THURSDAY, AUGUST 14, 1919.

PHOTOGRAPHY.

Photography: Its Principles and Applications. By Alfred Watkins. Second edition revised. Pp. xvi+333. (London: Constable and Co., Ltd., 1918.) Price 10*s.* 6*d.* net.

THE Watkins exposure meter is known wherever photography is practised, and the many other instruments that Mr. Watkins has introduced to render photography less haphazard than it so often is enjoy a wide appreciation. The author therefore comes to the task of writing a general treatise with what we may perhaps call a praiseworthy prejudice. Of this he is doubtless aware, for he says in his preface: "The greater attention given to my own methods in exposure and development will, I am sure, be forgiven." The author makes these methods clear and illustrates them well, and proves the error of certain notions that have been put forward from time to time, as, for example, that one should regulate the exposure of the plate according to the light that comes from the object rather than that which falls upon it.

As a practical guide for the ordinary photography of the amateur and the professional portrait photographer, the volume deserves commendation, although some important subjects are treated of with an unsatisfying conciseness. But when the author gets to matters of which he has presumably not made a special study, his statements are not so trustworthy. The confusion of "focus" and "focal length" has had such distinguished and prolonged patronage that perhaps we ought to pass it by; still, it is confusion, and it is avoidable. Mr. Warnerke is referred to as "Warneke," and Sir Joseph Wilson Swan, who died five years ago, as "Mr. J. W. Swan (now Sir John Swan)." With regard to Woodburytype, we are told that "a lead mould is made of a carbon print swollen in water so that the exposed parts are raised," and that "in the Woodburytype process the mould was taken by placing a polished sheet of lead on the wet carbon print and bringing both under heavy pressure in a hydraulic press." The gelatine relief was, of course, well dried before being caused to impress the lead. We have said enough to indicate that some parts of the book are much in need of revision.

The scope of the volume, as indicated by the table of contents, is very wide. We find stereoscopic work, panoramic photographs, enamels, ferrotypes, night photography, animated photography, "bioscope in colour," photo-telegraphy, photo-surveying by balloons, kites, and aeroplanes, telephotography, photomicrography, X-ray photography, astronomical photography, "spectrophotography," photo-mechanical processes, colour photography, etc., and each has at least an indication of its most obvious characteristics.

As the results of every method of sensitometry depend upon circumstances, and there can never be a standard method in a scientific sense, but only by agreement for the sake of convenience, all methods are of value, and we are glad to see that Mr. Watkins has again brought forward his "central speed" method.

C. J.

A RECORD OF SCIENTIFIC PROGRESS.

British Science Guild: British Scientific Products Exhibition, Central Hall, Westminster, July 3 to August 5, 1919. Descriptive Catalogue. Edited by Sir Richard Gregory. Pp. xxiii+358. (London: British Science Guild, 1919.) Price 2*s.* 6*d.* net.

MERELY to enumerate the contents of this interesting volume would occupy more space than could be reasonably allotted to an ordinary review. But this catalogue is something more than a list of exhibits, even admitting that there is much instruction to be derived from the descriptions associated with the objects shown.

The catalogue contains, first, an introduction by Sir Richard Gregory, chairman of the organising committee, and, if read attentively, as it ought to be, especially by employers and manufacturers, cannot fail to have a stimulating effect. The list of exhibits shows that in many directions this country has regained control of important raw materials, and by the application of scientific knowledge and technical experience has achieved results of which, as Sir Richard says, "the nation has every reason to be proud. Now is the time to see that the strong position thus gained is not lost, and to unite the interests of the people of these islands with those of British lands beyond the seas."

The volume before us sets out the sources from which new experimental results have proceeded during the war, and in the first place shows the extent of the debt incurred to the scientific authorities of the universities and technical colleges throughout the kingdom. In despatches at the end of 1916 warm acknowledgment of the help thus given is expressed by Sir Douglas Haig, and in 1919, again, by General Sir Henry Wilson, Chief of the Imperial General Staff. But in the past manufacturers have been slow to make use of the results secured by research in the scientific laboratory, and it is, therefore, all the more satisfactory to find that during the last five years very many of them have recognised the necessity of using scientific knowledge and employing scientifically trained men in their works to a much greater extent than heretofore. The result is that many industries are now associated directly with research either in the separate factories or by a co-operative arrangement through the medium of research associations. To manufacturers, whether or not they are contemplating this question with a view to their own requirements, the facts and figures provided in the article on "The Organisation of Scientific Research in Works," by Mr. A. P. M. Fleming

(p. 77), will be found worthy of careful consideration.

To those who have been so long hoping that some day the importance of science in connection with industry would be recognised by the State, the Government scheme for industrial research is a source of satisfaction. The department now established has made a good beginning in affording assistance to many workers from the fund of one million granted by the Government and in encouraging the formation of research associations among manufacturers. Many of these are already in operation and are enumerated, with the names of their officers, in the comprehensive volume under notice.

THE BIRDS OF COLOMBIA.

Bulletin of the American Museum of Natural History. Vol. xxxvi., 1917. *The Distribution of Bird-Life in Colombia: A Contribution to a Biological Survey of South America*. By Dr. Frank M. Chapman. Pp. x+729+xli plates. (New York: The American Museum of Natural History, 1917.)

DR. CHAPMAN'S "Report on the Distribution of Bird-Life in Colombia" ranks amongst the most important contributions ever made to the knowledge of the ornis of the Neotropical Region, the avifauna of which stands unrivalled both in the wealth and variety of its feathered forms and in the number of its peculiar family and generic types. Colombia, thanks to Dr. Chapman's investigations, is now known to be the richest portion of this remarkable area so far as bird-life is concerned. That this should be so is due, no doubt, to the varied physiographical features to be found in that equatorial republic, for these range from tropical pasture-lands and forests at low, or comparatively low, levels to regions of perpetual snow in the Cordilleras, and include the uppermost tributaries of the Orinoco and some of those of the Amazon.

In the year 1910 the American Museum of Natural History organised and commenced a series of expeditions for the systematic exploration of the bird-life of the republic. These extended over five years, and were carried out under the direction of Dr. Chapman, who himself took part in them in 1910 and again in 1913. As the result of these systematic and well-organised explorations, 15,775 specimens, representing 1285 forms (species and subspecies), were obtained. Hence the report is based not only upon scientifically collected data, but also upon intimate personal knowledge of the country and its birds on the part of its author—a combination which has rendered the work of inestimable value.

As the result of his studies on this ideal system, Dr. Chapman recognises the following vertical life-zones: A tropical, which ranges up to 4500–6000 ft.; a sub-tropical, from 4500–6000 ft. to 9000–9500 ft.; a temperate, from 9000–9500 ft. to 11,000–13,000 ft.; a paramo (high plateau), from 11,000–13,000 ft. to the snow-line at 15,000 ft. These zones he again subdivides into faunal areas, so that the distribution of bird-life in Colombia is worked in remarkable detail. The author tells us that the uniformity of life increases with altitude, and that the distinctness of the various animals and plants of these several zones was a constant source of surprise and joy to him.

It is quite impossible here to enter into details of the various distributional problems unfolded by the author, but the portions of the work devoted to them are the most interesting and valuable to be found in this great work.

The systematic portion of the report treats in detail of the distribution, plumage, haunts, habits, etc., of the 1285 forms of bird-life which constitute the ornis of Colombia. Of these, twenty-two species and 115 subspecies are new to science. It is much to be regretted that Dr. Chapman has not included in his report the birds, some 400 in number, which had previously been recorded, but did not come under the notice of himself or his explorers. If this had been done it would have rendered his volume a complete record of all that is known to date of the avifauna of Colombia.

The volume is enriched by a series of reproductions of photographs of scenery depicting the various life-zones, and of useful maps and charts illustrating the distribution of species, forests, etc. It is further embellished by four coloured plates, devoted to the newly discovered birds, by the well-known zoological artist, Louis Agassiz Fuertes, who accompanied Dr. Chapman on two of his expeditions.

The author is to be heartily congratulated on the completion of his admirable work and on the masterly manner in which he has presented its results. Congratulations are also due to that enlightened institution, the American Museum of Natural History, which made this grand undertaking possible.

W. E. C.

OUR BOOKSHELF.

Practical Physiological Chemistry. A Book Designed for Use in Courses in Practical Physiological Chemistry in Schools of Medicine and of Science. By Prof. Philip B. Hawk. Sixth edition, revised and enlarged. Pp. xiv+661+vi plates. (London: J. and A. Churchill, 1919.) Price 21*s*. net.

THIS book, written by one of the best known of American physiological chemists, first appeared in 1907. Its success is evident from the fact that it is now in its sixth edition, and is due to the clearness and completeness of the practical instructions with which it is packed. It does not pretend to be a complete work of reference, but, though designed for the use of students, it is far too exhaustive for the ordinary student of medicine, who in the few years of his curriculum has to learn so many other subjects, and it is difficult to imagine that the American student can devote

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more time to physiological chemistry, important as the subject is, than his brother in this country.

The book labours from the disadvantage under which all books which see many editions labour; no one is more acutely conscious of this than the present reviewer; it is so easy to add, so heart-breaking to excise. At the same time, Prof. Hawk has made a praiseworthy attempt to cut down the multiplicity of methods which assail him. For example, the only methods given for urea estimation are those based on the use of urease, and Van Slyke's procedure is the only one described for the determination of acetone bodies. The same ruthless use of the pruning-knife in relation to other materials (*e.g.* sugar) would add to the practical usefulness of a most admirable book.

It would be easy to criticise details; for example, the book starts with a study of the most difficult of all chemical problems, namely, enzymes, so that it is scarcely one to recommend to the beginner; then, too, it is not always up to date; for instance, we are told that English physiologists speak of metaproteins as infraproteins, a term they dropped many years ago; the account of muscle physiology does not appraise the work of Hopkins and Fletcher on lactic acid (probably the key to the whole situation) at its full value. But where so much is good, picking holes is neither profitable nor kind.

W. D. H.

Joseph Priestley. By D. H. Peacock. (Pioneers of Progress. Men of Science.) Pp. 63. (London: Society for Promoting Christian Knowledge; New York: The Macmillan Co., 1919.) Price 2*s*. net.

THE story of Priestley's life has been told and retold; but to the man of science it is always an attractive story, and to the general reader its appeal is perhaps scarcely less strong. To the chemist there is a never-failing interest in reading how this village minister, theological controversialist, and political reformer, who had no special scientific training and no particular facilities for experimentation, nevertheless was drawn to chemical studies, and acquired a just and lasting fame by his brilliant discoveries.

Priestley's mind was one of rare alertness, and if he missed many things through the weakness of his theoretical deductions, a remark of his biographer helps us to understand pretty clearly why this was so. "Chemistry was really little more than a hobby to him; theology was his life work. . . . Priestley was Priestley, not Cavendish."

Of this notable "pioneer" we get a good picture in Mr. Peacock's pages. There are only about sixty of these, but they suffice to tell pleasantly, even if briefly, of Priestley's early struggles, his prolific pugnacity in pamphleteering, his delight in experiments, his serenity under adversity, his pathetic exile, and his peaceful passing.

C. SIMMONDS.

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.*]

A Darwinian Statement of the Mendelian Theory.

So far as the present writer knows, no public notice has yet been given to a series of statements by Darwin in his "Animals and Plants under Domestication" that constitute virtually a statement of the Mendelian theory of the distribution and recombination of factors in hybrid offspring. Darwin's idea of dissociation is, of course, founded on Naudin's conception of disjunction, but the remainder of his theory is as original as Mendel's, except that it is purely speculative instead of being derived directly from experimental data. It is worked out, as a matter of fact, by means of his theory of pangenesis.

Darwin begins as follows:—"Another form of reversion is far commoner, indeed is almost universal with the offspring from a cross, namely, to the characters proper to either pure parent-form. As a general rule, crossed offspring in the first generation are nearly intermediate between their parents, but the grandchildren and succeeding generations continually revert, in a greater or lesser degree, to one or both of their progenitors" (vol. ii., p. 22).

He then quotes Naudin's view that "a hybrid is a living mosaic-work, in which the eye cannot distinguish the discordant elements, so completely are they intermingled. We can hardly doubt that, in a certain sense, this is true, as when we behold in a hybrid the elements of both species segregating themselves into segments in the same flower or fruit by a process of self-attraction or self-affinity, this segregation taking place either by seminal or bud-propagation" (p. 23).

Darwin goes on to comment on Naudin's view that the segregation of the male and female elements would be most likely to occur in the reproductive cells, since in this way their reunion through the fusion of pollen-grains and ovules would explain the phenomenon of reversion.

He then says:—

"If . . . *pollen which included the elements of one species happened to unite with ovules including the elements of the other species, the intermediate or hybrid state would still be retained, and there would be no reversion*" (p. 23).

