THURSDAY, SEPTEMBER 13, 1917.

FOUNDATIONS OF BIO-PHYSICS.

On Growth and Form. By D'Arcy Wentworth Thompson. Pp. xv+793. (Cambridge: At the University Press, 1917.) Price 21*s.* net.

THIS book, at once substantial and stately, is to the credit of British science and an achievement for its distinguished author to be proud of. It is like one of Darwin's books, well-considered, patiently wrought-out, learned, and cautious—a disclosure of the scientific spirit. It is an application of some of the concepts of physical science and sundry mathematical methods to the study of organic form. "My sole purpose is to correlate with mathematical statement and physical law certain of the simpler outward phenomena of organic growth and structure or form: while all the while regarding, *ex hypothesi,* for the purposes of this correlation, the fabric of the organism as a material and mechanical configuration." "Of how it is that the soul informs the body, physical science teaches me nothing. . . . But of the construction and growth and working of the body, as of all that is of the earth earthy, physical science is, in my humble opinion, our only teacher and guide." We think that it will be difficult to justify the word "only," for in the working of the body the soul (to use the author's dualistic terminology) takes part, as when a strong emotion influences our suprarenals, and, willy-nilly, we are back in psycho-biology.

The author begins with the general "principle of similitude" first laid down by Galileo, who showed that "neither can man build a house nor can Nature construct an animal beyond a certain size, while retaining the same proportions and employing the same materials as sufficed in the case of a smaller structure." The exposition of this illustrates in a vivid way "the profound differences of physical property and potentiality which are associated in the scale of magnitude with simple differences in degree." This is introductory to a fine discussion of the rate of growth, for the form of the organism is usually a direct expression of a rate of growth which varies according to its different directions.

"The velocities in different directions tend to maintain a *ratio* which is more or less constant for each specific organism; and to this regularity is due the fact that the form of the organism is in general regular and constant."

The author has dwelt most on those aspects of organic growth which have their analogies among inanimate things. He says comparatively little in regard to the regulative phenomena which are so distinctive in the growth of organisms; and his reference to the experiments of Gudernatsch, for instance, is inadequate. Not enough is allowed, as it seems to us, for the extraordinary differences of form which may result from a slight environmental difference—for instance, in the experimentally altered fates of the indifferent larvæ of Bonellia. The final form depends on the occurrence or non-occurrence of certain differentiations, and that depends on biochemical conditions. Then again, the remarkable disturbances of form which result from the introduction of toxic substances into developing embryos (see Werber's work) suggest that form depends on more than accelerations and retardations of growth in different directions.

"The cell, which Goodsir spoke of as a 'centre of force,' is in reality a 'sphere of action' of certain more or less localised forces; and of these, surface-tension is the particular force which is especially responsible for giving to the cell its outline and its morphological individuality." In a fascinating discussion Prof. Thompson shows that cell-division and other intra-cellular phenomena may be tentatively explained as the results of a conflict between surface-tension and its opposing forces. He favours the provisional assumption that "the phenomena of karyokinesis are analogous to, if not identical with, those of a bipolar electrical field." This leads on to an interpretation of the forms of free cells as essentially dependent on surface tension. "The simple fact is that the agreement of cell-forms with the forms which physical experiment and mathematical theory assign to liquids under the influence of surface tension, is so frequently and often so typically manifested, that we are led, or driven, to accept the surface tension hypothesis as generally applicable and as equivalent to a universal law."

Utilising the facts of adsorption and Macallum's fine researches, the author shows very cleverly how apparent exceptions may prove the rule. He proceeds to the more complex problem of interpreting the forms of cells in aggregates, utilising Leduc's remarkable "artificial tissues," and he shows the courage of his convictions in attacking the problem of the formation of blastula and gastrula. In an elaborate survey of a great variety of tissues he shows that it is possible to go a long way in interpretation with the help and guidance which the phenomena of surface-tension, the laws of equilibrium, and the principle of minimal areas are at hand to supply. Attention is directed to the fact that "all possible groupings or arrangements whatsoever of eight cells (where all take part in the *surface* of the group, none being submerged or wholly enveloped by the rest) are referable to some one or other of *thirteen* types or forms," or probably fewer than thirteen, "for there is reason to believe that, out of the total number of possible groupings, a certain small number are essentially unstable, and have at best, in the concrete, but a transitory and evanescent existence."

A very interesting chapter deals with concretions, spicules, and spicular skeletons. The form of the spicule may depend simply on its chemical nature; or the inorganic solid material may be laid down in conformity with the shapes assumed by the cells, tissues, or organs; or there may be intermediate cases where the molecular forces play their part in conjunction with, and

under the restraint of, the other forces inherent in the system. What is known as to the precipitation of calcium salts in various colloids, and as to similar phenomena, is used in the interpretation of the spicules of Sponges and Alcyonarians and the skeletons of Radiolarians and Foraminifers. There seems to be much in such formations that is not in any essential way dependent on their occurrence within living creatures.

"But every now and then we come to certain deep-seated signs of protoplasmic symmetry or polarisation, which seem to lie beyond the reach of the ordinary physical forces. It by no means follows that the forces in question are not essentially physical forces, more obscure and less familiar to us than the rest," comparable, for instance, with the formative force which Lehmann demonstrated in "fluid crystallisation." Crucial experiments are, we admit, awanting, but our faith is strained by the author's physical account of the apparently selective behaviour of certain Foraminifera which make for themselves very effective encasements of particular kinds of materials, such as sponge-spicules. We are inclined to think, also, that the author exaggerates the fluidity of Alcyonarian "species," for while his reproach may be justified in some genera, the striking feature in others is the rigid specificity, specimen after specimen like the duplicate of its predecessor, the absence of inter-grades, the clean-cut peculiarity of many of the spicular forms, and the individuality of the architecture around the polypes.

An attractive chapter deals with the logarithmic spiral which is of such widespread occurrence among animals, notably among Gasteropods. "In the growth of a shell, we can conceive no simpler law than this, namely, that it shall widen and lengthen in the same unvarying proportions: and this simplest of laws is that which Nature tends to follow. The shell, like the creature within it, grows in size, *but does not change its shape;* and the existence of this constant relativity of growth, or constant similarity of form, is of the essence, and may be made the basis of a definition, of the logarithmic spiral." From this type have evolved multitudinous diversities of form, mathematically identical, and natural selection may well be relieved of the burden of them. Of the author's explanations of horns and phyllotaxis, of the eggs of birds and the tests of sea-urchins, we have no space left to speak. We must, however, direct attention to what seems to us a slight blemish on p. 660, where the author adheres to a mechanical interpretation of the position of the spine on Bilharzia eggs, an interpretation which "destroys the chief evidence for the existence of a supposed new species of worm, a continued belief in which, among worms of such great pathogenic importance, might lead to gravely erroneous pathological deduction." We do not understand why Prof. Thompson deliberately allowed this to remain, knowing, as a note indicates, of Dr. Leiper's recent work, which does far more than assert that terminal and lateral spined eggs belong to separate and distinct species of Bilharzia. Is there not a risk that the retention of the page may "lead to gravely erroneous pathological deductions"?

With the often fanciful utilitarian interpretations of coloration and markings, of which a deliciously ironical exposition is given, the author contrasts the deep-seated adaptations of structure to mechanical efficiency, seen so well in a bone, where statical and dynamical considerations can be applied and established in detail. The book closes with a luminous essay on "the theory of transformations, or the comparison of related forms," in which it is shown, to put the matter rather roughly, how one harmonious deformation may lead from one skull or leaf to that of a related type, how trammels or lines of constraint may determine the action of the expansive forces of growth, now in one direction and again in another.

We offer Prof. D'Arcy Thompson felicitations on his masterly book. It marks a big advance in science, and it will make other advances possible. He has used his own observations and those of a hundred others to show, in a way that will surprise and delight many, what promise there is in the endeavour to carry into the study of living beings the laws and lessons of the inorganic. When first we laid the book down, we were tempted to say, "Magnificent, but not biology," but wiser reflections prevailed. Who knows better than the author what biology is and is not? We saw that he was but putting heredity and variation temporarily aside for his purpose, "to show that a certain mathematical aspect of morphology, to which as yet the morphologist gives little heed, is interwoven with his problems, complementary to his descriptive task, and helpful, nay, essential, to his proper study and comprehension of form." We would go further, and say that his argument, couched in a style that is always clear and dignified, and at times bewitchingly beautiful, has given us a fresh revelation of the unity of Nature.

J. ARTHUR THOMSON.

SCIENCE AND INDUSTRY.

The Chemistry of Dyestuffs: A Manual for Students of Chemistry and Dyeing. By M. Fort and Dr. L. L. Lloyd. ("Cambridge Technical Series.") Pp. xi+311. (Cambridge: At the University Press, 1917.) Price 7*s.* 6*d.* net.

THIS work, which has the scope of an elementary text-book, is a useful addition to the rapidly increasing number of manuals in the English language devoted to the subject of dyes and their intermediate products. The authors point out that the opportunity of development now presenting itself to the colour manufacturer in this country will lead to a greater interest in the chemistry of dyes and to an increasing demand for chemists possessing special knowledge of colouring matters. To the student equipped with

a knowledge of pure chemistry this treatise will prove an efficient guide to one of the most complicated and technical branches of applied chemistry.

The introductory chapters deal with the history of synthetic dyes and the nature of coal tar. It is of interest to note how remarkably the nature of tar varies with the temperature at which coal is distilled. When produced at 400–500° C. the tar is rich in volatile hydrocarbons, especially paraffins, and is valueless for the colour maker. At 900–1000° C. an optimum yield of aromatic (benzenoid) compounds is obtained. Tar produced at the higher temperatures contains, roughly, the following percentage amounts of important direct coal-tar products:—Benzene, 2; toluene, 0·5; phenol, 0·6; naphthalene, 5–6; and anthracene, 0·6. It is on these five substances, together with two or three others obtained in even smaller proportions, that the great synthetic colour industry is based.

Ten chapters are devoted to an explanation of the chemical processes whereby the foregoing direct coal-tar products are converted into intermediate products, or "intermediates." Sufficient theoretical matter is introduced into this section to make the practical details readable and connected. For example, the constitutions of quinones and diazo-compounds are treated fully because of their bearing on the structure of organic dyes.

The chapter on the application of dyes refers to the dyer's classification of colouring matters into acid, basic, mordant, direct cotton, vat, or sulphide dyes. Concrete examples are given of each of these groups of dyes with appropriate methods of applying the colouring matters to the textile fibres.

A chapter on the colour and constitution of dyes and coloured substances is followed by eleven chapters devoted to the synthetic dyes classified under their respective chromophores or characteristic colour-bearing groups.

One of the most informing of these sections is the chapter on vat dyes. In this group we find the oldest and newest colouring matters known to dyers. Indigo and Tyrian purple were used by the ancients, whereas the other indigoid dyes and the anthraquinone vat and sulphurised vat dyes have all been discovered since the commencement of the twentieth century.

The last chapter describes the principal natural dyes, a group of colouring matters which has during the war regained a certain amount of its former importance owing to the shortage of synthetic dyes.

The authors are fully alive to the national importance of establishing a British sphere of influence in dyes, and as an outward and visible sign of this sentiment perhaps they might be persuaded to drop the inelegant expression "dyestuffs," obviously a literal translation of "Farbstoffe," in favour of such English terms as dyes, colouring matters, and dyewares.

G. T. MORGAN.

LUIGI CREMONA.

Opere Matematiche. Di Luigi Cremona. Tomo Terzo. Pp. xxii+520. (Milano: Ulrico Hoepli, 1917.) Price Lire 30.

THIS final volume of Cremona's collected mathematical works contains thirty-six papers, including the treatise on the general theory of surfaces, the memoir on cubic surfaces, the tract on reciprocal figures in graphical statics, and various notes on birational transformations in space. Prefixed thereto is a biographical notice by Prof. E. Bertini, giving many interesting details of Cremona's career.

For many years Cremona was better known to English readers than were the majority of foreign mathematicians; and it is not difficult to give reasons for the fact. So far as the geometry of algebraic surfaces is concerned, he and Salmon were kindred spirits; and the latter gives numerous references, in his "Solid Geometry," to Cremona's investigations.

Then the Clarendon Press published two excellent English translations of his "Elements of Projective Geometry" and "Graphical Statics" at a time when interest in these subjects had been aroused by Henry Smith, Clerk Maxwell, and others. Finally, Cremona's cast of mind and style of composition could, and did, appeal successfully to English mathematical taste.

Perhaps Cremona's greatest achievements were due to his superb qualities as a teacher and educationist. Though he lived until June 10, 1903, the last of his mathematical papers appeared in Proc. L.M.S. for 1884; and the reason was that the Italian Government, recognising his value, appointed him to posts of such importance as to absorb all his energies. This is not the place to estimate his services to the Italian system of education; but they were undoubtedly very great, especially in such things as the courses given in engineering.

