THURSDAY, APRIL 11, 1918.

A SURVEY OF EXPERIENCE.

Elements of Constructive Philosophy. By Dr. J. S. Mackenzie. Pp. 487. (London: G. Allen and Unwin, Ltd.; New York: The Macmillan Co., n.d.) Price 12*s.* 6*d.* net.

THIS is a very pleasant and very instructive book. It is like a series of conversations with a thinker of great versatility and great learning, extending over the whole range of logical and metaphysical speculation. Dr. Mackenzie is definite without dogmatism, and earnest without fanaticism. And he is suggestive on all points that he touches.

The treatise falls into three parts. The first "book" is devoted to logical discussions; the second to metaphysic—explaining the principal categories by which we conceive of nature and spirit; the third to what might be called ultimate cosmology, to such problems as the unity and perfection of the universe, the survival of the individual, and the relation of time and eternity.

In book i., beginning from belief, which the author treats as a mode of selection, and pointing out that the selection cannot be arbitrary, he passes through an account of judgment and of the laws of thought to a first analysis of the controlling factor, the experience of objective orders. Logic he takes to be the general theory of implication, and all implication—that is, the essence of all inference and judgment and belief—depends upon the recognition of objective orders. To these he devotes a chapter, referring to Driesch's "Ordnungslehre" as the most elaborate treatment of the subject, and pointing out that any principle which has some possibility of continuous application may be taken as a principle of order. There are orders of all kinds, from the numerical to the moral order or order of values, and, as M. Bergson has suggested, it is doubtful whether the conception of disorder can mean anything but the absence of some particular order which we chose to expect. In referring to theories of knowledge, the author well explains that the antithesis of pluralism and cosmism is much more significant than that of realism and idealism, which need not necessarily be an opposition at all.

In book ii. the treatment of causation is of interest. In general agreement with Mr. Russell, Dr. Mackenzie holds that it amounts pretty much to the unity of different things as connected by relations that have some regularity. Cause tends to pass into a principle, and effect into a detail. Whether on this ground the distinction between cause and effect can be maintained may seem doubtful.

An important chapter in this second book is that dealing with valuation. Attempting to arrive at a conception of intrinsic value, the author concludes that it must be identified with truth, beauty, and goodness, and that all else can have value only as instrumental to these.

From this it is interesting to pass to the conception of ultimate reality in book iii., where the problem of reconciling time with the unity of the cosmos (the term universe is applied to units within the cosmos) is attempted on the lines of cycles or histories presenting themselves as dreams which have constancy within an eternal whole, as a play of Shakespeare exists in its own time within the imagination of the poet or reader. The point of the metaphor is that it admits time *into* the cosmos, but the time so admitted is not a time of the cosmos. And the eternal characters of the cosmos—truth, beauty, goodness—would thus appear in time, without being mere transient events. There is an interesting reference to Oriental sources for such views, and actually a diagram of the upward and downward path. Our fear about all such doctrines is that the paths and cycles may be imagined as divorced from each other and from the characters of the universe. They then become illusions, and the cosmos a "thing-in-itself." After all, it is in a woman's heart or a nation's spirit that we find what brings us nearest to cosmic reality.

It is part of Dr. Mackenzie's temperateness that he promises us from philosophy only hope, not conviction. There is truth in this position, so far as particular expectations are concerned. But yet it recalls to us a technical point about the "Laws of Thought." For him they are not based on the nature of reality: you cannot judge at the beginning whether reality will prove self-contradictory, but only at the end of your inquiry. This is more difficult than it seems. Unless you start from the coherence of reality, you can never get to it. You cannot separate thought from assertion about reality. If things may be both this way and that, and thought can be only one way, thought is obviously false, and you can make no step towards knowledge. "Make a hypothesis, and test it by facts." But if things being one way does not exclude their being the other way, there *are* no facts.

Attention should be directed to Dr. Mackenzie's observations on Mr. Russell and the new realists. His view of Prof. Nunn's theory of external objects seems reasonable. The double pitch of a tone, as heard by a stationary and a receding ear, certainly belongs to it. But neither pitch exists in the absence of the corresponding ear.

BERNARD BOSANQUET.

PRACTICAL ASPECTS OF PRUNING.

The Principles and Practice of Pruning. By M. G. Kains. Pp. xxv+420. (New York: Orange Judd Company, 1917.) Price 2 dollars net.

THE author of this work makes the following statement in his introduction: "Pruning demands a knowledge of plant physiology. Unless the pruner has a working knowledge of how

plants grow, he will be unable to prune intelligently and to secure the desired results." It is a matter for regret, therefore, that the chapter on plant physiology, with which the book opens, should be inferior to the later chapters, which deal in a clear and useful manner with the practical aspects of pruning. Readers with little or no knowledge of plant physiology would, however, be apt to find the treatment of the subject in this chapter somewhat involved and confusing.

In the succeeding part of the book the photographs of the branches of fruit trees are extremely good, and are accompanied by very clear and simple explanations of the methods of branching. These should prove useful to fruit-growers and to teachers of both horticulture and Nature-study. The pruning of nursery stock, of young and of mature trees, of bush fruits, and of ornamental shrubs is fully dealt with. A chapter on the "rejuvenation of neglected trees" may be mentioned, as it is a subject which should be of interest to some owners of small private orchards who are anxious to obtain the best possible yields from their trees. The author considers that in the case of apple, pear, and sweet cherry trees specimens fifty to seventy-five years old may be profitably "rejuvenated," but that in the case of plums and sour cherries it will be better to destroy the trees and to re-plant.

"Practical tree surgery" is another aspect of the subject which the author has fortunately included in the book, for frequently trees which are specially valuable on account of their position or association could be saved for long periods from decay by a little skilled care and attention. Some hints which might be useful to the authorities responsible for the care of street trees are given, and a model contract which should put "commercial tree-surgery on a basis that will tend to eliminate fakers" is outlined (p. 401).

The book contains numerous references to the experimental work on pruning which has been carried out in this country and in America, and summaries of such experimental trials and of their results are given. These accounts are both fuller and clearer than is usual in abstracts of this kind. As work of this nature has in the majority of cases been published only in the bulletins of the American experiment stations or in horticultural periodicals, it is frequently difficult to trace, and its inclusion in the book is a feature of great value.

In conclusion, it may be added that the book has a good index and more than three hundred excellent illustrations.

OUR BOOKSHELF.

Comment Economiser le Chauffage Domestique et Culinaire. Par R. Legendre et A. Thevenin. Pp. 123. (Paris: Masson et Cie, 1918.) Price 1.25 francs.

THE question of economy in the use of fuel for general domestic heating and cooking is of no small importance in relation to the general economy of fuel rendered imperative in France by the conditions arising from the war. This small book, issued at a low price under the auspices of the Ministère de l'Armement et des Fabrications de Guerre, is primarily intended to indicate practical methods of attaining economy in the domestic use of fuel, without pretence at scientific treatment of the subject, although there is an excellent section on the principles of combustion and the heat values of fuel.

In the earlier sections the various ordinary fuels are described and also the supplementary fuels, such as peat, lignite, sawdust, tan, etc., briquettes, and simple methods of briquetting small coal. The advantage of using substitutes to the utmost extent to relieve the demand on the better fuels essential for industrial purposes is emphasised.

The second section deals with domestic heating appliances, and, besides describing various forms of fireplaces, stoves, etc., deals with the principles of heating by radiation, conduction, and convection. There is a useful section on smoky chimneys. The final section is concerned with cooking, stress being laid on the advantages of the Norwegian oven. Each section concludes with a summary of possible economies and brief directions as to their realisation. An abbreviated issue of a similar character would well be worth consideration in this country.

The Pasteurisation of Milk from the Practical Viewpoint. By C. H. Kilbourne. Pp. iv+248. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 6*s*. net.

THE pasteurisation of milk consists in heating the milk to a temperature between 140° and 160° F., the milk being maintained at 140° for not less than twenty minutes or at 160° for not less than one minute. By this treatment disease germs which may have gained access to the milk are destroyed, as well as a large proportion of the bacteria commonly present in milk, whereby its keeping qualities are lengthened. In the United States pasteurisation has been very largely employed, and this little book gives a capital survey of the installation, operation, and control of pasteurising plants. The author speaks from first-hand knowledge, having been chief of the Division of Pasteurising Plants, New York City Department of Health. The various types of pasteurisers are sufficiently described, and this section is illustrated with a number of diagrams of various plants. The cleaning and cooling of milk, the cleaning of containers, and home pasteurisation are also dealt with, the efficiency of various apparatus is discussed, and the changes induced in milk by pasteurisation are described.

The book can be recommended as a thoroughly trustworthy guide on the subject of pasteurisation, useful alike to the student of hygiene and to the practical dairyman. R. T. H.

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 Eötvös "Tour de Force."

MAY I add to my article in NATURE of March 21, on the revolving balance of Baron Eötvös, that the method lends itself to determine the mass of the earth, or, more directly, the Newtonian constant of gravitation, with the same simplicity as it does to find the rotation of the earth. For this purpose it is merely necessary to place a large mass above the balance, say at the north end, and below the balance at the south end. Then if the direction of rotation is such that the north end is moving in the same direction as the earth the gravitational couple will act in the same direction as the $4Vv$ difference of centrifugal force, whereas if it turns in the opposite direction, the gravitational couple will be opposed to the centrifugal couple. If the large masses of radius c are spherical and are made of material of density d, and the fictitious distances of their centres vertically above and below the small masses at the ends of the balance-arms are also equal to c, the arm lengths being r, then the time of rotation necessary to make the one action equal to the other is given by the equation—

$$T=\frac{48\Omega r}{Gd\,c}\cos^2\phi.$$

Making provisionally $r=c$, and taking for d the density of lead, the time T comes out as thirty-one minutes, which, I fear, is much greater than that which could be realised as a free period. If, however, the period were one minute, the gravitational couple would add or subtract 1/31 part of the centrifugal effect, according to the direction of rotation, or the ultimate deflections in the two cases would have the ratio 15:16, a difference which might be observable. By fictitious distance I mean the equivalent distance vertically above or below the centre of the small mass m at which the centre of the large mass may be imagined acting on the small masses with a cosine distribution of force. Actually it would have to be larger and further away. This could more readily be determined in any particular case by arithmetical treatment than otherwise.

I have been considering in some detail the best way of constructing an Eötvös *tour de force*, if I may be allowed so to call it, with a view to the utmost possible delicacy, and as I have all the material, I am hoping to set one up in a cellar in the country admirably adapted to the purpose in such time as I can glean from other occupations. C. V. BOYS.

The Motion of the Perihelion of Mercury.

IN NATURE for March 21 Sir Oliver Lodge suggests that the unexplained part of the motion of the perihelion of Mercury may be attributed to the action of a resisting medium. Such a medium would not necessarily produce any effect on the mean distance of a planet, for such an effect depends entirely on the relative velocity, and it is probable that the medium would revolve with the planets. The principal effect of the medium would be to reduce the eccentricity, and de/dt would contain e as a factor. There would be no motion of the perihelion if e were small enough. Any motion of this could arise only if the eccentricity were considerable, and thus would contain it as a factor. Hence $d\varpi/dt$ and de/dt would be of the same order. Now the observed anomalous variations of ϖ and e in a century are $43''$ and $-0{\cdot}88''$, so that they are of different orders, and therefore cannot be due to a resisting medium.

Or, again, consider the density needed to produce the effect. The average resultant velocity of Mercury relative to the medium is of the order of the eccentricity multiplied by the planet's mean orbital velocity, or about eight kilometres per second. If ρ be the density of the medium, a the radius of Mercury, U this relative velocity, and M the mass of the planet, the retarding force would be nearly ρa^2U^2, and de/edt would be of the order $\rho a^2U^2/MU$. Substituting for all these quantities, except ρ, their known values, we see that ρ must be of the order 3×10^{-11} gm./cm.^{3}, while the maximum density consistent with the observed luminosity of the Zodiacal light is only about 2×10^{-17} gm./cm.^{3}. To account for the motion of the perihelion would, of course, require a still greater density.

Many recent writers on this subject have treated the discordance in the motion of the perihelion of Mercury as if it were the only unexplained perturbation in the solar system. Yet there is an unexplained advance of the node of Venus of the same order of magnitude, the motions in a century being $43''$ and $10''$ respectively. The latter estimate is admittedly subject to greater uncertainty, but it is 3·5 times its mean error, and the probability that so large a discrepancy is accidental is only about 0·0004. Now, whatever may be the effect of departure from simple Newtonian dynamics, it cannot alter the plane of an orbit, which can be done only by the attraction of other matter, or to a negligible extent by a moving resisting medium. It is found that a distribution of gravitating matter that would represent the motion of the node of Venus would necessarily account also for the whole of the discrepancy in the perihelion of Mercury, so that departures from Newtonian dynamics to explain the latter make the former impossible to account for. It is, of course, possible that the excess motion of the node of Venus may be due to errors of observation, but the probability against this is about 2500 to 1, and it must be admitted that any theory with such an *a priori* probability against it is open to very grave suspicion.

