers are intermediate in length between the extreme brachydactylous and the normal types. The abnormality is present in about one-half of the members of the affected family.

Much as there was of interest in the proceedings of the conference, not the least memorable of its features was the visit which the members were privileged to pay to the establishment of MM. Vilmorin, Andrieux et Cie. at Verrières-le-Buisson. One's only regret was that the time at our disposal was all too short for even the most cursory inspection of the wonderful collection of plants which has been gathered together here, and of the experiments in breeding and selection which are being carried on by M. Ph. de Vilmorin himself and by the firm of which he is the head. It is useless to attempt in a limited space to give any detailed description of Verrières; it need only be said that the whole establishment, gardens and museum alike, admirably reflects the enthusiasm which M. Ph. de Vilmorin, like the members of his family who have preceded him, has always shown for the scientific as well as the more obviously practical aspects of horticulture and plant-breeding.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

THE presidential address in Physiology has appeared in full in NATURE (September 14), and the remainder of the sectional proceedings can be summarised under three heads: reports of committees and papers related to them, discussions, and other communications.

Reports of Committees.

Committee on Anaesthetics.—The report contains four appendices. The first describes the installation of a chloroform-balance for daily use in hospital practice. The detailed instructions by Prof. Waller will be extremely useful for anyone who wishes to establish one of Prof. Waller's instruments. The second appendix contains some estimations of the probable percentage of ether inhaled by the "open" method of ether administration. The third appendix relates the experience gained by the use of a chloroform-balance in the out-patient department of St. George's Hospital, and the fourth is a recapitulation of the effect of recent advances on the practice of anæsthesia.

This report was followed by a paper by Dr. A. Vernon Harcourt, F.R.S., on additions to the use of a chloroform inhaler. As objection had been made to the vacuum principle of the author's chloroform inhaler, he has adapted his ingenious apparatus to work by the plenum system, and also for use with oxygen.

Committee on Dissociation of Oxyhaemoglobin at High Altitudes.—The hydrogen ion concentration of blood can be determined by the percentage saturation of hæmoglobin with oxygen at low pressures of oxygen. Using this method, it was found that at high altitudes the hydrogen ion concentration of the blood was increased.

The remainder of the reports contained information of such detailed nature that it is not possible to give a summary of their contents, but in some cases the work has already been published elsewhere.

Discussions.

Discussion on Inhibition.—Prof. C. S. Sherrington, F.R.S., opened the discussion by pointing out that it would be of great importance to discover the intimate nature of inhibition. The processes of inhibition are fundamentally the same whether they occur in the central nervous system or in apparently muscular organs such as the heart. He then described many of the phenomena of inhibition as exhibited by rhythmical reflex movements of the limbs. In dealing with the reciprocal action of muscles, it seems necessary to assume, as suggested by Macdonald, that there is an intercalated neurone in the inhibition path. Any after discharge from the muscle, which ought to have finished contracting, would lead to clumsiness in the alternating movements of flexion and extension; but inhibition removes all after discharge. In the same way inhibition diminishes the tonus in muscles antagonistic to those that are contracting. The utility of a common final path is evident, because there cannot be more than one movement going on at the same time; and so long as a path is held by inhibition contraction cannot occur, and *vice versa*. Examples were shown of double stimulation and algebraical summation of excitation and inhibition in both flexors and extensors. Two antagonists may be in action together, but their activity increases and decreases in reciprocal proportions; hence the smoothness and accuracy of trained movements. The conditions favourable to inhibition are fatigue and administration of chloroform, and those favourable to excitation are increase in the "background" stimulation and administration of strychnine and tetano-toxin. According to circumstances, the same stimulus may give either excitation or inhibition.

Dr. John Tait, rhythmical stimulation of cooled frog's nerve. The Wedensky effect was described, and Frohlich's explanation of the phenomenon was stated. By cooling the nerve a result was obtained similar to that of Wedensky. The effect is greater the greater the degree of cooling, the longer the piece of nerve cooled, and the more rapid the rate of stimulation. Conduction by the nerve is entirely blocked at $-2°$ C., and the phenomenon is present near this point. Fatigue favours the effect. Wedensky effect is shown by well-fed, but not by underfed, animals.

Dr. Keith Lucas, conduction between muscle and nerve with special reference to inhibition. Frohlich's explanation of the Wedensky effect does not hold in homogeneous tissues, as a second stimulus within the refractory period does not prolong the refractory phase. By indirect stimulation it was found that the blocking occurs at the junction between muscle and nerve. The refractory period of nerve is less than that of muscle, and a stimulus sent into the nerve shortly after the end of the refractory period causes a second refractory period. A stimulus to the nerve just after the end of the refractory period is so diminished in strength that it cannot pass the motor end plate. The explanation is that each stimulus to the nerve reduces the response to the succeeding stimulus, and thus all except the first are too weak to pass the resistance of the junction between muscle and nerve; thus there is a single contraction of the muscle with the first stimulus, and no further response as the stimulation continues. By applying the same processes to the synapses of the central nervous system, an explanation of central inhibition was given. Prof. Waller then spoke, and Prof. Sherrington replied.

Discussion on ventilation in confined quarters, especially in relation to ships. Dr. Leonard Hill, F.R.S., introduced the subject by explaining that under ordinary conditions the percentage of oxygen is never reduced to a dangerous extent, nor is the carbon dioxide increased beyond reasonable limits. The great factor in ventilation is to provide air under suitable conditions to promote evaporation from the skin and stimulate the nerve endings in the skin. He then described experiments showing that circulation of air in a closed chamber produced the same effect as admitting fresh air in promoting a feeling of well-being. A draught is dangerous, as it causes a local cooling, but cooling of the whole surface by evaporation from the skin is beneficial. He described some of the special difficulties met with on board ships, and advocated the wet- and dry-bulb thermometers as a test of the efficiency of ventilation. Fresh air is beneficial, as it dilutes harmful products, such as bacteria.

An abstract furnished by Prof. N. Zuntz, of Berlin, was read. He agreed with Dr. Hill that oxygen and carbon dioxide are not the predominating factors in ventilation, but he pointed out that there might be poisonous gases given off under some conditions. He then showed that unless the carbon dioxide be kept down to the limit usually given as the maximum allowable, the air becomes almost saturated with the moisture given off from the lungs. Therefore the moisture must be kept down by dilution with fresh air or by condensation on cold surfaces. The use of fans will not entirely remove the need for fresh air, but they will improve the working efficiency of the men.

Dr. C. J. Martin, F.R.S., spoke in support of Dr. Hill's view by referring to the conditions in Australian gold mines.

Fleet-Surgeon Whitelegg gave instances of the difficulties encountered on board battleships, where, of course, the fighting efficiency was the first consideration. He then described some of the precautions taken before men were allowed to enter unventilated spaces. Dr. Hill then replied.

Other Communications.

Prof. H. J. Hamburger, on the influence of iodoform, chloroform, and other substances dissoluble in fats on phagocytosis. In the absence of the author an abstract of this paper was read. In high dilutions the substances used promoted phagocytosis. This effect is the result of the substances dissolving in the lipoids of the cell wall, whereby the surface tension is lowered. When the surface tension is lowered there is less resistance to an increase of surface, and hence amœboid movements occur more easily.

Dr. J. Tait and Mr. J. A. Hewitt, certain physical questions regarding blood vessels and blood cells. Blood does not adhere to the endothelium of blood vessels. This is associated with a large amount of ether soluble material in the endothelial cells. Coating glass vessels with oil delays coagulation, as it prevents the adhesion to the glass of certain blood cells. Possibly the high blood-blood-vessel surface tension, as shown by non-adherence of

the blood to the vessel wall, is a factor in preventing coagulation of blood in the vessels. Contact of amœboid corpuscles with particles of carmine or Indian ink causes phagocytosis if the surface tension between corpuscle contents and particle is less than that between the plasma and particle. When a corpuscle adheres to the wall of a blood vessel it is driven outwards if the surface tension between corpuscle and blood-vessel wall is less than that between corpuscle and plasma, and hence diapedesis occurs. The association of hæmolytic and hæmorrhagic poisons may be due to a lowering of the surface tension causing both processes.

Mr. W. W. Waller, an attempt to obtain photographic records of the emigration of leucocytes. This was illustrated by a number of photographs showing blood vessels with white corpuscles escaping from them. Several interesting points were mentioned, such as a tendency for several corpuscles to escape at the same point, and apparently to form colonies after their escape.

