THURSDAY, JUNE 29, 1916.

RESEARCH IN INDUSTRY AND THE FUTURE OF EDUCATION.

THE demand for a drastic review of the whole of our educational policy and methods, having regard to the results, grows apace. The events of the war have served to reveal in startling fashion our shortcomings in production, especially in the domain of the applied sciences, and notably in the extent to which, by reason of our neglect to train adequately those engaged in scientific industries, we have found ourselves almost slavishly dependent upon our chief industrial and commercial rival—with whom, alas! we are now engaged in deadly strife—for some of the most vital necessities of our industries. Of this regrettable fact the great textile industries of Lancashire and Yorkshire (so large a proportion of which are engaged in manufacture for export), many important departments of chemical and engineering enterprise, the manufacture of chemical and optical glass and endless other productions of service in medicine and in the arts of life, not to speak of the grave difficulties with which we have been confronted in the supply of high explosives, furnish abundant evidence.

Could it be shown that this failure on our part arises from some special advantages of climate or of natural resources possessed by Germany, it might be accepted as in the order of Nature and as a satisfactory, though regrettable, explanation, but the very reverse is the case; nor is it to be found in any lack of intellectual ability in the English child. The real solution is to be found in the more effective provision for the education of all classes, such as that prevailing in Germany, whether of the rank and file or of those intended to be the directors of industry or of commerce. Hence the provision in Germany of (1) a complete system of elementary education applying without compromise to the children of the industrial class up to the close of their thirteenth year and continued under specialised conditions, within the normal working time, for at least six to eight hours per week in continuation schools until the age of eighteen is reached; we, on the contrary, allow some two and a quarter millions of our youth between the ages of twelve and eighteen to cease entirely their attendance at school; (2) ample facilities for all forms of secondary education, covering, from the tenth year, six or nine years, and leading up, so far as the higher schools are concerned, direct to the universities and technical high schools, with a preparation on the part of the matriculated students far in excess of that which, generally speaking, obtains with us, since the average length of secondary-school life in England does not exceed three years. These facilities for general education are crowned by magnificent provision for scientific training in the universities and technical high schools, not to mention numerous special schools dealing exclusively with mining, agriculture, forestry, or with the textile or other industries.

The easy optimism of some of the speakers at the recent conference of the British Imperial Council of Commerce is somewhat disturbing in view of the actual facts as to the students in attendance at German technical high schools, excluding those in the universities, as compared with those in all British institutions.

It may be admitted at once that since 1902 there has been a great and gratifying increase in the number and efficiency of the institutions in Great Britain giving scientific and technical training, and in the number of students participating therein, but so, too, has been the advance in Germany. A useful and striking comparison may be found in the statistics collected by the Associ ation of Technical Institutions in 1902. Information was obtained from *ninety-nine* institutions in the United Kingdom, including all the universities, as to the number of day students of *fifteen* years of age and upwards engaged in scientific and technical studies, no matter what their character, and the figures supplied were compared with those obtained from *nine* German technical high schools, with results absolutely startling in their significance. In no case were the students in the German schools less than eighteen years of age, whilst of these almost the entire number presented certificates of attendance on a nine years' classical or modern course, and their ranges of study were confined in the main to civil and naval architecture, engineering and chemical subjects. The total number of such students was 12,422, whilst the immatriculated students numbered 3020, or a total of 15,442, including a large body of foreign students.

Contrast this with figures relating to the *ninety-nine* British institutions, including the universities (the German universities were not included), which showed 3873 enrolled of fifteen years of age and upwards taking many subjects not included in the German return. Of this number 2259 took engineering and 667 chemistry, including dyeing and metallurgy. The number of third-year matriculated students in the nine German schools was 2021, in all the English institutions 535; in the fourth year it was 1800 and 113 respectively (in the Charlottenburg school *alone* there were 477 third- and fourth-year students). To seek another comparison, there were in the

Massachusetts Institute of Technology in 1902 more than 1100 students of the average age of 18·2. It is childish to talk of "enemy students in British schools" when in one German technical high school alone, that of Karlsruhe, there were in 1902 283 foreign students, whilst it is well known that in the camp at Ruhleben a large number of interned men are young English students who had gone to Germany to complete their studies.[1]

It is gratifying to find that at the annual meeting of the Association of Education Committees held on June 8 the appeal for a comprehensive review of the whole educational work of the country at the hands of a Royal Commission or some equally authoritative body met with such significant support, nor can we read unmoved the appeal in the Educational Supplement of the *Times* for June or the strong demand in support of it of the Royal Society, the British Science Guild, and the Teachers' Guild. All through the country it is felt on the part of educationists, of men of science, and of the leaders of industry that important and speedy changes in our system and methods of education are imperative, not only in the interests of industry and commerce, but in all that makes for enlightenment and good government, and that nowhere is it more necessary than in the sphere of general education, if scientific research and its application to the nation's needs are to be made effective. We want "freedom, variety, and elasticity," with the minimum of routine control, and we must needs adopt such measures as will ensure the adequate education of all the children of the nation and the easy passage of the gifted to the highest facilities of learning the nation can offer.

THE MOULDING OF HUMANITY.

Civilisation and Climate. By Ellsworth Huntington. Pp. xii+333. (New Haven: Yale University Press; London: Oxford University Press, 1915.) Price 10*s.* 6*d.* net.

THE effect of climate on civilisation is a fascinating subject; there is something hazardous in trying to define either of them. Both have a chequered past, and to bring the two into relation, historically and therefore prospectively as well, is an elusive but exciting pursuit. Mr. Huntington states his own position thus (p. 269):—

"The two phases of our climatic hypothesis are now before us. In point of time, though not of presentation in this book, the first step was a study of the climate of the past. Ten years of work along this line have led to the hypothesis of pulsatory changes, and finally to the idea that the changes consist primarily of a shifting of the belt of storms. After this conclusion had been reached a wholly independent investigation of the effect of present climatic conditions upon human activity led to two conclusions, neither of which was anticipated. One was that under proper conditions a relatively high temperature is not particularly harmful provided it does not go to undue extremes. The other was that changes of temperature from day to day are of great importance. On the basis of these two conclusions it at once becomes evident that the stimulating effect of climates in the same latitude and having the same kind of seasonal changes may be very different. It also becomes clear that the distribution of civilisation at the present time closely resembles that of climatic energy. From this the next step is naturally back to our previous conclusion that changes of climate in the past have consisted largely of variations in the location of the storm belt. If this is so, evidently the amount of climatic stimulus must have varied correspondingly. Thus we are led to the final conclusion that, not only at present, but also in the past, no nation has risen to the highest grade of civilisation except in regions where the climatic stimulus is great. This statement sums up our entire hypothesis."

So far as the book is concerned with the study of the variations of climate in historic time or recent geological time, it is a *résumé* and continuation of previous work by the same author, and arrives at the conclusion that both in Europe and America "the location of storms shifts in harmony with variations in the activity of the sun"; and thus we are invited to consider climatic changes as fluctuating rather than steadily progressive. One point in this connection invites further consideration—that is, the ultimate fate in this world of the accumulations of blown sand. Are they in process of being cleared away? Do they fluctuate with sunspots, or are they increasing progressively, and will sand ultimately bury modern civilisation in spite of all efforts, as it did the Egyptian yesterday?

In the study of civilisation Mr. Huntington's book strikes out a new line. We have, first of all, measures of the activity and efficiencies of workers in relation to various elements of climate and to the seasonal and casual variations of weather, from which it appears that in determining efficiency the fluctuations of weather are more important than the uniformities of climate. These studies are not always quite easy to follow. When, for example, one thinks of the output of work in Connecticut in relation to temperature one might have in mind the temperature of the workshop or of the habitation, and only in the third place of the unmitigated open air which makes climate. Indeed, in another part of his book Mr. Huntington himself suggests that warm climates may hereafter be mitigated by special measures for cooling houses, and it seems reasonable to regard cold climates as already mitigated by artificial means.

[1] In 1911 the number of full-time day students in the universities of the United Kingdom was about 20,000, in comparison with 55,000 in German universities. In our technical institutions the day students were about 2000, compared with 16,000 in the German technical high schools, with no adequate comparison on our part in respect of age, attainments on entrance, or duration of study.

Next there is a bold attempt to estimate numerically the stage of civilisation reached by different states or nations. This has been done by circular letter to 214 gentlemen, inviting each to assign to every nation under heaven its place in civilisation based upon "its power of initiative, the capacity for formulating new ideas and for carrying them into effect, the power of self-control, high standards of honesty and morality, the power to lead and control other races, the capacity for disseminating ideas . . . high ideals, respect for law, inventiveness, ability to develop philosophical systems, stability and honesty of government, a highly developed system of education, the capacity to dominate the less civilised parts of the world, and the ability to carry out far-reaching enterprises." Having received replies from 138 of the 214 correspondents, and opinions from 54, maps of the distribution of civilisation are prepared which are in curious agreement with the distribution of stimulating climate as previously defined.

It is odd that in enumerating his factors of civilisation the author says nothing about wealth or capital; and yet the maps of distribution of civilisation suggest at once the distribution of wealth more than anything else. In pessimistic moments, having regard to what is happening on this side of the Atlantic and on the other, civilisation seems to be little else than the wealth necessary "to 'maxim' other people as a Christian ought to do." A big M seems appropriate to this side, the little m to the other. A stimulating climate without the wealth necessary to protect himself strikes one as a very poor outlook for primitive man. The power to use climate to advantage must be very much a question of accumulated wealth. One can imagine a very stimulating health resort in Spitsbergen or Ross Island if it were preceded by sufficient preliminary outlay of capital and associated with some easy mode of producing wealth.

In presenting his case, therefore, Mr. Huntington has left a number of things for other people to say. The material adduced is solid or interesting, sometimes both, but the discussion is by no means closed. The book is, in fact, an invitation to others to take an interest in the subject, and the style, which is lively and unconstrained, makes the invitation still more attractive.

SALT AND ALKALI.

Manuals of Chemical Technology. VI., The Salt and Alkali Industry, including Potassium Salts and the Stassfurt Industry. By Dr. G. Martin, S. Smith, and F. Milsom. Pp. viii + 100. (London: Crosby Lockwood and Son, 1916.) Price 7*s.* 6*d.* net.

THIS book constitutes No. 6 of the series of "Manuals of Chemical Technology" which are being issued under the direction of Dr. Geoffrey Martin. In scope and general character it differs in no essential features from its predecessors. No matter what may be the relative importance of the subject, the various members of the series are substantially of the same size. They are published at a uniform price, and in return the purchaser obtains with each practically the same amount of printed matter. It is impossible, under such limitations, for the authors to ensure or for the reader to expect that the various subjects shall receive even approximately adequate treatment. We have already had occasion to point out this fact in noticing the preceding manual on sulphuric acid and sulphur products. What was stated in that case applies with even greater force to the present book.

The editor states that the industries dealt with in this manual are not only among the oldest, but they are also among the largest and most important of all chemical industries. "They form, so to speak, the basis or groundwork on which are erected most of the great trades of industrial countries." Yet all that we are informed concerning these large and most important of chemical industries, including illustrations, diagrams, numerical tables, statistical and bibliographical matter, is comprised within about ninety openly spaced octavo pages. It must be obvious, therefore, that the descriptive matter can only be of the very slightest character—such, in fact, as a précis-writer might attempt.

From the fragmentary and jejune nature of the editor's preface it would seem that the book is intended for the general reader. No practical man or student of technology needs to be told how a stoppage in the supplies of salt, and hence of soda ash and salt cake, by interfering with the manufacture of window glass would hamper the building trade. Indeed, apart from the bibliography and the statistical and tabular matter, there is very little in the book of value to the specialist or the student. With one exception, to be referred to hereafter, such a compilation might be put together in a few hours in a well-furnished library like that of the Patent Office by a fairly industrious person possessing bibliographical skill and the requisite *flair* for good "copy."

That the book has been compiled under some such conditions is obvious even after a very cursory examination. There are a want of balance and a lack of a sense of proportion in the arrangement and distribution of the material. Comparatively unimportant facts receive undue attention, whereas really vital matters are dismissed in a few words, even when they obtain any notice at all. The subject of the salt industry of the world—which should include descriptions of the various methods practised in England, Germany, France, Russia, Portugal, and America—occupies about a dozen pages. The manufacture of hydrochloric acid is dealt with in less than five pages. Salt-cake is disposed of in about the same space. A general survey of the sodium carbonate industry occupies less than three pages. An account of the Leblanc process, including diagrams and a slight reference to the treatment of alkali waste, is compressed within eight pages.

The one valuable feature of the work is a description of a form of the ammonia-soda process. This is evidently based upon expert knowledge,

and is both novel and interesting. It is the longest section in the book, occupying nearly one-third of the whole, and may be commended as being what the editor claims for it—the most authoritative and detailed account of the process which has yet appeared in the language.

