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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

INDEX NUMBER.

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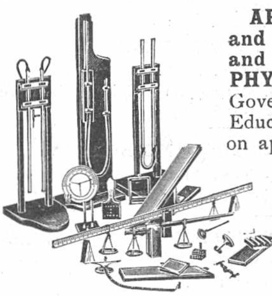

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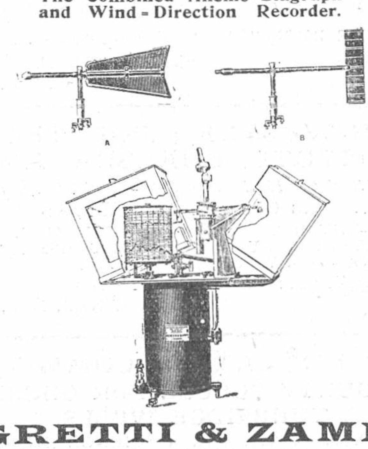

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Professor of Optical Design ... ... } A. E. CONRADY, A.R.C.S.
Lecturer ... ... { L. C. MARTIN, D.I.C., A.R.C.S., B.Sc.

During Session 1918–19, and pending the establishment of full-time courses of study leading to one of the Diplomas awarded by the Governing Body, a series of courses of lectures will be given, with corresponding laboratory work, designed especially to meet the needs of part-time students engaged in the optical industry; but available also for students who wish to study Applied Optics with a view to entering the profession of optical designing and testing.

For the present, and pending the establishment of full-time courses of study, the case of each student wishing to enter the Department for full-time work will be specially considered by the Director of the Department, who will determine the course of study to be followed.

The Lecture Courses for the Autumn Term, 1918, are as follows:—

"GENERAL OPTICS."*
By Professor F. J. CHESHIRE.
Beginning on Friday, October 4, 1918, at 2.30 p.m.

"OPTICAL DESIGNING AND COMPUTING."*
By Professor A. E. CONRADY.
Beginning on Monday, October 7, 1918, at 2.30 p.m. (Lectures suitable for Beginners.)

"PRACTICAL OPTICAL COMPUTING."*
By Professor A. E. CONRADY.
Beginning on Tuesday, October 1, 1918, at 2.30 p.m. (Suitable for more advanced students.)

"WORKSHOP AND TESTING-ROOM METHODS."*
By Professor A. E. CONRADY.
Beginning on Thursday, October 3, 1918, at 2.30 p.m.

"THE CONSTRUCTION, THEORY, AND USE OF OPTICAL MEASURING INSTRUMENTS."*
By Mr. L. C. MARTIN.
Beginning on Wednesday, October 2, 1918, at 2.30 p.m.

"MICROSCOPES AND MICROSCOPIC VISION."
By Professor A. E. CONRADY.
Beginning on Thursday, October 3, 1918, at 5 p.m.

These lectures are intended specially for users of the microscope, and will be as far as possible non-mathematical.

* Each lecture will be followed by a Laboratory or Computing Class.
All inquiries in respect of the above should be addressed to—

THE REGISTRAR OF THE IMPERIAL COLLEGE,
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SESSION COMMENCES SEPTEMBER 23, 1918.

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September, 1918. Director of Education.

NATIONAL UNION OF SCIENTIFIC WORKERS

The first General Meeting of the Union, which will determine its constitution and place it on a permanent basis, will be held in London in the last week of October. Any persons who desire to be represented at the meeting, and have not yet joined branches of the Union, should communicate at once with the Secretary, NORMAN CAMPBELL, North Lodge, Queen's Road, Teddington.

MANCHESTER MUNICIPAL

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Principal: J. C. M. Garnett, M.A. (late Fellow of Trinity College, Cambridge)
Vice-Principal: E. M. Wrong, M.A. (Fellow of Magdalen College, Oxford)

The Session 1918-19 will open on 3rd October. Matriculation and Entrance Examinations will be held in July and September. Matriculated students may enrol for 1918-19 from 1st August, 1918, and if under 18 years of age are eligible for membership of the Officers' Training Corps.