Cremona's ultimate rank as an original mathematician will probably rest mainly on his discoveries in the algebraical theory of birational transformations; and it is not without justice that the term "Cremona transformations" has been adopted for the simplest class of them. As developed by Nöther and others, this theory is of cardinal importance, both in analytical geometry and in the theory of Abelian functions; and we may fairly say that Cremona was the first to demonstrate its value and give brilliant and original applications of it. As an exponent of novel and comprehensive theories he displays qualities of the very highest order. G. B. M.

OUR BOOKSHELF.

Scientific Treatise on Smoke Abatement. By H. Hamilton. Pp. xiii+155. (Manchester: Sherratt and Hughes, 1917.) Price 5*s.* net.

IT is a little unfortunate that the term "scientific" should have been included in the title of this book, seeing that the author is clearly more familiar with the subject of mechanical engineering

than with either physics or chemistry. Without a sound knowledge of at least the fundamental principles of these two sciences, the scientific treatment of smoke abatement is bound to suffer, and the result is that the scientific part, if it may be so called, is ill expressed and arranged, incomplete, and often incorrect. For example, the term "British Thermal Unit" is defined and used; but the method of estimating the calorific value of fuels is never mentioned, or its relation to temperature, though the two are frequently referred to together. The confusion between molecular and atomic weights (p. 16) is not perhaps a serious error, but the statement that at low temperatures "hydrogen and carbon in the coal partially combine, producing hydro-carbons causing smoke" (p. 15), cannot be passed over so lightly. The statement on p. 12 that *excessive admission of air* produces carbon monoxide must surely be an oversight.

The author is evidently more at home with furnaces, boilers, and mechanical stokers, and the fact that he has qualified as smoke inspector by examination of the Royal Sanitary Institute explains the clear and full descriptive account of these appliances, together with various forms of gas-producers and fire-grates. Everyone must sympathise with the vigorous condemnation levelled by the author against smoke and those responsible for it, but we doubt whether the volume before us, either by suggestion or experiment or new appliances, has thrown very much fresh light on the problem, or added many facts to those already known. J. B. C.

Laboratory Manual of Bituminous Materials for the Use of Students in Highway Engineering. By Prévost Hubbard. Pp. xi+153 (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 6*s.* net.

SINCE the advent of the motor-car the use of bituminous materials in road-making has become more and more widespread, and a definite knowledge of the chemical and physical characters of these substances is of increasing importance to the road constructor. In the United States a number of the leading universities have instituted courses of instruction in highway engineering, which include laboratory practice in the testing of bituminous materials, and the manual under notice has been prepared by the author to meet the wants of students and instructors attending such courses.

The first part of the book deals with the definition and classification of the various bituminous substances used by the highway engineer, and also with general matters such as the sampling and preparation of the bitumens for analysis. In the second and main division the author describes the methods of applying the various tests—chemical, physical, and mechanical—by which the materials are assayed and evaluated. The descriptions are lucid and concise; they have evidently been drawn up by a writer who has first-hand knowledge of the special difficulties attending this class of analytical work. In the concluding part of the book the characteristics of the more important bituminous substances are discussed, including those of the fluid, semi-solid, and solid petroleum products, tars, asphalts, pitches, creosote oils, and bituminous aggregates. Typical analyses are given, and these are carefully dissected in order to bring out clearly the proper interpretation of the results. The book should prove of value to municipal and other chemists who may have to deal with the substances in question, as well as to the students for whom it is especially written. C. S.

THE DANGERS OF ELECTRICAL CURRENTS.

ON account of the widespread use of electricity at the present time, the small book before us, by M. Rodet,[1] is of considerable practical value. We note that an actual current must pass through the tissues of the body if any effect is to be produced. A static charge is harmless. A bird may perch on a high-tension main without any serious results. The resistance of the human body resides chiefly in the skin, and is very high if the skin is dry—from 20,000 to 80,000 ohms. But if the skin is moist and a good earth contact is made by bare feet in a wet mass, a man may be killed by touching a 100-volt main. A brief summary is given of the general physiological effects of stimulating various nerves by electrical currents. The development of heat is also discussed; burns are produced where the current density is great, as when it enters by a relatively small contact surface. With respect to high-frequency alternating currents, the interesting experiments of Kennelly and Anderson in America are described. They showed that, at an alternation of 100,000 per second, a voltage of 250 can send a current of half an ampere through the body without any sensation beyond that of warmth. The explanation is probably that given by Nernst, namely, that certain ions in the nerves must attain a certain minimal local concentration in order that stimulation may take place. Each half-wave of so rapid an alternation cannot, in the time permitted, effect this concentration before the opposite half-wave comes in and reverses what little has been done. The energy of the current is thus converted into heat without being able to produce electrolytic changes.

The second chapter is devoted to the nature of the accidents which may happen. These are indirect and direct. The former are due to a momentary shock, harmless in itself, but which may cause a fall from a height or similar result. The protection is obvious: to take care either that no live wires are within reach, or that the workman wears efficient insulating gloves, stands on insulators, and so on, if disconnection from the generator is impossible. The *direct accidents* are due to actual passage of current through the body. So many different effects are possible that it is frequently a matter of difficulty to say what

[1] "Actions Physiologiques et Dangers des Courants Électriques." Par J. Rodet. (Paris: Gauthier-Villars et Cie, 1917.) Price 3.25 francs.

a particular case may be suffering from, and an autopsy may not reveal the cause of death. An important point to decide, so far as practicable, is what voltage is to be regarded as dangerous. As stated above, the resistance of the skin may vary greatly. But, according to Jellineck, 100 to 150 volts may usually be handled with impunity; 200 to 500 volts are dangerous; anything above 500 volts nearly always causes death. It has been said that 0·1 ampere is fatal, but this is probably the upper limit of safety, and many persons, especially alcoholics, are very susceptible. The time of exposure naturally plays an important part, so that a short contact may be innocuous, while a longer one is fatal. This is partly due to the fact that the resistance decreases during the passage of the current, so that more and more is sent through. Cases where one of the mains is earthed are especially dangerous if contact be made with the insulated main. It appears, however, that the electrostatic capacity of a large circuit may render contact with a completely insulated alternating current dangerous.

The precautions to be adopted are detailed in the fifth chapter. These are partly of the nature of notices of danger placed in the neighbourhood of live conductors and instructions to workmen employed where there is risk of contact. All live conductors should, if possible, be placed out of reach, and all parts liable to obtain static charges, such as the outer cases of transformers, should be earthed. Since it is very rare that *both* mains come into contact with the body, a sufficient protection, up to 500 volts, is usually found in insulating gloves and such like. In the case of alternating currents special danger is incurred when the insulation between the primary and secondary coils of a transformer breaks down, or, in general, whenever a low-tension circuit becomes connected with one of high tension. Various methods of automatic connecting to earth, when this happens, are described. The advantages of connecting one main of the secondary circuit permanently to earth are fully discussed, and the means of making good earth contacts pointed out. Where there is a water main this forms the best of such connections.

The final chapter deals with the treatment of accidents. Burns require the usual dressings and present no special difficulties. On the other hand, the numerous effects of the passage of a current through the body make it difficult to know what has actually happened. The most obvious result is a cessation of respiration and of the beats of the heart. It is almost impossible to say which is the primary cause, since either involves the other. But the treatment is the same, namely, artificial respiration applied as soon as possible, without waiting for removal or for the arrival of a medical man. The report of the American Commission on the best method finds that Schäfer's is to be preferred. One of the most important points in its favour is, perhaps, not sufficiently insisted on: that is, that it can be carried on for a long time without fatigue to the operator. The value of this is shown by some of the cases mentioned, especially one in America, where the patient did not recover until artificial respiration had been carried on for six hours. Some other methods of artificial respiration are described, but, with the exception of the old Sylvester method, they are ineffective and so far mischievous, since they waste time during which an effective method might have been used. If compressed oxygen is available, advantage will be gained by arranging that the gas drawn in by inspiration shall consist of oxygen. As concerns the use of apparatus for insufflation of oxygen, in place of the mechanical movement of the chest, they are no doubt valuable, if at hand. But this is rarely possible, and M. Rodet rightly insists that a less effective method may be successful if used at once, where a more perfect one may be useless if it involves only a few minutes' delay.

The heart sometimes enters into fibrillary contraction. If this is the case with the ventricle, no means yet known are capable of restoring it. It seems that a more direct massage of the heart may in some cases be of use, if it can be done without interfering with the artificial respiration. Intravenous injections of saline solutions containing adrenaline may also be given. By this means a better supply of blood to the heart and brain is brought about by the rise in arterial pressure. It is to be remembered that Schäfer's method of artificial respiration involves, more or less, a rhythmical compression of the heart.

But, even when natural respiration has returned, the patient must be watched for some time, since he may cease breathing again and require renewed artificial respiration. He should be kept warm from the first and, after natural breathing has returned, may be given hot coffee. But on no account must liquids be given until that time. Secondary complications, such as paralysis or renal affections, may cause death days or weeks after the accident.

The author concludes that, in any case, prevention is better than cure, and that every means of avoiding the chance of contact with live conductors should be adopted, both for workpeople and for the public in general.

The book is written with the usual lucidity of French scientific works and should be in the hands of everyone likely to have to deal with the results of exposure to electrical currents.

W. M. BAYLISS.

IMPERIAL MINERAL RESOURCES BUREAU.

AS was briefly announced in NATURE of June 7 (p. 289), the Minister of Munitions has appointed a committee to prepare a scheme for the establishment of an Imperial Mineral Resources Bureau, to be located in London. This is obviously the first step towards carrying out the recommendation of the recent Imperial War Conference: "That it is desirable to establish in London an Imperial Mineral Resources Bureau, upon

which should be represented Great Britain, the Dominions, India, and other parts of the Empire," and no doubt both the recommendation of the War Conference and the later action of the Ministry of Munitions were powerfully influenced by the memorandum to this effect drawn up by the technical institutes that are most closely in touch with the exploitation of our mineral deposits and the utilisation of their products. The Ministry of Munitions cannot fairly be accused of undue haste, seeing that it is nearly a twelvemonth since the institutes directed attention to this important matter, which was commented on in the columns of NATURE of October 5, 1916; it is to be hoped that effect will be given promptly and energetically to the findings of the committee, although it is perhaps even more important that the scheme put forward shall be a thoroughly sound one and that it shall deal with every aspect of this very large subject.

The importance of the subject may best be gauged by considering that the number of workers employed in the mines and quarries of the British Empire was at least 2½ millions in 1913, and that the value of the mineral products at the point of their production was about 150,000,000*l.* sterling in the same year. This vast sum represents the value of minerals extracted from Imperial mineral deposits, and this means that the assets of the Empire are diminished by this amount every year; it cannot be too often insisted upon that it is this fact, in respect of which the mineral industry is unique amongst all others—namely, that minerals constitute a wasting asset, which, once taken from the ground, can never be renewed or recovered—that renders the establishment of a bureau to watch over the proper development and utilisation of our mineral resources an imperative necessity. The figure given above refers only to the value of the crude minerals at the mine; it need scarcely be said that the products obtained from, and depending upon, the mineral output are worth many times as much, in the same way that the number of workers engaged in the treatment of mineral products and depending also upon them is far greater than the number above stated, even when only the industries directly connected with the mineral production, such as the metallurgical industries, are considered.

It must, however, not be forgotten that the industries indirectly connected with the exploitation of minerals are very widely ramified, and are so complex that it is not easy to foresee all the results that may arise from any change in the direct treatment of the minerals themselves, and no doubt these considerations will need the most careful study by the bureau. To take an example, it is quite possible that one of the first questions that the bureau will have to consider is the extent to which metalliferous minerals should be smelted in the country of their origin, or alternatively imported as such to be smelted in this country; it may surely be taken for granted that the old blunder of allowing other nations to import our crude minerals and to reap the advantage of treating them outside the Empire will never be repeated. At first sight, having regard to the fact that for some time after the termination of the war there must be a shortage of tonnage, it might seem preferable to smelt, for example, Australian zinc concentrates in Australia, and to ship the smelted spelter to this country; if, however, this principle were carried too far, we might find that the diminished importation of sulphide ores might bring about a scarcity of sulphuric acid in this country, which might easily cripple our chemical industries, or, by affecting the output of sulphate of ammonia, might influence our agricultural production very adversely.

Obviously, if the Mineral Resources Bureau is to be of real value, it must be able to dispose of the fullest possible technical and scientific information, and it ought for this purpose to work in the closest possible co-operation, not only with the Department of Scientific and Industrial Research (which is already doing useful work in encouraging such researches as that now being conducted upon the dressing of ores of tin and wolfram), but above all with the technical institutions devoted to the advance of the mining and metallurgical industries. No doubt the ideal arrangement would be for the bureau and these various institutions all to be housed in one building, so as to be able to communicate with each other with the utmost readiness, and, above all, to have one common library, in which all books, papers, statistics, and information of any kind concerning mineral production should be housed. Such a joint library should be second to none in the world, and given its indispensable adjunct—a competent librarian—all information concerning any aspect of any mineral question should be readily available to anyone interested. Such a collection of all existing information should be one of the first cares of a Mineral Resources Bureau; only those who have been actually engaged in such work know how much time and money are being continually wasted in doing over again work that has already been done, merely because the records are not readily available to any inquirer.