A short account of the Stassfurt industry and of the extraction of potassium and magnesium salts, very slightly and imperfectly treated, concludes the volume.

A book of this kind may serve to show how dependent industry is upon science, and may possibly quicken the interest of the general reader in a question of which the national importance is now being forcibly brought home to us. But it is difficult to see what other useful purpose it fulfils. It certainly is not calculated to strengthen the position of any one of the branches of technological chemistry with which it professes to deal.

OPEN-AIR NATURAL HISTORY.

(1) *Rambles of a Canadian Naturalist.* By S. T. Wood. Pp. vii+247. (London: J. M. Dent and Sons, Ltd., 1916.) Price 6*s*.

(2) *The Life Story of an Otter.* By J. C. Tregarthen. New edition. Pp. xiii+188. (London: John Murray, 1915.) Price 2*s*. 6*d*.

(1) THE rambles of which Mr. S. T. Wood gives an account were pursued throughout the year, and their record makes a pleasant season-book. The studies express a blend of biological inquiry and poetic reflectiveness, and they represent an end, rather than a means, of nature-study. They put into words the joyous, intelligent appreciation which well-educated, normal human beings have, or should have, when they take country walks. "What is seen and heard—things revealed to the eye and ear—awaken a delighted interest, but our thoughts and fancies, stirred by what is partly revealed, have a deeper charm. Following these suburban rambles may yield the keen pleasure of observations verified. And, perhaps, in the wayward ramblings a community of fancy may be discovered more pleasant and more fraternal than the kindred joy of disclosing Nature's guarded secrets."

The author writes of the pitcher-plant and its interrelations, the early migrants and flowers, the renascence of spring, the honking of the wild-geese, the night-cries of the toads, the beauty of the dandelion, the midsummer birds, the life-cycle of the Promethea moth, the gorge below Niagara, the Great Northern Diver, the autumnal flocking, the haunt of the coot, some winter-visitors, and much more besides. We cannot say that we have found anything very remarkable in these essays, but we found each of them too short—which points to fine quality. They are altogether wholesome and beautiful, indirectly educative in the best sense.

Worthy of the highest praise are the characteristic colour illustrations—by Robert Holmes—of whip-poor-will, bloodroot, Promethea moth, lady's slipper, monarch butterfly, and winter's robin. There are also beautiful chapter-headings (of nature-study inspiration) by students of the Ontario College of Art. They are in fine harmony with the spirit of the book.

(2) Mr. J. C. Tregarthen's admirable "Life Story of an Otter" appears in a new edition, which deserves a wide welcome. With patience and sympathy he has been able to build up a coherent biography of a singularly elusive creature, which few naturalists know except in glimpses. His account of the education of the cubs, of the varied business of life, of the nomadism, of the combats of dog-otters, of the partnership of the pair, of the inextinguishable playfulness, and so on, is altogether admirable.

Mr. Tregarthen writes of what he has seen, his inferences are restrained, and his style suggests the open air. We do not share his enthusiasm for the otter-hunt, for which, however, he is prepared to give a reasoned defence, but we recognise the value of his first-hand observational natural history. There are some beautiful and interesting illustrations of the otter and its haunts.

OUR BOOKSHELF.

Penzance and the Land's End District. Edited by J. B. Cornish and J. A. D. Bridger. Pp. 128. (London: The Homeland Association, Ltd., n.d.) Price 6*d*. net.

THE Penzance Chamber of Commerce has conferred a boon on all visitors to their beautiful district, and especially on those who are interested in something more than mere scenery. Guide-books are generally most disappointing to anyone who seeks information on the geology or natural history of a region which is new to him, but the guide-book recently added to the Homeland series is a good example of the way in which the needs of scientific visitors may be met without in the least detracting from the usefulness of the book to the ordinary reader. The chapters dealing with each special topic have been entrusted to experts who know the district thoroughly, and they are consequently of real use to other experts or students to whom Penzance and its neighbourhood may be comparatively unknown.

The book is well got up, clearly printed in good type, very well illustrated, and is written in an easy and interesting style. There is a clear map of Penzance, and a sufficient map accompanies Mr. Dewey's lucid account of the local geology. The map of the district, however, might well be improved. It is a reproduction of the one-inch Ordnance Survey map, but seems to lack clearness. This is particularly noticeable in the names of points, bays, and places along the coast, which are often so obscured by the unnecessary shading of the sea as to be barely legible even with a lens. Again, Mr. J. B. Cornish contributes a good account of the antiquities of the district, and the value of this interesting chapter to an archæologist would be greatly enhanced if the places described could be easily identified, as by

red dots, or letters, or some such device printed on the map. This is, however, a small detail, and on the whole the book is one which we hope will be imitated for other holiday resorts.

Economics: An Introduction for the General Reader. By Henry Clay. Pp. xvi+476. (London: Macmillan and Co., Ltd., 1916.) Price 3*s.* 6*d.* net.

MR. CLAY has written a meritorious, in many ways an excellent, book; but, though his style is good and his reasoning clear, he has neither the elevated clarity of Bagehot nor the racy charm of Mr. Hartley Withers. Very rightly has he laid special emphasis both on the problems which border the two provinces of politics and ethics and on such essentially vital questions as speculation and wages. Indeed, his chapters on these last-mentioned subjects, amongst the best in the book, merit the highest praise. But the pages on banking, though containing an interesting discussion of the principles of finance, would, we fear, with their continual glib references to "runs," "liquid assets," etc., prove difficult reading for, let us say, a tutorial class; nor are such sentences as: "There is an 'intensive' as well as an 'extensive' margin of cultivation . . ." very delectable nourishment for the general reader.

The book, in fact, though in many ways an excellent elementary treatise on economics, is essentially academic.

The scope of the work has already been indicated, and includes the ordinary principles, money, banking, and finance. But it is not quite clear why Mr. Clay should consider that "the object . . . of economics is explanation solely," or that "ought" must necessarily involve a moral content. Surely it is arguable that any teleological conception may involve an appendent obligation, and that economics is a normative science. May we add that the absence of an index is not the criterion of popularity? A. L.

Methods in Practical Petrology: Hints on the Preparation and Examination of Rock Slices. By H. B. Milner and G. M. Part. Pp. vii+68. (Cambridge: W. Heffer and Sons, Ltd., 1916.) Price 2*s.* 6*d.* net.

THIS little book cannot be regarded as in any sense a complete exposition of the subject, but it contains some useful suggestions, especially on section-cutting and simple microchemical methods, incuding staining. It was, however, hardly necessary to give directions for the preparation of well-known dyes, such as fuchsine, malachite-green, and methylene-blue. We are even told how to prepare nitroso-dimethyl-aniline, one of the substances employed in the production of methylene-blue. Several pages are devoted to the subject of the classification of rocks, which is necessarily so briefly treated as to be somewhat misleading in places. If these digressions had been omitted, space would have been obtained for a more extended consideration of the practical methods with which the book is primarily concerned.

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.*]

Negative Liquid Pressure at High Temperatures.

IT must have been remarked in the discussions of the various forms of equation of state for vapour-liquid (*cf.* K. Onnes and Keesom, "Ency. der Math.," or in Leyden Communications, xi., 1912, p. 727) that this equation should determine the range of possible negative pressures in liquid. If we could assume the van der Waals form of equation to hold over the wide range that is concerned, it would readily follow that negative pressure could subsist only at absolute temperatures below 27/32 of the critical point of the substance. For water the latter is 365° C.; thus in that substance internal tension could (theoretically) persist up to 538° absolute, which is 265° C. Such an order of magnitude appears at first sight surprisingly high, though really there is nothing to compare it with. By an oversight I have recently (Proc. Lond. Math. Soc., 1916, p. 191) quoted the critical point of water as 365° absolute, and so obtained the much lower limit 35° C.; and it was a reference to experiments by Prof. H. H. Dixon (Proc. R. Dublin Soc., 1914, p. 233), realising, for vegetable sap, tensions of the order of a hundred atmospheres at temperatures around 80° C., that has given rise to this correction. JOSEPH LARMOR.

Cambridge, June 24.

Science, Scholarships, and the State.

ALL scientific men must welcome the renewed vigour of the campaign for a recognition of science by the State, and incidentally for the introduction of scientific instruction into our public schools, a campaign in which NATURE has taken so prominent a part. I have followed with the greatest interest the pronouncements of the many eminent men on the subject of science and Government published from time to time, and in view of the greatness of the authorities who have written on the question it is with considerable diffidence that I direct attention to what seems to be an oversight in many of the views put forward as to the proper way to give science its due in England.

I refer to the continued proposals to found fresh scholarships for the encouragement of scientific research, accompanied as they so often are by statements as to the lack of trained men of science. In view of the present (or rather, as I have no actual experience of the present conditions in England, let us say the pre-war) attitude of the State, the universities, and private enterprise towards the men already trained, it seems to me futile to make plans for training fresh men until very definite steps have been taken to see that there are to be recognition and scope granted to them when trained. Anyone who has a knowledge of the typical careers of the most successful (from a scientific point of view) students and younger research workers will readily understand the state of things I have in mind. If a concrete example is required, the case of the 1851 Exhibition scholars may be cited: I choose this case as those scholarships are in the nature of State institutions. They would seem to be exactly of the type intended by the advocates of the establishment of new scholarships; they are, according to the conditions of award (so far as I can recollect

them), granted for promise shown in scientific research to students whose work is considered likely to be of benefit to the nation and national industries. The men who have held these scholarships for two or three years form a body highly trained in the best English and Continental universities, with, in most cases, considerable research experience under varied conditions and breadth of view. Yet we see on all hands these men barely able to make a living (unless they go to America). They are in general men of all-round education, with specialised knowledge in science in addition; they are not particularly uncouth, unpractical, or unbalanced, as popular tradition would have men of science to be. It is this addition of specialised knowledge that, under present conditions, is the greatest obstacle to their earning a living; they would probably be better paid if they turned their hand to any employment other than the pursuit of science, or became the worst paid of Government clerks.

In case I should be supposed to be taking a sordid view and claiming riches for the man of science, I explain that when I write "earning a living" I mean earning just sufficient to enable a *single* man to live in the most modest way befitting a member of a learned profession, and I state without fear of contradiction that to do so was a matter of grave difficulty for our younger men of science before the war.

There is nothing unique about the treatment of the 1851 Exhibition scholars. Taking scientific research workers in general, the State has nothing to offer them except occasional grants of 5*l.* or 10*l.* towards purchasing apparatus; the modern universities offer them (and the offer is widely accepted) 150*l.* or so a year (see the advertisement columns of NATURE) for lecturing on the higher and lower branches of their science, and for spending all their spare time in research; private enterprise treats them as amiable eccentrics on a par with the pleasant gentlemen who devise in our popular papers and magazines problems dealing with the joint ages of old families, and the division of ridiculouslv shaped fields into absurd areas. Only their love of science keeps them employed on scientific work, and you are not likely to extend the class of men willing to accept scholarships under such conditions and with such prospects, however many scholarships you may offer.

So long as the present attitude towards science and scientific workers obtains it is useless to train fresh men, and by means of scholarships to set keen workers on a path which leads them through the pleasant fields of scientific discovery to the pathless waste of apathy and neglect which lies in the way of all workers in pure science in England, a waste where material life is very scarcely nourished. Once the waste is abolished the path need not be made so smooth. To drop the obscurity of metaphor, once show the young and keen student that he has some hopes of employment for his activities and recognition for his work, that there is some place for him in national life when he is accomplished as a research worker, and he will derive more encouragement from the prospect of some future definite goal than from all the help by the way to nowhere offered by scholarships, exhibitions, and such like. These are of little use until there is good prospect of the attitude of the governing classes towards science being changed, and, in my humble opinion, all energies should be devoted to bringing about this change of opinion. It is conceivable that a refusal by our great men of science to do national work for nothing but scant and grudging thanks would do more to increase the national reputation of science than any sort of begging for scholarships. It would mark a new era, when the man of science will be held worthy of his hire, and not as one rather permitted to exist than encouraged; and who will be found to say that such a new era would be a bad thing?

One further point. All present discussion seems to be concerned only with the direct application of science to industry, and not at all with the advisability of encouraging pure science. Many of us would welcome a definite pronouncement from the leading authorities as to their attitude towards pure science. If only science which can be immediately applied to industrial processes is in future to be considered of national value, let us have a clear announcement to this effect from some responsible body. This will give those of us who have spent their youth working in pure science, and who are now on active service, a fair opportunity to set about cultivating the correct attitude of mind towards science before returning to peace-time pursuits. For an attitude of mind is one of the few things easily cultivated within range of German guns.