Here is a statement of a theory of heterozygosis which, although not complete in exactly Mendelian form, is, so far as the writer knows, the first before the appearance of Mendel's paper. Darwin's more elaborate explanation comes later. He continues:—

"But it would, I suspect, be more correct to say that the elements of both parent-species exist in every hybrid in a double state, namely, blended together and completely separate" (p. 23).

Finally, in his chapter on pangenesis, Darwin approaches the theory of hybrids in thorough-going fashion, driving his pangenesis theory to its legitimate conclusions. By this theory, as is well known, it was assumed that the character-units existed in the somatic cells in the form of physical entities, however small, known as "gemmules." These, passing into the reproductive cells, conveyed thither the sum-total of the inheritance.

Darwin then approaches the subject of the theory of hybrids as follows:—

"The tendency to reversion is often induced by a change of conditions, and in the plainest manner by crossing. Crossed forms of the first generation are generally nearly intermediate in character between their two parents; *but in the next generation the offspring commonly revert to one or both of their grandparents,* and occasionally to more remote ancestors" (vol. ii., p. 383).

The somatic cells of the hybrid, according to the theory of pangenesis, throw off gemmules carrying the character-units, and, as Darwin says, "by the same hypothesis dormant gemmules derived from both pure parent-forms are likewise present. . . ."

"Consequently," he continues, "the sexual elements of a hybrid will include both pure and hybridised gemmules; *and when two hybrids pair, the combination of pure gemmules derived from the one hybrid, with the pure gemmules of the same parts derived from the other, would necessarily lead to complete reversion of characters*" (*ibid.*).

Here we have as exact a presentation of the allelomorphic idea of homozygosis as could be wished. We have merely to substitute the word "factors" or "genes" for "gemmules" to have virtually a statement in the form of the Mendelian theory.

Finally, Darwin says:—

"And, lastly, hybridised gemmules derived from both parent hybrids would simply reproduce the original hybrid form" (*ibid.*).

Here is what appears to be, and substantially is on its face, a Mendelian form of explanation of recombination in heterozygosis, with this difference: According to Darwin's conception, the "gemmules," or as we should say "factors," come over, $Dr \times Dr$, from the respective parents in an already hybridised state, and give rise, simply by virtue of their all being there in a hybrid, to a complete bodily state of *Dr*—the hybrid condition—not, however, by means of segregation and recombination. Here is lacking, of course, the conception of separation and recombination according to the law of chance of *D* and *r*, giving 1 *DD* : 2 *Dr* : 1 *rr*. Such an explanation could scarcely have been expected to be worked out short of an experiment such as Mendel's, involving actual counts. It does seem strange to us now, in view of the several times previously recurring observations by some five different breeders, including those of Goss and Knight, of the phenomenon of the appearance of different coloured peas in the same pod as the result of crossing, that this phenomenon should not have aroused curiosity and led to experiments on Darwin's part, for he refers to them all. However, in view of the fact that neither Nägeli nor Focke—the only investigators before 1900 who were acquainted with Mendel's papers at all—was particularly impressed with the importance of *his* experiments with peas, it is not surprising that Darwin should, among others, have failed to find the clue that Mendel did.

However, as a contribution to the development of the history of hybridisation, Darwin's application of his doctrine of pangenesis is highly interesting, showing the operation of an able mind, in the absence of adequate experimental data, in framing a conception of a theory of hybrids that comes surprisingly near being a statement of the present point of view as regards operation and, in the case of homozygosis, in regard to theory as well.

HERBERT F. ROBERTS.
Department of Botany, Kansas State Agricultural College, June 24.

Wild Birds and Distasteful Insect Larvæ.

DR. W. E. COLLINGE gives in NATURE of July 24 some most interesting details about the distastefulness of insects to birds. He observes that both the larva and imago of *Abraxas grossulariata* are eaten by various species. I would like to add the following observations:—During the last few years I have bred several thousand larvæ, including those of *A. grossulariata*, in order to study their genetics. Owing to the impossibility of setting all the imagines, a certain number were set free as soon as recorded. In this way I have thrown out of my window imagines of the following species:—*A. grossulariata, Spilosoma mendica* (larvæ and imagines), and both type and melanic forms of *Tephrosia consonaria, Boarmia consortaria,* and *B. abietaria.* I have noticed the following points:—(1) The birds round the house, chiefly sparrows, would eat the imagines of all five species, but *A. grossulariata* the least readily, tearing off the wings and devouring the body on the spot (it was too late in the year for them to be feeding young). (2) My larvæ of *S. mendica* were suffering from a disease (a filter-passer, I believe, for smears revealed no micro-organisms), and when an entire brood was past hope I used to throw them into the garden. Some were dead and many dying, but they were cleared away in a few minutes, in spite of their evil smell. (3) The imagines of *B. consortaria* and *B. abietaria* were eaten with the utmost avidity. No sooner had one or two insects been thrown out than a number of birds would crowd round waiting for the next, and if this were hidden in the ivy round the house they would hunt for it until it was found. On one occasion some insects were hidden in a flower-pot on the window-sill, but the birds soon found them, and would afterwards return to the edge of the pot, as if waiting for more. These birds would even carry off dry pinned insects, possibly for their nests. The fact that birds will not eat *A. grossulariata* readily, but will eat the diseased larvæ of *S. mendica,* seems to support Mr. Speyer's view, especially since the parasites mentioned do not live in the alimentary tract. For this reason they contain no proteolytic enzymes, and can therefore be of no conceivable harm to young birds.

Observations as to the extent to which birds prey upon the imagines of various species have a special interest, because those theories of mimicry which are based on natural selection demand some conscious selective agent such as birds, although there are very few actual observations to support such a conclusion. Evidence concerning European species is, of course, only of value by analogy.

H. ONSLOW.
3 Selwyn Gardens, Cambridge, August 2.

THE BRUSSELS MEETING OF THE INTERNATIONAL RESEARCH COUNCIL.

THE Inter-Allied Conference on International Organisations in Science, which met in Paris on November 26–29, 1918, adopted a number of resolutions for constituting such organisations for the promotion of co-operation in scientific work, and appointed an executive committee to carry them out until the scheme was sufficiently advanced for the International Council to be convened and to assume its final form as a federation of National Research Councils.

This took place at a meeting which was held in Brussels on July 18–28, where the following countries and dominions were represented by their delegates: Belgium, Canada, France, Italy, Japan, New Zealand, Poland, Rumania, Serbia, the United Kingdom, and the United States of America.

On the morning of Friday, July 18, the delegates met in the Palais des Académies, where King Albert was present. M. Harmignie, the

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Minister of Science and Arts, welcomed them in a short address in which he dwelt on the importance of the occasion and on the valuable results which would be obtained from international co-operation in science, and wished them success in their deliberations.

M. E. Picard, the president of the Executive Committee, was unfortunately prevented by ill-health from being present, and M. A. Lacroix presided at the meetings of the General Assembly. The first business was the consideration of the statutes of the International Research Council which had been provisionally agreed upon in Paris, and now came up for consideration in the final form as recommended by the Executive Committee.

The objects of the Council are therein defined to be:—

(*a*) To co-ordinate international efforts in the different branches of science and its applications.

(*b*) To initiate the formation of international associations or unions deemed to be useful to the progress of science.

(*c*) To direct international scientific action in subjects which do not fall within the province of any existing association.

(*d*) To enter, through the proper channels, into relations with the Governments of the countries adhering to the Council to recommend the study of questions falling within the competence of the Council.

The countries adhering to the Council are those already mentioned as represented by their delegates as well as Brazil, Australia, South Africa, Greece, and Portugal—that is, those of the Allied nations who were originally invited to form the International Council as possessing academies of science, and being engaged in scientific work. To these, other nations may be added at their own request or on the proposal of a country already belonging to the Council, or Union, by a three-fourths vote in favour of admission.

The work of the Council will be directed by the General Assembly, which will meet ordinarily every three years, but in the interval between its successive meetings business will be transacted by an Executive Committee of five members nominated by the General Assembly and holding office until the next meeting of the General Assembly. In the present case the Executive Committee, consisting of Prof. E. Picard, Dr. A. Schuster, Profs. Hale, Volterra, and Lecointe, has been re-elected and will consider its character and constitution and report to the next meeting of the General Assembly before its organisation is finally laid down.

The concluding meeting of the Council was held on Monday, July 28, when it was decided that all neutral nations should be invited to join the International Research Council and the International Unions created under its auspices, thus providing for the reconstitution of international scientific associations so far as is practicable at the present time.

The formation of unions for the organisation of international work and co-operation in different departments of science, which had been initiated at Paris, was carried considerably further at Brussels. In some cases unions with sections for dealing with special branches of the field covered by the union were organised. In other unions the delegates present came to the conclusion that at the present stage it was preferable to appoint committees to study the general position, and to report later to the union with a view to the formation at its next meeting of such sections as might be needed, when the representatives of the different countries would be better able to estimate their requirements.

The Astronomical Union, which was instituted in Paris, was now able to complete its organisation by approving its statutes, and by deciding upon the appointment of a number of committees for organising international co-operation in various branches of astronomical work, such an arrangement being considered better than the formation of separately organised sections. M. Baillaud was nominated president, and Prof. A. Fowler general secretary, of the union.

The Geodetic and Geophysical Union, which was also instituted at Paris in November last, includes several branches of science for which special organisations have existed for many years before the war. These have now been reconstituted as sections of the union, each with its own executive committee of international delegates. The statutes of the union, which follow generally those of the Council, were approved, and sections were formed for geodesy, seismology, meteorology, terrestrial magnetism and electricity, physical oceanography, and vulcanology. The section of geodesy takes the place of the International Geodetic Association, now non-existent, but which formerly had its bureau at Potsdam. The triennial meetings of this association, at which reports on different kinds of geodetic work were presented and new methods and plans for work discussed, were of the greatest value to geodesists, and the new section has a large field of work before it. Variation of latitude was formerly included among the subjects grouped under geodesy, but at Brussels it was agreed that it would be more conveniently dealt with by the Astronomical Union, which appointed a committee to consider and report upon this subject. Major W. Bowie, of the U.S. Coast and Geodetic Survey, was nominated president, and Col. Perrier, of the Service Géographique de l'Armée at Paris, secretary of this section.

In seismology the old pre-war association is still in being until April 1, 1920, since the countries belonging to it did not withdraw from it before the commencement of the last four-year period. Its central bureau was at Strasburg, which is now a part of French territory, and Prof. Rothé has been appointed professor of geophysics there. It was decided, therefore, that no definite action beyond the institution of a section of seismology should be taken until the old association had ceased to exist. The proposal was made at Paris that a section of the union should deal with meteorology, and this has now been confirmed, Sir Napier Shaw being nominated president, and Dr. Marvin, of the U.S. Weather Bureau, secretary. There has been for many years an International Committee of Directors of Meteorological Services, by whom administrative and technical questions relating to their work were discussed and international co-operation in that work was arranged. There is, however, ample scope for an organisation to co-ordinate work in meteorology, and to direct international work in the subject which does not fall within the administrative requirements of the meteorological services.

International work in terrestrial magnetism has hitherto been looked after by a sub-committee appointed by the International Meteorological Committee, but there was a general agreement that this subject and the electrical phenomena of the atmosphere should be dealt with by a special section which would co-operate with that dealing with meteorology and with the Physical Union in its work. Of this new section Prof. A. Tanakadate and Dr. Bauer, of the Carnegie Institution of Washington, were appointed respectively president and secretary.

To these sections were added two new ones—that of physical oceanography, to deal with tides, currents, temperature, density, salinity, and other physical phenomena of the oceans; and that of vulcanology for the study of the chemical and physical phenomena of volcanoes. In oceanography no president was nominated, but Prof. H. Lamb was elected vice-president, and Dr. Magrini, of the Hydrographic Service of Venice, secretary. In vulcanology the president is Prof. A. Riccò, of the Etna Observatory, and Dr. Maladra is secretary.

The executive committee of each union consists of a president, the presidents of its sections as vice-presidents, and a general secretary. In the Geodetic and Geophysical Union M. C. Lallemand, director of the Service de Nivellement de France, was elected president, and Col. H. G. Lyons general secretary.

The Mathematical Union was formed with Prof. Ch. de la Vallée-Poussin, of Louvain University, as president. In this union no sections have been formed, but it was agreed that the union should meet in Strasburg next year, when the further organisation of the union might be considered.

A Chemical Union was also formed, but the representation of this subject at Brussels was not sufficient to proceed further with its organisation there. The delegates representing physical science decided to form the Physical Union, leaving its complete organisation to a later occasion. An organising committee was nominated and charged with making arrangements for the next meeting as well as for forwarding various projects of importance for the progress of physical science.