Again, there is probably no industry that is so many-sided as the mineral industry, and therefore none in which there are so many specialists; it is safe to say that such specialists are best known to the secretaries of the technical institutions, who are necessarily in close touch with them, and an intimate co-operation between the bureau and these institutions would enable the former to get the benefit of the assistance of the best specialists in any problem that may arise in the readiest and most effective manner. Finally, it may fairly be hoped that close connection with the institutions, and through them with the men actually engaged in the mineral industries, may save the activities of the bureau from being strangled by official red-tape. The proper development of our mineral resources is of such importance to the future of the Empire that the organisation of this bureau, which could do so much for them if it is properly constituted, will be watched with the greatest anxiety.

HENRY LOUIS.

LINGUISTIC AND POLITICAL BOUNDARIES IN EUROPE.

NATIONALITY is to serve as an important factor in determining the boundaries of the New Europe. On broad lines the safest guide to the nationality of any populace is the language commonly spoken, usually the mother-tongue. Hence the importance of a map like that[1] lately published by Messrs. Stanford. Consider for a moment the political boundaries, both international and national, of Austria-Hungary. Practically nowhere do they coincide with a linguistic boundary. The only people wholly within that empire are the Magyars, who inhabit a compact block of territory bounded on the south by the Drave and the Maros, on the north by the foothills of the Carpathians, on the west by a line slightly west of south from Pressburg to the Drave, and on the east by a line north-east from Arad. South-east of the Magyars lie the Rumanians, who extend beyond the Carpathian political boundary; they include islands of Magyar and German settlers, former frontier guards. Along the south and to the south-west the great group of the Yugo-Slavs (Serbs, Croats, and Slovenes) extends beyond the confines of Austria-Hungary. To the west lie the Austrian Germans, who fill the Danube valley westwards beyond the frontier. North-west are the Slovaks, who link with the Moravians and Czechs as one great branch of the northern Slavs. These peoples do not reach the Austro-German frontier, since they meet the Germans within the borders of Bohemia, or the Austro-Russian frontier, since they meet the Poles. To the north-east the Magyars adjoin the Ruthenes, or Little Russians, whose limit is far to the east beyond the Don.

Suppose an independent Magyar kingdom be established, what are the chances of stability? First, a homogeneous race; secondly, a zone railway system which concentrates on the capital, Budapest; and, thirdly, a unity of soil, climate, and products mainly agricultural—all these tend to preservation. On the other hand, there would be no Magyar outlet to the sea, the two great waterways, Danube and Theiss, would not join in Magyar territory, and no boat could journey by Pressburg to Szabadka through Magyar territorial waters for the complete voyage. The great trunk railway from Vienna to Constantinople would only serve the south-western corner. Finally, would the Magyar kingdom march with Russia on the north-east and with Germany on the west?

Contrast this kingdom with Poland, cut across by pre-war international boundaries. The Poles form the most numerous non-German people in the German Empire; they extend into Austrian Silesia, and practically fill Galicia west of the San. Unlike the Magyars, the Poles reach the sea, along a few miles of coast west of Danzig. They march, however, with Germans on the west, with Russians on the east, and with a Slav people —Czecho-Slovaks—on the south-west. The linguistic boundaries of Magyars and of Poles rarely lie along rivers or mountain ranges; will the new era bring into play new factors which will determine the stability and utility of political boundaries?

Messrs. Stanford have done a public service in publishing this map, which should be examined and re-examined by all who are interested in the determination of the conditions which will make for a lasting peace.

[1] "A Sketch-map of the Linguistic Areas of Europe." Scale, 50·8 miles=1 in. (London: Edward Stanford, Ltd.) Price, in 4 sheets, 72 in. by 61 in., 2*l.* 2*s.*; mounted on rollers, 2*l.* 15*s.*; folded in cloth case, 3*l.* 10*s.*

APPLIED ENTOMOLOGY IN CANADA.[1]

DR. GORDON HEWITT'S recent report is an encouraging record of useful work. It forms a noteworthy testimony of his capability as an administrator and, at the same time, reflects great credit upon the Canadian Department of Agriculture in its wise provision for the needs of combating insect pests. In any such organisation as the Canadian Entomological Branch success to a large extent is dependent upon the individual capabilities and enthusiasm of field officers and assistants. Dr. Hewitt is indeed fortunate in having an excellent staff, comprising men well qualified to deal with the various problems first hand, wherever they may be reported. During the year under review four new entomological field laboratories have been erected in several parts of Canada; this in itself is a praiseworthy achievement. An addition to the permanent staff has also been made in the appointment of Dr. A. E. Cameron. Dr. Cameron is a former research scholar of our own Board of Agriculture, and conducted investigations in the Department of Agricultural Entomology at Manchester University.

In a country like Canada, the administration of the Destructive Insect and Pest Act naturally involves a good deal of routine work. More than 2¼ millions of imported trees and plants were examined in 1914–15. This work had special reference to gipsy and brown-tail moths and other foreign insect pests. Dr. Hewitt tells us, however, that owing to the war this number is only about one-half of that imported during the corresponding period the previous year. It appears that the intensity of the infestation of these two moths in Nova Scotia and New Brunswick has decreased, though the area over which they have spread has become extended. An excellent feature is the co-operation which has taken place with the U.S. Government in suppressing these pests, and in introducing into Canada certain of their more important insect enemies. The army cutworm (*Chorizagrotis auxiliaris*) occurred as an extensive outbreak in a corn-producing area of about 3000 square miles in S. Alberta. Prompt measures were, however, undertaken and widespread damage prevented. The lesser migratory locust (*Melanoplus atlanis*) was very abundant in Eastern Canada, but the timely publication of an entomological circular on the subject disseminated neces-

[1] Report of the Dominion Entomologist for the Year ending March 31 1916. By Dr. C. Gordon Hewitt. Pp. 73+7 figs. (Ottawa, 1917.)

sary information, and serious losses were prevented where the measures advocated were carried out. The outstanding feature concerning fruit crops was an outbreak of the pear thrips in British Columbia, and investigations of its life-history and means of control are now being conducted. The warble-fly is also a problem of great importance, especially as the two common species of Hypoderma are extending their range in Canada, through the introduction of cattle from infested areas. A definite method of control, by legislation or otherwise, is an urgent need not only in Canada, but also in the British Isles.

Among other topics, insects affecting the household and public health claimed much attention, also the protection of birds and mammals, and the arrangement of the national collections of insects.

A. D. IMMS.

EDOUARD SARASIN, (1843–1917).

WHILE the best young shoots are being ruthlessly destroyed the mature grain is being harvested. Edouard Sarasin has passed away. In him Science deplores the loss of a distinguished physicist, and Geneva a great man of an historic race, whose traditions, however, do not cease with him.

The place which Sarasin held in the world of science was in no way due to official position. He was at no time a professor at the university. The admirer of his work who sought him at the University of Geneva did not find him, and was told: "Edouard Sarasin? He is Maire of Grand Saeonnex." In answer to a puzzled question as to his academic position they would say: "He is President of the Société Helvétique, and editor of the Archives des Sciences physiques et naturelles."

Sarasin's experimental work, which was of the first order, was carried out at a private laboratory, often in collaboration with friends, whose names are no less illustrious than his own. He was not the head of a school, but a bright star in a galaxy. These men of science grew up under the influence of Auguste de la Rive; and Sarasin's first essay, dealing with electric discharges in rarefied media in presence of a magnet, were prompted by that great master. At the same time, under Soret, he was obtaining results which have become classical; among these we may mention the refractive indices of quartz, Iceland spar and fluorspar, still printed in the tables.

It was however in collaboration with Lucien de La Rive, the son of Auguste, that Sarasin's best known work in physics was achieved. This consisted in the experimental development of the Maxwell-Hertz theory. The discovery of "multiple resonance" is one of the results due to them. It is in virtue of this property that, for instance, a Marconigram may be picked up in transmission by any resonator. The last scientific work with which Sarasin was, only recently, engaged, consisted in delicate experiments on radio-activity carried out in conjunction with Tommasina.

At Geneva, however, the man of science cannot remain mewed up in a laboratory. Nature tempts him with her beauty and her mystery. Sarasin was a passionate lover of nature and an ardent student of the geophysics of his native land. We can but refer to the instrument invented by him for recording the "seiches"—those strange undulations which from time to time traverse the Lake Leman, and to his photographic studies on the penetration of light under water.

The reader who desires a fuller information as to the work of Sarasin is referred to the interesting article by C. E. Guye in the *Journal de Genève* of June 26, as well as to the forthcoming account by L. de la Rive in the Archives des Sciences.

GRACE CHISHOLM YOUNG.

NOTES.

SIR GEORGE GREENHILL reminds us, in connection with the correspondence on unusual rainbows in NATURE of August 30 and September 6, that letters upon this subject appeared in NATURE of January 23 and February 6, 1890 (vol. xli., pp. 271 and 316). In the issue of the former date Lord Kelvin sent a letter, with a diagram, showing a rainbow caused by reflection, and this was followed on February 6 by an illustrated description of eight rainbows seen at one time by Dr. Percival Frost. Lord Kelvin, in sending this letter, said:—"The theory of the rainbows produced by the sun itself directly, and by the image of the sun reflected from still water, is given in Prof. Tait's book on 'Light.' The phenomena seems to have been observed by Halley in 1698 (see NATURE, vol. x., pp. 437, 460, and 483 for interesting correspondence on the subject)." Referring to the observation described in NATURE of August 30, Mr. J. H. Grace writes from Cambridge to direct attention to a note in the Transactions of the Royal Irish Academy, bearing date November 14, 1826, and written by the Lord Bishop of Down and Connor, where there is a striking coloured diagram which illustrates the point raised by Mr. Low. The Bishop remarks: "It cannot be doubted that the extraordinary, or centre, bow was occasioned by the image of the sun reflected from the surface of the water. The description and the figure answer exactly to this explanation."

THE Tokyo Press publishes the scheme for the inauguration in that city of a scientific and industrial research laboratory. The principal scope of the institution is to assist in the application of modern methods to the development of Japanese industries. The chief sections of the laboratory will be those devoted to researches in electricity, chemistry, electrochemistry, textiles, and metallurgy. To meet the expenses Parliament has passed a law authorising the Government to make a grant to the laboratory of two million yen (approximately 200,000*l*.), payable in instalments over ten years at the rate of 200,000 yen per annum. The Imperial Household has also made a lump sum grant of one million yen (100,000*l*.). At a recent meeting the promoters of the scheme elected a committee the object of which will be the collection of funds independent of the Government grants. A sum of 2,900,000 yen (290,000*l*.) has already been collected, so that the laboratory will have available funds exceeding five million yen (half a million sterling). These particulars are taken from a paragraph in *L'Economista d'Italia* for August 30.

DURING the last three strenuous years, much has been done to organise chemical industries, and there is every reason to hope that in the difficult period after

the war they will be able to present a united front to the problems which await solution. The very influential Association of British Chemical Manufacturers is now firmly established and doing much good spade-work. It is a hopeful sign that a healthy spirit of give-and-take is abroad, and the amalgamations which have been announced from time to time—notably that recently made public of the firms engaged in the explosives industry—are pregnant with meaning for the future. One of the most important industrial problems of the immediate future is the relation between capital and labour. A body provisionally termed the Wages Committee of Chemical Manufacturers, but which will shortly have a more national title, has been called into being for this purpose, and has already received the support of the majority of chemical employers. Its immediate object is the adjustment of wages questions arising out of the present abnormal cost of living, but ultimately it will probably act together with the trade union representatives as the clearing-house for all questions affecting the relation of masters and men in the industry on the lines suggested by the Whitley Commission. Although the association and the Wages Committee are necessarily separate bodies they will work together in the closest harmony. We have received particulars of the formation of a new body with the title of the National Association of Industrial Chemists, which appears to be a trades union of industrial chemists. The objects of the new body are the economic, intellectual, and social advancement of industrial chemists, and the promotion of the interests of its members by collective action. A start has been made in the Sheffield district, where the new union has received general support. The development of the new association will be watched with interest.