DEGREE COURSES IN TECHNOLOGY

The Prospectus, forwarded free on application, gives particulars of the courses leading to the Manchester University degrees (B.Sc. Tech. and M.Sc. Tech.) in the Faculty of Technology in the following Departments:

MECHANICAL ENGINEERING,
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SANITARY ENGINEERING (including Municipal Engineering),
THE CHEMICAL INDUSTRIES (including General Chemical Technology, Bleaching, Dyeing and Dyestuff Manufacture, Printing, Papermaking, Fermentation Industries, Metallurgy, Fuels),
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Part II. Brewing.—A Course of 20 Lectures, with associated laboratory work, commencing Tuesday, January 14, 1919, at 7 p.m.

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Detailed syllabus of the courses may be had upon application at the Office of the Institute, or by letter to the PRINCIPAL.

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Full particulars of these Scholarships may be obtained free from the undersigned.

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SESSION 1918–19.

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Education Offices,
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WILLIAM COOPER,
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For other Official Advertisements see page xxvi *and page* ii *of Supplement.*

Cambridge University Press

Royal Society Catalogue of Scientific Papers. Fourth Series (1884–1900). Vol. XVI, I—MARBUT. Demy 4to. Cloth, £5 5s net. Half-morocco, £6 net.

A Course of Pure Mathematics. By G. H. HARDY, M.A., F.R.S., Fellow and Lecturer of Trinity College and Cayley Lecturer in Mathematics in the University of Cambridge. Second edition, revised. Demy 8vo. 12s 6d net.

"It is gratifying to see that Mr Hardy's excellent treatise has so soon reached a second edition. . . . The author combines, in a remarkable way, strictness of method with an agreeable style, and his choice of topics seems to us to be eminently judicious. The principal additions in this re-issue are an account of Dedekind's theory of irrational numbers; a proof of Weierstrass's theorem about points of condensation, of the Heine-Borel theorem, and of Heine's theorem about uniform convergence; the notions of 'limits of indetermination' and 'implicit function' are also discussed. The examp es are well chosen, and hints towards solution are frequently given."—*Nature*

Modern Electrical Theory. By N. R. CAMPBELL, Sc.D. Second edition, completely revised. Demy 8vo. 10s 6d net. Cambridge Physical Series.

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Matrices and Determinoids. By C. E. CULLIS, M.A., Ph.D. Vol. II. Royal 8vo. 42s net.

The Journal of Ecology. Edited for the British Ecological Society by A. G. TANSLEY. Vol. VI, No. 2. June, 1918. 5s net.

CONTENTS:—On the Relationships of some Associations of the Southern Pennines (2 text-figures), by R. S. ADAMSON; A Fox-Covert Study, by Rev. E. A. WOODRUFFE-PEACOCK; Cryptogamic Vegetation of the Sand-Dunes of the West Coast of England (3 text-figures), by W. WATSON; On the Ecology of the Vegetation of Breckland: VI, Characteristic Bare Areas and Sand Hummocks (4 plates), by E. PICKWORTH FARROW; REVIEWS:—Plants, Seeds, and Currents in the West Indies and Azores (GUPPY); A Contribution to the Phytogeography and Flora of the Arfak Mountains, etc. (GIBBS); Tidal Lands, a study of Shore Problems (CAREY and OLIVER).

The Journal of Agricultural Science. Edited by R. H. BIFFEN, M.A., F.R.S., Sir A. D. HALL, M.A., F.R.S., E. J. RUSSELL, D.Sc., and T. B. WOOD, M.A. Vol. IX, Part 1. August, 1918. 5s net.

CONTENTS:—Buried Weed Seeds, by WINIFRED E. BRENCHLEY; The Influence of Potsherds on Nitrification in the Indian Alluvium (4 text-figures), by JATINDRA NATH SEN; The Non-Persistence of Bacterio-Toxins in the Soil (4 curves in text), by H. B. HUTCHINSON and A. C. THAYSEN; Pheasants and Agriculture, by A. F. C.-H. EVERSHED and CECIL WARBURTON; The Influence of Plant Residues on Nitrogen Fixation and on Losses of Nitrate in the Soil (3 text-figures), by H. B. HUTCHINSON.