In biology Prof. Yves Delage was elected president, and M. C. Flahault secretary. Sections were established for general biology, physiology, zoology, botany, applied biology, and medical science, but here, too, it was recognised that the arrangements made could only be provisional.

Though the practical success of the International Research Council and the unions associated with it cannot be fully demonstrated until the next meeting, when three years' work will be available for report, and there will have been time to prepare projects for international working in each group, the organisation is now established on a working basis, and the meeting at Brussels showed that there was a large amount of work to be taken up, for the organisation of which the executive committees of the unions and sections now exist. The meetings in London, Paris, and Brussels form successive stages in this important achievement, and the members of the executive committee who have guided the Research Council through the first stages of its existence may well be satisfied with the result.

The legal domicile of the International Research Council will be at Brussels, and the periodical meetings of the General Assembly will take place there. The secretariat will continue to be in London, where the Royal Society has placed a room at its disposal. Unions and sections will meet at such times and places as their general assemblies or executive committees may decide.

On the day of their arrival the delegates were received at the Hôtel de Ville by M. Adolf Max, and receptions were given by the Minister of Science and Arts on July 26, and by the Minister of Foreign Affairs on July 28, at their official residences. On July 26 M. G. Lecointe, director of the Royal Observatory, invited the delegates to visit the observatory at Uccle, where they were shown over the buildings and its ample instrumental equipment.

H. G. L.

THE BOURNEMOUTH MEETING OF THE BRITISH ASSOCIATION.

IT is now possible to give further details of the meeting of the British Association to be held at Bournemouth on September 9-13. As already stated, practically all the meetings and discussions will be held in the Municipal College. This building, it is anticipated, will provide ample accommodation for all the activities of the association, with the exception of the very large assemblies—the inaugural general meeting, the discourses, and the conversazione (or, as it is now termed, the civic reception). It will readily be seen that in this respect members will find the arrangements far more convenient than at many previous meetings, when various buildings scattered over the town have had to be utilised.

The large hall of the college will be fitted up as the reception room. Other parts of the building will be converted into section rooms, staff rooms, luncheon and tea rooms, writing and smoking rooms, telephone room, etc. Members may be assured that they will find every convenience and comfort immediately at hand. Only in the problematical case of an exceptionally large sectional meeting will it be necessary to make use of another building.

It is unnecessary in this article to describe in detail the long programme of work, a copy of which can be obtained from the headquarters of the association. The journal, giving full particulars, will, as usual, be issued daily throughout the meeting. The general public will probably be most interested in the papers and discussions relating to scientific work in the war, on such subjects as tanks, submarine mining, the paravane, air photography, the progress of aviation, airships, and directional wireless. Of special topical interest will also be the discussions arranged by the Economics Section on the National Alliance of Employers and Employed, price-fixing, with special reference to Australian experience, transport, finance and taxation, and the gold standard; by the Agriculture Section on war-time food production; by the Physiology Section (jointly with that of Economics) on the influence of the six-hour day on industrial efficiency and fatigue; by the Education Section on various problems of modern education; and by the Geography Section on long-distance air routes, the geography of Imperial defence, frontiers in the East of Europe, and the colonisation of Africa.

Following the precedent set in Birmingham in 1913, citizens' lectures will be delivered in outlying parts of the town during the week, in co-operation with the Workers' Educational Association. These will comprise lectures by Prof. H. H. Turner on "Modern Astronomy," Prof. S. H. Reynolds on "Purbeck Isle and its Geology and Scenery," and Prof. J. L. Myres on "Woman's Place in Nature from an Anthropological Point of View."

Numerous excursions will be made to places of interest in the neighbourhood. The Engineering Section will, by special permission of the Admiralty, visit the Royal Naval Cordite Factory at Holton Heath, a vast organisation which has sprung up during the war, and will also inspect the Bournemouth and Poole Gas and Water Works and the power stations of the tramways and electric light undertakings. The Geology Section will journey each afternoon to points of geological interest in the locality, including such favourite haunts of geologists as Lulworth Cove and Kimmeridge. The Botany Section will find much material for work and discussion in the New Forest, at Shell Bay, and elsewhere. The Agriculture Section is arranging a visit to Iwerne Minster, in the neighbouring county of Dorset; while the Anthropology Section will organise an excursion to the Channel Islands if sufficient names are received before the meeting. Communications on the last-named subject should be addressed to Dr. R. R. Marett, Exeter College, Oxford, who is to read a paper on recent discoveries of archæological interest in the Channel Islands.

It may also be mentioned that Lord Montagu of Beaulieu, president of the Conference of Delegates of Corresponding Societies, has offered to show members and their friends over the beautiful Beaulieu Abbey, with its thirteenth and fourteenth century remains; and Sir Merton and Lady Russell Cotes have consented to throw open to them the East Cliff Hall and its fine collection of art treasures.

From the social point of view, those attending the meeting will find the Bournemouth week a very pleasant one, even though official functions on a large scale are not contemplated. Various local clubs and institutions will be ready to receive them as honorary members during the period of the meeting, and in other ways a great deal will be arranged in the way of hospitality and entertainment.

Hydrophones

SUBMARINE ACOUSTICS.

X Acoustics Submarine

THE war has been responsible for great developments in many branches of science. As a consequence of the submarine menace, close attention has been given to the subject of marine physics, with the result that notable advances have been made in several directions, especially in that of submarine acoustics. Much of what has been accomplished is still regarded as confidential information, but some interesting disclosures have recently been made by Prof. W. H. Bragg in the Tyndall lectures delivered before the Royal Institution, and in a lecture at the British Science Guild's Exhibition at Westminster.

The singular property which distinguishes a submarine from other ships is its capacity of rendering itself invisible when pursued or when seeking and attacking its prey. Robbed of this power, it is an extremely vulnerable craft, and falls a ready victim to more heavily armed and armoured surface ships when once its presence has been detected and its position located.

The acoustic method of detecting a submerged submarine moving in the open sea was found to be far more sensitive and to give a much longer range than all other methods. Instruments used for this purpose are called hydrophones. Many varieties of hydrophone have been evolved and perfected, but by far the largest class consist essentially of a microphone attached to a diaphragm which forms one wall of a watertight cavity. The microphone is connected through a suitable electrical circuit to ordinary telephone receivers, the complete installation resembling a unit of an ordinary land telephone system. In use the hydrophone is suspended from the bulwarks of a stationary ship, or mounted in tanks attached to the hull, or trailed behind in a suitable "fish" body in the case of a moving ship. The range of a hydrophone depends upon the size and speed of the source of sound, the depth and state of the sea, the presence of other sources of sound, etc., and may vary from a few hundred yards to several miles.

The difficulty of ascertaining the *direction* of a source of sound has been overcome in a number of ways. One type of directional hydrophone is shown in Fig. 1. In this instrument *both* sides of the sensitive receiving diaphragm are in contact with the sea, the microphone being encased in a small capsule at the centre of the diaphragm. If used in this form the instrument is deaf to sounds in its equatorial plane, but can hear sounds coming from other directions. It is, in fact, the reciprocal of the hypothetical "double source" of Helmholtz. The polar curve, showing the dependence of its response upon its orientation with respect to the source, is given in Fig. 2.

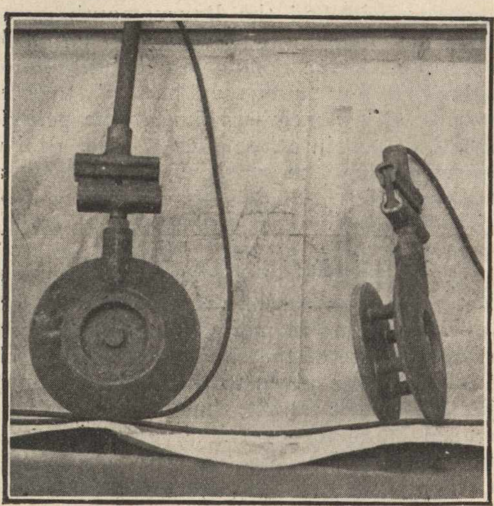

FIG. 1.—Uni-directional hydrophone.

It is obvious that the ambiguity involved in the *bi-directional* qualities of such an instrument would seriously diminish its efficiency in actual practice, and accordingly a modification was introduced to eliminate this defect. This consisted in the attachment to the hydrophone carcass, at some distance away from the sensitive diaphragm, of a bias plate, or "baffle," as it is now called. This can be seen in the side view of Fig. 1. When correctly adjusted in position, the "baffle" modifies the polar curve of Fig. 2, so that it takes the form shown in Fig. 3, and, as can be readily seen, renders the hydrophone *uni-directional.*

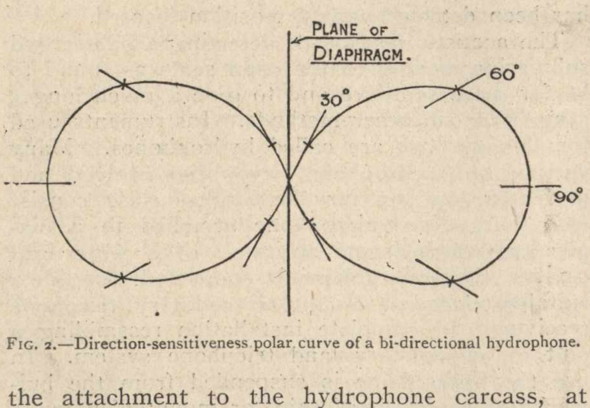

FIG. 2.—Direction-sensitiveness polar curve of a bi-directional hydrophone.

The construction and properties of "baffles" are very interesting, and have been the subject of prolonged investigation. The mathematical theory of their action has not been worked out fully, as it is difficult to specify all boundary conditions. Moreover, the phenomena are of the diffraction type, in which the obstacle is small compared with the wave-lengths of the incident disturbances. A fairly complete empirical knowledge of their properties has, however, been obtained. The essential feature of their construction is the inclusion of a film of gas in a non-resonant enclosure. If the "baffle" is placed too close to the receiving diaphragm, the hydrophone becomes non-directional, a limiting case being that in which one side of the diaphragm is completely enclosed, and, therefore, "over-baffled."

In his lectures Prof. Bragg also briefly described two other methods by which the direction of an under-water source of sound could be ascertained by making use of a number of hydrophones which do not themselves possess intrinsic directional properties. In the first of these use is made of the binaural principle. Two hydrophones are mounted on a rotating arm at a distance apart of from six to eight feet, one hydrophone being connected to the right ear-piece of the observer's telephone, and the other to his left ear-piece. If now the wave-front of the oncoming sound strikes the right-hand hydrophone first, the sound appears to come from the observer's right. On rotating the arm the hydrophone on the left side can be advanced so that the sound appears to come from the left. By rotating the device until the sound appears to come from ahead or astern, the observer is enabled to detect the direction of the source, a simple rule enabling him to resolve any fore-and-aft ambiguity. Instead of rotating the arm carrying the hydrophones, the angle which the wave-front makes with it can be found by compensating for the difference of path in water by introducing an equivalent length of air column between one or other of the observer's ear-pieces and his ear. In this case three hydrophones have to be used in pairs in order to obtain the direction of the source uniquely, the bearings being read off from the calibrated scale of the "compensator."

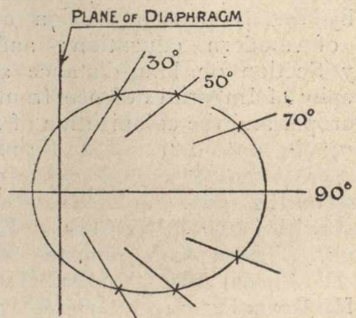

FIG. 3.—Direction-sensitiveness polar curve of a uni-directional hydrophone.

The second method consists in making use of the phase relationships between a number of hydrophones distributed at regular intervals in a straight line. It is obvious that in this case sound-waves from a distant source arrive in phase only when it is situated on the beam of the line of hydrophones. By making use of a multiple "compensator" the phases can be corrected for all directions, and the bearing of the source read off from the "compensator" when the observer has determined the setting for maximum intensity.

One gratifying feature of the work on submarine acoustics done during the war is the possibility which it provides of rendering navigation more safe in times of peace. Used in conjunction with suitable sound signalling apparatus fitted to vessels, and submarine bells moored near dangerous shoals and rocks, the improved hydrophones developed for war service should greatly reduce the dangers of collisions and shipwreck, due to fog, etc.

Already hydrographic surveys of the North Sea are being carried out in which the position of danger spots are located for charting purposes by exploding depth charges and recording the resulting disturbances at a number of hydrophones connected to land stations. This method of submarine sound-ranging is by far the most accurate method of locating such spots, and also provides a means of enabling a ship at sea to obtain its correct bearings. By dropping a bomb hundreds of miles at sea, a ship can in a few minutes communicate its position to the nearest shore station and receive this information itself back again by wireless.