IN an article in the issue of the *Scientific American* for August 18 Mr. C. H. Claudy gives a brief account of the way in which the resources of science are being mobilised for war by the United States. He explains how the National Research Council, the constitution of which has already been described in these columns, is acting as the Department of Science and Research of the Council of National Defence—which means that practically every research laboratory and practically every man of science is at the service of the United States, and to a large extent now engaged in war work. The National Research Council includes the chiefs of the technical bureaus of the Army and Navy, heads of Government bureaus engaged in scientific research, and groups of investigators representing educational institutions, research foundations, and representatives of industrial and engineering research. The representatives of the Government were appointed by the President. The chairman, Dr. G. E. Hale, the director of Mount Wilson Solar Observatory, is giving his entire time to the work in Washington. The work of the council is being done by about thirty-one committees, and naturally no details of the results of their labours are available for publication. As an example of the activities of the council it may be said that the Physics Committee is engaged in an exhaustive study for detecting submerged submarines and mines, in studying and devising range-finders of various types and instruments for the discovery of invisible aircraft and sapping parties, as well as in making improvements in wireless and other instruments used in the air. The greatest research laboratories, outside those of the universities, are maintained by some of the large manufacturing establishments. Several of these have not only offered their services, but have turned over whole staffs of experts, as well as the most complete of laboratory equipments, to the work of the council. Mr. Claudy sums up the work of the council by saying it can be considered as a clearing-house for men of science, a mobilising office for scientific facilities. "It provides the short cut between the man who knows the problem and the men who may find the answer. It has made a solid unit out of the laboratory and research facilities of the country and provided itself with such complete information that there is practically no question which Army or Navy can ask of science that it cannot supply the best man, the best equipment, to attempt to find the answer."

WE notice with regret the announcement in the *Times* of September 8 that Prof. Adolf von Baeyer, foreign member of the Royal Society, and Liebig's successor in the chair of chemistry at the University of Munich, has just died in his eighty-second year.

DURING the past season Dr. Smith Woodward has spent six weeks, partly in association with Prof. Elliot Smith and Major C. Ashburnham, in exploring the Piltdown gravel. Although a large amount of undisturbed material was sifted and carefully examined round the periphery of the pit in which the original discovery of Eoanthropus was made, nothing was found except one unimportant fragment of the tibia of a deer.

THE *Times* announces the death on September 10, on the eve of his eighty-seventh birthday, of Mr. Percy G. Westmacott, one of the notable engineers of the middle of last century. Mr. Westmacott was a pioneer in the use of hydraulics, specially for cranes, lock-gates, bridges, and grain elevators, etc., the swing bridge at Newcastle being one of the best-known examples of his inventions in this line. He collaborated throughout in the construction and development of the famous Armstrong gun. He was president of the Institution of Mechanical Engineers in 1883 and 1884, and only gave up his close association with engineering work in 1887 owing to ill-health.

THE ninety-ninth annual meeting of the Société Helvétique des Sciences Naturelles is being held this week at Zürich. The following lectures are included in the programme:—Prof. A. L. Perrier (Lausanne), The orientation of molecules in physics and crystallography: a sketch of a fruitful hypothesis and its consequences; Prof. F. Baltzer (Bern), The development and heredity of bastards; Prof. R. Chodat (Geneva), A botanic voyage to Paraguay; Prof. E. Bleuler (Zürich), The newest psychological directions in psychiatry and their importance in other subjects; Prof. E. Argand (Neuchâtel), the phases of alpine folding; Friedrich Schmid (Oberhelfenschwyl), The zodiacal light, a chapter in meteorological optics.

THE loss of its librarian, Mr. E. E. Riseley, who was killed in action on August 1, will be severely felt by the Linnean Society. Mr. Riseley was born at Abbots Ripton, on February 15, 1889, the only son of his parents, and at the age of fifteen became library clerk to the Zoological Society; there he acquired an excellent knowledge of zoological literature and library methods, which stood him in good stead when he became assistant librarian to the Linnean Society in the spring of 1914. From the autumn of that year he was the librarian, and his energy resulted in great improvements in the arrangement of the books, whilst his quickly gained knowledge of the special volumes in the library, made his services greatly appreciated, and a long career seemed to be his, when it was suddenly cut short by his death.

BY the death of Prof. Eduard Buchner, professor of chemistry, Breslau University, on the Western front near Verdun, Germany has lost one of her most distinguished workers in the field of biochemistry. It was in 1897 that Buchner made the memorable observation

that the yeast-juice prepared by Hans Buchner (his brother) and Martin Hahn, by grinding yeast with sand and pressing out with kieselguhr, had the power of fermenting sugar, although it was quite free from yeast cells. Thus was solved a problem which had defied the experimental resources of Pasteur and many others of less renown, and thus was established the fundamental principle that processes of fermentation are not inalienably dependent on the life of the organism, but are carried out by chemical agents, which may be removed from the cell without loss of function. Buchner's discovery, established in the face of strenuous criticism by careful and thorough experiments (collected and published in "Die Zymasegärung"), was received with intense interest by the scientific world, and acted as a great stimulus to research in biochemistry, the effects of which are by no means yet exhausted. Buchner himself was awarded a Nobel prize in chemistry (1907) and received the honours bestowed by Germany with unsparing hand upon her successful men of science. The experiments were extended to bacteria, and, although unexpected difficulties were encountered, it was proved that the same principle applied to these, the simplest of all living organisms. The work of Buchner must be regarded as marking a definite step forward in the exploration of the mysteries of the living cell. By it the frontier of chemical and physical explanation is advanced a stage and the unexplained residuum is at once diminished in area and more clearly outlined.

MAJOR A. N. LEEDS, whose death on August 25 we have already announced, was born at Eyebury, Peterborough, on March 9, 1847, and educated at the Warwick Grammar School. His early ambition was to enter the medical profession, but circumstances compelled him in 1868 to take over the management of the farm of his deceased father. There, in association with his brother, Mr. C. E. Leeds, who was then studying at Oxford, he became interested in the fossil bones of reptiles found in the brickfields in the Oxford Clay near Peterborough, and he spent the leisure of the rest of his life in collecting these fossils in a manner more systematic and scientific than had ever been attempted before. For about twenty years the two brothers worked together, until Mr. C. Leeds left this country for New Zealand. After that Major A. Leeds continued the collecting alone, aided only in the work of preparation by his accomplished wife, and occasionally by one of his sons, Mr. E. T. Leeds, now of the Ashmolean Museum, Oxford. From 1890 onwards all the most important specimens in the Leeds collection were gradually acquired by the British Museum, where they now form a unique series illustrating the osteology of the Ichthyosauria, Plesiosauria, Pliosauria, and marine Crocodilia, besides parts of certain Dinosauria. They are specially valuable because all the bones are completely extricated from the soft clay in which they were embedded, and many of the skeletons can be mounted like those of modern animals. The marine forms are described by Dr. C. W. Andrews in two exhaustive and well-illustrated volumes published by the trustees of the British Museum. Major Leeds also discovered many new fishes, which were described by Dr. Smith Woodward. In recognition of the scientific value of his work he was awarded the Lyell Fund by the Geological Society in 1893.

THE Departmental Committee appointed to inquire into the condition of the freshwater fisheries, as a possible emergency source of food, has issued an interim report. The investigation, which was carried out mainly by means of a *questionnaire*, dealt with trout, eels, and other coarse freshwater fishes, but not with salmon. The committee does not regard the available stock of such fishes as of much importance as an emergency food supply, and does not recommend any interference with the existing rights of owners and anglers. Most of the waters are privately owned, and the fish are therefore private property, so that exceptional exploitation would imply the payment of compensation. There are, it is stated, considerable quantities of migratory fishes, such as grey mullet, in the lower reaches of many rivers. Such waters are public ones, and the committee recommends the modification of any regulations which make the capture of these fishes difficult or impossible. The nutritive value of coarse freshwater fishes is dealt with. There are no available analyses of British species, but the committee gives a list of analytical results with respect to American and French fish. The food value appears to be very low. In a circular (Fisheries Notice, No. 8) sent out together with the report the Board of Agriculture and Fisheries gives a number of recipes dealing with methods of preparation, cooking, and smoking of coarse freshwater fishes.

THE forty-sixth annual report of the Deputy-Master and Comptroller of the Mint for the year 1915 has recently been issued. The outstanding feature of the year, so far as coinage is concerned, was the very great request for Imperial silver coin. The large demands which followed the outbreak of the war appeared to be satisfied by the spring of 1915. In August, however, when measures were taken to withdraw gold coin from circulation, it became clear that further large supplies of silver currency would be required. As against an average of under forty million silver pieces for the ten years 1905–14, no fewer than 105 million new silver coins were minted. In all more than 206 million new coins, of the value of 29,148,392*l*., were put into circulation. The issue of gold coin was also above the average of the previous ten years, but was considerably below that of the four years 1910–13. Returns of gold coin held on June 30, 1915, were made by sixty-eight banks, and the total, 110,188,109*l*., is the largest shown since the institution of the annual inquiry, exceeding the amount held in 1914 by more than twenty-seven million pounds. Compared with the results of the inquiry in 1909, when the returns of holdings were made on the same weekday, the total held in 1915 shows an increase of nearly 124 per cent. The profit on the year's working was 4,710,291*l*., and was much the largest in the history of the institution. The increase was chiefly due to the profits on the large sales of silver coin in the year.

IN vol. xii., part 10, of the Publications on American Archæology and Ethnology, issued by the University of California, Mr. S. A. Barrett describes the ceremonies of the Pomo tribe. Twenty years have passed since the last of the Pomo ceremonies was held in true aboriginal fashion. Elaborate rites of the more recently introduced "Messiah" cult were held so late as fifteen years ago, but these include only a few features common to the indigenous tribal observances. The details of the chief ceremonies have now been collected from the recollection of aged members of the tribe, and the description contains much that is interesting. The tribal rites were characterised by the absence of any fixed ceremonial season or sequence of ritual, and they were not controlled by a powerful priesthood or secret order in charge of the observances. The ritual mainly consisted of dances, some of which were adopted as integral parts of certain ceremonies, while others were merely incidental to them. One ceremony had a definite mythological background, but at the present day no myths are told to explain several parts of the rites. A distinguishing feature was the prominent part played by the women.

In two dances the number of performers drawn from each sex was definitely prescribed; in five only men might participate, and two were exclusively performed by women.

UNDER the title of "Fuel Values of Foods," an article by Dr. C. F. Bolduan, of New York, appeared in the *Scientific American* of July 28, in which a novel method is indicated of bringing home to the public the importance of knowing the real nourishing value of the foods they buy. This consists in attaching to each food displayed for sale a card indicating its calorie value per lb. The calorie value is the best all-round index of the nourishing properties of a food. The older idea of attaching special importance to the protein content is now discarded, since it is practically impossible to obtain any combination of natural foods suitable for human use which does not provide sufficient of this foodstuff. To complete the lesson the price per lb. of each food should be attached as well. Dr. Bolduan is a well-known authority on subjects dealing with public health, and at his suggestion one firm of restaurant proprietors has adopted the principle of giving, in parentheses on the *menu*-card, numbers which indicate the calorie value of the dishes offered for choice. Thus "(632–429) cold ham or corned beef, potato salad, 20 cents," indicates that the portion supplied, if ham were selected, would have 632 calories, if beef were chosen 429 calories. A similar practice has long been in use at the Battle Creek Sanatorium. The article is accompanied by a full-page illustration of a suggested window display of foods on these lines, in which fruit, vegetables, nuts, cereal foods, fish, poultry, meat of various kinds, etc., are all included. Other illustrations represent tables laid out with (1) a breakfast, which supplies 650 calories; (2) a lunch providing 900 calories; and (3) a meatless dinner of 1100 calories, the whole being sufficient for a man leading a sedentary life. It is not unlikely that we may soon see this method of teaching economy in the use of foods adopted in this country.

THE claim of the gipsy moth (*Ocneria dispar*) to rank as a British species, its former abundance in the fen districts, and its final disappearance throughout Great Britain, are very clearly set forth by Mr. Robert Adkin in the Proceedings of the Entomological Society for 1916–17. There seems to be no justification for the belief, at one time held, that this was an introduced species, though it is curious that it was unknown to the older entomologists. At no time does it appear to have become unduly numerous with us, though in North America, where it was accidentally introduced, it has become a formidable pest.

THE existence of fluorescent bacteria has been recorded, though the colouring matter produced by them is insoluble in ether. Further, E. Rostrup has observed that *Agaricus* (*Pleurotus*) *serotinus*, Schrad., imparts a peculiar fluorescence to spirits of wine, and A. Ling found that a Torula occurring in ale gave to it a greenish fluorescence. Now Prof. A. Klocker (*Comptes rendus des travaux du Laboratoire de Carlsberg*, vol. ii., part 6) describes the production of a faint greenish fluorescence when *Aspergillus glaucus* is grown in a medium containing sugar, and the isolation of the colouring principle. When the medium (*e.g.* beer wort) in which *A. glaucus* has been grown is shaken with ether, the latter acquires a faint yellowish colour, and in thick layers a blue fluorescence. If the ethereal solution is shaken with ammonia this exhibits a very marked green fluorescence, whilst if soda be used the fluorescence is reddish-brown. On evaporation the ethereal solution leaves a yellow residue having the properties described. The substance is not fluorescein, though it resembles this compound. If the Aspergillus is grown on gelatinised beer wort the liquefied gelatine develops the fluorescence. The reaction seems to be specific for *A. glaucus* and *A. repens*.

