NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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All persons who received grants in June, 1914, or in June of any previous year, whose accounts have not been declared closed by the Council, are reminded that reports must be in the hands of the Honorary Secretaries not later than Tuesday, June 1.

The Council wish to draw attention to the fact that the income arising from the donation of the Worshipful Company of Goldsmiths is more or less especially devoted to the encouragement of research in inorganic and metallurgical chemistry. Furthermore, that the income due to the sum accruing from the Perkin Memorial Fund is applied to investigations relating to problems connected with the coal-tar and allied industries.

UNIVERSITY OF LONDON

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March 30, 1915.

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THURSDAY, MAY 6, 1915.

THE TECHNOLOGY OF ILLUMINATION.

Modern Illuminants and Illuminating Engineering. By Leon Gaster and J. S. Dow. Pp. xiv + 462. (London: Whittaker and Co., 1915.) Price 12*s.* 6*d.* net.

WHEN a new branch of science, art, or industry becomes recognised, the literature on the subject might at first be expected to be scant in quantity and meagre in scope. But illuminating engineering is a new branch only in so far that attempts have been made to collect and arrange scattered facts and principles, and very few individuals call themselves illuminating engineers. So far as means, methods, and appliances for producing artificial light are concerned, the new movement has done little else than to record ancient and modern practice, but certain advances have been made on the scientific side by the development of photometry, and the extension of theoretical considerations of the distribution of illumination which are not to be found in text-books on optics. Some attention has been given to the subject of "glare" which is difficult to define, and to the artificial production of light not differing visually from ordinary daylight.

Having regard to the keen rivalry between the advocates of gas and of electric lighting, the success of an illuminating engineering society at one time appeared to be doubtful. It was founded in 1909, and has as its official journal the *Illuminating Engineer*. The membership has reached nearly five hundred, and many useful papers and discussions have resulted. This has been largely due to the tact and zeal of Mr. L. Gaster and Mr. J. S. Dow, the editors of the journal and the secretaries of the society. Even if the former of these were not a linguist or had a taste for antiquarian research and a genius for bringing competitors into harmony, and if the latter were not trained in physics and had not done any original work in photometry, they would have been in possession of a vast amount of material for a book, and well qualified to use it.

In accordance with the traditional opening of a Friday evening discourse at the Royal Institution, the first chapter begins with "the very earliest conceptions of light" in remote antiquity, and its use "among primitive peoples," and runs through history up to the Home Office Departmental Committee on Illumination, and the formation of the International Photometric Commission. The second chapter deals with gas burners, and does not touch on the chemistry or the making of gas. The section on high-pressure gas is compressed into only about five pages. The third gives as much on electric lighting as can be packed into thirty-six pages, while the fourth describes oil, petrol-air gas, and acetylene lighting. These constitute one-third of the book, and appear at first to be of a sketchy character, but almost every page has foot-notes, and most of these refer to English and foreign periodical literature. A bibliography is provided at the end, but it does not include more than a small portion of the publications referred to in the valuable foot-notes.

The fifth and sixth chapters on the human eye and colour vision are a useful epitome. The last half of the book consists of chapters on the measurement of light and illumination, shades and reflectors, problems of interior and of outdoor lighting. These are well illustrated by reproductions of photographs, many of which have appeared in the *Illuminating Engineer*. Although this does not profess to be a treatise or even a text-book, an omission or two must be noticed. Polar curves are given in considerable numbers, and the solitary place in which an integral expression is used warns the reader against a common mistake which is sometimes made in deducing mean spherical candle-power from such a curve. "The well-known Rousseau method," which achieves this result graphically, is not described or even foot-noted, but is merely alluded to. The Ulbricht globe which is experimentally used for the same purpose has a full-page illustration and a foot-note with eight references, but only eleven lines are allowed for a description of it. Prof. Clinton has shown that the illumination of a room may be pre-determined by calculation, and possibly his treatment was not suitable for a book of this type, but, on the other hand, there are several rule-of-thumb methods and tables for finding how many lamps or how much candle-power or flux in lumens are required for interior work, and some of these might have been included. An American trading concern cannot perhaps be blamed for giving the name "X ray" to a type of reflector, but it should not be mentioned without a disparaging "so-called."

The subject is still developing so rapidly that it must have required some courage to produce a volume of this kind, and it is so wide that to decide the proportion to be allowed to different sections must have been a matter of difficulty. Such questions of proportion are necessarily matters of opinion, and books, after all, are what publishers allow authors to offer us, and not what the reviewers think or even what the readers may desire that they should be. Some would like more mathematics, others data on economical points. The authors have succeeded admirably in the task which they have set themselves, and the book is well produced.

PLANT LIFE IN ICELAND AND CYPRUS.

(1) *The Botany of Iceland.* Edited by Dr. L. K. Rosenvinge and Dr. E. Warming. Part I. 2. An Account of the Physical Geography of Iceland, with special reference to the Plant Life. By Prof. Th. Thoroddsen. Pp. 191–343. (Copenhagen: J. Frimodt; London: J. Wheldon and Co., 1914.)

(2) *Bergens Museums Skrifter. Ny Raekke.* Bind i., No. 2. Studies on the Vegetation of Cyprus. Based upon Researches during the Spring and Summer, 1905. By Jens Holmboe. Pp. 344. (Bergen: John Griegs, 1914.)

(1) THE present instalment of "The Botany of Iceland," by Prof. Thoroddsen contains five chapters. The first chapter deals with general topography and geology. The island is a continuous table-land with an average height of 700–1000 metres above sea-level, excepting narrow borders of coastal land, valleys which cut into the table-land on all sides, and a few small areas of level land towards the south and west. More than two-thirds of the entire area is at so great a height above sea-level that almost no vegetation can thrive there. The sandy and stony deserts of the interior plateau, the lava tracts, and the glaciers are not fit dwelling-places for man, and it is almost exclusively, therefore, the coasts and valleys which are inhabited. The volcanic element is the most striking feature in the geology, and is treated at some length.

The second chapter deals with conditions of surface and soil. Basalt is the fundamental rock; the tuffs and breccias are for the most part basalt split and pulverised, and the mineralogical and chemical component is essentially the same throughout the island. The climate, discussed in chapter iii., is, owing to oceanic currents, much milder than would be expected from the position of the island. Evidence of the Gulf Stream is found in the drift material, which includes sugar-cane and seeds of *Entada* and other West Indian beans. The winter is long, but generally not severe; the summer is comparatively short and cold and the weather usually changeable and damp.

The general distribution of plant life and a sketch of the chief plant-formations form the subjects of the remaining two chapters. Only a small part of Iceland bears a continuous carpet of vegetation. The number of species of flowering plants and ferns is from 400 to 450, as compared with 380 in Greenland and about 1450 in Denmark. Of these eighty-four are grasses and sedges. Man, with his sheep and cattle, has exercised considerable influence on the vegetation. The coppice woods of birch (*Betula odorata*) which were once extensive are rapidly disappearing, and their destruction has affected the general vegetation. The nature of the country and the vegetation are well illustrated by a number of photographic figures.

(2) The detailed study of the botany of Cyprus is the result of a desire on the part of a Norwegian botanist to compare with the flora of his own country that of an area in which there had been no glacial epoch. The author gives a brief sketch of the topography, geology, and climate of the island, and a short history of our knowledge of the flora, including a list of plants mentioned by authors before 1787. The main part of the volume is devoted to a carefully annotated systematic list of the vascular plants hitherto observed spontaneously growing in Cyprus, and some remarks on the most important plant-societies of the island. During his seven months' stay the author was able to add considerably to the number of plants previously recorded, and also to study critically various elements of the flora. The cedar of the island he regards as a distinct endemic sub-species, with affinities partly with the cedar of Lebanon and partly with that of the Atlas range. Several new species of flowering plants are described, and these as well as many others of special interest are illustrated by excellent plates and text-figures.

Large deposits of calcareous tufa were discovered containing excellent leaf-impressions consisting mainly of *Laurus nobilis* and *Platanus orientalis*, with fragments of *Ficus carica*, *Smilax aspera*, and *Rhamnus oleoides*, all of which are represented in the present-day flora. The account of the plant-societies, though not exhaustive, is a valuable contribution, greatly enhanced by a number of photographic reproductions. There are also short chapters on the means of distribution of some of the plants and on the affinities and history of the flora; also a list of topographical names derived from plant names, and a bibliography.

PRIME NUMBERS AND THE COMPLEX VARIABLE.

(1) *List of Prime Numbers from 1 to 10,006,721.* By D. N. Lehmer. Pp. xv+133. (Washington, D.C.: Carnegie Institution of Washington, 1914.) Price 5 dollars.

(2) *Functions of a Complex Variable.* By Prof. J. Pierpont. Pp. xiv+583. (London: Ginn and Co., 1914.) Price 20*s.* net.

(1) THE table is similar in form to Mr. Lehmer's previously published factor-table (see NATURE, August 10, 1911, p. 178), and the same elaborate precautions have been taken to avoid error. Thanks to the work of Glaisher and

his predecessors, we may now be fairly confident that the primes in the first nine millions have been correctly determined; the introduction to the present table describes the checks used for the tenth million, and contains other very interesting matter. First we have an account of Kulik's remarkable work, which, although not accurate, has been found to be of great value as a check, and actually goes beyond 100,000,000; unfortunately the second of the eight MS. volumes is missing. Then we have an admirable summary of the work done in the theory of the distribution of primes, ending with Gram's series, which is a transformation of Riemann's celebrated formula. Finally we have a table, at steps of 50,000, giving comparisons of the actual count with the values found from the formulæ of Legendre, Tchébicheff, and Riemann respectively.

The superiority of the last-named becomes more and more evident the further we go; the errors fluctuate in sign, and their ratios to the true value diminish in a most remarkable manner. The error is actually zero for a table going from 1 to 9,050,000; and for 10,000,000 it is only +87, the number of primes, as counted, being 664,580. The errors in the other two calculated values are always in excess and Legendre's value is less accurate than the other; but the comparative smallness of the errors is noteworthy, being only 560 and 338 respectively for a ten-million table. Perhaps there may be a simple modification of Legendre's formula which would bring it into closer agreement with Gram's.

The liberality of the Carnegie Institution of Washington has made it possible to publish this table at a price which is remarkably low, considering the labour involved. We hope that English universities and colleges will provide themselves with copies, and make an announcement that they have done so; this would be a great benefit to scattered arithmeticians, who now and then wish to know whether a particular number is prime or not, and may not be able to afford even a sovereign for the luxury of possessing this work. The same thing may be said, with greater emphasis, about the factor-table.

(2) Prof. Pierpont's treatise on the complex variable is very good, and a judicious mean between elaborate works addressed to the expert and specious outlines which ignore all difficult points, and tempt the reader to draw all sorts of false conclusions. The method is practically that of Cauchy, as developed by Briot and Bouquet, and Hermite, no use being made of Riemann surfaces. On the whole, we think this is the preferable course, because, although in simple cases the Riemann surface provides a visual image of great simplicity, and is invaluable for purposes of research, we cannot *construct* it until we have worked out the analytical theory of the algebraic functions we are considering, and this comes to discussing a system of Cauchy loops.

Readers of Dedekind and Weber's memoir on algebraic functions will remember that the authors laid great stress on the precise meaning of "a point on a Riemann surface"; this is the main crux of the whole theory, and another way of putting it is to determine the complete characteristics of a singular point on a given algebraic curve. This last way was that of H. J. S. Smith and Halphen. The present writer is no doubt prejudiced; but he ventures to say that in his opinion Dedekind's notion of algebraic divisors, as expounded, for instance, in Hensel and Landsberg's treatise on algebraic functions, is the best way to express the analytical facts in a concise symbolical form. For one thing, it brings into prominence the idea of a compound modulus, which is bound to lead eventually to a great simplification of the theory of algebraic functions.

A good feature of the treatise is that special functions such as those of Legendre and Bessel, and the hypergeometric function and elliptic functions, are treated in the light of the general theory.

There are two points about which the author might have written differently with advantage. It is not correct to say that the argument (amplitude) of $x+yi$ is $\tan^{-1}y/x$; otherwise we should have arg $(x+yi)=$arg $(-x-yi)$. The author does not say this, but (p. 11) he invites this false conclusion. The correct statement may be written—

$$\arg\,(x+yi)=(\sin,\,\cos)^{-1}(y/r,\,x/r),$$

where $r=+\sqrt{(x^2+y^2)}$, and $(\sin, \cos)^{-1}(a, b)$ means an angle of which a is the sine and b is the cosine.

Thus arg $(x+yi)$ is determinate up to multiples of 2π; and this is the only way to avoid error arising from the definition.

The second point is this. Suppose we have two infinite series—

$$s=a_1+a_2+a_3+\ \ldots$$
$$s'=b_1+b_2+b_3+\ \ldots$$

of such a nature that $a_i=b_j$, where i is uniquely determined by j and conversely, we can define s' as a *permutation* of s, on the ground that every term of s' occurs in s and conversely. But it does not follow that the sum of s' is equal to the sum of s, even though both are convergent. We are, however, able to say that if s is absolutely convergent, and s' is such a permutation of s that the relation $b_j=a_i$ makes j finite whenever i is finite, and conversely, then s' is absolutely con-

vergent, and its sum is equal to that of s. The essential thing is to note that an infinite series is defined not only by its terms, but by the order in which they are written. The author fails to emphasise the fact that in dealing with permutations of series we must keep any term in a finite place in a finite place. G. B. M.

FARM MANAGEMENT AND RURAL IMPROVEMENT.

(1) *Soil Management.* By the late Dr. F. H. King. Pp. ix+311. (New York: Orange Judd Co.; London: Kegan Paul, Trench, Trübner and Co., 1914.) Price 1.50 dollars.

(2) *Hunt and Burkett's Agriculture: Farm Animals, covering the General Field of Animal Industry.* By Prof. T. F. Hunt and Prof. C. W. Burkett. Pp. ix+534. (New York: Orange Judd Co.; London: Kegan Paul, Trench, Trübner and Co., 1914.) Price 1.50 dollars.

(3) *A Handbook for Farmers and Dairymen.* Sixth edition. By Prof. F. W. Woll. Pp. xvi+490. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 6*s.* 6*d.* net.

(4) *Rural Improvement: the Principles of Civic Art Applied to Rural Conditions, including Village Improvement and the Betterment of the Open Country.* By F. A. Waugh. Pp. xi+265. (New York: Orange Judd Co.; London: Kegan Paul, Trench, Trübner and Co., 1914.) Price 1.25 dollars net.

(1) THE book on soil management, which has been prepared from various notes and lectures of the late Dr. King, bears eloquent testimony, not only to his wealth of knowledge of the subject he had made so thoroughly his own, but also to much painstaking inquiry into the systems of agriculture and soil treatment in China, Korea, and Japan. Much of the book is naturally devoted to the consideration of productive capacity as determined by water supply, soil structure, and the physical features of the soil generally, and also contains many original observations on the effect of cultivation, mulching, and drainage. Teachers of agricultural science in this country will not fail to find much useful matter and many apt illustrations in this portion of the book. Not the least valuable portion of the work, however, will be found in those pages descriptive of the practices adopted in the Far East, by means of which soil fertility has been conserved to such a remarkable degree that a greater number of people are fed per unit area than in any other country in the world. Strict economy of all fertilising material is the main consideration, but the practical experience of centuries of Asiatic agriculture has evolved modes of conservation, fermentation, and crop production in respect to which we stand, at the present day, merely on the fringe of investigation.

(2) The perusal of Messrs. Hunt and Burkett's book on farm animals leaves one with a number of dissimilar impressions. The work is primarily intended for use by high-school pupils of fourteen to eighteen years of age, and aims at providing a survey of the whole range of animal industry. The scope of the book is certainly wide enough for all ordinary requirements, and there seems to be no reason to doubt that by a process of judicious mental winnowing sufficient concrete impressions may be obtained to impart an intelligent recognition of the issues upon which successful husbandry depends. A number of admirable practical exercises constitute the most valuable portion of the book, but one is inclined to deplore the inclusion of matter such as the first lesson on the "sorting of animals" and the apparent lack of discrimination in respect to many illustrations of the kindergarten type.

(3) Prof. Woll's handbook comprises in tabular form many of the data of value in agriculture generally, and dairying in particular, and the fact that it is now in its sixth edition may be taken as evidence of the useful function it is performing. The various sections, *e.g.*, those on farm animals, poultry, veterinary science, seeds, weeds, farm pests, forestry, etc., are prefaced by short articles by American authorities, and give an excellent digest of the subject. A certain proportion of the data bears, of course, reference to American conditions only, but the majority of the subject-matter will be found useful by English and colonial readers. Most of the tables are taken from trustworthy sources, and only one or two of doubtful authenticity have crept in. It is perhaps a matter for regret, from an agricultural point of view, that soils have not received any attention.

(4) Although much of the attention of the dweller in American rural districts has, in times past, been occupied by the necessity of making both ends meet, signs are not lacking at the present time that the main problem now is "not how to make more money, but how to live more comfortably." Whilst the value of co-operation in the purchase and sale of commodities, however, has been extensively realised, that of common effort in the development of civic life and institutions has not received the attention which it must ultimately do, and Mr. Waugh in his interesting book on rural improvement makes a strong plea for the appreciation of civic art—the art that builds a sound physical frame for the

support of a healthy community life. Even if the American farmer is indifferent to the appeal for better surroundings as set forth in these pages, many of the problems discussed demand consideration on account of their economic importance. In the matter of roads, for instance, only 8 to 9 per cent. of the total roads of the States have been improved by surfacing with gravel, oyster shells, etc., whilst the remainder are often so despicably bad that the cost of haulage of farm products is three to four times the legitimate amount. The one-street town is passing away, and many of the suggestions advanced by Mr. Waugh as to farm and town planning are well worthy of practical adoption.