F. LLOYD HOPWOOD.

POWER ALCOHOL.

THE annual importation of petrol into this country rose to more than 100,000,000 gallons before the war. Most of this came from the United States. At that time the consumption in the States was about ten times this figure, but in 1919 will probably prove to be not less than thirty times as much. With these values to face it is impossible not to wonder whether the rapid expansion of usage in the States will allow the exportation—at any practicable price—of even the small relative quantity used in the United Kingdom before the war, to say nothing of any additional supply to meet the growth of our own needs for road, sea, and air.

These considerations suffice to render inquiry into the subject a matter of immediate moment, but there is an additional argument available to those who take a longer view. Any fuel product drawn from oil wells or coal mines has the nature of a fortunate dip in a "lucky bag." No one knows how long such supplies will last, nor what untapped stores there yet may be (nor where they are). Moreover, their renewal is a matter of hundreds, if not thousands, of thousands of years. For this reason it is wise for mankind to prepare to supply its future needs by drawing on the current account of the sun's radiant energy and to touch the capital as little as may be.

In most previous discussions on this subject it has been assumed that alcohol obtained from the potato crop is as feasible a source of supply as any that could be named. It now appears from the investigations of the Inter-Departmental Committee on Power Alcohol (Cmd. 218, 1919, price 2*d*. net) that whilst potatoes yield 20 gallons of alcohol per ton, the sun-dried flowers of the Indian mahua tree (costing about 30*s*. per ton delivered at the factory) will yield as much as 90 gallons of alcohol per ton. Here, as in so many other cases, it seems that raw material comes most abundantly and most economically from the tropics, which, indeed, in the present instance is not to be wondered at, seeing that it is the daily solar radiation the energy of which it is desired to tap.

The Government Committee above mentioned, with most praiseworthy energy, has also taken a decided step forward in probing the problems relating to the best use of the alcohol when produced. With this in view it has arranged with the London General Omnibus Co. for a complete fleet of motor omnibuses to be run for six months on both alcohol-benzol and alcohol-benzol-petrol mixtures, and for the results to be compared with running on petrol or other fuel. To use alcohol without any admixture might prove difficult owing to its reluctance to fire in a cold engine; moreover, for good thermal efficiency a high-compression pressure would be needed, and this again makes starting difficult. That, however, is but one of a series of problems which the Committee has arranged to have investigated at Manchester in the laboratory of Prof. H. B. Dixon, whose work on similar lines is well known. Both these investigations—scientific and commercial—should begin to bear fruit very shortly, and by Christmas it may not be too much to hope that the Committee will be able to publish information of such value as to enable the Government to take definite steps towards rendering power alcohol available for all internal-combustion engine users.

THE FORESTRY BILL.

THE Forestry Bill came before the Commons in Committee of the whole House on August 8, when amendments to several of the clauses were suggested. An important amendment increased the number of Commissioners from seven to eight, with the object of having one unpaid Commissioner sitting in the House of Commons, thus enabling the House to keep itself acquainted with the progress of the afforestation work. This amendment was agreed to, as was also another by Major W. Murray that not fewer than two of the Commissioners should have special knowledge and experience of plantation and forestry in Scotland.

Sir Philip Magnus strongly advocated the view put forward by the British Science Guild that at least one of the Commissioners should be a person of scientific attainments having a technical knowledge of forestry. This amendment was rejected on a vote, but Sir Philip persisted with it in the Report stage, which followed immediately after Committee was over, and it was then accepted and added to the Bill. He also put forward an amendment, which was accepted, that the Commissioners should have power, in addition to collecting and preparing forestry statistics, to publish and distribute them.

From the point of view of assuring that the new Forestry Authority should have expert guidance in inaugurating and formulating its forest policy, the acceptance of Sir Philip Magnus's amendment with reference to the inclusion of expert scientific opinion on the Commission is of the very first importance, for on that member will lie a heavy responsibility. It is to be hoped that in his selection the Commissioners will make every effort to secure a man of recognised scientific attainments and merit, who at the same time possesses a wide knowledge of up-to-date forestry methods as existing in the different forestry services in the world. The appointment will not be an easy one to fill.

To those acquainted with the requirements of a truly scientific forestry department, the setting up of which is arrived at in this country, Sir Philip's other amendment, with reference to the publication of forestry statistics, which was also urged by the British Science Guild, is of not less importance. The publication of the material collected in proper form—that is, in a form which shall comprise the issue of that collected in a separate series of publications, some for the scientific reader, and others for the lower grades of a forestry service and for laymen—is a matter of supreme importance. This importance is accepted by the man of science without question, but to the public the value of such reports is not self-evident. In this respect, therefore, the House of Commons is to be congratulated on possessing at least one Member having the knowledge and foresight to recognise the vital necessity of assuring that this aspect of the question is safeguarded, and to be an advocate of scientific interests generally. After passing through Committee the Bill was read a third time.

NOTES.

THE following names appear in the deferred list of honours in connection with the King's birthday, which was published yesterday:—Viscount Iveagh, chancellor of Dublin University (promoted to an earldom); Lt.-Col. H. G. Barling, vice-chancellor of Birmingham University, and Mr. C. H. E. Chubb, donor to the nation of Stonehenge (baronetcies); Dr. R. C. Brown, founder of a scholarship for research at Cambridge University, Prof. W. Boyd Dawkins, F.R.S., and Mr. J. Y. W. MacAlister, president of the Library Association and secretary of the Royal Society of Medicine (knighthoods).

THE Pontécoulant prize of the Paris Academy of Sciences has been awarded to Prof. A. S. Eddington for his work on astronomical research.

AN important demonstration in wireless telephony was given by the Royal Air Force in the Houses of Parliament on Monday, August 11. So far as can be judged from the Press accounts, the demonstration was entirely successful, over a range of twenty miles. General Seely explained that the Air Force took up the subject of wireless telephony early in 1915, and by March, 1918, the first two squadrons of aeroplanes had been fitted with the apparatus, which gave them such an advantage that it was found that German machines took care to avoid them. The postal aeroplanes, such as those plying between Kenley and France, are now so fitted. Ranges of 100 miles from an aeroplane and of 165 miles from an airship have been obtained, and could be increased by the use of larger aerials at the receiving stations, if any good purpose would be served thereby. Improvements still remain to be effected, such as the elimination of the trailing aerial on the aeroplane, and of the need of switching over between sending and receiving, which makes the interchange of conversation not quite so easy as it is with an ordinary telephone. Another part of the demonstration concerned direction-finding by wireless for the navigation of aircraft. For this purpose the aerial in the aeroplane takes the form of a coil of wire mounted on a rectangular frame about 4 ft. high and 3 ft. wide, which can be turned on a vertical axis, and the variations in the strength of the signals as this is turned round enable the direction of the sending station to be located. A coil of this kind was on view, and by its aid signals were picked up from the Eiffel Tower, a portion of a message received announcing itself as being an "order particularly for Budapest." An inter-communication telephone was also shown by General Seely. Worn on the neck of a member, with a wire-connection down the trouser-leg, it would enable him to speak to all the world.

IN a letter published in the *Times* of August 4 Prof. Karl Pearson directed attention to the serious financial difficulties of the Galton Laboratory. Owing to the war the equipment of the buildings provided for the housing of the laboratory staff was not proceeded with, and the institute was used as a military hospital. Now, owing to the rise in prices, not only will the equipment cost from two to three times as much as it would have done in 1914, but the slender endowment is quite inadequate to defray ordinary establishment charges, the cost of printing, and the provision of a living wage for the staff. Prof. Pearson writes:—"The Biometric and the Galton Laboratories were the first of their kind to be established; they no longer stand alone. The United States have their professors of biometry and their eugenics laboratories backed by funds which we cannot hope to rival. Why is it that Britain so often starts the new idea but leaves it to fructify in other lands? Especially important at the present moment is the field of activity for our science. The war has brought many problems to the fore; eugenical research has much ground to make up, and most serious questions as to national efficiency are demanding scientific treatment." This reasoning is cogent, and it will be a serious scandal if the Galton and Eugenics Laboratories are starved. The enlightened patronage by the State of research institutes maintained in connection with universities is nearly always a better method of promoting the true interests of science than the segregation of research workers in State Departments out of touch with the general developments of academic thought.

WE regret to have to record the death, at the early age of forty-three, of Prof. George Stephen West, holder of the chair of botany and vegetable physiology in the University of Birmingham since 1909. Prof. West's work in algology has a world-wide reputation, and under him the botanical department of the University had reached the first rank for the study of this branch of botany. His death while still a young man not yet at the zenith of his power is an irreparable loss to the University of Birmingham, and deprives the world of a botanist of first-rate ability, whose recent work on the algæ of the soil opens up a new field of investigation the economic importance of which is likely to be far-reaching. Prof. West was an indefatigable worker and an admirable director of research, admired and warmly appreciated by his students and colleagues. Though robust in appearance, he had recently been in indifferent health, and an attack of pneumonia ended fatally on August 7. He leaves a widow and two children.

THE death is announced, on August 8, at the age of eighty-five years, of Prof. Ernst Haeckel, of the University of Jena.

BY the death of Mr. Andrew Carnegie, on August 11, in his eighty-fourth year, a romantic career was brought to a close, and the world lost probably its most generous contributor towards the promotion of science, education, art, and other objects, for Mr. Carnegie held strongly that the possession of wealth carried responsibilities, and that "surplus wealth was a sacred trust which its possessor was bound to administer in his lifetime for the good of the community." He held that "it is a crime to die rich." Acting on these principles, he set himself to disburse his immense fortune to further enterprises which appealed to him. How much he distributed is not known, but in 1908 it was estimated that he had given more than 57,000,000*l.* in America, more than 7,000,000*l.* in Great Britain, and 1,000,000*l.* in Europe. Among his gifts may be mentioned 5,000,000*l.* to the Carnegie Institution of Washington, 2,000,000*l.* to inaugurate the Carnegie Institute at Pittsburgh, 2,000,000*l.* towards university education in Scotland, 50,000*l.* to the University of Birmingham, and, it is estimated, 10,000,000*l.* towards libraries alone. He also purchased the famous library of the late Lord Acton, which, through Viscount Morley, is now the property of the University of Cambridge. Mr. Carnegie was Lord Rector of St. Andrews University in 1903–7 and of the University of Aberdeen in 1912–14, and was the recipient of the honorary degree of LL.D. from the University of Cambridge.

THE death is announced of Mr. Herbert Ward, a traveller in many lands and a member of the rear-guard of Stanley's Emin Pasha Relief Expedition.

MR. CARLE SALTER, of the British Rainfall Organisation, has been awarded the premium of the president of the Institution of Water Engineers for his paper on "The Relation of Rainfall to Configuration," which was read before the institution in December last.

DR. SHAIFFER, of the University of Toronto, has been appointed expert in animal husbandry to the Government of Mysore. He will work under Dr. Coleman, the director of agriculture.

A DEPARTMENTAL Committee has been appointed by the President of the Board of Trade to investigate and report upon the present position and economic possibilities of non-ferrous mining in the United Kingdom, and to make recommendations as to such Government action as may be expedient in regard thereto. The members of the Committee are Mr. H. B. Betterton, M.P. (chairman), Mr. H. F. Collins, Mr. J. Harris, Dr. F. H. Hatch, Sir Lionel Phillips, Bt., Mr. R. A. Thomas, and Mr. James Wignall, M.P. All communications should be addressed to the secretary, Mr. W. Palmer, Gwydyr House, Whitehall, S.W.1.

WE are asked to announce that the time for accepting entries for the Cammell Laird scholarship in naval architecture and the Parsons scholarship in marine engineering of the Institution of Naval Architects has been extended to August 31. Application forms may be obtained from the secretary, Institution of Naval Architects, 5 Adelphi Terrace, Strand, W.C.2.

AS already announced (NATURE, July 10, p. 370), the Royal Society will in the coming autumn elect to two John Foulerton studentships for original research in medicine, the improvement of the treatment of disease, and the relief of human suffering. The latest time for the receipt of applications (which should be addressed to the Assistant Secretary of the Royal Society, Burlington House, W.1) is October 31.

A WAR section of the Royal Society of Medicine has recently been formed having for its object the dealing with questions affecting medicine and surgery in the Navy, the Army, and the Air Force. The first meeting of the section will be held on Monday, November 10, when the president, Sir Robert Hill, Medical Director-General, R.N., will give an address.

LORD WEIR has consented to open an Exhibition of Shipping, Engineering, and Machinery which is to be held at Olympia for three weeks, beginning on September 25 next. It was to have been held in 1914, but was postponed in consequence of the war.