E. N. DA C. ANDRADE.

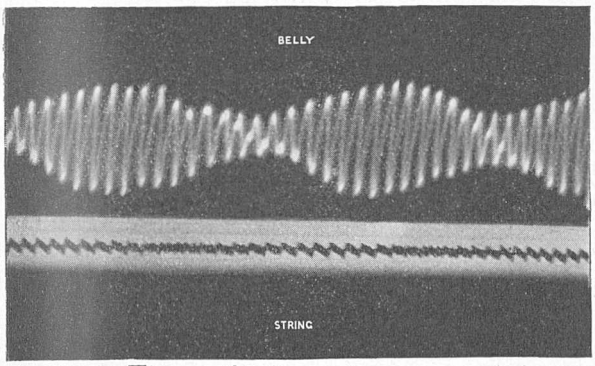
B.E.F., France, June 21.

On the "Wolf-note" of the Violin and 'Cello.

IT has long been known that on all musical instruments of the violin family there is a particular note which is difficult to excite in a satisfactory manner, and that when this "wolf-note," as it is called, is sounded, the whole body of the instrument vibrates in an unusual degree, and it seems to have been also understood that the difficulty of eliciting a smooth note of this particular pitch is due in some way to the sympathetic resonance of the instrument (Guillemin, "The Applications of Physical Forces," 1877). In a recent paper (Proc. Camb. Phil. Soc., June, 1915) G. W. White has published some experimental work confirming this view. The most striking effect noticed is the *cyclical* variation in the intensity of the tone obtained when the instrument is forced to speak at this point. White suggests as an explanation of these fluctuations of intensity that they are due to the beats which accompany the forced vibration imposed on the resonator. The correctness of this suggestion seems open to serious criticism. For the beats which are produced when a periodic force acts on a vibrator are essentially *transitory* in character, whereas in the present case the fluctuations in intensity are *persistent*.

The following explanation of the effect, which is different from that suggested by White, occurred to me some time ago on theoretical grounds, and has since been confirmed by me experimentally. The effect depends on the fact (which is itself a consequence of theory) that when the pressure with which the bow is applied is less than a certain critical value proportionate to the rate of dissipation of energy from the string, the principal mode of vibration of the latter, in which the fundamental is dominant, is incapable of being maintained and passes over into one in which the octave is prominent. When the bow sets the string in vibration the instrument is strongly excited by sympathetic resonance, and the rate of dissipation of energy rapidly increases and continues to increase beyond the limit up to which the bow can maintain the string in the normal mode of vibration. The form of vibration of the string then alters into one in which the fundamental is feeble compared with the octave. Following this, the amplitude of vibration of the belly decreases, but this change lags behind that of the string to a considerable extent. When the rate of dissipation of energy again falls below the critical limit, the string begins to regain its original form of vibration with the dominant fundamental. This is accordingly followed, after an interval, by a fresh increase in the vibration of the belly, and the cycle then repeats itself indefinitely.

The accompanying photograph showing the simultaneous vibration-curves of the belly and string of a 'cello amply confirms the foregoing explanation suggested by theory, and is itself of interest. It will be



seen that the changes in the vibrational form of the string are about a quarter of a cycle in advance of those of the belly, and that in both curves the octave is conspicuous when the amplitude is a minimum.

C. V. RAMAN.

The Indian Association for the Cultivation of Science, Calcutta, May 20.

THE ETHNOGRAPHY OF CENTRAL INDIA.[1]

THE publication of this work recalls the tragical fate of its author, who soon after the final revision of the proof-sheets sailed for India and lost his life in the s.s. *Persia*, sunk by a German submarine in the Mediterranean. The book is the result of a long study of the races of the Province, begun when the author was placed in charge of the census operations in 1901, and since steadily prosecuted, in spite of very indifferent health. He enjoyed opportunities denied to the writers of the volumes on Northern India—Mr. Crooke for the United Provinces and Mr. Rose for the Punjab, who dealt with regions where the all-absorbing Brahmanism and militant Islam had caused much of the more primitive beliefs and usages to disappear. Sir H. Risley, in his account of the tribes of Chota Nagpur, and Mr. Thurston, in those of the Nilgiri Hills, were dealing with people believed to be indigenous, or at least settlers of whose coming no information is now available, and their religion and organisation are of a very primitive type. The people considered by Mr. Russell are perhaps even more interesting—Gonds, Baigas, Korkus, and the like, about whom little has hitherto been known.

The scheme of Mr. Russell's work differs from that of others in the same series, inasmuch as in his Introduction and throughout the caste and tribal articles he has not confined himself to a mere description of the religious and social life. He has taken occasion to discuss questions such as the character and origin of the local totemism and animism, the Corn Spirit, the sanctity attached to opium and alcohol, the pig as a sacred animal, the buffalo as representing the Corn God, the respect paid to the umbrella and to counting, and so on. In the course of these digressions he quotes largely from standard words on anthropology, such as Sir J. G. Frazer's "The Golden Bough," "The Religion of the Semites," by Prof. Robertson Smith, "The History of Human Marriage" and "The Origin and Development of Moral Ideas," by Prof. Westermarck, and other standard authorities. This method possesses some advantages, inasmuch as it tends to popularise the principles of anthropology, and his work is learned and interesting. But it is doubtful if this advantage justifies the space which is occupied by these discussions. They are unnecessary to the trained anthropologist, and it is a question how far this learning is likely to be assimilated by the persons—the officials, European and native, of the Province—who will chiefly use the book. Further, it must be remembered, as appears from

FIG. 1.—Bahrūpia impersonating the Goddess Kāli. Reproduced from "The Tribes and Castes of the Central Provinces of India."

Prof. Ridgeway's latest book, reviewed recently in these columns, many of these principles are still the subject of active controversy.

[1] "The Tribes and Castes of the Central Provinces of India." By R. V. Russell, assisted by Rai Bahadur Hira Lal. Four volumes. Vol. i., pp. xxv+426 Vol. ii., pp. xi+540. Vol. iii., pp. xi+589. Vol. iv., pp. xi+608. (London: Macmillan and Co., Ltd., 1916.) Price 42s. net, four vols.

The scheme of the work is purely ethnographical. Anthropometry, in India at least, has fallen into some discredit since the death of Sir H. Risley, partly because it is now realised that the materials on which he based his conclusions were incomplete, partly because the groups which he discriminated have been shown to be less completely isolated than he supposed.

Much space might have been saved by compression. If, for instance, a set of standard accounts of birth, marriage, and death observances were once for all prepared, it would save constant repetition, and it would be necessary only to refer to variations from the normal practice. But the author has followed here the example of other writers in the series. When these monographs come to be revised, the scheme of arrangement might with advantage be reconsidered.

FIG. 2.—Jain Ascetics with cloth before mouth and sweeping brush. Reproduced from "The Tribes and Castes of the Central Provinces of India."

In these criticisms we must not be supposed to underrate the value of this important contribution to the ethnography of India. Every article shows the assiduous care with which the facts have been investigated; the articles are well arranged, and in the case of the less known tribes, like the Gonds, Bhils, and Korkus, much novel information is supplied, while other less distinctively local groups, like Marathas, Jats, Gujars, and Rajputs, are adequately dealt with, the articles displaying full acquaintance with the work done in other Provinces, which is invariably quoted with full acknowledgment. In almost every page there are accounts of quaint usages and beliefs of the highest interest. The work is provided with an excellent set of photographs, and its format is what might have been expected from the reputation of the publishers.

The untimely death of Mr. Russell is a serious loss to anthropology, and it is sad to think that it occurred on the eve of the publication of a book which was the work of his life, and will do much to preserve the memory of his learning and devotion to science.

BIRDS' SONGS AND THE DIATONIC SCALE.

A LETTER from Dr. R. H. Bellairs, of Cheltenham, appeared in the *Times* of June 14, describing the performance "by a wild bird, probably a thrush, of the arpeggio of the common chord in tune, absolutely in tune." This was followed by other letters, of which the *Times* printed three and gave a summary of the rest. Their contents amount to this: blackbirds do occasionally sing a few notes in our diatonic scale; thrushes less often. Only one other bird was mentioned, "the whitethroat or willow-wren," which leaves the identity of the species doubtful; and neither whitethroat nor willow-wren has ever even dimly suggested to me the use of our musical scale. But as the voices of blackbird and thrush do now and then make this suggestion, I will venture, at the Editor's request, to say a few words on the subject.

Few ornithologists are musicians, and few musicians are ornithologists, so that a knowledge of the elementary facts of the two sciences (if I may for the moment consider music as a science) is not a common acquisition. But if we are to judge of the songs of birds by reference to the diatonic scale, we must be quite clear about the following two facts: First, our present musical scale is an artificial selection, the result of a long evolutionary process, from innumerable possible intervals within the octave, and does not seem to be based on any natural human instinct, prompting to one particular selection rather than another. (See the article "Scale" in Grove's "Dictionary of Music," or Dr. Pole's "Philosophy of Music," chaps. v. and vii.)

Secondly, the vocal instrument of a bird is not constructed so as to produce with any readiness the tones of any scale consisting of fixed intervals. The pitch of the bird's notes is regulated by muscles attached to the windpipe, which is as elastic as the body of a worm; and a moment's thought will show that this is not an apparatus suited for producing a fixed succession of sound-intervals. Our reed instruments are more like the bird's organ than any others, but they are of hard material, with air-holes and a mechanism based on mathematical principles.

Combining these two facts, we may safely conclude that it needs a muscular effort, and probably a strong one, for a bird to produce anything like a tune on our scale; but at the same time it is not impossible where the notes are produced slowly and deliberately, as in the blackbird's song, and to some extent in that of the thrush. It would seem that these birds are occasionally prompted to such

an effort by an imitative instinct which is strong in all birds that sing vigorously; and they succeed in imitating with something like accuracy church bells or other musical sounds made by human beings on the diatonic scale. Sometimes this accuracy in the production of intervals may be the result of accident rather than imitation.

The difficulty that birds have in attaining this accuracy is well shown in a letter by Canon Greville Livett (June 16), who tells how a blackbird which had attained it one year had to practise hard for a week the following spring before he recovered it. The only bird known to me whose natural "song" is on the diatonic scale is the cuckoo; and I am inclined to think that his third is not often perfect major or minor, but fluctuates between the two.

W. WARDE FOWLER.

DR. R. H. SCOTT, F.R.S.

DR. ROBERT HENRY SCOTT died on Sunday, June 18, at the advanced age of eighty-three. He was well known as the chief of the staff of the Meteorological Office from the commencement of the operations of the Meteorological Committee of the Royal Society in 1867 until his retirement on a pension in 1900, for the first nine years as Director of the Office, and for the remainder of the term as secretary of the Meteorological Council, which took over the direction of the Office in 1876. He was also secretary of the International Meteorological Committee from its commencement in 1874 until his retirement from office, and his work for that body was held in high esteem by his colleagues in all quarters of the globe. He was a fellow of the Royal Society from 1870. He received the honorary degree of D.Sc. at Dublin in 1898.

Dr. Scott was born in Dublin in 1833, a member of a well-known family. His father was a Q.C., and his mother a daughter of the Hon. Charles Brodrick, Archbishop of Cashel; one of his brothers was Headmaster of Westminster, and another was Vicar of Bray and Archdeacon of Dublin. He was educated at Rugby and Trinity College, Dublin, where he was classical scholar in 1853, and graduated as Senior Moderator in Experimental Physics in 1855. He studied also at Berlin and Munich, 1856 to 1858, chiefly chemistry, physics, and mineralogy. He was appointed Lecturer in Mineralogy to the Royal Dublin Society in 1862, and published a Manual of Volumetric Analysis in that year. He also published in the same year a translation of the second edition of "The Law of Storms, by H. W. Dove, F.R.S.," whose lectures he had attended at Berlin. The book is dedicated by the author to FitzRoy, who had translated the first edition. It was on that account that Scott was selected by the Meteorological Committee of the Royal Society, of which Sir Edward Sabine was chairman, to take charge of the Meteorological Office. His relations with Sabine were intimate, and he became his executor.

In 1861 FitzRoy, whose original duty was exclusively with the meteorology of the sea, had begun the issue of forecasts and storm-warnings, based upon the information collected daily by telegraph and charted on maps. A map of the weather is often a fascinating document, and the impulse towards sharing the information with the general public, all of whom are interested in the weather, is very difficult to resist; but some prominent members of the Royal Society thought that FitzRoy's action in publishing forecasts and storm-warnings was premature. They were interested in the continuous records of weather which they had obtained at Kew Observatory, and thought the proper plan was to have seven other observatories of the same kind and study the maps in relation to the records. The popular interest which FitzRoy's action had aroused secured for them, with the co-operation of the Admiralty and the Board of Trade, a Government grant of 10,000*l.* a year for the Office, and Scott was entrusted with the direction of the new enterprise, while a marine superintendent, Captain Henry Toynbee, was appointed to carry on the original duty of collecting and discussing marine observations.

The issue of forecasts and storm-warnings was suppressed; but at the request of the Board of Trade the issue of storm-warnings was at once revived. The telegraphic work was developed on careful lines, and the first result of Scott's work appeared in 1876 in a little book entitled "Weather Charts and Storm-Warnings." In 1879 the work had progressed so far that it was deemed appropriate by the Meteorological Council, a very powerful body of scientific experts then in control of the Office, to recommence the issue of forecasts. The issue was commenced on April 1 of that year, and has continued ever since. This was followed in 1883 by Scott's "Elementary Meteorology," in the "International Scientific Series," which took a foremost place as a text-book of meteorology.