HAROLD JEFFREYS.

Bee Disease.

IN connection with the article on bee disease which appeared in NATURE of March 21, perhaps my experience with diseased bees may be of interest. I have subjected to microscopic examination the contents of the intestines and chyle stomachs of several dozen bees, all guaranteed by a professional lecturer in bee-keeping to be suffering at the time from the "Isle of Wight disease." In all cases the examination under the 1/12 immersion was conducted within five minutes after the bees had been killed. In no case did I find a trace of *Nosema apis*. In some there was a predominance of wild yeasts in the affected parts; in others again bacterial multiplication was very far advanced. It may, of course, be advanced that these particular bees were not suffering from the "Isle of Wight disease," but in view of the conclusion adopted by several competent biologists that *Nosema apis* has no causal connection with the "Isle of Wight disease," and also of the importance of the subject, further investigation is urgently needed. The impression left on the present writer was that *Nosema apis*, when found, was an accessory, and not a causal agent; and the fact that in practically all the observations of this disease that have been made in Scotland *Nosema apis* has been conspicuous by its absence supports this impression. It would appear that different causative agents produce the same symptoms; from the practical point of view, as the agents may be protozoa, or yeasts,

or bacteria, we need more diagnostic data, for the method of combating the disease must necessarily depend on the nature of the micro-organism to be combated.

DAVID ELLIS.

Royal Technical College, Glasgow, March 30.

THE object of the article on bee disease which appeared in NATURE of March 21 was to emphasise the fact that, though bees suffer from many diseases, the macroscopic symptoms are practically the same, and to claim that the only acceptable definition of "Isle of Wight disease" is the "disease caused by *Nosema apis*." As Mr. Ellis's experience would appear to support this contention, it is to be regretted that he should have received the impression that Nosema, when found, has no causal connection with the disease. The correct deduction would appear to be that, in spite of the guarantee of the professional lecturer on bee-keeping, the bees he examined were not suffering from "Isle of Wight disease." It would at any rate be interesting to know on what scientific data this guarantee was given. The conclusions in the last sentence of Mr. Ellis's communication are identical with those drawn in my article.

THE WRITER OF THE ARTICLE.

Prices of Scientific Apparatus.

THE method of advertising at present adopted by some of our scientific instrument makers is, I venture to think, open to serious objection. The prices mentioned are, it would appear, not the current prices at all. An addendum (printed in small type or in some other inconspicuous way) informs the public that, owing to the war, the prices quoted in the advertisement are subject to an addition of 10 or 20 per cent., and in some cases to as much as 33 per cent. Would it not be advisable to abandon entirely the publication of pre-war prices, and to quote instead the sums for which the various forms of apparatus are to be obtained at the time the advertisement meets the public eye?

FREDK. J. BRODIE.

Loxley Road, Wandsworth Common, S.W.,
April 2.

COTTON-GROWING STATISTICS.

THE forecasting of the cotton crop, upon which depends one of the greatest industries of the world and in which Great Britain is especially interested, has settled into a mixture of reports based on a glance round a cotton field, a chat with a proprietor, and a combination of a few climatic notes which a Government department wisely issues for a farmer's guidance. It is all unsubstantial, but these reports are spread over the world and are used as a basis for business and speculation according to the credit any particular reporter may have at the moment.

It is not surprising that serious attempts are made to eliminate this casual method and establish a scientific basis in its stead. A short time ago a particular investigation conducted in Egypt necessitated the obtaining of a certain amount of data of the growth of the cotton plant. The collection of the data was carried out on scientific lines and evidently served its purpose. It was found, however, that the data and method used for this particular purpose gave indication that their use could be extended to the solution of a far more important problem, viz. forecasting with some degree of accuracy the flowering, ripening, and stages in the picking of the cotton crop. In other words, an estimate of the yield of the crop could be made several weeks before the cotton was ready for picking. The line of argument for this conclusion is fairly simple. The rate of the growth of the plant in height (stem growth) was considered to be, in some proportion, indicative of the rate of flowering; so that a curve of growth, compared with some standard growth curve, would indicate the rate of flowering three weeks before flowering commenced. The flowering curve, in its turn (with certain corrections), offered a ready means of estimating the number of bolls of cotton, or the amount of ripe cotton, that could be anticipated two months later. Forecasting on these lines became a scientific matter, and it held out a distinct promise of a wide field of usefulness.

The Ministry of Agriculture of Egypt evidently determined to test this new method of forecasting the cotton crop, and during the year 1915 arranged a number of stations in Egypt where the growth of various classes of the cotton plant could be observed systematically and complete data obtained of their rates of growth, flowering, and ripening of the bolls. The whole of the data thus collected has now been published in the *Agricultural Journal of Egypt* (vol. vii., 1917). An elaborate series of curves has been graphed from the data. It is apparent that one of the chief objects of the whole investigation was the testing of the new method of forecasting, for a statement is made to that effect. In spite of this, however, no direct reference is afterwards made in the report as to the effectiveness of the method, nor has an attempt been made to express an opinion.

The curves and data accompanying them have evidently been considered by the Egyptian authorities to be so adverse to this new method of forecasting that they have deliberately refrained from editorial comment.

Whilst this particular feature occupies nine-tenths of the report, it is evident from the other sections, in the form of editorial remarks and data, that previous to 1915 cotton-growing in Egypt was not conducted on correct lines, and that too strict an adherence to Mendelian principles was not yielding the results anticipated. In the editorial statements on this feature the phraseology used is unfortunately liable to misconstruction. It must, however, be conceded that further remarks on this feature make it clear that whilst Mendelian principles will be the basis of future work (this, of course, is inevitable), consideration will be given to practical factors according to districts and local conditions.

The whole subject is one of such practical utility that someone should be associated with the botanist to act as a guide in pointing out the direction in which utility is desirable. One or two details of the report—for instance, the measurement of the fibres, etc., and the import of them, the experimental spinning, and the interpretation of the results—clearly indicate the necessity for complementing the staff of the Egyptian Ministry of Agriculture dealing with cotton-growing by the addition of a man thoroughly acquainted with all the practical aspects of the cotton industry.

MODERN METHODS OF WELDING.

THE union of two pieces of metal by fire fusion and hammering is an old-established art in connection with iron, and is rendered easy by the fact that the change from liquid to solid is not abrupt in the case of this metal, which exists in a pasty condition over a considerable range of temperature. Since the invention of the oxy-hydrogen blowpipe by Hare in 1801, steady progress has been made with the welding of iron and other metals by methods involving flame heating, the earliest successes in this direction being achieved with platinum and lead. During the last ten years flame welding has made rapid strides, mainly owing to the use of acetylene as the combustible gas, and is now firmly established as an everyday process in all large engineering workshops. The high temperature procurable by the use of electricity has led to the development of electric welding, which is now employed for a large variety of operations, and may be expected to extend still more as electric power grows cheaper. In addition to the foregoing, a further method of welding is provided by the use of "thermit" mixture, which has proved successful for many classes of work. During the present time of stress all the methods named are being used to the utmost, and are playing an invaluable part in the production of munitions of war.

The gases used for flame welding may be either hydrogen, coal-gas, water-gas, or acetylene, which are burnt in blowpipes of suitable construction in air or oxygen, according to the temperature needed. Hydrogen is more expensive than the other gases named, and is used only in cases in which the work might be damaged by impurities such as sulphur and phosphorus, one or both of these being liable to be present in the alternative gases. Coal-gas has long been used for the autogenous soldering of lead, but has not been applied to any great extent to the welding of iron, owing to its varying composition and the presence of impurities. Water-gas, which has the advantage of being the cheapest of all gases suitable for welding, is now extensively employed for pipe welding, particularly in America and Germany, the parts to be joined being brought to a welding heat by blowpipes, and then hammered with a pneumatic hammer, or pressed together by rollers. Fig. 1, from a paper published by Capt. Caldwell, R.E., in the Transactions of the Institution of Engineers and Shipbuilders in Scotland for February last, shows a pipe welded in this manner and used in a hydro-electric installation in California. Water-gas is used in this connection as a substitute for a fire, and the temperature attained need not be so high as that required for fusion welding, in which joining is effected without hammering.

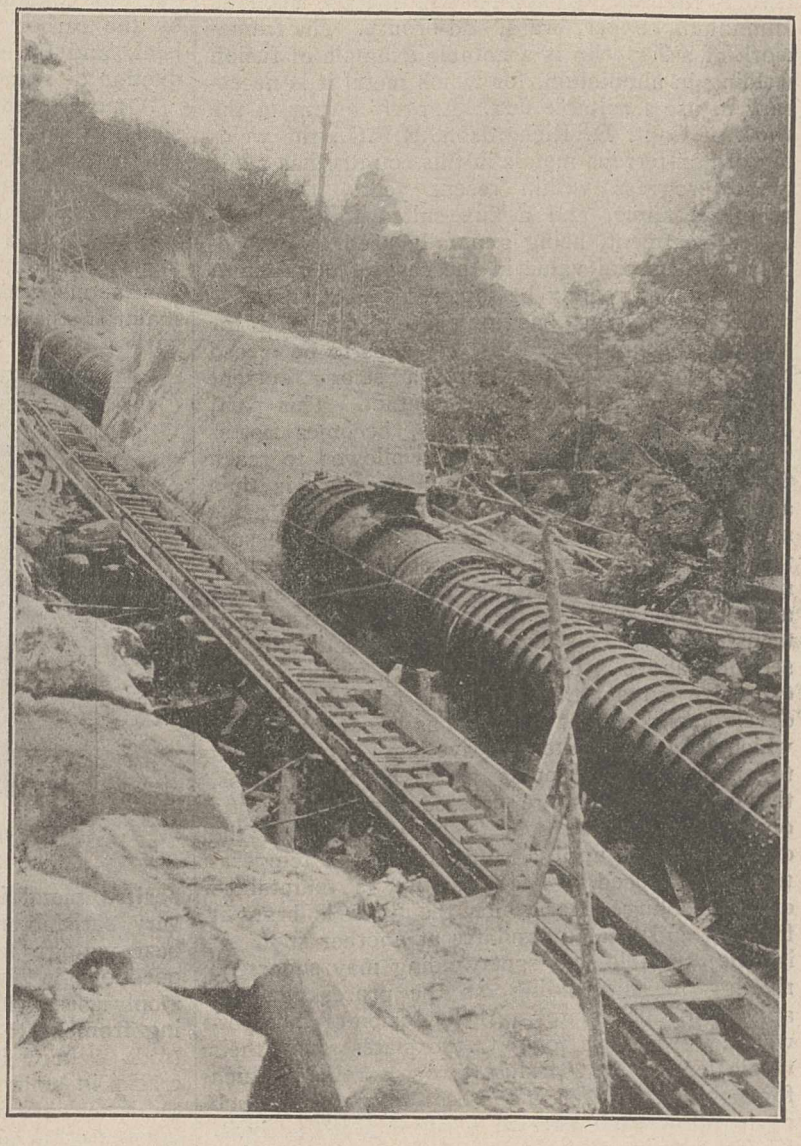

FIG. 1.—Large pipe welded by water-gas method. From Transactions of the Institution of Engineers and Shipbuilders in Scotland.

The oxy-acetylene flame is most generally used for fusion welding, owing to its high temperature, which, at the hottest part, approaches 3000° C., a further advantage being that a zone of unburnt hydrogen exists round the working-tip of the flame, which prevents oxidation of the work. In fastening two surfaces by fusion welding, the

edges are chamfered and brought together so as to form a V-groove. The lowest part of the groove is brought to fusion by the blowpipe, and metal run in from a rod held in the flame, the process being continued until the groove is filled, when, if both the work and added metal have been thoroughly fused, a good joint will result. The oxy-acetylene flame is extensively used in this manner for welding iron, and is now growing in favour for joining non-ferrous metals, such as aluminium, copper, brass, and bronze. The framework of a Zeppelin is a notable example of fusion welding in aluminium, for which metal it is necessary to use a suitable flux. Largely owing to the work of Capt. D. Richardson, R.F.C., the welding of non-ferrous metals in this country has made great progress within recent years, the oxy-acetylene flame, and a flux suited to the metal under treatment, being generally used. The process is of special value in the case of aluminium, which cannot readily be joined by soldering.

Electric welding has long been employed for joining iron and steel rods, the ends to be pieced being brought together, and a strong current passed through the point of contact. This part, owing to its higher resistance, becomes hotter than the rest of the rod, and is allowed to reach the fusion point. Longitudinal pressure is then applied, so that complete union of the two parts may be ensured; and after releasing the pressure the weld is hammered during cooling. An alternating current is used, the requisite high current at low voltage being secured by the use of a transformer. This method is impracticable for sections above a certain diameter, owing to the excessive current that would be needed. A later development is what is known as "spot" welding, which is a substitute for riveting. In fastening together two overlapping plates by this process, the two electrodes are pressed, one above and one below, on the spot to be welded, and the current passed until a sufficiently high temperature is produced. The pressure is maintained during cooling, after which the work is brought forward and treated similarly at another spot. It is quite possible that spot welding may supersede riveting in shipbuilding, as the process can be applied to thick plates. An extension of the spot-welding process is to unite the plates along their whole length, by passing through rollers which form the electrodes, the rate of travel being such as to allow each part to attain a welding heat. So far, continuous seam welding of this kind has been applied only to comparatively thin sheets.