A MEMORIAL tablet to Sir Walter Ralegh—the gift of the Société Jersaise—has been placed on the wall of the States Chamber of Jersey, Sir Walter having been Governor of the island from 1600 to 1603. In unveiling the tablet the Bailiff of Jersey said that of all the distinguished men who had been connected with the Channel Islands none had been more remarkable than Ralegh, who was one of the group of Devon men who had conceived the magnificent idea of the British Empire.

THE Department of Mines and Industries of the Union of South Africa is requiring the services of a scientific officer for the Fisheries and Marine Biological Survey of the South African coast. The duties of the officer will be to superintend operations, chiefly on board surveying vessels, connected with sounding, dredging, trawling, physical observations, the pressing of specimens, etc. Applications should be sent, in duplicate, not later than September 15, to the High Commissioner for the Union of South Africa, 52 Victoria Street, S.W.1.

THE Government has issued as a White Paper (Cd. 280, 1919) a report on the food conditions in Germany by Prof. E. H. Starling, supplemented by memoranda on agricultural conditions and statistics by Messrs. McDougall and Guillebaud. Prof. Starling shows very clearly that the chief cause of the collapse was a food policy erroneous in principle and unworkable in practice. So late as 1917–18 the total available food, after meeting the needs of the Army, would, if equally divided, have sufficed to provide 3000 Calories per average man; but, owing to failure to control producers, the distribution was altogether inequitable. The producers continued to consume their pre-war ration, nearly 25 per cent. of their disposable surplus was estimated to be distributed by illicit trade—to the advantage, of course, of the wealthy—and not more than 1500 Calories were left to be distributed as the average ration per man per day. The result was that the brunt of the suffering had to be borne by the working-class and middle-class urban populations. Prof. Starling finds that the conditions are grave. Even under the most favourable conditions, and "if Germany is treated by the world as a sick child to be nursed back to health, it will take one, and perhaps two generations before she can recover her previous efficiency. After that, whether she is a danger or not to Europe depends on her Government. Her docile and industrious people are, at any rate, sickened of war, and represent no longer any active menace to the people of Europe." It appears that if Germany is to be in a position to utilise her full working capacity, she will need during the coming year imported food amounting to about a quarter of that normally imported into the United Kingdom.

AT the invitation of Sir Robert Hadfield some 200 representatives of the firm of Messrs. Hadfields, Sheffield, including directors, members of the technical, financial, and commercial staffs, the research department, managers, foremen, workmen, and boys, visited London recently to inspect the British Scientific Products Exhibition, at the Central Hall, Westminster, and the Science Exhibition, South Kensington. At a luncheon at the Central Hall Sir Robert Hadfield, who presided, said he was far from being a pessimist at the present time. Naturally the workmen, owing to higher prices prevailing, wanted higher wages. What was wanted was the exercise of more patience on both sides, and the recognition of the fact that the best way to gain one's ends was by the constitutional method of Parliament. That was the method which would, he was sure, commend itself most to the British working man. Sir Richard Gregory, chairman of the organising committee of the British Scientific Products Exhibition, said that the lesson to be learned from the exhibition was that modern civilisation demanded progressive work from science and from industry. After lunch a visit was paid to the Science Museum at South Kensington, where the party was joined by Prince Albert, who spent half an hour with them in looking over the exhibits. The Prince, who is chairman of the Industrial Welfare Society, expressed his pleasure at meeting such a happy lot of workers, and said he would be very glad to receive a copy of the essay which won the prize offered by Sir Robert Hadfield to the boy who wrote the best account of his visit to London.

KILDARE, the site of the nunnery of St. Brigid, was undoubtedly in pre-Christian times the site of a fire and solar sanctuary, and the traditions of the older establishment have in more than one respect coloured those of the later. In *Man* for August Prof. R. A. Macalister quotes an early story about Dar-Lughdach, a pupil of St. Brigid, who was smitten by unholy love for a man. An angel warned her in a dream to fill two shoes with hot coals and to walk shod therewith. The fire extinguished her ardour, and St. Brigid blessed her feet and the burns were healed. Prof. Macalister suggests that this legend is a tradition of the practice at pagan Kildare of the rite of the fire-walk. Starting with fragmentary recollections of a woman who walked on fire with unhurt feet, the legend would naturally assume its present form. The name of the heroine means "Daughter of Lugaid," but it is highly probable that this is a perversion or a by-form of Dar-Luga, "Daughter of Lug," the sun-god.

UNDER the title of "A Brief History of the Study of Greek Vase-painting" Mr. S. B. Luce, in the Proceedings of the American Philosophical Society (vol. lvii., No. 7, 1918), gives a useful summary of what has been done to elucidate the subject. A valuable addition to his paper is a classified list, by countries, of museums containing collections of vases, with accounts of the catalogues which have been issued. A study of this will probably lead to the discovery of other smaller collections which deserve attention, and will stimulate the curators of museums containing uncatalogued collections to supply the want.

IN the Report for 1918 on the Lancashire sea-fisheries laboratory at the University of Liverpool and the sea-fish hatchery at Piel, Prof. Herdman, Mr. Andrew Scott, and Miss H. Mabel Lewis give a short account of their intensive study of the marine plankton around the south end of the Isle of Man. One conclusion, they state, is becoming clear from the accumulated observations of the last ten years, and that is the surprisingly small number of different kinds of organisms which make up the bulk of the plankton that are of real importance in regard to fish. Seven genera of diatoms and six species of copepods are named in this connection, and particular attention is directed to one of the copepods, *Temora longicornis*, which was found in 1917 to be related definitely to the summer herring fishery off the Isle of Man. To the same report Dr. Johnstone contributes a summary of his investigations into the dietetic value of sprats and other clupeoid fishes, including a short discussion of the nature of the "maturation" which takes place when pilchards, herrings, sprats, etc., are "processed and packed *à la sardine*." When newly packed the bones are not softened, and the taste and smell not those expected; the ripening is the result of allowing the tins to stand unopened for a period of six months to four years, during which the fish continually improve in flavour and the bones become softened. Apparently nothing is known as to the nature of this maturation process, but bacterial action can be excluded. Dr. Johnstone suggests that it may be a process of autolysis due to specific intracellular enzymes normally present in the flesh of the fish, but on chemical examination the amount of amino-acids—which would be formed on the partial splitting of the protein—was found to be negligible. Further investigation is required to elucidate the nature of the process.

PROF. ARTHUR THOMSON gives an account (*Journ. of Anat.*, vol. liii., pts. ii. and iii., 1919) of his observations on the maturation of the human ovum, and holds that there is distinct evidence of the first and second polar bodies being given off while the egg still lies in the ovary within the discus proligerus of the Graafian follicle, and therefore before it has been subjected to the influence of the spermatozoon. This is contrary to the general rule, for in other vertebrates the sperm usually enters the egg during the second maturation division. The average size of the human ovum is, according to Prof. Thomson, $0{\cdot}11 \times 0{\cdot}095$ mm. (including the zona pellucida)—that is, considerably less than is generally stated.

LITTLE has hitherto been known of the Polyclad Turbellaria of the Japanese coasts, and the attention of workers on this interesting order may be directed to a paper by M. Yeri and T. Kaburaki (in Journ. Coll. Sci. Imp. Univ. Tokyo, vol. xxxix., December, 1918), recently received, in which are described twenty-six species referred to fourteen genera. Two new genera have been formed, and seventeen of the species are described as new. One of the latter belongs to the remarkable genus Bergendalia, and has the peculiar duplicate male organ not connected with the vas deferens.

AN article on "The Passing of the American Potash Famine," contributed by Prof. P. G. H. Boswell to the Journal of the Society of Chemical Industry (June 16, 1919), states that large quantities of potash will probably be delivered from Germany both to the British Isles and to America. This would seem to suggest that the new potash-obtaining methods introduced during the war are not producing sufficient supplies. In America the total production of potash for 1917 was 50,000 tons, against 230,000 tons imported before the war. Just before the National Exposition of Chemical Industries, held in New York in September, 1918, Russian potash was being used to some extent by the chemical industry, and in large quantities by the glass industry. This potash was obtained from sunflower plants, which were the chief source of fats for the South Russian peasantry. At first it realised as much as 90 cents per lb., but now it is sold with difficulty at 15 cents. Only a small quantity of this supply was permitted to be exported to Britain, until the restrictions were removed shortly before the armistice, when, too, our own supplies were better because of the new recovery process from blast-furnace flues. The greater part of the potash imported in the United States was used for fertilising purposes, and this is thought to have been the result of German propaganda work. Obviously the poor, sandy soils of northern Germany and our own much cultivated, and consequently exhausted, soils need potash far more than do the practically virgin soils of America. It is therefore probable that America will in future use far less potash for fertilising purposes, and, in consequence, the world's demand for potash will be much more easily satisfied.

THE microscopic structure of coal has been a matter of scientific interest for the best part of a century, but it was in the year 1854 that the study was started with fresh vigour by Prof. John Quekett. Again in 1870 the subject was revived by Prof. Huxley in his article on "The Formation of Coal," and since then it has been approached from time to time, almost always with regard to its vegetable contents, and some papers by J. Lomas and others are still fresh in our minds. A paper recently published by Dr. Marie C. Stopes on "The Ingredients of Bituminous Coal" (Proc. Roy. Soc., B, vol. xc., p. 470, 1919) led one to expect some further light upon the botanical side of the question, but this paper attacks the problem from an entirely different point of view. "Coal is a rock," the author says, and may be studied in the same way that petrologists work at other rocks. The general structure of coal as seen in sections is described, and the *three* layers hitherto generally recognised are pointed out; but the bright layer is now divided so that there are four kinds of substance, for which names are proposed. Some account is also given of "The Behaviour of the Four Ingredients with Certain Chemicals."

MR. J. MORRISON puts forward a new view in a paper on "The Shap Minor Intrusions" (Quart. Journ. Geol. Soc., London, vol. lxxiv., p. 127, 1919) to account for the presence of corroded crystals of orthoclase and quartz in a magma of basic character. He suggests that differentiation into a granitic type above and a more basic type below occurred in a large body of molten rock, and that the crystals, as they developed in the upper levels, sank through the mass until they became incorporated in the basic portion, from which they could not have separated by ordinary processes of crystallisation during cooling.

MESSRS. E. T. WHERRY and E. Q. Adams ("The Classification of Mimetic Crystals," Journ. Washington Acad. Sci., vol. ix., p. 153, 1919) endeavour to get rid of the indefinite prefix "pseudo" in mineralogy, when a mineral crystallises in a form closely resembling that of a system other than its own. They describe quartz, for example, not as pseudohexagonal, but as cryptotrigonal and phenohexagonal, and other terms are introduced for cases where crystals compounded by twinning produce forms simulating a foreign degree of symmetry.

THE *Annales* of the National Observatory of Athens (vol. vii., 1916) contains several papers by Prof. D. Eginitis and Messrs. E. Goulandris and N. Critikos on earthquakes in Greece during the years 1912–14. The total number of shocks recorded is 1366, giving an unusually high annual average for so small a country. Two destructive earthquakes (on January 24, 1912, and October 17, 1914) were felt over the greater part of Greece and ruined many places, the one in the south-east of Cephalonia and the north of Zante, the other in and around Thebes. Both occurred without any warning fore-shocks, and were followed by a large number of after-shocks (the Thebes earthquake by 712 within a year), several of them strong enough to add to the ruin wrought by the principal shocks. On November 23 and 27, 1914, and January 27, 1915, destructive earthquakes were felt in western Greece and the Ionian Islands, the epicentres being respectively near the south-east and north-west coasts of Santa Maura and the north-west coast of Ithaca. In a general discussion Prof. Eginitis states that, of the earthquakes registered at Athens from 1900 to 1914, 733 occurred during the night (6 p.m. to 6 a.m.) and 611 during the day; but he suggests that to prove the greater night-frequency, a longer series of records would be required.

THE strong earthquake which disturbed the Midland counties on January 14, 1916 (NATURE, vol. xcvi., 1916, pp. 572, 601), is described by Dr. C. Davison in the *Geological Magazine* for July (vol. vi., 1919, pp. 302–12). The earthquake occurred at 7.29 p.m., and was sensible over an area of about 50,200 square miles. It originated in two distinct foci, one about two miles north-east of Stafford, and the other about one and a half miles north-west of Eccleshall, the distance between them being eight or nine miles. The vibrations from the two foci coalesced along a narrow band crossing between them and at right angles to the line joining them. As this band is slightly concave towards the west, and lies nearer the western focus, it follows that the eastern focus was first in action, and that the impulse at the western focus occurred before the vibrations from the other had reached it. The earthquake was thus a twin earthquake. The relations between the Stafford earthquake and the twin earthquakes of Derby in 1903, 1904, and 1906, and those of Leicester in 1893 and 1904, are considered, and it is suggested that the crust at some depth must be corrugated in two systems of perpendicular folds about seventeen miles in wave-length.