Dr. Hariette Chick and Dr. C. J. Martin, F.R.S., the chemistry of heat coagulation of proteins. Coagulation takes place in two stages, denaturation and agglutination. Denaturation is due to the presence of water, depends on the temperature, and is an exponential function of the concentration. The temperature coefficient is remarkably high. Egg albumin differs from hæmoglobin owing to a change in reaction during coagulation, but by using boric acid to keep the hydrogen ion concentration constant the egg albumin then behaves like hæmoglobin. Increase of acidity favours denaturation. Agglutination depends on the concentration of hydrogen ions. Three factors, namely, surface tension, electrical charge, and velocity of Brownian movement seem to regulate the agglutination.

Prof. Freundlich spoke on this communication, referring to the importance of such investigations into the processes of coagulation.

Dr. W. N. F. Woodland, recent views concerning the physiology of gas production in connection with the gas bladder of bony fishes. The structure of the rete mirabile duplex is concerned with the secretion of oxygen. The composition of the gas varies in different species. The pressure of any particular gas may be greater than that in the blood stream, and hence there must be some process of secretion. Fish which change their depth rapidly secrete oxygen to compensate for the effects of pressure. A weighted fish rises after some time, mainly due to increase of oxygen in the swim bladder. It has been stated that a toxin is formed which causes hæmolysis of the red blood corpuscles, but none was found as the result of activity, nor, as previously stated, were gas bubbles found in the secreting cells. The author urged physiologists to undertake the study of the process of oxygen secretion.

Prof. J. S. Macdonald and Dr. J. E. Chapman, heat production and body temperature during rest and work. By means of the calorimeter at Sheffield the heat production of a fasting man was determined at rest and then during the performance of work. Heat output lags behind heat production owing to a rise of body temperature, which stores a certain amount of heat. The lighter the clothing the more nearly the heat output keeps pace with the heat production. Fatigue is not shown in the record of heat output, but it is shown in the rate of cycling.

Dr. H. E. Roaf, carbon dioxide output during decerebrate rigidity. The carbon dioxide output was measured during decerebrate rigidity, and then after abolishing the rigidity. Abolishing the rigidity by curare or by cutting the motor nerves did not lower the carbon dioxide output. Hence decerebrate rigidity differs from ordinary muscular contraction, as there is no increased production of carbon dioxide during rigidity.

Dr. F. W. Edridge-Green, the frequency of colour-blindness in males. The percentage of colour-blind men has been underestimated. The author finds at last 6 per cent. are colour-blind, and that 25 per cent. have diminished colour-vision.

Prof. G. J. Stokes, paramnesia. The author suggests that the same idea may reach the brain by two different routes, one passing through a greater number of synapses, and thus arriving after the other. Hence in certain cases a feeling that the incident is not new, although it could not possibly have happened before.

Miss May Yates, the nutritive value of whole meal and white bread. This was a correction of some statements made in a recent Local Government Board report. It was claimed that the report did not correctly compare the nutritive value of white flour and flour without removal of the germ and bran.

Prof. A. D. Waller, F.R.S., read an interesting historical paper reviewing the documentary evidence of the discovery of the distinction between motor and sensory nerves.

It was an unfortunate coincidence that the two foreign guests who had accepted invitations as representatives of physiology should at the last moment have been prevented from attending the meeting. Apart from this, the meeting was an agreeable and interesting one for physiologists.

AGRICULTURE AT THE BRITISH ASSOCIATION.

THE outstanding event this year was the elevation of agriculture to the position of a full section; henceforward agriculture comes definitely within the purview of the British Association, and permanently figures as Section M. The increasing output of work by investigators in this country fully justifies this step, while the great interest always shown in agricultural matters by the members of the association encourages the hope that the new section will at least contribute its share to the attractiveness of the meetings.

The problems presented by soils, crops, and animals are so complex that agricultural investigators are bound to keep in close touch with workers in pure science in order that their methods and conclusions may be critically examined. At the British Association meetings more than anywhere else such critical discussions are possible, and in permanently arranging for them the association is fulfilling the first of its declared objects—"to give a stronger impulse and a more systematic direction to scientific inquiry."

The president's address dealt broadly with the application of genetics to the problems of agriculture and horticulture (see NATURE, September 21), and several of the papers dealt with special aspects of this subject. In an interesting communication Mr. C. C. Hurst discussed the genetics of horse-breeding. Chestnut coat colour is recessive to bay and brown; consequently chestnut horses always breed true when mated together, notwithstanding their bay and brown ancestors. Bays and browns, however, are of two kinds, one throwing chestnuts, the other not. Grey is dominant to bay, brown, and chestnut, but since grey × grey matings are rare in England, English grey thoroughbreds are nearly all heterozygous, throwing bays, browns, or chestnuts; a homozygous grey is, however, known in Germany which throws nothing but greys. In certain strains a partial coupling is observed between coat colour and racing power, bay and brown descendants of St. Simon being much better racers than the chestnuts. There is apparently a partial tripling of brown coat colour, high racing power, and female sex in St. Simon's own offspring.

Prof. Wilson described his studies of the inheritance of milk yield in cattle, the earlier accounts of which have attracted a good deal of attention. After eliminating abnormalities due to time of calving, period of lactation, food, shelter, and age of the animal, it is found that full-sized mature cows fall into three grades, giving, respectively, 500 to 600, 650 to 850, and about 1000 gallons of milk a year. The two extreme grades are approximately pure, while the middle grade is a hybrid.

A different type of problem was dealt with by Mr. W. J. Backhouse. A systematic inquiry was undertaken into the gametic composition of our common plums with the view of putting the raising of new plums on a scientific basis. At the height of the flowering period the flowers of certain plums were carefully hand-pollinated with their own pollen. Some varieties proved remarkably self-fertile, the flowers setting very well to fruit. Other varieties, however, proved self-sterile, and set absolutely nothing. It is understood that these interesting observations are being followed up.

A useful day was spent in discussing the bacterial

diseases of plants. Prof. Potter opened with a summary of our present knowledge of the subject. The old idea that the plant was not susceptible to the attacks of bacteria is now known to be erroneous; indeed, certain bacterial diseases can be faithfully reproduced with absolute certainty by inoculation in healthy tissues. The plant possesses many vulnerable points of attack; infection may take place through the water pores, the stomata, the floral nectaries, and wounds, the vessels of the xylem affording a suitable channel for the dispersion of the invading bacilli. Further, certain bacteria secrete a toxin and cytolitic enzyme which destroy the protoplasm and rapidly dissolve cellulose. The actual penetration of the bacterium through the cell-wall has been observed. A complete homology has been established between the parasitism of bacteria and that of various fungi. Saprophytic bacteria, like fungi, develop under certain conditions into virulent parasites, and their aptitude as parasites may be increased or suppressed by variations in nutrition. The nature of the soil, manurial treatment, and other factors materially affect the constitution of the host and its predisposition to infection. Mr. Brooks followed with an account of the gum disease of the sugar-cane, caused, as Irwin F. Smith has shown, by a specific bacterium, *Pseudomonas vascularum*. A disease of cherry trees, accompanied by profuse gumming, has been traced by Aderhold and Ruhland to *Bacillus spongiosus*. On the other hand, the mosaic disease of the tobacco plant, formerly attributed to bacteria, is now regarded as the result of some physiological disturbance within the plant.

Dr. Pethybridge described his investigations on the bacterial diseases of the potato plant in the west of Ireland. From a confused group of diseases formerly known as "yellow blight" he has disentangled a definite disease, "black stalk rot," resembling the "black leg" of other authors, and caused by an organism which he names *Bacillus melanogenes*. The organism not only brings about the untimely death of plants in the fields, but also causes a most serious rot in stored potatoes, even healthy unwounded tubers being capable of infection through their lenticels.

Mr. A. S. Horne emphasised the effect of external conditions on the incidence of disease. The probability that a plant will thrive in a given spot depends upon certain combinations of factors relating, respectively, to (1) the structure and internal constitution of the plant and the organisms associated with it; (2) the soil and soil organisms; (3) the climate, season, and aërially-borne organisms. Disease may occur if the optimum arrangements of the factors be disturbed.

Another day was spent in considering how best the university agricultural departments can come into contact with the practical farmer. Mr. R. Hart-Synnot opened with a description of the Irish system and a modification that seemed suitable to English conditions. It is admitted that the English system has not been entirely successful; indeed, it became evident in the discussion that some of the most successful departments have broken altogether from the conventional lines. Principal Ainsworth Davies considered that the universities should not only undertake research work and the training of experts, but should also disseminate the results obtained among the farmers, and act as bureaus of information generally. Mr. Burton dealt with the place of the agricultural instructor, whose title, he thought, ought to be changed to that of agricultural adviser.