The foregoing electric methods are all based on the heating effect due to resistance. The high temperature produced by the electric arc is additionally utilised for welding, and has a varied and rapidly extending application. The carbon arc, which yields a temperature of 3700° C., is used for welding seams, the procedure being the same as when the oxy-acetylene flame is used as the source of heat. Direct current is used, the work being connected to the positive pole and the carbon to the negative. It is customary to work at a pressure of about 90 volts and a current of from 50 to 500 amperes, according to the size of the work. An adjustable resistance is used to regulate the current, and the carbon rod is held in an insulating holder, forming a handle by which the workman moves the arc along the joint. It is not attempted to bring the work to a higher temperature than is necessary for complete fusion, but this condition is brought about more rapidly by the carbon arc than by any other source of heat, and the method is much used in the production of seamless steel drums, etc.

A more recent development of arc welding consists in the substitution of an iron rod as negative electrode in place of the carbon, which is fused by the heat, and the fused metal carried across the arc on to the work opposite. The iron electrode, which is usually coated with a flux to prevent oxidation, is rapidly used up, and must be continuously moved forward by the welder to maintain the correct length of the arc. The deposited metal is hammered during cooling, and very satisfactory joints are thus secured. The best voltage to employ is as yet an unsettled question; in American practice 45 volts are commonly used, whilst in this country pressures ranging from 75 to 110 volts are general. Iron-electrode welding is particularly useful for repairing cracks in boiler-plates or shafts, the procedure in the latter case being to cut away the metal adjoining the crack on either side, forming two conical pieces meeting in a point. The part cut away is then filled in by the arc, commencing at the narrowest point and working outwards. Fig. 2 shows the method applied to the filling in of the worn parts of a tram-rail, a repair of this kind often saving the cost of a new rail. In all arc welding the eyes of the welder must be protected from the rays of the arc, and suitable glass screens are therefore provided. One advantage claimed for arc welding in the case of boiler repairs is that, owing to the heat produced being intensely local, a joint may be made without caus-

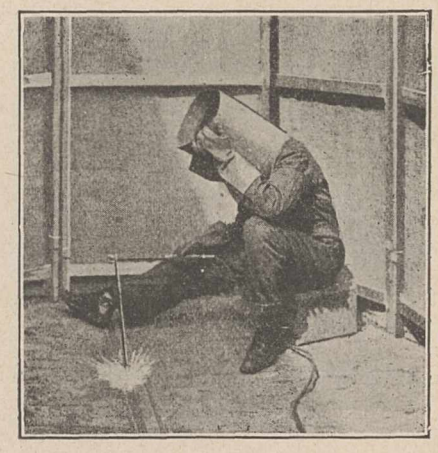

FIG. 2.—Repairing a tram-rail by arc welding, using an iron electrode.

ing strains in the vicinity, as may be produced by flame welding.

Thermit welding finds its chief application in work on large sections, such as rails and thick shafts. In welding together the ends of two consecutive rails, for example, the rails are made to touch, and a refractory mould is placed round the two ends. The thermit mixture, consisting of powdered aluminium and oxide of iron, is fired in a crucible by the ignition of a small quantity of a mixture of barium peroxide and aluminium, the reaction resulting in the production of aluminium oxide and metallic iron at a temperature of about 2500° C. The molten mass is run from the crucible into the mould, the quantity being such that the lower part of the rails is surrounded by molten iron and the upper part by the fused alumina. After a short time longitudinal pressure is applied to the rails, which are now at a welding heat, and complete union is secured. After removing the mould, the thermit iron is left adhering to the lower part of the joint and the slag broken away from the upper part. This is now the common method of welding rails, and forms a typical example of the use of thermit.

In comparing the various methods of welding, it may be said that each has its special advantages and is preferable for one kind of work. When a choice has to be made in a case in which the work could be executed by several methods, the user is guided by experience as to which is likely to suit best, and also by cost and convenience. In all instances much depends upon the skill of the welder, and figures showing the strength of welds will not be realised in practice unless the work is carried out by a thoroughly competent workman. C. R. D.

European War and Science

SULPHURIC ACID AND THE WAR.

MODERN warfare has been described as an affair of mechanics and chemistry. Of course, this is a very partial and incomplete definition, inasmuch as it neglects what, after all, is the paramount factor—the human element. But, given that the human factor is equally potent on both sides, it is certainly true that the belligerent which is most alert and most resourceful in the use of the methods and practical achievements of science will inevitably triumph in the end. The whole conduct of the war shows that our enemies have not been slow to appreciate this fact, and if we have been a little more tardy in learning the same lesson we are rapidly making good whatever leeway we may have lost.

Nothing distinguishes this war more markedly from previous campaigns than the manner in which the scientific knowledge and intelligence of the nation have been enlisted, both in its prosecution and in the repair of its ravages. We have a notable instance of this circumstance in the recently published Report of the Departmental Committee appointed to consider the post-war position of the sulphuric acid and fertiliser trades. Sulphuric acid is indispensable in war; a nation deprived of it, or of certain of the products which can be obtained only by its means, would be helpless in face of its enemies. It required, however, nearly nine months of actual warfare for those in authority in this country to realise the danger of a possible shortage in the supply of the sulphuric acid absolutely essential to the production of explosives, and a small but eminently competent committee of well-known manufacturers was at length appointed to advise the Government in the matter. The result was that the makers of sulphuric acid and its principal users were organised in view of the national emergency. The request that the demands of the explosive factories should receive priority was willingly acceded to, and it is satisfactory to learn that their requirements were fully met.

The enormous amount of sulphuric acid of high strength needed in the manufacture of explosives has, however, led to an extraordinary development in the industry, and to many far-reaching changes which those who are charged with the consideration of questions of what is termed "reconstruction" view with no little apprehension and concern. Concentrating plants on a large scale have been everywhere erected; large oleum plants have been constructed in connection with Government factories, and private manufacturers have been encouraged to extend their chamber plants and to work them continuously and intensively. The result is that the productive power of the country has now reached an amount greatly in excess of the pre-war consumption, and the problem which the Committee has had to consider is how this expansion can be dealt with in view of possible post-war requirements.

If the outcome of the war is to lead to the continued existence of militarism, the Government explosive factories with their contact and oleum plants will have to be maintained, for it is inconceivable that we shall revert to the fatuous policy of letting things take care of themselves, and of not foreseeing and making provision in advance, which prevailed at the outbreak of hostilities. As regards private manufactories of concentrated acid and oleum, it is to be expected that the resuscitation of the synthetic dye industry in this country will continue to absorb an increasing amount of these products. We may hope that it will prove to be one more instance of a superfluity in supply creating a new demand. But, however optimistic one may be in this respect, it can scarcely be doubted that for some time to come the supply will greatly exceed the demand, and that much plant will lie idle and may possibly be "scrapped."

There is at least one new source of sulphuric acid in this country, created by the war, which it is greatly to be hoped will be maintained and extended, and that is the production of acid from Australian zinc concentrates. The manufacture of zinc was instituted in this country before it was started in Belgium and Germany, but it has not been developed here to anything like its proper extent. Although London is the chief zinc market

in Europe, the main production of the metal has been in the hands of Germans, who have also acquired a controlling interest in the Belgian concerns. This fact has, no doubt, something to do with the tenacity with which, under the pressure of Silesian magnates and capitalists, our enemy seeks to retain his hold on Belgium. It is well known that Germany, with the view of maintaining her practical monopoly in the production and distribution of zinc, gained control of the rich deposits of zinc ores in Australia, and that the great bulk of the Australian concentrates found their way to Belgium and Silesia, mainly by way of Antwerp and Hamburg, Germany's own deposits being meanwhile conserved. This is now, happily, a thing of the past, but whether the former condition is to be resumed time alone will show. Meanwhile, the consolidation and development of the zinc industry in this country are not proceeding at the rate which could be wished. The debate in the House of Commons on the Non-Ferrous Metals measure showed plainly enough that there are doctrinaires who are blind to our true economic interests.

There is one outlet for sulphuric acid which is capable of far greater development, and that is in the manufacture of fertilisers, and especially of superphosphates. There can be no doubt that the food shortage in the country, due to our enemy's activities, has had a profound effect on our agricultural policy, and will lead to a permanent increase in home production. This will, of course, necessitate a greatly increased demand for fertilisers, such as sulphate of ammonia, as well as of phosphatic manures. Much ammonia is at present absorbed in the production of nitrate of ammonia, which is needed in the manufacture of munitions. But this ammonia will be liberated after the war, and will be largely converted into sulphate for agricultural use. In the past about 60 per cent. of the sulphuric acid we produced was absorbed in the manufacture of fertilisers, in which there was a considerable, although of late declining, export trade, in addition to the home demands. The changed carrying conditions caused by the war may, if we seize our opportunity, lead to a recovery and possible extension of this export trade, induced, on one hand, by the comparative abundance of cheap sulphuric acid, and, on the other, by the greatly increased demand for fertilisers.

These and many other points are concisely dealt with in the admirable Report of the Committee now before us. It is an eminently businesslike production, commendably short and to the point. It has the merit, too, of being unanimous, and its recommendations are practicable and such as will appeal to practical men. They involve recommendations for (1) providing an outlet for, and generally dealing with, the surplus sulphuric acid which may be expected over pre-war production; (2) for the relief of acid and fertiliser makers from the competitive effect of surplus acid; (3) for improving the status of the technical chemist, for a more systematic study of manufacturing costs, and for the establishment of a strong national association of sulphuric-acid makers. All these are matters which directly affect the interests of the industries dealt with in the Report, and should, and no doubt will, receive the serious consideration of those immediately concerned. Legislation will presumably be required to give effect to certain of the proposals, but there are others upon which immediate action might be taken under existing powers, and although the end of the war is not yet in sight, it is very desirable that no undue delay should occur with respect to them.

T. E. THORPE.

INTERNATIONAL SCIENTIFIC NOMENCLATURE.

IN the *Comptes rendus* of the Paris Academy of Sciences for February 11 there is a manifesto in the form of a memorandum entitled "Observations on Modern Scientific Language" by a number of French men of science, MM. Bigourdan, Blondel, Bouvier, Branly, Douvillé, Guignard, Haller, Haug, Henneguy, Lacroix, Lallemand, Laveran, Lecomte, Lecornu, Lemoine, Maquenne, Emile Picard, Roux, Schloessing, jun., and Tisserand. The writers of this note enter a protest against a tendency they have observed on the part of the younger generation of scientific workers both to neglect literary form in their publications and to introduce new and strange words which are often unnecessary or badly constructed.

It is suggested that youthful authors may perhaps think that the use of outlandish expressions lends an air of learning to their communications, whereas the impression sometimes produced upon the reader is that he has come upon a bad translation of a work originally published in some foreign language.

It is pointed out that, owing to the international character of science, words and expressions which are quite appropriate in one language have been transferred bodily into another language without proper steps having been taken to adapt them to their new home. For example, our words "control" and "to control" have been translated "contrôle" and "contrôler." But "contrôler" means "to register," and, therefore, ought not to be used in the sense of "to regulate" or "to exercise an influence over." The English expression "self-induction" sometimes appears in French papers on electricity in the shortened form of "le self." Even an Englishman would find it difficult to discover the meaning of such an expression, so that a Frenchman may be pardoned if he finds it barbarous.

The writers of the note express the hope that the more closely the bonds between the Allied nations are drawn, the more care may be taken in translating scientific terms and expressions. It is suggested that international congresses and all forms of international co-operation afford a means of "controlling" the international language of science.

Attention is directed to the adjectives "thermostable" and "thermolabile," in the first place

because these words are partly Greek and partly Latin, and in the second on account of the signification given to them. A "thermostat" is an instrument for maintaining a constant temperature, so that "thermostable" should apply to a condition in which the temperature remains constant, such as that found when a piece of ice is floating on ice-cold water. Yet the adjective "thermostable" is used to mean "not affected by *change* of temperature." The writers prefer the term "acyclic" to "aliphatic." Indeed, "aliphatic" is an unwieldy adjective, suggesting the inquiry as to whether elephants are really fat.

We are further told that in the writings of biologists we may read that "un microbe *cultive* sur pommes de terre," and that "un animal *reproduit* en captivité," meaning in the first case that the microbe "can be cultivated," and in the second that the animal "reproduces itself," or, rather, "produces its offspring," in captivity. We learn also that the Latin genitive *coli* may be found used as a substantive to represent *Bacterium coli* or *B. coli* in such expressions as "cette culture renferme du coli."

We fear that the writings of English men of science are not free from the careless use of expressions which the writers themselves would not have employed had their attention been directed to them. It is also to be noted that many of the terms we have taken from the German are, perhaps, too literally translated. Why should "Farbstoff" always be rendered "dyestuff" instead of using the shorter word "dye"? Apparently there is no word for "dye" in German, so that they are obliged in Germany to use the cumbrous expression "colour-stuff."