Le Temps of August 27, in an article on the newly founded Institut d'Optique, gives some interesting figures on the growth of the optical industry in France during the war. These indicate that the output of instruments suitable for military purposes increased about ten times between 1914 and 1918. The supplies of optical glass did not present so great a cause for anxiety as in this country, for before the war, with three optical glass factories in operation, the supplies were more than adequate for their domestic requirements. The output increased from 4000 kilos. a month in 1914 to 12,000 in 1918. The claim advanced in the article that this represents 80 per cent. of the total Allied production can scarcely be correct, as our own output during 1918 probably exceeded 9000 kilos. a month. Like ourselves, France was largely dependent before the war on German sources for supplies of the higher grades of optical instruments. She is determined that this position shall not recur, and has taken steps not only to safeguard her own supplies, but also to secure a share of the world market. As a means to this end, the Institut d'Optique, providing for higher instruction in optics, research and testing laboratories, as well as for the training of skilled glass workers and mechanics, has been founded. As the head of the institute she has been fortunate enough to secure Prof. Fabry, for whom it is proposed to create a chair of optics at the Sorbonne. The institute aims at fulfilling for the whole French optical industry the functions which, in Germany, the special technical staffs exercise for their own firms. The institute will receive annual subsidies from the Ministries interested in its work.

THE question is frequently raised in connection with the use of aluminium and its alloys whether they can be satisfactorily soldered; and, if so, by what method and with what metals and alloys. Aluminium and, to a less extent, its alloys can be welded quite satisfactorily by the oxygen-gas process, but often it is not desirable to heat the parts to be joined to the relatively high temperature necessary to weld them in this manner, owing to the resultant distortion of the parts, and a means of joining it at lower temperatures is sought. The U.S. Bureau of Standards accordingly, in its Circular No. 78, gives an account of special tests recently made at the Bureau to determine the general trustworthiness of aluminium solders. The most common of these consist of tin as a base, with the addition of zinc and aluminium, and sometimes lead, in moderate proportions. These metals and their combinations are electrolytically electro-negative to aluminium. A soldered joint is, therefore, rapidly attacked and disintegrated when exposed to moisture. There is no solder of aluminium of which this is not true. Such joints should, therefore, never be made unless they are to be protected against corrosion by paint or varnish. Solders are best applied without a flux after a preliminary cleaning and tinning of the surfaces to be soldered. The composition may be varied within wide limits. It should consist of a tin base with the addition of zinc or both zinc and aluminium, the chief function of which is to produce a semi-fluid mixture within the range of soldering temperatures. The tensile strength of a good aluminium solder is about 7000 lb. per sq. in. There is no reason why it need be brittle, as several commercial varieties are, and it is very undesirable that it should be. Its strength depends upon the type and workmanship.

IN consequence of the increased cost of production, the published prices of the *Observatory* and the *Companion* are to be raised to 1s. 6d. and 2s. 6d. respectively, beginning with the new volume.

THE Wireless Press, Ltd., will shortly begin the publication of a new monthly periodical entitled the *Radio Review*, which will be devoted to the scientific development of radio-communication and contain a review of all current wireless literature.

OUR ASTRONOMICAL COLUMN.

KOPFF'S PERIODIC COMET (1906 IV.).—This comet, an observation of which by Dr. Wolf was announced last week, has since been photographed at Algiers on August 4, and at Greenwich on August 6 and 7. In default of an ephemeris, an approximate place for a few days may be inferred from these observations:—

	G.M.T. h.	R.A. h. m. s.	S. Decl. ° ′
July 30	10	19 27 12	9 32
August 4	10	19 26 32	9 5·7
6	10·6	19 26 24	8 57·1
7	10·6	19 26 23	8 53·2

The comet was said to be of magnitude 10·5 on July 30, and 11·0 on August 7.

MAGNITUDE OF NOVA AQUILÆ.—The *Astrophysical Journal* for June contains a series of measures of the brightness of this star made by Mr. Stebbins and Mr. E. Dershem with the photo-electric photometer between June 9 and December 10 of last year, on seventy-eight nights in all. Noting the precision of the instrument, for the probable error of one observation is said to be of the order of a hundredth of a magnitude, this series might be accepted as standard. It shows an almost uniform decrease in the light of the star until June 30 to mag. 3·3. There was an increase of 0·2 mag. between the nights of July 1 and 3, a similar increase between July 22 and 27, and an outburst measured by 0·7 mag. between August 5 and 6. Later dates when the brightness increased were September 1–5 (0·4 mag.), September 19–21 (0·2 mag.), October 6–12 (0·3 mag.), and, except for these, the fall of brightness was slow but uniform until December 10, when the magnitude was 5·67. The authors say that they were disappointed not to detect any rapid changes of light. Although the measures often extended over four or five hours, there was only one night (June 10) when a variation so large as 0·10 mag. could be established, and the measures do not show any sudden and erratic variations in the course of an hour or so. It would, indeed, have been interesting if the large outburst between August 5 and 6 had happened in the course of an evening's observations. Most of the increases above mentioned have been recorded in other series of observations.

MASS AND MOMENTUM OF STELLAR SYSTEMS.—A memoir of the College of Sciences of the Kyoto Imperial University (vol. iii., No. 7, August, 1918) is useful, since it gives collected lists of binary and multiple stellar systems, with the determined elements of the orbits and the adopted parallax. From this data the authors, Messrs. Shinjo and Watanabe, have found that for all double and multiple systems the mass is of the same order of magnitude, being in the mean about one and a half times that of our solar system. For spectroscopic binaries of the A type the mass is found to be only slightly larger, but four spectroscopic binary systems of the B type have in the mean a mass twenty times that of our system. A similar research by Prof. Aitken recently showed that the visual binary systems were about twice as massive as our sun, and suggested that stars of classes K and M are less massive than those of classes A to G. The authors of the memoir now before us computed also the angular momenta of the systems, and found that, on the whole, this is of the same order of magnitude for all visual systems, being more than a hundred times that of our solar system. That the masses of the celestial bodies are, approximately, of about the same order of magnitude has already been accounted for by theoretical considerations. Messrs. Shinjo and Watanabe endeavour to show that the constancy of angular momentum results from the hypothesis that the celestial bodies have evolved from primordial swarms of meteorites.

THE DESIGN OF OPTICAL MUNITIONS OF WAR.

In a paper read before the Optical Society in January last,[1] Lt.-Col. A. C. Williams, the officer until lately in charge of the inspection of optical munitions at Woolwich, described in some detail the tests made by his department when inspecting the various optical instruments submitted by the manufacturers. The precedent thus set is a most useful one. It is common knowledge what an immense number of instruments were made and accepted, but it is not so generally known how stringent were some of the tests. Col. Williams makes no apology for the stringency of these tests, and in stating the conditions of service shows how different Army conditions are from those of civil life. They are indeed severe. "It must be remembered that Service instruments may be sent to any part of the world, and must remain serviceable when used in Arctic snows, Flanders mud, Mesopotamia heat and desert sandstorm, or after travelling in lorries for thousands of miles over bad roads. In some cases they are attached to guns, and have to withstand the shock of firing. It must also be remembered that they are not always used by men accustomed to handling delicate instruments, and that it is only on rare occasions that they can be sent to a workshop for repair." In addition to these considerations, that of weight is always present. As Mr. J. W. French in his interesting contribution to the discussion points out, it is easy to make an instrument to withstand severe shock tests if lightness is not of importance.

Interesting as is the description of the various tests made at Woolwich, the most interesting part of the paper is the glimpse given of the pre-war attitude of the Government Department to the scientific instrument maker.

Col. Williams assumes that the manufacturer by some uncanny instinct "should know what classes of instruments are required, and should submit to the authorities the highest class of designs of such instruments." The designs would then be considered by a committee of experts, who would criticise and decide on the most serviceable.

In the past the complaint of almost every manufacturer of scientific instruments has been the difficulty of learning what instruments were required by the Services and of obtaining detailed information of the particular problem. Secrecy was necessary during the war, but even then it was frequently insisted upon to an unnecessary extent. In times of peace it has the effect of holding back the development of new instruments. It is common knowledge how much Prof. Cheshire did to bring together the manufacturer and the officers testing and using the instruments when made. In the future it is essential that the designs of the Service instruments should be jointly considered by a body of experts, manufacturers as well as officers, so that instruments are not built up in the haphazard way they were in days gone by. It is not necessary to trace the evolution of an instrument by its obsolete excrescences or unnecessary parts It is essential, however, that the fundamental parts should be accurate, within certain specified limits, and that the experts should decide on those limits.

The Government must also be prepared to pay liberally for the manufacture of first models. In the future, with the aid of the National Physical Laboratory, the Institute of Technical Optics, the British Optical Manufacturers' Association, and the British Scientific Instrument Research Association, the Government Departments should not find it difficult to obtain good and generous technical assistance.

ROBERT S. WHIPPLE.

[1] "The Design and Inspection of Certain Optical Munitions of War." By Lt.-Col. A. C. Williams, R.A. (Trans. Optical Soc., January, 1919.)

THE OUTLOOK OF METEOROLOGICAL SCIENCE.[1]

At no period in the sixty-nine years of the society's existence has the president had a wider range of choice for the subject of his address than at the present moment; and certainly never has the richness of choice been more of an embarrassment than on this occasion. The notable and welcome increase in the number of fellows adds to the responsibility of the situation. Whether we look backward over the days of war, or forward to the future and all that it may have in store for those who are interested in the study of weather, there is more than enough to occupy the time which tradition has placed at my disposal.

Looking Backward—The Position before the War—The Investigation of the Upper Air.

Looking backward, we must take account of a promise of remarkable activity in all branches of meteorology. Even if there had been no war, the last five years would have been fruitful years in the development of the science. The progress of aerial navigation, already begun in 1914, promised unexampled opportunities in the comparatively new study of aerography, in addition to those which meteorologists had previously made for themselves.

The Shock of War and the Reaction.

Thus the outbreak of war found the various meteorological agencies actively employed upon their own projects for the world's enlightenment, and its first effect was to paralyse a good deal of their activity. It cut our wireless communications, hampered our telegraphic reports, put shipping out of bounds, claimed our active workers and their possible substitutes for services that wore a uniform, and altered the whole balance of the complicated machinery which had been elaborated for our contribution to the world's stock of knowledge of the atmosphere.

The whirligig of time has brought its revenges. We are no longer allowed to regard the weather as a subject of curious inquiry that can be ignored in time of war. It has been borne in upon us that weather has its influence on the production, preservation, and transport of food; that it has a bearing upon the health of the community; that floods and droughts, sunshine and storm, such trivial circumstances as low clouds and fog, have their effect upon operations of offence and defence; and we have learned in the school of experience that aerial navigation may be attended with danger to others beside the navigators.

The Call for more General Knowledge of Meteorological Methods and Results.

The quickened interest in the study of weather for all purposes has expressed itself in the creation of a number of special establishments for the Naval Air

[1] From an address on "Meteorology: The Society and its Fellows," delivered before the Royal Meteorological Society on January 15 by Sir Napier Shaw, F.R.S., president of the society.

Service, for the Navy itself, for the Army, and for the Royal Air Force.

Throughout the whole course of the war we were constantly reminded that what was standing in the way of an effective use of past experiences of weather in all parts of the world was a lack of general knowledge of the common methods of meteorological study and of the principles deduced by their aid. Until this position is secured, every letter in reply to a simple inquiry must be prefaced with an explanation of what you mean by an isotherm, an isobar, the exposure of an anemometer, and even the difference between the points of the mariner's compass and the geographical orientation, and every popular lecture must begin, and generally has to end, with a recitation of rudimentary ideas.

The Preliminary Training Required for a Professional Career.

Here, perhaps, it is desirable to make it clear that the practice of the science of meteorology includes the process of observing, of the first part; the compilation and summarising, in maps or otherwise, of the facts of weather, of the second part; the application of meteorological principles, which includes the forecasting of future weather, of the third part; and the development of the science of meteorology, of the fourth part. Any one of the first three may be pursued according to recognised canons of procedure with satisfactory results; every one of them is indispensable, and history is my witness that all three of them may be pursued simultaneously without any effective recognition of the fourth part, which forms our only avenue to the comprehension of the secrets of the sequence of weather.