TEXT-BOOKS OF PHYSICS.

(1) *Cours de Physique.* By Prof. E. Rothé. Pp. vi+183. (Paris: Gauthier-Villars et Cie, 1914.) Price 6.50 francs.

(2) *Traité de Physique.* By Prof. O. D. Chwolson. Translated by E. Davaux. Pp. vi+266. (Paris: A Hermann et Fils, 1914.) Price 9 francs.

(3) *Preliminary Practical Science. Some Fundamental Principles of Physical Science, with their Practical Applications.* By H. Stanley. Pp. viii+128. (London: Methuen and Co., Ltd., n.d.) Price 1*s.* 6*d.*

(4) *Outlines of Applied Physics.* By H. Stanley. Pp. viii+227. (London: Mills and Boon, Ltd., 1914.) Price 2*s.* 6*d.*

(5) *Preliminary Practical Physics.* Part ii.—*Heat.* By A. E. Lyster. Pp. vii+73. (Dublin: Educational Co. of Ireland, 1914.) Price 7*d.* net.

(6) *A School Electricity.* By C. J. L. Wagstaff. Pp. xi+250. (Cambridge: At the University Press, 1914.) Price 5*s.* net.

(7) *Elementary Geometrical Optics.* By A. S. Ramsey. Pp. xi+173. (London: G. Bell and Sons, Ltd., 1914.) Price 6*s.*

(1) AS judged by the size of the first two books of the "Cours de Physique," which Prof. Rothe is writing, the whole work will be of very considerable magnitude. According to the author's foreword, these two books represent the introduction only to the course itself, which is intended for students who have already studied physics, and primarily for those who are proceeding to technical institutes. In several ways this introduction is rather remarkable. The subjects covered in the first book are (i) units, and their transformation from one system to another; (ii) the principle of similitude in physics; and (iii) methods of measuring the fundamental physical quantities, and the errors involved. In the second book, the statics of fluids and the experimental measurement of densities and pressures are dealt with. There is, perhaps, too little stress laid upon theory, but there can be no doubt that the detailed descriptions of the methods of measurement with great precision, together with the diagrams illustrating these methods, are in every way excellent.

(2) Many physicists regard Prof. Chwolson's treatise on physics as the best in existence—and with justice. Prof. Chwolson has not only given us a most complete and accurate survey of experimental physics in practically all its branches, together with an exhaustive bibliography, but he has also contrived to make his work a critical essay. The translation of this work into French, making it—as it will do—available to those students who do not know Russian and read German with difficulty, is a most desirable event. That now published is the tenth part, and contains the chapters on electromagnetic induction, Maxwell's theory, the basis of electronic theory, and the principle of relativity. The translation has the advantage of having been revised by the author himself, who has, at the same time, considerably augmented the edition. The chapters on the theories of electrons and relativity have, consequently, an added interest, and it will be found that they give a very comprehensive survey of these subjects which are at present so much under discussion.

(3) This little volume adds another to the already large number of similar books which have been published within recent years, and follows much the same lines of treatment. A considerable number of simple physical experiments are described, principally in mechanics, heat and light, those in electricity and magnetism numbering only half-a-dozen. Each exercise combines a simple statement of the theory of the experiment and a description of the method of procedure. In some of them, however, the results obtained would not be what the student is led to expect. For example, in the experiment on the spectrum, no lens is used to focus the light on the screen, and we are told incidentally that the spectrum consists of *seven* colours. A refreshing feature of the book, however, consists of some excellent notes on experimental work which, if all students would follow, would bring about a great improvement in their practical records.

(4) In the main, this book is a series of examples in theoretical physics, for not only are there numerous numerical exercises at the end of each chapter, but more than four hundred of a miscellaneous character at the end of the book. The work, as the author himself points out, is

in no way descriptive, and therefore could not serve as a text-book. Indeed, it seems rather to partake of the "cramming" nature, and would tend to make physics appear to consist of a series of mathematical formulæ. Still, provided that it does not lead students to neglect the experimental side of physics, the book will probably be found quite useful.

(5) This is a little paper-covered pamphlet containing descriptions of some forty simple experiments in heat, and, although small, is well printed and arranged. The diagrams all represent *sections* of the apparatus, and are free from elaborate details. This is a good feature, for, as the author points out, it will encourage the reader to do the same in his practical records, instead of wasting time over sketching the exact apparatus—a thing which but few students can do well.

(6) It is not often that there appears a physical text-book so generally good as this one of Mr. Wagstaff. It is the outcome of the author having been persuaded to publish a book comprising the notes of his lectures at Oundle School, and he is to be congratulated on the result. Not only is the treatment obviously based upon experience in teaching the subject, but the descriptive work and the methods of explaining those parts of the theory which present difficulties to the average student have an originality which is very refreshing. Besides this, all the diagrams and plates are excellent, and these features, together with the good printing of the text, give the book a general appearance which is very pleasing. One or two criticisms may be made. These, however, detract but little from the value of the book. The first is with reference to the definition of the ampere in terms of silver deposited during electrolysis. One knows, of course, that it is so defined by law, but it cannot be clear to a student why the special amount, 0·001118 gram per second, is chosen. In fact, we disagree entirely with the position which the author advocates in his preface, viz., that it is desirable to begin teaching current electricity using direct reading instruments such as ammeters, instead of by means of the tangent galvanometer, which, besides having a mode of action which is simpler than that of an ammeter, serves also to measure the current absolutely.

In the second place, the study of electrostatics and magnetism ought to be taken earlier than it is in this book. The book opens with a very short chapter on magnetism, then proceeds with current electricity, and the treatment proper of magnetism and statical electricity is not reached until half-way through. It would, however, be possible for these chapters to be read first, and the objection would thereby be partially removed. In any case, it is not of great importance, and the book is to be thoroughly recommended.

(7) This book, also, is well produced, and deals with a subject somewhat neglected. Although the treatment is not advanced, it comprises a wide field, including the important subjects of achromatism, thick lenses, and optical instruments. There are frequent examples which will, no doubt, be useful for training the students. It is quite certain that there has been for some time an opening for a book of this kind, and the present volume is well fitted to supply the demand which exists. In fact, students of the subject of light would be well advised to read this volume in conjunction with their text-books of physical optics; and those who intend becoming optical instrument makers would benefit greatly by studying it.

OUR BOOKSHELF.

Œdema and Nephritis: a Critical, Experimental, and Clinical Study of the Physiology and Pathology of Water Absorption in the Living Organism. By Prof. M. H. Fischer. Second edition. Pp. x+695. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 21*s.* net.

THIS is the second edition of a work which has already attracted some attention in the physiological world. The author's main theme is that dropsy is not due to disorders of the circulation, or to changes in osmotic processes, but is wholly produced by the tissues themselves sucking up water from the blood, and that increase in acidity of the tissues is the sole factor in their being able to attract more water into their colloid structure. The main experiments upon which this theory depends were performed by placing dead frogs' legs and pieces of gelatin in fluids of different composition and reaction. Even the swelling which occurs in a limb when reflux of blood from it is prevented by occluding the veins is explained on the acid theory. Addition of such salts as sodium chloride to the experimental fluid lessens the amount of swelling; yet it is well known that excess of such salts favours dropsy during life. This is ingeniously explained by saying that the excess of salt lessens vital oxidative processes, and this leads to formation of acid, and therefore indirectly to œdema. The only piece of evidence advanced in favour of this view is that rabbits on an excessive salt diet become cyanotic; an impartial observer might quite reasonably argue that cyanosis may be the result of the dropsy.

Prof. Fischer argues that disturbances of the circulation cannot be the cause of dropsy because in his dead frogs or strips of gelatin, no circulation was going on at all, and yet they became dropsical. Acidity may be, and probably is, one cause in œdema-production; but this is a

very different thing from maintaining that it will explain everything; one might just as well search for a universal pill which will cure all the ills to which human flesh is heir. W. D. H.

The Chemistry of Paints and Painting. By Sir A. Church. Fourth edition. Pp. ix+387. (London: Seeley, Service and Co., Ltd., 1915.) Price 7*s.* 6*d.* net.

THE facts that this is a fourth edition, and that the author has been before the world for more than fifty years as a student of the subject on which he writes, are sufficient reasons for welcoming it with respect. But the volume itself fully justifies its existence, and it is difficult, if not impossible, to suggest any change in it that would better fit it to serve the purpose for which it was originally issued. The temptation to use a material that facilitates or immediately improves one's work without due regard to its lasting qualities is always very strong, and especially is this the case with those who are so absorbed in the study and practice of pictorial art, that the scientific aspect of their work becomes distasteful to them. But it is not right to accept ignorantly the opinion of the salesman, however honest he may be, or to trust to a few superficial experiments made by one's self or one's friends. The author deals with painting grounds, vehicles, varnishes, pigments, methods, and results, giving just such details concerning them as the artist wishes, or ought to wish, to know.

The previous edition of the treatise was translated into German and edited by Prof. Ostwald, who added a few paragraphs. The author has incorporated the substance of these in the present edition, definitely indicating such paragraphs, and adding to their value by comments of his own. He gives, in short, the results of probably all those who are known to have systematically tested pigments for permanency, and usefully, and we think fairly, criticises the methods and results of these investigators. The preservation and restoration of pictures receive due attention, and throughout the volume the style of the author is such that a previous acquaintance with scientific principles and nomenclature is not necessary for the understanding of it.

Machine-shop Practice. By W. J. Kaup. Pp. xii+199. Second edition. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 5*s.* 6*d.* net.

IN this little book will be found descriptions of the hand- and machine-tools employed in an up-to-date workshop, together with clear instructions for their use. The author has desired to lead the pupil in the shop to think, and not merely to do. For this reason the why of each step or operation is emphasised as much as the how. The function of college workshops is to familiarise students with the working properties of the materials employed and with the tools in general use. Such information cannot be adequately obtained from any book, but a book may be very useful for the purpose of supplementing the verbal explanations of the instructor. It is not easy to make other than mental notes in the course of workshop practice, and it is often inconvenient to pull a machine, or part of a machine, to pieces for the purpose of explanation.

The book before us will be found to be very helpful in such matters. Probably the most noteworthy feature in it is the clearness of the illustrations. Where most books of the kind contain merely half-tone illustrations of machines (generally from makers' catalogues), the author has given perspective line drawings, and has named the parts clearly on the drawings. These drawings will be found to be of much value, even when the machine installed in the students' workshop differs in detail from that in the book. Nomenclature is not so serious a barrier in this volume as in some American books. We can heartily commend this book to workshop instructors.

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 Age of the Earth.

WHILE reading through Dr. F. A. Lindemann's defence of Lord Kelvin's estimate of the age of the earth, I was reminded that in spite of the sympathetic spirit in which he always entered into any discussion, he would never allow the least doubt to be thrown on the correctness of his estimate of the earth's age. Yet it is open to several objections: he assumed that the solidified crust, as it was being formed, would sink toward the centre of the earth until it was solid throughout, whereas there can be no doubt about its core being so heavy that the crust material could not possibly sink. He also assumed a diminishing rate of cooling, whereas the greater portion of the earth's surface is covered by water the bottom temperature of which must have been practically constant for millions of years. He also cuts down the temperature in the earth's centre from 410,000° F., which it would be according to his assumption, to 7000° F.; whereby the available heat is reduced enormously. However, if radio-active processes can supply the earth's radiation losses there is no need to deal with the older question.

I notice that Dr. F. A. Lindemann draws the conclusion that the sun's radiation just compensates the amount lost by the earth, but this is not correct. The earth's loss is estimated from the known temperature gradient in the earth's crust; it is a net loss over and above any possible interchange of heat with the sun. Then, also, Dr. Lindemann limits the earth's age by the sun's age, but amongst the several possible sources of its heat supply he does not even mention the heat-producing power of a meteoric bombardment. Yet, as I have shown in my work, "Unity in Nature," in the chapter on matter (pp. 85–92), it is not at all unlikely in comparatively recent time the sun may have passed through a large cloud of heavy meteoric matter. One effect of a comparatively slight addition of heavy meteoric matter would have been to increase its density from, say, 1·00 to 1·38, and the other effect would have been to raise the sun's surface to such a high temperature that it would have evaporated and formed an atmosphere

extending perhaps beyond the orbits of the asteroids. In fact, the difference in the densities of the inner and outer planets and the sun, and the fact that practically all rotations and revolutions are in the same sense, suggest that our solar system once consisted of a sun and the outer planets, all having a very low density, and that on passing through a cloud of heavy meteoric matter, the density of the sun was slightly increased, and the inner heavy planets created; but it is impossible here to go into the details of these interesting questions.

As regards the nearer evidence of the earth's age to be sought for in the sedimentary rocks, no notice seems to have been taken either of the time required for the innumerable raisings and lowerings of level which certainly occurred during the coal periods or of the time which it must have taken to tilt horizontal strata through 90° and more. Thus Japan is being tilted at the rate of about 0·5″ per century, and if this tilting rate were steadily maintained in one locality, which is highly improbable, the Japanese strata would stand on end like our Cambrian strata in about forty million years' time. Yet a few such tiltings were completed before some of our oldest strata were formed and overthrusts suggest a still greater antiquity for the age of sedimentary rocks.

C. E. STROMEYER.

"Lancefield," West Didsbury, April 26.

Man's True Thermal Environment.

IN connection with Prof. Leonard Hill's very interesting and instructive article on "Healthy Atmospheres" (NATURE, April 22), perhaps I may be allowed to direct attention to a paper which I contributed to the Journal of the Scottish Meteorological Society for 1912, entitled "On Atmospheric Cooling and its Measurement: An Experimental Investigation." In that paper will be found a description of an instrument termed a psuchrainometer (ψυχραίνω = I become cold; and μέτρον = a measure) which traces on a moving paper strip, a continuous record of the amount of electrical heating needed to maintain at blood heat a body freely exposed to the atmosphere. This seems to serve much the same purpose as Prof. Hill's caleometer. In the same paper I also gave a table of preliminary numerical results obtained by its use in conjunction with an anemometer and self-recording thermometer, and from these data deduced an empirical formula giving the rate of cooling (ψ) as a function of temperature and wind velocity.

The question as to whether ψ could always be thus expressed as a function of already existing meteorological data can only be settled by a long continued series of observations with appropriate instruments, in the construction of which I have been engaged for some time. If ψ can be so expressed, then evidently there would be no need for a widespread installation of special apparatus for its measurements. If, however, this hope be disappointed, a new apparatus must be placed in the hands of meteorologists, and the simpler this is the better. I have now constructed a simple psuchrainometer, consisting essentially of a thermometer furnished with a small heater through which a constant current is always passing. This may be termed a "constant energy" psuchrainometer, and I propose to calibrate it against the necessarily more complicated form of "constant temperature" psuchrainometer, different patterns of which are described both in Prof. Hill's article and in my paper.

JAMES ROBERT MILNE.

Physical Laboratory, Edinburgh University,
April 30.

THE AUSTRALIAN ANTARCTIC EXPEDITION.[1]

THE most vexed question in antarctic geography has been the nature of the region west of South Victoria Land. D'Urville and Wilkes, who explored that region in 1838 and 1839, reported land in so many localities that it has been generally believed that their tracks skirted a continuous ice-covered and ice-barred land. Ross, however, sailed across the site of some of the land reported by Wilkes, and later explorers have had the same experience. The view has therefore often been held that this part of Antarctica consists of an archipelago. The first material step toward the solution of this problem was the sledge journey of David, Mawson, and Mackay during Shackleton's expedition. Their journey afforded strong evidence in favour of the continuity of the land; but this land might end far south of Wilkes's track and be separated from it by a fringe of islands. This question has been finally settled by the Australian expedition of 1911 to 1914 under Sir Douglas Mawson. The narrative of its experiences with some indications of its scientific results are given in two massive and superbly illustrated volumes.

The expedition sailed in the *Aurora* under the skilful command of Capt. Davis, whose soundings between Australia and the opposite coast of Antarctica are themselves of the highest geographical importance. Two bases were established in Antarctica, the main base in Adelie Land (about 142°40′ E.), and a western base under Wild in Queen Mary Land (95° E.); at each of these stations elaborate observations were taken, and the expedition established on Macquarrie Island a wireless station, which should be permanently maintained in the interests of Australian meteorology. From each of the bases extensive sledging expeditions were made to explore the surrounding areas. Wild sledged 4° eastward along the northern coast to Queen Mary Land in the hope of reaching Knox Land. A second party under Dr. S. E. Jones travelled westward to the Gaussberg, and thus reached the field of work of the German Antarctic Expedition under Drygalski. From the main base in Adelie Land one sledging party went eastward to Deakin Bay; a second under Bage nearly reached the Magnetic Pole; a western party sledged 4½° along the coast which had been seen by D'Urville. A sledge journey eastward over the ice-covered plateau led to one of the most tragic of Antarctic adventures, for Mertz and Ninnis perished on the journey, and only the lucky finding of a food depôt enabled Mawson to crawl back to his base.

The journey toward the South Magnetic Pole under Dr. Bage was one of the most arduous and successful of the sledging expeditions. The party reached lat. 70°36′5″ S. and 148°10′ E., where the magnet had a dip of 89°43½′ or only 16½

[1] "The Home of the Blizzard. Being the Story of the Australasian Antarctic Expedition, 1911–14." By Sir Douglas Mawson. Vol. i. Pp. xxx+349. Vol. ii. Pp. xiii+338. (London: W. Heinemann, 1915.) Price 36s. net two volumes.

min. from the vertical. This locality was 175 miles from the point reached by David's party in 1909, so the two journeys gave a nearly full section across Antarctica from South Victoria Land to Wilkes Land.