There is, we fear, little likelihood that scientific workers will ever agree upon questions of nomenclature. About thirty years ago the British Association appointed a "Committee on Chemical Nomenclature." So long as this committee confined its considerations to the origin and history of the various chemical terms, it carried on its labours in perfect harmony, but as soon as it tackled the problem of laying down rules to guide future writers in the forms of nomenclature they should use, it was found that agreement was no longer possible, so that further meetings of the committee were abandoned.

Although complete agreement in these matters is not to be expected, we feel that there is some reason for the criticisms expressed by the authors of the memorandum.

NOTES.

WE regret to notice the death of Emile Yung, professor of zoology in the University of Geneva. A typical and patriotic Swiss, Prof. Yung studied zoology under the famous Carl Vogt, and after a period of assistantship became his successor at Geneva some thirty years ago. For many years the treatise on "Practical Comparative Anatomy," by Vogt and Yung, was a familiar book in zoological laboratories. It contained minute descriptions of a long series of types, and was uncommonly well done. Prof. Yung was greatly interested in the influence of environmental conditions on the organism, and made numerous experiments bearing on this problem. Thus he was one of the early investigators of the determination of sex in tadpoles, and supported the conclusion that the proportions of the sexes could be greatly altered by changing the diet. The value of this result was lessened, however, by the fact that the sex of the larvæ that died in the course of the experiments was not recorded. In another investigation he showed that the growth of tadpoles was modifiable by alterations of diet; thus tadpoles fed on beef grew three times as fast as those fed on plants. The effect of diverse temperatures and illuminations was also tested; thus tadpoles reared under violet light were emphatically longer than those reared under white light, and very much longer than those reared under green light. Prof. Yung took a keen interest in the description of the fauna of Switzerland, and made many a study of the plankton of the Lake of Geneva and its seasonal variations. Many of his experimental investigations had a pleasant quality of freshness. Thus we may recall how he took a score of marked bees from a hive near the lake, put them in a box, and liberated them in the country six kilometres away. Seventeen returned, some in an hour. Next day the seventeen were taken on a boat to a distance of three kilometres on the lake. When liberated, they flew about aimlessly, and none returned. Throughout a vigorous life Emile Yung did much for science, and his genial personality will be long remembered.

THE *Revue Scientifique* announces that Dr. Armand Thevenin, of the Sorbonne, died on March 7, aged forty-eight. He had been experimenting for some time with poisonous gases for the use of the French Army, and in the course of this work contracted an illness which unfortunately proved fatal. Geologists and palæontologists will lament Dr. Thevenin's premature loss, for he was one of the most accomplished members of the French school, full of activity in important research. For many years he collaborated with the Geological Survey of France on the south-western margin of the central plateau, and did much valuable work in stratigraphy. He was, however, more especially interested in fossils, and both at the Paris Museum of Natural History and (after 1913) at the Sorbonne he was engaged in many researches of which he published important results. His memoirs on the Permian reptiles and amphibians of France and on various fossils from Madagascar, contributed to the *Annales de Paléontologie*, will be specially remembered. Dr. Thevenin was president of the Geological Society of France in 1914, and received from the Academy of Sciences "le grand prix des sciences physiques" in 1909.

THE death is announced of Dr. Friedrich August Rothpletz, professor of geology and palæontology in the University of Munich. Born at Neustadt-a.-d.-Haardt, Bavarian Palatinate, on April 25, 1853, he graduated at Leipzig in 1882, and was engaged for some time on the Geological Survey of Saxony. In 1884 he became privat-dozent at Munich, in 1895 he was made extraordinary professor, and in 1904 he succeeded Prof. K. A. von Zittel as professor. Prof. Rothpletz had a very wide interest in geology, and wrote much on subjects so far apart as the structure of calcareous algæ and the folding of the rocks in mountain ranges. He was, however, always particularly fascinated by the geological problems presented by the Alps, and to these he devoted two important volumes, "Geotektonische Probleme" in 1894, and "Geologische Alpenforschungen" in 1900-8. He also studied the marine geological formations of the Canary Islands, and co-operated with Dr. Simonelli in a

memoir on this subject, published by the Geological Survey of Spain in 1898. Prof. Rothpletz was well known to the geologists of this country, and was elected foreign correspondent of the Geological Society of London in 1894, and foreign member in 1905.

AFTER thirty-eight years' service, Mr. Richard Hall has retired from the staff of the geological department of the British Museum. Entering the museum as an ordinary mason, he soon acquired remarkable skill in preparing fossil skeletons, and so did much to facilitate the progress of vertebrate palæontology. His extrication of the bones of Pariasaurus and Cynognathus from an almost intractable matrix began a new era in the study of South African fossil reptiles, which had previously been only imperfectly prepared; and *Dicynodon halli* is named to commemorate his success in this work. He also prepared the fine skeleton of Hyperodapedon from Elgin, described by Prof. Huxley in 1887, besides many other fossils now exhibited in the public galleries of the museum.

THE seventy-first annual meeting of the Palæontographical Society was held at Burlington House on April 5, Dr. Henry Woodward, president, in the chair. Besides instalments of the monographs of Pliocene Mollusca, Cambrian Trilobites, Palæozoic Asterozoa, and Wealden and Purbeck Fishes, the first part of a new monograph of British Bellerophontacea, by Dr. F. R. C. Reed, was announced for publication. Mr. C. H. Cunnington, Mr. E. Gibson, Mr. A. W. Oke, and Dr. A. Strahan were elected new members of council; Dr. Strahan was elected new vice-president; and Dr. Henry Woodward, Mr. Robert S. Herries, and Dr. A. Smith Woodward were re-elected president, treasurer, and secretary respectively. In a brief address the president paid a tribute to the memory of Dr. G. J. Hinde, who for many years took an active part in the work of the society.

THE council of Girton College recently decided to endeavour to raise a sum of money with which to found a fellowship for the encouragement of research in natural science, and especially in botany, as a memorial of Miss Ethel Sargant, whose original contributions to botany gained for her a prominent and honourable position in the scientific world. Miss Sargant was not only an original investigator of great ability, but she also consistently advocated the importance of providing opportunities of research for others. She was the first woman to preside over a section of the British Association and to serve on the council of the Linnean Society. Subscriptions may be sent to Miss E. Lawder (hon. treasurer of the Executive Committee of the Ethel Sargant Memorial Fund, Girton College), 25 Halifax Road, Cambridge.

THE death is announced of Prof. Christian Hornung, at the age of seventy-three. For fifty years Prof. Hornung held the chair of mathematics and astronomy in Heidelberg University, Tiffin, Ohio.

PROF. J. H. JEANS and Sir William S. McCormick have been elected members of the Athenæum Club under the provisions of the rule of the club which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public service."

THE *Times* of April 9 announces the sudden death, in his sixty-first year, of Pandit Sir Sundar Lal, Vice-Chancellor of the University of Allahabad, and representative of the University on the Provincial Legislature. The successful organisation of the Benares Hindu University was largely due to his efforts, and he was its first Vice-Chancellor.

AT the ordinary scientific meeting of the Chemical Society, to be held at Burlington House on April 18, at 8 p.m., the first of the Hugo Müller lectures will be delivered by Sir Henry Miers, who has chosen as his subject "The Old and the New Mineralogy."

THE *Bulletin des Usines de Guerre* for March 18 (quoted in *Le Génie Civil*) gives particulars of a motor-car propelled by hydrogen which is probably the first of its kind. Experiments made with the vehicle show: (1) that a car motor can be made to work perfectly well with a mixture of pure hydrogen and air; (2) that it is not necessary to modify the construction of the motor; and (3) that the motor can be worked with a simple type of carburettor.

IT is announced in *Science* that Prof. J. M. Coulter, professor of botany in the University of Chicago, has been elected president of the Chicago Academy of Science. Prof. Coulter is this year president of the American Association for the Advancement of Science and of the American Association of University Professors. Our contemporary also states that Dr. G. T. Moore, director of the Missouri Botanical Garden, has been elected president of the Academy of Science of St. Louis, to succeed Dr. E. A. Engler, whose death we announced recently.

THE Minister of Munitions, in agreement with the Secretary of State for the Colonies and the Petroleum Executive, has appointed a Committee to inquire into certain matters relating to the production of fuel oil from home sources. The terms of reference are:—"To consider the report which has been rendered by the Petroleum Research Department on the production of fuel oil from home sources, and to advise to what extent, and within what time, it should be possible under present conditions to carry out the proposals made in this report; and to consider the steps which have been taken by the Ministry of Munitions in this connection." The members of the Committee are:—Marquess of Crewe (chairman), Col. A. Stirling, Maj. G. Collins, Engineer Vice-Admiral G. G. Goodwin (Engineer-in-Chief of the Navy), Sir Richard Redmayne (representing the Controller of Coal Mines), Sir Lionel Phillips (representing the Ministry of Munitions); secretary, Mr. G. C. Smallwood (Ministry of Munitions).

WITH the view of endeavouring to meet the coal shortage which has arisen, due to the tonnage question, the Danes have commenced the exploitation of the lignite deposits of Iceland and the Färoe Islands, while recent announcements indicate that an attempt will be made to work the coal-beds of the island of Bornholm. These latter deposits have been worked before, but had to be abandoned owing to difficulties of exploitation and the low calorific value of the fuel. The geological conditions, etc., have been given in a description of the island by Grönwall and Milthers published by the Danish Geological Department. Nevertheless, it is stated (*La Nature*, March 30) that geologists and a capitalist have resolved to take in hand the further exploitation of these deposits. The newspapers announce that it is hoped to obtain a yield of 500,000 tons per annum before long.

IN an article in the *Morning Post* of April 4 entitled "The Long-range Gun: Some Future Possibilities," it is stated that military opinion in Germany and Austria seems to be that the bombardment of Paris is an experiment to obtain data for a similar attack on London. It is pointed out that once the problem of projecting shells to a range of seventy or eighty miles has been solved, speedy developments are certain to follow,

with the possible result that shells, more destructive than those now being fired into Paris, could be thrown from Ostend to London, a distance of some 130 miles. It is pointed out that if the experiments on long-range ballistics, which were initiated in this country in 1887, had not been curtailed owing to the stupidity of our officials and politicians, we should probably have been the first to produce such a long-range gun, and it is urged that we should set to work at once to produce a better weapon than the German gun.

THE results of two expeditions equipped by Mr. I. Wanamaker—one to work in the south, the other in the north, of Alaska—are described in the *Museum Journal* (vol. viii., No. 2, June, 1917). Among the collections received are old works of art handed down for many generations in the Chilkat tribe. The northern expedition worked among the Eskimo on the shores of the Arctic Ocean, who have been seldom visited, and retain many of their characteristic institutions. This expedition will throw much light on the chain of pure Eskimo culture which reaches from Labrador on the Atlantic side of the continent across the shores of the Arctic Ocean and Bering Sea to the Northern Pacific.

MR. B. C. WALLIS has contributed to the *Geographical Review* (vol. iv., No. 6, December, 1917) a paper on "The Peoples of Hungary: their Work on the Land." The paper gives a good instance of geographical control upon the life of man. The Magyar is deep-rooted in the heart of Hungary, the central Alföld. The Slovaks show a definite tendency towards the development of an economic life which essentially differs from that of the other races, due in part to the mountains and plains of which their land is composed, and yet in sharp contrast with the life of the Rumanians in Transylvania, where the best farm work is usually done by Germans or Magyars. This Slovak development has occurred in the face of direct opposition from the Magyar official class. The work of the Slovaks is also of greater value than that of either Croat or Serb in the south-west.

DR. A. J. CHALMERS and Wäinö Pekkola have published in the *Annals of Trop. Med. and Parasitology* (vol. xi., No. 3, pp. 213–64, two plates) a memoir on *Chilomastix mesnili*, a flagellate protozoon common in the intestine of man. A detailed account is given of the history of our knowledge of this organism, and of the morphology, fission, cyst formation, and systematic position. The authors believe that an infection can persist for years, but that when the organism increases in numbers it becomes pathogenic and causes diarrhœa. After a consideration of the known species of Chilomastix with the view of finding whether any animal is a carrier, the authors conclude that man is the important carrier of *C. mesnili*, and that the infection spreads from man to man by means of the cysts.

IT is notorious that much more study has been devoted to the form than to the function of teeth. A recent paper entitled "Form and Function of Teeth: A Theory of Maximum Shear" (*Journ. of Anat.*, October, 1917), by Mr. D. Macintosh Shaw, of the Royal Dental Hospital, is particularly welcome, because it deals with the functional significance of dental cusps. Mr. Shaw has applied to the mechanism of mastication the "immense body of knowledge built up by engineers and mathematicians," and finds that the teeth are so shaped, set, and moved as to produce a maximum shearing stress on the material placed between their opposed blades. That the front, or incisor, teeth can act as shearing blades has been long acknowledged, but the application of this doctrine to the molar, or cheek, teeth is new. Mr. Shaw regards the outer, or buccal, cusps as shearing blades; the function of the inner, or lingual, cusps is quite different: they serve to retain the food in position so that it may be subjected to the shearing force applied through the outer cusps. He also points out how necessary canine teeth are to serve as guiding structures; canine teeth, by their sliding contact, ensure the alignment of the opposing shearing edges of the molar and premolar teeth. The crowns of the teeth are shaped so as to protect the gums from the impact of food during mastication.