DR. JOHN TAIT has published in vol. xxxvii. of the Proceedings of the Royal Society of Edinburgh a series of five papers under the general title of "Experiments and Observations on Crustacea." Some of the questions dealt with are purely physiological, as in the case of the first paper, which gives the results of experiments on the resistance of the terrestrial Isopod, Ligia, to immersion in fresh and in salt water. It was found that while immersion for prolonged periods in sea-water had little, if any, harmful effect, some of the specimens surviving for three months, distilled water proved fatal, within forty-eight hours, to specimens immersed in it. It is shown that this toxic effect is due, in all probability, to the withdrawal of essential salts from the body of the animal. Several papers deal with problems that are described as "semi-morphological," and in these the author shows a preference for far-fetched comparisons that seems to be characteristic of medical physiologists who touch on comparative morphology. The way in which the leg of the Isopod Ligia is bent is illustrated by "selecting, say, the limb of a land mammal for comparison." We are told that the correlation between the two is "sufficient to excite wonder." One paper gives an account of some points in the structure of the giant Antarctic Isopod, Glyptonotus, and includes the most detailed account yet published of the articular surfaces of a joint in the leg of a Crustacean.

IN an article in the *Revue générale des Sciences* for June 30 and July 15, Dr. Legrand expounds a theory of heredity which he calls "L'emboîtement des Plasmas." He distinguishes in every inheritance between the fixed specific characters and the non-fixed sexual, varietal, atavistic, and parental characters. The fixed hereditary characters have their localisation in the specific cytoplasm, while the chromatin apparatus of the nucleus is the vehicle of the non-fixed characters. The fertilised ovum (or "the original trinitary block") consists of the ovum-cytoplasm with the fixed specific characters (a view for which there is a good deal of experimental evidence) and a nucleus containing the varietal, atavistic, and individual plasmas (respectively maternal and paternal), which the author pictures as segments of a spheroid, overlapping one another (like young leaves in a bud) with the most recent to the interior. According to the particular plan of the bud or *emboîtement*, different nuclear blocks will have different degrees of contact with the cytoplasmic envelope, and this affords a sort of mechanical symbolisation of paternal or maternal preponderance, of latent and patent characters, of male or female sex (which seems to us to get mixed up with paternal and maternal respectively). Dr. Legrand draws ingenious diagrams expressing the results of experiments on the inheritance of coloration in mice, or a familiar case like the hereditary composition of a mule. He seeks to illustrate by a "complex visible" model the "simple invisible" reality. Starting from the meticulous longitudinal splitting of the chromosomes and the orderly movements of karyokinesis, he develops the idea that the cytoplasm supplies the indispensable specific foundation, and that the minor details of the developing edifice are due to the way in which the factors of the non-fixed characters are disposed within the nucleus in relation to one another and to the environing cytoplasm with which there is interaction. To us the theory appears only a diagram; to Dr. Legrand it is much more.

PART 2 of vol. ii. of the Memoirs of the Kyoto University contains an account of the recent measurements made by Messrs. T. Takamine and S. Nitta in the extreme ultra-violet portion of the spark and arc spectra of a number of metals. The sparks were produced by the Hilger apparatus, and the arc in a vacuum lamp, between poles of the metal to be investigated. The spectra were obtained by means of either of two Hilger quartz spectrographs, and were photographed on Schumann plates. The wave-lengths were calculated from the measurements of the plates, the lines of the silver and iron sparks as given by the Blochs being taken as standards. The spark spectra of silver, aluminium, gold, bismuth, cadmium, cobalt, iron, manganese, antimony, and thallium in the region 2000 to 1830 were examined, and a number of new lines found for each element. In the cases of manganese and platinum the whole of the lines are new. The vacuum arc spectra of bismuth, antimony, and thallium gave several new lines in the same region.

IN a paper read before the R. Accad. delle Scienze dell' Istituto di Bologna, in March of this year, Prof. A. Righi returns to the question of magneto-ionisation, already dealt with in previous papers. A beam of X-rays ionises the gas between two metal plates which are suitably connected to an electrometer and an accumulator battery. A magnetic field can be created in a direction parallel to the plane of the plates. Without the latter field the voltage-current curve shows the usual features of a saturated phase followed by one in which ionisation by collision is prominent. When a magnetic field of 430 gausses is super-imposed, there is found a current decrease for the lower voltages, *i.e.* in the earlier portion of the saturated phase, but for voltages of 400 or above the current is slightly increased. This is ascribed by the author to the action of the magnetic field in promoting ionisation. In the opinion of the writer of this note Prof. Righi's interpretation of his results is by no means the only one which is possible, and though his ingenious experiments are of great interest, his theory will need further support before it obtains general acceptance. In particular, it will be necessary to show that the increase of current is not caused by the oblique, and therefore longer, paths of the ions under the joint actions of the two fields. When the saturated phase is passed, any increase in the distance travelled over by the negative ions means more opportunities for the production of further ions by collisions, and this may be all that is necessary to explain the results.

IN *La Nature* for August 11 M. Guillaume gives some interesting information concerning the work of the Bureau International des Poids et Mesures, of which institution he is director. As is well known, the Bureau has custody of the primary standards relating to the metric system, *i.e.* length and mass. This involves fairly frequent restandardisations and comparisons of the secondary with the primary standards. The institution also undertakes the verification of the standards of other countries which subscribed to the Convention du Mètre in 1875. Dilatation measurements also play an important part in the operations of the Bureau. Two methods are used, viz. the comparator and dilatometer methods, the former being used for large bars (generally 1 metre in length) and the latter for test-pieces the greatest dimension of which is of the order of 1 cm. These measurements are important, not only because it is necessary to know accurately the dilatation-coefficient of all standards issued from the institute, but also by reason of the fact that such measurements are employed in investigating metals and their alloys. The numerous applications of the nickel-steels for industrial purposes originated at the Bureau. It is interesting to note that most of the geodetic survey standards at present in use in the world have been verified at the Bureau International on a geodetic comparator (or tape bench) erected specially for that purpose. A large universal comparator is in use for determining the values of the various subdivisions of the metre now widely employed, the values being checked to within a few tenths of a micron (0·001 mm.). Reference is made in the article to the important work carried out by Michelson, in collaboration with Benoît, on the measurement of wave-lengths, using a cadmium lamp as standard; and to similar experiments undertaken fifteen years later by Benoît, Fabry, and Perot, which agreed with the results of the earlier investigations to within 1 part in 10,000,000. The use of *invar* (the nickel-steel of very low expansion-coefficient), which was promoted by the researches of the Bureau, has now extended to horology and metrology (bars and tapes) and in other directions.

THE use of alcohol as a fuel in the internal-combustion engine and the possibilities of manufacturing it economically in Australia are discussed by Mr. W. T. Rowe in Bulletin No. 8 of the Department of Chemistry of South Australia. Alcohol has some obvious advantages over petrol, such as its greater safety in storage, freedom from unpleasant smell, and constant composition, but in addition its vapour when mixed with air will stand a much higher compression without pre-ignition. In suitably constructed engines the efficiency per b.h.p. for alcohol is 28 to 31 per cent., as compared with 16 to 20 per cent. for petrol. One of the chief causes militating against the use of alcohol industrially is the restrictions of the revenue authorities, but denatured alcohol would form a good motor spirit provided that methyl alcohol were *not* used as a denaturant. Benzol or petrol is recommended for this purpose. Alcohol can be economically manufactured from substances grown in Australia, and might thus form a valuable industry. The supply of non-utilised molasses in the whole of Australia is insufficient to yield the amount of alcohol equivalent to the petrol imported by South Australia alone; considerably larger quantities of straw are available, however, but its use on a commercial scale has not yet been tried. In South Australia the raw materials offering the greatest promise are wheat, barley, potatoes, straw, and perhaps beet, but, except the straw, these would have to be specially grown to yield enough alcohol to replace the imported petrol. Using wheat or potatoes, the cost of raw material is approximately the same, because, although wheat contains more starch, potatoes give a greater yield per acre; in each case the total cost of the spirit would be from 1*s.* 9*d.* to 3*s.* 6*d.* per gallon, according to the price of the raw materials.

IN the Proceedings of the Tokyo Mathematico-Physical Society, vol. ix. (2) 4, Mr. Hantero Nagaoka obtains equations for evaluating the maximum force between two circular electric currents, and suggests uses for the calculations in connection with electric methods of comparing the intensity of gravity at different places on the earth.

A NOTE on a modification of the epicycloidal method of tracing the profiles of toothed wheels is the subject of a note by Prof. T. Levi Civita in the *Atti e memorie* of the Padua Academy, vol. xxxiii., 11 (Padua: Giov. Batt. Randi, 1917, pp. 8). In it use is made of the "line of action," which is the locus, traced in space, of the point of contact of the wheels as they revolve.

THE catalogue (No. 168) of second-hand books just issued by Messrs. W. Heffer and Sons Ltd., Cam-

bridge, contains particulars of many interesting, and some scarce, works in anthropology, archæology, folklore, mythology, botany, geology, mathematics, astronomy, and physics. We notice in the astronomical section a set of the *Astrophysical Journal*, and the "Nautical Almanac" for 1875–1916.

OUR ASTRONOMICAL COLUMN.

RELATIVITY AND GRAVITATION.—According to the original form of the theory of relativity, an absolute velocity v in space cannot be determined by any physical means, all matter as well as electrical and optical fields being contracted, in the terminology of the older physics, in the same ratio $(1-v^2/c^2)^{\frac{1}{2}}$. Using the same terminology, Einstein's recent gravitational theory requires a gravitational field to suffer contraction in this same ratio, so that an absolute velocity v must remain for ever hidden from our knowledge. Einstein has shown that this theory, suitably generalised to cover independently-moving bodies, leads to changes in the perihelia and eccentricities of the four inner planets which agree well with those observed. In the *Phil. Mag.* for August Sir Oliver Lodge suggests an alternative explanation of the changes in Mercury's orbit. In accordance with pre-relativity theory, the mass of Mercury, when moving with velocity v, is supposed to be $m_0(1-v^2/c^2)^{-\frac{1}{2}}$; of this only the stationary mass m_0 is supposed subject to gravitation, while the sun's gravitational field is not supposed to suffer distortion as it moves through space. The assumed increase in inertia, uncontrolled by gravitation, is found to lead to a revolution of Mercury's orbit in its own plane, which will agree with that observed if the sun has a velocity of about 68 km. a second towards longitude 294°. This velocity would also give an apsidal progression for Mars about equal to that observed, but in the September *Phil. Mag.* Prof. Eddington has shown that it would give orbital distortions for the earth and Venus enormously greater than those observed. In these papers no allowance is made for the distinction between longitudinal and transverse electromagnetic mass, but it seems impossible that this correction could reconcile theory with observation; indeed, the discussion suggests that no theory of the general type suggested by Sir Oliver Lodge can be made to fit all the facts, so that the relativity theory appears to be left in a stronger position than ever.

PHOTOGRAPHS OF NEBULÆ.—A remarkable collection of photographs of nebulæ taken with the 60-in. reflector of the Mt. Wilson Observatory has been published by Mr. F. G. Pease (*Astrophysical Journal*, vol. xlvi., p. 24). The objects selected were in general nebulæ of unknown structure, or nebulæ which were known to exhibit unusual features. Most of the exposures were made with aperture ratio F/5, but several of the bright planetary nebulæ were also photographed with the 80- and 100-ft. focus Cassegrain arrangements of the telescope, in order to give a larger scale. The exposures ranged from ten minutes to seven hours. It is interesting to note that the perfection of the photographs was increased in the case of very long exposures by the use of two guiding stars, which allowed of correction being made for variation in size and for rotation of field produced by refraction and imperfect adjustment of the telescope. In addition to the sixty-five nebulæ which are fully described, attention is directed to others which appeared incidentally on the plates, and to a number of uncatalogued nebulæ and nebulous stars. The photographs show a great amount of intricate detail, and bear witness alike to the excellence of the instrument and the skill of the observer.

THE 100-IN. REFLECTOR AT MOUNT WILSON.—An illustrated description of the great reflector of the Mount Wilson Observatory is given by Mr. Pease in the *Scientific American* for August 11. As supplementing the account already given in the columns of NATURE of July 12 (vol. xcix., p. 385), it may be noted that the moving parts of the telescope, which is mounted on the English pattern, weigh 100 tons. The greater part of the weight is taken up by the mercury flotation system, 40 tons at the north pedestal and 60 tons at the south pedestal. The driving clock is regulated by an isochronous governor of the conical pendulum type, and the weight is wound up automatically at intervals of twelve minutes without interference with the driving. The clock itself stands 6 ft. high and occupies a floor space of $5\frac{1}{2}$ ft. by 4 ft. The actual diameter of the mirror is 101·2 in., and its focal length 507·5 in., giving an aperture ratio of 5·05. Elaborate arrangements have been made to maintain the mirror at constant temperature by water circulation. Manipulation of the dome and telescope involves the use of forty motors of 1/20 to $7\frac{1}{2}$ horse-power, with an aggregate of 50 horse-power and more than thirteen miles of wiring. It is estimated that about 300 million stars will be within range of the new instrument.