These great sledge journeys, combined with Capt. Davis's soundings along the coast, have proved the existence of land all along this part of Antarctica, though somewhat south of the positions where it was reported by Wilkes. Thus the *Aurora* sailed in clear weather over the site of the land marked by Wilkes to the east of his Cape Carr. Nevertheless, the result of the expedition is to confirm the general belief that from Cape Adare, for more than 80° westward, is one continuous ice-capped land, which forms the northern coast of Antarctica. Mawson attaches the name of the American explorer to a small part of this area, but the name of Wilkes Land appears too firmly established for the whole of it to be easily displaced. The discovery by the expedition of Queen Mary Land in the west, the long line of land to the west of Adelie Land, and of King George V. Land on the east has definitely established the northern coast of Antarctica in this district as approximately along the line of the antarctic circle. There are indications, however, from the charts that either shallow water or land extends in some places north of the circle.

The greatest trial of the expedition was the terrific violence of the wind. Gusts of wind are recorded with a velocity of two hundred miles per hour. The rate of 180 miles per hour is said (vol. i., p. 168) to have been common. The average velocities recorded for whole days are unprecedented. Thus on May 15 the mean for the whole twenty-four hours is given as ninety miles per hour. On May 18, a year later, it was 93·7 miles. The average for May was 60·7 miles per hour. The most appalling testimony to the wind strength is the record that the average speed for the whole year was fifty miles per hour (vol. ii., p. 157). Both volumes contain repeated references to hardships due to these hurricanes, and the prevalence of winds blowing at 100 miles per hour with a temperature of −28° F. (vol. i., p. 134) justifies Sir Douglas Mawson's lament that owing to "the rushing might of these eternal blizzards" Wilkes Land is "an accursed country" (p. 134). The wind records were apparently mainly made by a Robinson anemometer, which we are told was the greatest source of worry; and as meteorological authorities have issued frequent warnings of the untrustworthiness of anemometers, opinion as to the exact value of the

FIG. 1.—The *Aurora* lying at anchor, Commonwealth Bay. In the distance the ice slopes of the mainland are visible rising to a height of 2000 feet. In the foreground is a striking formation originating by the freezing of spray dashed up by the hurricane wind. From Sir Douglas Mawson's "The Home of the Blizzard." (W. Heinemann.)

records may be suspended until more detailed accounts of the observations are issued. There is, however, abundant evidence in the book to show that the main base is abnormally windy, and perhaps to justify the claim that it is the windiest place on earth. The "Roaring 'Forties" must give place to the "Shrieking 'Sixties." The author explains the power of the wind as due to the torrent of air rushing outward from a high pressure area around the south pole; but it is difficult to reconcile this theory, as now stated, with the experiences of Amundsen and Shackleton.

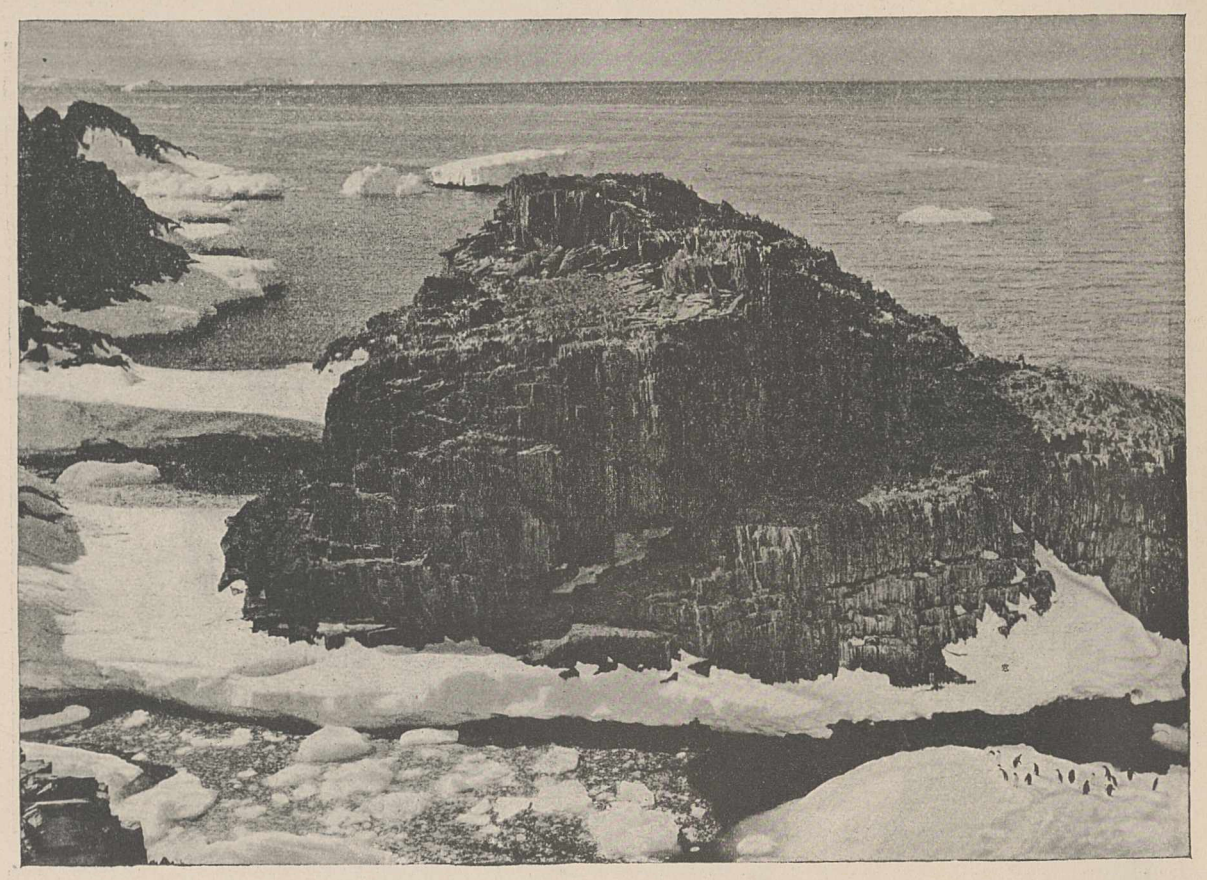

FIG. 2.—A view of a rocky stretch of the Adelie land coast west of Commonwealth Bay. From Sir Douglas Mawson's "The Home of the Blizzard." (W. Heinemann.)

The book, like much Antarctic literature, must have its usefulness restricted by its bulk; private students can scarcely afford the book space for such cumbrous volumes, a fact the more regrettable in this case owing to the exceptional beauty of the illustrations. Colour photography has been used with excellent results, and those of the starfish show the great value of this process in biology. The work includes only preliminary notices of the scientific results, but it shows that the Australian Expedition must rank as one of the most successful of modern antarctic expeditions.

J. W. G.

RECORDING RAIN GAUGES.

OF mechanical devices for the registration of rainfall there is no end, and from the early date of most of them it is scarcely too much to say that in this direction there is no new thing under the sun. Up to 1898 Mr. G. J. Symons had described and figured in "British Rainfall" no fewer than forty-five different patterns of self-recording rain gauges, and now there are at least a dozen more. Very few of these have proved fully satisfactory. The diversity between the various forms consists mainly in subordinate details. With the exception of Mr. W. J. E. Binnie's electrical drop-counter and Wild-Hasler's over-shot water wheel, I cannot find more than three principles which have been applied singly or in combination for the automatic recording of rainfall by a pen writing on a rotating drum. These are (1) the double tipping-bucket on a fixed pivot; (2) the descending counterpoised receiver, and (3) the ascending float.

Tipping-bucket rain gauges are amongst the oldest forms, and they have been constructed to record directly or through an electrical device, by an escapement wheel, a cam in the axle of

which raises the pen by a step at a time, the value of the interval shown by the step being the capacity of the bucket, which empties as it tips. The best instrument of this type is that in use by the United States Weather Bureau, which has a bucket tipping with one-thousandth of an inch of rain, and so gives a fairly continuous line, even in moderately light showers. Attractive and well-made tipping-bucket rain gauges have been put on the market by the firms of Negretti and Zambra, and Pastorelli and Rapkin, of London, and by Richard Frères in Paris. These tip with one-hundredth of an inch, or sometimes with half that amount, but are useless for measuring duration of any but heavy rain, though under careful inspection fairly satisfactory for measuring amounts. The amount of rain can always be measured more accurately by means of a direct reading rain gauge of the Snowdon or Meteorological Office pattern, of which the former is, in my opinion, better as well as cheaper.

The only scientific purpose served by a recording rain gauge is to furnish a measure of duration and intensity. The two types of gauge involving the respective use of a counterpoised receiver or of a float give their record in the form of a continuous curve. Each type has several modifications rendered necessary by the practical convenience of using a shallow drum while retaining an open scale. Where expense and space are no objects rain gauges of unimpeachable accuracy can be made on either principle by having a drum deep enough to record the whole rainfall of the wettest day possible with the necessary degree of magnification.

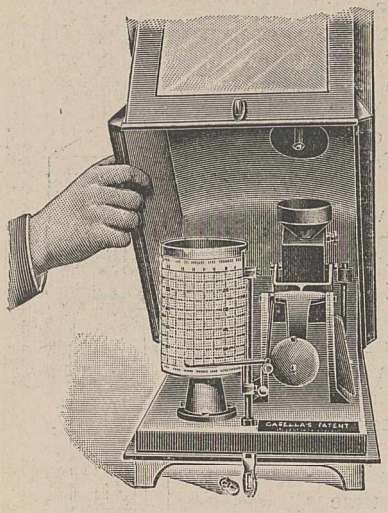

FIG. 1.—New Casella recording rain-gauge.

In order to keep the moving parts compact and the drum small, the capacity of the receiver is in practice usually limited to from 0·20 in. in the case of a counterpoised vessel to 0·50 in., or rarely 1 in., in the case of a float, and an automatic contrivance for emptying the vessel whenever it fills has to be employed. This is the weak point of most recording rain gauges, for when the receiver has to be emptied five times for every inch of rain it is subject to much friction and wear, and when it empties only once or twice for an inch of rain the time of clearing is appreciable and introduces a risk of error.

The Beckley rain gauge made by Mr. Hicks and used in the observatories of the Meteorological Office for about forty years is the best example of a counterpoised receiver writing directly on the drum as it sinks vertically and discharging automatically by means of a self-starting syphon. The Casella recording gauge, which has been in use at Camden Square for about thirty-five years, is undoubtedly the best example of the counterpoised receiver emptying by automatic tipping when it comes to the lowest point. It writes by means of a system of levers on a drum with a horizontal axis. A modified form of this gauge (Fig. 1), recently introduced by Messrs. Casella at a low price, has a simpler mechanism, the receiver only tipping far enough to start a syphon, through which it is emptied, while the pen writes on a vertical drum by means of a hinged piece at right-angles to the main lever, thus securing a curve with approximately rectangular co-ordinates.

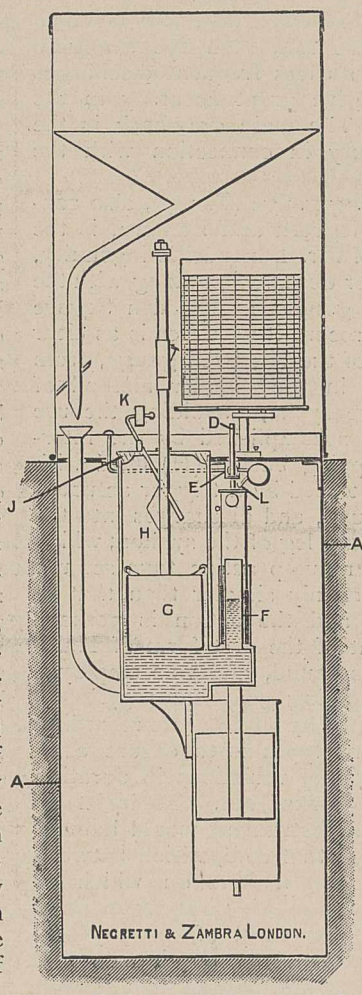

FIG. 2.—Section of Halliwell standard recording rain-gauge.

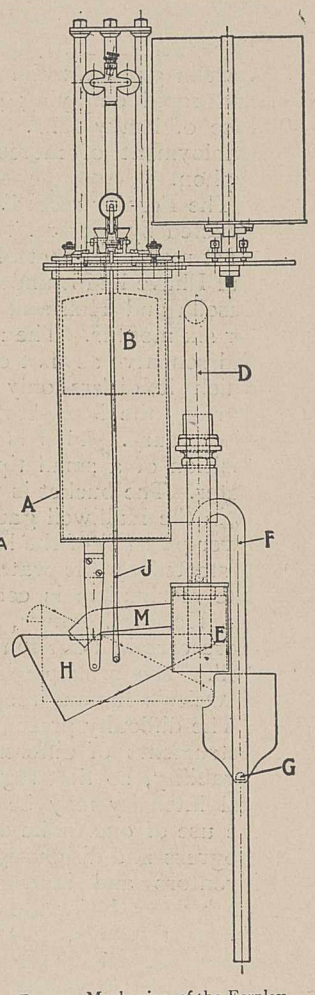

FIG. 3.—Mechanism of the Fernley recording rain-gauge.

Of float rain gauges the best of which I have had experience is the improved form of the Halliwell rain gauge (Fig. 2) first constructed by Mr. F. L. Halliwell with the advice of Mr. Baxendell, the well-known director of the Fernley Observatory,

Southport, and now manufactured by Negretti and Zambra. The theory is to make use of a pen actuated directly by a rod rising with the float (G), the receiver emptying by means of a syphon of large bore (F) started by being dropped a little by the action of a trigger (K) set off by the float rod when the receiver is full, and reset automatically by the escaping water entering a lower cylinder. In its first form this instrument was troublesome, sometimes failing to discharge, sometimes discharging too soon, but these difficulties have now been overcome, and when it is in careful hands I know of no better recording gauge. It gives an exceedingly clear and steady trace, and is much more sensitive to light rain than the Standard Casella gauge, while its less frequent discharges and rapid emptying give great accuracy in the case of heavy falls. The main drawback is the employment of mercury in connection with the syphon.

The Fernley recording gauge (Fig. 3), also constructed by Messrs. Negretti and Zambra, is the most recent product of Mr. Baxendell's ingenuity, and I have had it under observation along with the Casella and Halliwell gauges at Camden Square for six months. The record it produces is as clear and sensitive as that of the Halliwell gauge, from which it differs only in the simpler method of starting the large-bore syphon, avoiding the use of mercury. This is accomplished by the interposition of a small tipping bucket (H) filled with water. The bucket is tipped by a trigger actuated as in the Halliwell gauge, and discharges into the lower part (E) of the long leg of the syphon, which is started by the water pump action thus set up. The mechanism is certainly simpler than that of the Halliwell gauge, and the action is perhaps more certain than that of the first form of Halliwell. The principle is sound, and was employed in Osler's famous recording gauge of 1837.

The difficulty presented by all accurate recording instruments of different types is to ensure comparability, so that regional variations in duration and intensity may be worked out. To insist on the use of one make of instrument would hamper progress and discourage that competition between inventors and instrument makers on which so much depends for the progressive improvement of practical details. As the result of many years' experience I have formulated the requirements of a satisfactory recording rain gauge for general use, as follows:—

(1) A recording rain gauge is not a labour-saving contrivance which will work by itself for a week or more. The time scale should be so open that a drum of reasonable size cannot include more than the record of twenty-four hours, and it must be visited daily and the pen set to the correct time every morning.

(2) If a recording rain gauge is to be generally adopted its price must be less than 10*l.*, substantially so if possible, hence great size and elaborate mechanism must be avoided.

(3) The depth scale must be magnified at least four, and preferably eight times, and to avoid the inconvenience of having a very high drum some mechanical arrangement must be made by which the pen, on reaching the end of the chart, returns to zero automatically.

(4) The usual method of bringing the pen back to zero by emptying the receiver when half an inch or less of rain has been accumulated necessitates the use of uncertain or complicated mechanism, hence the receiver should be large enough to contain at least four inches of rain, and the automatic return of the pen should be secured by some device unconnected with the discharge.

(5) Friction is the only other serious practical difficulty, and this should be minimised by having as few moving parts as possible and these with the shortest bearings compatible with rigidity.

It was in order to meet these views that Messrs. Casella introduced their modification of their old standard recording gauge, but though most of the conditions were complied with, No. 4 was not. The Hyetograph (Fig. 4) devised at the same time by Negretti and Zambra, carries out my views more nearly than any other gauge I know; but it has not quite overcome the difficulty of friction in the float chamber, though when signs of this appear a very slight adjustment puts things right. Its curve also presents the inconvenience common to those of the ordinary barograph and thermograph of being referable to a straight co-ordinate for time and to the arc of a circle for amount.

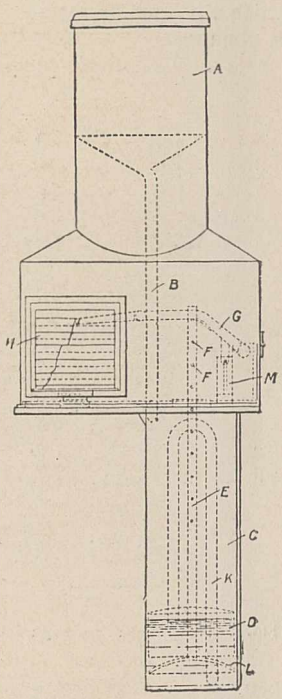

FIG. 4.—Section of Hyetograph.

Its advantages are that the receiver takes four inches of rain without overflowing, an amount which, it is true, may be exceeded in twenty-four hours in any part of the country, but which cannot be expected to be exceeded twice in a lifetime at the same place. It is emptied by a syphon actuated by suddenly depressing the float by hand, and should be so emptied each morning when the amount collected exceeds a small fraction of an inch. The pen drops on reaching the top of the chart by the edge of a plate fixed on the pen lever dropping from a peg (F) on the float rod (E) on to another peg below, an oil brake (M) at the short end of the lever (G) absorbing the shock. The record is thus not interrupted so long as rain is falling. During snow, a night-light placed in the instrument under the funnel ensures instantaneous melting.