From that time onward Scott devoted his attention mainly to the administration of the Office and to the work of the Meteorological Society, of which he became the foreign secretary, a post which he retained up to the time of his death. He was president in 1884 and 1885. He still continued to take an active interest in mineralogy and was at one time president of the Mineralogical Society. His other contributions to meteorological literature, whether official or unofficial, were mostly of a technical character.

After the great generalisation of cyclones and anti-cyclones, and their movement, which emerged almost immediately from the study of maps and records, meteorology was found to resist all ordinary endeavours to make it disclose its secrets, and it was not until the development of the study of the upper air from 1896 onwards that a fresh impetus was given to it and we learned that many of the fundamental ideas of atmospheric circulation required revision. But by that time Scott's active interest in the development of the subject had waned.

He was most methodical and punctilious in the

discharge of his many official duties. He probably never left the Office with an official letter unanswered. Perhaps it was his methodical habits which led to a number of rather serious feuds in the small meteorological circle. Certainly they did exist, though Scott himself was a kindly and thoroughly clubbable man. He was a recognised leader of the Royal Society Club and took a leading part in the incorporation therewith of the Philosophical Club. He retained his connection with the Athenæum to the last. He was an energetic and useful member of the governing body of the South-Western Polytechnic.

Shortly after his retirement he had the great misfortune to lose his wife, who was a woman of strong personality and character, and very active in the management of workmen's dwellings in Chelsea. She was a daughter of the Hon. W. Stewart, Island Secretary, Jamaica. Shortly after her death Dr. Scott had a severe fall on the stairs of the Meteorological Society and injured the base of his skull, grimly remarking when he was recovering that if he had not been Irish the accident would have been fatal. But he never completely recovered from the effects, and for the later years of his life, though he preserved all the outward forms of business, he was not able to take an active part in it. He was buried at Peper Harrow, the seat of the Brodrick family, near Godalming, on Wednesday, June 21. NAPIER SHAW.

NOTES.

THE adjourned extraordinary general meeting of the Chemical Society, called to consider the question of the removal of the names of nine alien enemies from the list of honorary and foreign members, was held on June 21, Dr. Alexander Scott, president, in the chair. Prof. W. H. Perkin's amendment, which was carried on May 11, "That judgment be suspended until after the war, in accordance with the resolution of the former council," was the motion before the meeting. As an amendment to this it was proposed by Mr. J. L. Baker, and seconded by Mr. F. F. Renwick, "That the fellows of the Chemical Society hereby record their detestation of German malpractices in connection with the war, and whilst they refrain at the present time from attaching personal responsibility for the initiation of these to individual chemists, they desire to mark their protest by resolving that the names of the following alien enemies:—A. von Baeyer, T. Curtius, E. Fischer, C. Graebe, P. H. R. von Groth, W. Nernst, W. Ostwald, O. Wallach, and R. Willstätter, shall not appear in the list of honorary and foreign members so long as the war shall last, after which their position shall be reconsidered." After considerable discussion, this amendment was put to the meeting and was declared lost. Mr. John Hodgkin then proposed a second amendment in the following terms:—"The Chemical Society considers that it is neither compatible nor consistent with its loyalty to the Crown, whence the royal charter under which it works was derived, to retain any alien enemies upon its list of honorary and foreign members. It is therefore resolved that the names of A. von Baeyer, T. Curtius, E. Fischer, C. Graebe, P. H. R. von Groth, W. Nernst, W. Ostwald, O. Wallach, and R. Willstätter, who were elected under happier conditions in recognition of their eminent services to chemical science—for which the society still retains an undiminished appreciation and regard—be, and are, hereby removed from the list of honorary and foreign members." This was seconded by Dr. S. Russell Wells, and put to the meeting, and the president declared it as carried by 94 votes to 76. The amendment was afterwards carried as a substantive motion, and the meeting then ended.

DR. J. G. ANDERSSON, until lately head of the Geological Survey of Sweden, has accepted the task of organising, as director, a Geological Survey for China.

PROF. H. THÉEL has retired from his post as intendant of the collection of invertebrate animals at the Riksmuseum, Stockholm. Dr. E. W. Dahlgren, the State Librarian, has also retired on the completion of a specially extended term of service.

THE special correspondent of the *Times* at Port Stanley (Falkland Islands), in a message dated June 26, says:—"Sir Ernest Shackleton returned here yesterday. The relief ship got to about twenty miles off Elephant Island, but was unable to make its way further through the icebergs and floating masses of ice which surrounded the island. Winter conditions in the Antarctic this year are peculiarly severe, and a more powerfully equipped ship than that lent by the Uruguayan Government is needed to force a way to Elephant Island, and relieve the twenty-two men stranded there."

THE death of Mr. Frederick Enock removes a figure well known to the public as a popular lecturer on natural history. Few, however, realised the immense amount of time he devoted to original research, chiefly into the life-histories of insects. Of recent years he devoted himself largely to the study of the Mymaridæ, or "fairy flies," a group of very minute hymenopterous parasitic insects. In this group he discovered many new genera and species, and traced out the life-histories of not a few. Unfortunately, the results of most of these investigations have not yet been published. Mr. Enock's powers of manipulation, whether as draughtsman or mounter of microscopical objects, were of a high order. Originally intended for the engineering profession, his innate passion for Nature soon asserted itself, and his life was practically all devoted to work in natural history. He had suffered for some time from pernicious anæmia, and passed away at his home at Hastings in his seventieth year.

THOSE who are interested in rites of initiation will be attracted by a paper by the Rev. Noel Roberts on "The Bagananoa or Ma-laboch: Notes on their Early History, Customs, and Creed," published in the issue of the *South African Journal of Science* for last February. It contains a very complete account of the practice of circumcision, which is the leading part of the tribal initiation rite. A remarkable feature in the beliefs of the tribe is the cult of an image of the sacred crocodile, carved out of a block of wood and kept in a secret mountain cave. A goat is sacrificed, and after it is cooked the soup is poured into a rude trough hollowed out in the underside of the image. The crocodile is known as "the father of the snake." The writer, on obviously insufficient grounds, compares this rite with the Egyptian legend of the contest between Horus, god of light, and Sut, god of darkness. The correct interpretation is probably to be found in a further study of the tribal myths, which is obviously desirable.

IN the issue of *Man* for June Mr. V. Giuffrida-Ruggeri discusses the relation of the Neolithic

Egyptians to the Ethiopians. His notes are not published in a form which admits of full examination, but he supposes that "the prehistoric series were, at least to a great extent, made up of Ethiopians, and that afterwards a great infiltration in the opposite direction took place; this infiltration must have been fed from the near east, that is, from Syria, the peninsula of Sinai, and the North African coast, territories already occupied by the Mediterranean race." Into the wider speculations advanced by the writer we cannot enter, but it is noteworthy that he assumes that the brachycephalic form of skull "does not imply any correlation to other physical characters. This skeletal character owes its exaggerated importance to the fact that it is very visible in the living man and in the series of skulls collected in museums, but in my opinion it is only valuable in determining varieties; therefore it has no value in joining together across the terrestrial space all those who are alike in that character."

A VALUABLE "Review of the American Moles," by Mr. Hartley Jackson, has just been published by the U.S. Department of Agriculture—No. 38 of the series on the North American Fauna. In his introduction the author discusses the habits and economic status of moles, the characteristics of the young, pelages, and moults, and variations; while further details of this kind are given under the heading of the various species. Among the many interesting details the author has brought to light in the course of his investigations is the fact that the star-nosed mole (*Condylura cristata*) accumulates fat around the tail at the approach of winter. In the matter of classification, the author objects to the system proposed by Mr. Oldfield Thomas, who recognises no fewer than five subfamilies. To be consistent, he maintains, every genus would have to be raised to the rank of a subfamily. Numerous text figures, maps, and several plates add materially to the value of this most excellent piece of work.

DURING the past year the State of California experienced more earthquakes than all the remaining States. According to Mr. A. H. Palmer (Bull. Seis. Soc. America, vol. vi., 1916, pp. 8–28), the number of sensible shocks observed was eighty-three, of which, however, only two (those in the Imperial Valley on June 22) were of destructive intensity. Except in this valley, they were most numerous in the district bordering the Pacific coast. They were entirely absent from northern California, which includes the active volcano of Lassen Peak, and only one occurred at Lone Pine (Inyo County), the seat of the great earthquake of 1872.

LASSEN PEAK is not the only active volcano in the United States (excluding Alaska), but it is described by Mr. J. S. Diller as the most active (Bull. Seis. Soc. America, vol. vi., 1916, pp. 1–7). The peak rises to a height of 10,460 ft., the oldest crater is more than a mile in diameter, and, until the end of May, 1914, it had not been in action for about two centuries. The first phase of activity lasted for about a year, and consisted of more than 150 gas eruptions from a new crater formed within the old one. In May, 1915, the second phase began; a stream of lava filled both the new and old craters, and flowed some way down the western side of the mountain. This phase culminated on May 19 and 22, when hot blasts, resembling those of Mont Pelée, descended the north-eastern slope.

THOUGH it may be long before the stratigraphy of the Philippine Isles can be correlated with that of other lands, the exploration of the country for useful products is bringing details of interest to light. Mr. W. D. Smith, in his "Geologic Reconnaissance of Mountain Province, Luzon" (*Philippine Journ. of Sci.*, vol. x., 1915, p. 177), quotes von Drasche on the definite stratification of certain uplifted coral-reefs. Von Drasche held this structure to be due to a periodic cessation in coral growth. The large part played in reef-formation by sediments intercalated between the corals is now more fully recognised. The hilly and difficult nature of the surface of the province is well illustrated. The same author deals with Panay (p. 211), where petroleum may possibly exist. Mr. W. E. Pratt, who ingenuously refers to "old" Spanish records of 1892, has an interesting paper (p. 241) on "Petroleum and Residual Bitumens in Leyte." The bitumens promise material for asphalt paving; but no large mass of porous strata is yet known in the petroleum region. The same author, in a paper on "The Persistence of the Philippine Coal-beds" (p. 289), points out encouragingly that their discontinuity is due to faulting, so that mining of the seams may some day be resumed. It should be noted that the Bureau of Science, Division of Mines, is now issuing geological maps in connection with the *Philippine Journal of Science*.

THE annual report for 1914 of the Department of Mines and Geology of Mysore gives an interesting summary of progress in the mining and geological work of that State. The Mysore gold mines well maintain their output, though the Ribblesdale section has now entered a poor zone like that once passed through in the higher levels. The air-blasts or explosions of rock owing to the relief of tension during mining, which are so unusually troublesome on the Mysore goldfield, occasioned somewhat fewer fatalities, only seventeen instead of thirty-one in the year before. No method of recognising when the rock is in this explosive condition has yet been discovered. A geological map of the State on the scale of eight miles to the inch has been commenced. Dr. Smeeth, the director, again insists that the great Kaldurga conglomerates are crush conglomerates and not of sedimentary origin, a view for which the evidence has been regarded by some geologists as inadequate. He shows that many of the Mysore quartzites are intrusive into the schists, and are silicified felsites or acid quartz-porphyries. In the hope of developing the iron industry in the State the iron ores have been further studied, and Dr. Smeeth publishes a valuable report upon them. He classifies them into five groups; they include banded iron-stones; ores of magmatic origin in the ultra-basic rocks and in the charnockite series, of which the latter are low-grade quartz-magnetite ores; and also various replacement ores in schists. This last group includes those which appear most likely to be of commercial value.

THE recent presidential address delivered by Dr. A. W. Rogers before the Geological Society of South Africa gives an interesting description of the geology of the copper deposits of Namaqualand. He shows that the deposits of economic importance are those associated with igneous intrusions in gneiss, and thus fall into line with many of the important copper deposits in other parts of the world. The most widely distributed of these igneous rocks is mica-diorite, which is well developed at Ookiep, where, as is well known, the most important of the Namaqualand copper mines is situated. Next in importance comes norite, which appears to be of a very variable composition, ranging from rocks that differ only from the mica-diorite by the presence of a little hypersthene to rocks so rich in the latter mineral as to be almost capable of being classed as hypersthen-

ites. Hornblendites also occur, but appear not to be associated with copper deposits to the same extent as the two first-named. It will be noted that the igneous rocks are of a decidedly basic type and that they are rich in magnesian minerals, although the absence of olivine forms a constant and interesting feature in their mineralogical composition. The igneous intrusions assume many different forms, such as dykes, pipes, sheets, and irregular bodies, but no true batholites have yet been met with. No fewer than 344 such intrusions have been mapped up to the present. Very many of these rocks show a certain admixture of sulphide, including copper sulphide, in the form of interstitial grains. The question whether these sulphides are or are not original constituents of the rocks does not admit of any very precise answer, but must be decided by a review of the whole of the phenomena characterising these occurrences. Dr. Rogers concludes, upon the whole of the evidence, that the copper deposits are magmatic segregations; that "the intrusions were complex bodies of two or more differentiates from one magma basin"; that each differentiated portion of the magma held a certain quantity of sulphides at the time of intrusion; and that these sulphides often collected together within the individual differentiates, and that they were further able to migrate and to impregnate the country to a distance of a few feet from the contact. The paper forms an interesting contribution to the study of magmatic ore deposits, a group to which increasing attention has been devoted during recent years.

