THURSDAY, AUGUST 29, 1918.

ITALIAN GEOLOGY.

(1) *Bibliography of the Geology and Eruptive Phenomena of the More Important Volcanoes of Southern Italy.* Compiled with the assistance of Madame A. Johnston-Lavis by Prof. H. J. Johnston-Lavis. Second edition, completed after the author's death by Miss B. M. Stanton and edited with a preface and short life of the author by B. B. Woodward. Pp. xxiv+374. (London: The University of London Press, Ltd., 1918.)

(2) *Italian Mountain Geology.* By Dr. C. S. Du Riche Preller. Part i. *The Piémontese Alps, Ligurian Apennines, and Apuan Alps.* Pp. 1–99. Part ii. *The Tuscan Subapennines and Elba.* Pp. 101–92. (London: Dulau and Co., Ltd., 1918.) Price 2*s.* 6*d.* net each.

(1) THE late Prof. H. J. Johnston-Lavis was an untiring worker, and the bibliography now so handsomely published is a monument to the thoroughness with which his studies were pursued. The Italian volcanoes, on account of their position in the heart of Mediterranean culture, and their consequent accessibility to every inquiring pilgrim who made his way to Rome, have formed, almost unaided, the foundation of the science of vulcanology. Sir William Hamilton, our Ambassador at the Court of Naples at the close of the eighteenth century, brought systematic and continuous observation to bear upon the phenomena of Vesuvius. Spallanzani, very little later, undertook the description of Sicily. The contemporaneous and acute researches of Faujas de Saint-Fond among the extinct volcanoes of France owed their influence on geological thought to the author's comparisons of chilled materials with the products of active cones in Italy. Werner of Freiberg, the exponent of cabinet geology, was defeated when his pupil von Buch travelled southward of the Alps. The bibliography of South Italian volcanoes, as we look back on memorable controversies, is indeed a conclave of great names. If we could rearrange the papers cited in the order of their dates, instead of the far more convenient author-system here employed, we should have a history of alarm and wonder-seeking, passing into more or less sober speculation, and finally into patient observation varied by exciting episodes.

The division of the subject in this work into papers on various areas has led to a repetition of many entries. This could have been avoided if each entry had been numbered and a cross-reference made when requisite. This matter is worth mentioning, since the repeated references have very different bibliographic values. That to the famous "Campi Phlegræi," for example, under "Hamilton" in the section on the Æolian Isles is far better than the previous one in the section on Vesuvius. The Æolian reference to "Der Aetna," by Sartorius von Waltershausen (edition of 1880), is, on the other hand, less satisfactory than that given later under Etna. This finely printed work is of value to all geologists and also to all public libraries. It contains, moreover, a characteristic portrait of the compiler, standing among the Vesuvian tuff-beds, as some of us remember him in 1906, a year highly memorable in the history of the mountain that he loved.

(2) Dr. Du Riche Preller's collected papers on the structure of western and north-western Italy are the result of much close observation in the field and of careful consideration of the published work of others. After each descriptive exposition, the author states his own conclusions, and the numerous references, given as footnotes, render it easy to pursue any controverted point in detail. He reasons that the marble of Carrara (p. 96) is of Triassic age, since it has none of the schistose character of the Alpine Permian. He furnishes interesting remarks on the *pietre verdi* of various types, assigning them generally to submarine basic eruptions, dating from Palæozoic to Eocene epochs. The penetration and overriding of Mesozoic rocks by granite in western Liguria are attributed to intrusion in Cainozoic times, rather than to transport of the crystalline rock by over-thrusting. The more extreme movements demanded by Termier are viewed with some suspicion. The tone of the papers is far from controversial, and the bringing together of so much matter of diverse interest is distinctly helpful to geologists. We do not know why the author prefers "Piémont" to the English form, and he certainly must not be allowed to use "euphodite," as he does quite consciously, for "euphotide." The term is due to Haüy and not to Delesse (p. 24), and we must not forget its author's charming explanation—"parce que le fond de la roche réfléchit le blanc . . . et que le diallage réfléchit tantôt le vert, qui est la couleur amie de l'œil."

GRENVILLE A. J. COLE.

THE GROWTH OF SCIENCE.

An Introduction to the History of Science. By Prof. W. Libby. Pp. x+288. (London: G. G. Harrap and Co., Ltd., 1918.) Price 5*s.* net.

WE cordially recommend this book to the general reader as well as to educable teachers and students of science. It is admirably written, the work of a scholar and thinker who knows the value of restraint. By careful selection of his illustrative material, and by aiming, not at a chronicle, but at an exposition of the great factors in the development of scientific thought, he has succeeded in giving us a really useful *short* history of science. With what Prof. Libby says in his preface regarding the educative value of school instruction in the history of science we are in entire agreement, and he has supplied the introductory book that was wanted. It helps us to realise how the sciences have grown up, that they continue growing, that their growth has had instructive vicissitudes, that their development depends on social as well as on personal factors, that they are democratic and international, and that they develop inter-linked with one another.

The scope of the book may be briefly indicated. The banks of the Nile, the Tigris, and the Euphrates saw many interesting beginnings, *e.g.* in astronomy and medicine, for the most part oriented to practical needs. The deepening influence of abstract thought, often linked to observation and experiment, is illustrated by Thales, Pythagoras, Plato, Euclid, Aristotle, and Archimedes. The Roman practical and regulative genius is illustrated by Vitruvius, with his fine conception of the synoptic dignity of architecture, and we are led on to Pliny the Elder and to Galen. An instructive chapter on the continuity of science through the Middle Ages is followed by a discussion of the classification of the sciences, Bacon's in particular. The development of scientific method is illustrated by the work of Gilbert, Galileo, Harvey, and Descartes; and the fundamental importance of measurement by the achievements of Tycho Brahe, Kepler, and Robert Boyle.

The story of the Royal Society is the diagram of co-operation in science; the early development of geology illustrates the value of interaction; in a vivid chapter Benjamin Franklin is taken as representing the eighteenth century in its struggle for intellectual, social, and political emancipation; the relation of science and religion is discussed in connection with Kant and the astronomers; Dalton and Joule illustrate the reign of law; Sir Humphry Davy is pictured as an ideal man of science; scientific prediction finds its classic illustration in the discovery of Neptune; the stimulus that travel gives to science is typified by Darwin's Columbus-voyage; the relief of man's estate by scientific discovery has its fine examples in the work of Pasteur and Lister; science as the mother of inventions is exemplified by the Langley aeroplane. Such are the subjects of successive chapters of a fascinating story, which ends with discussions of scientific hypotheses, scientific imagination, and the relation of science to democratic culture. Our only serious criticism is that the book takes relatively little account of biological science.

WHALE-FISHING.

Modern Whaling and Bear-hunting. A Record of Present-day Whaling with Up-to-date Appliances in Many Parts of the World, and of Bear- and Seal-hunting in the Arctic Regions. By W. G. Burn Murdoch. Pp. 320. (London: Seeley, Service, and Co., Ltd., 1917.) Price 21*s*. net.

THE literature of the whale-fishery is large, and there is much delightful reading to be found in it. Scoresby still stands first and foremost; he had the true scientific eye, he told us just what he saw, and we go to his books to read not only of whales, but also of snow-crystals, and the heights of waves, and a multitude of other things that many have seen and few recorded. But Scoresby was a little apt to be incredulous of the things he had not seen, and so it happened (for instance) that he led naturalists astray for half a century by declaring that there was no such thing as a "Basque whale." We have also the old books of Martens and of Zorgdrager, and many older accounts than these, from the days of Baffin and of Edge and his Muscovy Company. And, besides all these, we have a long series of narratives, more or less exciting, of whaling voyages for the last hundred years and more, Colnett and Bennett and H. J. Bull, and many others, not forgetting among the older ones the Commandeur Frederik Pietersz's voyage to Greenland "op het Schif De Vrouw Maria," nor among the latest the romantic story of the "Cruise of the *Cachalot.*"

To all these Mr. Burn Murdoch has now added another, to tell of "modern whaling" in many seas, north and south and round the world; and he weaves into the story of his own adventurous voyages a lively account of the growth and recent origin of this extensive and prosperous industry. The reader may learn here, for instance, how old Svend Foyn spent years and years on the perfecting of his "harpoon-gun," and the planning of the little swift ships from which it was to be used; how, when all was complete, the great Finner whales and humpbacks, which had lived an innocent and unmolested life since the world began, were harried from sea to sea, and boiled down into oil and ground up into bone-meal and cattle-food; how the whale-oil is "hardened" into "white, tasteless, edible fat excellent for cooking purposes," and how sensible men eat the whale-beef and find it excellent; and how Svend Foyn became rich thereby beyond the dreams of avarice, and his little town of Tonsberg, where his statue stands, became an important place and a busy centre of commerce and industry.

The book is a gossipy one; it roves from one theme to another; it is full of stories, and some few of them (perhaps the usual small proportion) are good; and, better than the stories, it brings to our ears, for once in a way, the tune of some fine old lively chantey, like "Blow, ye winds, hey ho, to California." Every now and then, among the lighter stuff, Mr. Burn Murdoch lets us see that he is a shrewd observer, and better still, that he can, when he pleases, write very admirable English. Best of all, to our thinking, are some of his descriptive bits of really fine word-painting: as, for example, of the "rich, colourful light of the Gulf Stream, that seems to increase south and westerly as you follow it, say, from the west of Kirkcudbright to Spain, and westwards till you come to the Sargasso Sea"; or, again, of "that jewel of a Sea-town," Ponte Delgado, San Miguel in the Azores. D. W. T.

OUR BOOKSHELF.

Dynamic Psychology. By Prof. R. S. Woodworth. (Columbia University Lectures.) Pp. 210. (New York: Columbia University Press; London: Humphrey Milford, 1918.) Price 6*s*. 6*d*. net.

THIS short course of lectures is designed to give an account of the distinctive character of the modern movement in psychology. It provides a sketch of the historical development of the science, and shows the revolution it has undergone, as essentially a part of, and determined by, the general revolution in the whole conception of modern science which has followed the abandonment of the geocentric point of view. Psychology is the youngest of the empirical sciences, but in none has the revolution been more marked and rapid. This is due to the fact that only in very recent times have we come to recognise that psychology is something more and other than a chapter in general philosophy, that it has for its subject-matter a class of empirical facts as distinct, as obstinate, and as capable of being abstracted for the purposes of special study as the facts with which physics and biology deal. Prof. Woodworth sees the real beginning of modern psychology in John Locke and the English empiricist philosophers. Its notable advance in recent times, and the complete change it has undergone, are mainly due to the discernment of the significance of the facts revealed in abnormal psychology, and also to the study of the instinctive basis of human nature. The "drive" and the "mechanism" are the two factors which mutually condition one another, and it is the object of the modern psychologist to discover their true nature and relation in order to lay the foundations of a practical or applied science. Although the lectures make no pretension to add anything to our theoretical or practical knowledge, they are very valuable as indicating the new conception of the much-debated scope and method of psychology.

H. W. C.

Aids in the Commercial Analysis of Oils, Fats, and their Commercial Products: A Laboratory Handbook. By G. F. Pickering. Pp. viii + 133. (London: C. Griffin and Co., Ltd., 1917.) Price 7*s*. 6*d*. net.

THIS is a book intended for the works chemist who has to deal with oils, fats, and their products as raw materials for his industry. The author does not treat of the elements of his subject, but writes for those already engaged in the examination and utilisation of fatty substances. A good deal of sound practical advice is given, such as, for instance, the directions for taking samples of materials to be examined. Bad sampling, it is truly said, has caused far more differences between buyer and seller than the use of different methods of analysis.

The book includes a useful collection of analytical methods suitable for employment in works laboratories. The author remarks that all the figures [numbers] given "are now published for the first time." This, however, is not necessarily a recommendation unless they cover a sufficiently wide range of examples to be truly representative, and not much is said on that point. The section on fat "splitting" (*i.e.* decomposition into glycerol and fatty acids) is one of distinct value, as are also those on glycerine, resins, and recovered products.

In a work of this kind the facts are the important things, but it may be pointed out, without hypercriticism, that the author is occasionally a trifle careless in his expression of them. Thus (p. 8) we are told that a certain distillation had been "performed by dissolving resin in the oil," which does not quite convey the idea intended. On p. 87 there are directions to "drop in a little sulphuric acid (34·7 c.c. of concentrated acid and 37·5 c.c. of water)," which again must not be taken too literally. The expression "ethyl ethers," too, where esters of fatty acids are meant (p. 89), is not very accurate—or, at best, is antiquated. These, however, are minor blemishes. The book, as a whole, is a very practical and useful aid to the technical chemist.

Natural Science in Education. Being the Report of the Committee on the Position of Natural Science in the Educational System of Great Britain. Pp. viii + 272. (London: Published under the authority of His Majesty's Stationery Office, 1918.) Price 1*s*. 6*d*. net.

THE report of the Committee, of which Sir J. J. Thomson was chairman, appointed by Mr. Asquith in August, 1916, to inquire into the position occupied by natural science in the educational system of Great Britain, especially in secondary schools and universities, was reviewed in our issue of June 6 last (vol. ci, p. 265), and it is unnecessary to emphasise its importance again. We welcome the opportunity, however, of directing attention to its republication in convenient book form, which will make it possible to have the report among one's reference volumes easily accessible for constant use. It may be hoped that all future important Government reports may be issued in a similar style, for they will be much more likely to be studied than if printed on the old familiar foolscap sheets.