I may perhaps be allowed to mention that neither the British Rainfall Organisation nor I personally have any financial interest in any rain-measuring appliances, and we thus retain perfect freedom for the helpful criticism of all such instruments.

HUGH ROBERT MILL.

INSECT PESTS AND WAR.[1]

WAR is associated in the popular mind with the summoning of armies, the thunder of the guns, and the carnage of blood-stained battle-fields. Patriotism is manifested in personal sacrifice in many directions, some public, many unsuspected. All cannot help in the direct attack on our enemies, but all are able to assist in preventing disease that plays so important a part in the progress of a campaign. Horrible as are the features of any war, times arise when the destructive "minor horrors," or insect pests, that are the inevitable accompaniment of the concentration of large numbers of men, assume a major import. The victims of the typhus now ravaging Serbia know this only too well. It is, then, a patriotic action on the part of Dr. Shipley to have set forth the life-histories of many noxious and disease-carrying arthropods, as well as certain leeches, together with very practical hints as to their prevention, in his book, "The Minor Horrors of War."

At the present time there is an undoubted need for the dissemination of knowledge regarding the *rôle* of various pests, both insect and others, in a simple yet practical form. The advantage is considerably increased when the information is presented in a lucid manner, with numerous illustrations, and in a style that may perhaps be best described as fully human. The accounts of the habits of lice, bugs, fleas, flies, mites, ticks, and leeches, which all have a share in injuring man, are set forth in a form that arrests the attention, stimulates personal interest, and, at the same time, by humorous interludes, neither repels nor disgusts the reader. The practical side, as before mentioned, is kept in view throughout.

Lice undoubtedly are unpleasant, but to ignore their existence does not minimise the danger arising from their presence. At least two diseases that are known to occur in certain areas of the present war zone are transmitted by lice (Fig. 1). Relapsing fever is due to a spirochæte that develops in the body-louse. The spirochæte reaches man when, in his endeavour to alleviate the irritation due to the insect, he scratches his skin. Simultaneously, he crushes one or more of the unwelcome insects, and spirochætes are unwittingly rubbed into the slightly damaged skin. Troops operating in Africa understand how easy it is to touch the eyes to remove sand or dust, and a finger soiled by a crushed louse has been shown to convey relapsing fever when so used. Typhus fever also is spread by lice, and there is no need to dwell on the fearful rapidity with which this fell disease may spread.

It must be remembered that the irritation of the body due to insect pests reacts on the mind, and is manifested in mental restlessness and lowered spirits. The clearly expressed preventive measures recommended against lice will doubtless be appreciated during the present campaign.

Bugs are very undesirable intruders in houses, and troops operating in India and Persia have reason to fear their attentions. Ticks occur in the Eastern theatre of war, and also in African territory where other troops are engaged. One tick, *Ornithodorus moubata,* transmits *Spirochaeta duttoni,* the cause of a more severe form of relapsing fever. The young tick is unlike the adult, and being so much smaller, is more easily overlooked, and is therefore more dangerous, especially as it may be born infected. Knowledge of its life-history, as set forth by Dr. Shipley, is important.

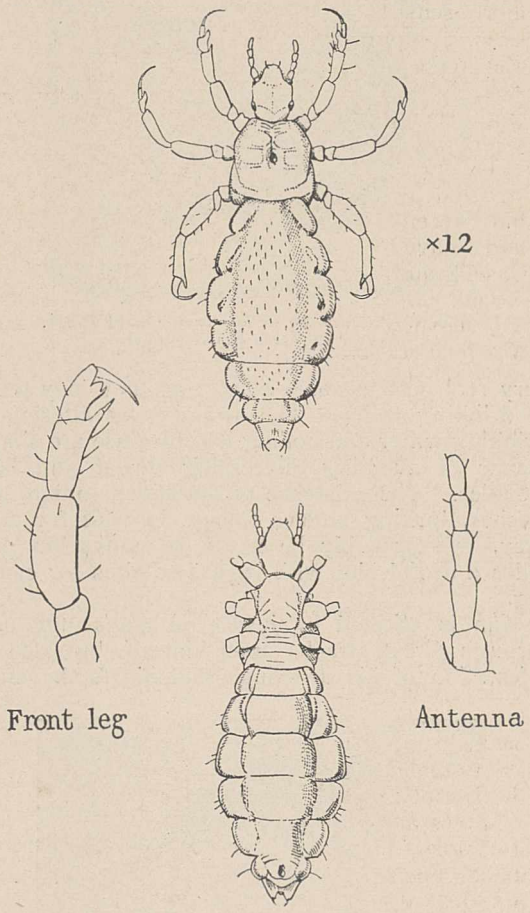

FIG. 1.—*Pediculus vestimenti.* The louse. Dorsal and ventral views. From "The Minor Horrors of War."

Mites are small relatives of ticks, and those that infest man are often known to soldiers and field-workers by the name of harvest mites. The habits of these small pests, as well as those of the "itch insect," together with the modes of dislodging them, are facts that should be better

[1] "The Minor Horrors of War." By Dr. A. E. Shipley. Pp. xvii+166. (London: Smith, Elder and Co., 1915.) Price 1*s.* 6*d.* net in paper covers, 2*s.* net in cloth.

known. Fleas, too, need attention. The dreaded plague is spread by means of infected rat-fleas that leave their natural host and pass to man. Fleas also convey other diseases, and apart from this, the broken rest due to flea-bites is a factor that makes even such an insignificant insect worthy of consideration.

Blood-sucking leeches occur in Belgium and Germany, and also in parts of India, Ceylon, Egypt, and Palestine. These animals, although not belonging to the arthropoda, constitute a

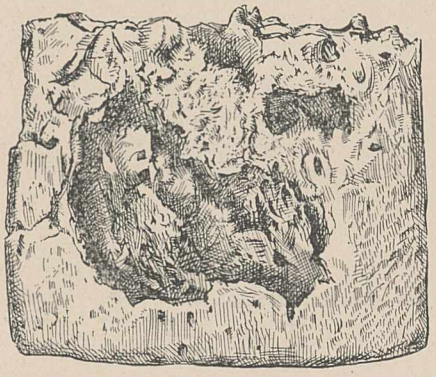

FIG. 2.—*Ephestia kühniella*. Moth-infested biscuit. From "The Minor Horrors of War."

very real pest in some places, as they may occur in drinking water. The straining or filtering of drinking water and boiling it before use are simple means of avoiding distressing throat and lung troubles. The existence of voracious Indian land leeches, lurking among foliage in wait for their prey, will probably be news to many, but provides a useful hint with regard to sites for camping.

Man is affected by insect parasites not only through direct attacks upon himself, but also by infestation of his dwellings and his food. Flies

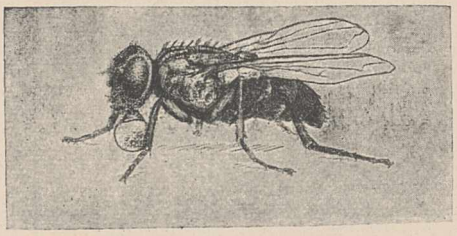

FIG. 3.—*Musca domestica*, the house-fly, in the act of regurgitating food. ×4½ (After Gordon Hewitt.) From "The Minor Horrors of War."

and flour moths are therefore discussed. Fortunately, the occurrence of "maggotty" biscuit (Fig. 2) is not so common as formerly, but the possibility of its recurrence under war conditions should be remembered. Flies are a more serious pest. House-flies are concerned with the conveyance of several diseases to man, typhoid fever perhaps being the best known. The typhoid bacilli can live for six days in the intestine of a house-fly, and food and milk can be polluted by its promiscuous visits during this period (Fig. 3). Insight into the life-history and habits of flies is sufficient to cause anyone to join in the anti-fly crusade. The love of filth and carrion displayed by the various blow-flies or meat-flies, too, is a means of spreading disease, and there are records, even in the present war, of wounded men suffering agony from the presence of fly larvæ in their neglected wounds. The abolition of filth is the simplest means of securing freedom from flies by destroying their breeding places.

The relation of insect pests to the health of men and animals is a subject of interest to all, and it is not surprising that the large first edition of Dr. Shipley's book was practically exhausted in a month, and that a second edition is in preparation. The combination of literary charm and scientific information of practical utility, particularly at the present time, is certain to ensure its continued success. H. B. FANTHAM.

THE SUPPLY OF OPTICAL GLASS.

THE serious position in which this country was placed at the outbreak of hostilities by the almost complete stoppage of the supply of optical glass and of the import of optical instruments, is at last attracting the attention of the public which should have been much sooner focussed upon it. The importance of the subject was early recognised by the British Science Guild, which referred its consideration to its Technical Optics Committee. This committee, after fully investigating the evidence then available, reported, and the guild forwarded an important report to the Board of Trade; the report was printed in full in our issue of March 25 (page 104). So far as can be ascertained, however, no official action appears to have resulted.

Quite recently, Sir Philip Magnus, the member for the University of London, put on the order paper of the House of Commons questions addressed to the representatives of the War Office and the Admiralty, asking whether the supply of optical glass and optical instruments for the use of the Services was keeping pace with their immediate requirements. To these questions official replies of the stereotyped order were given and, in addition, the representative of the Admiralty informed the House that a large firm of makers of optical glass in this country "had greatly increased their output and were still adding to their plant." Before these replies were given, a long letter on the subject was published in the *Times* over the signature of Dr. Walmsley, the Principal of the Northampton Polytechnic Institute, an institute which is intimately associated with technical instruction in applied optics. There had also been other allusions to the matter in the Press.

In the report of the British Science Guild, referred to above, the main points involved are clearly indicated; and with regard to the supply of optical glass for instruments required by the Government, the report states that at the time of its issue there seemed to be no call for any special

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NATURE.

The number for **last week** (**April 29**) contained:—
The Value of the Rarer Elements. By JAMES H. GARDINER.—**Abnormal Psychology.** By Dr. WILLIAM BROWN.—**Pasteur and Preventive Medicine.** By Prof. R. T. HEWLETT.—**Electrical Engineering.** By Prof. DAVID ROBERTSON.—**Letters to the Editor:**—The Nature of Gas Ions. Prof. E. M. WELLISCH.—Migrations in the Sea. Prof. A. MEEK.—A Mistaken Butterfly. Prof. G. H. BRYAN, F.R.S.—**The "Cracking" of Oils and its Commercial Use.—Servi Sevorum Dei.** By STEPHEN PAGET.—**The Use of Asphyxiants in Warfare.—Richard Lydekker, F.R.S. Dr. W. J. Sell, F.R.S.—British Geology.** (*Illustrated.*) By G. A. J. C.—**Experimental Botany at Trinity College, Dublin.—Engineering, Education, and Research.** By Dr. W. CAWTHORNE UNWIN, F.R.S.

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effort. This statement, however, was made in January, and things have not been standing still since. More especially there was no indication then that either the country or the Government was aware of the necessity for enormous efforts for the adequate supply of "munitions," amongst which must be included "optical appliances." As is well known, the only firm supplying optical glass in this country is the firm referred to in the House of Commons, namely, Messrs. Chance Brothers, of Birmingham; and a paragraph appeared in the *Times* on April 26 to the effect that this firm will now supply optical glass only to those manufacturers of optical instruments who can produce a War Office or Admiralty certificate showing that the glass is needed for the fulfilment of a Government contract. This means that, notwithstanding the large increase in the capacity of the plant at Birmingham, the whole of the optical industry of this country, other than that engaged in Government work, cannot be supplied at the present time with any optical glass whatever. When we consider the important trades which require such glass in fairly large quantities for other than Government purposes, there is no doubt of the great seriousness of the position. But so optimistic is the Government that it has declined a patriotic offer of Lieut.-Col. J. W. Gifford to hand over to the nation free of cost practically the whole of a collection of fine optical glass, considerably over a ton in weight, which he has accumulated during twelve years of laborious research, some of the results of which have been published by the Royal Society from time to time.

The definite proposal made in Dr. Walmsley's letter to the *Times* is that the Government should at once take over the optical glass branch of Messrs. Chance's factory. We understand that this proposal is, as yet, a suggestion of Dr. Walmsley's only, and that, for obvious reasons, he did not communicate beforehand with the firm in question. In passing, we may say that great credit is due to this firm for its very vigorous and patriotic efforts to deal with the situation, but the matter appears to us to have got beyond the point at which any private firm should be required, for the good of the whole community, to undertake such heavy capital expenditure as it has already made and to risk the great sacrifices which may be called for if this expenditure be rendered unproductive after the war. As pointed out by Dr. Walmsley, the natural solution, that competing firms should instal plant and enter the market, is not applicable in this case, because the whole amount involved is too small to make it worth while for any important firm to enter into competition. The supply of fine optical glass for the United Kingdom involves probably an outside turn-over of not more than 20,000*l.* a year, an amount which is not worth dividing. But the supply of this small quantity of raw material, in the form of unwrought optical glass, affects an industry in which the value of the finished products runs to millions of pounds' worth of goods per annum, and in which the greater part of the cost of output goes in wages to highly skilled labour.

It is true that the firm named already has risen to the occasion, has octupled its plant, and, if Ministerial replies are taken at their full face value, has succeeded so far as to supply present Government requirements. But what of the rest of the industry, and, moreover, what is to happen when the war is over? The foreign supply of this vital "key" product will doubtless be resumed, surrounded by the *ante bellum* "wire entanglements" to which Dr. Walmsley refers, such as restrictive contracts on users, the lodging of dummy and blocking patents in our Patent Office, and all those means by which officially-nurtured foreign competition in the past has endeavoured to kill the production in this country of the far more vital and more costly finished products. Is it too late in the day to ask that these methods of competition should not be used against private firms without any greater safeguards available than those which have proved so ineffective in the past?

It seems to us that the proper course is to act generally in the direction of Dr. Walmsley's suggestion, with such modifications as may be found desirable on full investigation. This would mean, in substance, that the Government should undertake the supply of this "key" product. With a Government department empowered to deal with eventualities, full attention could be given to the other important matters dealt with in the report of the British Science Guild, namely, the adequate development of research, better provision for the testing of the physical and optical properties of samples of glass, and, most important of all, provision for adequate technical training and research in applied optics, so that this country may recapture speedily the position it held for so long in the forefront of the world's optical developments.

ASPHYXIATING GASES IN WARFARE.

DR. J. S. HALDANE'S report on his investigation of the nature and effects of the asphyxiating gases, used by the Germans in their attack last week on the French and British lines near Ypres, leaves but little doubt that chlorine or bromine was the chief agent employed, whilst shells containing other irritant poisons were also used.

Prof. H. B. Baker, who accompanied Dr. Haldane, is carrying out an investigation as to the chemical side of the question, and until his report is available, surmises as to the nature of the poisonous gases and the methods adopted for their use would be premature, but the evidence seems to point clearly to the fumes floated by the wind on to the Allies' lines being chlorine, as at ordinary pressure bromine is a liquid below 59° C., and at ordinary temperatures would not give off its vapour with sufficient rapidity to cause the seven-foot bank of vapour that drifted on to the Allies' trenches, whilst the colour of the cloud would have been a rich brown and not the "green-

ish" or "yellowish-green" colour so frequently described, which undoubtedly points to chlorine.

Chlorine gas is 2·45 times heavier than air, and if discharged "down wind" would only slowly rise, so that at a distance of one hundred yards from its point of disengagement the bank of fume might be expected to be six or seven feet deep, but with bromine vapour, which is more than five times the weight of air, the thickness of the layer of vapour would, under the same conditions, be much less. Liquid chlorine has, for many years, been a commercial article: the gas is liquefied by a pressure of six atmospheres at 0° C., and is stored in lead-lined steel cylinders, being largely exported for use in the extraction of gold in localities where, from difficulties of transport, plant and materials for making the gas *in situ* would be more expensive.

It is said that such cylinders, 4 ft. 6 in. long, were sunk in the German trenches and were connected to pipes six feet long pointing towards the Allies' lines: under these conditions, intense cold would be produced at the point where the cylinders discharged into the delivery pipes by gasification of the liquid and expansion; this would soon check the rapid production of gas, and the white smoke seen behind the greenish cloud of gas may well have been caused by brushwood fires lighted above the delivery pipes to warm them and prevent stoppage.

Although all the evidence and the symptoms found in the unfortunate victims overcome at this particular section of the line point to chlorine as the gas employed, there seems every probability that liquid bromine has also been used in shells or grenades, which, bursting in the air, would scatter the liquid under conditions that would rapidly gasify it, when the weight of the vapour would cause it to descend on the troops below.

Both chlorine gas and bromine vapour, when present to the extent of 5 per cent. in air, rapidly cause death by suffocation, by acting on the mucous linings of the nose, throat, and lungs, so causing acute inflammation; but bromine poisoning is generally distinguishable by the skin of the victim being stained yellow, and the intense action on the eyes, which is much greater than with chlorine.

The Germans have an unfailing source of bromine in the crude carnallite, worked at Stassfurt for the production of potassium chloride, but when full particulars are available it will probably be found that, besides such obvious asphyxiants as chlorine, bromine, and sulphur dioxide, they have also employed compounds of a more complex character.

CHEMICAL STANDARDS FOR WHISKY.

IT may be remembered that the Royal Commission on Whisky, which in 1908–9 gave a lengthy consideration to the matter, did not find a very satisfactory answer to the query "What is whisky?" The Government of Western Australia has also been debating this question, and some years ago it issued regulations under which certain chemical standards for "pure pot-still whisky" were proposed for adoption. The proposals met with some criticism. It was alleged, in fact, that many pot-stills employed in Great Britain could not produce whisky which would comply with the requirements.