A group of papers came in from the Cambridge Agricultural Department. Prof. Wood and Mr. Harvey described a very ingenious method of determining the baking strength of single ears of wheat. Hitherto it has been necessary to work with large quantities of flour, which can only be obtained with difficulty in plant-breeding experiments. The method suggested simply requires one gram of flour. On shaking with water an opalescent extract is obtained, the humidity of which affords a measure of the strength of the wheat. The sensitiveness of the method is increased by addition of iodine to the turbid extract. Mr. H. A. D. Neville gave a preliminary description of the mucilage of linseed. On hydrolysis with sulphuric acid, mucilage yields dextrose, galactose, arabinose, xylose, and small amounts of a cellulose-like substance and of an acid which forms a soluble barium salt. It appears to be completely digested by the animal, but is neither acted upon by saliva nor by pancreatic juice; it is rapidly decomposed, however, by the bacteria of the cæcum. Messrs. Marshall and Mackenzie introduced a technical subject of very great importance—the question of ovariotomy in pigs. This practice has been known for many years, but has not hitherto received the scientific attention it deserves. If the ovaries are removed after sexual maturity is reached, the uterus undergoes a gradual atrophy; on the other hand, the removal of the uterus has no effect on the development or functional activity of the ovaries. Further, if the ovaries are only incompletely removed, a fragment left behind may in the course of a few months regenerate into an ovary of considerable size. Ovariotomy frequently results in a deposition of fat in various parts of the body; hence its commercial value. In a second paper the same authors dealt with the temperature variations during the œstrous cycle in cows. The rise may be as much as 5°, whilst on the approach of heat a rise of 2° or 3° was usual. These results have special importance in connection with the tuberculin test, in which an animal is supposed to react if the temperature rises 2°.

Mr. H. W. Elwes gave an account of aboriginal races and little-known breeds of domestic sheep, which elicited an interesting discussion, in which Profs. Ridgeway and Wilson, the chairman, and others took part. Domesticated animals seem to have been curiously neglected by zoologists, and Mr. Elwes could find only few references to them in zoological literature. By dint of much inquiry in remote and comparatively inaccessible regions of the British Islands and elsewhere, he has succeeded in finding a number of aboriginal breeds interesting not only in their relationship to our present breeds, but because of their potential value to the practical man, inasmuch as they are extremely hardy and might be used to restore to some of our present breeds the constitution that has been partially lost. Another livestock subject was dealt with by Mr. J. Hendrick in his discussion of the effects of ventilation on the temperature and carbon dioxide content of the air of byres. The amount of pollution is sometimes extraordinary, more than 100 parts of carbonic acid per 10,000 having been recorded, whilst the average CO_2 content was 30 parts where ventilation was restricted and 12 to 15 where it was freer. In spite of the low temperature resulting from free ventilation, the health of the cows was better and their yield of milk was as good as in the warm, badly ventilated byres.

Messrs. Barker and Hillier described a disease known as cider sickness that causes a loss probably amounting to several thousand pounds sterling each year in the west of England alone. It is brought about by a bacterium capable of fermenting dextrose and lævulose with production of alcohol and carbon dioxide, together with a small amount of hydrogen, an unrecognised acid, and an odour resembling that of decaying lemons. It does not appear to attack saccharose, maltose, or lactose. Prof. Priestley and Miss Lee described an ingenious method of measuring the effects of various factors on the growth of micro-organisms. The rate of production of the metabolic products as measured by the change in electrical conductivity of the culture solution is taken as an index of growth, and is found to give results in accordance with the much more tedious process of counting. The particular factor investigated was the influence of electricity. Currents up to about 60 micro-amperes had a favourable effect on the rate of growth of *Bacillus bulgaricus*, whilst currents of greater strength inhibited their activity. No difference could be detected between the effects of direct and alternating currents. In a paper with Mr. Knight, Prof. Priestley dealt with the influence of electricity on the respiration of germinating seeds; a direct current was found to be harmful; a rapidly alternating current at low strength stimulated respiration, but had no effect at 150 micro-amperes; whilst stronger currents caused a decrease; the overhead discharge gave irregular results until some turpentine was introduced to absorb the ozone produced, and then an increase was observed in the amount of carbonic acid produced.

After a suggestion for the reform of the British system

of weights and measures had been put forward by Mr. J. Porter, two papers, that brought the meeting to a close, were read by Prof. Bottomley. In the first he adduced further evidence in support of his contention that the bacteria Azotobacter and Pseudomonas fix more nitrogen per unit of carbohydrate consumed when grown together than when grown separately. In the second he claimed to have obtained evidence of the existence of bacteriotoxins in the soil.

A new feature introduced this year was a semi-popular lecture, by Mr. Hall, on the local soils and farming practices. So great was its success that a semi-popular lecture is likely to become a regular part of the programme of the Agricultural Section.

THE EAST AFRICAN NATURAL HISTORY SOCIETY.[1]

THERE has been no falling off in the East African Journal of Natural History: No. 3 of vol. ii. is as interesting as its predecessors. The scientific student of Africa welcomes these genuine, first-hand studies, these notes and records without the flim-flam, facetiousness, and vague inaccuracy which so often characterise the articles contributed to similar societies in young colonies.

In the part under review the most noteworthy articles, perhaps, are:—"Notes on the Common Pathogenic Protozoa in British East Africa," by R. Eustace Montgomery; "Some East African Pigs," by C. W. Woodhouse; and "Mendel's Principles of Heredity," by Dr. A. H. Marsh (this last with reference to the crosses between *Bos taurus* and *B. indicus*).

Mr. Montgomery is the veterinary bacteriologist for British East Africa. In his paper he devotes himself chiefly to describing the protozoa of the groups Mastigophora and Sporozoa. Of the first-named, the Spirochætæ—causing diseases among cattle and domestic poultry—are transmitted mainly or entirely by ticks of the genera Boophilus, Argas, and Ornithodorus, and another tick seems to be the introducer into the human system of the *Spirochaeta duttoni*, which is the cause of human relapsing fever. (The closely allied flagellate, *Treponema pallida*, is the cause of syphilis. We are all aware of the ordinary and normal manner of conveying the infection of syphilis, but the question arises whether in Uganda and similar countries where it rages infection may not also be conveyed by the agency of a tick.) There are four recognised trypanosomes in British East Africa and Uganda: *T. gambiense*, the deadly germ of sleeping sickness; *T. dimorphon*, which may produce disease in horses, cattle, dogs, &c., but does nothing to man; *T. vivax*, of which the same may be said; and *T. lewisi*, a parasite in rats. The transmitting agencies of the trypanosomes appear to be not only the notorious *Glossina palpalis*, or tsetse-fly, of equatorial Africa, but possibly also other Glossinæ, a gad-fly, Tabanus, and a mosquito, Stomoxys.

Among the East African Sporozoa, the genera Babesia, Nuttallia, Theileria, and Anaplasma are pathogenic among cattle and dogs. The transmitting agency for all these sporozoa of the suborder Acystosporea is a tick—Boophilus, Rhipicephalus, or Hæmaphysalis. Babesia is the cause of red-water, or Texas fever, and also of tick fever in the dog; Nuttallia creates biliary fever in horses, asses, and mules; Theileria is the parasite of East Coast fever in cattle; and Anaplasma produces a form of gall sickness in cattle.

With regard to the article on East African pigs (in which there is much fresh material concerning the appearance and habits of the giant forest pig), a puzzling mistake occurs in the first paragraph, wherein reference is made to an Abyssinian type of "wart-hog," *Phacochoerus johnstoni*. This should be *Potamochoerus johnstoni* (the East African river-hog); and it is not, we believe, Abyssinian in range, but equatorial East African.

A question is raised on p. 76 as to the attitudes of marabou storks during flight. It has always seemed to the present writer that in the normal attitudes of this bird when flying the neck was stretched out like that of other storks, or slightly curved and retracted, especially when wheeling. Others have asserted that the marabou drew back its neck into the ruff of shoulder feathers as a heron would do. It is a point which could best be decided by instantaneous photographs. As a general rule, storks, Balæniceps, and Scopus (besides ibises) stretch out their necks when flying; herons and pelicans retract them.

This No. 3 contains as a frontispiece a remarkable photograph of a record head of a Cape buffalo from Uganda—a splendid specimen almost recalling in length and curve of horns the extinct *Bos antiquus*. There is also an interesting article on birds in Uganda forests, another on anthropometry, and a third on the seasonal variation of the Junonia genus of butterflies.

H. H. JOHNSTON.

[1] The Journal of the East Africa and Uganda Natural History Society, vol. ii., No. 3, March, 1911. (London: Longmans, Green and Co.) Price 5s. 4d.