THE geographical problems in boundary marking are discussed by Sir Thomas H. Holdich in the *Geographical Journal* for June (vol. xlvii., No. 6). Sir T. H. Holdich has had a great deal to do with frontier delimitations in India and South America, and no man is better qualified to speak on the subject and to direct attention to the necessity of geographical knowledge on the part of the statesmen who decide frontiers. The paper gives many instances of complications, needless expense, and the threat of war due to ignorance of geographical conditions or the misapplication of geographical terms. The question will soon be one of vital importance. It may be too much to hope that expert geographical advice will be sought at least in the wording of frontier treaties, but it is nevertheless not an unreasonable demand to make.

MR. O. F. COOK gives an interesting account of agriculture and native vegetation in Peru in the Journal of the Washington Academy of Sciences, vol. vi., No. 10, May, 1916. Mr. Cook deals particularly with the region around Cuzco, the chief centre of the Inca and pre-Inca civilisation. He points out that the present distribution of the principal types of vegetation is not a natural effect of altitudes, climates, or soils, but an artificial result of intensive agricultural occupation of land over a long period of time. The primeval forest which probably clothed the hills has, in his opinion, been everywhere destroyed for agricultural purposes, and the forests which are now found are of secondary origin, having sprung up on land which has gone out of cultivation. The absence of palms in such forests is cited in support of this view. He considers that the denudation of the higher land formerly under cultivation has given rise to the large areas of grass land now sterile and abandoned.

THE Optical Society, 39 Victoria Street, Westminster, has reprinted in pamphlet form, at the price of a shilling, the paper on the manufacture and testing of prismatic compasses read recently before the Society by Mr. F. E. Smith, of the National Physical Laboratory. It describes the methods adopted at the laboratory to test the instruments for the possible errors, and gives sufficient details to enable any maker to set up without great expense his own testing arrangements. In addition, much valuable information is given as to the best form of needle, the best shape of the hard steel pivots, the superiority of garnets to agates as jewels, the proper degree of hardness of the needle (secured by the faintest straw colour in tempering), the advantage of magnetising the needles in coils giving a magnetic field of 400, and the superiority of a dead-beat motion of the needle, secured by the use of liquid, air, or magnetic damping. In practical use Mr. Smith thinks it advisable to tap the compass gently to give the needle the best chance of taking up a correct position. He finds many of the compasses at present made cannot be trusted to half a degree.

BULLETIN No. 59 of the Technological Series of the Bureau of Standards gives an account of an investigation of standard test specimens of zinc-bronze (Cu 88, Sn 10, Zn 2) by C. P. Carr and H. S. Rawdon. The authors conclude (*a*) that the addition of the small percentage of zinc does not affect the theoretical microstructure of the alloy; (*b*) that the method of casting, pouring temperature, etc., affect the structure only indirectly by influencing the rate of cooling, amount and distribution of "enclosures," etc.; (*c*) that the microstructure offers an explanation for the characteristic appearance of the tensile bars after testing; and (*d*) that of the various microstructural features affecting the physical properties, oxide films must be considered to exert by far the greatest influence. The best type of test bar where the metal is to be cast into sand is the cast-to-size shape, and if the metal is poured anywhere in the range 1270–1120° C. uniformity of tensile strength and ductility are obtained. The advantages of the cast-to-size shape are that it is easy to mould and inexpensive to machine into the shape and size required for testing. It is recommended as the form which should be adopted as standard for general foundry practice.

CONSIDERING what a fundamentally important substance it is, and the fact that it is frequently used in molecular weight determinations, one would have thought that trustworthy data for the melting and solidifying points of benzene would have been recorded long ago. From an article by Mr. R. Meldrum in the *Chemical News* for June 9, however, this does not seem to be the case. With the most nearly pure benzene commercially procurable, which was solidified at 3° C. for twenty-four hours, and then drained, this author obtained 3·92° and 3·95° C. as the solidifying point. The rate of crystallisation at this temperature, however, slackened very considerably after 10 per cent. had solidified. For the melting point, determined by keeping the thermometer immersed in the melting crystals, the value obtained was 4° C. Using the crystals solidified from the sample, after pressing between filter paper at 3° C., the author found 5·6° for the solidifying point and 5·7° for the melting point. Benzene kept in a tube of 1-in. bore at a temperature of 1° C. solidified without crystalline structure, and hence was probably in the colloidal condition. Mr. Meldrum concludes that above the melting point benzene exists in more than one modification.

THERE has just been completed on one of the main lines of the Great Central Railway a bridge over one of the English rivers (which cannot be named for military reasons) having a Scherzer rolling-lift opening span weighing 2900 tons, the largest in this country, if not, indeed, in the world. An illustrated

account of this bridge appears in *Engineering* for June 23. The bridge was designed by Mr. T. B. Ball, the engineer of the railway company, and provides for a double line of railway and for a broad road bridge, with footpaths parallel to the railway track. The lifting span gives a clear waterway 150 ft. in width. The operating gear is provided with two electric motors, each of 115 horse-power, and these are connected by gearing to the main gudgeon pins at the outer girders. The bridge is accurately balanced, with a slight preponderance to the nose end in order to prevent hammering on the bearings. The gear is sufficiently powerful to operate the bridge against a 20-lb. wind, and the time for opening, or closing, is three minutes. The bridge was constructed by Sir William Arrol and Co., Ltd., of Glasgow.

OUR ASTRONOMICAL COLUMN.

COMET 1915*e* (TAYLOR).—Messrs. Jeffers and Neubauer, of the Berkeley Astronomical Department (University of California), have calculated elements and ephemeris for this comet. Three normal places were formed from the observations, 1915, December 5–10; 1916, January 7–11 and April 5, the latter being photographic (Lick Observatory Bulletin, No. 281). The new orbit agrees very closely with the Copenhagen calculation (NATURE, March 16; see also issue for February 17):—

$T = 1916$ Jan. 30·9403 G.M.T. $P = 6{\cdot}3662$ years

$\mu = 557{\cdot}3450''$

Equinox 1916·0	Epoch 1916 Jan. 8·5 G.M.T.
$\omega = 354^\circ\ 49'\ 01{\cdot}6''$	$M_0 = 356^\circ\ 31'\ 33{\cdot}0''$
$\Omega = 113^\circ\ 54'\ 05{\cdot}1''$	$e = 0{\cdot}546458$ $(\phi = 33^\circ\ 7'\ 27{\cdot}7'')$
$i = 15^\circ\ 31'\ 43{\cdot}5''$	$\log a = 0{\cdot}535922$

The ephemeris has been calculated to August, but the comet is stated to have been only of the fifteenth magnitude early in May.

RETURN OF DANIEL'S COMET (1909*e*).—According to new elements calculated by S. Einarsson and Margaret Harwood, the undisturbed time of perihelion passage is 1916, May 23·422 G.M.T., but the ephemeris shows that the comet will not be favourably situated for observation.

VARIATION OF LATITUDE.—In the course of a review of this subject Prof. F. Schlesinger incidentally mentions that on account of the war the second American station of the International Latitude Service may possibly be closed down (Proc. American Philosophical Society, vol. liv., No. 220). The two American stations were Gaithersburg and Ukiah. The former has already been abandoned (NATURE, March 2). An American observatory—Cincinnati—participates, but, of course, is not maintained by the international organisation.

DIFFERENCE OF LONGITUDE BETWEEN PARIS AND WASHINGTON.—Prof. Abraham's photographic method of recording wireless time signals has been tested during the past winter in the determination of the above long arc. For various reasons only seven pairs of records are available for reduction; nevertheless, comparison with the results obtained by telephonic reception is decisively favourable. M. Baillaud (*Comptes rendus*, No. 24) states that the Bureau of Longitudes has come to the conclusion that for the determination of longitudes over distances too great for the transmission of very short signals the only method which can be employed with success is that of photographic registration.

THE CONSTITUTION OF THE MILKY WAY.—Prof. C. V. Charlier has published a preliminary statement of results obtained at Lund on the distribution of the helium stars. The special significance of this group of celestial bodies is due to their close and real association with the Milky Way. As it now appears that the whole class (804 stars) has been catalogued at Harvard, they afford a unique body of data for statistical investigation (*Comptes rendus*, No. 23). The luminous radiation of these the brightest and hottest of stars is such that, viewed at the limits of the stellar universe, one of them would still appear as an 8th magnitude star. The nearest of the type is 4 siriometers (1 S.M. = 1,000,000 astronomical units) distant, and the most distant 250 S.M. The centre of the group—considered to be the probable centre of the sidereal universe—is situated in the direction of Carina ($\alpha = 7{\cdot}7$h., $\delta = -55{\cdot}6^\circ$). Two-thirds are contained in an ellipsoid of revolution having axes of 37·3 and 13·1 S.M. in the plane of the galaxy and at right angles respectively.

HYDROLOGY AT THE ARCTIC CIRCLE.[1]

THERE is something mysteriously fascinating about regions which are remote from the ordinary haunts of men. The silence of illimitable wilds and the solitudes of eternal snow stir the heart and stimulate the imagination as no other field of human enterprise can do. Explorers feel the irresistible call; pioneers grope their lonely way; by degrees the trackless unknown is traced and probed and scanned, until the survey is complete and earth's secret recesses are defined as completely and accurately as an English county.

Such is the reflection which arises as one turns over the pages of the extremely interesting hydrographical record of the Yukon-Tanana region, Alaska. Lying along the Arctic Circle, hemmed in by frozen seas and peaks of ice, this great tract of 40,000 square miles has been patiently mapped out and indexed through six long years, with praiseworthy persistence and energy, by workers in the United States Geological Survey. The preface does them but bare justice when it points out that their investigations have necessitated journeys which have put their physical endurance to severe tests and entailed considerable hardship.

The Yukon-Tanana region forms part of the central plateau of Alaska. It is an upland diversified by many broad valleys, with flat, interstream areas, above which rise numerous rounded domes and mountain masses. The surface of the upland ranges from 2000 to 3500 ft. in altitude; the domes, irregularly distributed, reach 4000 to 5000 ft., and the highest mountain crests to 6000 ft. high. The domes are almost entirely composed of igneous rocks, and the mountains of these and closely folded sediments. As a geological field, the country is one of great interest; it is a region of sedimentation, diastrophism, widespread metamorphism, abundant intrusion, and volcanic action.

The rocks may be divided into two principal groups: one consisting of metamorphic schists of pre-Ordovician origin, and the other, ranging in age from Ordovician to Carboniferous, made up of folded argillites, quartzite, conglomerate, sandstone, and limestone, resting unconformably in relation to the schists. Igneous rocks are represented by areas of granite and by dykes of varied composition. The most notable mineral resource of the country is placer gold, the developed deposits of which lie chiefly among the elder schistose and intrusive rocks. Silver, antimony, silver-lead, and tin ores are also worked.

As might be expected, the climate is one of extremes.

[1] "Surface Water Supply of the Yukon-Tanana Region, Alaska." By C. E. Ellsworth and R. W. Davenport. (Water Supply Paper No. 342.) Pp. 343, with maps, photographs, and diagrams. (Washington: United States Geological Survey, 1915.)

The annual range varies from 120° to 160° F. The maximum temperature reported is 96° F., the minimum −76° F. A range of 90° or more is experienced in the months of January and February. The winters are long and intensely cold, with the result that the ground has become frozen, in places, to depths of more than 300 ft. The effect of the brief summer warmth is merely to thaw a few feet at the surface.

The mean annual rainfall is estimated on the incomplete data available at about 12 in., but there is considerable local variation, and the records are as yet too inadequate, both in extent and duration, to permit of any definite conclusions being drawn from them. Vegetation generally takes the form of a covering of moss, beneath which is the *tundra*, a thick turf, consisting of a wet, spongy mass of roots and accumulated vegetable matter. Spruce trees are plentiful, and birch and cottonwood grow in certain areas. The conditions are scarcely such as to lead one to expect to find much horticultural development, yet it is stated in the report that in nearly every small town and in many outlying districts gardening has proved successful. Many varieties of vegetables are profitably grown for local use.

Transportation is difficult, slow, and expensive. There are three main routes, two available during the summer months only, the third mainly used for passengers and mails during the winter at considerable cost. Many outlying places are accessible with the greatest difficulty.