In order to investigate the matter further the Government analyst for Western Australia was deputed last summer to visit this country. Here, conjointly with an analyst representing the distillers, he inspected some forty Scotch distilleries and analysed a large number of samples of the whisky produced. In addition, twelve distilleries in Ireland were visited alone by the official analyst. The papers now issued [1] give an account of the investigation. They are prefaced by the statement that the proposals, as now modified, have been approved by the Governor in Executive Council and gazetted accordingly.

Briefly, the stipulations are that, as regards Scotch whisky, it shall have been distilled at a strength not more than 35 degrees above proof and matured in wood for not less than two years; and that "standard pot-still whisky" shall contain at least 45 grams of esters, 3·5 of furfural, and 180 of higher alcohols per 100 litres of absolute alcohol, as estimated by methods prescribed. For Irish whisky no furfural standard is proposed at present, but the proportion of esters is required to be not less than 35 grams, and of higher alcohols 200 grams, per 100 litres of absolute alcohol.

Whisky other than "standard pot-still," whether Scotch or Irish, is required to be sold as "blended" whisky. Of this there are three classes, containing respectively at least 75 per cent., at least 50 per cent., and less than 50 per cent. of standard pot-still whisky. For the first and second classes minimum limits are fixed for the proportions of esters, furfural, and higher alcohols—omitting the furfural, however, in the case of Irish whiskies. The third class includes all whisky which does not comply with the requirements for any of the other classes. The respective kinds are to be labelled with the appropriate designations.

A good deal of the criticism to which the original proposals were subjected has been turned aside by the change of a single word in the regulations. "Pure" has become "standard" pot-still whisky. There was just cause of complaint when specifications for the "pure" pot-still product were drawn up, because in certain cases these requirements could not be satisfied by whisky distilled in an apparatus which had certainly hitherto been regarded as a "pot"-still, even if somewhat modified from the simple form. To stigmatise by inference such products as adulterated because they did not comply with the stipulations for "pure" pot-still whisky was indefensible. But, obviously, a community has the right to say what it will regard as a "standard" whisky, and this has now been done.

[1] "Papers in Connection with the Establishment of Standards for Whisky in Western Australia." (Perth: The Government Printer.)

The effect of the regulations will be that as regards the amount of the chief "secondary" constituents (esters, furfural, and higher alcohols), which distinguish whisky from "silent" or patent still spirit, the whisky sold in Western Australia will be classified into four varieties, and the consumer will know, within limits, what is the proportion of these secondary products in the beverage he drinks. C. S.

NOTES.

WE regret to see the announcement of the death on May 4, at seventy years of age, of Sir William R. Gowers, F.R.S., distinguished by his work on diseases of the nervous system and related subjects of medical science.

PROF. SYDNEY J. HICKSON has been elected president of the Manchester Literary and Philosophical Society for the ensuing year (1915–16).

THE council of the Institution of Civil Engineers has made the following awards for papers read and discussed during the session 1914–15:—The Telford gold medal to Mr. A. L. Bell (Rosyth); Telford premiums to Mr. C. W. Anderson (Chakradharpur, India), Sir Thomas Mason (Glasgow), Dr. H. F. Parshall (London), and Mr. H. E. Yerbury (Sheffield), and the Crampton prize to Mr. F. D. Evans (Kuala Lumpur, F.M.S.).

IN reply to a question asked in the House of Commons on May 4, Mr. Tennant said:—"The latest information with regard to the incidence of enteric fever among the British troops in the Expeditionary Force is as follows:—Up to date 963 cases have occurred, and of these 780 have been analysed; 142 cases have occurred in men inoculated fully with two doses of vaccine. Among these ten deaths have occurred, giving a case mortality of 7 per cent.; 157 cases have occurred in men partially protected by inoculation—that is, who have had only one dose of vaccine. Among these there have been ten deaths, giving a case mortality of 6·36 per cent.; 481 cases have occurred in non-inoculated men. Among these there have been 100 deaths, giving a case mortality of 20·79 per cent. To appreciate the full value of these figures it must be brought to notice that 90 per cent. of the troops forming the Expeditionary Force have been inoculated voluntarily. Therefore, among 90 per cent. of the force (*i.e.* inoculated men) there have been 299 cases and twenty deaths. In the other 10 per cent. (uninoculated men) there have been 481 cases and 100 deaths.

ON May 1, at about 5 a.m., the instruments of the seismological observatories of this country registered an earthquake of quite unusual strength, of which, however, we have as yet received no other news. At West Bromwich, the oscillation was so great that one of the recording needles was dismounted. The approximate position of the epicentre, as deduced from the Eskdalemuir seismogram, is latitude 47° N., longitude 156° E., or on the east side of the Kurile Islands. The earthquake is evidently one of the most interesting of the last decade. The Kurile Islands and the Japanese Empire are, as is well known, in the form of festoons, the convex, or eastern side, of which slopes steeply into the deeper waters of the Pacific Ocean. In the Kurile Islands, earthquakes are weak and infrequent as compared with Japan. The recent earthquake thus visited a district in which great shocks are almost or quite unknown. Moreover, the epicentre lies (at a depth of about 4000 fathoms) near the base of the western slope of the great depression which forms the north-easterly continuation of the Tuscarora Deeps.

IN view of the Chancellor of the Exchequer's proposals for a differential tax on beer, it may be of interest to note in what manner the specific gravity of beer is related to its alcoholic strength. As explained in an article in NATURE of April 8, the basis of the beer duty is not the actual amount of alcohol in the beer, but its potential amount as measured by the "original" specific gravity of the wort. In beer as it is sold, the proportion of alcohol varies somewhat even for worts of the same original specific gravity, because they may be fermented to somewhat different degrees either in the primary fermentation or in the slow after-fermentation which generally supervenes. Broadly, however, it may be said that in light beer of original gravity 1043 (water = 1000), the tax on which is not affected by the present proposals, the proportion of alcohol is usually about 6 or 7 per cent. of proof spirit. This represents 3½ to 4 per cent. of real alcohol—that is, of ethyl hydroxide, $C_2H_5.OH$, by volume. Beer of original specific gravity 1050 to 1055, on which a supertax is to be levied, contains about 9 to 11 per cent. of proof spirit when sold, corresponding with 5¼ to 6¼ per cent. of real alcohol. This represents the beer ordinarily drunk, such as dinner ale, pale ale, "porter," and the beer generally supplied on draught in public-houses. Heavier beers and stout range from about 1060° to 1090° of original gravity; these contain from 11 to 14 per cent. of proof spirit, or 6¼ to 8 per cent. of real alcohol. In special "strong ale" the original gravity may be more than 1100°, and the amount of proof spirit as much as 20 per cent., or approximately 11½ per cent. of alcohol.

WE have sadly to record the death of Erasmus Darwin, the only son of Mr. and Mrs. Horace Darwin, of Cambridge, and a grandson of Charles Darwin, and of the first Lord Farrer. He was killed on April 24, leading his men in action in Flanders. On the outbreak of war in August last he instantly applied for a commission, and was gazetted Second Lieutenant in the 4th Battalion Alexandra Princess of Wales's Own Yorkshire Regiment in September last. He went into camp at Darlington until November, and then was stationed at Newcastle-on-Tyne, and was put in command of the scout work, which he entered into with all that quiet zest which was characteristic of him. He delighted in the work of training himself and his men in long expeditions by night and by day over the moors. Not even the pressing offer, which was made to him a few days

before he went to the front, of an important post at home in connection with munitions of war would move him from his desire to give his personal services at the front with the scouts to whom he had become so attached. He was a man of very lovable disposition and unusual ability. He was born on December 7, 1881, and was educated at Marlborough and Trinity College, Cambridge. He took the Mathematical Tripos in his second year, 1903, and afterwards passed out in the Mechanical Sciences Tripos in 1905. For some time after taking his degree he worked at Messrs. Mather and Platt's at Manchester. For a time, too, he carried out important work in the test-room of the Cambridge Scientific Instrument Company, and by his exceptional business ability and foresight he rendered highly valued service as a director of the company. About seven years ago he went to Messrs. Bolckow Vaughan's at Middlesbrough, and his sound practical judgment and administrative ability soon won for him a very important position in the firm. In this war the country has to mourn the loss of many valuable lives, and Erasmus Darwin was one of those whose fine, modest conscientiousness and unswerving strength and loyalty made us know that we lose a man whom we should have been proud to see taking his part in the guiding of public affairs in the country.

THE director of the Meteorological Office, Dr. W. N. Shaw, has sent us a copy of a new scale of velocity equivalents of the numbers of the Beaufort scale of wind force which he has received from Prince Boris Galitzin, the director of the Russian Meteorological Service. The table has been drawn up at the Observatoire Physique Central Nicolas, and expresses the wind force determined by the Wild wind-gauge in terms of the Beaufort scale. These values will be used by Russian Meteorological stations as from May 1. The table has been compiled in accordance with the decisions of the International Meteorological Committee, at the meeting held at Rome in 1913.

Beaufort scale	Velocity in metres per second	Beaufort scale	Velocity in metres per second
0	0	7	14–17
1	1	8	18–20
2	2–3	9	21–24
3	4–5	10	25–28
4	6–8	11	29–33
5	9–10	12	34 and more.
6	11–13		

THE Smithsonian Institution announces that fossil bacteria have been discovered in very ancient limestones collected in Gallatin County, Montana, by Dr. C. D. Walcott, secretary of the institution. For some time Dr. Walcott has believed that these bacteria existed, and mention of the fact was made before the Botanical Society of Washington on April 6, when attention was directed to their existence in association with fossil algal deposits of the Newland limestone. The belief that bacteria were the most important factor in the deposition of these ancient limestones was also mentioned by Dr. Walcott in a preliminary publication of the Smithsonian Institution. At that time, however, no definite bacteria had been discovered, but in thin sections of limestone from the collections made in 1914 the microscope now shows these very minute forms of life, some twenty to thirty million of years old. The bacteria were discovered in three sections cut from an algal form included under the generic name Gallatinia, named after the great American explorer Gallatin. The bacteria consist of individual cells and apparent chains of cells which correspond in their physical appearance with the cells of Micrococci.

THE Art Museum of Boston has recently acquired one of the gems of Minoan art, which is described by Prof. E. Gardner in part ii. of *Ancient Egypt* for 1915. It is an ivory statuette with gold ornaments and details, 6½ in. in height. The resemblance of the figure to that of the famous Snake Goddess found by Sir A. Evans at Knossos is obvious. But it resembles not so much any art of ancient Greece as that of Gothic work of the thirteenth century. At the same time, the character of the materials seems to preclude the possibility of forgery. She wears a dress of Cretan type, and her head is adorned with a splendid crown, on which a gold ornament was probably fixed. The statuette exhibits for the first time a treatment of the human figure which is comparable with the fine studies of animals characteristic of Cretan or Mycenæan art. It may be placed not far from the high-water mark of Cretan pottery, and it may go back to the Middle Minoan age. This new discovery emphasises more than ever the contrast between the art of Crete and that of ancient Hellas. It is much to be regretted that this fine work of art has not found its home in our national collections.

MR. T. ERIC PEET has issued in the Publications of the Manchester Museum, No. 75, an account of the Stela of Sebek-khu, which contains the earliest record of an Egyptian campaign in Asia, one of the most important documents ever found in Egypt. It was unearthed at Abydos in 1901 by Prof. Garstang, and is now in the Manchester Museum. It measures 16½ by 10 in., and the inscriptions and representations are somewhat carelessly incised. Its importance lies in the fact that this is a record of an early campaign in a period hitherto unknown preceding the age from which date the Hyksos invasion, the great wars of Thotmes III. and Rameses II., down to the campaign of Sheshonk, mentioned in the Old Testament. It represents the beginning of reprisals in the Asiatic field at the beginning of the twelfth dynasty. The people now attacked by Egypt were the Mentu of Sebet, or nearer Asia, and the Mentu were an Asiatic tribe living close to the Egyptian frontier. On this occasion the Mentu were aided by their allies, the Retenu, probably inhabiting the Peninsula of Sinai. Sekmem, the place attacked, was somewhere in Palestine. However the details of the campaign may be worked out, this Stela remains our best authority for Egyptian conquest in Asia prior to the eighteenth dynasty.

ACCORDING to the *Victorian Naturalist* for March, examples of parasitic Copepods belonging to the family Monstrillidæ, have been discovered for the first time in Australia by Mr. J. Searle, but as yet their specific

identity has not been determined. These small crustacea are parasitic on Serpulid worms, whence they escape, by rupturing the body wall of the host, to liberate their ova. This they do as free-swimming organisms, but lacking a functional alimentary canal, death ensues on the completion of the reproductive functions.

IN the *Australian Zoologist* for February, Mr. Allan McCulloch gives a brief, but extremely interesting account of the hitherto unrecorded migration of the larval eel-gudgeon (*Galaxias attenuatus*) from the sea to fresh water. He found numbers of these larvæ, about 38 mm. long, and quite transparent, making their way through the surf into a small fresh-water stream about 6 ft. wide. Very little is known of the habits of Galaxias, but some interesting notes on the occurrence of *G. truttaceus* in damp soil in Tasmania have been made by Mr. T. Hall and Mr. J. Fletcher. It would seem that this species is capable of burrowing into soft earth to a depth of eight or nine inches, when the water dries up in times of drought, and there æstivating until released by the rains.

HOW insect pests extend their range into new and distant areas is shown by Mr. W. J. Rainbow in the *Australian Zoologist* for February, where he records the occurrence of the carpet beetle (*Attagenus piceus*) in woollen goods imported from London by a large drapery establishment, and of a West Indian longicorn beetle (*Eburia binodosa*), which had worked its way out of of an imported oak chair. This insect, doubtless in a similar manner, has also made its way into England, but so far with no evil results. The discovery of the carpet beetle in Australia is, however, a more serious matter, for much damage had been done before it was detected. Hence there is a possibility that its ravages may spread.

THE peculiar methods of feeding displayed by the starfish are well known; but Mr. H. N. Milligan, in the *Zoologist* for April, describes for the first time the means adopted for disposing of a victim so unusual as a pipe-fish. After some experimenting the body was seized between two of the arms, and held in position by means of the suckers, while the three remaining arms were made to serve as the legs of a tripod. The upper portion of the abdomen of the still living captive was brought immediately under the mouth of the captor, when the stomach was everted in the usual manner to envelop this unwieldy morsel, which was held there until hunger was appeased. No similar case seems ever to have been recorded. Two excellent figures add not a little to the interest of this strange record.

FROM the annual report of the Zoological Society of London, it is apparent that the war has not only curtailed its income, and made rigid economy necessary, but it has further hampered the smooth running of the menagerie. More especially is this true in regard to the fish supply. Early in August the contractor was unable to continue his supply, and fish had to be bought daily at from 4½*d.* to 7*d.* per pound, instead of 1½*d.* per pound. Then the inspector of the Fishmongers' Company at Billingsgate came to the rescue, and allowed the society to take away from the market quantities of fish good for immediate consumption, but not fit to distribute through the retail trade. But this source of supply failed when the cold weather came. Happily, so far it has been possible to arrange for a regular supply from Grimsby. We would suggest that should this fail recourse should be had to netting some of our inland waters for "coarse fish," of which there must be an abundance for a long time to come.

IT is extremely gratifying to learn, from the spring number of *Bird Notes and News*—the organ of the Bird Protection Society—that the colonies of the great skua are still increasing on the Shetlands, though they have to be guarded jealously against the raids of the egg-collector. Strenuous efforts are being made to save from extermination the red-throated diver, the black-tailed godwit, and the harrier. It is to be hoped that these efforts will meet with their due meed of success during the coming nesting season. The largest colony of great black-backed gulls in Great Britain, we are told, is to be found on Noss. But this does not afford us unmixed satisfaction. This bird is ruthlessly destructive of the eggs of other species, and of late years has become unduly numerous; measures might, therefore, with advantage, be taken to reduce their numbers. In the same number we learn with much pleasure that the choughs and buzzards are more than holding their own in Cornwall, thanks to the efforts of the society's watchers.

THE report for 1913 of the periodic variations of glaciers (*Annales de Glaciologie,* vol. ix. (1914), pp. 42–65) includes the Swiss, Eastern, and Italian Alps, and gives some information about the glaciers of Norway, Russia, the Himalayas, New Zealand, and North America, especially Alaska. The Alpine glaciers, on the whole, are still retreating, though a few advances are recorded. For instance, of sixty-one Swiss glaciers, twenty-five continued to recede in 1913, and ten probably did the same, while only one certainly and ten probably advanced; the movements of the rest being doubtful. In the other two Alpine districts the observations are less numerous, but on the whole they point in the same direction. In other countries the evidence, which, however, is sometimes rather imperfect, shows that glaciers in the same neighbourhood are uncertain in their movements, but are generally receding, the small being more sensitive than the large to the annual snowfall. This, however, seems certain, that in the Alps the ice-streams have not nearly regained the ground which they began to lose rather more than half a century ago. At present information about these variations, though in a few cases it goes back some three centuries, is too imperfect to admit of any satisfactory explanation. Oscillations such as have been observed during several years, including the last one, are probably due to variations in the temperature and snowfall during one or more preceding seasons, but the great advances, with corresponding thickening of the ice-

streams, such as those which culminated approximately in 1820, and in 1850, lasting, perhaps with occasional slight recession, until well past 1860, must be due to a more general cause. For determining this the records, accumulated by the Commission Internationale des Glaciers, will be ultimately very valuable.