DURING the past winter several distinguished medical men have been invited to Edinburgh to discuss the best means of improving the teaching of medical subjects. It was a fortunate choice that led to the invitation of Prof. Elliot Smith, of Manchester, to discuss "The Teaching of Anatomy." His lecture may be read in full (*Edinburgh Medical Journal*, March); here we need only summarise his chief conclusions. In his opinion "anatomy should be regarded as an integral and intimately co-ordinated part of the whole medical course, and it should be the business of the teacher to give expression to this broad view in his teaching." The anatomy taught must refer to the *living*, not to the *dead*, body. Dissection is essential for the proper training of the medical student. "The primary value of dissection to the student is to enable him to find his way about the body. Much of the knowledge he acquired is of a subconscious nature, but is none the less real on that account. By a limited experience I have learned to find my way from Princes Street to the University, but I cannot name a single street or landmark, nor give more than the vaguest description of the route, yet I have the essential knowledge which meets my needs. The vital knowledge of anatomy is of a similar nature." Prof. Elliot Smith regards the delivery of a systematic course of lectures on anatomy as indefensible, and the teaching of osteology as a separate subject as a "wicked and sterilising farce." The ideal course of instruction which he maps out aims at making anatomy the real basis of medical education.

THE Mediterranean fruit-fly (*Ceratitis capitata*, Wied.), which has been introduced from Australia into Hawaii, where it has caused "a serious and permanent check upon horticultural pursuits," is described at length by E. A. Back and C. E. Pemberton in a recent Bulletin (No. 536) of the U.S. Department of Agriculture. The relation of the fly to various tropical fruits is discussed in detail.

BRITISH students of forest entomology may welcome the recent publication of two papers—one, by J. W. Munro, on Hylastes, a rather neglected genus of bark-beetles (Proc. R. Phys. Soc. Edinb., vol. xx., part 3, 1917), and the other on the Chermes of spruce and larch, by H. M. Steven (Proc. R. Soc. Edinb., vol. xxxvii., part 3, 1917). The latter will be especially useful as a guide to much recent Continental literature on a group with many bionomic problems.

PROF. D'ARCY THOMPSON, in the *Scottish Naturalist* for March, continues his analysis of the scarcer fishes of the Aberdeen market. In this article he passes in review the occurrences of the sturgeon, sea-bream, deal-fish, and red-mullet. The sturgeon, he shows, is most abundant off our coasts in the spring and early summer, when it is proceeding towards, or preparing to ascend, the rivers to spawn. The English records, he remarks, show a tendency to cluster round about the river mouths. "The Severn is a well-known haunt of this fish, and it would in all probability breed there if protected. All our records for that river are for April

and May." Having regard to the importance of the sturgeon as a "food-fish," it would seem well worth while to afford the protection suggested by Prof. D'Arcy Thompson in this brief but valuable survey.

A VERY welcome insight into the life-history of the little penguin (*Eudyptula minor*) is afforded us by Dr. Brooke Nicholls in the *Emu*—the official organ of the Royal Australasian Ornithologists' Union—for January. Dr. Nicholls's shrewd observations have added much to our knowledge of the habits of these nocturnal birds. He has also told us much in regard to their food, moulting, the coloration of the soft parts, and the differences between the sexes, which are closely alike. His observations were made on Philip Island and neighbouring stacks. He comes to the conclusion, in spite of statements to the contrary, that there is but one species of little penguin on Philip Island, and expresses regret that these birds are "not found upon the list of our protected birds." The need for this step, he points out, is urgent, since they are now threatened by increasing settlement, and, besides, are largely used as bait by fishermen for their lobster-pots.

THE special Committee appointed by the Board of Agriculture, Trinidad, to inquire into the present position and prospects of rubber cultivation in the island has recently published its report in the Bulletin of the Department of Agriculture, vol. xvi., part 3. The report is a very interesting and valuable document, tracing the history of the industry from the year 1876, when two plants of *Hevea brasiliensis*, the Para rubber, were sent from Kew to Trinidad. The report is based on returns sent in from estates, but as several replies have not yet been received the total acreage under rubber cannot be given. From the returns received there are found to be 130,593 trees of Hevea, 81,975 of Castilloa, and 45,000 of Funtumia. The return for Castilloa should be much higher, as owing to the highly favourable views entertained as to this plant it was very largely planted in the colony. Experience has shown, however, that this Central American rubber tree is far inferior in every way to Para rubber as a plantation tree, and much of the work done in Trinidad must be regarded as a failure. On many estates Castilloa has now been removed, and a good deal of rubber land is derelict. The Committee points out that there is a good deal of land in Trinidad suitable for Hevea cultivation, and the report indicates clearly the proper lines on which planting should be undertaken and the returns which may be anticipated. The report ends with a summary of recommendations, in which the Committee states that, while cacao, sugar, and coconuts hold first place, Hevea should certainly rank in the front line of the secondary industries, such as limes, rice, and coffee. It is also pointed out that coffee may be interplanted with Hevea. Two important recommendations relate to the need for co-operation among rubber growers, and the formation of a Rubber Planters' Association, either on lines similar to those of, or in amalgamation with, the present Cocoa Planters' Association.

THE Advisory Council of Science and Industry of the Commonwealth of Australia has recently issued a bulletin upon "The Factors Influencing Gold Deposition in the Bendigo Goldfield." This goldfield is famous for the very exceptional character of its reefs of auriferous quartz, which are either bedded reefs, subdivided into saddle reefs, trough reefs, and leg reefs, or fault reefs or spurs. A large number of data concerning these reefs has been collected, but the inferences that can be drawn from these have not, so far, proved very helpful to the prospector. It is pointed out that the various dykes are geologically younger than the quartz reefs, and can have played no part in their origin, which is probably to be referred to the intrusion of the granodiorite in Lower Devonian times. Mineral solutions connected with this intrusion have been injected under pressure and have produced the reefs, in the case of saddle reefs mainly by the filling of fissures, in the case of the other types of deposit, mainly by replacement. The gold in the reefs is principally concentrated on the walls, and its distribution is never uniform along the reefs. Whilst "the replacement origin of the reefs provides a possible explanation for the gold shoots," it has to be admitted that "some additional factors, at present unknown or only guessed at, must influence the localisation of the shoots"; in other words, science has not yet progressed far beyond the old Cornishman's "Where she be, there she be"!

A NOVEL method of investigating the variation of the germicidal action of ultra-violet light with wave-length has recently been described in the Proceedings of the Royal Society, series B, vol. xc., by Drs. C. H. Browning and S. Russ. The method consists in photographing the ultra-violet spectrum on plates covered with a film of gelatine or agar-agar inoculated with micro-organisms instead of on an ordinary photographic plate. After suitable exposure these plates are incubated, and the action of the radiation is thereby rendered visible; those parts affected by the radiation remain transparent, while the remaining parts become opaque owing to the copious growth of the organisms which were not destroyed by the action of the rays. The region of activity of the radiation is between the wave-lengths 2960 and 2100 Å.U., with a maximum in the region 2800 to 2540 Å.U.; the rays are, however, easily absorbed by 0·1 mm. of skin, so that this type of radiation can only be effectual in dealing with organisms on the surface of a wound. The range of susceptibility varies slightly for different organisms, but not sufficiently so to provide a means of differentiating between several kinds.

AN account of the optical stores captured from the enemy, which were exhibited and described to the Optical Society in November by Lt.-Col. A. C. Williams, is given in the November issue of the Transactions of the society. The collection is fairly representative, and includes range-finders, directors for field and heavy artillery, dual sights, clinometers, sighting arcs, stereoscopic telescopes, periscopes, and sighting telescopes for machine-guns. Col. Williams pointed out how they all showed evidence of careful design and high-class workmanship, how lacquer had been discarded in favour of a tough, well-stoved enamel, and how in many cases the instruments had been painted after completion in order to cover all screws and render the instruments waterproof. Single complex prisms have been substituted for double reflecting prisms in order to diminish the loss of light and to facilitate adjustment. The balsaming of prisms together was well done, and the balsam very hard. From the discussion which followed the exhibition it appeared that while there was no new principle involved in the instruments captured, the working out of the details showed evidence of great care, and would repay study on the part of British instrument-makers. The instruments may be examined by permission of Prof. F. J. Cheshire, Imperial College of Science, South Kensington.

A LONG paper by Prof. Palazzo, chief of the Italian Meteorological Service, discussing magnetic observations taken at Theodosia, in the Crimea, between August 17 and 28, 1914, appears in the *Memorie della Società degli Spettroscopisti Italiani* (vol. vi., 1917).

The object of the observations was to obtain data for August 21, the date of a solar eclipse, which was total at Theodosia, and for comparison data from some adjacent days. The records were derived with the aid of a magnetograph of the Mascart type, which is fully described and illustrated by photographs. The curves were read at five-minute intervals for some hours during the time of the eclipse, and the tabulated results for declination, horizontal force, and vertical force are compared with the corresponding mean results from the adjacent days. The data are exhibited graphically in curves, with corresponding data from De Bilt (Netherlands), Rude Skov (Denmark), Seddin (Germany), and Ekaterinburg (Russia). In the case of horizontal and vertical force, it is shown that some movements, which might not unnaturally be associated with the eclipse if the Central European records only had been available, must be assigned to some other cause, but Prof. Palazzo is disposed to associate some of the declination phenomena with the eclipse. There are a good many references to earlier work on the subject.

PROF. A. RIGHI has published a second memoir (*R. Accademia delle Scienze dell' Instituto di Bologna*, November 25, 1917) dealing with the ionisation produced by X-rays in a magnetic field. In the first part of the paper Prof. Righi discusses the question raised in these columns (NATURE, vol. c., p.32, p. 224, 1917) of the possibility of explaining the experimental results as to the increase of current by taking into account the oblique, and therefore longer, paths of the ions under the joint actions of the two fields. He points out that the kinetic energy of an electron (or of an ion) depends only on the electric field and on the projection of the path on the direction of the said field, and is not affected by the existence of the magnetic field. Prof. Righi's own view of magneto-ionisation is that an electron in motion can ionise a gaseous atom by collision, when this is in a magnetic field, even if the kinetic energy of the electron does not reach that minimum which is necessary when the field does not exist. On this theory it is possible to explain not only the increase in current due to the magnetic field, but also the fact that when the field is made sufficiently strong there is an inversion of the observed effect, the current diminishing instead of increasing. There are two causes at work, producing opposite effects: magneto-ionisation and the magnetic deviation or change in the paths of the particles. The former increases with the magnetic field, but reaches a limiting value; the latter increases indefinitely, and finally gets the upper hand. The paper contains an analytical discussion of the motion of an electron in a uniform electric field on which is superposed a perpendicular magnetic field, a problem previously considered by Sir J. J. Thomson ("Conduction of Electricity through Gases") and treated elegantly by a purely geometrical method by W. B. Morton (Phys. Soc. Proc., vol. xxi., p. 300, 1909). The last part of the paper gives an interesting account of new experiments carried out with an apparatus specially designed to test the existence of magneto-ionisation. Curves are given showing the relation between the current and the applied potential difference for various magnetic fields. These indicate an increase in the current when a magnetic field is applied, the increase being most marked when the potential difference exceeds a certain value depending on the strength of the magnetic field.

THE so-called "iminohydrins," or *iso*amides, were first prepared by Eschweiler in 1897, who gave them the general formula R.C(OH) : NH. They were afterwards (1901) investigated by Hantzsch, and given the dimolecular formula NH : CR.O.NH_2 : CR.OH. Dr. H. G. Rule has studied these compounds afresh, and gives an account of his results in the January issue of the Journal of the Chemical Society. He shows that they are amidine salts of the general type R.C(NH_2) : NH,R.CO_2H, and that "glycolliminohydrin," the first of Eschweiler's preparations, is really glycollamidine glycollate,

$$OH.CH_2.C(NH_2) : NH,OH.CH_2.CO_2H.$$

The constitution of this and similar compounds is proved by its synthesis by the interaction of sodium glycollate and glycollamidine hydrochloride, this method of preparation giving a far better yield than Eschweiler's method of treating the imino-ether hydrochlorides with moist silver oxide. Besides the glycol compound methoxyacetamidine methoxyacetate, acetamidine acetate and phenylacetamidine phenylacetate were prepared, whilst mandelamidine mandelate was obtained by Dr. J. E. Mackenzie. Molecular weight determinations, by the cryoscopic method, of these compounds support the new theory of their constitution, on the assumption that they are almost completely ionised in solution. To explain the formation of these amidine salts by the action of water on the imino-ethers, Dr. Rule suggests that the latter first undergo autohydrolysis, forming ammonium salts of the corresponding acids, and that these then interact with the imino-ethers.