In the present position of meteorological science there are two extremes of opinion: either to think the penetration into the secrets of the subject to be so difficult that we must be content to forgo the attempt and deal with what we have, or to think it so easy that only observations are required and the training of our brains is of no account. Both these extremes ought to be avoided. Brains without observations are certainly of no avail at all; and observations, however numerous and however widely distributed, will not at this stage of meteorological science exonerate us from the use of highly trained intelligence.

If trained intelligence is to be devoted to the important questions which fall within the scope of meteorology, there must be money to pay for it at the rates which prevail in the professions with which meteorology must in practice compete.

The Society: Its Relation to the General Meteorological Organisation.

What, then, is the relation of the society to such a future? If I may venture to define it, I would say that the society, as representing all the many-sided interests of meteorological study, may fairly claim the right and duty of fostering, or even of creating, the atmosphere which is necessary for the successful development which is now required.

One of the urgent questions for the future is a new home for its meetings and for its invaluable library. Its journal has enriched the literature of the science with contributions of many different kinds. That, again, is capable of development with great advantage, and in one respect the need for development is extremely urgent. Meteorology is a co-operative science in the progress of which all nations share. Its literature, all told, is probably larger and more diversified in character than that of other sciences. When we take into account the diversity of language and of form, I suppose that there is no meteorologist who can follow for himself without the aid of many colleagues the progress of the science in different parts of the world; and that makes it all the more necessary for the fellows of the society to come to the assistance of each other by providing an effective survey and summary of the work that is being done.

If meteorology is to be put upon a proper footing to discharge its multifarious duties to the public, due provision must be made for the collection of observations to give a proper survey of the rainfall and other aspects of weather for all public purposes.

The Future Responsibility for the Public Memory.

So far there is very little difference of opinion, but when we take the next step and inquire with whom should rest the duty of supplying the necessary observations, the unanimity may be less marked. We are all agreed that it is a matter of national importance, and the necessary cost should be borne by national funds. Now national funds are of two kinds, some derived from Imperial taxation and others from local taxation. In either case the money comes ultimately out of the same pockets, and to me it appears clear that the proper division of responsibility in this case is that the local authorities should contribute the necessary local observations, while the central authority should provide for the organisation of the observations, the co-ordination of the results, and the distribution of the information. Such an arrangement is at the same time the most economical and the most efficient. If the nation wants to know what the weather has been doing at Magna-Parva, it seems natural that it should apply to the local authority of Magna-Parva for the information, because the events of which a record is required occurred within the jurisdiction of the local authority. That the events should be allowed to pass unrecorded, because somebody has not been sent from somewhere else to record them, approaches the limit of absurdity.

A full weather-station of the Meteorological Office now includes a barograph, a thermograph, and a hygrograph. The instruments are easily procured, and, except in an atmosphere like that of London, they are very durable. But such instruments are scientific only if scrupulous attention is paid to setting, checking, and timing—duties which require even more skill and care than the daily readings of standard instruments. A new survey of the meteorology of the country on the basis of self-recording instruments is not unworthy of your attention. They require for their interpretation the accompaniment of the nephoscope and the camera. And, in passing, let me say that the camera obscura which Capt. Cave introduced at South Farnborough seems to me to have possibilities as an instrument of meteorological observation which are in many ways unrivalled.

Other Opportunities of Co-operation.

But observing and experimenting are only one side of meteorological activity, and dealing with observations that have been made requires quite as much scientific skill and daring as devising and making the original observations. From the recollections of my correspondence at the Meteorological Office, I feel sure that there are a considerable number of people with scientific aspirations in this country who regard the Meteorological Office as a collection of leisured clerks waiting to be moved to do something by the fortunate originators of bright ideas who flourish most outside, but, so to speak, within striking distance of, Government institutions. I do not think I do some of my correspondents injustice if I say that the gist of the correspondence is that if they supply the ideas in the way of the design for an instrument or some original observations in the crude form the Office can do the rest. I can assure them that I have never known the staff of the Office to be at a standstill for lack of ideas to carry out, and from the freedom of this chair I will be bold enough to say that there are worse services to meteorology than helping to carry out the ideas of the Meteorological Office.

The Fellow as a Centre of Local Influence.

And outside the immediate sphere of the society there is much that is necessary to create an atmosphere favourable for the development of the science. We want people to know that meteorology is not exclusively forecasting. No doubt the view into the unknown future is, as Prof. Schuster said in his address to the British Association in 1915, the lure of scientific research, but the long way that has to be travelled in order to make sure of it rewards us with many side-views of common human interest. The discovery of the separation of the atmosphere into troposphere and stratosphere surely belongs to the great achievements of the human intellect, and the meteorological exploration of the globe is worth reciting. So I picture to myself a meteorologist, even in a part of the kingdom or the Empire so remote that he cannot share the privileges of our monthly meetings, who would be a centre of knowledge of the weather without aspiring to a reputation for foretelling the fortunes of his neighbour's hay or anticipating the prospects of a smooth passage.

RECENT IRON-ORE DEVELOPMENTS IN THE UNITED KINGDOM.[1]

WHILST the basis of the prosperity of a country is admittedly agriculture, its industrial growth is founded on mineral resources, and its participation in the world's markets is chiefly dependent on the extent to which these raw materials can be applied to home manufactures.

It is true that the first historical reference to this country mentions the export of tin from Cornwall, and that Great Britain's production and export of copper in the early part of the nineteenth century were the largest in the world; but for its modern industrial pre-eminence it is indebted to its coal and ironstone.

The cheap manufacture of iron and steel in this country has in the past been greatly aided by the providential dispensation that the ironstone was so closely associated in Nature with the fuel required to smelt it that the factor of transportation was practically eliminated

But the gradual exhaustion of the richer blackbands and clay-ironstones of the Carboniferous formation, and the introduction of the acid Bessemer process of steel manufacture, which requires a pure ore free from phosphorus and sulphur, made it necessary to find other sources of iron-ore supply. For many years the United Kingdom has been dependent for 30 per cent. of the iron-ore used in its blast furnaces on foreign countries. Foreign ore plays even a bigger *rôle* than at first sight appears, since it contains 50 per cent. of iron as against an average of 30 per cent. for home ores. The importation of hæmatite, rich in iron and low in phosphorus, from Spain and the Mediterranean has built up the big iron industries that are engaged in the manufacture of steel by the acid process in South Wales, on the North-West Coast, on the North-East Coast, and in Scotland, where the ports of Cardiff, Port Talbot, Whitehaven, Barrow, Middlesbrough, Newcastle, and the Clyde, situated in close proximity to an ample supply of labour, enable foreign ore and native coal to be easily assembled and cheaply handled.

But it was found to have its drawbacks when the war broke out; and the scarcity of ship-tonnage, which resulted from the activity of the enemy submarines, raised the cost of imported ore from about 20s. (at which best Bilbao ore ruled in British ports in 1914) to an actual price of more than 6*l*. per ton, although (under the cloak of Government subsidies) it figured at a lower level. At one period of the war the supply from these sources threatened to be cut off altogether.

To meet this situation an increased development of the Jurassic ironstones of this country was decided on. These ironstones, although abundant and cheaply worked, are what the ironmasters term "lean"—that is to say, they are low in iron, averaging only 28 per cent. of that metal. Moreover, they have a high phosphorus- and sulphur-content, and for the most part are rather siliceous.

The increased production of the domestic phosphoric ores brought about by the war raised many difficult problems. In the first place, it necessitated a different metallurgical treatment. This involved the substitution of basic-lined steel furnaces for those of the acid type, with consequent increased supplies of suitable refractory materials. It also involved large additional supplies of fuel for smelting, and of limestone for fluxing the ore in the blast-furnaces.

Especial difficulties arose with regard to magnesite and magnesite bricks. Prior to the outbreak of the war the magnesite-brick industry was almost wholly in the hands of the Austrians. Possessing in their own country extensive deposits of magnesite peculiarly suited for brick-making, they devoted both skill and money to the perfecting of their products, with the result that before the war they commanded practically the entire custom of the steel trade of this country. To make up for the loss of the Austrian material, arrangements were made by the Ministry of Munitions for the manufacture in this country of magnesite bricks, and the raw material was obtained from Eubœa, in Greece, and from Salem, in Madras.

To furnish the required dolomite and limestone, new quarries were opened up in this country.

With regard to labour a fresh supply had to be found, not only to work the new quarries of ironstone, limestone, dolomite, etc., but also to build the railways required to open them up, to erect extensions to existing plant, to man the new works, to reline furnaces, etc., and this in face of the incessant and urgent calls of the Army to fill the gaps in the fighting line.

Considerable use was made of prisoner labour. The difficulty with prisoners was to induce them to work. On account of the Army regulations, work could be compelled neither by force nor by a reduction of rations. The difficulty was overcome by the introduction of piece-rates, but only to a limited extent, as there was no outlet for surplus earnings in the canteens, food supplies having been cut down on account of the general food shortage. On the average, the efficiency of prisoner labour was about 50 per cent. of that of British labour.

The shortage of quarrymen led to active steps being taken in responsible quarters to supplement and to increase the efficiency of the manual labour at the quarries by the provision of mechanical appliances for stripping, breaking, and loading the ironstone.

In these open workings the output per man employed varies with the thickness of the ironstone-bed, the amount of cover to be removed, the use made of mechanical appliances, and the condition of the weather. The weather materially affects the output, especially where hand-labour is concerned. From

[1] Abstract of a lecture delivered at the Royal School of Mines on May 27 by Dr. F. H. Hatch.

returns made to the Ministry of Munitions in December, 1917, it appears that the average output in the Midlands per man employed was 5 tons per shift, and that it ranged from 3·8 tons where hand-labour was alone employed to more than 15 tons where mechanical excavators were in use under favourable conditions. The actual saving of manual labour which resulted from the installation of mechanical plant in the ironstone quarries during the war is estimated to have been equivalent to more than 3000 men.

The Jurassic ironstones have a wide distribution both in this country and on the Continent. In 1913 Germany mined in Lorraine and Luxemburg 28,000,000 tons of minette ores of Jurassic age out of a total production of 36,000,000 tons of iron-ore, while she imported in addition 3,800,000 tons of the same ore from Briey. Without the Lorraine iron-ore basin, which she stole from France in 1871, Germany would have been unable to go to war, and she took care to secure the remaining portion of the field (*i.e.* the Longwy and Briey basins) soon after the commencement of hostilities. One of the best guarantees for future peace is the provision in the Peace Treaty that no portion of this iron-ore field remains in German hands.

In England the Jurassic formation stretches as a broad band from the coast of Yorkshire to that of Dorset. The ironstones occur on four different horizons, as shown in the following table, which also gives the proportion in which they were worked (in relation to the total production of the United Kingdom) in 1917, and their average iron-content.

Table showing Relative Production and Iron-content of the Jurassic Ironstones.

Ironstone	Ratio to total production. Per cent.	Average iron content (as mined). Per cent.
Inferior Oolite (Northamptonshire and Rutland) ...	21	32
Middle Lias (Cleveland) ...	32	28
Middle Lias (South Lincolnshire, Leicestershire, and Oxfordshire)	9	25
Middle Lias (Raasay) ...	0·5	23
Lower Lias (North Lincolnshire)	18	23
	80·5	27·6

The Jurassic ironstones accounted in 1917 for more than 80 per cent. of the total output of iron-ore in the United Kingdom, the remaining 20 per cent. being made up of hæmatite mined in Cumberland and Lancashire (10½ per cent.), blackband and clay-ironstone mined in the English and Scottish coalfields (8 per cent.), and sundry ores mined in Wales, Forest of Dean, Devonshire, Weardale, and Ireland (1½ per cent.).

The Jurassic ironstones, although poor in iron, are valuable because of their considerable thickness and widespread occurrence at only a slight depth below the surface. With the exception of the Cleveland district of Yorkshire, where the ironstone is now mined underground, the workings are almost everywhere at the surface, the ironstone being quarried after stripping off an overburden of soil, sand, or clay, as the case may be. Since the angle of the dip is usually small—or, in other words, the beds are practically horizontal—considerable areas can be worked before the overburden becomes too great for removal at a reasonable cost. As much as 60 ft. of soft material (sand or clay) can be removed, and, under favourable conditions, probably 100 ft. will be removed.

The different beds of ironstone vary considerably in thickness. The thickest is the Frodingham bed in North Lincolnshire. This ironstone is 25 ft. to 30 ft. in thickness, and consequently can be worked very cheaply by mechanical excavation. Before the war the cost of the stone in wagons at the quarries (exclusive of royalty) was not more than 1*s.* per ton. Probably it is double that now.

As compared with 1916 figures, the production of the Jurassic ironstones as a whole was increased by 45,000 tons per week, equivalent to 2⅓ million tons per annum. The increase reached this maximum in the first half of the year 1918. But it was not possible to maintain production at that figure on account of the calls of the Army on labour. The increase was made mainly in Northamptonshire, Rutlandshire, and Leicestershire, the quarries in these counties accounting for 59 per cent. of the total increase; but Cleveland accounted for 26 per cent. and Oxfordshire for 9 per cent.