INDUSTRIAL FATIGUE.[1]

UNDER the above title Prof. Spooner has collected articles written by him in 1916 for publication in *Co-partnership*. The pamphlet is a useful contribution to the discussion of reconstruction, which already is receiving anxious attention from many who realise its extreme importance and its extreme difficulty.

Evidently in so small a space but few details can be given, but the author has touched upon many points which show how wide is the problem and how great are the difficulties which surround it. Perhaps the main impression left upon the mind after a perusal of these fifty-nine pages is one of the immense amount of scientific investigation which remains to be done before industrial processes—to say nothing of industrial management—can be placed on a thoroughly satisfactory footing. It is only quite recently, and largely on account of present conditions, that the general public and directors of industry have begun to realise that science after all is merely crystallised and systematised knowledge, and that to attempt to conduct industrial processes without it is to dispense with one of the greatest aids to success. Now, however, the leaven is spreading. Many firms operating processes which depend on scientific principles have their own scientific staff working in admirably equipped laboratories, and so far as their own processes are concerned little more is needed, though it would undoubtedly contribute to the general advance if the results of the investigations carried out could be made available for all to profit by. But apart from these questions there are larger problems which affect all industries, and which can only be dealt with effectively by some central authority. Such, for instance, is the question of the number of hours' work per week which will enable an operative to produce the largest output without injurious fatigue. Evidently no general answer can be given to such a question. The answer must vary with conditions, and all conditions must be studied in order that their influence in producing fatigue may be determined. But certain fundamental facts may be established, and perhaps the most im-

[1] "Industrial Fatigue in its Relation to Maximum Output." By Henry J. Spooner, C.E. Forewords by Sir Robert Hadfield, F.R.S., and Mr. J. R. Clynes, M.P. (Co-partnership Publishers, Ltd., 6 Bloomsbury Square, W.C.1.) Price 6*d.* net.

portant that has yet emerged is that *output is not necessarily proportional to the hours worked.* The recognition of this fact alone has led to the emancipation of countless victims of long hours, to their lasting benefit, and to the benefit of the factories for which they work. Prof. Spooner points out that conclusions as to overtime and Sunday work, based on accurate scientific investigations, agree with those that managers of industrial works have long known to be more or less true. It is a lamentable result of our inability to take advantage of knowledge lying close to hand that lines of conduct indicated by such conclusions should have been followed by so few. It is nevertheless a distinct gain that the study of industrial fatigue must always in future be recognised as an essential factor in a right determination of the conditions of labour, and that never again will the fortunes of tens of thousands of workers hang entirely upon the will of uninstructed and often unsympathetic employers. Moreover, by placing industry on a scientific basis it will be demonstrated that the interests of master and man are identical, and many of the differences between capital and labour will cease to exist.

There is only space in a short notice to refer to unnecessary fatigue, dilution and subdivision of labour, restriction of output, scientific management, motion-study and time-studies, welfare work, labour turnover, and after-the-war problems, but on all these points Prof. Spooner has something of interest to say. Scientific management, as its name implies, is an application of scientific principles to factory management. Where properly applied there can be no question of its legitimacy, or of its advantages to capitalist and worker, since these are its conditions of success. Unfortunately, it has been sadly misunderstood in this country. Only recently the workers in a large factory, being convinced that it meant more work and less pay, stated emphatically to the writer: "We *will not have* Taylorism here," whilst in the pamphlet before us we find the writer of a foreword describing it as "tending to make the workman into a machine."

The facts of the case are as follows: Some years ago the late Dr. Taylor, struck by the enormous waste of effort involved in industry, took up the study of the subject, and, as a result, introduced his system of scientific management. He recognised that the ordinary comparison of the human body to a steam-engine, whilst possessing elements of truth, was likely to lead to erroneous conclusions, since the conditions of action in the two cases are profoundly different. He showed that in the case of the human body the percentage of the working day for which the muscles could remain under load without undue fatigue was strictly limited, and that this proportion was greatly influenced both by the severity of the labour and by the distribution of the work and rest periods. In such a simple task as the handling of pig iron he showed that a remarkable gain in efficiency could be reached and maintained for long periods by the introduction of appropriate intervals for rest, so that the day's wages could be increased, or, alternatively, the same wages as before could be earned and time saved.

By his lamented death industry was deprived of a great benefactor, but his work remains, and, by great good fortune, his mantle has fallen upon worthy successors. Frank Gilbreth and his co-workers still continue the work, and by the ingenious application of photography to recording movements involved in industrial processes have introduced in "motion-study" a method of investigation of which the effects are only now beginning to be felt. The method aims at recording the movements performed in a given process by learner and by expert. These movements are found to differ chiefly in the direction of a simplification of the movements of the expert, and of a discarding of a number of unnecessary movements observed in the learner. But even in the expert certain unnecessary movements will probably be found, and by the discarding of these also his expertness will be increased, whilst in the case of the learner it becomes possible to arrange a definite course of instruction in the performance of the necessary movements only, which leads at once to great simplification and to the learning of precise series of motions, in place of the old system whereby the learner tried blindly to imitate his teacher. That economy of effort must follow the adoption of such a system is evident, but its results are surprising. Efficiency is very largely increased, and tasks can be performed in far less time than before. The increased efficiency may be used in different ways. It may be used to increase output, but if this be done, labour should share in the increased profit. The increased output may be produced actually more cheaply than the original output, since standing charges should be less in proportion, and therefore the extra output should be profitable to the owners when paid for at old rates. On the other hand, the worker is enabled to turn out more output with the same expenditure of energy and the same amount of fatigue.

Thus the unusual situation arises of the owner being in a position to pay higher wages, whilst the workers do not necessarily demand that payment, since their fatigue and labour are not increased. And yet it is just upon this very point that the ship has split. In some cases, as a result of increased output, rates for piece-work have been "cut"; the workers have resented this, and have adopted the "ca' canny" attitude. The movement has spread, and in many factories the miserable situation has developed of the owners being unable to increase wages because the men will not work honestly, whilst the men will not work honestly because they fear that rates will be "cut."

The other alternative, which in normal times would probably be adopted, largely provides for the maintenance of output at the old level. Since, however, efficiency has increased, this output is now produced in a shorter working day. There remains the time saved, and much of this may legitimately be devoted to bringing into the life of the worker those things which up to now he has lacked. In many industries want of leisure has led to want of health, waning interest, and the impossibility of living a rational life. With leisure, these unfortunate conditions may be changed. A mere reduction of fatigue, if used to increase output, would lead to discontent. But used to increase leisure it may achieve much. For besides the benefits which leisure itself would bring must be considered its effect upon the relations between capital and labour. Capital has no direct interest in the leisure of the worker, though the fact that it is prepared to adopt measures to increase that leisure is itself an indication of a changing attitude. But increased leisure should lead to better education of the worker, and better education will facilitate an appreciation of industrial conditions. Ultimately, it may be hoped, a real understanding between capital and labour may be possible.

It is a calamity that the system which appears to offer the best chance of such an agreement should be so far misunderstood as to be described as an attempt to drive the worker.

Prof. Spooner may be congratulated upon having done something to clear away this misunderstanding. His pamphlet is a valuable contribution to the question of industrial fatigue. A. F. STANLEY KENT.

THE FOREST DEPARTMENT OF INDIA.

THE Government of India has issued a pamphlet of sixty-five pages, entitled "The Work of the Forest Department of India," by Mr. R. S. Troup. This gives in popular form, and at the low price of 5*d.*, an account of the forests of India, and of the methods by which they are protected and managed. The Forest Department controls one-fifth of the total area of India, viz. 249,867 square miles; but no fewer than 141,882 square miles of this are so-called "unclassed" forests, where control is nominal, being restricted to the collection of revenue. Of the "reserved" and "protected" forests, 107,985 square miles in area, about one-half, 55,629 square miles, are scientifically managed and subject to sanctioned working plans. The most important commercial forests are the teak forests of Burma, the sal forests of Northern, Central, and North-Eastern India, and the deodar and pine forests of the North-Western Himalaya. Forests yielding inferior kinds of timber are scarcely less important, as they provide wood, fuel, fodder, and other produce for the surrounding agricultural population. The *personnel* of the Forest Department includes 237 officers trained in England, 231 officers recruited in India and trained at Dehra Dun, and a subordinate service of 1610 rangers, 2000 foresters, and 10,500 forest guards. The Forest Research Institute of Dehra Dun, which was founded in 1906, prosecutes investigations in sylviculture, forest botany, economic products, zoology, and chemistry, and has already issued a considerable output of scientific literature. The pamphlet contains a valuable list, with short descriptions of the forty-four most important forest trees, and an excellent chapter on minor produce, which includes bamboos, grasses, fibres, oil seeds, tanning materials, essential oils, oleo-resins, gums, india-rubber, drugs and spices, and animal products like lac, silk, horns, hides, and ivory. An interesting account is also given of various forest industries which have been established by the Forest Department, such as the tapping of *Pinus longifolia* for resin and turpentine, which has now passed out of the experimental stage, the annual collection amounting to 2592 tons. The paper-pulp industry, the manufacture of matches, the antiseptic treatment of timber, and the dry distillation of wood are industries which appear to be capable of considerable development in India.

THE GREAT ERUPTION OF SAKURA-JIMA.

PROF. F. OMORI, the well-known director of the Seismological Institute of Tokyo, has recently issued a third valuable memoir on the great eruption of the Sakura-jima on January 12, 1914 (Bull. Imp. Earthq. Inv. Com., vol. viii., December, 1916, pp. 181–321). The first two memoirs have already been noticed in NATURE (vol. xciv., p. 289, 1914, and vol. xcviii., p. 57, 1916). The third memoir is principally concerned with details which, though of great value, are unsuitable for reproduction in a note. Two or three points, however, are of general interest. On and around the plateau of Hakamagoshi, which projects from the west side of the island, there are unmistakable signs of the generation of volcanic blasts. The school-house was entirely destroyed and carried away. On a farm near the top of the plateau a great number of large mandarin-orange trees were uprooted and carried some distance up a slope. The blasts were directed principally against the north-east corner of Hakamagoshi and the neighbouring village of Koike. The destruction here was general, and the tree-trunks were mostly overthrown or broken between two directions which, when produced backwards, passed through the highest and lowest of the western series of craterlets. On the east side of the island no distinct trace of the blast could be detected. Before the eruption the island was separated from the mainland on the east side by the Seto Strait, which, in its narrowest portion (400 metres in width), varied in depth from 29 to 40 fathoms. The lava entered the strait on the morning of January 13, blocked it up after sixteen days, and finally rose in height to about 54 metres above the sea. The movement of the lava stream on this side ceased with the close of 1914. About three months later there took place a second outflow of lava, not directly from the craterlets, but from the southern face of the south-eastern lava-field. The new outflows expanded into a form like that of a chrysanthemum leaf, the greatest elongation amounting to nearly 900 metres.

Prof. Bundjiro Kotō has published (Journal of the College of Science, Tokyo, vol. xxxviii., art. 3, December 25, 1916) a comprehensive and handsomely illustrated account of the same eruption. The author reached the city of Kagoshima on January 15, 1914, and saw the great lava-sheets flowing from the volcanic island, a most unusual spectacle among the explosive volcanoes of Japan. The tremendous "Strombolian" outburst of January 12, when the fragmental matter rose as a great cloud-pillar to a height of more than 18,000 metres, is shown in the photographic frontispiece, which forms a most memorable addition to our historic pictures of volcanoes. The inhabitants of the island were rescued in boats by volunteers from the shore of Kyûshû, and traversed a pumice-laden sea. The ejected materials, which are described in petrographic detail, consist of femic augite-andesite. There is evidence in the scorched trees of a *nuée ardente*, like those of Martinique, which spread down the western slope on the early morning of January 13. Among the ejecta are many resembling porcelain, and composed of cordierite, plagioclase, and glass. This type has been described from Asama-yama, and Prof. Kotō now styles it ceramicite.

THE DISSEMINATION OF FUNGUS DISEASES.

VERY little has been heard of the International Phytopathological Convention of Rome since the outbreak of hostilities, but there is little doubt that the subject will be revived when terms of peace are settled or shortly afterwards. A careful consideration of its proposals is, therefore, all the more necessary at the present time, and the reasoned criticism published by Dr. E. T. Butler, the Imperial Mycologist, in vol. ix., No. 1, of the Memoirs of the Department of Agriculture in India, on the dissemination of parasitic fungi and international legislation is doubly welcome from both the scientific and the administrative points of view.

Dr. Butler discusses, in the first place, the various methods by which such fungi may be conveyed over great distances, and decides that little is to be feared from natural means, the chief agent being civilised man engaged in commerce. He then recounts some of the attempts that have been made to control the spread of plant diseases by legislation, and criticises the procedure proposed by the Rome Convention, chiefly, of course, with reference to the conditions under which India is situated.