IN a paper on the possibilities of the ferro-concrete ship read by Major Maurice Denny at the Institution of Naval Architects on March 22, the author raises the interesting point of the permissible stress on the steel reinforcement under tension, without the risk of rupture occurring in the adjacent concrete. A usual figure taken in land structures is 16,000 lb. per sq. in. for the working tensile stress in the steel; with a modular ratio of 12·5 this would produce a tensile stress of about 1300 lb. per sq. in. in the neighbouring concrete—*i.e.* a stress sufficient to produce rupture of some sort. The matter is of serious importance in ship construction, owing to the necessity for maintaining watertightness. In the discussion on this paper—reported in *Engineering* for April 5—Mr. J. Foster King provided a long and valuable contribution, in the course of which reference was made to the same matter. Taking the elastic modulus of reinforced concrete to be the same as that of plain concrete—8 per cent. of that of steel—the permissible stress on the steel must not exceed 5400 lb. per sq. in. if the concrete is to remain unbroken. As reinforced concrete lost homogeneity under tensile stresses which exceed the breaking stress of the concrete by 45 per cent., the designed working stress on the concrete should be less than its own tensile strength, so as to leave such a margin between ordinary and extraordinary stresses as experience had forced upon shipbuilders. Experience of reinforced concrete had been derived from ratios of steel to concrete of about 1 per cent., and it seemed unreasonable to expect effective bond of steel and concrete when the ratio exceeds 8 per cent. Mr. King suggests experiments upon material exposed concurrently to tension and water pressure, in order to ascertain the point where steel and concrete cease to lend their properties to one another.

ERRATUM.—A correspondent points out that it was Pope Innocent VIII. who, in 1484, gave the sanction of the Church to the popular beliefs concerning witches referred to in NATURE of April 4 (p. 82), and not Pope Innocent VII., as there stated. The reference in Dr. Withington's article was correct, but was wrongly given by the reviewer.

OUR ASTRONOMICAL COLUMN.

SPECTRUM AND RADIAL VELOCITY OF N.G.C. 1068.—Further photographic observations of the spectrum of the spiral nebula N.G.C. 1068 (M77) have been made at Flagstaff by Dr. V. M. Slipher (Lowell Observatory Bulletin, No. 80). Among the photographs obtained was one taken with a two-prism spectrograph, which received a total exposure of thirty-five hours during five nights. Besides confirming the composite character of the spectrum and the high velocity previously recorded, this photograph shows that the bright hydrogen lines extend farther into the fainter parts of the nebula than do the two green nebular lines, and that both bright and dark lines are strongly inclined. The inclination is about 5°, and indicates a rotation about an axis through the shorter diameter of the nebula, the velocity of rotation being approximately 300 km. per sec. at 1′ from the nucleus. This is the highest rotational speed which has yet been recorded, and there is evidence that the inner part is turning into the arms of the spiral, like a winding spring, as in the case of other spirals in which rotation has been observed. A peculiar feature of the emission lines is that instead of appearing as simple images of the slit, they appear as small discs; pressure increasing towards the nucleus is a possible explanation. The recent photographs consistently indicate the enormous receding velocity of 1120 km. per sec. for this nebula.

CHANGES IN THE SPECTRUM OF γ ARGÛS.—A preliminary account of some photographs of the spectrum of γ Argûs, which were taken at Cordoba with a 5-in. objective prism attached to the astrographic equatorial, has been given by Dr. C. D. Perrine (*Astrophysical Journal*, vol. xlvii., p. 52). The star is well known as being the brightest example of the Wolf-Rayet type, and the new observations appear to show comparatively rapid fluctuations in the structure of $H\beta$, which is doubly reversed. While the bright band was most intense on the red side of the weak absorption line on plates taken in August, 1917, it was brightest on the violet border during November. Variations in the widths of the bright bands in the region λ450 are also indicated. From a comparison with earlier records by other observers, it is concluded that considerable changes have occurred during the last twenty years. Dr. Perrine has further noted a broad, faint brightening in the region of the chief nebular line, and a suspected brightening in the region of the second nebular line; it may be suggested, however, that these are not the nebular lines at all, but the adjacent lines of helium, as previously photographed at Johannesburg by W. M. Worssell. The latter photographs, it may be recalled, gave no certain evidence of secular changes in the spectrum.

UNITED STATES NAVAL OBSERVATORY.—The report of the U.S. Naval Observatory for the year ending June 30, 1917, has been received. The routine observations were continued without intermission, including meridian work, observations of comets and occultations with the equatorials, observations of asteroids of special interest, and photographic investigations of the variation of latitude. The nautical instrument repair shop was especially active, and has continued to prove economical both in time and expense; more than 3000 instruments were put in order during the year. The observatory has continued to encourage suggestions and developments of methods and instruments for navigation, particularly for submarines and aircraft.

CORRECTIONS TO THE BONN DURCHMUSTERUNG.—Prof. F. Küstner, director of the Bonn Observatory, publishes in *Astronomische Nachrichten*, 4929, a useful list of corrections to the B.D., which all astronomers who use that work would do well to incorporate in their copies; some of the corrections refer to the star-positions, others to their magnitudes, others to the catalogue references, whilst a list is given of the stars in each volume that have been recognised as variables since the publication of the B.D. Considering the immense number of stars in the catalogue, and the small size of the instrument with which it was made, the list of errata is extremely short, and reflects the greatest credit on Argelander and his assistants.

AURORAL OBSERVATIONS IN THE ANTARCTIC.

THE paper referred to below[1] was prepared, the author tells us, in 1911, but printing was delayed as Sir E. Shackleton, the leader of the 1908 Antarctic Expedition, hoped to publish the scientific work as a complete series. That idea unfortunately had ultimately to be abandoned. The paper is a very valuable contribution to our knowledge of aurora, and its appearance, if late, is very welcome. The auroral log occupies pp. 155–200, and includes particulars of the times when aurora was observed, and various descriptive information as to the nature and trend of the aurora when it consisted of curtains, arcs, or streamers having a definite direction. A preface explains the scheme of observations, and the terms employed are dealt with in the introductory remarks. Sir Douglas considers the curtain the fundamental type of aurora. When streamers alone are visible, they represent in general, he thinks, "the visible parts of an invisible curtain."

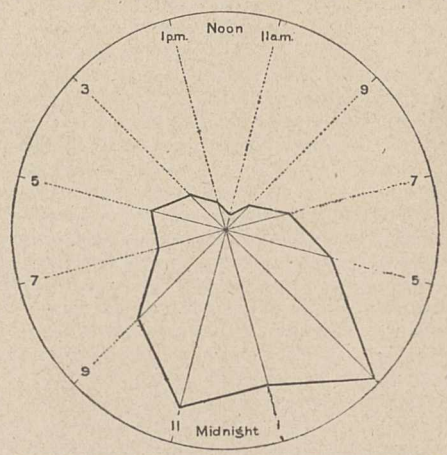

FIG. 1.—Daily time-distribution at Cape Royds. Graphical illustration of the relative frequency of auroral phenomena at different hours of the day. Radius vectors on scale such that 3/160th in. equals one hour's display.

A discussion of the phenomena is given in a summary, pp. 201–12. This is illustrated by a plate and by Figs. 1 and 2, here reproduced. Fig. 1 shows the diurnal variation in the frequency, and Fig. 2 the relative frequency with which aurora was observed in the different geographical directions. Only the observations of June, July, and August, 1908, were employed. The station being at 77° 32′ S. lat., the sun was continuously below the horizon during these months, so the disturbing effects of daylight or twilight were at a minimum. Observers in the northern hemisphere have usually, if not always, found the maximum frequency before midnight. At Cape Royds, as Fig. 1 shows, it appears near 3 a.m. This is in general agreement with the conclusions reached by Mr. L. C.

[1] "Auroral Observations at the Cape Royds Station, Antarctica. British Antarctic Expedition, 1908." By Sir Douglas Mawson. (From Trans. Roy. Soc. of S. Australia, vol. xl., 1916, pp. 151–212.)

Bernacchi, the physicist of the first Scott Antarctic Expedition, 1902–4. The result is of obvious importance in any theoretical explanation of aurora. The plate, which is not reproduced here, deals with the diurnal variation of the frequency of aurora as seen in different geographical directions. A maximum of frequency near 3 a.m. was observed in most directions, from N. through E. to S.E., but not in all directions, *e.g.* west.

Fig. 2 shows in the clearest way that aurora at Cape Royds was much more in evidence to the east than to the west. The magnetic needle at Cape Royds pointed about 30° east of south, *i.e.* the S. magnetic pole of the earth lay north of N.W. Sir Douglas seems to think that the greater frequency in the east may be due to that being the direction of the open sea, land areas prevailing to the west. It may mean, however, only that Cape Royds lies within the zone of maximum auroral frequency.

Some of the author's conclusions are very suggestive. "Making due allowance," he says (p. 206), "for the obscuring effect of daylight . . . auroral phenomena . . . at Cape Royds favour the portions of the sky which are (*a*) directed towards, (*b*) directed away from, the sun, having regard for the position of the

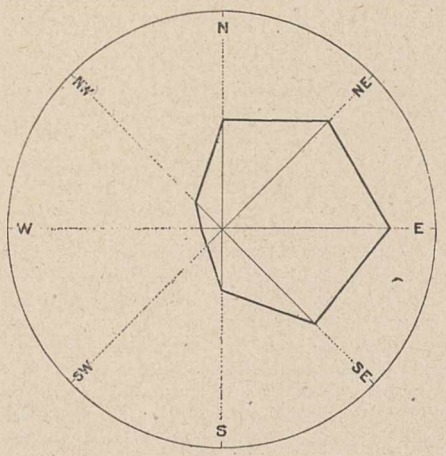

FIG. 2.—Distribution in azimuth of auroral phenomena at Cape Royds. Graphical illustration of the relative frequency of aurora seen at Cape Royds in relation to geographical direction. Radius vectors on scale such that 1/8oth in. equals one hour's display.

latter at the time of observation." Again, p. 207: "Auroral displays at Cape Royds are distinguished by the large proportion of curtains traversing the heavens in a linear, or nearly linear, direction. A remarkable daily sequence was observed in their trends. Always (on the average) they appeared directed approximately towards the sun. Thus, should a curtain persist for any length of time, it was noted always to exhibit a slow rotational movement counter-clockwise." On p. 209 we read: "After due consideration the following interpretation has been adopted: that at Cape Royds, in the case of steady, straight bands and curtains, they take up a position . . . approximately directed towards the sun." In June and July aurora was visible every day when clouds permitted, but the majority of the displays in these months "were much calmer and [more] localised than during the preceding or succeeding months."

In the daily logs there are frequent indications of the observer's impression that the aurora was at no very great height, and that its form was influenced by Mt. Erebus when it lay in that direction. Thus, of an aurora on May 23 it is said:—"As it extended past the cone of Mt. Erebus, there appeared a local bend, curving outwards from the mountain . . . the lower border appeared to show below the summit of the mountain." Of a curtain on May 31 it is said:—"It appeared to be very low over Mt. Erebus, and to touch the . . . crater. At one stage it ringed the crater." On June 21, we are told, "a strong luminous nebula appeared on the N. flanks of Mt. Erebus. . . . The luminous nebula stood out brightly between us and the slopes of Mt. Erebus."

In view of the apparent conflict between these observations and the measurements of auroral heights made of late years by Prof. Störmer and others in the Arctic, it is obviously desirable that the programme of the next Antarctic expedition should include the measurement of auroral heights after Prof. Störmer's method. A 25-km. base, such as Prof. Störmer used in his latest observations, is, however, naturally fitted only for measuring great heights, so it would be well to have, in addition to a long base, a much shorter one of 2 or 3 km., the two bases having desirably one station in common. Sir Douglas tells us that the records of the Australasian Antarctic Expedition of 1912–13 supply much fuller information as to aurora than those of the 1908 expedition, so we may look forward to an even more valuable contribution from his pen on a future occasion. C. CHREE.

THE ANNUAL CONFERENCE OF THE NATIONAL UNION OF TEACHERS.

THE conference of the National Union of Teachers, which was opened at Cambridge on Monday, April 1, gave a welcome opportunity for a declaration of policy on the part of this large and influential body on the question of the Education Bill now before Parliament. It is satisfactory to observe that the conference resisted all amendments to the Bill on the ground that it was desirable to present to the House of Commons a clear call in favour of the general principles embodied in the Bill, and to trust to the future for any desirable amendments in its provisions. It secures at least the abolition of half-time, mainly prevailing in the textile areas of Lancashire and Yorkshire, and of the labour certificate, which took the intelligent child from the schools at a premature age. It gives the further advantage of continued education, both general and special, within the working hours of young people from fourteen to eighteen years of age, by which means two and a half millions of adolescents will continue within the healthy influence of the school in preparation for life and in the right use of leisure, and so promote a higher standard of citizenship, and thus make fruitful the early training begun in the day schools.