With regard to the non-Jurassic iron-ores of this country, the most important are the hæmatite deposits of Cumberland and Lancashire. These ores are remarkable for their richness in iron and their freedom from both phosphorus and sulphur, and therefore furnish a pig-iron very suitable for the acid Bessemer process, and yield an exceptionally pure steel. They are, consequently, in great demand, and this demand was emphasised during the war by the difficulty at one time experienced in securing sufficient supplies of hæmatite ore from Spain. Every effort was therefore made to push production to the utmost, and many abandoned mines were reopened in order to extract the pillars.

The deposits occur in masses of irregular shape in the Carboniferous Limestone, a formation which in this district rests unconformably on the old Skiddaw Slates, and is itself concealed in places by overlying Coal Measures and Red Sandstones or by Boulder Clay. The existing mines are situated between Lamplugh, in Cumberland, and Ulverston, in Lancashire, a distance from north to south of thirty-five miles.

No doubt, besides the known deposits, many undiscovered ore-bodies exist in the Carboniferous Limestone that can be found only by systematic prospecting by boring. Already before the war borings through the Red Sandstones had disclosed, south of Egremont, some of the largest ore-bodies that have been found in either county, with the possible exception of that worked by the Hodbarrow mine. The Beckermet, Ullcoats, and Ullbank Companies are now engaged in developing and working these deposits.

Since the Carboniferous Limestone is of widespread occurrence in the United Kingdom, it might have been expected that valuable hæmatite deposits would have been discovered in other parts of the country. With the exception, however, of deposits of limited extent in South Wales and in the Forest of Dean, this has not proved to be the case.

In the industrial recuperation of this country, now that the war is over, the working of the low-grade Jurassic deposits, which it is fortunate in possessing, is destined to play a great part. This has been rendered possible by the great extensions to iron and steel works that have been initiated with Government assistance during the war. These works have been planned on the most modern lines, and possess on the same site by-product coke-ovens, blast-furnaces, steelworks, and rolling mills. They are designed for the basic process of steel-making, and will be fed with home ores. In choosing the sites for these works regard has been paid to the situation of the raw materials—ore, fuel, and flux—required to supply them. On the completion of these extensions there should be no necessity for this country to import a single ton of foreign steel. Before the war something like 2,500,000 tons of steel, in the form of slabs, blooms, and billets, were imported into this country annually, mainly from Germany.

But for success in this great undertaking cheap ore and fuel are essential, and these can be obtained, in face of the greatly augmented cost of labour and material, which is a legacy of the war, only by an all-round increase in efficiency, embracing capital, engineering, and labour—capital by the installation of up-to-date equipment, engineering by improved mining methods, and labour by an increased output per man per shift.

These are the pressing problems of the immediate future.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The following appointments have been made:—At King's College: Mr. J. E. Barnard, lecturer in microscopy; Major J. Quinton, iecturer in mathematics; and Dr. W. Wilson, as whole-time senior lecturer in the department of physics. At Bedford College for Women: Mrs. Orson Wood, demonstrator in the department of physics; Miss Woodman, part-time demonstrator in the department of physiology. The chemical department of the college has been divided into the two departments of (*a*) organic chemistry and (*b*) inorganic and physical chemistry. The following appointments have been made to the staff of the new departments:—Mr. Crompton, head of the department of organic chemistry and director of the laboratories; Dr. Spencer, head of the department of inorganic and physical chemistry; Miss Vanderstichele and Miss Triffitt, demonstrators in the department of organic chemistry; Miss Crewdson, demonstrator in the department of inorganic and physical chemistry. At Goldsmiths' College: Mr. G. T. White, head of the engineering and building department.

The title of assistant professor of physiology has been conferred upon Dr. O. Rosenheim, of King's College.

OXFORD.—Mr. Julian S. Huxley, a scholar of Balliol from 1905 to 1909, and from 1913 to 1916 associate professor of biology in the Rice Institute, Houston, Texas, and Mr. Henry Clay, scholar of University College from 1902 to 1906, and author of "Economics for the General Reader," have been elected fellows of New College.

DR. A. W. STEWART, of the University of Glasgow, has been appointed to succeed the late Prof. E. A. Letts in the chair of chemistry in the Queen's University of Belfast.

THE late Sir Archibald D. Dawnay bequeathed for scholarships 5000 1*l.* shares in the firm of Archibald Dawnay and Sons, Ltd., to the Royal Institute of British Architects, 5000 to the London County Council, 1000 to the South Wales Institute of Engineering, Cardiff, and 1000 to the Battersea Grammar School. The bequests will become operative after the death of Lady Dawnay.

APPLICATIONS for the William Julius Mickle fellowship, which is of the value of at least 200*l.*, must be made to the academic registrar of the University of London before October 1 next. The fellowship is open to both men and women, and will be awarded to a graduate of the University, resident in London, who has done most to advance medical art or science during the past five years.

APPLICATIONS are invited by the Joint Studentship Committee of the Empire Cotton-growing Committee of the Board of Trade and the British Cotton Industry Research Association for studentships from graduates desirous of continuing their studies on the living plant. The studentships are of the yearly value of about 150*l.*, and applications must reach the secretary of the British Cotton Industry Research Association, 108 Deansgate. Manchester, on or before August 27.

THE prospectus of university courses in the Municipal College of Technology, Manchester, for the session 1919–20 has now been published. The college offers systematic training in the principles of mechanical, electrical, municipal, and sanitary engineering; of architecture and the building trades; of the chemical industries and the textile industries; and of photography and the printing crafts. It possesses extensive laboratories and workshops equipped with full-sized modern machinery, tools, and apparatus, including not only machines of the types now in general use, but also machines especially constructed for demonstration, experiment, and original research. There is a generous provision of both entrance and post-graduate scholarships. Courses of post-graduate and specialised study and research are offered for a fourth year to students who have successfully completed the three years' course for a degree in the Faculty of Technology in the Victoria University of Manchester conducted in the college, or are otherwise deemed competent to enter upon them.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 21.—M. Léon Guignard in the chair.—J. **Boussinesq**: The existence of an approximate relation, pointed out by M. Carvallo for quartz, between the two rotatory and dispersive powers of bodies.—A. **Gautier** and P. **Clausmann**: The action of fluorides upon vegetation. Field culture experiments. The fluorine in these experiments was added in the form of amorphous calcium fluoride; it was found to be favourable to the growth of wheat, oats, carrot, broad bean, cabbage, pea, poppy, potato, and hemp. No effect was observed with barley, rye, bean, buckwheat, and mustard, whilst beetroot, turnip, and onion were prejudicially affected by fluorides.—P. **Sabatier** and A. **Mailhe**: The catalytic formation of alkyl chlorides, starting with the primary alcohols. A mixture of hydrochloric acid and alcohol vapour, passed over alumina heated to 370° to 450° C., gives the alkyl chloride mixed with the ethylenic hydrocarbon produced by the dehydration of the alcohol. Primary, secondary, and tertiary chlorides may be formed in this reaction.—V. **Grignard** and G. **Rivat**: The addition compounds of halogen acids to diphenylarsenic acid. The addition products $[(C_6H_5)_2.AsO.OH]_2HCl$ and $(C_6H_5)_2.AsO.OH.HCl$ and two corresponding compounds with HBr were isolated and analysed.—G. **Giraud**: The classification of substitutions of certain automorph groups of n variables, and the algebraic relations which exist between any $(n+1)$ functions corresponding with certain of these groups.—M. de **Broglie**: The X-ray spectra of the elements. Measurements of the K spectrum of rhodium and L absorption spectrum of radium.—J. **Hebert-Stevens** and A. **Larigaldie**: Radiotelegraphy by infra-red radiation. The light from an arc projector is filtered through a screen which absorbs all the visible rays but allows a portion of the infra-red rays to pass. The receiver is a parabolic mirror with a sensitive thermo-couple placed at its focus, and the latter actuates a relay. Messages have been sent over 20 kilometres with this apparatus.—S. **Posternak**: The synthesis of the hexaphosphate of inosite and its identity with the phospho-organic reserve principle of green plants. The ester was prepared from inosite and phosphoric acid in presence of an excess of phosphorus pentoxide. The yield is low, 3 to 5 per cent., and the substance is identical in all respects with the natural product from phytine.—R. **Levaillant** and L. J. **Simon**: The action of chlorosulphonic acid on methyl hydrogen sulphate. Methyl chlorosulphonate, $Cl.SO_2.(O.CH_3)$, can be isolated from the products of this reaction.—P. **Thiéry**: The geology of the region of Alais (Gard).—L. **Gentil**: The genesis of the forms of strata in chalk districts called *rideaux*.—S. **Stefanescu**: The teeth of elephants and mastodons.

CAPE TOWN.

Royal Society of South Africa, June 18.—Dr. J. D. F. Gilchrist, president, in the chair.—Miss Ethel M. **Doidge**: South African Microthyriaceæ. This group of fungi has been recently revised by von Hohnel and Theissen and others, and the characters of the family Microthyriaceæ have been more clearly defined. A short account of the genera represented in South Africa, and descriptions of species in the Cryptogamic section of the Union Mycological Herbarium, Pretoria, are given.—C. L. **Herman**: Note on carbolic acid as a fixative for histological preparations. Carbolic acid in 5 per cent. solution was found a most efficient fixative for histological purposes. It has been used since 1912 for all organs, including the central nervous system. For the thyroid gland it is especially good, as it gives thorough fixation of the colloid without shrinking or distortion. It acts by precipitating the protein without, however, entering into combination with it. It rapidly penetrates all tissues, especially the nervous tissue, and fixes both the cytoplasm and the nucleus without distortion or alteration. The optical differentiation becomes very good, and all cell-structures are found well and clearly defined. Staining is facilitated, and all stains are readily taken up.—J. R. **Sutton**: A contribution to the study of the diamond macle, with a note on the internal structure of diamond. The first part of this paper describes the aspect and characteristics of macles from various South African diamond mines, and gives statistics showing that the standard thickness to which macles tend to conform is almost exactly one-half that of the perfect octahedron standing upon an equal face. The so-called "twinning plane" is not necessarily a true plane at all, but rather an irregular surface. Bultfontein Mine is remarkable for the large number of irregular twins it produces and the small percentage of macles. In the second part the author discusses the "grain" of diamonds, as revealed by broken macles and by broken simple crystals, in which the fracture lies in a dodecahedral plane of symmetry, and deduces therefrom the primary cubical structure. The points of agreement and disagreement with the structure deduced by Bragg (by means of X-ray research) are indicated. Three orders of cleavage are shown, *i.e.* parallel to the faces of the octahedron, cube, and rhombic dodecahedron respectively.

BOOKS RECEIVED.

Strawberry Growing. By Prof. S. W. Fletcher. (The Rural Science Series.) Pp. xxii+325+xxiv. plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) 1.75 dollars.

A Large State Farm: A Business and Educational Undertaking. By Lt.-Col. A. G. Weigall and Castell Wrey. Pp. xiii+82. (London: John Murray, 1919.) 2*s.* 6*d.* net.

The Flower and the Bee: Plant Life and Pollination. By J. H. Lovell. Pp. xvii+286. (London: Constable and Co., Ltd., 1919.) 10*s.* 6*d.* net.

Utility Ducks and Geese: Their Successful Management for Egg and Meat Production, with Brief Notes on Some Ornamental Waterfowl. By J. W. Hurst. Pp. 93. (London: Constable and Co., Ltd., 1919.) 2*s.* 6*d.* net.

The Farmer and the New Day. By K. L. Butterfield. Pp. ix+311. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1919.) 8*s.* 6*d.* net.

The Fauna of British India, including Ceylon and Burma. Coleoptera, Chrysomelidæ (Hispinæ and Cassidinæ). By Prof. S. Maulik. Pp. xi+439. (London: Taylor and Francis, 1919.)

The Cactaceæ: Descriptions and Illustrations of Plants of the Cactus Family. By N. L. Britton and J. N. Rose. Vol. i. (Publication No. 248.) Pp. vii+236+xxxvi. plates. (Washington: The Carnegie Institution, 1919.)

The Iron and Steel Industry of the United Kingdom under War Conditions: A Record of the Work of the Iron and Steel Production Department of the Ministry of Munitions. By Dr. F. H. Hatch. Pp. xii+167. (London: Privately printed for Sir John Hunter by Harrison and Sons, 1919.)

The North Riding of Yorkshire. By Capt. W. J. Weston. Pp. viii+161. (Cambridge: At the University Press, 1919.) 2*s.* 6*d.* net.

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