BULLETINS 41 and 42 of the Agricultural Research Institute, Pusa, deal with investigations on sugar-yielding plants in India. In No. 41 Mr. H. E. Annett deals with sweet sorghum and the variation in composition of this crop during growth, giving extensive and valuable data resulting from experiments and analyses. He concludes that owing to the high glucose ratio and other difficulties, sweet sorghum is not worth growing in India as a source of sugar, but that it seems likely to prove a valuable source of fodder, being a fairly quick-growing crop; also that soon after flowering the plant shows no increase in total weight or in sugar, hence it should not be allowed to grow beyond this stage, after which its value as fodder decreases. Bulletin 42, by Mr. G. Clarke and others, deals with cane-crushing. It is pointed out that in order to ascertain the value of a variety of sugar-cane and the possibility of its succeeding as a field crop in any given district, it is necessary to investigate in the field the general crop characters; in the laboratory the sugar content and quality of the juice; and in the mill what proportion of juice and total sugar can be extracted, and the cost of doing so. Tabulated details are given, representing the results of a long-continued series of experiments on sugar-crushing and the sucrose yields of different varieties of cane; and the authors conclude that future increase in area under cane in the United Provinces and in number of mills will depend upon the introduction of cheaper and quicker methods of dealing with the produce, the present crop being as much as the bullock-power of the provinces can deal with, and the industry unlikely to increase unless some cheaper form of crushing is introduced.

THE general deficiency of rainfall in March as shown by *Symons's Meteorological Magazine* for April in the tentative table for the British Isles is of more than ordinary interest. The wet spell which was so characteristic of the recent winter has fortunately come to an end. Statistics previously given by the British Rainfall Organisation show that the aggregate rainfall for the four months—November, 1914, to February, 1915—was 168 per cent. of the average over England and Wales, and more than 200 per cent. of the average over the Thames Valley. The rainfall table for March shows a totally different result. Rain measurements are given for fifty-five stations scattered over the entire kingdom, and of these only five have the total rainfall for the month in excess of the average; they occur along the east coast of England and in the north of Scotland. The greatest excess from the normal occurs at Gordon Castle, where the rainfall was 147 per cent. of the average, and at no other station was the percentage of the average more than 110. At twenty-one stations out of fifty-five the rainfall was less than 50 per cent. of the average, and at two stations, Launceston and Killarney, the rainfall was less than 25 per cent. of the average. For the British Isles as a whole the rainfall was 58 per cent. of the average, whilst for the several parts of the United Kingdom the percentages are: England and Wales, 54; Scotland, 79; and Ireland, 40.

CIRCULAR No. 24, issued by the Bureau of Standards, contains a list of the papers which have appeared in each of the ten published volumes of the Bulletin and a classified list of the papers, with a short account of the contents of each. The Bureau also announces that in future the Bulletin will be supplied to subscribers at one dollar a volume unbound, plus 50 cents for postage to this country. Subscriptions should be sent in advance to the Superintendent of Documents, Washington, D.C. We have no doubt there are many in this country who will take this opportunity of getting a valuable series of papers which up to the present could only be found in the libraries of scientific societies.

IN a paper read before the Royal Society of Arts on April 14, and published in the Journal of the Society for April 18, Mr. T. Thorne Baker gave a short account of the industrial uses to which radium is at present put. Radium residues left over after treatment of the ores may or may not improve the growth of plants, according to the materials other than radium contained in them, but if the metals have been removed during the process of extraction of the radium the residue in suitable quantities appears to facilitate growth. These residues may also be utilised in the treatment of disease and as bactericides. In the discussion which followed the reading of the paper, it was pointed out that in much of the plant growth work which had been done with radium, sufficient care had not been exercised to enable it to be affirmed with certainty that the increased growth found in some cases was not due to the nitrates and phosphates in the residues, rather than to the radium. Until this question is settled, there appears no justification for the use of radium in horticulture.

AN account of "Röntgen Motion Pictures" is given in the *Scientific American* for April 3. An illustration of the apparatus designed for the purpose of producing them, by F. Dessaur, is also given, together with a number of somewhat indefinite results. During the meeting in London of the International Congress of Medicine, we had the advantage of seeing this remarkable arrangement in action, and we brought away the impression that it added at least a new terror for the patient who has to come in contact with the already rather alarming armament of a modern radiologist. While it is certainly a model of ingenuity, the plate-changing operation is accompanied by a good deal of noise and clatter, and there is no doubt that beyond fixation of the image little or no more is to be learned from the results than can be ascertained by an ordinary screen examination with a far simpler outfit. The apparatus, however, is not without special significance to us in these days. To have brought it to perfection must have involved great expenditure of time and money, nor is it likely, on account of its price and size, to find a very ready sale. Yet this sort of thing is done

in Germany, and done well, to attract and to create the impression of progress and thereby to catch the market in X-ray apparatus generally. In the end it pays and incidentally leads to much interesting work, as well as fostering a spirit of enterprise.

WE have received from Kodak, Limited (Wratten Division), a copy of the third edition of their booklet on photomicrography. As compared with the second edition, it is somewhat enlarged, and it comprises within its thirty-six pages simple and straightforward instructions as to the arrangement of the apparatus, undisfigured by diagrams and directions with regard to the illuminating system that are too often found in the text-books, although they can never be realised. We refer to "parallel light," and so on. The price of the pamphlet is 3*d.*, and, of course, its strong point is the photographic side rather than the microscopical side of the art, and especially the use of colour filters. The spectrum transmissions of nine filters are given, and also the dominant wave-lengths of ten, most of the latter being a combination of two. Another table gives the absorption bands of the eighteen principal stains used in microscopy, with the suitable filters for securing maximum contrast in the photograph. Other tables give the relative sensitiveness of various Wratten plates to different light sources, and exposure factors for different focal lengths and apertures of objectives, for various magnifications, for different light sources, and for fifteen different light filters, in connection with the "M" plates. The illustrations include two excellent reproductions of stained preparations, and two little colour filters in a pocket of the cover, for viewing them through, serve to demonstrate the potency and usefulness of colour filters.

THE March number of the *Journal of Chemical Technology* contains a report of a special meeting of the London Section of the Institution of Chemical Technologists which was held on March 11 to discuss "The Future of British Chemical Industry." In opening the discussion, Colonel C. E. Cassal emphasised the fact that the chemical profession in this country stands alone among the professions in that it is utterly without organisation, and is split up into a number of different camps. At the present time there is little sympathy between the college laboratory and the technical laboratory; it is on the closer union of these that future progress of chemical industry will depend. Colonel Cassal, in referring to the ignorance of the general public and of State departments as to the value of science, illustrated his remarks by a reference to the now notorious advertisement of the Royal Arsenal, referred to in NATURE of April 1 (p. 119), and to the organisation of "British Dyes, Ltd." Mr. W. J. Dibdin remarked that the chemical department of the London County Council, of which he was formerly the chief, effected a saving of 10,000,000*l.* capital expenditure in the plant necessary for dealing with the sewage of London. The general trend of the debate was that only by the education of the chemist supplemented by the education of the employer will it be possible successfully to fight Germany in the field of industrial chemistry.

ALTHOUGH it is perhaps one of the minor chemical products, allyl alcohol has been used extensively in research, and is by far the most readily accessible of the series of unsaturated alcohols. Originally prepared through the iodide from glycerol, it was a very costly product, but came into common use when Tollens showed that it could be prepared directly from glycerol by heating it with oxalic acid. A greatly improved preparation has recently been described by Dr. Chattaway in the Journal of the Chemical Society (vol. cvii., p. 407). Five hundred grams each of glycerol and of anhydrous oxalic acid are heated at 100° in a vacuum during four or five hours, whilst a certain amount of formic acid is distilled out; the product, which contains much dioxalin, is then decomposed by heating under ordinary pressure to 220°–240°, when carbon dioxide is set free and allyl alcohol and allyl formate are produced. The oxalic acid is decomposed almost completely, leaving a residue of glycerol, which can be made up again to 500 grams, mixed with 500 grams more of oxalic acid, and used over again; this can be repeated four or five times. The waste of material is therefore very small, and the glycerol used up is converted almost quantitatively into allyl alcohol, whilst the oxalic acid is converted on one hand into carbon dioxide, and on the other into formic acid.

THE importance, both to the manufacturer and the consumer, of having at disposal adequate facilities for the scientific investigation and testing of the quality of textiles is very great. At the present time when immense quantities of such materials are being manufactured for military and naval purposes such facilities are exceptionally valuable. The Public Textile Testing and Conditioning House carried on under the auspices of the Corporation of Belfast, and located in the Municipal Technical Institute of that city, has just issued the fifth edition of its regulations and schedule of charges, and this publication indicates very strikingly the extent to which textile testing has now been elaborated and perfected. The Belfast testing house is one of the more recently opened, having been established in the year 1910 by the corporation at the direct request of the textile trades of Belfast and district. The house is carried on under Parliamentary authority, has power to grant certificates respecting the articles submitted for examination, and certificates so issued are receivable as evidence in a court of law. The schedule of charges shows that a very wide range of tests are undertaken in the testing house. The tests include physical, chemical, and microscopical investigations of fibres, yarns, cloths, and bleaching and dyeing materials. A noteworthy section of the testing scheme is that concerned with the determination of the cause of defects in cloth, more especially such causes as are classed under the technical heading of "tendering."

PART 4 of the Proceedings of the Institution of Mechanical Engineers for 1914 has just been issued, and contains the recommendations of the refrigeration research committee. There are also given charts of entropy and total heat for each of the three substances in common use for refrigerating purposes,

viz., carbon dioxide, ammonia, and sulphur dioxide. The use of these charts is explained in a note by the chairman of the committee, Sir J. A. Ewing. The chart for carbonic acid uses Dr. Mollier's figures, but with British units of pressure and with some additions based on the recent researches of Prof. Jenkin and Mr. Page. For the other two substances the experimental data available are much less complete. For ammonia, the chart must be regarded as no more than provisional; values given by Prof. Goodenough and Mr. W. E. Mosher have been adopted. The chart for sulphurous acid is also provisional; values given by Dr. J. Hýbl have been employed. Tables giving the properties of these substances are also included.

ERRATUM.—In NATURE of April 29, p. 238, col. 1, line 10 from bottom, for "solstice" read "equinox."

OUR ASTRONOMICAL COLUMN.

COMET 1915*a* (MELLISH).—The following is a continuation of the ephemeris of Mellish's comet (1915*a*) taken from *Astronomische Nachrichten*, No. 4796:—

	R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
May 6 ...	18 53 31	... −14 46·2	
8 ...	57 6	... −16 25·9	... 6·5
10 ...	19 0 55	... −18 17·3	
12 ...	5 2	... −20 22·2	... 6·2
14 ...	19 9 32	... −22 42·1	

The comet is rapidly moving southwards, and is situated a little to the north of π Sagittarii.

A third series of elements and an ephemeris of this comet are published by Mr. R. T. Crawford, of the Berkeley Astronomical Department, in the Lick Observatory Bulletin, No. 270. It is pointed out that there seems to be a similarity between these elements and those of comet 1748 II., and computations are being undertaken to test the possibility of the identity.

ORBIT OF JUPITER'S NINTH SATELLITE.—A more rigorous reduction of the elements of the orbit of the ninth satellite of Jupiter is given by Seth B. Nicholson in the Lick Observatory Bulletin, No. 271, this being a continuation of the investigation previously published in the Bulletin, No. 265 (see this column for April 1). The following are the new elements derived:—

Epoch and Osculation = 1914 August 21·0 G.M.T.

$$\left.\begin{aligned} M &= 135^\circ\ 57{\cdot}2' \\ \omega &= 359^\circ\ 53{\cdot}5' \\ \Omega &= 310^\circ\ 30{\cdot}6' \\ i &= 156^\circ\ 57{\cdot}9' \end{aligned}\right\} 1914{\cdot}0$$

$$e = 0{\cdot}1105$$
$$\mu = 0^\circ{\cdot}4518$$
$$P = 2{\cdot}182 \text{ years}$$
$$\log a = 9{\cdot}2192$$

As a result of the alteration in the elements it is stated that the errors in the final elements do not exceed 2 per cent. of their values. An ephemeris for the coming opposition is promised at an early date.

THE SATELLITES OF URANUS.—Two communications regarding measures of the satellites of Uranus are published in the Lick Observatory Bulletin, No. 269. The first, by Prof. R. G. Aitken, were made in 1914 with the 36-in. refractor using a 350 power eyepiece. An interesting opportunity presented itself on July 21 to estimate their relative brightness. The four satellites were all south of the planet, Ariel and Umbriel almost in line with it, and only a few seconds of arc apart. Ariel was seen at the first glance, and was conspicuously visible while measuring the other satellites; Umbriel was seen with much more difficulty, and made no impression on the eye except when special efforts were made to see it. By direct comparison it was estimated to be from $\frac{1}{2}$ to $\frac{3}{4}$ magnitude fainter than Ariel. The latter appeared to be a magnitude fainter than Titania; Oberon, from $\frac{1}{4}$ to $\frac{1}{2}$ magnitude fainter than Titania. While these observations were being made the sky was very clear, the seeing good, and the planet screened by an occulting bar. Measures of the satellites were made by Mr. S. B. Nicholson from photographs taken with the Crossley reflector at the Lick Observatory during 1914. The positions of Uranus and of the satellites were measured in rectangular co-ordinates, so that the distances of the satellites from either Uranus or one of the outer satellites could be obtained.

THE GREENWICH SECTION OF THE ASTROGRAPHIC CATALOGUE.—The third volume of the Astrographic Catalogue 1900·0 deals with the Greenwich Section, declination +64° to +90°, and is deduced from photographs taken and measured at the Royal Observatory. The first portion contains a catalogue of 2212 stars within 3° of the north pole in standard rectangular co-ordinates. In the original scheme of publication this, the third volume, should have included a general discussion of results, but the Astronomer Royal has deferred this discussion for a fourth volume. The present catalogue includes: (1) stars used as reference stars for the astrographic plates; (2) other stars contained in the catalogues of the *Astronomische Gesellschaft;* (3) stars contained in Carrington's Catalogue (1855·0); and (4) stars in the Bonn Durchmusterung Zone, 80°. The right ascensions and declinations depend throughout on the places of stars observed with the transit circle at Greenwich in the years 1897 to 1905. The proper motions given in the Greenwich Catalogue have been used in forming the constants of the plates. In the main catalogue the epoch is 1900·0. The stars are arranged in zones of declination 1° wide, and the photographic magnitudes are on the scale of Prof. E. C. Pickering's north polar sequence.

RECENT PAPERS IN THE "ASTRONOMISCHE NACHRICHTEN."—The following is a continuation of the chief contents of some of the earlier numbers of the *Astronomische Nachrichten* referred to in this column last week:—No. 4785: Trial of the photographic magnitude-scale of the bright Pleiades stars, by E. Hertzsprung. No. 4784: Observations of Halley's comet 1910 II., made at the Chamberlin Observatory of the University of Denver, by Herbert A. Howe. No. 4783: Photographic observations of some bright double stars, by E. Hertzsprung; observations on the brightness and form of comets, by M. Ebell. No. 4782: The special motions of stars with known parallaxes, by R. Klumak. No. 4781: Observations of planets and comets made with the 360-mm. refractor of the Copenhagen Observatory, by C. F. Pechüle and E. Strömgren and R. Andersen. No. 4780: Observations of the planet Venus, by W. Rabe; definite orbit of comet 1906 VII. (Thiele), by E. Waage. No. 4779: Observations of the planet Mars, by H. E. Lau; observations of the variables U Sagittæ and R. S. Vulpeculæ, by M. Maggini. No. 4778: Test for variability of 113 Herculis and α Sagittæ, by E. Hertzsprung; photographic measures of the magnitude difference between the two components of ν Draconis, by E. Hertzsprung; observations of the variables *o* Herculis, *g* Herculis, and RZ Cassiopeiæ, by M. Maggini. No. 4777: Mean elements of sixty minor planets, by M. Brendel; ephemeris for Polarissima (BD +89° 37′) for 1915, by L. Courvoisier.

SMITHSONIAN INSTITUTION EXPLORATIONS.

THE report of Explorations and Field-work of the Smithsonian Institution for 1913 (Smithsonian Miscellaneous Collections, vol. lxiii., No. 8, 1914), including the National Museum, Bureau of American Ethnology, and Astrophysical Observatory, represents much activity in various directions, even if, owing to scarcity of funds, some promising enterprises were abandoned.

In geology the most important work was a survey by Dr. C. D. Walcott of the Robson Peak district in British Columbia and Alberta, and the Field region in British Columbia, which he regards as one of the finest geological sections in the world (see NATURE, December 24, 1914, p. 468). A series of admirable photographs, one of which (Fig. 1) is here reproduced by the courtesy of the secretary of the Institution, illustrates the splendid mountain and glacier scenery of this region. At Field a large collection of specimens was made from the great Cambrian fossil quarry. Mr. F. Springer's exploration in Illinois produced numerous examples of fossil crinoidea, and in Montana Mr. E. Stebinger discovered a new ceratopsian or horned dinosaur, the first example possessing a complete articulated tail and hind foot, which contributes greatly to our knowledge of the skeletal anatomy of this group of extinct reptiles. Dr. W. L. Abbott continued his work in Kashmir, his acquisitions including a curious silvery-grey shrew about 74 millimetres long, quite different from anything he had before seen, and a fine snow leopard with complete skeleton.

In the field of anthropology Dr. A. Hrdlicka continued his exploration in Peru with the object of determining the relations of the ancient Peruvians of the mountains with those of the coast, with the result that he finds no evidence of any great antiquity of man in Peru. Except the cemeteries or burial caves of the coast or mountain people, there was no sign of human occupation and no trace of anything older than the well-represented pre-Columbian Indians, neither the remains of the coast nor of the inland people disclosing an antiquity greater than some twenty centuries. In the Antilles Dr. Fewkes finds a race of sedentary people possessing a form of culture extending from Trinidad to Porto Rico, preceded in Cuba and Hayti by a cave-dwelling race, and followed by the comparatively late Carib immigration.