In the course of her presidential address Miss Conway dwelt upon the extraordinary demand which would be made on the teaching profession, not only in meeting the requirements of the new Bill, but also in supplying the grievous loss entailed by the present and future exigencies of the war. Already some 20,000 teachers out of about 37,000 have been called up for service with the Army in the field, 1000 of whom have given their lives. Women, as in so many other spheres of labour, have been called upon to fill the places of men so withdrawn, but under onerous conditions of much larger classes in schools, often disorganised, and they have nobly and successfully responded. The adequate training of the teacher is admitted to be a matter of the most serious concern, but it cannot be expected that the profession will continue to attract gifted men and women to its service, especially that of women, upon whom the duty to a much larger extent in the future will inevitably fall, unless its status be raised, its prospects improved, its emoluments increased, and suitable retiring pensions

provided. The advent of women in the political sphere will of necessity open up other professional careers for women, the training for which will not be more onerous than that of the teacher, and in which the prospects will be more attractive and the remuneration in proportion to the skill employed without reference to sex. Equal pay for equal service found eloquent expression at the conference, but on a division was defeated by 16,717 votes, whereupon a referendum will be taken. Despite Mr. Fisher's declaration of minimum salaries, which gave a proportion of nine-tenths to women as compared with men, the tendency to a much larger differentiation, especially in London, is on the increase, the maximum of the women head-teachers in many cases in that area being actually 20*l.* below the minimum of the men head-teachers.

The poor remuneration of teachers is strikingly shown by a return of the Board of Education of November last, where it appeared that out of 36,827 certificated men teachers, 2639 received less than 100*l.* per annum, and out of 77,139 certificated women teachers, 32,314 received less than the foregoing sum. Until this matter receives drastic reform it is impossible to ensure a contented and happy body of teachers.

The provision of nursery schools, where children can have the advantage of trained nurses and medical advice, and which should be linked up with the neighbouring elementary schools, was warmly commended as tending to ensure a much better supply of healthy children. A strong plea was put forward for the employment of capable cultured women in the active work of the contemplated continuation classes, so as to give to the girls a wise training in matters relating to their responsibilities as citizens and in the duties of domestic life, and no less was it urged that men of broad sympathy and of wide academic and professional training should be placed in charge of the boys. Teachers are anxiously awaiting the enactment of the Fisher Bill, which gives effect to many of their most ardent aspirations cherished during many years. The conference adopted a scheme for the direct representation of teachers on all education committees.

THE INDIGO INDUSTRY.

IN the *Agricultural Journal for India* (vol. xiii., part i., January, 1918) Mr. W. A. Davis, indigo research chemist to the Government of India, gives a review of the present position and future prospects of the natural indigo industry. In 1896, the year before the large-scale introduction of synthetic indigo, the combined exports of natural indigo from India and Java had a value of more than 3¾ millions sterling, whilst very large additional quantities were also produced and consumed in India, China, and Japan. The value of the total world's market for indigo under pre-war conditions considerably exceeded five millions sterling, a value almost equal to that of all other artificial organic dyes put together.

The rapid displacement of the natural by the synthetic product is evidenced by the facts that whilst the exports of synthetic indigo from the German Customs district rose from 658 tons in 1895 to 16,354 tons in 1907, the exports of natural indigo from India fell in the same period from 9367 tons to 1755 tons, with a further decline to 547 tons in 1913–14. Nearly the whole of the last-named export consisted of the higher-grade Bihar indigo, the export of the lower-grade Madras indigo having practically ceased. Again, whereas in 1897 the price of natural indigo of better quality (60–70 per cent.) was 7*s.*–8*s.* per lb., the price in 1914 before the war had fallen to 3*s.* per lb. The number of employees engaged in indigo manufacture in India fell from 360,000 in 1880 to 30,795 in 1911.

The first effect of the war was to cause an enormous increase in the price of natural indigo, and steps were immediately taken to increase the cultivation, with the result that in 1916–17 the total area under indigo in India was three and a half times the average of the preceding five years, although still less than one-half the area of 1895. The statistics of the exports of synthetic indigo in the years before the war reveal the fact that China and Japan together took three-fifths of the whole production. It is very clear from these data that the prosperity of the Indian industry and its ability to compete with the synthetic product in the future will depend largely upon its being able to supply these Eastern markets. Mr. Davis is hopeful that the Indian industry will be able at least to put up a good fight, and he proposes in a future article to outline the measures of improvement which must be effected if success is to be achieved.

A FRENCH SOCIETY OF CHEMICAL INDUSTRY.

THE issue of the *Revue Scientifique* for March 2–9 contains an interesting account of the aims and organisation of La Société de Chimie Industrielle, which has been established in France with the object of promoting and consolidating the development of the chemical industries of the country. The formation of a society similar in character to our own Society of Chemical Industry had been under consideration before the war; the circumstances of French chemical industries during the period of the war have now given the necessary stimulus for the realisation of the project, with the full co-operation and support of the leading chemists, chemical engineers, and manufacturers of the country. The outstanding objects of the new society are to aid the development of all branches of chemical industry, to co-ordinate the labours of all workers in pure and applied chemistry for their mutual advantage, and to assist the progress of industrial chemistry not only by means of science, but also from the economic and commercial points of view. These objects, which are planned so as not to interfere with or overlap the work or publications of existing societies, are to be developed by the publication of a *Review*, the first number of which has already been issued, by the holding of conferences, exhibitions, and competitions, and by the establishment of a bureau of industrial chemistry and of a central library. The president of the society is M. Paul Kestner; Profs. A. Haller and H. Le Chatelier are hon. presidents; MM. F. Binder, Duchemin, Matignon, and Staub vice-presidents; M. Jean Gerard general secretary; and Comte G. de Germiny treasurer.

The formation of this new society shows that in France, as in this country, the national importance of the services of chemical science needs far fuller recognition than in the past, especially in the direction of effecting that co-operation between science and industry which is fundamental for the economic development of scientific discoveries. La Société de Chimie Industrielle should do much to secure this co-operation, and we cordially wish its promoters every success in the wide and well-chosen field of their proposed activities.

CIVIL SERVICE ESTIMATES FOR SCIENCE AND EDUCATION.

THE Parliamentary Paper dealing with Class IV. of the Estimates for Civil Services for the year ending March 31, 1919, has now been issued. The subjoined summary gives the main items of the estimated expenditure for the year, with the details relating to scientific investigation and higher education. Reference may be made to a few particular points in these Estimates. A special grant of 30,000*l.* is included

in aid of certain universities, colleges, medical schools, etc., to meet loss of income arising from circumstances of war. It may be remembered that the Estimates for 1915–16 included a similar grant of 145,000*l.* for the same purpose. The grant for the National Physical Laboratory has been transferred from the head of the Royal Society, under which it formerly appeared, to that of the Department of Scientific and Industrial Research. It amounts to 89,750*l.*, being an increase of 64,475*l.* upon the grant for 1917–18. The State receives, however, for testing fees and other services rendered by the laboratory the sum of 11,250*l.*, and 3000*l.* as contributions from co-operating bodies. The new Fuel Research Station has a grant of 7000*l.*, of which 4000*l.* is required for salaries and wages, and 3000*l.* for apparatus, materials, etc. The grants made by the Department of Scientific and Industrial Research amount to 56,500*l.*, in comparison with 30,000*l.* in 1917–18. The salaries, wages, and allowances of the Department are estimated at 8900*l.*; and we notice that this estimate includes 500*l.* as fees to expert consultants.

The estimated grants for technical schools, etc., are 634,500*l.*, being an increase of 103,000*l.* on those of 1917–18, made up chiefly of 5000*l.* to technical schools, 7000*l.* to junior technical schools, 40,000*l.* to other schools and classes, and 50,000*l.* in supplementary grants. The grants to university institutions in respect of technological work are increased from 60,000*l.* to 65,000*l.* Most of the other grants remain the same as last year; the total of the whole Estimates under Education, Science, and Art is 25,529,228*l.*, which is a decrease of 690,803*l.* on the Estimates for 1917–18.

United Kingdom and England.

BOARD OF EDUCATION.

	£
Administration	216,103
Inspection and examination	218,560
Grants in respect of public elementary schools, etc.	15,924,138
Grants for training of teachers	422,200
Grants towards expenditure on secondary schools and pupil teachers and bursars, etc.	1,568,570
Grants towards expenditure on other aided institutions, schools, and classes, and on assistance in choice of employment	724,035
Imperial College of Science and Technology and Chelsea Physic Garden (grants in aid)	32,150
Royal College of Art	7,512
The Victoria and Albert Museum	62,153
Science Museum	13,435
Geological Museum	3,336
Geological Survey of Great Britain	15,006
Bethnal Green Museum	2,382
Gross total	19,209,580
Deduct—	
Appropriations in aid[1]	2,875
Net total	19,206,705
Net increase[2]	190,925

[1] In addition, receipts from sale of catalogues and other publications supplied by the Stationery Office, estimated at 400*l.*, will be paid to the Vote for Stationery and Printing.

[2] Total original Net Estimates, 1917–18 ... £15,159,780
Add Supplementary Estimate ... 3,856,000
£19,015,780

BRITISH MUSEUM.

	£
British Museum[3]	90,022
Natural History Museum	44,045
Gross total	134,067
Deduct—	
Appropriations in aid	7,925
Net total	126,142
Net decrease	2,453

IMPERIAL WAR MUSEUM.

Salaries, expenses, purchases of exhibits, etc. (grant in aid)	19,000
Net decrease	2,000

SCIENTIFIC INVESTIGATION,[4] ETC.

	£
Royal Society	6,000
Meteorological Office	22,500
Royal Geographical Society	1,250
Marine Biological Association of the United Kingdom	500
Royal Society of Edinburgh	600
Scottish Meteorological Society	100
Royal Irish Academy	1,600
Royal Irish Academy of Music	300
Royal Zoological Society of Ireland	500
Royal Hibernian Academy	300
British School of Athens[5]	—
British School at Rome	500
Royal Scottish Geographical Society	200
National Library of Wales	3,200
National Museum of Wales	7,500
Solar Physics Observatory	3,000
School of Oriental Studies	4,000
North Sea Fisheries Investigation[5]	—
Royal College of Surgeons in Ireland	500
Edinburgh Observatory	1,691
Total	54,241
Net decrease	20,490

SCIENTIFIC AND INDUSTRIAL RESEARCH.

	£
Salaries, wages, and allowances	8,900
Travelling and incidental expenses	1,200
Grants for investigation and research[6]	56,500
Fuel Research Station	7,000
Scientific and industrial research (grant in aid)	—
National Physical Laboratory	89,750
Gross total	163,350
Deduct—	
Appropriations in aid	15,000
Net decrease	914,975

[3] The British Museum (Bloomsbury) (except the reading-room, etc.) and part of the Natural History Museum, South Kensington, are closed during the war.

[4] The expenditure out of these grants in aid, with the exception of that for the Meteorological Office, will not be accounted for to the Comptroller and Auditor-General, nor will any unexpended balances of the sums issued be surrendered by the payees at the close of the financial year. In the case of the Meteorological Office the expenditure, though not liable to surrender of balance, will be subject to audit by the Comptroller and Auditor-General.

[5] These grants are suspended owing to the war.

[6] These grants will be distributed by a Committee of the Privy Council, on the recommendation of an Advisory Council, to promote the development of scientific and industrial research in the United Kingdom, and will be subject to such conditions as the committee may think necessary.

UNIVERSITIES AND COLLEGES.

Universities and Colleges, Great Britain.	£
University of London	8,000
Victoria University of Manchester	2,000
University of Birmingham	2,000
University of Wales	4,000
University of Liverpool	2,000
Leeds University	2,000
Sheffield University	2,000
Bristol University	2,000
Durham University	2,000
Scottish Universities	84,000
Colleges, Great Britain	150,000
University Colleges, Wales	12,000
Welsh University and Colleges: Additional grant	20,500
Total for Universities and Colleges...	292,500

Intermediate Education, Wales.	£
Examination and inspection, grant in aid...	1,200
Schools	28,000
Total for Intermediate Education, Wales	29,200
Grand total	321,700
Increase	500

Scotland.

PUBLIC EDUCATION.

	£
Administration	30,082
Inspection	43,357
Elementary schools	2,614,914
Continuation classes and secondary schools	214,500
Royal Scottish Museum, Edinburgh ...	9,876
Training of teachers	127,245
Examination of accounts	1,571
Total	3,041,545
Net decrease	2,076

Ireland.

PUBLIC EDUCATION.

	£
Administration	34,553
Inspection	51,713
Training colleges	67,967
Model schools	4,831
National schools	1,963,830
Manual and practical instruction	13,767
Teachers' residences	6,550
Superannuation, etc., of teachers (grants in aid)	60,593
Gross total	2,203,804
Deduct—	
Appropriations in aid	700
Net total	2,203,104
Net increase	1,086

INTERMEDIATE EDUCATION.

	£
Towards salaries of teachers, including cost of administration	40,000
Intermediate Education	50,000
Total	90,000

SCIENCE AND ART.

	£
Institutions of science and art	48,612
Schools of science and art, etc.	114,050
Geological Survey	1,801
Examinations in courses of instruction conducted in technical schools	700
Gross total	165,163
Deduct—	
Appropriations in aid	1,770
Net total	163,393

UNIVERSITIES AND COLLEGES.