The weak points in the Convention, especially those caused by the loose phraseology of the much-debated Article 5, are duly pointed out, but Dr. Butler concludes with the opinion that, subject to certain necessary amendments, and if certain clauses are broadly interpreted, there are obvious advantages in adhering to it, and that "after a few years' experience, and as soon

as other countries have established the organisation required if they wish to adhere, there seems to be a good prospect of a much more efficient control of the dissemination of the fungus diseases to distant countries than has ever been thought possible in the past."

The memoir contains an appendix giving a brief history of the spread of most of the important cryptogamic diseases of cultivated plants, the extension of which has attracted notice during the past seventy years.

PARIS ACADEMY OF SCIENCES.

BONAPARTE FUND.

THE committee has considered twenty applications for grants from the Bonaparte Fund. It is considered desirable to reserve the greater part of the annual income until after the conclusion of the war and to defer grants for the purchase of apparatus. The grants recommended and approved by the Academy are :—

(1) 2000 francs to Edmond Bordage, for the publication of his histological researches on the metamorphoses of insects.

(2) 2000 francs to E. Chauvenet, for the continuation of his researches on zirconium.

(3) 2000 francs to Gustave Dollfus, for the continuation of his studies on the Paris basin.

(4) 2000 francs to Henri Froidevaux, for the production of a catalogue of the periodicals, more than eight hundred in number, in the library of the Société de Géographie.

(5) 2000 francs to Emile Gadeceau, for his studies on the submerged forests of Belle-Ile-en-Mer.

(6) 2000 francs to F. Gagnepain, for assistance in the publication of an etymological dictionary of botanical genera, with illustrations.

(7) 2000 francs to L. Joubin, for pursuing at Messina the researches he has undertaken on the deep-sea Cephalopods.

(8) 2000 francs to W. Kilian, for the pursuit of his studies and his publications on the fossil fauna and the stratigraphy of the south-east of France.

Including the balance from 1916 (55,000 francs), the amount in hand is 105,000 francs, and the balance carried forward, after paying the above-named grants, is 89,000 francs.

THE AMERICAN PHILOSOPHICAL SOCIETY.

THE American Philosophical Society held a very successful meeting in Philadelphia on April 12–14. The address of welcome was delivered by the president, Dr. W. W. Keen, who, with Vice-Presidents W. B. Scott and G. E. Hale, and with Dr. A. A. Michelson, presided. More than forty papers were presented. The national crisis also received some attention, Dr. M. T. Bogert, of Columbia University, outlining the work chemists may do to aid the National Research Council in the solution of certain war problems. Suitable badges to identify "members of the industrial army" so that they may not be called slackers was urged. Attention was directed to England's mistake in permitting general enlistment for "the front" when in many cases men with special ability could have been of much more value using their brains in the laboratory. A well-trained industrial army is just as important as the army of fighters.

A brief outline of the effect of different lighting conditions on the eye and the factors which cause the eye to lose in efficiency and to experience discomfort was given by Dr. C. E. Ferree, of Bryn Mawr College. More than forty different lighting conditions have been investigated, and many experiments conducted pertaining to the hygienic use of the eye. The loss of efficiency sustained by the eye in an unfavourable lighting situation seems to be muscular, not retinal. The retina has been found to lose little, if any, more in functional activity under one than under another of the lighting systems employed. The observation of motion pictures for two or more hours causes the eye to lose heavily in efficiency. The loss decreases rather regularly with increase of distance from the projection screen. It seems little, if any, greater, however, than the loss caused by an equal period of steady reading under much of the artificial lighting in actual use. In all the lighting situations tested a close correlation was found to obtain between the loss in power to sustain clear seeing and the tendency to produce ocular discomfort.

A spectroscopic method of deriving the absolute magnitudes of stars, and a new formula connecting parallax and proper motion for studying the relationship between the motion of stars and their true or absolute magnitudes, were described by Dr. W. S. Adams, of Mount Wilson Observatory. About one thousand stars have been used in the investigation, and the results establish almost certainly a definite increase in velocity with decrease in brightness.

The skeleton of a gigantic extinct bird found last summer in the Bighorn basin of Wyoming by an expedition from the American Museum of Natural History was described by Dr. W. D. Matthew, one of the curators. It is of the Lower Eocene age, a contemporary of the little four-toed horse, the fossil remains of which are found in the same region. The bird was about as large as the extinct moas of New Zealand, much bulkier than any living bird, although not so tall as an ostrich. It stood nearly 7 ft. high. The head was enormous, 18 in. long with huge compressed beak like the extinct Phororhachos of Patagonia, but unlike any living bird. The neck, too, was very massive and rather short, and it was quite unable to fly, the wings being about as large as in the cassowary. Although it resembled the modern ostrich group in some ways, it was not related to them, and only remotely related to any other known birds, the nearest perhaps being the seriema of South America. A few fragments of this gigantic bird were found by the late Prof. Cope more than forty years ago, and named Diatryma, but it remained practically unknown until the discovery of this nearly complete skeleton. A description of this specimen by W. D. Matthew and Walter Granger, with photographs and a reconstruction, will appear in the Bulletin of the American Museum.

In a paper by E. S. Botch, of Philadelphia, the present status of our knowledge about early man in America was summed up as follows. Man lived during at least a part of the Pleistocene period for tens of thousands of years south of the Glacial moraines. He probably went through an Eolithic period, and certainly through a Chelleen period in some places, and therefore was truly a Palæolithic man. He may have shown rudimentary fine art. Palæolithic American man was the ancestor of the Neolithic historic Indian, and although less advanced in culture, much like his descendant in anthropological characteristics. Whether he was an autochthon in America or whether he came from some other place, and, if so, when, we do not as yet know positively, although his affiliations seem to be to the west. And it is to four men above all others that we owe our knowledge: Abbott, the discoverer of Palæolithic implements and horizons; Volk, the corroborator; Lund, the first finder of probably Palæolithic bones; and Winchell, the investigator of patination.

A valuable paper describing the factors influencing the sex ratio in poultry was read by Dr. Raymond Pearl, of the Maine Agricultural Station. In the present war conditions any information which would make it possible for the poultryman or farmer to produce a larger number of pullets to lay eggs, with out producing so many cockerels to eat up costly food, would be of very great value. This study, which is based on eight years' experiments and more than 22,000 individuals, demonstrates, first, that the determination of sex in poultry is primarily a matter of a definite, hereditary mechanism, just as it is in insects and other forms which have been studied. At the same time, it is demonstrated, however, that in certain physiological circumstances the operation of this mechanism may be modified in such a way as to lead to the production of more females in proportion to the number of males. The chief factor in bringing about the modification in the direction of a larger production of females is the fecundity of laying ability of the hens used as breeders. The larger the number of eggs which a hen lays before being put into the breeding pen, the larger will be the proportion of females and the smaller the proportion of males produced by her eggs. Some years ago it was shown by the speaker that the ability to lay eggs (fecundity) in poultry is a matter of definite Mendelian inheritance. As a result of this knowledge, it is possible to breed strains of hens in which productivity is a definitely fixed characteristic. The present results, taken in connection with the earlier ones, show that when the poultryman breeds along the right lines for increased egg production, he will at the same time be producing a strain in which profit-making pullets preponderate in place of the less profitable cockerels.

The session on Saturday afternoon (April 14) was set apart for a special symposium on aeronautics, the speakers including Dr. A. G. Webster, of Clark University, a member of the Naval Advisory Board, and Dr. W. F. Durand, chairman of the National Advisory Committee for Aeronautics.

On Friday evening (April 13) a reception was held in the hall of the Historical Society of Pennsylvania, when Prof. G. E. Hale, director of the Solar Observatory at Mount Wilson, California, gave a most interesting address on "The Work of the Mount Wilson Observatory."

A very pleasant feature of the Saturday afternoon session was the presentation of a portrait of Dr. J. Minis Hays, dean of the Wistar Association, by Joseph G. Rosengarten, LL.D., on behalf of the association, on the centennial anniversary of its organisation, and in the twenty-first year of Dr. Hays's secretaryship of the American Philosophical Society.

ARTHUR W. GOODSPEED.

EXPERIMENTAL WORK IN AERONAUTICS.[1]

THE report to Parliament of the Advisory Committee for Aeronautics for 1916–17 has just been issued, and is a further vindication of the foresight shown when this committee was inaugurated in 1909 under the presidency of Lord Rayleigh. Since that time funds have been continuously placed at the disposal of the Royal Society for the development of the experimental investigations at the National Physical Laboratory, the aeronautical work of which in all its branches is controlled by the Advisory Committee for Aeronautics.

Although less directly responsible to the Advisory Committee than the National Physical Laboratory, the Royal Aircraft Factory carries on its experimental work in close co-operation, as does also the Meteorological Office in its aeronautical work. Other institutions and private bodies find the Advisory Committee for Aeronautics a suitable body to receive and review their communications.

In normal times approved reports and papers are collected annually into a technical report issued for sale, but for obvious reasons publication has not taken place since the opening of hostilities. The volume of material collected is now very large, and special arrangements have been made to render it available to British designers, to whom it is of incalculable value. As the brief report now issued appears to have been framed to give as much information as is permissible and is of very general interest, it is reproduced below almost in full.

The experimental investigations carried out under the control of the Advisory Committee for Aeronautics into the many problems affecting the development of aircraft have been continued and extended during the past year.

Owing to the growth of the work of the committee in certain directions, sub-committees have been formed to advise in regard to special matters. An Internal-Combustion Engine Sub-Committee has been appointed under the chairmanship of Dr. Dugald Clerk, while Mr. H. Fowler is chairman of a Light Alloys Sub-Committee. Other sub-committees have been constituted from time to time to investigate particular problems.

Many changes and developments in the design and construction of aircraft have taken place as the result of the continued and varied experience gained from their use in warfare under modern conditions. An increasing number of special problems is thus constantly presented for investigation, and these have very closely occupied throughout the year the attention of the staffs engaged in experimental work, both at the National Physical Laboratory and at the Royal Aircraft Factory. In addition to aerodynamical research, much attention has been given to questions relating to engines, materials of construction, strength of construction and design, instruments and accessories, as well as to methods of attack from aircraft, and other matters.

Equipment for Experimental Work at the National Physical Laboratory.—Reference was made in the report for last year to the additional equipment provided for experimental work. The wind channels now available comprise two 7-ft. channels, two 4-ft., and one 3-ft. The new 7-ft. channel was completed and brought into use early in the year 1916–17. No important departure has been made in its design from that of the earlier 7-ft. channel, but some minor modifications have been introduced which experience had indicated as tending to greater convenience in working. An air-speed of 85 ft. per second can be reached in this channel with an expenditure of 160 h.p. It is doubtful whether further increase in size of channel or in speed of air-current would advance existing knowledge to an extent sufficient to outweigh the greatly increased cost and other disadvantages involved. If it should prove necessary, for certain purposes, to conduct experiments on a larger scale and at higher speeds, it would appear, therefore, to be necessary to employ a method in which the model is moved through the air. As is well known, this procedure presents various difficulties, and the securing of even moderately accurate data in this manner is, at the best, extremely laborious. Probably the least troublesome way of applying this method is by installing measuring apparatus on the aeroplane itself, and it seems probable that only in this way can an

[1] Report of the Advisory Committee for Aeronautics for the Year 1916–17. (Cd. 8629.) (London: H.M. Stationery Office.) Price 1*d*. net.

accurate comparison be obtained between model and full-scale conditions. The matter is of importance, and attention is being given, so far as existing circumstances permit, to the devising of suitable measuring apparatus.

Improved methods of supporting the models under test in the channel have been devised for use in special cases. The effect on the measured resistance of the method of holding the model is often surprisingly large, and without the necessary care and experience in avoiding effects due to interference with the air-flow, very large errors may result. The difficulty is, of course, in general greatest in measurements on forms of small head-resistance, *e.g.* aeroplane bodies and airship envelopes. Earlier measurements on airship models of stream-line shape were made to determine the form of least resistance, and were, in the main, comparative; from the cause mentioned, it is probable that little reliance can be placed on the absolute values then obtained. With the new methods of support the possible error has been greatly reduced, and when full-scale values have been determined with accuracy, the prediction of full-scale resistance from the model experiments will be established on a satisfactory basis. The new method of support is employed also in tests of models of complete aeroplanes.

Experimental Work in Aerodynamics.—It is not proposed at present to enter in detail into the consideration of questions on which experiment has been in progress. Flyers and designers have, of course, given close attention to matters in which improvement would be of value, and this has led to the repetition and re-examination, from a somewhat modified aspect, of many earlier investigations. The experiments have been of very varied character, and have included tests of models of, probably, all types of aircraft at present employed. A large part of the work has arisen from specific inquiries proceeding from the service departments, but progress has been made with some investigations of more general character.

A number of experiments have been carried out relative to the resistance of airship shapes, and further observations on the distribution of pressure in such cases have been made.