WHELKS AND THE VALUATION OF THE SEA.[1]

IN the first of these Reports Dr. Petersen discusses the possibility of combating the harmful animals of the fisheries, especially the whelks (Buccinum and Nassa), in the Limfjord. It appears that these animals are exceedingly troublesome in the Limfjord owing to their great abundance and rapacity. They feed on the plaice caught in the nets (gill-nets), and Dr. Petersen estimates the loss to the fishermen at a third of the year's total catch, a very considerable amount. The process of deliberate extermination is not recommended, however, as being too costly and uncertain, nor does it appear possible to make any economical use of the whelks; but it is suggested that the fishermen should clear their nets at more frequent intervals, and for the rest hope for an epidemic among the whelks. The possibility of the latter seems by no means remote.

In the twentieth report Dr. Petersen displays the foundations of an extensive and notable work on the quantitative determination of the animal life on the bottom of the sea. The investigation is stated to be a logical extension of Hensen's ideas; but, as a matter of fact, the "census of the sea" of Hensen, Brandt, and Herdman is widely different from the "valuation of the sea" of Petersen. Where the former lay stress on the plankton, and ignore the part played by the organic matter dissolved in sea water and in the bottom soil, the latter rather discredits the plankton, pointing out, in agreement with Lohmann, that its "producers" are not always able to supply sufficient food for its own "consumers," and lays stress on the organic matter. In the first part of this report Dr. Boysen Jensen discusses the results of his chemical analysis of the bottom soil and sea water, and concludes, *inter alia*, that the organic matter must come essentially from the benthos flora (algæ, and especially Zostera) in the Limfjord. The benthos animals—*e.g.* the oyster—are dependent on this organic matter, and not on the plankton.

It follows from this that the methods of investigation used by Dr. Petersen are entirely different from those of the planktologists. The basal idea is to determine the quantity of animal life on a fixed unit of surface (0·1 m.²) at as many different stations as possible, and at all seasons of the year. For this purpose Dr. Petersen has designed a special apparatus, which is simple in construction and can be used at any depth. To count the animals, after sifting, from such a unit of surface is obviously a much easier matter than the enumeration of the plankton. But Dr. Petersen goes much further, and, with the assistance of Dr. Boysen Jensen, gives the equivalents for each species in grams of organic matter. This common denominator thus serves as a basis of comparison of the value, not only of the different species, but also of different areas or fishing grounds. From this basis also it is possible to compare the amount of nourishment available and the amount consumed, as by the fishes. Even the fishes are reduced

[1] Nineteenth Report from the Danish Biological Station. Some Experiments on the Possibility of combating the harmful Animals of the Fisheries, especially the Whelks in the Limfjord. By C. G. Joh. Petersen. Pp. 20. (1911.)

Twentieth Report from the Danish Biological Station. Valuation of the Sea. I. Animal Life of the Sea-bottom, its Food and Quantity (Quantitative Studies). By C. G. Joh. Petersen and P. Boysen Jensen. Pp. 81; with 6 tables, 3 charts and 6 plates. (1911.)

to the common denominator; and it is shown, for example, that in the Limfjord the annual increase in weight of the plaice is only about one-sixth of the amount of organic matter consumed, and that the annual consumption of the plaice and eel together is only about one-ninth of the nourishment available.

The work is stated to be in its beginning, and this report is to be regarded as the introduction only; even so, it is remarkable for its broad and philosophic insight into fisheries problems and its wealth of ideas and practical suggestions. It can be strongly recommended to the planktologists—as an antidote. K.

SCIENTIFIC WORK OF THE IMPERIAL INSTITUTE.

WE have received a copy of the "Report on the Work of the Imperial Institute, 1910" (Cd. 5467-23), which contains a prefatory statement describing the organisation and objects of the institute, and includes summaries of the investigations carried out by the scientific and technical staff during the year. These comprised the examination of various minerals; of vegetable products such as cotton, rubber, oils, tobacco, foodstuffs, and so forth; and of a few animal products, including sponges, shells, feathers, and hair. Among the minerals mention is made of thorianite from Ceylon, containing 51·1 per cent. of thoria and 24·9 per cent. of uranoso-uranic oxide, the case being of special interest as indicating the kind of rock with which thorianite may be expected to occur in other localities.

Deposits of lignite from Southern Nigeria have been found to yield briquettes of excellent quality, and it is now clear that the use of local fuel, by obviating the heavy expenditure on imported coal, will materially assist the development of the West African colonies.

In the East African Protectorate an immense deposit of "soda" is to be worked; it consists essentially of sodium sesquicarbonate, and merely requires heating to furnish commercial "soda" of good quality. Numerous samples of rubber were examined, though only one actual consignment of any magnitude is described; this consisted of about 650 lb. of Landolphia rubber from the Bahr-el-Ghazal, which was of good chemical quality and realised fair prices.

In connection with the production of lemon-grass oil, the report states that the cultivation and distillation of lemon-grass in Uganda is now securely established. Samples of wheat from the East African Protectorate and from Northern Nigeria were found to be of excellent quality, and some "Turkish" tobacco from the Cape Province was regarded by experts as very promising. During the year three papers on geological and mineralogical questions, and one on the synthesis of caoutchouc, were contributed to scientific journals by members of the staff of the institute.

EXHIBITION OF MODEL AND EXPERIMENTAL ENGINEERING.

MR. PERCIVAL MARSHALL and those who are acting with him are to be congratulated on the success of the third biennial exhibition of model and experimental engineering. As before, this is held at the Royal Horticultural Hall, and it closes next Saturday. Model engines and boats, both sailing and steam, and kites, have always supplied an unfailing attraction to the younger generation; but now the amateur mechanic and experimentalist has a wider and more attractive field, largely dependent on the gas or petrol engine, a field in which in the last two years enormous strides have been made. Aëroplanes and hydroplanes of model size are doing wonders, though, of course, in most cases the engine of the aëroplane is made of elastic. The gyroscope and electricity afford more subject-matter for the experimentalist, as the model engineer now so often becomes, to work upon. Even wireless telegraphy is not outside his reach. When it is realised that a speed of more than twenty miles an hour has now been reached by a model "speed boat," and about half a mile has been traversed by a model aëroplane, it must be felt that the model engineering and experimental art as fostered by the society for which Mr. Marshall is doing so much is more than mere toy-making—it has a valuable educational influence.

It may be said that there are two types of small machine or model, one the faithful copy on a small scale of the big machine, and the other the small machine made so as itself to be as good as possible as a working machine. The two ideals are wholly distinct; each has its attractive side, each is well represented at the exhibition; but it is the second that is the most instructive, and this appeals most to the scientific imagination. While the visitor cannot help admiring the model of an engineering workshop with its steam engine, shafting, travelling crane, lathes, shapers, and planing machines, all beautifully made, and with leg vices, spanners, and small tools all in keeping, and while so beautifully made a model is quite instructive, model machines made not a bit like their large prototypes, but with their proportions altered so as to make them work as well as possible, are more interesting. They may fail in appealing to the æsthetic sense, if that be the sense which makes scale models so attractive, but if so they satisfy the reasoning faculty and experimental sense, and to the writer they appear the more important. Of course, at times proportions become so wildly inverted as to lead to a ludicrous appearance; but that only indicates the triumph of reason over the imitative art. For instance, there is a model petrol engine with pressure tank, carburettor, and engine in which the proportion of carburettor and cylinder irresistibly remind one of Lear's "young bird in that bush."

The only regret, and this is expressed not for the first time, is that Mr. Marshall so far has been unable to organise his exhibition at a time of year when boys are having their holidays.

FORTHCOMING BOOKS OF SCIENCE.

IN addition to the books announced in NATURE of October 5, the following works may be expected:—

AGRICULTURE.

W. H. and L. Collingridge.—Manures for Garden and Farm Crops, W. Dyke. *John Murray.*—A new edition of Elements of Agriculture: a Text-book Prepared under the Authority of the Royal Agricultural Society of England, by the late Dr. W. Fream, edited by Prof. J. R. Ainsworth-Davis, illustrated.

ARCHÆOLOGY.

Cambridge University Press.—The Thunderweapon in Religion and Folklore: a Study in Comparative Archæology, Dr. C. Blinkenberg, illustrated. *Oxford University Press.*—Four Years' Excavations at Thebes, the Earl of Carnarvon and Mr. Howard Carter, with chapters by Mr. F. L. Griffith, M. George Legrain, Dr. Moller, Prof. Newberry, and Prof. Spiegelberg, illustrated.

BIOLOGY.