Chemistry for Beginners and School Use. By C. T. Kingzett. Third edition. Pp. 211. (London: Baillière, Tindall, and Cox, 1918.) Price 2*s*. 6*d*. net.

THE first edition of Mr. Kingzett's little book has been reviewed already in these columns (vol. xcix, p. 422). The opportunity provided by the demand for a new edition of the book has been taken to add an additional part, illustrated by eighty-one figures, dealing with chemical apparatus and experiments. Originally the volume was planned to give an introduction to chemistry to beginners having no opportunity to witness or perform experiments, yet it may be doubted if the addition of the new part will render the book sufficiently practical for use in most schools where chemistry is studied.

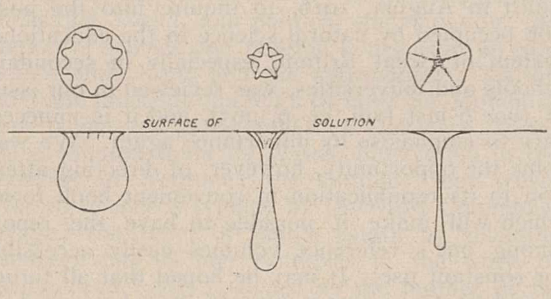
LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Production of Medusoid Forms from Gels.

THE reference to the phenomena of ordinary drops in Prof. D'Arcy W. Thompson's letter on "Medusoid Bells" in NATURE of August 8 has suggested to me the possibility of obtaining permanent imitations of such forms as he describes by producing drops of gelatin in a suitable medium. The latter must be one of the solutions which harden gelatin, must have a specific gravity very near that of the gelatin sol at the temperature at which it is used, and must possess an appreciable interfacial tension against the sol. I have found that a solution of aluminium sulphate can be made which fulfils all these conditions.

If 20 per cent. gelatin sol, which may be coloured with any convenient dye, is dropped into such a solution from a tube about 4 mm. diameter, with its orifice from 2 to 8 mm. above the surface, rather interesting forms are obtained. The specimens do not lend themselves very well to photographic reproduction, but I have drawn diagrammatically three typical cases. In all instances the crenated or stellate portion rests on the surface. With a 10 per cent. gelatin sol permanent vortex rings can be obtained, as well as discs with a thickened rim, rings with a cylindrical fringe, etc.



To approach more nearly to the conditions of the budding organism, it would be necessary to discharge the drops below the surface of the liquid. This procedure entails some experimental difficulties, which, however, I hope to overcome. The forms so far produced do not show to me any evidence of vibration, but appear to be completely explicable by the effects of surface and interfacial tension and of the removal of water from the gel. Further experiments may show such evidence, and it would be very interesting if they could furnish support for so attractive a hypothesis in view of its two *prima facie* difficulties: the origin and the persistence of vibration in a medium with the peculiar elastic properties of dilute gels. Perhaps the results described may induce others, more competent than I am to interpret their biological and morphological aspects, to make such experiments; the conditions may be varied in a great number of ways which will readily suggest themselves to anyone familiar with the properties of gelatin.

EMIL HATSCHEK.

10 Nottingham Mansions, Nottingham Street, W.1, August 16.

Formulæ for Tetrahedron.

PERHAPS some readers of NATURE may be able to tell me whether the following results are new:—

Let ABCD be any tetrahedron; $BC=a$, $DA=a'$, and so for the other edges; (BC)=dihedral angle of which BC is an edge, and so on; (aa') the angle between BC, AD, and so on; α, β, γ, δ the areas of the faces opposite A, B, C, D respectively. Then we have identically

$$aa' \cos(aa') + bb' \cos(bb') + cc' \cos(cc') = 0 \qquad \text{(i)}$$

$$aa' \cos(aa') \cos(BC) \cos(AD) + bb' \cos(bb') \cos(CA) \cos(BD) + cc' \cos(cc') \cos(AB) \cos(CD) = 0 \qquad \text{(ii)}$$

It is a known theorem, due to Steiner, that the four altitudes of ABCD are generators of the same hyperboloid. With the help of (i) and (ii) I have found that, taking ABCD as the tetrahedron of reference, the equation of Steiner's hyperboloid is, in volume co-ordinates,

$$aa' \cos(aa')\{\alpha\delta yz \cos(BC) + \beta\gamma xt \cos(AD)\} + bb' \cos(bb')\{\beta\delta zx \cos(CA) + \gamma\alpha yt \cos(BD)\} + cc' \cos(cc')\{\gamma\delta xy \cos(AB) + \alpha\beta zt \cos(CD)\} = 0.$$

In these formulæ certain conventions have to be made in the definitions of the angles (aa'), etc., so as to make the cosines come out with the proper signs.

Another interesting result is that if V is the volume of the tetrahedron,

$$4\alpha\beta\gamma\delta\{\cos(AB)\cos(CD) - \cos(CA)\cos(BD)\} = 9V^2 aa' \cos(aa')$$

with two other identities derived from this by interchange of letters.

All the formulæ can be translated into vector identities; thus $\Sigma aa' \cos(aa') = 0$ corresponds to the quaternion identity

$$S\{(\beta-\gamma)\alpha + (\gamma-\alpha)\beta + (\alpha-\beta)\gamma\} = 0,$$

but the others do not seem to me to be so easily derivable.

G. B. MATHEWS.

7 Menai View, Bangor, August 17.

Rotating Discs.

A NOTE in NATURE, August 22, p. 491, referring to a recent article by Mr. H. Haerle, says: "The problem of ascertaining the distribution and magnitudes of the stresses in a revolving disc by means of mathematical formulæ is tedious and complicated. With the exception of the cases of discs of constant thickness and constant strength, for which definite integrals can be found, the analytical solution involves highly complex equations, and the ultimate result is doubtful." May I point out that the ordinary approximate solution for the rotating circular disc of uniform thickness, whether complete or holed, involves only simple powers of the radius vector? The corresponding solution for the thin elliptical disc involves expressions of an equally elementary type, though naturally longer. But in addition we have possessed for more than twenty years (see Proc. Roy. Soc., vol. lviii., p. 39) a complete solution for an ellipsoid of any shape rotating about a principal axis. This involves only simple powers of the variables x, y, z, and it applies, of course, to discs of very varied shapes. All the ordinary elastic solid equations, whether internal or external, are exactly satisfied in this case. Thus the uncertainties are only those inevitable through the difference between the ideal elastic solid problem and its realisation in practice.

C. CHREE.

August 26.

LORD BALFOUR'S COMMITTEE AND THE CHEMICAL TRADES.

AMONG the many subjects dealt with by Lord Balfour's Committee on Commercial and Industrial Policy after the War, in the attempt to grapple with the first term of their comprehensive reference, viz. "What industries are essential to the future safety of the nation, and what steps should be taken to maintain or establish them?" was that of the chemical trades. Unfortunately, these trades were not very adequately represented on the Committee, and there was practically no one member of it who was able to speak from his own knowledge of much that is comprised within so wide-embracing a phrase. It is significant of the Committee's attitude towards what they apparently regarded as a subordinate and relatively unimportant section of our staple industries that its consideration is dealt with only when that of all the others had been disposed of. This may possibly be accounted for by the circumstance that in all the other cases the members had before them reports from Sectional Departmental Committees appointed to consider the special circumstances of particular industries and to embody their findings in recommendations with which it was the function of Lord Balfour's Committee to consider further with the view of arriving, if possible, at a consistent and uniform commercial and industrial policy. Although the Committee alludes to memoranda from the National Health Insurance Commission and from the Pharmaceutical Society and War Office with respect to certain drugs, mainly for Army use, there is nothing in the final report to show that it had any opportunity of considering any similar reports of Sectional Committees representing the various divisions of the chemical trades. This is greatly to be regretted.

The subject of the present and prospective position of the chemical trades of this country, in view of their essential importance to the future safety of the nation, cannot be said to have been adequately considered as yet by any properly constituted body or bodies. Partial attempts have been made to deal with pressing difficulties arising from the shortage of dyes and drugs at the beginning of the war by a sort of hand-to-mouth policy. The enormous development of the manufacture of oil of vitriol required for the making of munitions has occasioned some perturbation of mind among those who are concerned with the future of the industry after the war, and a special Committee has considered and reported upon the matter. But as yet there has been no such collective action in the case of the chemical trades as we have seen in the case of the coal trade, the iron and steel trades, the engineering trades, in shipbuilding and marine engineering, the electrical trades, the trade in non-ferrous metals, and the textile trades. This, perhaps, may be partly due to the very diverse character of the industries which are comprised within the term "chemical trades," but these are not more diverse than those comprehended by that of the textile trades. Certain of these chemical industries are, no doubt, very small in point of output, and are represented by few firms of wealth or political influence. Some of these firms would unquestionably be enlarged, their number increased, and the variety and range of their products extended, if the Legislature could be induced to make up its mind with regard to the future commercial and industrial policy of the Empire after the war; but so long as all is uncertain, and the Government waits on events, or is moved only by party considerations, capital will not be attracted towards the development of industries which may at any time be crushed by the relentless and unscrupulous methods of German combinations, protected and encouraged by an equally relentless and unscrupulous Government.

Although Lord Balfour's Committee has dealt with the question of the position and future prospects of the chemical trades, in regard to the future safety of the nation, in a very imperfect and inconclusive manner, it must be admitted that the Committee has been accurately informed of much that is, unfortunately, only too true concerning their past history, and the report contains much plain speaking in regard to the lack of enterprise and originality which British chemical industry, especially in a number of the smaller trades, has hitherto manifested. Lord Balfour and his colleagues are under no illusions as to the sources of Germany's strength in the chemical arts. Her exports of chemical products in 1912 were double those of the United Kingdom. In other words, starting from an almost insignificant amount, Germany, since she became an Empire, has doubled the chemical output of the nation which long regarded itself as the premier manufacturing nation of the world.

"The predominant position," it says, "of Germany in the world in these industries, and the remarkable progress made by that country in recent years, were due . . . mainly to the persistent and thorough manner in which scientific knowledge and research and business ability have been combined for the building up of a great and comprehensive industry." It points out that "for synthetic dyestuffs the dye-using industries, and in particular the textile trades, of the world were dependent upon a group of very powerful German companies, which to great technical ability and financial resources added a most effective marketing organisation. Closely related to the dye-making industry was the manufacture of synthetic drugs, in which again Germany dominated the world. In fine chemicals . . . and a wide range of other chemical products, the German industry occupied an almost equally strong position. The large scale," it adds, "on which the German industry operated, the great technical ability at its disposal, and its very elaborate organisation, made it possible to market its produce at a price with which British manufacturers could rarely effectively compete, and facilitated the frequent adoption of a policy of systematic 'dumping,' with a view to the prevention of the development of competitive industries elsewhere." And then follows this humiliating admission:—"In numerous cases, both in respect of the classes of commodities already mentioned, and in *heavy chemical trades also, British manufacturers had found it necessary, in order to* *retain some part of the trade, to enter into agreements with their German competitors, and existed in some cases only on sufferance.*"

There must be "something rotten in the State" that brings a proud and powerful nation to such a pass as this. The Committee, in its "General Conclusions," points out how we have allowed certain branches of production of great importance as a basis for other manufactures to come entirely or very largely under German control, and it enumerates many examples which have been made painfully familiar to us since 1914. "In all these cases the strength of the German position was due largely to persistent scientific work and organising skill." It might have been added that this "persistent scientific work and organising skill" was directed by a "commercial and industrial policy" deliberately designed to strike at the welfare and even at the very existence of this Empire.

Much of all this has been said many times already, but if the country is to be thoroughly aroused to a sense of the jeopardy in which it stands now that Germany has unmasked herself, it cannot be said too often. In stating its convictions as to how the present position has been brought about, the Committee is also repeating a twice-told tale. It has been due to a number of causes. They are thus summarised in the report. First, the conservative influence of history and tradition, engendering a feeling of over-confidence in the maintenance of our position, and in the methods hitherto pursued, with but little recognition of the necessity for constant vigilance and constant effort to meet the changing conditions and requirements of world trade. Secondly, the admitted success in many directions of the competition of Germany with the United Kingdom was due in part to the comparatively late entrance of German industry into the field; that economic conditions in Germany made cheap production possible; that she started with all the advantages of completely modern equipment and without the handicap of a traditional organisation. Lastly, that,

> from the first there was in Germany complete recognition of the great value of the application of science to industry and the close co-operation of the two; this, though most strikingly exemplified in the chemical trades, may fairly be said to be characteristic of German industry as a whole. Amongst British manufacturers, though there were some marked exceptions, there was, speaking generally, no such recognition.