The investigation into the stability of the aeroplane has been continued. A number of special cases have been examined, and results of importance have been reached. The theory of airship stability has also been investigated.

Research into the nature of the flow of fluids round obstacles has been continued.

A number of investigations relating to airscrews have been carried out with the view of increasing the accuracy of prediction of performance, and thus facilitating the design of airscrews for special purposes. Tests on screws to be used as windmills for the production of power have also been made.

The work has included a complete series of tests on more than one complete aeroplane model. The information thus derived is of considerable importance for practical purposes in aeroplane design.

Strength of Construction.—A number of questions relating to strength of construction have been investigated, and some general conclusions have been reached tending to simplification of strength calculations. The basis to be adopted in design to secure adequate strength in high-speed machines, with the power of rapid manœuvring essential in aerial fighting, is a matter demanding the most careful consideration. To secure the highest possible speed it is necessary to keep down the weight to a minimum, and the best compromise between these two opposed conditions does not admit of precise determination. This question has received attention, and the manner in which strength varies with increase of dimensions has also been made the subject of investigation. Cases in which vibration has been set up have been examined, and calculations relating to the strength of the body structure have been made.

Engines.—A number of questions relating to engines and engine design have been submitted by the Air Board for consideration by the Engine Sub-Committee. These have required very careful investigation, and the sub-committee has been closely occupied since its formation with the various problems which have arisen. Experimental work has been carried out, by request of the sub-committee, at the Royal Aircraft Factory; and the sub-committee has received much assistance in the examination of special questions, both from the Royal Aircraft Factory and from manufacturing firms the works of which have been visited.

An extensive series of experiments on radiators has been carried out at the National Physical Laboratory, and other investigations relative to the transfer of heat from surfaces to fluids flowing over them are in progress. These have an immediate bearing on the design of the cooling systems in aeroplane engines. Experiments relating to the performance and efficiency of magnetos have also been made.

Light Alloys.—The use of light alloys in the construction of aircraft and aircraft engines is becoming of rapidly increasing importance, and improvements in the production of light alloys will have great effect on future development. The investigations relating to light alloys which have been in progress for many years at the National Physical Laboratory have been continued, and results of special interest have been achieved during the past year. Suggestions have been made to the Air Board by the committee which may, it is hoped, help to secure the best conditions in manufacture for the development of such alloys. The formation of the Light Alloys Sub-Committee will be of great assistance in co-ordinating the work on light alloys which is being done in various quarters, and in collecting the information resulting from experimental investigation and manufacturing experience. Experimental work has been carried out for the sub-committee at the Royal Aircraft Factory, the University of Birmingham, the National Physical Laborafory, and elsewhere, and arrangements have been made for placing the information obtained at the disposal of manufacturers.

Fabrics, Dopes, etc.—A number of special questions have arisen for investigation in relation to airship and aeroplane fabrics. A large amount of attention has been given to materials for use as dopes, varnishes, etc., and the Laboratory has collaborated with the Military Air Department in an investigation into the behaviour of fabrics, dopes, and protective coatings under the conditions of tropical exposure. The results of exposure to ultra-violet radiation have been studied in relation to the effect of sunlight, and conclusions of importance have been reached. The committee is indebted to Dr. Shakespear, of the University of Birmingham, for information he has placed before them as to the methods developed by him for determining the permeability of fabrics by hydrogen; comparisons have been made with the results obtained at the National Physical Laboratory. Methods of determining the purity of hydrogen have been investigated.

Investigations Relating to Seaplanes.—Tests on models of seaplane floats in the William Froude National Tank have been continued and extended. The provision made last year for an increase in the staff available for carrying out this work has enabled more rapid advance to be made, and a number of important questions have received attention. The methods employed have been improved and elaborated, and new apparatus has been designed whereby addi-

tional measurements can be obtained and further information secured relative to special conditions arising in practice.

Special Matters.—As usual, a large number of special questions have been referred to the committee for advice or investigation. The experiments relating to bombs have been continued, and valuable communications relative to the flight of bombs have been received from the Air Department of the Admiralty and from the Central Flying School. The committee is indebted to Prof. Karl Pearson, F.R.S., for communicating to it the results of his calculations of bomb trajectories. This question has also been the subject of investigation at the National Physical Laboratory.

Questions relating to the attack of aircraft from aircraft have been examined. Problems in connection with the aeroplane compass have been further considered. Other instruments and apparatus for use on aircraft have been investigated.

As previously, a number of inquiries have been received from the Board of Invention and Research and the Munitions Inventions Department, and investigations have been carried out at their request at the National Physical Laboratory and at the Royal Aircraft Factory.

Reports from the Experimental Stations of the Air Services.—A number of communications have been received during the year relating to experimental work carried out by the R.N.A.S., and by the Testing Squadron of the Royal Flying Corps. Many of these have been of great interest and value, and of much assistance in the application of the results obtained from the model experiments and in the estimation of aeroplane performance.

The committee visited on various occasions during the year military and naval air stations, as well as the Royal Aircraft Factory and the National Physical Laboratory, and witnessed many interesting experiments and trial flights.

EXPERIMENTAL WORK AT THE ROYAL AIRCRAFT FACTORY.—*Engine Experiments.*—Much research has been made into various methods for improving the output and the trustworthiness of aeroplane engines. A large number of radiators of various types have been tested, and an efficient type has been standardised. Great progress has been made in the development of the air-cooled engine. Work has been done on the compensation of carburettors for variation of air density, and a device for improving the performance of engines at great heights has been tested on several engines.

Full-Scale Aeroplane Experiments.—The measurement of the resistance of aeroplanes in flight has been continued with the object of confirming the model experiments, and an instrument for measuring the resistance directly has been developed. The distribution of air-pressure over the surface of the wing of an aeroplane in flight has been measured, and further experiments on these lines are in progress. Experiments have been made on longitudinal and lateral stability of aeroplanes in flight, and much theoretical work on the same subjects has been done. Measurements have also been made of the disturbance of the air behind a propeller to obtain data which are required in the design of new machines.

Instruments.—The behaviour of various types of magnetic compass in an aeroplane in flight has been investigated. Two new types of bombsight have been developed, and are now being tested. The improvement of the standard aeroplane instruments has been continued, and a number of special instruments have been devised for use in connection with full-scale experiments on aeroplanes. The means of communication between pilot and observer have been improved.

Fabrics, Dopes, etc.—Weathering tests on fabrics and experiments on the influence of humidity on their strength have been made. The development of a calendered fabric has received attention. The deteriorating effect of various agents (bacteria, light, etc.) has formed the subject of considerable research. The experiments on the composition of dopes, varnishes, and pigments, and on fluxes, paints, and oils have been continued.

Light Alloys.—Much experimental work has been done to arrive at the most suitable aluminium alloys for engine parts. Experiments have also been carried out in the application of the alloys which have been developed at the National Physical Laboratory.

METEOROLOGICAL WORK.—Experimental work in meteorology has been mainly in connection with the inquiry into the location of distant thunderstorms and the tracing of their progress across the map by means of a properly organised system of observations at various stations.

On some occasions the progression of thunderstorms across the map has been satisfactorily identified, although the identification on other occasions was uncertain.

Further attention is necessary in order to develop an apparatus which is more directly suitable for the purpose than that which is at present in use, in consequence of the variability of the sensitiveness, which with the present form of apparatus is unavoidable.

In addition, an inquiry into the variation of the gustiness of wind between day and night has been provided for by the erection of an anemometer with its vane at 140 ft. above the ground.

Observations have also been made of the variation of the wind with height close to the ground; and a large number of observations of pilot-balloons have been made and duly reported.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

WE learn that Dr. W. C. M'Intosh, professor of natural history in the University of St. Andrews since 1882, is about to retire from the position, in consequence of advanced years and conditions of health.

MR. W. BREW, hitherto lecturer in electrical engineering at the Belfast Municipal Technical Institute, has been appointed head of the electrical department of the Birmingham Municipal Technical School.

ACCORDING to the *Aftonbladet*, special lectures are to be given during the coming winter at Greifswald University on "Germany's Commercial Relations with Scandinavia," and a chair of the Swedish language is to be founded in the University after the war.

THE new session of the Sir John Cass Technical Institute commences on September 24. The syllabuses of classes which have reached us show that special courses of higher technological instruction in connection with the fermentation industries have been arranged; instruction will be given in brewing and malting, and in the microbiology of the fermentation industries. The methods of differential and integral calculus and their application to chemical and physical problems will be studied in the department of physics and mathematics. Courses of an advanced character will be provided in the metallurgy department on gold, silver, and allied metals, and on the heat treatment of metals and alloys. The courses of instruction are for the most part designed to supply a technical training for persons engaged in chemical, metallurgical, and electrical industries, and in trades connected with them. A number of the more specialised courses of instruction which in former years formed a characteristic of the work of the institute have for the present been discontinued.

TECHNICAL schools and colleges are now issuing particulars of the courses of study they have arranged for the forthcoming winter session, and we have received a number of college calendars and prospectuses from various districts. At the Battersea Polytechnic, in the Technical College for Day Students, the usual courses are offered in mechanical, civil, electrical, and motor engineering, building science, and applied chemistry. In addition, new courses have been arranged in gas engineering and manufacture, and in the technique of paper-making. The polytechnic is continuing its special war work, which includes classes for the training of men and women munition workers, courses for women in engineering tracing, and free instruction for disabled soldiers and sailors in motor-car engineering, electrical testing, sanitary inspectors' duties, and other forms of remunerative work. The City of Bradford Technical College offers a complete training for the various branches of the textile, chemical, and engineering industries, including the underlying sciences. The diploma courses extend over three, or in some cases four, years, and occupy the full time of the student, much of whose work is of an advanced character. A special characteristic of the courses is the great importance attached to scientific research. At the West of Scotland Agricultural College, Glasgow, students are provided with facilities for the study of agriculture, dairying, forestry, horticulture, and poultry-keeping. Some of the courses have been arranged in conjunction with the University of Glasgow, and under conditions explained in the prospectus students may qualify for the B.Sc. degree in agriculture of the University.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 27.—M. Ed. Perrier in the chair.—A. **Lacroix**: The composition and modes of alteration of the ophites of the Pyrenees.—G. **Humbert**: Some properties of binary indefinite quadratic forms.—H. **Deslandres**: Contribution to the supposed influence of the cannonade on the fall of rain. The opinion of M. C. Saint-Saëns.—A. **Laveran**: The experimental inoculation of *Leishmania tropica* in apes: multiplication of the primary lesions by auto-inoculations in a *Circopithecus mona*: Paul **Sabatier** and G. **Gaudion**: The various modes of decomposition of amines by catalysis: return to aniline and the substituted anilines. Examples are given of the various types of decomposition effected by metallic nickel, removal of hydrogen, separation of ammonia, and separation of aromatic amine.—F. **Delhaye** and **Sluys**: The formation of the Karoo in the western Congo.—MM. **Lapicque** and **Legendre**: The improvement of war bread by neutralisation of the ferments of the bran. An extraction of 85 per cent. of the wheat gives a flour containing such a proportion of bran that the bread made from it is unpleasant in taste and rapidly goes mouldy. The addition of a proportion of lime water in making the bread neutralises the acidity of the bran and gives a bread which has a better taste and keeps longer than bread made from the same flour without the addition of lime water.

BOOKS RECEIVED.

British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. Vol. iv. No. 1, Echinoderma. Part 1. Actinogonidiata. By Prof. F. J. Bell. Pp. 10+plates. (London: British Museum (Natural History) and others.) 2*s.* 6*d.*

Transactions of the Royal Society of Edinburgh. Vol. li. Part iv. Sessions 1915–16–17. (Edinburgh: R. Grant and Son.) 31*s.* 6*d.*

Jacob and the Mandrakes. By Sir J. G. Frazer. Pp. 23. (London: H. Milford.) 2*s.* 6*d.* net.

Primitive Man. By Prof. G. Elliot Smith. Pp. 50. (London: H. Milford.) 3*s.* 6*d.* net.

Shells as Evidence of the Migrations of Early Culture. By J. W. Jackson. Pp. xxviii+216. (Manchester: At the University Press; London: Longmans and Co.) 6*s.* net.

Our Analytical Chemistry and its Future. By Dr. W. F. Hillebrand. Pp. 36. (New York: Columbia University Press; London: H. Milford.) 1*s.* 6*d.* net.

Thomas A. Edison. Pp. 216+plates 8. (London: G. G. Harrap and Co.) 3*s.* 6*d.* net.

Thrice through the Dark Continent. By Prof. J. Du Plessis. Pp. viii+350+map and illustrations. (London: Longmans and Co.) 14*s.* net.

Founder's Day in War Time: An Address delivered on March 23, 1917, at a Memorial Service for Members of Manchester University who have Fallen in the War. By Sir A. W. Ward. Pp. 55. (Manchester: At the University Press; London: Longmans and Co.) 1*s.* 6*d.* net.

Carnegie Endowment for International Peace. Year Book for 1917. Pp. xvii+213. (Washington.)

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