Blackie and Son, Ltd.—Methodical Nature Study, W. J. Claxton, illustrated. *Gebrüder Borntraeger (Berlin).*—Die Wirbeltiere, Prof. O. Jaekel, illustrated; Symbolae Antillanae seu fundamenta florae Indiae Occidentalis, edited by I. Urban, Band iv., fasc. 4; Flora von Steiermark, Dr. A. von Hayek, Band ii., Heft 1; Handbuch der systematischen Botanik, Prof. E. Warming, new edition by Prof. M. Möbius; Kulturpflanzen und Haustiere in ihrem Übergange aus Asien nach Griechenland und Italien sowie in das übrige Europa, V. Hehn, new edition, edited by Prof. O. Schrader. *Cambridge University Press.*—Types of British Vegetation, by members of the Central Committee for the Survey and Study of British Vegetation, edited by A. G. Tansley, illustrated; The Vegetation of the Peak District, Dr. C. E. Moss; Life in the Sea, J. Johnstone; Heredity and Eugenics, edited by J. M. Coulter; American Permian Vertebrates, S. W. Williston, illustrated. *W. H. and L. Collingridge.*—Orchids for Amateurs, C. A. Harrison, illustrated; Rock Gardens and Alpine Plants,

E. H. Jenkins, illustrated. *Herbert and Daniel.*—Evolution in the Past, H. W. Knipe, illustrated. *Hutchinson and Co.*—The Flower Fields of Alpine Switzerland, G. Flemwell, illustrated; The Story of Evolution, J. McCabe, illustrated. *Jarrold and Sons, Ltd.*—Horses and Practical Horse Keeping, F. T. Barton, illustrated; Farther Afield in Birdland, O. G. Pike, illustrated; Wild Animals and the Camera, W. P. Dando, illustrated; My Book of Little Dogs, G. V. Stokes and F. T. Barton, illustrated; Our Dogs and All About Them, F. T. Barton, new edition, illustrated. *John Murray.*—Further Researches into Induced Cell-reproduction and Cancer, H. C. Ross, illustrated; The Genus Rosa, E. Willmott, drawings by A. Parsons, in parts, continued; Science of the Sea: an Elementary Handbook of Practical Oceanography for Travellers, Sailors, and Yachtsmen, prepared by the Challenger Society for the Promotion of the Study of Oceanography, and edited by Dr. G. H. Fowler, illustrated; and a new edition of Recent Advances in the Study of Variation, Heredity, and Evolution, R. H. Lock, illustrated. *Williams and Norgate.*—Introduction to Science, Prof. J. A. Thomson. *Grant Richards, Ltd.*—The Complete Wildfowler Ashore and Afloat, S. Duncan and G. Thorne, illustrated; The Birds of the British Islands, C. Stonham, parts 19 and 20, completing the work. *Seeley, Service and Co., Ltd.*—The Wonders of Bird Life, J. Lea. *Whitcombe and Tombs, Ltd.*—An Australian Bird Book, J. A. Leach, illustrated.

Chemistry.

Gebrüder Borntraeger (Berlin).—Chemisch-technisches Praktikum, Dr. W. Moldenhauer; Die Chemie der Cellulose, Prof. C. G. Schwalbe; Magnetochemie, Prof. E. Wedekind, illustrated.

Engineering.

Cassell and Co., Ltd.—Electrical Engineering, by H. H. Simmons, in 14 parts, illustrated. *Seeley, Service and Co., Ltd.*—The Wonders of Modern Engineering, A. Williams.

Geography.

Cambridge University Press.—The Climate of the Continent of Africa, A. Knox, illustrated; The Physical Geography of South Africa, A. L. Dutoit; Cambridge County Geographies, illustrated: Buckinghamshire, Dr. A. M. Davies; East London, G. F. Bosworth; West London, G. F. Bosworth; Northamptonshire, Rev. M. W. Brown; North Lancashire, Dr. J. E. Marr, F.R.S.; Monmouthshire, H. A. Evans; The Isle of Man, Rev. J. Quine; Oxfordshire, Rev. P. H. Ditchfield; Dumfriesshire, Rev. Dr. J. K. Hewison; Midlothian, A. McCallum; Perthshire, P. Macnair. *John Murray.*—Rambles in the Pyrenees and the Adjacent Districts—Gascony, Pays de Foix and Rousillon, F. H. Jackson, illustrated. *G. Philip and Son, Ltd.*—Philips' New Historical Atlas for Students, Prof. R. Muir; Philips' Chamber of Commerce Atlas: a Graphic Survey of the World's Trade, with a Commercial Compendium and Gazetteer Index; Philips' Modern School Atlas of Comparative Geography, edited by G. Philip, new edition; The Imperial Stations from Gibraltar to the Far East, prepared for the Visual Instruction Committee of the Colonial Office. *Whitcombe and Tombs, Ltd.*—The Geography of New South Wales, Historical, Physical, Political, and Commercial, Dr. Woolnough, assisted by A. W. Jose, G. Taylor, with introduction by Prof. T. W. David, illustrated.

Geology.

Gebrüder Borntraeger (Berlin).—Geologischer Führer durch das Mainzer Tertiärbecken, Dr. E. Mordziol, illustrated; Geologische Charakterbilder, edited by Prof. Stille: Heft 7, Westgrönland, Basalt- und Sedimentgebirge, by A. Heim; Heft 8, Der Odenwald bei Heidelberg und sein Abbruch zur Rheinebene, by W. Spitz and W. Salomon, illustrated.

Mathematical and Physical Science.

Cambridge University Press.—An Elementary Treatise on Cross-ratio Geometry, with Historical Notes, Rev. J. J. Milne; and new editions of A Primer of Astronomy, Sir R. Ball, F.R.S., illustrated; The Mathematical Theory of Electricity and Magnetism, J. H. Jeans, F.R.S. *Hutchinson and Co.*—Photography, edited by H. P. Maskel. *John Murray.*—A New Geometry, A. E. Layng. *G. P. Putnam's Sons.*—Star Lore of all Ages, W. T. Olcott, illustrated. *Williams and Norgate.*—Astronomy, A. R. Hinks.

Medical Science.

D. Appleton and Co.—A Text-book of Bacteriology: a Practical Treatise for Students and Practitioners of Medicine, P. H. Hiss, jun., and H. Zinsser; Treatise on Tuberculosis, edited by A. C. Klebs; Plastic and Cosmetic Surgery, F. S. Kolle; Clinical Symptomatology, with Reference to the Life-threatening Symptoms and their Treatment, A. Pick and A. Hecht; A Text-book of Medicine for Practitioners and Students, Dr. A. V. Strumpell; A Text-book in Psychotherapy, including the History of the Use of Mental Influence, directly and indirectly, in Healing, and in the Principles for the Application of Energies derived from the Mind to the Treatment of Disease, J. J. Walsh. *Gebrüder Borntraeger (Berlin).*—Pharmakognostischer Atlas, Zweiter Teil der mikroskopischen Analyse der Drogenpulver, Prof. L. Koch, Band i., illustrated. *Herbert and Daniel.*—The Romance of Modern Surgery and its Making: a Tribute to Listerism, Dr. C. W. Saleeby. *J. Nisbet and Co., Ltd.*—Tuberculin in the Diagnosis and Treatment of Tuberculosis, Dr. W. C. Wilkinson; The Intensive Irradiation and Wave Current Treatment of Rheumatism, Sciatica, Lumbago, Neuritis, and Painful Joints, L. E. Creasy.

Technology.

Gebrüder Borntraeger (Berlin).—Internationale Zeitschrift für Metallographie, edited by Dr. W. Guertler, Band i., illustrated; Handbuch der bautechnischen Gesteinsprüfung, Prof. J. Hirschwald, illustrated. *C. Arthur Pearson, Ltd.*—Wires and Wireless, T. W. Corbin. *Seeley, Service and Co., Ltd.*—Mechanical Inventions of To-day, T. W. Corbin, illustrated; The Romance of Aëronautics, C. C. Turner. *John Hogg.*—A new edition of Silverwork and Jewellery, H. Wilson, with notes by Prof. U. Bisei, illustrated.

Miscellaneous.

Gebrüder Borntraeger (Berlin).—Gedanken und Vorschläge zur Naturdenkmalpflege in Hohenzollern; Die Gefährdung der Naturdenkmäler und Vorschläge zu ihrer Erhaltung, Prof. H. Conwentz, new edition. *Cambridge University Press.*—Byways in British Archæology, W. Johnson, illustrated; Assyrian and Babylonian Letters Belonging to the Kouyunjik Collections of the British Museum, edited by R. F. Harper, parts x. and xi. *John Murray.*—Early Norman Castles in the British Isles, E. Armitage, illustrated; The Excavation of Gezer, 1902–5 and 1907–9, Prof. R. A. Stewart MacAlister, 3 vols., illustrated.—*Scott Publishing Company, Ltd.*—The Composition of Matter and the Evolution of Mind, D. Taylor. *Williams and Norgate.*—Psychical Research, Prof. W. F. Barrett, F.R.S.; The Dawn of History, Prof. J. L. Myres.