As regards the Indian tribes of the States, the most interesting information is that collected by Mrs. M. C. Stevenson among the Tewa tribe, where the rain-priests retire into an underground ceremonial chamber, symbolising the lower world, and, after undergoing a strict fast, pray for rain. It is startling to learn that this tribe still propitiate the rattlesnake in order to prevent it from injuring them, by a quadrennial human sacrifice, either of the youngest female infant or of an adult unmarried childless woman. The victims are drugged until they seem to be dead and are then exposed to the sacred snakes, who are allowed to devour the corpse. The skeleton is then buried with offerings under the floor of an adjoining room.

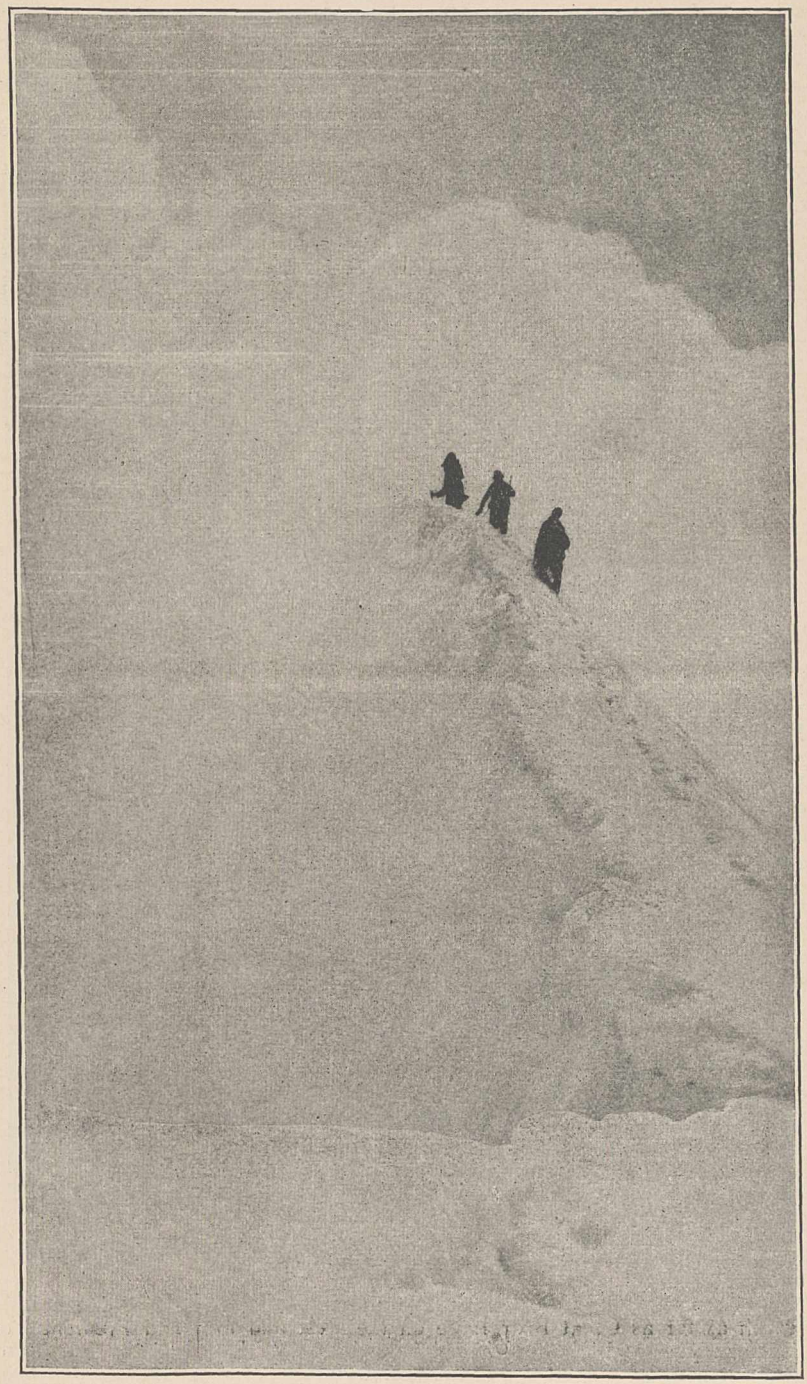
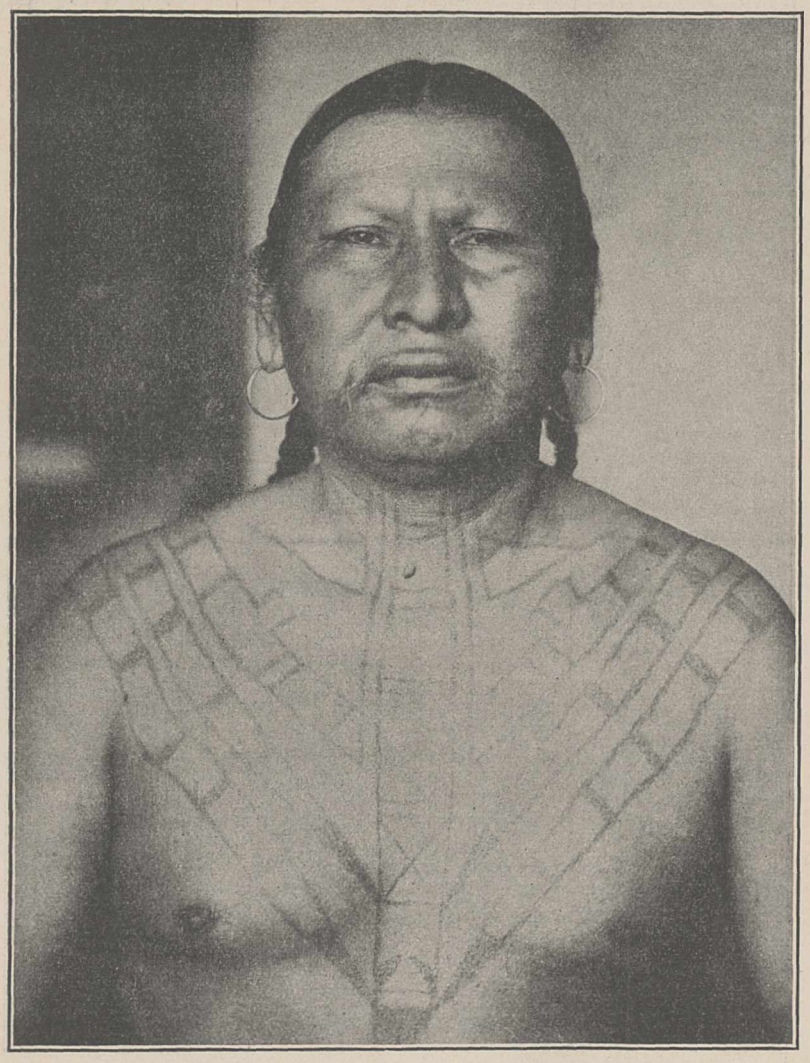


Photo.] FIG. 1.—Summit of Mount Resplendent, British Columbia. [*P. L Tait.*

The account of the tattooing ceremony among the Osage tribe (Fig. 2), by Mr. F. La Flesche, is noteworthy. Formerly the honour was restricted to warriors distinguished in a campaign. Now, as they have gained wealth, it has become a means by which any person can publicly display his affection towards a relative.

Mr. V. Stefánsson contributes to Museum Bulletin No. 6 of the Department of Mines, Canada, a paper on prehistoric and present commerce among the Arctic coast Eskimo. This was, as might have been anticipated, usually conducted by sea. The main route ran along the coast from Mackenzie Bay on the east to King William Island on the west, diverging to the north through Victoria Island, and reaching south as far as Great Bear Lake on the west and to Thelon River and Chesterfield Inlet on the west. He finds a certain tribal specialisation of industries and some division of labour resulting from the varied natural resources of this wide area. But each tribe believes the articles made by its members to be superior to those of neighbouring tribes. Though the people are very conservative, there is a constant interchange of manufactures between distant districts, and with this arises a commerce of ideas which are readily assimilated with the indigenous beliefs and practices.



Bureau of American Ethnology.

FIG. 2.—An Osage Indian with tattooing.

RECENT WORK ON VERTEBRATE PALÆONTOLOGY.

UNDER the direction of Prof. H. F. Osborn a number of expeditions have been dispatched from the American Museum of Natural History to collect the mammalian faunas of the Lower Eocene Wasatch and Wind River beds of Wyoming, and the collection of such remains in that institution is consequently very large, especially as it includes the extensive series brought together by Prof. Cope, which was purchased in 1895. The stratigraphical observations made during these expeditions and the careful record of the exact horizon of each fossil have rendered it practicable to correlate the various faunas, and to trace out the evolution of the different species and groups in a manner which was previously impossible. With the object of putting these new facts before the scientific public, Messrs. Matthew and Grainger have undertaken a revision of our knowledge of these faunas, the first portion of which appears as vol. xxxiv., art. 1 (pp. 1–103), of the Bulletin of the American Museum of Natural History. This, which is by Dr. Matthew alone, treats of the creodont carnivora, seven families of which are represented in these formations, and of which three genera and a large number of species are described as new.

Quarto Bulletin No. 89 of the U.S. National Museum is devoted to the first portion of a descriptive account of the osteology of the armoured dinosaurs, with special reference to the genus Stegosaurus, by Mr. C. W. Gilmore. The memoir, which includes 136 quarto pages and thirty-six plates, is dated December 31, 1914, but copies did not reach this country until the latter part of the following March; it is based almost exclusively on specimens in the collection of the National Museum, and gives the first detailed description of the entire osteology of Stegosaurus. The material includes considerable portions of the skeletons of several individuals, among which the one most nearly approaching completeness, and which alone exhibits the true arrangement of the dermal armour, is the type of *S. stereops*. With few exceptions, the entire series of stegosaurian remains were obtained from two quarries, situated respectively in Albany County, Wyoming, and Fremont County, Colorado.

Nine species of the genus—all American—are at present provisionally recognised, the European forms described by Owen as Omosaurus being regarded as generically distinct, under the name of Dacentrurus, the original designation being pre-occupied. In some of the later restorations of Stegosaurus the double series of upstanding dorsal plates were ranged alternately, and the number of pairs of spines on the tail reduced from four to two; in the latest restoration, however, there is a return to the paired arrangement

of the plates, and the retention of four pairs of tail-spines. Stegosaurus, which attained a length of about 20 ft., had relatively small and feeble teeth, which appear to indicate that it fed on succulent plants. The structure of the feet suggests that these reptiles inhabited low, swampy tracts rather than uplands; and there is good reason to believe that the members of the genus are descended from bipedal dinosaurs specially adapted for locomotion on land.

Until quite recently remains of man-like apes were almost unknown from the Indian Siwaliks, the only specimens being a canine collected by Falconer and Cautley, and a palate from the Punjab described in 1879 by Mr. Lydekker as Palæopithecus. During the past few years the collectors employed by the Geological Survey have, however, brought together a considerable series of teeth and fragmentary jaws of these and other Primates. These form the subject of an illustrated article contributed by Dr. G. E. Pilgrim to the February number of the Records of the Geological Survey of India (vol. xlv., pp. 1–74). Among the remains of man-like apes, a considerable number are referred to the European genus Dryopithecus, of which the author recognises three Siwalik species. These specimens include one exhibiting two of the upper molars *in situ*, which were previously unknown. A separate tooth, characterised by the roughness of its enamel, is described as a new genus, under the name of *Palaeosimia rugosidens*.

The greatest interest attaches, however, to specimens described as *Sivapithecus indicus*, and referred to the family Hominidæ. This genus and species were originally described on the evidence of a single tooth, but the author now proposes to take as the type part of a lower jaw with several teeth; this, of course, being totally unjustifiable. The author gives an ideal restoration of the whole mandible, but it is somewhat difficult to realise all the evidence on which it is based. A special feature of the restoration is the extreme shortness of the symphysis, which is found elsewhere (save in the Hominidæ) only in gibbons. The author is at great pains to show that Sivapithecus is generically distinct from Palæopithecus, but as the latter is definitely known only by the palate, his arguments do not appear absolutely conclusive, especially when it is borne in mind that the occurrence of a number of types of ape-like creatures in the Siwaliks is unlikely.

The author concludes his article with observations on the evolution of the Anthropoidea, in the course of which it is suggested that Sivapithecus should take its place as a side-branch from the main stem which gave rise to man himself. On the other hand, the Piltdown Eoanthropus, which Dr. Smith Woodward considers to be a direct ancestor of man, is thrown altogether out of the line of human ancestry. While the article is full of interest, further consideration is advisable before the author's views are accepted in their entirety.

In an earlier paper in the same serial (vol. xliv., pp. 265–79) Dr. Pilgrim describes and figures a number of Siwalik teeth referable to the creodont genus Dissopsalis, named by himself in 1910. The genus is regarded as forming the summit of a branch of the Hyænodontidæ, running nearly parallel to the one culminating in Hyænodon and Pterodon. It is also shown that a Siwalik tooth described by the present writer as *Hyaenodon indicus* is really inseparable from *Hyotherium sindiense*, named by him at an earlier date. Later on in the same issue Dr. Pilgrim points out that the name Progiraffa proposed by himself for a Siwalik giraffe-like ruminant, has to give place to Propalæomeryx of the present writer. R. L.

THE UNITED STATES BUREAU OF STANDARDS.

IN his report for 1913–14, Dr. Stratton, the director of the U.S. Bureau of Standards, shows how very extensive and varied is the work carried on at the Bureau. During the past few years its growth has been exceptionally rapid, and increased accommodation is still asked for. Much of the work carried on is strictly technical and includes tests on paper, paints, and varnishes, the shrinkage of wools, the properties of lime and cements, and the study of ceramic glazes. In the electrical division an important electrolysis survey was conducted in Springfield, Massachusetts, and useful information obtained with regard to the bonding of tracks, etc.

The unfortunate accident to the *Titanic* centred attention on possible methods of detecting the near presence of icebergs, and assistants of the bureau conducted experiments on two naval vessels. The general conclusions reached are that the temperature variations in parts of the ocean far removed from ice are often as great and as sudden as in the immediate neighbourhood of icebergs, and that it is not possible to draw positive conclusions as to the absence or presence of icebergs from the temperature variation of sea-water. An attempt was also made to detect by means of submarine telephones, the submarine echoes from the submerged portion of a large iceberg. Sound waves were produced by striking the ship's bell under water. The experiments were not completed owing to lack of time and facilities, but the results obtained merit further trials.

Researches of a strictly scientific nature are numerous. One of considerable interest is the determination of standard wave-lengths throughout the entire spectrum. This is being carried out in accordance with the recommendations of the International Solar Union, and the results, while needed mainly by men of science, will also be of value in the industries. For example, the spectroscopic analysis of steel and other substances cannot be successfully undertaken until the characteristics of the spectra of the constituents are more accurately observed.

Another optical research deals with the transmission of glass for the ultra-violet rays, mainly with a view of determining their fitness for spectacle-making.

An interesting innovation is the establishment of standards of radiation in the form of incandescent lamps. In these standards the intensity of the radiant energy per unit area at unit distance from the lamp, has been established in absolute value. A long-felt want has thus been supplied.

In the chemical department work is in progress on the methods and standards employed in volumetric analysis. The final scheme for this research was prepared after criticisms and suggestions had been received from about 150 experienced chemists. A beginning has been made with the study of acidimetry and the subject of indicators. The quality of chemical reagents on the market is also being investigated. It has become the practice of many well-known dealers to attach labels to the bottles containing reagents, setting forth the nature and amount of the impurities. In many cases it has been found that the labels do not state the truth, and as a consequence some action will probably be taken. One suggestion is that the bureau shall purchase material and assume all the duties of bottling and sale.

In the division of metallurgy, among other interesting results are included the melting points of various metals. The results given are:—Nickel, 1452° C.; cobalt, 1478°; iron, 1530°, manganese, 1260°; chromium, 1520°; vanadium, 1720°; and titanium,

1795°. It is stated that accurate measurements of the melting point can be made with the micropyrometer on samples as minute as 0·001 milligram. The micropyrometer has also been employed to measure the monochromatic emissivity of microscopic samples. This constant has been determined for some twenty elements. It is expected to determine the melting points and emissivities of all the available refractory elements and of numerous oxides.

One of the most important recommendations of the director is to establish a radio-laboratory at the bureau. The importance of wireless telegraphy to the United States Government is pointed out, and a grant of 10,000*l.* for the construction of such a laboratory is asked for. For maintenance an additional 2000*l.* is required.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

ABERYSTWYTH.—Prof. Alexander Findlay has been appointed Thomson lecturer in chemistry for the session 1915–16 in the United Free Church College, Aberdeen.

CAMBRIDGE.—The Linacre lecture will be delivered by Prof. E. H. Starling, in the anatomy lecture-room, at 8 p.m., Thursday, May 6, on the governor mechanism of the heart. The Rede lecture will be delivered by Dr. Norman Moore, at 5 p.m. of the same day, in the Senate House, on St. Bartholomew's Hospital in peace and war.

In view of the difficulties of the present financial situation, the Special Board for Biology and Geology has decided to allocate only such sums of money from the Gordon Wigan Fund as are necessary to prevent the extinction of research work already in progress. The grants made are: 10*l.* to Prof. Hughes, for research among the Pliocene deposits of the Cambridge district; 40*l.* to Prof. Punnett, to ensure that the Botanic Garden Syndicate will continue to offer special facilities for plant-breeding experiments; and 21*l.* to Mr. H. Scott, curator in entomology, for the care and development of the collections of insects.

SHEFFIELD.—Sir Joseph Jonas has given the University 5000*l.* to found, endow, and equip a laboratory, in connection with the applied science department, for testing metals, minerals, and similar substances, especially those involved in the production and manufacture of steel.