From the data collected, it is evident that the water resources are not adapted for hydraulic development to any extent. Mining is, of course, the principal consideration at present, and for this the winter supply is quite inadequate, while in summer the flow fluctuates considerably. Hitherto wood fuel has been exclusively used for the production of steam for power purposes, but each year the cost increases with the greater distance of transport. The problem of obtaining power is therefore annually becoming more serious with the diminution in the supply of fuel. It is one, moreover, which will have to be faced and solved before any extensive industrial development of the region becomes practicable. B. C.

UPPER AIR INVESTIGATION.

THE Meteorological Service of Canada has published an interesting account of its upper-air investigation. Part i., which is now published, deals with the records of registering balloons; the work has been done, and the report prepared by Mr. Patterson, under the direction of Mr. Stupart, the director. Ninety-four balloons were sent up, and fifty-three recovered, a fair proportion perhaps, considering the nature of the country. The instruments and methods are practically the same as in England, but the balloons have all been started at 8 p.m. local time, so as to avoid solar radiation. The mean annual temperature at each height up to 11 km. is very similar to that in England, the temperature fall per kilometre is almost identical, but the actual temperature is a degree or two higher. In view of the lower latitude this is not surprising. But in Canada the fall of temperature continues to a greater height than in Europe, the mean value of H_c being given as 11·7 km., against about 10·7 for Europe, and in consequence the temperature of the stratosphere is from 6° to 7° C. colder. Except in the case of the surface pressure, the variations of all the elements are larger in Canada; the amplitude of the seasonal variation of H_c is about 2·0, and the standard deviation is 1·96. The correlation between H_c and the pressure at 9 km. is very high, but the correlation between the surface pressure and the other quantities is very small, perhaps on account of the small variation shown by the former. The most remarkable result given is that the temperature of the stratosphere over Canada is colder in summer than in winter. The number of observations is scarcely enough to establish this with absolute certainty, but they suffice to make it almost certain, and, after all, it is no more surprising than that the lowest temperatures of the stratosphere should have been found over the equator. The general drift of the balloons, in Canada as in Europe, is towards the east, but there are a few instances of a balloon falling westward of its starting point.

GENETIC STUDIES FROM AMERICA.

A FURTHER instalment of Dr. Raymond Pearl and M. R. Curtis's "Studies on the Physiology of Reproduction in the Domestic Fowl" appears in the *Journal of Experimental Zoology*, vol. xix., No. 1. In this paper they deal with the distinction between "genetic" and "somatic" sterility. Some hens from high-laying strains, with the genetic characters for rich egg-production, were found to be sterile; the cause, when made evident by dissection, proved to be an oviduct with a mouth too narrow to afford entrance to the yolks, which, shed into the body-cavity, became absorbed through the peritoneum.

Some suggestive remarks on "Heredity and Mutation as Cell Phenomena" will be found in a paper by Dr. R. Ruggles Gates (*Amer. Journ. Bot.*, 1915, pp. 519–28), in which attention is directed to the fact that whereas the normal number of chromosomes is fourteen in Œnothera, *Œ. lata* has fifteen, one of the original chromosomes having been doubled through an irregular meiotic division; *Œ. latescens* has sixteen; and *Œ. gigas* and its derivatives have twenty-eight, the chromosome series in this case being doubled and "the plant being a cell-giant and not merely gigantic in its external dimensions."

In view of the importance now assigned by many biologists to the "mutation theory," interest will be aroused by Dr. Gates's appreciation (*Amer. Nat.*, vol. xlix., pp. 645–8) of the neglected work of Thomas Meehan (1826–91), a British gardener who settled in Philadelphia. Meehan asserted, from his observations on wild and garden plants, that "strikingly distinct forms come suddenly into existence . . . and act in every respect as acknowledged species," and that "morphological changes in individual plants are by no means by gradual modification."

CHEMICAL SCIENCE AND CIVILISATION.[1]

WE who enjoy all the privileges of modern civilisation are apt to forget how much we owe to the efforts of mankind to investigate, understand, and utilise the things around them. Let me very briefly trace this element of civilisation in its relation to the chemical arts and chemical science. It is certain that the early development of human beings was dependent upon their ability to gain the mastery over other animals of greatly superior strength, speed, and power of attack. This was rendered possible by the discovery of means of making efficient weapons and tools; the former for purposes of attack and defence and for the obtaining of food, the latter for building secure habitations, tilling the ground, and

[1] From an address on "The *Rôle* of Chemical Science in Civilisation," delivered in the Lecture Theatre of the new Chemical Laboratories at University College, London, on May 16, by Prof. F. G. Donnan, F.R.S.

cooking food. Metallurgy, or the methods of extracting the metals from their ores, which is a branch of chemistry, has thus been one of the greatest factors in civilisation. Indeed, the successive discoveries of the means of extracting metals, and out of them fashioning weapons and tools, form recognised landmarks throughout the development of civilisation. Thus the age of stone has been followed by the ages of copper, bronze, iron, and steel. The science and the art of engineering, which attained to such a vast development in the nineteenth century, and of which the present century has already witnessed such a new and wonderful development in the mastery of the air, are wholly dependent on chemical science, which has provided the engineer with the chief materials for the construction of his tools, engines, machines, and structures.

The invention and development of explosives have conferred on man undreamt-of powers of action, and have raised his puny strength to that of a giant who can move mountains. Without the use of explosives we could not quarry for stone, mine for coal and metallic ores, bore tunnels and build railways, or carry out many of the great works necessary for the modern complex civilisation of the present day. The progress of engineering is thus absolutely dependent upon the progress of chemistry. The high-speed tools, the armour-plate, the aeroplanes and aeroplane engines of to-day, have only been made possible by successive advances in the application of chemical science. If men have in past ages, as at the present hour, made use of the discoveries and inventions of the chemist and the engineer to compass their own destruction, it is a question, not of chemistry and engineering, but of the imperfect development of national and international psychology. Or perhaps, from the point of view of the angels, it may represent but a fluctuating molecular turbulence in a statistically harmonious system, just as most of our laws of physics and chemistry, simple and harmonious as they appear to us to be, are but the expressions of statistically steady averages beneath which lie the wildest molecular devilry and commotion.

If we turn to the realm of art, we find that plastic and pictorial art and architecture itself are individually bound up with the discoveries and inventions of chemical craft and science. We may admire the magnificent blue of an Egyptian enamel, the white depth and the glorious hues of Chinese porcelain, the mural decoration of a Roman villa, or the splendid colours of the Book of Kells or of the painting of a Flemish master, but do we always realise that behind the imaginative work of the artist lies a long and laborious history of chemical craft and science?

I have spoken of chemistry in its relation to engineering and art. I shall not weary you with a detailed account of chemical science in its relation to the manifold material wants of modern civilisation. There exists, however, scarcely a single branch of industry that does not in some shape or form make use of chemical craft and knowledge. We are dependent upon these for paper, glass, porcelain, metals, alloys, soap, dyes, drugs, disinfectants, perfumes, etc., to mention only a few classes of common substances of daily use.

A great man once said that one could measure the civilisation of a nation by its consumption of sulphuric acid. However that may be, the present century will be dominated and characterised by the development and application of chemical science, just as the nineteenth century was characterised by the enormous development and progress of mechanical and engineering science. Germany alone of the nations of the world has had the ability and prescience to foresee this. It is chemical science that has made the power of the Germany of to-day, and however much we may loathe and abhor the policy of those who rule her, there is no gainsaying the fact that she represents a great and powerful force in material and intellectual progress. Viewed quite apart from any question concerning the morality of war in general or of the present war in particular, Germany alone amongst the nations has perceived to its full extent that the problem of organising a nation for attack or defence is largely a question of the development and organisation of chemical science and chemical industry. Previous to the war we failed to realise that vital and fundamental fact. We may dislike war, but we have to defend our honour. We have to take the world as it is and to face realities. It may be stated with a sense of the most solemn conviction that the very life-blood of England to-day is sulphuric acid. It is not a question of ethics or of polite political philosophy. It is a question of life or death. Whether we like it or not, without sulphuric acid and a few other fundamental chemical substances the honour of England would to-day be lying in the dust, and the blood of our brave manhood would have been poured out in vain, a tragic libation to the gods of vanity and ignorance.

But it is not in the grim necessities of war that I would ask you to seek the paramount importance of chemical science. Let us turn from the destruction of life to the conservation and production of life, to life itself. What do we find there? That life has chosen chemical action as the mode of its material expression. We who consider ourselves the overlords of creation are as dependent as the modest flowers beneath our feet upon the ever-recurrent ebb and flow of chemical change. The green plant is, as Huxley said, the fundamental capitalist, the producer of that store of potential chemical energy on the setting free of which in the process of oxidation all life ultimately depends. The struggle of life is the struggle for chemical energy.

Agriculture is indeed the fundamental industry of man, as it is the fundamental chemical industry. It is only by supplying the soil in increasing quantities with the required amounts of potash salts, chemically combined nitrogen, and phosphates that the ever-increasing population of the earth can be fed. The progress of agriculture is dependent upon the application of chemical science in ever-increasing measure. This applies as much to the rearing and feeding of live-stock as to the growing of plant crops. A cow is a chemical apparatus for the manufacture of milk or beef from grass and clover. For the efficient operation of this chemical machine it is necessary to make the most careful chemical study of the food or fodder which is supplied to it, and which it in its turn transforms into food for ourselves.

A man, like any other animal, requires for the performance of his work a definite stock of chemical energy, a definite diet consisting of certain determinate chemical substances, such as carbohydrates, fats, proteids, salts, and water. The amount and composition of his diet must be most carefully adjusted to the physical and mental work which he has to perform. The study of national diet from the point of view of chemical physiology is more important to the statesman and the political philosopher than many matters over which they are apt to wrangle and debate.

The cure and the prevention of disease depend ultimately on a profound understanding of the conditions which control and regulate these chemical changes. It is perhaps needless to dwell on the advances already made. Chemical science has supplied the physician

with his means of allaying pain and fever, of regulating many physiological functions, of neutralising bacterial poisons, and of determining the death of the parasites of disease. Already the chemical manufacture of pharmacologically active substances constitutes one of the vital activities of modern civilisation. But the application of chemical science to physiology and medicine is in its earliest infancy, though it will lead in time to advances as yet undreamt of. For further progress we require a finer and more subtle analysis of those wonderful chemical and physico-chemical changes which preserve the mobile and dynamic equilibrium of living matter.

The problem of life, of living matter, forms one of the great goals of chemical science, on the slow and progressive solution of which depend our future existence and well-being. At the other end of the long chain of evolution lies the problem of the birth of matter. This is perhaps the other great goal of chemical science. It is a very long way from the shining nebula to the speck of protoplasm. There are many who would dig an impassable ditch in this long road.

But however that may be, the question of the synthesis and possible reconstruction of what we call our material world is one of truly transcendant importance. The discovery that the atoms of matter can, and in certain instances actually do, break up into other atoms and into electricity we owe to the genius of French and British science, and the first recognisable transmutation was discovered at University College, London, by Sir William Ramsay and Prof. Soddy. So tremendous, however, are the forces in operation during these changes that hitherto it has proved impossible to control them in any wise. I might perhaps mention that we owe to Sir William Ramsay and to Prof. Norman Collie the first determined and courageous attempts to begin this battle of the giants. We find ourselves here in a new world of chemical and molecular science. We are the spectators of forces and velocities hitherto undreamt of. But the progress of electrical science, which has ever been the fairy godmother of chemistry, gives us reason to be of good courage.

Already we know that electricity, which is but a finer form of matter, is a component of the atom. We know from the researches of von Laue and of Prof. Bragg and his son that the excessively short electric waves sent out by certain forms of electrical discharge, the so-called X- or Röntgen-rays, can penetrate and analyse the exceedingly fine-grained atomic structure of a crystal. Is it too much to hope that still shorter and denser electric waves, sent out by the most powerful sources, may be able some day to penetrate the very core and nucleus of the atom and disturb the potent equilibrium that reigns therein?

The researches of astronomers, chemists, and physicists have shown that in the gaseous nebulæ and the early stars matter exists in forms as yet unknown to us on our planet, and that as the progress of stellar evolution proceeds we gradually arrive at stars akin in nature and composition to our sun and our own world. Is it too much to hope that we may so succeed in employing electricity and electrical energy as synthetic reagents that we shall eventually, and indeed perhaps at no distant date, arrive at the production of these simple and primary forms of nebulous matter? Whether these problems will admit of solution in the near or the distant future, or whether, indeed, some of those which I have mentioned will ultimately defy all our efforts, it is here that I would ask you to seek the profound *rôle* which chemical science is destined to play in civilisation.