THE SCIENTIFIC MISAPPROPRIATION OF POPULAR TERMS.[1]

ONE of the main functions of the British Association is to prevent the development of a scientific caste in this country. The essential ideas of caste and science are diametrically opposed; nevertheless, the spirit of caste has in times past invaded the spirit of science, with the natural consequence that the eager explorers of knowledge became the academic guardians of tradition; and the same invasion now would deprive science of the popular sympathy and support which are more than ever necessary for its steady development. The members of the corresponding societies have special opportunities for helping that part of the Association's mission, for their personal intercourse with all sections of the community enables them to do much "to obtain a more general attention to the objects of science." Their influence must be exerted mainly through words, and the proper use of words is a matter of vital importance to the welfare of science. The recent appeals

1 Address to the Conference of Delegates at the Portsmouth meeting of the British Association, by Prof. J. W. Gregory, F.R.S., chairman.

for the improvement of the language of scientific literature are therefore direct contributions to scientific method; and as the societies represented at this conference are the strongest link between the technical specialist and those who take a friendly interest in science, special sympathy may be expected here with the complaints against the unintelligibility of some scientific writings owing to the excessive use of technical terms. I wish this afternoon, without denying that technical terms are sometimes used unnecessarily, to direct attention to a more neglected and insidious evil—the use of well-known English words with a technical meaning. The temptation to adopt an old word for a new idea, instead of inventing a fresh term, is often strong. It saves trouble—at the time. The old word is probably shorter than a new one would have to be, and its use avoids burdening a passage with an unknown and perhaps uncouth term. A sentence in which all the words are familiar appears to present no difficulties; a reader skims lightly over it pleased with the lucidity of the author and ignorant of the fact that it has been misunderstood, as the leading word conveyed to him a meaning different from that intended by the writer. The danger of a passage being misunderstood is more serious than that of its being not understood. It is worse to be misled by a plausible phrase than to be startled or repelled by a correct technical statement. A new word compels a conscientious reader to determine its true meaning, and should help him to a clear conception of the fresh idea; whereas the use of an old word with a new meaning discourages inquiry and encourages slovenliness in work and thought. The use of popular phraseology may render scientific literature apparently less strange; but if that phraseology be incorrectly used, the ultimate effect is to increase the divergence between the scientific and popular languages, and the estrangement between science and public opinion. For the scientific use of terms inconsistently with their ordinary meanings is apt to persuade the layman that the language of science is so different from his own that it is no use attempting to understand it.

Most sciences have adopted popular terms with new and restricted meanings; and if the origin of such a word be forgotten, scientific writers are apt to treat any use of it in its original sense as a popular blunder. For example, zoologists not only now reject spiders from the class of Insecta, but treat the idea that a spider is an insect as a mistake due to simple ignorance. Thus, to quote a recent standard work, J. H. and A. B. Comstock, in their "Manual for the Study of Insects" (1909, p. 12), remark that spiders "are often mistaken for insects," although the authors have abandoned "Insecta" as the name of the class in favour of Hexapoda. The word insect is much older than modern systematic zoology and the class Insecta. The word insect is derived from the Latin *insectum*, which is based on the verb *insecare*, "to cut into"; and it was used for animals the bodies of which are notched or incised into sections. This meaning of the word is well expressed in the definition by Philemon Holland, who is the earliest English author quoted in the "New English Dictionary" as having used the word insect. In his book, "The Historie of the World, commonly called the Naturall Historie of C. Plinius Secundus" (1601), he says, "Well may they all be called Insecta, by reason of those cuts and divisions, which some have about the necke, and others in the breast and belly; the which do go round and part the members of the bodie, hanging together only by a little pipe and fistulous conveiance."

The class Insecta was based by its founder, Linnæus, on the segmentation of the body, and not on the number of legs; it therefore included scorpions, millipedes, and spiders. It was not until half a century later that Lamarck excluded spiders from the class Insecta; and as late as 1864 we find so distinguished a naturalist as Bates[1] remarking that the spiders "Mygales are quite common insects." Even such a recent standard modern cyclopædia as the "Jewish Encyclopædia"[2] retains the millipedes as insects. The term insect should not, however, be applied to a coral polyp; "coral insect" is justly denounced as a misleading blunder, due to ignorance of the nature of the coral animal. The terms *insectum* and insect according to their original usage no doubt included worms, and Holland expressly mentioned earth-worms as insects. In many worms, however, the body is not divided into segments, and worms were therefore early and appropriately excluded from insects; so Milton writes[1] in his description of the bower in Eden:—

"Other creature here,
Beast, bird, insect, or worm, durst enter none."

Johnson's Dictionary (first edition, 1755) accepted a definition restricting insects to animals whose body is nearly divided in the middle into two parts. "Insects may be considered together as one great tribe of animals; they are called insects from a separation in the middle of their bodies whereby they are cut into two parts, which are joined together by a small ligature, as we see in wasps and common flies." This definition, while admitting spiders, excluded worms. The present zoological separation of insects from other air-breathing arthropods is based mainly on the presence of six legs. The term Hexapoda is therefore more suitable for the class as now defined than Insecta; and the restriction of Insecta in systematic zoology to a group based not on the insection of the body, but on the number of legs, is less accurate and appropriate than its previous use in zoology and in popular English. It would seem better to admit that the spider is an insect, but insist that it is not a hexapod.

The term worm, on the other hand, illustrates cases in which a restriction of popular meaning is both appropriate and convenient. A worm was originally not necessarily one of the Vermes of the zoologist. Thus the worms mentioned in the Old Testament included various insect larvæ. Dr. Ridewood tells me that the manna collected by the Israelites in the desert was probably a small lichen, and that the worms bred in it[2] were probably fly grubs; and the references by Job and Isaiah to worms that cover the dead may include both insect grubs and nematodes. When Job reminds the sinner of the worm that "shall feed sweetly upon him,"[3] he had in mind the larvæ of blow-flies; and though the worms that ate Herod[4] may have been an endoparasitic worm or fluke, the worm that caused the withering of Jonah's gourd[5] was probably a beetle larva.

In popular English, moreover, worms always included snakes, as shown both by Dr. Johnson's definition of a worm, "A small, harmless serpent that lives in the earth," and by Shakespeare in Cleopatra's inquiry:—

"Hast thou the pretty worm of Nilus there,
That kills and pains not?"[6]

Uniformity between popular and zoological terminology can best be secured in regard to the term worm by inducing the public to use it only for one of the Vermes, for it is less necessary to have one term for all creeping things than to distinguish noxious snakes and centipedes from the lowly and useful worm.

The word fish illustrates how a popular word may become unduly extended and then be again restricted with fuller knowledge. The word is of very ancient origin, and was probably originally limited to what the zoologist accepts as fish. The term fish is not derived from the primitive Aryan language, and it was not introduced until the Latin-Teutonic section had separated from the Indian and the Greek; and as the term was invented by people who apparently had no knowledge of the sea, they doubtless used it for fresh-water fish.[7] The primitive hunters who went to the coast may have extended it to shellfish, and it was adopted in the English crayfish by a corruption of the French *écrevisse*. When whales and dolphins were discovered, they were accepted as fish in ignorance of their affinities, for such aquatic animals as seals and otters were never included among fish, since their mammalian characters were obvious. That whales, porpoises, and their allies are not fish is now admitted in current language, though the old usage survives among whalers. The terms whale-fishery and seal-fishery are firmly established; but they are unobjectionable, because those industries have so many important features in common with the capture of fish. The general current limitation of fish to the fish

1 "A Naturalist on the Amazon," p. 96. 2 1906, vol. vi., p. 105.

1 "Paradise Lost," iv. 2 Exodus, xv. 20. 3 Job, xxiv. 20.
4 Acts, xii. 23. 5 Jonah, iv. 7. 6 "Antony and Cleopatra," v. 2.
7 See O. Schrader, "Prehistoric Antiquities of the Aryan Peoples," 1890, pp. 117–118, 127–128, 353–354.

of the zoologist is only a return to the primary meaning of the word.

Chemistry supplies an excellent illustration of the justifiable adoption of an old term with a revised meaning. Element is used in its later classical meaning, and Chaucer in 1386 shows that it was used in Early English in a similar sense. He says in the Frere's Tale (line 206) :—

"Make ye yow newe bodies alway
Of elementz.'

Its modern chemical use means the resurrection of the word element to a new period of usefulness.

The chemical adoption of the terms metal and non-metal for the two classes of elements is, on the other hand, an example of the inconvenience that results when a new definition is only approximately coincident with a well-established current meaning. The word metal appears to be derived from the Greek μέταλλον, connected with μεταλλάω, "to seek after," through the Latin *metallum*, a mine or quarry, or substance obtained by mining. Hence road metal for stone is correct.