LADY HUGGINS, who died on March 24, leaving unsettled estate valued at 12,586*l.* gross, with net personality 12,109*l.*, made the following bequests, among others:—A sum not exceeding 1000*l.* to the Bedford College for Women (University of London); 500*l.*, and, if her estate is sufficient, a further sum of 500*l.* for the erection of a memorial in St. Paul's Cathedral to the memory of her husband; 1000*l.*, and, if her estate is sufficient, a further sum of 1000*l.* to the City of London School, Victoria Embankment, for the endowment of a scholarship for the study of astronomy, tenable at Cambridge, to be called the "Sir William Huggins" Scholarship; and a sum of not more than 300*l.* for finishing, editing, and illustrating the book on which she was engaged, being the life of her husband. The residue of the estate, if any, is also left to the City of London School.

WE learn from *Science* that Princeton University has received from Mrs. W. C. Osborn 25,000*l.* to establish the Dodge professorship of medieval history, and 20,000*l.* from an anonymous donor to endow a professorship of economics. Our contemporary also states that the Schools of Mines, Engineering, and Chemistry of Columbia University have received an anonymous gift of 6000*l.*, to be applied to the reconstruction and new equipment of the laboratories of quantitative, organic, and engineering chemistry in Havemeyer Hall; that a gift of 4000*l.* is announced from Mrs. S. W. Bridgham, daughter of a trustee of Columbia University from 1860 to 1903; and that Mr. G. W. Brackenridge has given to the University of Texas his yacht *Navidad*, valued at 20,000*l.*, to be assigned to the biological department of the institution. A preliminary survey of the Texas coast is to be made in the *Navidad*, starting from Port Lavaca.

THE ninth annual report, that for 1914, of the Apprenticeship and Skilled Employment Association, shows that in common with other bodies dependent for their support on voluntary contributions from the public, the association has suffered already financially as a result of the war, and would welcome an addition to its income. The work of the association has continued on its now familiar lines. Interesting tables are provided in the report classifying according to trades the numbers of boys and girls placed in employment by the various London committees. During the year 1914 the total number of boys placed was 532, and of these 60 went into office and clerical work, 47 took up mechanical engineering, 41 scientific instrument making, 40 electrical engineering (including wiring), and 34 motor work. Of the 333 girls who were found employment, 93 took up dressmaking, 34 office and clerical work, and 29 machining. The remaining girls were distributed among thirty-four different trades. Full particulars of the work of the association can be obtained from the offices, 53 Denison House, Vauxhall Bridge Road, S.W.

THE Benares Hindu University Bill was introduced in the Viceroy's Legislative Council at Delhi on March 22 by Sir Harcourt Butler, the vice-president, and the introduction of the Bill was carried *nem. con.* During the course of his speech, which is reported in the *Pioneer Mail* of March 26, Sir Harcourt Butler said:—"The main features of this University will be, first, that it will be a teaching and residential university; secondly, that while it will be open to all castes and creeds it will insist upon religious instruction for Hindus; and, thirdly, that it will be conducted and managed by the Hindu community and almost entirely by non-officials." The University is to be an All-India University. It is incorporated for the teaching of all knowledge, but will commence with five faculties of arts, science, law, Oriental studies, and theology. Many of the promoters desired to add a faculty of technology, and this desire has the full sympathy of Sir Harcourt Butler. The Governor-General will be Lord Rector, and the Lieutenant-Governor of the United Provinces of Agra and Oudh will be Visitor, of the University. The governing body will be a numerous and very representative Court, with an executive body in a council of not more than thirty members, of whom five will be members of the Senate. The academic body will be the Senate, consisting of not fewer than fifty members, with an executive body in the Syndicate. The Senate will have entire charge of the organisation of instruction in the University, and the constituent colleges' curriculum and examination and discipline of students and the conferment of ordinary and honorary degrees. The following large subscriptions have already been received:—Maharana of Udaipur, 1½ lakhs; the Maharaja Holkar, 5 lakhs; the Maharaja of Jodhpur, 2 lakhs, with a grant in perpetuity of 2000 rupees per month; the Maharaja of Bikanir, one lakh, with a grant in perpetuity of 1000 rupees per month; the Maharaja of Kashmir, a grant in perpetuity of 1000 rupees a month; the Maha-

raja Bahadur of Darbhanga, 3 out of 5 lakhs; and one lakh from each of the following—the Maharao of Kotah, Dr. Rash Behari Ghose, Dr. Sundar Lal, the Maharaja of Casimbazar, Babu Bijendra K. R. Chaudhri of Ghorepur, and Babu Moti Chand. The Maharaja Scindia of Gwalior has promised five lakhs of rupees and others have promised liberal donations, of which, in many cases, part payment has been made.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 29.—Sir William Crookes, president, in the chair.—H. **Hartridge** and A. V. **Hill**: The transmission of infra-red rays by the media of the eye, the transmission of radiant energy by Crookes's and other glasses, and the radiation from various light sources. The different eye structures were found by the authors to absorb infra-red rays of different length to approximately the same extent as would a layer of water of the right equivalent thickness. From the values of the percentage absorption of water at different wave-length they have, therefore, calculated the amount of heat absorbed by cornea, iris, and lens. The heat absorbed by the lens was found to be too slight for cataracterous changes to be due to direct action. The condition might still be caused, as Parsons suggested, by impairment in the nutrition of the lens brought about by the action of heat rays on the ciliary body and iris. Samples of Crookes's glasses were tested and were found to absorb the heat waves strongly, and also to some extent the ultra-violet.—E. **Beard** and W. **Cramer**: Surface tension and ferment action. The action of a ferment on a substrate is retarded or inhibited by extending the surface of the system in which the reaction proceeds. This effect has been studied in some detail in the system cane-sugar—invertase.—W. **Cramer**: Surface tension as a factor controlling cell metabolism. The considerations developed in this paper are based on the fact demonstrated experimentally that the action of ferments is conditioned by surface tension. The great surface development in the cell and the living organism must therefore produce conditions which markedly affect the action of ferments *in vivo* when compared with their action *in vitro*. It is shown how the cell may, through the factor of surface tension, control and regulate its metabolism. It is thus possible to form a conception of the chemical organisation of the cell without having to assume the existence of hypothetical membranes in the cytoplasm which are supposed to surround the different chemical systems and separate them from each other. Lastly, it is pointed out that if the conceptions formulated in this paper are correct, substances which are strongly surface active, but which do not affect protoplasm chemically, should exercise a profound effect on the metabolism of the cell. This expectation is realised in the action of narcotic and cytolytic substances.

Challenger Society, April 28.—Capt. Alfred Carpenter in the chair.—Dr. G. H. **Fowler**: Investigations on drift currents in British waters.—Dr. S. F. **Harmer**: Records of Cetacea stranded on the British coasts during 1913 and 1914. The paper was based on an arrangement which had been made by the Board of Trade, which had issued an instruction to coastguard officers to report the stranding of Cetacea by telegram to the British Museum (Natural History). In this way, and aided by written reports, sketches, and photographs supplied by persons on the spot, much valuable information has been obtained, and a certain number of interesting specimens have been secured. By procuring a blade of baleen, in the case of the whalebone whales, or the lower jaw, in the case of the smaller toothed whales, it has been possible to determine the species in a considerable proportion of the records. Seventy-six records were obtained during 1913, and fifty-seven during 1914. The outbreak of war was clearly responsible for the smaller number during 1914. The common porpoise proved to be far the commonest species, as might have been expected. Several records of the occurrence of the common dolphin were obtained, principally on the more exposed parts of the coast-line. Other species which were represented by several records were the bottle-nosed whale, the pilot-whale, the white-beaked dolphin, the bottle-nosed dolphin, Risso's dolphin, the lesser rorqual, the common rorqual, and Rudolphi's rorqual. The most interesting record was a Sowerby's whale, stranded at Rosslare in September, 1914. Contrary to expectation, the district where strandings were most numerous was the coast-line of Lincolnshire and Norfolk, though a number of specimens were found on the shore of the southern counties (see NATURE, April 15, p. 182).

PARIS.

Academy of Sciences, April 26.—M. Ed. Perrier in the chair.—Gaston **Darboux**: The representation on a plane of the surface of the fourth order which admits a conic as a double curve.—G. **Bigourdan**: Scintillation. Comparison with the undulations of instrumental images of celestial bodies. There seems to be no identity between scintillation and undulations, as might at first sight appear probable. More quantitative data are required for the undulations.—A. **Haller** and Edouard **Bauer**: The action of sodium amide on the allyldialkylacetophenones. The preparation of 3 : 5-dimethyl-3-ethyl and 3 : 3-diethyl-5-methylpyrrolidones.—A. **Laveran**: The artificial acentrosomic varieties of the Trypanosomes. For *Tr. Evansi* and *Tr. Brucei* the disappearance of the centrosome produced by the action of oxazine is permanent after three or four hundred passages through animals. Morphologically, this might be regarded as a new species, but its biological characters are unchanged. Animals immunised against trypanosomes with centrosomes have acquired immunity for the acentrosomic trypanosomes and inversely.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the fourth quarter of 1914. Observations were possible on fifty-eight days, the results of which are given in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—A. **Perot**: Variation of the wave-length of the telluric lines with the height of the sun. Particulars of measurements made with an interference spectroscope installed at the Observatory of Meudon. A line of the B group of oxygen was chosen; the wave-length increased from morning to noon and then decreased.—E. **Bompiani**: Laplace equations with equal invariants.—L. **Bouchet**: Electric pressures acting at the surface of a liquid insulating sheet. The displacements are very rapid for conducting liquids such as water and mercury, but with turpentine, vaseline oil, benzine, and petroleum ether there is a slow displacement. The instantaneous depression was deduced graphically and a relation established between this figure and the strength of the field.—Ph. **Flajolet**: Perturbations of the magnetic declination at Lyons (Saint Genis Laval) during the fourth quarter of 1914.—C. **Sauvageau**: A new species of Fucus, *F. dichotomus*. This is distinguished from *F. platycarpus* by its ramification and by the cylindrical form of its receptacles.—Jules **Amar**: Principles of professional re-education. A discussion of the problem of the work possible for wounded soldiers discharged as cured; from the physiological point of view.—MM. **Viallet** and **Dauvillier**: A new

radioscopic method for the localisation of projectiles.—H. **Morize**: The determination of the position of projectiles in the human body by radioscopy. Remarks on a note by Dr. Foveau de Courmelles (January 18) on the same subject.—Marc de Selys **Longchamps**: Autotomy and regeneration of the viscera in *Polycarpa tenera*.—Lucien **Semichon**: The use of heat for fighting insects and parasitic cryptogams in cultivated plants. Hot water may be used provided its temperature does not exceed 70° to 75° C. Details are given of the temperatures required to kill various forms of mould and larval pests.—Em. **Bourquelot**, M. **Bridel**, and A. **Aubry**: The biochemical synthesis of the β-mono-*d*-galactoside of ethylene glycol. The synthesis was effected with the aid of emulsin.

BOOKS RECEIVED.

Morale fondée sur les Lois de la Nature. Cinquième et Sixième Mille. By M. Deshumbert. Pp. 191. (London: Watts and Co.)

Proceedings of the Royal Society of Edinburgh. Session 1914–15. Part 1. Pp. 112. (Edinburgh: R. Grant and Son.)

A Study of Prolonged Fasting. By F. G. Benedict. Pp. 416. (Washington, D.C.: Carnegie Institution.)

The Water-Relation between Plant and Soil. By B. E. Livingston and I. A. Hawkins. The Water-Supplying Power of the Soil as Indicated by Osmometers. By H. E. Pulling and B. E. Livingston. Pp. 84. (Washington, D.C.: Carnegie Institution.)

The Absorption Spectra of Solutions as Studied by Means of the Radiomicrometer. By H. C. Jones and Collaborators. Pp. 202. (Washington, D.C.: Carnegie Institution.)

Joseph Pennell's Pictures in the Land of Temples. Plates xl+Notes. (London: W. Heinemann.) 5*s*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 6.

ROYAL SOCIETY, at 4.30.—Some Problems Illustrating the Forms of Nebulæ: G. W. Walker.—Observations on the Resonance Radiation of Sodium Vapour: Hon. R. J. Strutt.—Local Differences of Pressure near an Obstacle in Oscillating Water: Hertha Ayrton.

ROYAL INSTITUTION, at 3.—Advances in General Physics: Prof. A. W. Porter.

ROYAL SOCIETY OF ARTS, at 4.30.—Constantin Meunier et les Sculpteurs Belges de son Temps: M. Paul Lambotte.

LINNEAN SOCIETY, at 5.—Some Bird Problems: W. Percival Westell.—The Brown Seaweeds of the Salt-marsh: II.: Dr. Sarah M. Baker and Miss M. H. Bohling.—A Collection of Borneo Mosses made by the Rev. C. H. Binstead: H. N. Dixon.—Photographs of a Curiously-grown Tree from a Tunbridge Wells Garden: Rev. T. R. R. Stebbing.

FRIDAY, MAY 7.

ROYAL INSTITUTION, at 9.—Electrons and Heat: Prof. O. W. Richardson.

GEOLOGISTS' ASSOCIATION, at 8.—Radio-activity and the Measurement of Geological Time: A. Holmes.

SATURDAY, MAY 8.

ROYAL INSTITUTION, at 3.—Photo-Electricity: Prof. J. A. Fleming.

MONDAY, MAY 10.

ROYAL SOCIETY OF ARTS, at 8.—Foodstuffs: Dr. D. Sommerville.

TUESDAY, MAY 11.

ROYAL INSTITUTION, at 3.—The Animal Spirits: Prof. C. S. Sherrington.

ZOOLOGICAL SOCIETY, at 5.30.—The House-fly Campaign: Prof. H. Maxwell Lefroy.—Minchinia: A Haplosporidian: Mrs. Helen L. M. Pixell-Goodrich.—The Head Cavities and Development of the Eye Muscles in *Trichosurus vulpecula*, with Notes on some other Marsupials: Miss Elizabeth A. Fraser.—(1) The Organ of Jacobson and its Relations in the "Insectivora." II.: Talpa, Centetes, and Chyrsochloris; (2) The Anomodont Genera Pristerodon, and Tropidostoma: Dr. R. Broom.

SOCIETY OF ENGINEERS, at 7.30.—Some Future Developments in Heating and Ventilation: A. H. Barker.

WEDNESDAY, MAY 12.

ROYAL SOCIETY OF ARTS, at 8.—Recent Progress in Pyrometry: C. R. Darling.

INSTITUTE OF METALS, at 8.30.—The Passage of Electricity through Metals: Sir J. J. Thomson, O.M.

GEOLOGICAL SOCIETY, at 8.—*Parka decipiens*: Dr. G. Hickling and A. W. R. Don.

THURSDAY, MAY 13.

ROYAL SOCIETY, at 4.—Election of Fellows. At 4.30.—*Probable Papers*: The Development of the Thymus, Epithelial Bodies and Thyroid in the Vulpine Phalanger (*Trichosurus vulpecula*): Elizabeth A. Fraser and Prof. J. P. Hill.—Some Observations on the Development of the Thymus, Epithelial Bodies and Thyroid in Phascolarctos, Phascolomys, and Perameles: Elizabeth A. Fraser.—Measurement of the Specific Heat of Steam at Atmospheric Pressure and 104·5° C., with a Preface by Prof. H. L. Callendar.—Thermal Properties of Carbonic Acid at Low Temperatures. II.: C. F. Jenkin and D. R. Pye.

ROYAL INSTITUTION, at 3.—The Movements and Activities of Plants: Prof. V. H. Blackman.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Trade and the War: Sir C. H. Armstrong.

IRON AND STEEL INSTITUTE, at 10.30.—A Selection of: Diffusion of Carbon in Iron: F. W. Adams.—Supplementary Notes on the Forms in which Sulphides may exist in Steel Ingots. II.: Prof. J. O. Arnold and G. R. Bolsover.—Researches on Iron, Silicon and Carbon Alloys: G. Charpy and A. Cornu.—Corrosion of Iron in Aqueous Solutions of Inorganic Salts: Dr. J. A. Newton Friend and P. C. Barnet.—(1) Relative Corrodibilities of Gray Cast Iron and Steel; (2) Note on the Removal of Rust by means of Chemical Reagents: Dr. J. A. Newton Friend and C. W. Marshall.—Communication on the Heating of an Open-hearth Furnace by means of Tar: Dr. A. Greiner.—Sound Steel Ingots and Rails: Sir R. A. Hadfield and Dr. G. K. Burgess.—The Nature of the A_2 Transformation in Iron: K. Honda.—Brinell Hardness and Tenacity Factors of a series of Heat-treated Special Steels; Dr. A. McWilliam and E. J. Barnes.—Thermo-electric Properties of Special Steels: A. M. Portevin and E. L. Dupuy.—Stress-strain Loops for Steel in the Cyclic State: Dr. J. H. Smith and G. A. Wedgwood.—Detection of Burning in Steel, and Iron, Carbon, and Phosphorus: Dr. J. E. Stead.

FRIDAY, MAY 14.

ROYAL INSTITUTION, at 9.—The Archives of Westminster Abbey: Rev. E. H. Pearce.

IRON AND STEEL INSTITUTE, at 10.30.—A Selection of Papers mentioned above.

ROYAL ASTRONOMICAL SOCIETY, at 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Distribution of Heat in the Cylinder of a Gas-engine: Prof. A. H. Gibson and W. J. Walker.

MALACOLOGICAL SOCIETY, at 8.—A Dibranchiate Cephalopod (Plesioteuthis) from the Lithographic Stone of Bavaria: G. C. Crick.—Description of a New Species of Zingis from British South West Africa: J. R. le B. Tomlin.—Diagnosis of a New Species of Dyakia: G. K. Gude.

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ROYAL INSTITUTION, at 3.—Advances in the Study of Radio-active Bodies: Prof. F. Soddy.

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