It is admitted not only that the war has served to bring home to us the weakness of our economic position, but also that its requirements have roused us to an intensity of effort unparalleled in the industrial history of the nation, and in no branch has our potential power and productive capacity been more strikingly shown than in that of chemical industry. The Committee is glad to recognise that

> through British industry generally the cutting off of foreign supplies, of commodities hitherto regarded as indispensable and unobtainable except from abroad, has stimulated British manufacturers to efforts to fill the gap by the provision of similar commodities or adequate substitutes. In numerous directions attempts of this kind have been made, with and without Government assistance, to establish new lines of production of varying degrees of importance, and a substantial measure of success has already been attained in some cases . . . and the knowledge and experience gained during the war should be a most valuable asset in respect to our post-war trade.

In the special cases of drugs and dyes it is not only a question of competition with our enemies for a portion of the world's trade. Apart from the purely commercial aspect, these things are of vital importance to the health and economic life of the nation, both in war and in peace. It is absolutely necessary for our national welfare—nay, even for our very existence—that we should be no longer solely dependent upon outside sources of supply, and it is therefore the bounden duty of the Government to see that adequate steps are taken to ensure that such a consummation shall be reached. If individual enterprise is unable to secure it, then it must be the business of the State, in the interests of national security, to undertake its attainment.

SCIENTIFIC WORK IN INDIA.[1]

THE Board of Scientific Advice for India, the origin and functions of which were explained in these pages three years ago (NATURE, July 8, 1915), has, like similar bodies elsewhere, felt the effect of war conditions. The board has been strengthened by the addition of a representative of the Indian Munitions Board, and power has been conferred upon the president to appoint sub-committees, membership of which need not be confined to members of the board, for the purpose of dealing with particular investigations. The board has found it necessary to modify the treatment of programmes of work submitted by individual scientific departments, and to resolve that the annual report for 1916–17 be confined to a brief statement of work actually done during the year, also that the bibliography of publications bearing on particular subjects be consolidated. But the establishment of a Zoological Survey, recorded for the year under notice, has not affected the composition of the Board of Scientific Advice, representation of this subject having been provided for already. That its organisation should have been so slightly affected affords striking evidence of the soundness of the original constitution of the board.

The report of the board for 1916–17 is an interesting document, and much of its contents, especially where the applications of science are concerned, may repay perusal outside India. In agriculture the low values of available phosphate in certain Indian soils—at times only $\frac{1}{50}$ to $\frac{1}{20}$ of the amount usually regarded as necessary for fertility

[1] Annual Report of the Board of Scientific Advice for India for the Year 1916–17. Pp. 172. (Calcutta: Superintendent Government Printing, India, 1918.) Price 1*s*. 9*d*.

—have been under investigation. So, too, have been the low values of available potash in certain other soils. In this connection efforts have been made not only to correlate potash-deficiency with disease in animals and plants, but also to utilise the ash of at least one proclaimed weed as a means of adding potash to the soil, and incidentally as a partial set-off against the cost of eradication. Botanical work has included, in addition to survey operations, much that is of immediate economic importance. One notable instance is afforded by the device of a method of selfing cotton, which is not only simple, but is also said to have proved successful. Much sound work has been done with indigo, jute, opium, rice, sugar, and wheat on agricultural lines, and with grasses, as well as trees, on forestry lines.

On the physical side we find that researches in solar physics have included an investigation of the displacement of the lines of the solar spectrum compared with lines given by the electric arc. This study has supplied interesting results, and led further to a determination of wave-lengths in the spectrum of the planet Venus with results that are of promise. In geology, besides survey operations, useful economic work has been done in connection with the output of wolfram. Three new meteorite falls—all chondrites—have been reported for 1916–17 from northern India. The most notable item of economic geodetic work for the year has been the taking of hourly readings of a tide-gauge at Basra, erected in connection with military requirements. The constants deduced from the reductions of these readings have been transmitted to the National Physical Laboratory at Teddington, to admit of the tracing of tidal curves for 1917–18. Important also has been the compilation of a list of the plumb-line deflection stations of India and Burma.

The work undertaken in connection with plant- and animal-pathology has been useful and varied. In this relationship an item which deserves attention is an account of practical tests of the use of hydrocyanic acid gas for the destruction of vermin. While less successful than might be desired in the case of houses, this method has proved satisfactory as regards railway carriages and ships.

Appended to the report is a memorandum on work done for India at the Imperial Institute. A striking item in this memorandum is the record of a sample of Assam-grown flax, valued in London under war conditions in December, 1916, at 150*l.* per ton, which was found to compare favourably with the medium qualities formerly received from Belgium.

Perhaps the time is approaching when a body, similar in its functions to this Indian board, may be brought into being so as to ensure for the scientific departments of our various Crown Colonies that correlation of effort which, as this report testifies, already so happily attends the operations of the different scientific departments of the Indian Government.

PROF. PAOLO PIZZETTI.

ITALIAN geodesy sustained a serious loss by the death, on April 14, of Paolo Pizzetti, professor of geodesy in the University of Pisa. An account of Pizzetti's work is contributed to the *Atti dei Lincei*, xxvii. (1) 9, by Prof. Vincenzo Reina, and the following particulars are mainly derived from it.

Prof. Pizzetti was born at Parma in 1860, and at the age of twenty qualified in the Engineering School at Rome. He afterwards remained there as assistant to the Department of Geodesy at the time when Profs. Pisati and Pucci had commenced their researches on the absolute value of gravity. Prof. Pizzetti soon began to publish researches dealing with the determination of azimuth, conformal representation in geodesy, and similar subjects. In December, 1886, he was appointed professor extraordinarius of geodesy at Genoa, and while there devoted his main attention to the theory of errors, with special reference to combinations of observations. It was then that he produced his important papers on the results of a system of direct observations, published by the Royal Society of Liège, and on the mathematical foundations for the criterion of experimental results, the last-named paper appearing in the jubilee volume published in 1892 at the fourth centenary of the discovery of America by Columbus. We are indebted to Prof. Pizzetti for clearing up many points of doubt regarding the relative value of such concepts as measure of precision, mean error, probable error, and error of maximum probability. At the same time, he interested himself in the study of atmospheric refraction, on which he published papers dealing with the trajectories of light rays and the difficult problem of refraction in azimuth.

In 1900 Prof. Pizzetti removed to Pisa, and in the following year he took charge of the classes in celestial mechanics. He here initiated an important series of researches dealing with the figure of the earth and planets, and with Stokes's formula for the potential of a gravitating planet, of which he gave a rigorous proof. Previously some doubts existed as to the limits within which this expansion was valid, and these were set at rest by Prof. Pizzetti's investigation. It is scarcely surprising that he did not escape from the attractions of the ever-popular and seductive "problem of *n* bodies."

The bibliography at the end of Prof. Reina's notice enumerates ninety-two papers by Prof. Pizzetti, mainly devoted to geodesy, astronomy, and celestial mechanics, but including a few papers on pure mathematics and some reviews and articles of a more popular character.

To the present writer the name of Pizzetti will ever be associated with reminiscences of a day at Pisa at the conclusion of the Mathematical Congress of Rome in 1908, where it was his privilege to meet Prof. Pizzetti and his colleagues in friendly intercourse in the "Sala dei Professori," a room reserved for these informal gatherings at the Hotel Nettuno. It is true that we have professors' common rooms in this country, but there was a certain indefinable element about the "Sala dei Professori" which we seem rather to miss here.

G. H. BRYAN.

NOTES.

WE announce with deep regret the death on August 26, in a flying accident, of Prof. Bertram Hopkinson, C.M.G., F.R.S., professor of mechanism and applied mechanics in the University of Cambridge.

THE position of the company known as British Dyes, Ltd., appears to have been at last determined by the results of a meeting at Huddersfield, on August 21, at which the shareholders approved, by an overwhelming majority, a scheme for amalgamation with Messrs. Levinstein, Ltd., of Manchester. It will be remembered that British Dyes, Ltd., was the company formed in 1915 on the basis of the previously well-known firm of colour-makers, Messrs. Read Holliday and Co., and subsidised by the Government to the extent of a million sterling, with extra provision for research. There have been many expressions of dissatisfaction with the progress made under the original directorate, and the view has already been expressed in the columns of NATURE that the board required amendment by a larger representation of science in its composition. In the statement made recently in the House of Commons by Sir Albert Stanley this aspect of the question was not referred to, but the conditions laid down appeared to afford satisfactory guarantees that after the war there would be such a restriction of imports as to afford time for the struggling industry to be firmly established, while the dye users would be sufficiently protected as to both supplies and prices. There can be no doubt that the amalgamation when effected will have good results in putting an end to undesirable competition between the two companies and in bringing the operations at British Dyes, Ltd., under the influence of Dr. Herbert Levinstein's experience, which really amounts to giving science, as against pure finance, a more definite position in respect to the affairs of the company. The history of the origin and progress of the famous colour works of the Badische Company at Ludwigshafen on the Rhine has still to be written so as to be at once instructive and convincing to the British commercial world.

THE David Livingstone centenary medal of the American Geographical Society has, it is stated in *Science*, been awarded to Col. Candido Mariano da Silva Rondon in recognition of his valuable work of exploration in South America.

IT is announced in *Science* that Prof. S. J. Barnett has resigned his post as professor of physics at the Ohio State University in order to accept the position of physicist in charge of experimental work at the department of terrestrial magnetism of the Carnegie Institution of Washington. Prof. Barnett entered upon his new work at Washington on July 15.

THE Council of the Institution of Electrical Engineers has been in communication with the Ministry of National Service with reference to the utilisation, with due regard to their skill, of members of the institution called up for military service under the Military Service Act, 1918, No. 2. With the view of their being posted, so far as vacancies are available, to technical units, members of the new military age, on being called up for military service, are therefore invited to communicate with the secretary of the institution, who will supply them with the form and certificate approved by the Ministry for this purpose.

THE twenty-ninth annual general meeting of the Institution of Mining Engineers will be held at University College, Nottingham, on Friday, September 13, under the presidency of Mr. Wallace Thorneycroft. The Institution medal for the year 1917–18 will be presented to Mr. C. E. Rhodes. The following papers will be submitted: A Method of Determining the Magnetic Meridian as a Basis for Mining Surveys, T. Lindsay Galloway; The Chance Acetylene Safety-Lamp, W. Maurice; Recent Developments in the Coalfields South of Sydney, New South Wales, Dr. J. R. M. Robertson.

No. 10 of the *Berichte der deutschen chemischen Gesellschaft*, which has been published after some delay, contains the announcement of the death of Dr. Johannes Thiele, professor of chemistry in the University of Strasburg, at the age of fifty-three. Prof. Thiele first became well known by his work on nitro- and amino-guanidines, which opened up new methods of preparing hydrazine and hydrazoic acid, and secured for him an appointment as extraordinary professor at Munich. Here, as a result of Baeyer's work on the reduction of muconic acid, he took up the study of what were afterwards called conjugated double-bonds, and developed his theory of partial valencies, by which he was best known. Prof. Thiele was appointed successor to Fittig at Strasburg in 1902.

THE German Chemical Society has celebrated its jubilee by collecting a fund of 2½ million marks for the more extensive publication of chemical works of reference, such as Beilstein. We notice further, in a report of the annual general meeting, that an agreement has been concluded with the Verein deutscher Chemiker with regard to publications. The *Chemisches Zentralblatt* will deal more fully with technical chemistry, and will be available to the members of the latter society at a reduced rate. The *Berichte* will be subdivided, one section dealing with reports of meetings, notices, etc., the other containing the original scientific publications. The annual subscription to the German Chemical Society will become 10 marks, but will then only entitle members to receive the first of the above-named sections. A separate subscription will be required for the scientific section, as was already the case with the *Zentralblatt*.

DR. A. C. HADDON discusses in the August issue of *Man*, with numerous sketches, an anomalous form of outrigger-canoe attachment in use in the Torres Straits, and its distribution. The normal arrangement of connecting the float to the outrigger booms is in the Y form. This occasionally becomes modified into the V or U form. Some doubt still exists as to the origin and distribution of these modifications. But Dr. Haddon states that his "main object in compiling these notes is to emphasise how suggestive such an apparently insignificant feature as an outrigger attachment may be in the elucidation of the problems of distribution."

MR. T. SHEPPARD has reprinted from the *Naturalist* for July an account of a small but interesting exhibit of Bronze-age weapons from the collection of the late Cotterill Clark, now deposited in the Doncaster Museum. The specimens include a rapier-shaped blade, six spears, one flat axe, eight palstaves, three socketed axes, and a chisel, all from the eastern side of Doncaster, where, owing to the prevalence of fen bogs, such objects would be likely to be lost. One of the palstaves is of a somewhat unusual pattern, those with a transverse edge; as Sir J. Evans remarked: "Palstaves of the adze form, having the blade at right angles to the septum between the flanges, are seldom found in Great Britain." He figures examples from Cumberland and Lincolnshire, and mentions other specimens. The Doncaster example is different from any described by Sir J. Evans, but approaches nearest to that from Lincolnshire.

IN the *Museums Journal* (vol. xviii., No. 2, August, 1918) Mr. Harlan I. Smith, archæologist, Geological Survey, Canada, in a paper entitled "Archæological Museum Work and the War," remarks that the war has cut off from many firms in Canada and the United States the supplies of new designs in many industries, such as the textile trades, which were supplied by foreigners. To meet the sudden stoppage of the design supply, the writer has prepared an album of archæological specimens found in Canada suitable as motives for distinctive Canadian decorative and symbolic designs and trade-marks. In the same way in America designers have been developing designs from aboriginal objects in the United States museums, specimens from Peru, Mexico, the South-Western States, Siberia, China, etc. Though the colour combinations in silks woven from some of the designs developed from New World specimens are poorer than aboriginal colour combinations, yet these silks met with a ready sale, thus proving that aboriginal designs are not, as some have believed, crude, but can be successfully used in modern industries.