By the time of Johnson the word metal was usually restricted to those products from mines which have metallic as distinct from earthy or stony properties. Johnson's definition—"We understand by the term metal a firm, heavy, and hard substance, opake, fusible by fire, and concreting again when cold into a solid body such as it was before, which is malleable under the hammer, and is of a bright, glossy, and glittering substance where newly cut or broken"—states the general idea of a metal.

The chemical adoption of the word for the larger of the two classes of elements has resulted in the use of the word metal in science with two contradictory senses; thus in elementary geology the word is used with its chemical meaning; but in economic geology metal is used in its commercial sense.

Sodium and potassium are therefore metals in elementary geology and academic mineralogy; but they are not metals in advanced economic geology. This double use of the word is an occasional source of confusion and discounts any good advice that may be given to students as to precision in the use of terms. It is perhaps too late to change, but it would have been better if the chemists had adopted technical terms for the two groups of elements instead of applying the term metal to a material so unlike the ordinary idea of a metal as is sodium.

Geology has been a particularly flagrant sinner in the misuse of popular terms. Its nomenclature has not only unconsciously absorbed and modified many English words, but committees of experts have deliberately committed such wholesale piracy that our language has been left bankrupt in some departments. Thus terms are needed in stratigraphy for the various subdivisions of the sedimentary rocks and for the lengths of time occupied in their deposition. The International Geological Congress proposed the following series of terms, beginning with the larger divisions :—

Formation	Equivalent Time
Group.	Era.
System.	Period.
Series.	Epoch.
Stage.	Age.

Although a systematic nomenclature would be very useful, this scheme has not been generally adopted; and I think the reason is that, by assigning definite meanings to all the indefinite terms available, there is nothing left for use in an indefinite sense. Thus a number of beds, which together may be either more or less than a subdivision of a system, cannot be called a series without risk of misunderstanding. All the above eight terms are required for use in geology with their current English meanings. The scheme proposed by the International Geological Congress involves using these words sometimes in a technical and sometimes in a non-technical sense. In literature the difficulty may be overcome by printing the words with capital letters when they are used as the names of definite divisions; but that is impossible in speech. The principle recommended by the International Geological Congress was excellent, but the scheme proposed has proved impracticable owing to its application of old words to new things.

Buckman adopted a sounder policy when he introduced the term Hemera for the time equivalent to a zone.

Geologists have adopted some common words with meanings which render geological phraseology unintelligible or even ludicrous to the man who has not been warned that they require special interpretation. Thus the need in elementary teaching for emphasising the difference between mineral species and mineral aggregates has led to the frequent use of the term mineral as an abbreviation for mineral species. Some authors have been led by this practice to deny that mineral aggregates are minerals, and therefore assert that coal, most iron ores, oil shale, mineral oil, &c., are not minerals. According to that view the mineral industry has little concern with minerals; and the mineral resources of the British Isles, which are generally regarded as extensive, are reduced according to this nomenclature to practically nothing.

Another triumph of dauntless logic is the use of the word rock. It is no doubt convenient, when speaking of the crust of the earth, to have one term to cover all its materials; and rock is used in this way just as the dust in the atmosphere and the salts in the sea may be included with the air and the water. Hence has arisen the geological convention of calling any large constituent of the earth's crust a rock, quite regardless of the cohesion of its particles. G. H. Kinahan, for example, in his "A Handy Book of Rock Names" (1873), says, "Thus loose sand, clay, peat, and even vegetable mould, geologically speaking, are rocks" (p. 1); and on p. 131 he includes ice among rocks.

Now this use of the term ignores the very essence of the popular idea of a rock. The term appears to be derived from the same word as crag, and the essential quality of a rock is firmness. The parable of the man who built his house upon a rock would need to be retranslated, and Shakespeare's "He's the rock, the oak not to be windshaken,"[1] loses its meaning if rock may be loose, drifting sand. The conventional use of the word rock in geology has been so widely adopted that objection to it may appear pedantic. Rosenbusch,[2] however, has defined "Rocks as the geologically independent constituents, of more or less constant chemical and mineralogical composition, of which the firm ('feste') crust of our earth is built." Hence such definitions as that in my "Structural Geography" (p. 21) of rocks as the firm coherent masses which form the main part of the lithosphere may shelter behind the high authority of Rosenbusch.

Reference to the paradox of calling clay and sand rocks reminds me that the word clay is now used in two very different senses in two sections of geology. In mineralogy the clays are a group of mineral species which are hydrous silicates of alumina. To the merchant, the farmer, and the economic geologist the essential quality of clay depends on texture and not on chemical composition. The word clay appears to be based on the same root as clog and cleave, while the Russian glina and the Greek γλία connect it with glue and glutin. The root of the word clearly refers to the adhesiveness which clay owes to its plasticity.

The essential property of clay is that it becomes plastic when wet. In England this property is chiefly found in material, which, being formed from decomposed felspars, is a hydrous silicate of alumina; but other common materials have the same property, if ground to the requisite fineness. Quartz flour is a common clay-forming material in many parts of the world, and much of the material called clay by the farmer is pure silica. Hence the definition of economic and agricultural geologists that clay is earthy material, which is plastic when wet, its particles being no more than 0·05 mm. in diameter, is a more common-sense definition than any based on chemical composition.[3]

If a name be wanted to distinguish clays which are silicate of alumina from clays of different composition,

[1] Coriolanus, v. 2, 117. Cf. also Zangwill—"Feeling solid-based upon eternal rock."

[2] H. Rosenbusch, "Elemente der Gesteinslehre," Stuttgart, 1910, third edition, p. 1.

[3] Ries's definition—"Clay is the term applied to those earthy materials occurring in nature whose most prominent property is that of plasticity when wet" (H. Ries, "Clays, Their Occurrence, Properties, and Uses, with especial reference to those of the United States," 1906, p. 1)—is an example of those based on texture and not on composition.

then a new name should be invented, instead of adopting a definition which refuses to accept as clay the slime of the quartz miner, much of the Scottish boulder clay, and any one of the nine brick-clays in the table of brick-clay analyses given by Ries.[1]

I have referred to a few instances to illustrate the frequent misappropriation of current terms by various branches of science, in the hope that the members of the corresponding societies will use their influence to discourage this practice. It should be remembered, however, that there are many cases in which it is a wise policy to transform a current popular term. It may be even justifiable, as in the case of minium and cinnabar, to use a word with the very opposite of its original meaning. A term may be adopted and redefined where, as in the cases of fish and worm, the popular meaning involves a wrong idea, which it is advisable to correct, or overlooks a distinction which is practically important. Change and growth in nomenclature must be allowed. A dead language is very good for fixed ideas; but rigid adherence to original meanings is a bondage from which it is to be hoped scientific terminology will be always free. It is useless to suggest rules as to when popular terms may be revised; each case should be judged on its merits.

The casual adoption of current words with new meanings is often an attempt to secure specious simplicity at the price of subsequent confusion. Deissmann's recent book, "Light from the Ancient East" (1910), directs attention to the misconceptions that have similarly arisen in theology, for he urges that words used in the New Testament are now understood, in what the authors of that volume would decidedly call a non-natural sense. The idea that science is being driven into an intellectual wilderness owing to its technical terminology is an idle bogie. Reference to the sporting or business columns of any daily paper will show that all specialised pursuits have their own special language. The language of golf is as technical as that of geology, and I venture to urge that science will lose more by the misuse of current English than by the invention of new terms for new ideas and new materials. A rose by any other name may smell as sweet, but we cannot get sweet-smelling roses if we order them under the name of dandelions. In short, to put new meanings into standard English words appears as unjustifiable as to put home-brewed beer into Bass-labelled bottles.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The next combined examination for sixty-eight entrance scholarships and a large number of exhibitions, at Pembroke, Gonville and Caius, King's, Jesus, Christ's, St. John's, and Emmanuel Colleges, will be held on Tuesday, December 5, and following days. Mathematics, classics, and natural sciences will be the subjects of examination at all the above-mentioned colleges. Most of the colleges allow candidates who intend to study mechanical sciences to compete for scholarships and exhibitions by taking the papers set in mathematics or natural sciences. A candidate for a scholarship or exhibition at any of the seven colleges must not be more than nineteen years of age on October 1, 1911. Forms of application for admission to the examination at the respective colleges may be obtained as follows:—Pembroke College, W. S. Hadley; Gonville and Caius College, The Master; King's College, W. H. Macaulay; Jesus College, A. Gray; Christ's College, The Master; St. John's College, The Master; Emmanuel College, The Master; from any of whom further information respecting the scholarships and other matters connected with the several colleges may be obtained. The forms of application must be sent in on or before Saturday, November 25.