EVOLUTION AND SYMMETRY.[1]

IN the animal kingdom two dominant types of body symmetry are to be found. In animals that are sedentary or floating in habit the symmetry is frequently radial, but in animals that are free and move rapidly by their own muscular activity the symmetry is bilateral. In those classes of animals now sedentary in habit, which by their developmental history show a descent from a previously free and bilaterally symmetrical ancestry, a secondary radial symmetry is usually found either in the form of the body or in the arrangement of the organs for the capture of food. Similarly in the Echinodermata some examples are found, particularly in the class Holothuroidea, of animals descended from a sedentary and radially symmetrical ancestry assuming with their freedom and increased muscular activity a secondary bilateral symmetry.

In the groups of animals that are radially symmetrical, whether sedentary or floating in habit, there is usually a far greater range of variability than in those that are bilaterally symmetrical, and in the endeavour to classify them into genera and species on the Linnean system the zoologist finds so many cases of overlapping and fusion that some doubt arises as to the existence in Nature of discontinuous specific groups.

In the order of the sea-pens there is a complete series of forms connecting the radially symmetrical colonies of the genera Veretillum and Cavernularia with the bilaterally symmetrical genera Pennatula and Pteroeides. In this series the difference between the range of variation in the radially symmetrical genera and that in the bilaterally symmetrical genera is very pronounced.

In such characters as the size of the zooids, the size and shape of the spicules, and the length of the axis, remarkable variations are found in the radially symmetrical genera. In the bilaterally symmetrical genera these characters are far more definitely fixed, and can usually be relied upon for determination of species.

Having examined a large number of specimens of the Pennatulacea collected by the *Siboga* expedition and in other collections in this country and abroad, the author believes that in some of the radially symmetrical genera there is no such discontinuity of structure as would justify their division into specific groups. In the bilaterally symmetrical genera, on the other hand, the existence of definite specific groups is certain. If this view is justified, the conclusion would be reached that the evolution of those discontinuous groups of specimens which are commonly recognised as species is correlated with the change from a radially symmetrical to a bilateral symmetry of the body.

The evidence at present at our disposal points very definitely to the conclusion that the radially symmetrical sea-pens are more primitive than the bilaterally symmetrical sea-pens, and evidence is produced which suggests that the former are derived from an Alcyonacean ancestry which assumed a floating or drifting habit.

[1] Summary of the Croonian Lecture on "Evolution and Symmetry in the Order of the Sea-pens," delivered before the Royal Society on June 22 by Prof. S. J. Hickson, F.R.S.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—The degrees conferred on Commemoration Day, June 26, included the following:—Doctor of Laws (*honoris causâ*), Dr. J. Ferguson, emeritus professor of chemistry; Doctor of Letters, W. H. Dunn, thesis, "The Development of English Biography"; Doctor of Science, Alex. Scott, thesis, "Con-

tributions to the Petrology of the West of Scotland," with other papers; Doctor of Science in Public Health, Dr. W. Barr, thesis, "I.K. Therapy in Pulmonary Tuberculosis."

LEEDS.—Sir James Roberts, Bt., has made a gift of 10,000*l.* to the University for the foundation and maintenance of a professorship of the Russian language and literature.

LIVERPOOL.—By the will of the late Mr. N. E. Roberts 500*l.* is bequeathed to the Chancellor of Liverpool University for the benefit of the University, and 1000*l.* for the endowment of a scholarship in the department of infectious diseases, payable on the death of a niece.

LONDON.—At a meeting of the Senate held on June 21 Sir Alfred Pearce Gould was elected Vice-Chancellor for a second term of office, viz. until June, 1917. The following doctorates were conferred:—*D.Sc. in Physical Chemistry*: Mr. A. Bramley, an internal student of the Imperial College (Royal College of Science), for a thesis entitled "A Study of Binary Mixtures, with special reference to Viscosity." *D.Sc. in Chemistry*: Mr. A. F. Joseph, an internal student of the Imperial College (Royal College of Science) and Birkbeck College, for a thesis entitled "Experimental Investigations on the Properties of Bromide Solutions." *D.Sc. in Geology*: Mr. W. Jones, an external student, for a thesis entitled "The Origin of the Tin Ore Deposits of Kinta District, Federated Malay States," and other papers.

OXFORD.—The delegates of the University Museum have just presented their annual report. They direct attention to the large number of members of the teaching staff, research workers, and service staff who have been serving in the Navy or Army, or have been otherwise engaged on work directly connected with the war. In the pathological department much bacteriological work has been done for the Third Southern General Hospital; a standards laboratory has also been set up, and is occupied in the preparation and issue of standard agglutinating cultures and serums for use in the diagnosis of typhoid and paratyphoid fevers. The report in physiology records researches by the Waynflete professor, by Dr. Vernon, Dr. Chuai Asayama, of Kioto, and Prof. Denys, of Louvain. It also mentions the gaining of the V.C. by Lieut. Maling, a physiology student in 1909–10, and adds that of recent students in the department ten have lost their lives in the war. In the department of zoology and comparative anatomy research has been carried on, in the absence on military service of the Linacre professor, by the deputy-professor and Mrs. Goodrich, by Mr. G. W. Smith and Mr. J. B. Gatenby. A representative collection of insects, presented by the Hope department, has been prepared and exhibited. Since the resignation, after fifty years' service, of Prof. Clifton, the work of his department has been carried on by Mr. James Walker. Research on wireless telegraphy for the naval air service has been conducted by the Wykeham professor of physics, who reports with great regret the loss in action of Mr. H. G. J. Moseley, 2nd Lieut. R.E., already a very distinguished physicist. War work, as well as other forms of activity, has gone on, under Prof. Perkin, in the new chemistry laboratory now open. The report of Mr. H. Balfour, the curator of the Pitt-Rivers Museum, contains a long list of donations, some of the most important of which were procured by Miss M. Czaplicka during her recent expedition to Siberia. Other accessions worthy of special mention came from Mr. J. H. Hutton and from Mrs. Sollas, the latter forming part of the collection made by the late Prof. Moseley during the voyage of H.M.S. *Challenger*.

The School of Geography announces that a vacation course for teachers and others interested in geography will be held this year from August 3 to August 18. Particulars of the lectures and classes planned, with other information, may be obtained on application to the vacation course secretary, School of Geography, 40 Broad Street, Oxford.

The third conference on new ideals in education will be held at Oxford on July 29–August 5. The programme includes papers on The Boy Scout movement, by Sir Robert Baden-Powell; The place of science in education, by Sir Henry Miers; Universities and their re-planning, by Prof. Geddes; Workmanship and education, by Mr. H. Wilson; and Regional studies and human surveys, by Prof. Fleure. Among the chairmen are the Earl of Lytton, Lord Sydenham, Sir William Mather, Dr. Macan (Master of University College, Oxford), Rev. T. Provost (of Oriel College, Oxford), Mr. Fred Burridge, Miss Caroline Herford, Mr. A. C. Coffin, and others. All information with reference to the conference can be obtained from the Secretary, 24 Royal Avenue, Chelsea, S.W.

FOLLOWING on the large developments undertaken by British Dyes, Limited, the governors of the Huddersfield Technical College have decided to establish a new department for specialised study and research in coal-tar colour chemistry (aniline and alizarine dyes). The department has been placed under the headship of Dr. A. E. Everest, now lecturer in chemistry at University College, Reading, who, during recent years, has been carrying out a series of investigations upon colours and plant pigments. Work will be commenced in September next, and the department will provide advanced teaching in matters relating to the production of dyestuffs, colours, and other allied substances. Facilities will be offered for research of all kinds relating to the chemistry of colouring matters. The department will be worked in close connection with the existing departments of chemistry and of dyeing, thereby giving its students the benefit of keeping in touch with the practical application of the products to be dealt with. Spacious laboratories are to be provided, furnished with modern equipment and arranged with a view to special attention being devoted to research. The department is being founded with the full concurrence and support of the directors of British Dyes, Limited, who are prepared to contribute towards its establishment.

MIDDLESBROUGH, the most important iron centre of the north of England, has depended in the past for its research work upon the enterprise of individual firms, but the question of erecting a technical college where students could be trained efficiently to take their places in the works' laboratories has been persistently before the Education Committee for some years. A plan for erecting a college was seriously contemplated in 1914, but the outbreak of war, by preventing the raising of a loan, caused any prospect of building to be relegated to the conclusion of hostilities. The opportunity to make progress in metallurgical science was not postponed, for the Cleveland Institution of Engineers took the matter in hand and designed to start a research laboratory of its own. The plan was progressing when, on June 5, a combined meeting of the Cleveland Institution of Engineers and the education authorities of Middlesbrough and the neighbouring localities was held to hear of the munificent offer of Mr. Joseph Constantine to guarantee a sum of 40,000*l.* for the erection of a technical college on a piece of ground which had already been purchased by the Middlesbrough Town Council for such a purpose. This splendid offer

was accepted with considerable applause and gratitude, and led to other members of the meeting making further offers. Messrs. Bell Bros., Ltd., and Messrs. Dorman, Long and Co., Ltd., and their allied firms offered 10,000*l.*, and Messrs. Sir Bernard Samuelson and Co., Ltd., 5000*l.*, towards the equipment. It is expected that the sum of 100,000*l.* will be obtained without difficulty. The minor scheme of establishing a metallurgical laboratory is being proceeded with, and part of its equipment may come out of the generous donations which have been made, and at the end of the war the equipment will be transferred to the new Constantine Technical College.

IT is somewhat of a novelty to find in a paper such as the *Manchester Guardian*, in its issue of June 19, a full-column advertisement urging the claims of education. But "it brings hope with it and forward-looking thoughts," since it gives welcome evidence that the value of education has at last come home to the British business man, who now sees that "national education of the broadest possible kind is the only method by which we can secure permanent British trade supremacy." The advertiser, Mr. C. F. Higham, realises that this cannot be done unless measures are taken to ensure for every child of the nation "a sound, efficient education" at the hands of more and much better paid teachers, and that such effective training should be followed by specialised teaching in every branch of industry for both employers and employed. He further urges a closer co-operation between capital and labour, and a better appreciation of their respective functions. "National education is a fundamental need." It "should be the national extravagance after the war." Let us maintain the same energy of organisation and of production for the purposes of peace that we have shown in equipment for war. The cost will be heavy, but it is the price demanded for efficiency, and, as the war has clearly shown, our financial resources are fully equal to any demands required for the well-being of the nation. This is a timely plea that British industrial enterprise shall be fostered and maintained upon a sound footing, namely, that of an "all-round enlightenment," and that no mere "tinkering with tariffs or making mild concessions after strikes will ensure it." Amidst all this strife it might, perhaps, be as well to listen to a voice of the eighteenth century, that of Rousseau in his "Emile": "To live is the trade I would teach him."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, June 21.—Major H. G. Lyons, president, in the chair.—J. E. **Clark** and H. B. **Adames**: Report on the phenological observations for 1915. The year, as a whole, approximated closely to the mean for the twenty-five years over which records now extend, being, if anything, a shade earlier; but this new mean for England and Wales, falling on May 18 (taking the whole British Isles, the mean date is May 21), is a day earlier than that for the twenty years. Every one of the intervening years was early, whilst the four preceding these had been late; 1914 was seven days earlier than 1915, of which the outstanding features were the mild and very wet winter; the following period of drought, interrupted in most parts through July and early August, in others almost continuous through October; the genial conditions, as a whole, in April and June, but with cold spells and frosts in May and June; the cold, sunless, wet July, followed by a genial autumn ending in the unprecedented November frosts. The cold periods in spring affected migrants adversely, the mean date being April 26, compared with April 24 in 1914 and April 23 for the twenty years' mean of the *Natural History Journal* records, 1877 to 1896. An important appendix deals with a communication by Dr. Ihne, of Darmstadt, extending to the British Isles the mean date, in six weekly zones, of the coming of spring in various parts, such as he has carried out for the Continent. The map representing this roughly shows that Central England corresponds to Belgium, North England and the Lowlands of Scotland to Holland, and the northern Highlands to Denmark. Ireland has similar zones, except the last, the southern parts, as also in England, coming under the two earlier zones, starting from April 17.—M. **Christy** and W. **Marriott**: Audibility of the gun-firing in Flanders over the south-east of England, September, 1914–April, 1916. The sound of the fighting in Flanders has been repeatedly heard in many parts of the south-east of England since an early period of the war. From the records collected it appears that the gun-firing has been heard at one time or another over the counties of Essex, London, Kent, Surrey, and Sussex, the most distant place being about 150 miles from Ypres. The weather charts show that generally there is a somewhat irregular or not definitely defined distribution of barometric pressure, but mostly with a region of high pressure wedged in between areas of slightly lower pressure. These conditions are such as to produce light winds at the surface, mostly between north and east, over the neighbourhood of the North Sea. Aspect and elevation are also important factors for the hearing of the firing.—Lieut. F. H. **Chapman**: The relation between atmospheric pressure and rainfall at a single station. In this paper the author deals with the relationship between (1) actual pressure values and rainfall, and (2) mean pressure values and rainfall totals. The former relationship is small, and the author deals with it by the method of probability values. Curves are given showing the chances of rain at Kew during the hour 6.30 a.m.–7.30 a.m., and during the twenty-four hours 7.30 a.m.–7.30 a.m., according to the height of the barometer at 7 a.m. These curves are based on data for Kew for the ten years 1904–13. The relationship between mean pressure and rainfall totals is dealt with by the method of correlation. The coefficients obtained are high, and the corresponding regressions are shown to be very nearly linear. In this latter part of the paper, data for Kew and Valencia for the forty-seven years 1869–1915 are used.