THE July issue of *Science Progress* contains an interesting article by Sir Henry Thompson on the food requirements of a normal working-class family. A comparison is instituted between the physiological values of the diets reported upon by the Board of Trade in pre-war times and some data collected by the War Emergency Committee in 1917. In reducing the family diets to man-values Sir Henry Thompson has employed a more liberal scale of requirements for children than the older standard of Atwater, which is now generally recognised to be unsatisfactory. The three diets do not differ greatly in respect of energy-value; the highest average is that of the urban working-class families (1913), yielding 3410 calories; the lowest, the 1917 sample, is 3160 calories, a reduction of but 250 calories. Sir Henry also provides ration scales based upon his estimate of the food consumption of Great Britain in 1908, upon that of the Royal Society's Food Committee for 1909–13, and upon the committee's estimate for the war-year 1916. Making allowance for loss in distribution, the calorie values of the diet scales calculated in this way do not differ very much from the observed values in the samples, although, as might be expected, the proportion of energy derived from breadstuffs is rather larger among the working-class families which provided the sample budgets than in the country as a whole.

A BRIEF, but very admirable, summary of the factors causing "grouse disease" on Scottish moors appears in *British Birds* for August. The author, Mr. Dugald Macintyre, surveying the conditions of heather-moors and their relation to "heather-blight," is of opinion that when, in exceptional years, heather suffers from frost in June, drought in July, and an excess of wet weather and too little sunshine during the early spring months—a combination of adverse conditions aggravated by the ravages of the heather-beetle—grouse disease is inevitable, and for the reason that the birds succumb to the drain on their vitality caused by their internal parasites, which in normal years of plenty cause them little or no discomfort. A practical remedy for grouse disease, he suggests, would be artificial feeding in those years when the heather crop fails. This he tried with a fair measure of success in 1912. The food supplied to the birds, after they had been trained to visit oat-sheaves laid out on the moors, was small, round maize, which the birds ate greedily. The ravages of the disease, he considers, are to be attributed largely to the fact that the birds are now artificially numerous; that is to say, the moors are carrying more birds than would be the case if they were left to "run wild."

So little is known generally of the vast and varied flora of South Africa that the short sketch of "The Plant Geography of South Africa," written by Mr. I. B. Pole Evans, chief of the division of botany and plant pathology in the Department of Agriculture, is very welcome. The sketch was printed in the official "Year Book" for last year, and has now been reprinted as a separate pamphlet. The vegetation is considered under the three main heads of woodland, grassland, and desert. All three types are well represented in the Union of South Africa, which includes almost all the area lying south of latitude 22° from the valley of the great Limpopo River and the Tropic of Capricorn to the sea. The article is accompanied by a good vegetation chart marking the forest and scrub area in the south and south-west, the palm belt along the Natal and Mozambique coast, with the thorn-veld extending from the south coast from Port Elizabeth to East London, and then to the west of the palm belt as far as the Transvaal. Basutoland and the Orange Free State Colony are almost entirely high veld, while the Transvaal is marked as bush veld, and the centre of the area is the Kalahari grassland. The Karroo and Namaqualand are, as is well known, extensive desert areas. Brief descriptions of the more prominent types of vegetation are given, and lists of the typical trees, grasses, and other plants, with particulars as to where such plants may be found. Not the least valuable portion of the article are the twenty-four excellent plates showing features like the natural Drakensberg forest, the silver trees on Lion's Head at the Cape, the acacia thorn veld, the Euphorbias of the bush veld in the Transvaal, and some very interesting photographs of the high veld grassland near Johannesburg and Pretoria. All the photographs have been taken by Mr. Pole Evans, and are very well reproduced. It is much to be hoped that a systematic botanical survey of the whole region may shortly be undertaken before any further changes in the vegetation due to the disturbing influence of man take place.

MUCH light is thrown on Balkan problems by a map compiled by Prof. Jovan Cvijic of the zones of civilisation in the Balkan peninsula. The map, which appears in the *Geographical Review* for June (vol. v., No. 6), is accompanied by a short article, and follows a map and paper by the same author in the previous number of the review on the distribution of Balkan races. Studied side by side, these maps are most instructive. In the present map Prof. Cvijic distinguishes three main civilisations: the old Balkan or modified Byzantine, distributed in Thrace, Macedonia, and Greece in the main; the Turko-Oriental, principally in the south-east, in the Vardar valley, and in parts of Bosnia; and, lastly, the patriarchal *régime* in the north and west of the peninsula. Attempts are also made to map the various contacts between these civilisations and those of Central and Western Europe. Western civilisations reached the Balkan peninsula chiefly by sea routes, and, according to Prof. Cvijic, nowhere, except along certain easy routes, penetrated far inland. From Trieste to Constantinople the seaboard shows Mediterranean influences. There are traces of Venetian civilisation in Serbia, but too few to be mapped. Magyar civilisation was a later influence, but it has spread widely and deeply along the main routes. Naturally, it is felt most in cities. Finally, Prof. Cvijic notes the tendency, especially in Serbia, to create a new endemic civilisation out of the mingling and fusion of other civilisations. The depth and power of spreading of that national civilisation will be a determining influence in the Balkans in future years.

A PAPER by the late Mr. R. C. Burton on "The Laterite of Leoni, Central Provinces" (Records Geol. Surv. India, vol. xlviii., p. 204, 1917), revives the frequently expressed view that some pisolitic laterites, at any rate, have accumulated by deposition as lacustrine strata. Grey bauxite is interbedded with laterite at Aturwani, and must have had a similar origin. Near Magarkatta, bright red lithomarge, passing into a brecciated condition, contains veins of kaolinite. Mr. Burton, who died from wounds received in the present war, was probably unable to examine the most recent literature on the interbasaltic rocks of Ireland, where similar associations have been recorded, and where pisolitic structure occurs within the bole that results from the decay of basaltic lavas by penetrating influences from above. He refers, however, to the views of Forbes and Mallet, who accepted a lacustrine origin, and to those of Lacroix (1913) as to the formation of concretionary pisolite *in situ*. Where, as the author believed to be the case in Leoni, the limits of the laterite coincide with those of a former lake, the pisolitic structure may well be a feature of original deposition.

KOREA is maintaining its claim to systematic registration of climatic conditions, as shown in the issue of the annual meteorological report for the year 1916, compiled under the direction of the Government-General of Chosen (Korea). Hourly observations made at Jinsen (Che-mul-po) are given for each month for air pressure, air temperature, relative humidity, direction and speed of wind, hours with sunshine by Jordan's recorder, and remarks showing the character of general and exceptional weather. Monthly and annual results at twelve stations well scattered over the peninsula from four-hourly observations are given for the elements already mentioned, as well as for tension of water vapour, precipitation, evaporation, direction of upper clouds, and surface temperature of earth. There are results of observations of air temperature and precipitation at 182 auxiliary meteorological stations, many of which are lighthouses, where observations are made three times daily. The volume also contains results of seismic observations at Jinsen. A map is given at the end of the report showing the geographical distribution of meteorological, climatological, and rain-gauge stations in Korea at the end of 1916. The whole of the peninsula is well covered by observations. In summarising the work done, mention is made of improvements in the routine work as the result of the decision of the congress of the directors of all the meteorological stations of the Japanese Empire held in Tokyo. The present volume shows an increase from nine to twelve in the number of branch meteorological stations. It is noteworthy that special attention is given to the selection of a suitable site in the matter of an observatory. Change has been made in the position of the building at Taikô. Improvements have been made in the issue of weather forecasts and storm warnings. Experience shows that a gale caused by a cyclone passing through the peninsula ceases generally within about twenty-four hours, so it has been determined that the effective interval of a warning is twenty-four hours from the time of issue.

AN interesting gravitational problem, with a bearing on the theory of coral reefs, has lately been studied by Motonori Matsuyama (Memoirs of the College of Science, Kyoto Imperial University, vol. iii., No. 2, February, 1918). Using an Eötvös gravity-variometer, he has determined the second derivatives of the gravitational potential (the complete set of these derivatives defines the space variations of the first derivative, *i.e.* of the gravitational acceleration or force, which was not measured and remains still unknown) in the Jaluit Atoll. This atoll (169° E., 6° N.) is situated at the southern end of the Ralick chain of the Marshall Islands. The shallow lagoon, of irregular rhombic shape (the diagonals being about 30 km. and 50 km. in length), is surrounded by a narrow coral reef about half a kilometre wide, with its top just at the level of low water. On this reef low banks of coral, sand, and *débris*, rising just above high water, form a chain of discontinuous islets. The island is situated in a sea which at ten kilometres distance from the atoll is four kilometres deep. The study of the gravitational field on an isolated island of very simple construction is calculated to throw light on the state of mass distribution under the atoll. The coral reef is built on a denser foundation, probably of volcanic origin, and the differences of density between the water, the reef, and the foundation are to some extent known. The problem which the gravitational data help to solve is that of the distribution and depth of the coral. After various instrumental and other corrections (for the effect of tides, the oblateness of the geoid, etc.) had been applied to the observed second derivatives of the potential, these were compared with the second derivatives theoretically calculated, on various assumptions as to the depth of the coral reef and the density of the foundation. For convenience in the numerical integrations employed, the foundation was supposed flat; three values were assumed for its density, viz. 2·6, 2·8, and 3·0. The "effective" depths determined for the coral reef ranged from 243 to 1000 metres.

E. ELÖD (*Elektrotechnische Zeitschrift*, March 21) has carried out experiments from which he concludes that during the formation of nitric oxide by the electric arc in the production of nitric acid from the air, the electric discharge causes the nitrogen and oxygen to split up into atoms, so as to be capable of producing chemical reactions.

THE use of black millet (*Sorghum vulgare*) for the production of alcohol has been suggested in Germany (*Zeitschrift für angewandte Chemie*, April 23), for which purpose it possesses suitable properties. The food-value of the grain is high, so that its cultivation, which costs no more than wheat or rye, is recommended to the farmer as being a paying crop. The use of the "straw" as a source of cellulose or alcohol would make the crop doubly valuable. According to recent French notices, the cultivation of sorghum for the production of sugar has been widely suggested.

ACCORDING to the *Zeitschrift für angewandte Chemie* for May 17, at a recent meeting of the German Bunsen Society the question of the production of synthetic rubber was discussed, and its possibilities as a substitute for the natural product considered. In spite of the difficulty of obtaining material, 150 metric tons of synthetic methyl rubber are produced monthly. At first the substitute proved unsatisfactory, being oxidised by the air, and it was hard to vulcanise. Improvements in manufacture have, however, overcome this trouble. By experimenting with the addition of other substitutes, a vulcanite is now produced which equals the natural material in firmness and durability, and is 20 per cent. better for electrical purposes. At ordinary temperatures, however, the soft rubber is not elastic, but leather-like; it becomes elastic as its temperature is raised. The addition of dimethylaniline and toluidine increases elasticity. The substitute is now used, with satisfactory results, for heavy road motors.

The Reichsanstalt at Charlottenburg has carried out an extensive series of tests on the effect of chemical changes and heat treatment on the magnetic properties of iron alloys. Tests were also made to ascertain the change of the temperature coefficient of bar-magnets with variations in their dimensions. Reducing the length of a 0·6 cm. thick bar from 22 to 2·4 cm. produced an increase of 2·4 to 4·2 per cent. in the mean temperature coefficient between 20° and 100° C. Tests were made with bars 0·9 cm. thick and of length varying between 33 cm. and 6 cm.; and it was found that the determination of the coercive force was trustworthy within 1 to 2 per cent. (using the magnetometer method) for cylindrical bars with values of l/d (l=length, d=diameter) down to 10, but that the value obtained for the coercive force was rather too small for lower values of l/d. These results are given in the *Zeitschrift für Instrumentenkunde* for May last, but the main results of the investigation will not be published until after the war.

Sulphurous acid liberated in the combustion of pyrites and other sulphurous substances contained in coal is rapidly transformed into sulphuric acid in the atmosphere. It is found in rain-water and snow. If the rain-water or snow is left for a few hours, the small quantities of non-oxidised sulphurous acid that they contain are rapidly converted into sulphuric acid. Thus the determination of the quantity of sulphuric acid in the snow or rain provides a means of determining the vitiation of the air in a particular industrial district by factory smoke. In one and the same industrial region from 6 to 9 mg. of sulphuric acid (or sulphuric anhydride) per cubic metre of snow was found in places protected from the wind, and three times that quantity in places not so protected. The mean was 15 to 20 mg. The quantity diminishes rapidly with increase in distance from the source of vitiation. According to the *Zeitschrift für angewandte Chemie* for April 9, similar data were found on experimenting with rain-water. It is also possible to determine the deleterious action on plant-life through the same cause by collecting, by suitable means, the rain collecting at a tree-trunk, and comparing the foliage, etc., with that of other trees in another neighbourhood (not near a factory) offering the same climatic conditions.