Grants—	£
Queen's University of Belfast	18,000
University College, Dublin	32,000
University College, Cork	20,000
University College, Galway	12,000
National University of Ireland and University College, Dublin	12,350
Additional grant to University College, Galway	2,000
Total	96,350

SUMMARY.

United Kingdom and England.	£
Board of Education	19,206,705
British Museum	126,142
National Gallery	11,639
National Portrait Gallery	3,779
Wallace Collection	4,012
London Museum	2,300
Imperial War Museum	19,000
Scientific Investigation, etc.	54,241
Department of Scientific and Industrial Research	148,350
Universities and Colleges, Great Britain, and Intermediate Education, Wales ...	321,700
Universities, etc., Special Grants	30,000
Scotland.	
Public Education	3,041,545
National Galleries	4,283
Ireland.	
Public Education	2,203,104
Intermediate Education (Ireland)	90,000
Endowed Schools Commissioners	855
National Gallery	1,830
Science and Art	163,393
Universities and Colleges	96,350
Total	25,529,228
Net decrease	690,803

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is stated in *Science* that the Carnegie Corporation has presented McGill University with 200,000*l.* in recognition of the University's "devoted service and sacrifice towards Canada's part in the war."

THE sum of 4000*l.* has been given by Mr. F. W. Chance to the Carlisle Education Committee for the establishment of a laboratory and lecture-room for chemistry and physics. An income of 600*l.* a year is assured for five years. The gift is intended as a memorial to the late Capt. A. F. Chance.

MR. GEORGE MATTHAI, of Emmanuel College, Cambridge, who for three years held the MacKinnon studentship (on the biological side) of the Royal Society, has been appointed by the Secretary of State for India to the Indian Educational Service as professor of zoology, Lahore, Punjab, India.

THE Markham Skerritt memorial prize of the University of Bristol is awarded to the medical member of the University of Bristol who has in the previous three years published the best original work in any branch of medical science. The consideration of this year's award will be given by the medical board of the University on May 3.

NOTICE is given of the impending award of the Lindley studentship in physiology of the University of London. The studentship is of the value of 100*l.*, and awarded every third year. Statements of the qualifications of intending candidates and particulars of their proposed modes of research must reach the academic registrar of the University by April 30. Applications for grants from the Dixon fund must be received not later than the first post on May 15.

AMONG the lectures arranged at University College, Gower Street, W.C.1, for the third term of the current session, and announced in the *London University Gazette*, are the following:—A course on "Some Biological Problems of To-day" includes lectures beginning at 5 p.m.: on May 13, by Dr. H. M. Vernon, on industrial efficiency and fatigue; on May 27, by Prof. F. W. Oliver, on substitution of raw materials; on June 3, by Dr. R. C. McLean, on the anaerobic treatment of wounds; and on June 10, by Prof. H. R. Kenwood, on fresh air and efficiency. On May 2, at 2.30 p.m., Prof. W. M. Flinders Petrie gives the first lecture of a course on the "Objects of Daily Life." The lectures are open to the public without fee.

THE new South African University of Cape Town was inaugurated on April 2. The Prince of Wales has accepted the Chancellorship, and sent an appropriate message wishing success to the new venture. As has been recorded in these columns already, three Acts were passed by the Union of South Africa in 1916 constituting and establishing three universities in the Union. The University of the Cape of Good Hope, together with certain institutions, was by one of these Acts incorporated in a federal University; a second Act provides that the Victoria College, Stellenbosch, in the Cape of Good Hope, shall be incorporated as a University; and a third Act similarly incorporates South African College, Cape Town, as a University. As a result of these Acts, the University of the Cape of Good Hope becomes the University of South Africa, with its administrative seat at Pretoria, and it has six constituent colleges. The Victoria College, Stellenbosch, becomes the University of Stellenbosch, with its seat in the division of Stellenbosch, in the province of the Cape of Good Hope. The South African College becomes the University of Cape Town, and its seat is to be upon the Groote Schuur estate in the Cape Division of the Cape of Good Hope. The *Times* correspondent at Cape Town states that at the inauguration of this University stimulating speeches were delivered by Lord Buxton, in his double capacity of Governor-General of the Union and visitor of the new University, Mr. Malan, Minister of Education, and the Principal, Prof. J. C. Beattie.

PROF. R. WALLACE, of the Department of Agriculture in the University of Edinburgh, has addressed a long open letter to the Prime Minister "urging *postponement* until after the war, as well as the effective *recasting*, of the English and Scottish *Education Bills* —legislation dangerous to the stability of the Empire and subversive of the soundest canons of education." It would have been a more gracious act had Prof. Wallace addressed himself to the respective heads of the Departments for Education of England and Scotland, and especially to Mr. Fisher, who has shown his complete familiarity with questions of education, and has been at such pains to make clear the principles upon which all sound education should be based and the means whereby they are to be realised. It would be well for Prof. Wallace to turn his attention to the preface written by Mr. Fisher by way of introduction to his educational reform speeches, wherein he says that "many people have a very limited faith in the value of education. They are prepared to believe that it is good for well-to-do people—for the aristocracy of the human race, upon whom the task of intellectual leadership is devolved. . . . They remember their own schooldays, and . . . reflect that schooling did not help them, so far as they can remember, to earn a single shilling, and so they think and talk against education, and, if they are very silly, write books against it." Prof. Wallace, with all his profession of intimate knowledge of the 85 per cent. of the population and its real needs, cannot ignore the unanimous resolve of the great body of the elementary-school teachers to give the fullest support to the Education Bill, since they are in the main drawn from the same class as their pupils, and must have actual experience of their needs. They are convinced that the true policy is "to put the *whole* child to school," and its solution is not to be found "in relays of children [who] should follow each other during the working hours of the day to maintain a continuous supply of labour," nor, if the child "is to be a competent attendant on either cattle or sheep," he "must grow up with them and begin to know and understand them before he is ten," as Prof. Wallace demands.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, March 20.—Mr. G. W. Lamplugh, president, in the chair.—Dr. W. F. **Smeeth**: The geology of Southern India, with particular reference to the Archæan rocks of the Mysore State. The geological formations of Southern India consist largely of a highly folded and foliated complex of Archæan gneisses and schists, followed by patches of pre-Cambrian slates, limestones, and quartzites; with these are associated basic lava-flows and ferruginous jaspers. The remaining formations consist of remnants of the Gondwana Beds (Coal Measures of Permo-Carboniferous age), a few patches of Cretaceous rocks, some Tertiary and Pleistocene deposits, and recent sands and alluvium, all situated along the coastal margins of the Peninsula. The scanty post-Archæan record of Southern India was contrasted with the formations of Northern India which record oft-repeated movements culminating in the rise of the Himalaya in Tertiary times and accompanied by igneous activity on a gigantic scale. The history of the various views which have been held concerning the Archæan complex were reviewed. In 1913 Holland produced a classification of the pre-Cambrian rocks of India which exhibits a remarkable parallelism with that given by Lawson (1913) for the pre-Cambrian of Canada. The work of the Mysore Geological Survey eliminated the fundamental gneissic complex, and showed that within the area of the Mysore State the oldest rocks were the Dhárwár system, which had been intruded into by at least four successive granite-gneisses. The Mysore Archæan succession is either incomplete, or does not fit in with the classifications of Holland and Lawson. Holland's classification dealt

with a wider area than Southern India, and the essential problem appeared to be whether his Bundelkhand gneiss (Laurentian) and the Bengal gneisses (Keewatin) were older than, and unconformable to, the Dhárwár system, or whether they were post-Dhárwár eruptives corresponding with portions of the Mysore gneissic complex. On lithological grounds the Dhárwár system is divided into an Upper and a Lower Division. The former is composed largely of basic flows and sills with their schistose representatives. The Lower Division is composed of dark hornblendic epidiorites and schists, which are distinguishable from the greenstones of the Upper Division by their dark colour and practical absence of chlorite. Brief reference was made to the autoclastic conglomerates usually associated with intrusions of the Champion Gneiss, to the intrusive character of some of the quartzites or quartz-schists, and to the evidence that the limestones are due to metasomatic replacement of other rocks by carbonates of lime and magnesia. The Dhárwár schists of Mysore contain a widely extended series of banded quartz iron-ore rocks, very similar to those of the Lake Superior district.

BOOKS RECEIVED.

Our Vegetable Plot. A Year's Record. By S. Graveson. (London: Headley Bros., Ltd.) Price 7*d.* net.

Radiography and Radio-Therapeutics. By Dr. R. Knox. Part ii., Radio-Therapeutics. Pp. x+385–606. (London: A. and C. Black, Ltd.) Price 15*s.* net.

Married Love. By Dr. M. C. Stopes and others. Pp. xvii+116. (London: A. C. Fifield.) 5*s.* net.

Frontiers. By C. B. Fawcett. Pp. 107. (Oxford: At the Clarendon Press.) 3*s.* net.

Cellulose. By Cross and Bevan. New impression, with a Supplement. Pp. xviii+348. (London: Longmans and Co.) 14*s.* net.

An X-Ray Atlas of the Skull. By A. A. R. Green. Pp. x+27. (London: Longmans and Co.) 10*s.* 6*d.* net.

Analytic Geometry and Calculus. By Prof. F. S. Woods and Prof. F. H. Bailey. Pp. xi+516. (London: Ginn and Co.) 10*s.* 6*d.* net.

Equipment for the Farm and the Farmstead. By Prof. H. C. Ramsower. Pp. xii+523. (London: Ginn and Co.) 10*s.* 6*d.* net.

Everyday Physics. By J. C. Packard. Pp. vi+136. (London: Ginn and Co.) 4*s.* 6*d.* net.

Theory of Maxima and Minima. By Prof. H. Hancock. Pp. xiv+193. (London: Ginn and Co.) 10*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, APRIL 11.

ROYAL INSTITUTION, at 3.—Experimental Psychology: Lt.-Col. C. S. Myers.

INSTITUTION OF ELECTRICAL ENGINEERS (Cancer Hospital, Fulham Road), at 6.—Joint Meeting with the Electrical Section of the Royal Society of Medicine.—Papers on Medical Electricity.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—Presidential Address: Hugh F. Marriott.

OPTICAL SOCIETY (Imperial College of Science and Technology, South Kensington), at 8.—The Balsam Problem: J. W. French.

FRIDAY, APRIL 12.

ROYAL INSTITUTION, at 5.30.—Absorption and Phosphorescence: Prof. E. C. C. Baly.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Secular Acceleration of the Sun as Determined from Hipparchus' Equinox Observations; with a Note on Ptolemy's False Equinox: J. K. Fotheringham.—Differential Transit Observations: W. E. Cooke.—The Chromospheric and Coronal Spectrum (λ 6300–λ 7600) in the Total Solar Eclipse, 1911, April 28: Rev. A. L. Cortie.

SATURDAY, APRIL 13.

ROYAL INSTITUTION, at 3.—Musical Instruments Scientifically Considered: Prof. E. H. Barton.

MONDAY, APRIL 15.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Resection in Survey—The First Problem: G. T. McCaw.

ROYAL SOCIETY OF ARTS, at 4.30.—Military Explosives of To-day: J. Young.

TUESDAY, APRIL 16.

ROYAL STATISTICAL SOCIETY, at 5.15.

ILLUMINATING ENGINEERING SOCIETY, at 5.—Light and Vision: the Physiology of the Retina: Prof. W. M. Bayliss.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—Relation between Viscosity and the Chemical Constitution of Lubricating Oils: A. E. Dunstan and F. B. Thole.

WEDNESDAY, APRIL 17.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Variations of Underground Water-level near a Tidal River: E. G. Bilham.—Suggestions as to the Conditions Precedent to the Occurrence of Summer Thunderstorms, with Special Reference to that of June 14, 1914: J. Fairgrieve.

GEOLOGICAL SOCIETY, at 5.30.

ROYAL SOCIETY OF ARTS, at 4.30.—Agricultural Machinery: F. S Courtney.

THURSDAY, APRIL 18.

INSTITUTION OF MINING AND METALLURGY, at 5.30.

LINNEAN SOCIETY, at 5.—Narrative of the Percy Sladen Expedition Brazil in 1913, with Lantern-slides: Prof. J. P. Hill.

ROYAL INSTITUTION, at 3.—Present-day Applications of Experimental Psychology: Lt.-Col. C. S. Myers.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Overseas Distribution o Engineering Appliances: L. Andrews.

CHEMICAL SOCIETY, at 8.—Hugo Müller Lecture: The Old and the New Mineralogy: Sir Henry Miers.

ROYAL SOCIETY OF ARTS, at 4.30.—Water Power in India: A. Dickinson.

FRIDAY, APRIL 19.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.

ROYAL INSTITUTION, at 5.30.—The Use of Soap Films in Engineering: Major G. I. Taylor.

SATURDAY, APRIL 20.

ROYAL INSTITUTION, at 3.—Musical Instruments Scientifically Considere Prof. E. H. Barton.

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