The syndicate appointed to consider the question of providing pensions for professors and others in the service of the University has considered the desirability of framing a contributory scheme. The stipends, however, which the University is at present able to pay do not seem to the syndicate sufficiently large to justify a tax for providing pensions. The syndicate has also considered whether the University should enter into an arrangement with an assurance company or should form its own pension fund; but it recommends that the University should establish its own pension fund. In its scheme the syndicate has aimed at providing pensions for professors (with certain exceptions), readers, and certain officers on the basis of compulsory retirement at a given age; the maximum pension to be 500*l.* a year or five-sixths of the stipend, whichever is the less; and the actual pension to be in a proportion, varying with the length of service, to the maximum pension. The amount of pension is further limited to 500*l.* a year, inclusive of any college pension, stipend, or emolument. The syndicate proposes that in the first instance the pension scheme should apply only to professors, readers, and officers appointed in the future, in which case the annual contribution for pensions would for many years probably be small. But it is hoped that the University may be able in due course to provide pensions for some of the present staff if they are willing to place themselves under the scheme. There are nineteen professors, twelve readers, and nine university officers of the present staff who would be under the age of sixty on January 1, 1911, and entitled to pensions according to the scheme.

The syndicate appointed to consider the financial administration of the various scientific departments of the University, and the financial relations between these departments and the museums and lecture-rooms syndicate, has issued a revised report, in which the following rules are formulated, among others:—(1) That the responsibility for the working and superintendence of each of the scientific departments and for the administration of the departmental fund rest with the professor who is the head of the department. (2) That, subject to any subsisting agreement for the retention of fees by individuals, all fees received for lectures and practical courses be paid into the departmental fund. (3) That a university buildings syndicate be established in substitution for the museums and lecture-rooms syndicate, and that all university buildings be placed under its charge except the University Press and any other buildings specially committed by the Senate to any special board or syndicate. (4) That a general maintenance fund for university buildings be established in substitution for the museums and lecture-rooms maintenance fund, and that it be referred to the financial board to advise the Senate what annual payment should be made to this fund.

The financial board has reported on the college contributions for 1911. In its opinion the sum of 30,071*l.* should be raised in the present year by contributions from the colleges for university purposes. This report has been accepted by the Senate.

It is proposed to establish a post of demonstrator in medical etymology in connection with the Quick Laboratory. The appointment will be made by the Quick professor of biology with the consent of the Vice-Chancellor, and the office will terminate with the current period of the tenure of the Quick professorship.

THE governing body of the Lister Institute has made the following appointments:—Drs. E. E. Atkin and W. Ray to be assistant bacteriologists, Mr. A. W. Bacot to be entomologist, and Dr. Casimir Funk to be a research scholar.

AN international exhibition is being arranged by the Imperial Russian Technical Society to illustrate the organisation and equipment of schools. The exhibition is to be opened on April 15, 1912, and will last until the following July 15. This will be the first exhibition of its kind to be held in Russia. Full particulars and the conditions for exhibitors can be obtained from the executive committee of the International Exhibition "Organisation and Equipment of Schools," St. Petersburg, Panteleimonskaia, 2.

REUTER'S correspondent at Simla states that about 30 lakhs of rupees (200,000*l.*) have been collected for establishing a residential Hindu university at Benares with an adequate European staff. Mr. Butler, of the Viceroy's Council, in writing to the Maharaja of Darbhanga, indicated the conditions upon which the Government would recognise the university, and these conditions have been

[1] H. Ries, *ibid.*, p. 185.

accepted by the promoters of the scheme. The Maharaja of Darbhanga has given five lakhs of rupees (about 33,330*l.*) towards the university.

It is announced in *Science* that the late Dr. William Flynn, of Marion, has bequeathed his entire estate, valued at about 6000*l.*, to the Indiana Medical College, in which he was a member of the faculty for many years. From the same source we learn that among the public bequests made by Mr. G. M. Pullman was that of 240,000*l.* for founding and endowing the Pullman Free School of Manual Training at Pullman, Ill. This fund has increased to more than 500,000*l.* The first step towards founding the school was the purchase, in 1908, of forty acres within the limits of the town of Pullman at a cost of 20,000*l.* Mr. Laenas Gifford Weld, until recently professor of mathematics and dean of the faculty of liberal arts in the Iowa State University, was appointed principal in May, and entered upon his new duties on September 1. He will visit the leading technical and trade schools in this country and in Europe before the preparation of definite plans is undertaken.

SOCIETIES AND ACADEMIES.

MANCHESTER.

Literary and Philosophical Society, October 3.—The president, Prof. F. E. Weiss, gave an address on recent researches on heredity in plants. After mentioning the work of earlier investigators, Prof. Weiss referred to the experiments of Mendel on the crossing of different strains of peas. From the results Mendel deduced the two fundamental laws of heredity: first, the dominance of certain unit characters in the first hybrid generation, and, secondly, the segregation of the dominant and recessive characters in the second hybrid generation. This latter law, though not its numerical ratios, was independently discovered by Naudin. These discoveries remained almost unnoticed for half a century, until de Vries, Correns, Bateson, and others brought them prominently before biologists at the beginning of the century. Confining himself to the phenomena of heredity in plants, Prof. Weiss dwelt upon some of the investigations of Correns and Bateson on colour inheritance in *Mirabilis jalapica* and sweet peas, and referred also to his own experiments in crossing the scarlet and blue forms of the common Pimpernel. The resultant cross was completely scarlet, like one of the parents, but in the subsequent generation 25 per cent. of the offspring were pure blues. The same result was obtained by crossing the blue form with pollen from a pink variety of Pimpernel, blue being recessive in the first hybrid generation. Prof. Weiss also dealt with the numerical ratios exhibited in the inheritance of paired characters, and with some of the more complex manifestations, such as the appearance of coloured flowers as the offspring of two white parents. Dealing with the analysis of hybrid plants, he referred to his experiments with *Geum intermedium*, the cross between the common and water avens, a hybrid not uncommonly met with in the limestone dales of Derbyshire. This plant exhibits in the size, colour, and shape of its flowers an intermediate condition between its two parents, and is thus easily distinguished from either. The flowers of the hybrid possess both the yellow plastids of the common avens and the red sap (anthocyanin) of the water avens. When pollinated with its own pollen, this very fertile hybrid gives rise to plants some of which have red flowers with no trace of yellow, while others are yellow with no red sap, and, in addition, a number of plants with pure white flowers were obtained. A similar "throwing" of white flowers was observed in the offspring of the hybrid between the primrose and the oxlip. The question of the determination of sex has also been attacked from the botanical point of view by Correns with some success, and his results, on the whole, tend to confirm the view that this problem may yet be satisfactorily solved on Mendelian lines.

DIARY OF SOCIETIES.

THURSDAY, OCTOBER 19.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Economics of Tube-milling: H. Standish Ball.—Fallacies in the Theory of the Organic Origin of Petroleum: Eugene Coste.

FRIDAY, OCTOBER 20.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Endurance of Metals; Experiments on Rotating Beams at University College, London: E. M. Eden, W. N. Rose, and F. L. Cunningham.

TUESDAY, OCTOBER 24.

ZOOLOGICAL SOCIETY, at 8.30.—On a New Tree-Frog from Trinidad, living in the Society's Gardens: E. G. Boulenger.—Distant Orientation in Amphibia: B. F. Cummings.—The Duke of Bedford's Zoological Exploration of Eastern Asia.—XV. On Mammals from the Provinces of Sze-chwan and Yunnan, Western China: O. Thomas, F.R.S.—Game Sanctuaries and Game Protection in India: E. P. Stebbing.

WEDNESDAY, OCTOBER 25.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.—The President's Address.—Jovian Latitudes: C. T. Whitmell.—Meteors from Taurus: W. F. Denning.—Note on the Resisting Medium: F. W. Henkel.—Observations of the Kiess Comet: Major S. A. Eddie.—Saturn's Rings: F. H. Beattie—Conjunction of Mars and Saturn: H. MacEwen.

THURSDAY, OCTOBER 26.

THE CONCRETE INSTITUTE, at 8.—Fire-proofing: R. L. Humphrey.

FRIDAY, OCTOBER 27.

PHYSICAL SOCIETY, at 5.—Further Observations on the After-glow of Electric Discharge and Kindred Phenomena: Hon. R. J. Strutt, F.R.S.—Homogeneous Fluorescent X-radiation of a Second Series: Prof. C. G. Barkla and J. Nicol.

MONDAY, OCTOBER 30.

ARISTOTELIAN SOCIETY, at 8.—The Relations of Universals and Particulars: Hon. Bertrand Russell, F.R.S.

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