The June *Biochemical Journal* contains work on the antineuritic and antiscorbutic accessory substances by Messrs. A. Harden and S. S. Zilva. These authors find that pigeons are protected from attacks of polyneuritis by autolysed yeast, but not by autolysed yeast which has been shaken with fuller's earth or with dialysed iron, thus confirming Seidell's observation. Further, polyneuritis is curable by autolysed yeast, but not by autolysed yeast which has been treated with the adsorbent, and a bad case was cured by administration of the solution obtained by alcoholic extraction of the dialysed iron precipitate and evaporation *in vacuo*. On the other hand, when the precipitate obtained by shaking orange-juice with dialysed iron is extracted with alcohol, the product will not cure guinea-pigs of scurvy, nor will it protect healthy animals against attacks of the disease. But orange-juice which has been treated with dialysed iron or with fuller's earth retains practically all its antiscorbutic activity so far as can be judged biologically. A mixture of equal parts of orange-juice and autolysed yeast will both cure and protect from attacks of polyneuritis and scurvy. But after treatment with fuller's earth the mixture was found to have lost its antineuritic power whilst retaining its activity against scurvy. Thus it is shown that the antineuritic and antiscorbutic principles behave differently towards adsorbents. Orange-juice can be filtered through a Berkefeld filter without losing an appreciable amount of its antiscorbutic activity.

In order to supply material for testing the theories of thermal and electrical conductivities in metals and alloys, and especially in ferro-magnetic substances, Prof. K. Honda, of Sendai University, has measured the thermal and electrical conductivities of a number of nickel-steels. His results are given in the July issue of the Science Reports of the University. He finds that both the electrical and thermal conductivities decrease rapidly as iron is added to nickel or nickel to iron, and that an alloy containing 30 per cent. of nickel has the least conductivity in both cases. The curves showing the variation of the conductivities with content have the same general appearance as the melting-point curves for a binary mixture. The least electrical conductivity is about one-fifth and the least thermal about one-tenth the conductivity of either pure substance. The quotient of the thermal by the electrical conductivity varies from about 2 to about 1·5 millions. The magnetisation curves for the alloys are also given, and show low susceptibilities for alloys containing 27 to 30 per cent. of nickel.

Rapid inter-Imperial communication of every description now promises to become so vital a matter for developing inter-Imperial trade—as well as for other eminently important national reasons—that Mr. Charles Bright has prepared a revised edition of the map included in his recent book, "Telegraphy, Aeronautics, and War," showing not only the world's cable system, but also (1) both past and prospective "wireless" stations, (2) suggested air stations. The map will be issued shortly by the publishers of the volume, Messrs. Constable and Co.

The *University of London Press, Ltd.*, is about to issue "Everyman's Chemistry: The Chemist's Point of View, and his Recent Work told for the Layman," by E. Hendrick. The *Yale University Press* (and, in London, *Mr. Humphrey Milford*) will publish shortly "Human Nature and its Re-making," by Prof. W. E. Hocking.

OUR ASTRONOMICAL COLUMN.

Variable Stars.—As many of the ephemerides of these stars that were formerly available are discontinued or inaccessible owing to the war, M. Luizet has prepared a useful set of ephemerides for 1917, which is published in the *Journal des Observateurs* (vol. ii., No. 8). It comprises 124 stars of the Algol type, 18 stars of the β Lyræ type, and 33 stars of the δ Cephei type; the period and date of first minimum (or maximum) in each month of 1917 are given, and other data, which make it easy to calculate intermediate minima or to extend the ephemerides to 1918 or later. The lists are practically confined to stars visible in European latitudes.

THE ORIGIN OF COMETS.—In an article which appears in the August issue of *Scientia* (vol. xxiv., p. 85), Prof. E. Strömgren gives an interesting account of the reasons for regarding comets as permanent members of the solar system. In recent years exact calculations have shown that comets which have appeared to traverse hyperbolic orbits, when in the neighbourhood of the sun, acquired the hyperbolic form in consequence of the perturbations to which they were subjected by the planets. It is accordingly concluded that comets belong to our system, and that the so-called non-periodic comets are merely comets which have very long periods. The possibility of a comet entering our system from without is not excluded, but it is stated that no case of this kind is yet known. By reference to the dynamics of star-clusters it is argued that, while remnants of nebulous matter would, in general, be retained within the systems formed by individual suns, those which originally occupied the intermediate spaces would escape from the galactic system on account of the high velocities corresponding with their small masses. On this view, comet-forming materials would not exist in interstellar space.

SOLAR PHYSICS OBSERVATORY REPORT.—The fifth annual report of the director of the Solar Physics Observatory, Cambridge, relating to the year ending March 31 last has been received. A study has been made of the South Kensington series of photographs of the spectrum of β Lyræ, and information has been gained as to the best epochs for further records with comparison spectra. Further investigations of the hydrocarbon-band lines in stellar spectra have indicated a sequence in which there is a gradual strengthening of the hydrocarbon lines from type F to type G, and a gradual weakening of the same lines from the G to the M type. Photographs of the sun's disc in calcium light were obtained on 161 days, and of prominences at the limb on 153 days; the disc spectroheliograms provide records for fourteen days which were missed in the Kodaikanal series. Numerous photographs of sunspot spectra were also obtained, and a comprehensive table of the affected lines recorded by various observers has been prepared. The necessity for a daily reference photograph of the sun's disc has led to the utilisation for this purpose of the image-lens of 60 ft. focal length which forms part of the McClean solar installation; by the use of slow bromide paper the photographs obtained have proved to be of greater value than was anticipated, inasmuch as they present the faculæ as well near the centre of the disc as near the limb. These photographs seem likely to be of special value in the elucidation of the relation between faculæ and flocculi. Investigations connected with the national defence have also been undertaken.

BRITISH SCIENTIFIC INSTRUMENTS AND PRODUCTS.

OF the lectures delivered at the British Scientific Products Exhibition, organised by the British Science Guild at King's College, a feature common to all is the disclosure of the backward state of the industries with which they were respectively concerned when the war broke out. In radiology the outbreak of war four years ago found a condition of unpreparedness in common with other branches of medicine. It was necessary to provide large quantities of new apparatus and the adequate staff for many new departments. This state of affairs was described by Dr. R. Knox in the course of a lecture on the practical uses of radiography; and the backward state of the industry which he described as prevailing four years ago is all the more remarkable when we remember that although the X-rays were discovered by Prof. Röntgen, the discovery, as Mr. A. A. Campbell Swinton, who presided at the lecture, pointed out, could never have been made but for previous scientific research carried out in England. Had it not been for the work of Faraday, the necessary high-tension electric currents would not have been available, while the Crookes high-vacuum tube with which the rays were produced was the result of the laborious and long-continued investigations of that veteran scientific explorer, Sir William Crookes, who, although eighty-six years of age, is still young enough to be an exhibitor at the exhibition. Mr. Campbell Swinton also pointed out that the two greatest advances made in connection with X-rays since their original discovery were due in large measure to professors at King's College, the original Crookes "focus" tube having been adapted to X-ray purposes by Sir Herbert Jackson, and the recently invented Coolidge tube, though brought out in the United States of America, was based on the experimental results obtained by Prof. O. W. Richardson, also of King's College, working on lines laid down by Sir J. J. Thomson, of Cambridge.

Though the industry associated with radiography is small, its importance is great and promises to become greater in the future. Dr. Knox stated that experience gained in the administration of X-ray departments on a large scale, such as had been possible during the past four years, had taught us the necessity for a standardisation of apparatus. Had this been achieved before the outbreak of war, as he considers it well might have been, the task of rapidly equipping numerous departments would have been easy and the standard of work done much more satisfactory than it has been under the conditions possible in war time. The lecturer emphasised the need for research in connection with the production of essential apparatus and X-ray tubes if we were to hold our own in competition after the war. Most important research work has been carried out in this country lately in connection with the accessory apparatus, and Dr. Knox stated that the intensifying and fluorescent screens at present in use are an advance on those we formerly imported from Germany. The manufacturers of X-ray plates have more than held their own, and the production of a trustworthy photographic paper upon which X-ray negatives may be produced directly is one of the achievements of the war period. The most striking of the recent applications of X-rays and radium described by Dr. Knox is that used by Mr. Percival P. Cole in connection with his operative work on injury to the face and jaws. Another new development in plastic surgery is also associated with Mr. Cole's name, the well-known depilatory power of X-rays having been used for the destruction of hair in portions of the scalp and face which are used in plastic surgery. Dr. Knox insisted more than once in the course of his lecture on the need for encouraging research and bringing about the co-operation of all interested in the work. He said that steps are in progress with the view of forming a British school of radiology and physicotherapy.

In describing advances in bacteriology during the war, Dr. C. H. Browning, director of the Bland-Sutton Institute of Pathology of the Middlesex Hospital, mentioned that the need to overcome the poison of sepsis in wounds had stimulated profitable investigations on the properties of flavine and other dye-stuffs as antiseptics. He emphasised the relation

Scientific apparatus & instruments

between biology and chemistry and physics, and said that the chemical manufacturers could be of special help by assisting in the production of new drugs, under the guidance of the observations of biologists. In this line Germany had been especially active in the past. The microscope furnishes another example of the German development of English ideas. At present the industry for all practical purposes has almost ceased to exist, but Mr. J. E. Barnard claimed that it was undergoing a process of transformation which at the close of the war would make the British microscope pre-eminent. Between 1880 and 1890 this country stood foremost in the microscope industry, but after that time it lost its position to Germany because the latter gave us an instrument which was much needed at that time, being simpler in design and easier to construct. The Germans turned out a type known as the "Continental Model" which was useful for laboratory purposes. There was an insufficient supply of the English instrument, and this fact, coupled with the high price of the British article, enabled the Germans to obtain pre-eminence in this field. Unfortunately, it became the fashion to use the German instrument; and although the English instrument was equally good, home makers had little chance owing to the orders passing to the Continent. As in the case of the British dye industry, the English microscope industry was in British hands, but was lost for preventable reasons.

This is practically the same tale as Dr. M. O. Forster had to tell with regard to British dye-making in the course of his lecture on August 26. Dr. Forster traced the decay of the British industry after 1870, up to which time the principal competitors were the French manufacturers, but after the Franco-German War the German factories rapidly took the lead, and the period 1870 to 1880 must be recognised as that in which British dye-making was definitely overtaken by the German industry. The causes of this change are easy to recognise. The liberal Government subsidy to the German universities, wisely paid out of the enormous indemnity wrung from the defeated French nation, resulted in producing a rapidly increasing army of well-trained and enthusiastic young German chemists, who were quickly absorbed by the chemical factories. These were strengthened also by several older chemists, who, discouraged by the outlook for chemistry in this country, left the colour factories in which they had been working and returned to their own country in search of more agreeable conditions. Moreover, Prof. Hofmann had already left this country in 1865, and, occupying the professorship of chemistry in Berlin University, was largely instrumental in building up the German school of organic chemistry. Dr. Forster said that ten to fifteen years would be required before this country would be able to equal the position of Germany in regard to dye-making, and then only if the same principle of patient inquiry into scientific principles, liberal expenditure on chemistry and chemists, thoughtful attention to the requirements of customers, strict self-control in the distribution of profits, and constant devotion of these to further developments were observed. The establishment of synthetic indigo manufacture on a commercial basis was the outcome of close and systematic study by a large number of German chemists, who were subsidised by a company sufficiently courageous to spend money in this manner rather than distribute it as dividends to shareholders. It is only by following these same processes of development that we can earn the right to take credit to our countrymen for the aniline colour industry.

HIGH-TENSION MAGNETOS.

THE British Scientific Products Exhibition at King's College, London, organised by the British Science Guild, provides many encouraging examples of the success of British engineers in applying the results of scientific research. Many visitors interested in applications of electrical science are impressed by the range of magnetos exhibited, not only because it represents the successful establishment in Great Britain of an industry which was formerly a German monopoly, but also because the development of that industry has accelerated progress in numerous branches of scientific industry. It is no exaggeration to say that the degree of success achieved in the development of the combustion motor has at all stages been primarily dependent upon the efficiency of the ignition system used, and that the rapid strides which have during recent years been made in the construction of the petrol motor have mainly resulted from the very satisfactory high-tension ignition system that has been available.

During the past twenty years we have witnessed the birth and healthy development of high-tension ignition in the form of the magneto, and the wonderful efficiency of this system, coupled with its extreme flexibility—enabling one magneto to cope with almost any number of cylinders—is primarily responsible for the enormous advances which have taken place in the application of the petrol motor to industrial and, in more recent times, to war purposes. Prior to the outbreak of war the number of high-tension magnetos being produced in this country formed a negligible proportion of the total number used for a variety of purposes. Through laxity on our part, this most vital "key" industry was allowed to develop in Germany, but it is satisfactory to know that the war has taught us a lesson in this respect, and the exhibition demonstrates how effectively this lesson has been learned. During the past four years three hundred thousand magnetos have been manufactured for war service alone, and what is even more important is that, according to those in a position to judge, the British magneto, as at present constructed, is more than equal to the pre-war Bosch magneto emanating from Stuttgart. This is sufficient testimony that British manufacturers have done their duty.