Mineralogical Society, June 20.—Dr. A. E. H. Tutton, past-president, in the chair.—Dr. J. W. **Evans**: The relations between different laws of twinning giving the same twin-crystal. If the untwinned crystal has no symmetry, different twin-laws give different results. In the presence of a centre of symmetry an axis of rotation-twinning is an axis of reflection-twinning. An axis of rotation-twinning lying in a plane of symmetry has at right angles to it in the same plane an axis of reflection-twinning. If the normal to a plane of symmetry be an axis of rotation-twinning, or if a line of symmetry (axis of even symmetry) be an axis of reflection-twinning, the same result may be obtained by the complete inversion of the structure; *vice versâ*, in an inversion-twin the normal to every plane of symmetry is an axis of rotation-twinning, and every line of symmetry is an axis of reflection-twinning. If a twin-axis be at right angles to an axis of n degrees of symmetry, there will be in all n twin-axes of the same kind at right angles to the

same axis of symmetry. Other more complex relations were described.—Dr. G. T. **Prior**: The meteorites of Khairpur and Soko-Banja. The Khairpur meteorite is precisely similar to the Daniels Kuil, and, like it, belongs to the rare Hvittis type of chondritic stones, which contain oldhamite, and are almost free from oxide of iron. The Soko-Banja meteorite contains a small amount (4 per cent.) of nickel-iron, very rich in nickel, together with ferro-magnesian minerals rich in ferrous oxide.—Dr. G. T. **Prior**: The classification of meteorites. In chondritic stones the richer the nickel-iron in nickel the richer the ferro-magnesian minerals in ferrous oxide, and in general the smaller the amount of nickel-iron the richer it is in nickel. On these principles chondritic stones are divided into four groups corresponding to the types:—(1) Daniels Kuil; (2) Cronstad; (3) Baroti; (4) Soko-Banja. Under the same groups the meteoric irons may be arranged according to their richness in nickel, and the non-chondritic stones according to the richness in iron of the ferro-magnesian silicates, except that a fifth group is added for Eucrite, Howardite, Shergottite, Angrite, and Nakhlite, since they are richer in lime, ferrous oxide, and mostly also in alumina, than any chondritic stone at present known.—Lieut. A. **Russell**: Note on a new occurrence of gold from Cornwall. Alluvial gold was found in the bed of a small stream adjoining a jamesonite mine near Port Isaac.—A. **Holmes**: A series of volcanic rocks from the neighbourhood of the Lucalla River, Angola. The rocks described were collected by J. J. Monteiro in 1860, and include porphyritic basalts, biotite trachyte, trachyte with ægirine and cossyrite, nephelinite, and pyroxene andesite. They occur partly over Archæan, and partly over Karoo, rocks, and are probably related to the Tertiary alkali rocks between Senza do Itombe and Bango. An olivine camptonite of post-Miocene age from Dombe Grande, near Benguella, was also described.—Prof. T. L. **Walker**: Spencerite, a new zinc phosphate from British Columbia. The new mineral occurs as the core of stalactites of hemimorphite in the H.B. zinc mine near Salmo, in the West Kootenay district. It is snow-white in colour, with brilliant pearly lustre on the perfect cleavage. The three rectangular cleavages and the optical characters suggest at first sight rhombic symmetry, but complex lamellar twinning is present, and etched figures are symmetrical about one plane only. Analyses of the very pure material conform closely with the formula $Zn_3(PO_4)_2.Zn(OH)_2.3H_2O$, the mineral being a hydrated basic zinc phosphate, and thus differing from the other zinc phosphates—hopeite, parahopeite, and tarbuttite. It is named after Mr. L. J. Spencer, of the British Museum.—E. L. **Bruce**: Magnesian tourmaline from Renfrew, Ontario. Brown crystals occur at the contact of crystalline limestone and gneiss in a limestone quarry at the town of Renfrew. Analysis shows the presence of 14·53 per cent. of magnesia.

PARIS.

Academy of Sciences, June 13.—M. Camille Jordan in the chair.—G. **Bigourdan**: The discovery of the visibility of the stars in full daylight, and the works of Gassendi. The author corrects his former note on this subject, as the author of the MSS. describing the appearance of Mercury in daylight was Peiresc, and not J. Gaultier.—B. **Baillaud**: Remarks on the determination of the difference of longitude between the Observatories of Paris and Washington. The figures are based on wireless telegraphy between the two stations, and the value adopted for the difference of longitude is 5h. 17m. 36·771s.—L. **Landouzy**: Observations on the note of A. Chauveau (*Comptes rendus*, 1916, p. 855). A discussion of the relations between tuberculosis and alcoholism.—C. **Guichard**: A particular class of congruences of circles.—W. H. **Young**: The basis of the theory of integration.—C. **Chéneveau**: A direct reading density balance. The instrument described permits the determination of the density of a liquid (up to 2·5) to about one unit in the third decimal place.—M. **Zenghelis**: The synthesis of ammonia. Experiments of the combination of hydrogen and nitrogen at the ordinary temperature in presence of various catalysts.—W. **Broniewski**: Martensite in the iron-carbon diagram.—F. **Zambonini**: Some observations on the composition of apatites.—C. **Sauvageau**: The "mucilage glands" of certain Laminaria.

NEW SOUTH WALES.

Linnean Society, March 29.—Mr. A. G. Hamilton, president, in the chair.—A. G. **Hamilton**: Presidential address. A review of the relations of birds and flowers in regard to pollination, with special reference to the Australian aspect of the subject. The entire absence of bird-pollinated flowers from the European flora is responsible for some general statements concerning the relations of insects and flowers, which are not applicable, without qualification, to other floras. Mr. Bentham, in his important paper, "Notes on the Styles of Australian Proteaceæ," was apparently unaware that, so far as is known, the highly specialised flowers of the suborder Folliculares are entirely dependent on birds for pollination, for he speaks of the possibility of insect-agency being required to transfer the pollen of certain Grevilleas to adjoining flowers. In addition to the Proteaceæ, there are numerous less specialised flowers—species of Myrtaceæ (Eucalypts, Angophora, Callistemon, Darwinia, etc.), Epacrideæ (Styphelia), Loranthaceæ, and others—which, though freely visited by birds, may not be entirely dependent on them, as these are also visited by numerous insects. The Australian "professional" pollinating birds comprise seventy-two species, in twenty-three genera, of Meliphagidæ, and seven species of brush-tongued lorikeets, besides a few species of other families which, occasionally, may play a subordinate part as amateurs. The interaction of these agencies, over a continental area, must, in the aggregate, be of some considerable magnitude. Bird-pollination is a much more difficult problem for investigation than insect-pollination. The birds are shy, and resent the presence of intruders, so that the observer can rarely approach sufficiently near to make out all-important details, and quick in their movements. The individual flowers of the Australian Proteaceæ are small, though usually massed in showy spikes or heads, and this increases the difficulty.—R. J. **Tillyard**: Studies on Australian Neuroptera. No. II.—Descriptions of new genera and species of the families Osmylidæ, Myrmeleontidæ, and Ascalaphidæ.—A. **White**: Revision of the Stratiomyidæ of Australia (Diptera). The Stratiomyidæ form one of the larger families of the Diptera, containing about one thousand species from all parts of the world. They are conspicuous flies, many of them possessing splendid metallic colouring, but, so far as the Australian species are concerned, they have been little studied. The present paper lists thirty species, belonging to eighteen genera, all the species, with one doubtful exception, and twelve of the genera being peculiar to Australia.

CAPE TOWN.

Royal Society of South Africa, May 17.—Dr. A. Marius Wilson in the chair.—W. T. **Saxton**: Ecological notes on the district of Manubie, Transkei.

The area comprises three chief plant formations, namely, woodland, park-like grassland with scattered trees and bushes, and in the more low-lying parts of the latter, sedge vegetation. The soil is essentially uniform throughout the area, being a fine red-brown loam containing comparatively few large particles or stones. No marked differences in climatic or edaphic factors distinguish the woodland from the grass land, though these are of strikingly different appearance and are separated by a sharp boundary line.—J. S. v. d. **Lingen:** (1) Note on the radiations emitted by degenerating tissues; (2) note on the ionisation produced by degenerating nerve-muscle preparations. The author brings forward some evidence that organic tissues may *post mortem* give rise to ionisation, which can be detected by the discharge of an electroscope. On the second and third days after death the discharge seems to attain its maximum. There is also some evidence that radiations are given off which can affect photographic plates. The author states that control experiments are in progress.

BOOKS RECEIVED.

Aids to Bacteriology. By C. G. Moor and W. Partridge. Pp. viii+278. Third edition. (London: Baillière, Tindall and Cox.) 3*s.* 6*d.* net.

A Bibliography of British Ornithology, from the Earliest Times to the End of 1912, including Biographical Accounts of the Principal Writers and Bibliographies of their Published Works. By W. H. Mullens and H. Kirke Swann. Part i. Pp. 112. (London: Macmillan and Co., Ltd.) 6*s.* net.

The Declining Birth-rate: its Causes and Effects. Pp. xiv+450. (London: Chapman and Hall, Ltd.) 10*s.* 6*d.* net.

University College of Wales, Aberystwyth. Agricultural Department. The Improvement of Upland Pastures. By A. E. Jones and R. G. Stapledon. Pp. 24. (Aberystwyth: John E. Evans.)

Luther Burbank: his Life and Work. By Dr. H. S. Williams. Pp. xii+333. (London: Grant Richards, Ltd.) 10*s.* 6*d.* net.

What is Coming? A Forecast of Things after the War. By H. G. Wells. Pp. 295. (London: Cassell and Co., Ltd.) 6*s.* net.

Lays of Love and Life. By Rev. E. E. Bradford. Pp. 163. (London: Kegan Paul, Trench and Co., Ltd.) 2*s.* 6*d.* net.

Survey of India. General Report, 1914–15. Pp. 40+14 maps. (Calcutta.) 2 rupees, or 3*s.*

Annals of the South African Museum. Vol. xv., part iii., containing:—(3) Contributions to the Crustacean Fauna of South Africa. By K. H. Barnard. Pp. 105–302. Plates xxvi–xxviii. (London: Adlard and Son.) 12*s.* 6*d.*

Canada. Department of Mines. Geological Survey. Memoir 55: Geology of Field Map-Area, B.C. and Alberta. By J. A. Allen. Pp. viii+312. Memoir 77: Geology and Ore Deposits of Rossland, B.C. By C. W. Drysdale. Pp. xi+317. Annual Report of the Mineral Productions of Canada during the Calendar Year 1914. Pp. 362. (Ottawa: Government Printing Bureau.)

Board of Agriculture and Fisheries. Fishery Investigations. Series ii. Sea Fisheries. Vol. iii., No. 3: An Analysis and Review of the English Plaice-Marking Experiments in the North Sea. Pp. 126. (London: H.M.S.O.; Wyman and Sons, Ltd.) 8*s.*

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1915. Pp. iv+444+98. (London: H.M.S.O.; Wyman and Sons, Ltd.) 4*s.* 6*d.*

DIARY OF SOCIETIES.

THURSDAY, JUNE 29.

ROYAL SOCIETY, at 4.30.—The Determination of Gravity at Sea: Prof. A. Schuster.—The Genesis of Pleochroic Haloes: Prof. J. Joly.—Some Determinations of the Sign and Magnitude of Electric Discharges in Lightning Flashes: C. T. R. Wilson.—The Kinetic Theory of a Composite Monatomic Gas; Diffusion, Viscosity, and Thermal Conduction: S. Chapman.—Further Observations on Protozoa in relation to Soil Bacteria: Dr. T. Goodey.—New Bennettitean Cones from the British Cretaceous: Dr. M. C. Stopes.—And other Papers.

ROYAL SOCIETY OF ARTS, at 4.30.—The Sikhs: Sirdar Daljit Singh.

FRIDAY, JUNE 30.

PHYSICAL SOCIETY, at 5.—A Sensitive Magnetometer: Dr. P. E. Shaw and C. Hayes.—The Latent Heat of Fusion of a Metal and the Quantum-Theory: Dr. H. S. Allen.—Experiments on the Thermoelectric Properties of Fused Metals: C. R. Darling.—Cohesion, Part II: Prof. H. Chatley.

MONDAY, JULY 3.

ARISTOTELIAN SOCIETY, at 8.—The Import of Propositions: Prof. J. Brough.

FRIDAY, JULY 7.

GEOLOGISTS' ASSOCIATION, at 7.30.—Geology and Scenery of the Cardiff District: Prof. T. F. Sibly.

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