All electrical systems of ignition are direct descendants of Faraday's great discovery of electro-magnetic induction in 1831, when for the first time in the world's history he succeeded in producing a spark by electro-magnetic means. The first system of electric ignition ever used was devised by Lenoir in 1860. He utilised the high-tension spark of a Ruhmkorff coil for ignition purposes, employing a high-tension distributor for connecting the secondary winding, first to one plug and then to the other. It is worth noting that the modern battery system of ignition now used extensively in America is strikingly similar to the old Lenoir system, even to the detail of introducing an extremely small air gap between the rotating metal brush and the distributor segment—a method of distribution that is now being followed on magnetos. Marcus appears to have been the first man to construct a magneto for ignition purposes. His was a low-tension machine having the now familiar form of H-armature, the current induced in the winding being broken at pre-determined times in the cylinder by a system of cams and levers. This system was further developed in 1898 by Simms and Bosch, using a fixed H-armature and rotating segments for producing the necessary flux changes in the armature core. This is of special interest because afterwards, by the addition of the second winding on the same armature core, a high-tension magneto was evolved.

To the Bosch Company, of Stuttgart, belongs the credit of having established the fact that a high-tension magneto can be manufactured on a commercial basis to give trustworthy and efficient ignition in practice. Although this important industry was allowed to develop in Germany, the modern high-tension magneto was first conceived in France by M. Boudeville, who, unfortunately, omitted to include a condenser in his scheme for eliminating sparking at the contact points. A condenser is a vital part of every magneto; without it the machine would be quite impracticable. It is surprising that M. Boudeville should have overlooked this feature, because, here again, the idea of using a condenser for such a purpose is of French origin, Fizeau being the first to suggest, in 1853, connecting a condenser in parallel with the contacts on a Ruhmkorff coil to prevent excessive sparking.

The magnetos made in this country vary somewhat in design, being based to some extent on the original Bosch model with improvements in many respects. Thus the trouble which was experienced with the original Bosch D.A.L. design of misfiring has been completely removed in a machine of the rigid armature single-cylinder type intended for use on rotary engines like the Gnome. The Bosch Z.U.4 machine was formerly extensively used in this country. The design of this has been considerably simplified, chiefly in respect of construction of the bearing for the half-speed wheel. An 8-cylinder sleeve-inductor magneto with fixed armature, now made in this country, is designed to give four sparks per revolution, and is therefore fundamentally different from the ordinary rotating armature type, which cannot give more than two sparks per revolution. The sleeve-inductor rotates at engine speed, whereas, in the case of a 6-cylinder machine built on the same principle, it runs at three-quarters engine speed.

In a single machine of the 8-cylinder type there are 860 parts, no fewer than 397 of which are of different design. The manufacture is therefore attended with considerable difficulties, and can be undertaken successfully only if highly skilled labour is available and the component parts are all machined to extremely fine limits. The fact that these magnetos are being produced in very large quantities is evidence that the difficulties are being overcome. A magneto of the polar induction type, also developed in this country, is intended more especially for 12-cylinder work. This is probably the first 12-cylinder model developed and standardised in this country. The machine is inherently of much simpler design than the sleeve-inductor machine, because the latter, which on account of its design is very difficult to manufacture, is replaced by a polar inductor which is designed to be easily made, and is at the same time a more rigid and trustworthy mechanical structure. Other features combine to simplify the manufacturing problem greatly.

No matter for what purpose a magneto is to be used, the chief feature must be trustworthiness, and this is possible only if the design is good, the materials are correctly chosen, and the workmanship is perfectly sound. Of the first- and last-mentioned conditions there can be no question. With regard to the choice of materials, the development of both the metallic and non-metallic industries has left it beyond doubt that such materials will be available. The improvement in foundry methods has resulted in the regular supply of trustworthy aluminium castings; in steels important advances have been made, which now give the required strength with a minimum weight of material. Die-castings made of an aluminium alloy containing no zinc are a great advantage. The manufacture of die-castings was formerly neglected here, but British producers are now devoting their attention to the subject, with the result that there is available an adequate supply of these castings. The advantage of die-castings over sand-castings is that the amount of machining that has to be performed on the parts is very much reduced, the metal is much tougher, and the threads in tapped holes are not so likely to become stripped when the screws are securely tightened. With regard to non-metallic materials, the most important requirements are insulating materials, comprising varnished silk, cambric, and paper. These insulating materials are essential to the manufacture of a satisfactory magneto armature, and although they can be purchased in England at the present moment, a fair portion is still imported. It is probably correct to say that the small extent of the magneto industry contributed in a large measure to the backward state of the insulating material industry in this country, in regard not only to paper, silk, and cambric, but also to moulded insulating material comparable with "stabilite," a German product. Now, however, this industry is becoming firmly established. Here, again, we have an impressive example of the effect of one industry upon another. The magneto industry itself is of sufficient importance and magnitude to be regarded as a "key" industry. With its development there has been established a number of new industries concerned with the supply of component parts. The manufacture of insulating materials, varnish, platinum-iridium or tungsten contacts, aluminium-copper die-castings, special steels—these industries either did not exist at all in England, or else were of only small dimensions. Each of them has now become an important British industry, largely in consequence of the home production of magnetos. Even if the British Science Guild had done no more, its achievement in pressing home this fact through the medium of the exhibition at King's College would entitle the Guild to the thanks of the nation.

ELECTRON.

WEATHER INFLUENCES ON OPERATIONS OF WAR.

AN article on "Weather Controls over the Fighting during the Spring of 1918," by Prof. Robert deC. Ward, appeared in the *Scientific Monthly* for July. Such vast interests are at stake in the present war that any factor which can help or hinder is of immense importance. The part played by meteorological controls is set out by the author as fully as is possible at the present time, leaving fuller information for a later date.

In the Western war zone the season of aggressive operations has generally been from April to November. The offensive on the part of the enemy began this year on March 21, and the author states that "the time must have been carefully chosen after consultation with the meteorological experts. It was a spell of fine, dry weather." Easterly winds usually accompany such spells, and these are "favourable for the use of gas by the enemy and also carry the smoke of artillery firing to the west, thus helping to screen the attacking troops." A thick fog also favoured the attack, and "the Allied gunners could scarcely see their own horses"; the author mentions that "the surprise of the British Fifth Army was largely attributed to the fog." In the opinion of the present writer, no meteorologist could have foreseen with any reasonable certainty such favourable weather conditions. A change to less settled weather occurred at the end of the month, and it proved very favourable to the Allies, whilst "the Germans were at once greatly handicapped because of the difficulty of moving their troops, artillery, and supplies through the deep and sticky mud."

Advantage was again taken by the enemy of fog during a dry spell in the second week of April, but the general weather conditions throughout the month were unsettled and not favourable for aggressive work, whilst similarly unfavourable weather prevailed during the greater part of May.

The German offensive was renewed on May 27. A high and steady barometer with light easterly winds prevailed with morning fogs, and similar weather was experienced through the first week of June, whilst in the after part of the month short spells of similar weather occurred

The controlling influence of the weather on the Western front during the summer push commenced by the Allies about the middle of July and continued for so many weeks with such marked success should tell in favour of the Allied meteorologists. The move was undertaken when an exceptionally wet period was drawing to a close, and the lengthy spell of fine and dry weather, with a succession of calms and light winds and a steady barometer with not too high a temperature, has proved a most favourable weather control. This aggressive move is beyond the period of Prof. Ward's article.

Some interesting occurrences are given in connection with the use of gas; two instances, April 10 and May 12, are cited of a sudden shift of wind blowing the gas back in the face of the enemy. The Daily Weather Charts, published by the Meteorological Office, support the change of wind.

The most favourable season for submarine activity is referred to; the smoother water and the longer daylight of summer are mentioned as an advantage in that season, but as an offset in winter there are the longer nights "to come to the surface to re-charge their batteries, to rest their crews, and to make long trips unsubmerged, thereby increasing their effective area."

A despatch from Rome, dated May 20, mentioned that "the only obstacle which prevents an enemy attack is the weather . . . but the weather is becoming undeniably milder, and the snow is beginning to melt. . . ." The author reminds us that "during the last days of May the Italians won a brilliant victory in the Tonale region, some 12,000 ft. above sea-level, whilst the ground was still covered with snow."

In Palestine a sandstorm on March 16 is referred to as a weather control, under the cover of which "a company of the Turkish Camel Corps was surprised and destroyed."

The author states that in the daring raid on the German naval bases at Zeebrugge and Ostend (April 22) "certain conditions of wind and weather" were waited for, whilst "the losses of the Zeebrugge raiders were due almost entirely to a shift of the wind, which prevented the complete success of the smoke screen."

The prevailing westerly winds occasion much difficulty to our airmen at the front, and an aviator has said: "If an airman ever wishes for a favourable wind, it is when he is breaking for home." Whatever aircraft can do, it is noteworthy that no air raid has as yet occurred in London with an overcast sky.

C. H.

MAGMATIC SULPHIDE DEPOSITS.

PROFS. C. F. TOLMAN AND A. F. ROGERS, of the Leland Stanford University, California, have issued a small volume in the University Series of Publications entitled "A Study of the Magmatic Sulfid Ores." They restrict the term "magmatic ores" somewhat more narrowly than most other writers on the subject have done, and consider that such ores are not the product of segregation properly so called. The ores studied by them are associated with basic igneous rocks, such as norite, gabbro, peridotite, etc., these rocks occurring generally as small dykes or sills, and comparatively rarely as large laccoliths. The ore is generally segregated at the margins of the intrusives, but occasionally occurs as a lenticular mass well within the magma, and never migrates more than a few feet into the adjoining rocks. Apart from the magnetite-ilmenite group, which is excluded from the present discussion, magmatic ores are divided into two classes, (*a*) pyrrhotite-chalcopyrite and (*b*) chalcopyrite-bornite; pyrites is not a typical magmatic mineral. The metallic minerals are formed at a late magmatic stage by a partial replacement of silicate minerals, and there is also evidence of the replacement of one magmatic metallic mineral by another. Hydrothermal alteration is relatively insignificant, and is distinctly later than the magmatic-ore period. The following is the series of events recognised by the authors as leading to the formation of magmatic ore deposits:—(*a*) Crystallisation of primary silicates; (*b*) development of hornblende and biotite, and occasionally tourmaline and garnet, as magmatic alteration products; (*c*) introduction of ore-minerals; (*d*) re-arrangement of ores and development of secondary silicates by hydrothermal solutions. The temperature at which the introduction of the metallic minerals commences probably does not exceed 300° to 400° C. It will be noticed that the authors ascribe the formation of these magmatic sulphide deposits to causes very different from those generally accepted.

THE PROPOSED UNIVERSITY OF THE EAST MIDLANDS.

THE movement for establishing a University of the East Midlands took its start some dozen years ago in the growth of the University College, Nottingham, and steps towards obtaining a charter were already being taken before the war. The war seemed at first to stand in the way of further action, but the needs which it brought to light, and the readiness to co-operate which has been displayed throughout the East Midland province, have extended the plans of the supporters of the movement. The proposed University will, indeed, have its foundation in the University College, Nottingham, but it is anticipated that the neighbouring cities and counties will enter upon a federal relation through the development of their existing educational institutions and the establishment of new. For example, the Agricultural College which is jointly maintained by the county councils of the East Midlands at Kingston, near Loughborough, is marked out for the agricultural faculty. Further, the close proximity of Leicester, Derby, and Nottingham will make it easy for the services of professors and lecturers in the University to be shared by these three centres.

The Corporation of the City of Nottingham, which founded the University College in 1881, has declared its readiness to hand over the present site and buildings, representing a value of some 200,000*l*., and to make a permanent annual grant of 15,000*l*. when the University charter is granted. The Nottinghamshire County Council has, under similar conditions, promised an annual grant of 5000*l*. The neighbouring authorities are taking up a friendly attitude to the scheme, and have under consideration the form and amount of the assistance to be given. The Mayor of Nottingham has undertaken to raise an endowment fund of 150,000*l*.

The new University, it is expected, will not only further the application of science to industry throughout the locality, but will also embody the very spirit of humanism by working in close touch with the artisan classes, and especially with the Workers' Educational Association.

THE ROMANCE OF PETROLEUM.[1]

PETROLEUM is defined in the Petroleum Act of 1871 as including "any rock oil, Rangoon oil, Burmah oil, oil made from petroleum, coal, schist, shale, peat, or other bituminous substances, and any products of petroleum, or any of the above-mentioned oils."

The scientific definition is even wider, embracing natural gas, solid bitumen, and ozokerite.

It is, therefore, an appropriate introduction, for the suggestion of which I am indebted to the Fullerian professor of chemistry, to recall that it was in the laboratory of this institution, in 1825, that Faraday examined the liquid which separates when the gas made by the destructive distillation of fixed oils is subjected to compression, and isolated from it the hydrocarbon benzene, as well as several other compounds of carbon and hydrogen.

In 1815 John Taylor was granted a patent for a process described as producing "inflammable air or olefiant gas applicable to the purposes of giving light" from vegetable or animal oil, fat, bitumen, or resin. This oil-gas, compressed by a method patented by Gordon and Heard in 1819, was supplied by a company having the title of the London Portable Gas Company. It was contained in vessels having a capacity of 2 cubic ft., which were delivered to the premises of consumers, and returned when empty to be refilled. The liquid which separated when the gas was compressed into these cylinders was that which Faraday examined.

It is not reasonable to assume that whilst he was ascertaining the chemical constitution and properties of what was actually synthetic petroleum, Faraday can have realised the importance of the part destined to be played by these hydrocarbons in peace and in war.

Nevertheless, his extended reference to what he describes as the remarkable action of sulphuric acid upon the compounds of carbon and hydrogen which he had isolated, and his subsequent paper on the mutual action of sulphuric acid and naphthalene, appear to indicate that he may have had an intuitive perception of the valuable industrial developments in the manufacture of dyes which after many years followed his classic researches.

In the same year Faraday also published the results of his examination of caoutchouc, and showed that this substance is mainly a compound of carbon and hydrogen.

Eleven years later Edmund Davy, a cousin of Sir Humphry Davy, discovered the gaseous hydrocarbon which we now know as acetylene. The account of his discovery which he gave at the meeting of the British Association in 1836 was as follows:—"Early in the present year the author, in attempting to procure potassium by strongly heating a mixture of calcined tartar and charcoal in a large iron bottle, obtained a black substance which readily decomposed water and yielded a gas which, on examination, proved to be a new compound of carbon and hydrogen."

It is interesting to note the relation between these respective researches of Faraday and Edmund Davy and the rival theories of the organic and inorganic origin of petroleum, to which further reference will be made.

There are many obvious allusions to the occurrence and uses of petroleum in the Old Testament scriptures. Thus in the account of the building of the Tower of Babel we are told that "slime had they for mortar," the word "slime" in our version being given as "bitumen" in the Vulgate. Again, in Genesis xiv. 10, the vale of Siddim is described as "full of slime pits," and on this account it has been suggested that the destruction of Sodom and Gomorrah may have occurred through the sudden outburst of petroleum in this region. This has led Mr. W. H. Dalton to remark that the destruction of these cities and our recent conquests in Palestine were effected by the same agency, with the essential difference that in the latter case the flow of the oil was under control.

The vale of Siddim, with its slime pits, is no more; even its precise position is a matter of doubt, but the pitch spring of the Ionian island of Zante, described by Herodotus in 450 B.C., may still be seen.

The photograph of this spring of petroleum now projected on the screen was taken in 1890, whilst my guide was in the act of inserting an olive branch into the spring and withdrawing it dripping with the oil, the flow being, apparently, as abundant as it was more than two thousand three hundred years previously. I may add that drilling for petroleum in the locality has not resulted in obtaining any yield of commercial importance.

Long before the Christian era the drilling of wells for natural gas, with a view to its use as a source of heat in evaporating brine, was a recognised industry in China, and it is worthy of note that the instruments employed bear a close resemblance to modern drilling appliances.

Petroleum occurs in greater or less quantity throughout the whole range of strata of the earth's crust, from the Laurentian rocks to the most recent members of the Quaternary period, but it is found in quantities of industrial importance almost wholly in the comparatively old Devonian and Carboniferous formations on one hand, or in the various divisions of the comparatively young Tertiary rocks on the other.

Its origin has been the subject of much controversy among distinguished geologists and chemists who have devoted special study to the subject. Berthelot and Mendeléeff lent the weight of their authority to the theory that petroleum was derived from metallic carbides lying far beneath the porous strata in which the oil is stored, and made the attractive suggestion that the process might be conceivably in operation at the present time. The view is now, however, universally accepted that petroleum is of organic origin, and that it has been produced from vegetable matter and the lower forms of animal life, chiefly aggregated during the geological periods referred to, when favourable conditions, which did not persist through the whole period, occurred. In certain places—for instance, in Karabugas Bay, on the eastern side of the Caspian Sea, in Sweden, in Sardinia, and in the eastern part of the Mediterranean—there is some conversion of organic matter into petroleum actually to be seen in progress at the present time.

Whilst, however, as I have said, there is general agreement as to the organic origin of petroleum, there is considerable difference of opinion as to whether the oil is in all cases indigenous to the strata in which it is found, and as to whether the conversion of the organic matter was practically completed when the strata were formed, so that the age of the rocks is that of the petroleum found therein. There are distinguished advocates of the view that petroleum results from the action of a slow, continuous process of dis-

[1] Abridged from a discourse delivered at the Royal Institution on Friday, June 7, by Sir Boverton Redwood, Bart.

tillation of the material yielding it, accompanied by a transference of the product to strata lying above those in which its formation originated. According to some, this process occurred at a definite and distant time in the past, long subsequent to the formation of the petroliferous strata; but in the opinion of others it may be in progress at the present time. The question is not one of academic interest only, for it obviously would be of vast importance if it could be demonstrated that our stores of petroleum, which are being depleted with alarming rapidity, might be replenished. I fear, however, that there is no ground for such an encouraging anticipation. As Lesley, the United States geologist, remarked in 1886:—"I am no geologist if it be true that the manufacture of oil in the laboratory of Nature is still going on at the hundredth or the thousandth part of the rate of its exhaustion. And the science of geology may as well be abandoned as a guide if events prove that such a production of oil in western Pennsylvania as our statistics exhibit can continue for successive generations. It cannot be. There is a limited amount. Our children will merely, and with difficulty, drain the dregs."

Probably each of the views expressed in relation to the organic origin of petroleum has some elements of truth in it, and it is reasonable to assume that a substance so varied in chemical and physical characters has not in all cases been created under precisely the same conditions or from an exactly similar source. On the whole, however, the balance of evidence appears to point to the conclusion that the petroleum which we now find in the Palæozoic and Tertiary rocks is of substantially the same geological age as the rocks themselves. It is, I believe, uncertain whether man existed on the earth before the close of the Tertiary period, but there is abundant evidence of the existence of the human race in the following Quaternary period. The advent of man may, therefore, have been coeval with the completion of the petroliferous formations.

Not less important than the provision of adequate supplies of organic matter to be transformed into petroleum is that of a suitable rock-formation for its reception and conservation. For the latter we need a porous stratum, such as coarse-grained sandstone or conglomerate or dolomitised limestone, with an impervious cover, such as that provided by fine-grained shale. In addition, in order that the wells drilled may furnish individually a large yield of oil, it is essential that the petroliferous strata should have been caused to assume an anticlinal structure. Under these tectonic conditions any natural gas accompanying the oil accumulates at the crest of the anticline, whilst the oil occupies the flanks, and water is found in the synclines. The gas often occurs at a pressure of many hundred pounds on the square inch, and it is obvious that in these circumstances a well drilled into the flank of the anticline may produce an oil fountain.

The geographical distribution of petroleum is no less wide than the geological, but the deposits mainly occur along well-defined lines, often associated with the mountain ranges. This is chiefly due to the formation, in the elevatory process, of minor folds, which have arrested and collected the oil in richly productive belts, between more or less barren areas, in the manner already referred to.

There are, however, but few of the localities indicated as petroliferous which contribute largely to the world's output of petroleum, estimated for last year as approximately 70,403,128 metric tons.

The predominant contributor is the United States, which furnished no less than 64·74 per cent. of the estimated total for 1917, the others in order of importance being:—Russia, with 13·26 per cent.; Mexico, with 11·37 per cent.; the Dutch East Indies, with 2·74 per cent.; Rumania, with 2·08 per cent.; India (Burma and Assam), with 1·61 per cent.; Persia, with 1·32 per cent.; Galicia, with 0·947 per cent.; Japan, with 0·615 per cent.; Peru, with 0·511 per cent.; Trinidad, with 0·303 per cent.; Germany, with 0·189 per cent.; the Argentine, with 0·170 per cent.; Egypt, with 0·094 per cent.; Canada, with 0·037 per cent.; Italy, with 0·002 per cent.; and other countries, with 0·006 per cent.

It is not surprising that the flood of oil which has been poured out by the wells of the United States in ever-increasing volume since 1859 should now be attended by signs of the approaching exhaustion of the petroliferous territory, and it has been estimated by Dr. David T. Day that, at the present rate of increase of the output of petroleum, the known oil-fields of that country will, on the basis of the minimum quantity of oil obtainable, be exhausted by the year 1935.

The oil-producing countries of the British Empire are India (Burma and Assam), the West Indies (Trinidad), and Canada, and these in the aggregate furnish only 2 per cent. of the total given.

Under these conditions the British Government is to be congratulated on having secured the control of the exceptionally prolific oil-fields of Persia.

In the British Isles, as is well known, there is a flourishing industry in the mining and distillation of Scottish shales as a source of mineral oil and ammonia. This industry owes its existence to James Young, of Kelly. In 1847 Young's attention was directed by Playfair to a stream of oil flowing from the top of a coal-working at Alfreton, in Derbyshire. From this oil he succeeded in extracting, on a commercial scale, paraffin-wax, lubricating oil, and burning oil. The supply of the raw material being soon exhausted, Young attempted to imitate the natural processes by which he believed the oil to have been produced, by the action of gentle heat on coal, and in 1850 made his invention the subject of his celebrated patent for "obtaining paraffine oil, or an oil containing paraffine, and paraffine from bituminous coals by slow distillation." The process was extensively carried out in the United States, under licence from Young, until crude petroleum was produced in that country in such abundance, and at so low a cost, that the distillation of bituminous minerals became unprofitable.

In this connection it is interesting to note that, in consequence of the approaching exhaustion of the oil-fields of the United States, attention is now being actively given to the utilisation as a source of oil of the immense deposits of bituminous shales known to exist in that country.

I have mentioned the work carried out by Young on the crude petroleum of Alfreton, and this leads me to refer to the prospects of obtaining free oil in quantity in this country. For many years there was an actual output of petroleum recorded in the General Report and Statistics relating to Mines and Quarries in the United Kingdom, issued by the Home Office. The annual output reached its maximum in 1893, when it amounted to 200 tons, valued at 488*l*. It had fallen to five tons, valued at 12*l*., in 1899, and was returned as nil in the following year. There was a recorded production of eight tons in 1901, and twenty-five tons in 1902, none in the two succeeding years, forty-six tons in 1905, and ten tons in 1906, the principal locality of production for the latter years being Dumbartonshire. Since 1906 no output has been recorded.

Apart from the production referred to, there have been discoveries of oil in this country from time to time, some of which were of a very doubtful character. An interesting occurrence of free petroleum was brought to my notice in 1892. It took the form of a sudden influx of some hundreds of gallons of light-coloured oil into a well which was the source of the water supply of an isolated dwelling-house standing on high ground near Shepton Mallet. Another case, which is certainly genuine, is that of the oil find in a test-boring made for coal at Kelham, near Newark. From this bore-hole, which at a depth of between 2400 ft. and 2500 ft. had penetrated a bed of porous sandstone, a flow of characteristic crude petroleum amounting to five or six gallons a day took place. The much-advertised discovery at Ramsey, near Huntingdon, cannot be included in the same category, for the oil had unquestionably leaked from an adjacent store.

It may confidently be asserted that in certain parts of Great Britain the geological conditions are consistent with the existence of valuable stores of petroleum, but doubt has been expressed as to whether the drilling operations which the Government has decided to undertake will be attended with success. It is, however, admitted that the only conclusive test is that of the drill. Some months ago Lord Cowdray publicly announced his belief that oil may be found in commercial quantities in Great Britain, and stated that his firm was prepared to spend 500,000*l.* on exploration and development if certain areas were reserved to them.

Even if we should be unsuccessful in finding free oil, we know that we have abundant stores of bituminous minerals from which oil can be obtained by destructive distillation.

For centuries petroleum has been raised from hand-dug wells in Burma, Rumania, and Galicia. In the days when King Thebaw reigned in Burma the winning of petroleum by hand-digging in the Yenangyaung district was an important source of revenue.

This primitive system of production has been superseded by the introduction of modern methods of drilling, in which steam-driven machinery is employed.

The drilling of petroleum wells has been brought to such perfection that depths of a mile or more may be reached without serious difficulty in a moderate length of time, but the yield of oil needs to be considerable to render drilling to such depths a profitable undertaking. Four years ago there were in the Boryslaw-Tustanowice oilfield of Galicia sixteen wells of a depth of more than 5000 ft., and one was then yielding oil from strata which had been reached at 5873 ft., or nearly a mile and a furlong.

It not infrequently happens that oil is met with on completion of the well under such high pressure, sometimes several hundred pounds on the square inch, that the flow is uncontrollable. Most of us have seen pictorial representations of the famous oil-fountains of Baku, but less is known of similar occurrences elsewhere, which were of an even more remarkable character. A fountain in the Grozni oil-field in the northern Caucasus, which began to flow in August, 1895, was estimated to have thrown up during the first three days more than 4,500,000 gallons, or about 18,500 tons, of oil a day. It flowed continuously, but in gradually diminishing quantity, for fifteen months, quickly destroying the derrick, and afterwards periodically. When I visited the spot in April, 1897, there was still an occasional outburst of oil and gas. To save the enormous volume of oil ejected an army of workmen was employed day and night in throwing a dam across the valley, so as to form a gigantic reservoir. This dam gave way, and a second was constructed below it; a third, still lower down the valley, being afterwards added as a measure of precaution.

Probably the most sudden and violent of the outbursts of oil which have been experienced is that which occurred in 1908 on the San Diego property of Messrs. S. Pearson and Son (Lord Cowdray's firm) in Mexico. In the early morning of July 5 in that year oil was struck in a well known as No. 3 at a depth of 1824 ft. The pressure gradually increased, and in fifteen or twenty minutes the ground round the well began to tremble. In various places, some so far distant as 250 ft. from the well, fissures appeared, through which oil and gas were emitted. One of these fissures extended under the boilers, and although the fires had been drawn the gas ignited. The flame was immediately communicated to the outflowing oil, and the well burned for a period of fifty-eight days with an estimated loss of 3,000,000 barrels of oil.

The flames reached a height estimated at 1460 ft., with a maximum breadth of about 480 ft. So brilliant was the light emitted that at 9.40 p.m. on July 8 persons on board a vessel at anchor in the Tamiahua lagoon, a distance of nearly eleven miles from the well, were able to read a newspaper by it. This is the more remarkable when it is considered that the approximate limit of distance at which an object 100 ft. high is visible to a spectator at sea-level is a little more than twelve miles, so that unless the light from the burning well had been reflected from smoke or cloud, only the upper part of the column of flame could have had illuminating effect at the distance recorded. Besides ejecting the large quantity of oil mentioned, the well yielded a considerable volume of water, estimated to reach at times nearly 1,500,000 barrels daily. This great flow of liquid carried away from the sides of the well solid matter estimated approximately at 2,000,000 tons. On August 31 the flow of oil temporarily subsided, and it became possible to extinguish the fire by means of sand pumped into the crater with centrifugal pumps. On September 26 the area of the crater was about 15,000 square metres, and on January 28 of the following year about 117,600 square metres.

The deposit of ozokerite in Boryslaw, Galicia, is unique, although the mineral occurs in other localities in that country, as well as in Russia and in Utah. The Boryslaw deposit underlies a pear-shaped area, the central and richest part of which is about fifty acres in extent, but this is surrounded by an outer zone of less productive territory, which increases the area of the workable field to about 150 acres. The ozokerite occurs in veins varying from extreme tenuity to many feet in thickness. It is usually plastic, and has evidently been forced up from underlying beds by lateral pressure through fissures resulting from the local yielding of the marl to the compressive strain. The pressure which still exists is attested by the viscous flow of the ozokerite in the mines and by the frequent distortion or collapse of the timbering of the galleries. As an illustration of this it is recorded that in one mine the perforation by a miner's pick of a thin, impervious stratum of rock forming the floor of a gallery resulted in the gradual appearance of a vertical stalk of ozokerite, which for a long time was replaced when it was removed. This curious appearance of growth gave the name of Asparagus Mine to the working.

Crude petroleum varies greatly in character, some descriptions being of pale colour and highly mobile, whilst others are almost black and viscid. The specific gravity appears to range from 0·771 to 1·06.

As regards its chemical composition, petroleum consists essentially of carbon and hydrogen, together with oxygen, and varying amounts of nitrogen and sulphur.

Pennsylvanian petroleum consists chiefly of a large number of hydrocarbons of the paraffin series, whilst naphthenes or polymethylenes are the predominant constituents of Russian petroleum. In some descriptions of crude petroleum, notably those of the Dutch East Indies, Persia, and Burma, aromatic hydrocarbons are largely present.

These paraffins and naphthenes are very accommodating, in the sense that they readily lend themselves to conversion, by dissociation, or "cracking," as it is termed, into other compounds of carbon and hydrogen, of lower boiling-point or higher volatility, which are so largely in demand at the present time in the form of motor-spirit. The conversion occurs when the oil is distilled under pressure or is brought into contact with highly heated surfaces. The chemical changes which occur in these circumstances and the constitution of the products were investigated by Thorpe and Young many years ago. In 1888 I was privileged to be associated with the Fullerian professor in experimental work which involved the construction of suitable apparatus for carrying out the process on a practical scale, and it was found that in order to obtain the best results it was necessary to effect the condensation of the vapour also under pressure. The process devised at that time is essentially the same as that which is now very largely carried out in the United States, with the object of augmenting the inadequate supplies of motor-spirit normally obtainable from the crude oil by fractional distillation. By carrying this treatment further it is possible to obtain aromatic hydrocarbons.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

STONYHURST College, Blackburn, is aiming at raising 20,000*l*. as a war memorial, and the bulk of this sum will be devoted to the erection of new science laboratories.

MR. S. H. STROUD, formerly demonstrator in chemistry in the School of Pharmacy, Bloomsbury Square, has been appointed lecturer in pharmacy and chemistry in the University of Sydney, N.S.W.

DR. RICHARD C. MACLAURIN, president of Massachusetts Institute of Technology, has, we learn from *Science*, accepted the appointment of director of college training, in charge of the Students' Army Training Corps under the U.S. War Department's Committee on Education and Special Training, which aims at mobilising the higher institutions of learning.

IT is stated in *Science* that the residuary estate of the late Mr. John W. Sterling, which it is estimated will amount to 3,000,000*l*., has been left by the terms of his will to Yale University. The clause which gives the residue of the estate to Yale University contains the following passage:—"All the rest, residue and remainder of my estate not hereinbefore effectually disposed of, I direct my said trustees to dispose of in the manner following: To apply the same, as soon after my decease as may be practicable, to the use and for the benefit of Yale University, in the erection in New Haven, Conn., upon land selected at its expense by it with the approval of my said trustees, of at least one enduring, useful, and architecturally beautiful edifice, which will constitute a fitting memorial of my gratitude to and affection for my *alma mater*."

A GROUP of large firms engaged in the principal industries of the Manchester district has offered to the governing body of the College of Technology, Manchester, the sum of 3000*l*., spread over a period of five years, towards the cost of establishing a new department of industrial management, and this has been accepted by the Manchester City Council. A lecturer will shortly be appointed for this period of five years, at a salary of 600*l*., to conduct research in the subject of industrial management, to organise a new department, to lecture to members of the college and to the public, and to assist industrial concerns in the solution of management problems. To make doubly sure that the department shall keep in close touch with practice, a number of managers, directors, scientific experts, and others who have had special experience or are responsible for important innovations will be invited to deliver public lectures, being offered substantial fees for placing their knowledge at the disposal of their fellow-managers, and thus serving to encourage enterprise and experiment in matters connected with management.

A SIGNIFICANT indication of the Government's attitude towards higher education and of its readiness to increase the State aid to universities was given by the Prime Minister in his reply to a deputation, which he recently received, representative of university education in Wales. That the Government is prepared to approach the question of grants to education in a spirit totally different from that which formerly prevailed was made abundantly clear by Mr. Lloyd George. In Wales it is proposed that the county councils should levy a penny rate for higher education, and some of the councils have already decided to do so; and the Government is now asked to give a pound for each pound raised locally. Before an increased grant will be made, however, the University authorities must draw up a scheme for the expenditure of the money, and this must receive the approval of the Government, advised by the President of the Board of Education. It is also laid down as an essential condition of increased aid that the county councils shall agree to a pooling of their resources, and that the county contributions shall be made unconditionally and without the claim that so much of the money shall be used for founding scholarships. It is explained that any increased grant made as a result of increased local effort will be supplementary to the grants made for the training of teachers and for agricultural education, and every indication of a desire to give much greater assistance to universities was shown by the remarks of the Prime Minister. The question of making proportionate grants by the State towards capital expenditure is under consideration. The treatment given to Wales will be given to other universities also, and the Prime Minister stated that every claim for increased State aid on behalf of other universities would be considered by the President of the Board of Education "in a thoroughly liberal and enlightened spirit." Special reference, it should be added, was made to the low scale of salaries and pensions for professors—"There is no greater folly than to underpay these men, apart from the cruelty of it. It is stupid beyond words; it is unutterably stupid"—and the University of Wales is admonished, in any scheme which it may submit, to do something to improve the pay and sense of security of the teacher. As the amount of State aid will depend on the amount of local contributions, it is to be hoped that the country as a whole will rise to a sense of its responsibilities and its privileges.

SOCIETIES AND ACADEMIES.

LONDON.

Faraday Society, July 23.—Sir Robert Hadfield, president, in the chair.—J. G. A. **Rhodin**: Contributions to the chemistry of aluminium and aluminium alloys. The paper dealt with the sorting of various kinds of scrap according to the percentage of aluminium by means of direct determination of aluminium, soluble in 10 per cent. NaOH. The method was described in detail, and it was claimed for it that it allowed oxide to be determined as well. Certain phenomena relating to the behaviour of aluminium powder, when heated in air, were discussed, and also the preparation of Al_3O_4. A curve of specific gravities corresponding with percentages of aluminium in various alloys was given. Determination of specific heats was mentioned as an alternative.—R. J. **Anderson**: Metallography of aluminium: recrystallisation and grain-growth—the result of deformation in the cold prior to annealing. During the course of some recent tests on the recrystallisation of cold-rolled aluminium sheet on annealing, some interesting recrystallisation and grain-growth phenomena were observed in this metal, which are confirmatory of the general laws of grain-growth and recrystallisation as now understood. While the degree of strain is indefinite, the effects of temperature on deformed aluminium are recorded, and instances of differential grain-growth are presented. These results appear to show definitely that aluminium is similar to other metals as regards annealing laws.—Prof. H. J. M. **Creighton**: Reinforced concrete *v.* salt, brine, and sea-water. On account of the rapidity and cheapness of construction, at present attention is focussed on the reinforced-concrete ship. The durability of this is still an undetermined factor, but in a large measure it will depend upon the action of the sea-water on the concrete and on the iron reinforcements. Reinforced concrete immersed in brine or sea-water is liable to subtle and persistent deterioration, due to electrolytic action between the salt and the reinforcements. Therefore, the permanence and durability of reinforced-concrete ships are matters of considerable doubt, unless the sea-water is prevented from coming in contact with the reinforcements. Such prevention may be effected by coating the reinforcements with protective paint, or by applying to the outer surface of the concrete some material which will render it waterproof.

PARIS.

Academy of Sciences, August 5.—M. P. Painlevé in the chair.—J. **Boussinesq**: The second and third formulæ of Tresca, for punching a block, with a lateral surface, not free, but cased in a rigid, polished, hollow cylinder, and for its flow through a lower orifice under the pressure of a piston of the same radius as itself.—A. **Blondel**: A phenomenon of instrumental diplopy and its application in medicine. The prism binocular may be used in the diagnosis of affections of the central nervous system, as, under certain conditions, a patient sees double images through the binocular, although seeing a normal single image by direct vision.—G. A. **Boulenger**: What is the *Eleotris gobioides* of M. Legendre?—G. **Sizes**: The doctrine of Aristoxene; temperament of the Pythagorean scale.—P. **Weiss**: The characteristic equation of fluids. A study of the isochores of air, plotted from Witkowski's experiments, of ethylene and ether, from Amagat's experiments, and of *iso*pentane from S. Young's data, shows that isochores in each case consist of two straight lines inclined at an angle. The theoretical interpretation of this bend in the isochore is not obvious, but a similar bend is shown by the corresponding magnetic phenomenon.—L. **Tschugaeff**: A new reaction of osmium. A solution of OsO_4 or K_2OsCl_6, heated with thiourea in excess and a few drops of hydrochloric acid, gives a deep red or rose coloration, according to the concentration of the osmium solution. The reaction is characteristic and will detect osmium at a dilution of 1 : 100,000.—Ch. **Gorceix**: The post-Würmian Fier.—L. **Gentil**: The geology of Andalusia.—J. **Amar**: The nutritive equilibrium of the animal organism. Remarks on a recent paper by F. Maignon (July 22).—A. **Besredka**: Vaccination against dysentery by the mouth.—H. **Vincent** and G. **Stodel**: Antigangrene serotherapy by a multivalent serum.—A. **Sartory**, G. **Blaque**, and M. **Schulmann**: A case of pulmonary sporotrichosis. A tumour in the lung, giving all the apparent signs of tuberculosis, but no Koch bacillus in the sputum, proved to be due to *Sporotrichum beurmanni*.

CAPE TOWN.

Royal Society of South Africa, June 19.—Dr. J. D. F. Gilchrist, president, in the chair.—J. R. **Sutton**: A note on the possibility of long-range weather forecasts. The author shows that the June temperatures, and especially the minima, at Kimberley are modified by the character of the May rainfall.—J. S. v. d. **Lingen** and A. R. E. **Walker**: Preliminary note on Anatase. The authors gave a preliminary account of their investigations on the radiation pattern of Anatase.

BOOKS RECEIVED.

The Processes of History. By Prof. F. J. Teggart. Pp. ix+162. (New Haven, Conn.: Yale University Press.)

The Portal of Evolution. By a Fellow of the Geological and Zoological Societies. Pp. 295+ii. (London: Heath, Cranton, Ltd.) 16*s*. net.

Handbook of Travel. Prepared by the Harvard Travellers' Club. Pp. 544. (Cambridge, Mass.: Harvard University Press.) 2.50 dollars.

Descriptive Catalogue of the British Scientific Products Exhibition, August 12–September 7, 1918, with Articles on Recent Developments. Pp. xxiii+236. (London: British Science Guild.) 2*s*. 6*d*. net.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.