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THURSDAY, SEPTEMBER 26, 1918.

APPLIED OPTICS.

Applied Optics: The Computation of Optical Systems. Being the "Handbuch der angewandten Optik" of Dr. Adolph Steinheil and Dr. Ernest Voit. Translated and edited by J. Weir French. Vol. i. Pp. xvii+170. (London: Blackie and Son, Ltd., 1918.) Price 12*s*. 6*d*. net.

THE first volume of Steinheil's handbook appeared twenty-eight years ago, and the promised second and third volumes of the work never materialised, probably owing to the first meeting with insufficient appreciation. The book before us is a translation of the first half of Steinheil's first volume, and the fact that a prominent member of one of our foremost optical firms (Barr and Stroud) considered it worthy of this labour is eloquent proof of the truth of a statement by the late Prof. Silvanus P. Thompson in a noted outburst:—

"The simple reason of the badness of almost all recent British text-books of optics is that . . . they are written, not to teach the reader real optics, but to enable him to pass examinations set by non-optical examiners. The examination-curse lies over them all."

Steinheil's book certainly does not belong to this category; it is severely practical and almost crude in its empiricism. Scarcely any of the numerous formulæ given in the book are proved; the reader must either accept them and mechanically follow the scheme of the numerous numerical examples, or he must discover the proofs by his own effort. In the case of the complicated Seidel-formulæ for rays not proceeding in a plane containing the optical axis, a student unfamiliar with modern spherical trigonometry is not likely to succeed in this, and the proof of these formulæ, together with a clear explanation of the adopted method of astronomical computation with angles up to 360°, should certainly have been included in this first volume of the translation instead of being relegated to the promised second volume.

The Steinheil system of symbols is safe, but cumbersome, on account of the multitude of suffixes; the use of precisely the same symbols for paraxial and for marginal rays is, however, likely to cause confusion. The sign-conventions agree in all ordinary cases with those almost universally adopted by practical computers; the only defect in them is that all the signs are made to depend on the direction in which the light travels through the system; hence if the latter includes reflecting surfaces—a case expressly and necessarily included in the scheme—the signs of all the angles and intersection-lengths must be reversed before proceeding to the following surface. This complication is entirely avoided if the direction of the light is ignored and axial intercepts are given the sign usual in analytical geometry, and if the acute angles between the optical axis and the ray are called positive when corresponding with a clockwise turn.

The worst feature of the book is to be found in the definitions of the various aberrations, which are not only loose, but also frequently positively incorrect. Thus on p. 45 the important sine-condition is merely implied—and only in the form which it takes for systems applied to infinitely distant objects. The condition is correctly stated in its general form on p. 57, but the statement is immediately vitiated by the assertion that it is fulfilled "when the system has the same true focal length for any portion of the whole aperture"—*i.e.* when it is fulfilled for infinitely distant objects. With rare exceptions, in the case of certain systems having great thickness or wide separations, the exact contrary is true: A system fulfilling the sine-condition for objects at infinity does *not* fulfil it for objects at finite distances.

The worst confusion of this kind occurs in the case of distortion. On p. 44 this is correctly, although loosely, defined in its accepted meaning. Throughout the rest of the book the term is used for the defect universally known as coma, simply because the latter, by diffusing the rays over a certain area, necessarily causes most of them to fall away from the position of the ideal image-point. Steinheil thus ignores the fact that true distortion may exist in an otherwise perfect image, and that it causes a linear displacement of any image-point which is proportional to the third power of its distance from the optical axis, whilst the coma-displacement is proportional directly to the distance of an image-point from the optical axis, and also to the square of the aperture of the image-forming cone—which latter has no effect at all on true distortion.

On p. 56 coma is described as "spherical aberration out of the axis," which, again, is wrong; true spherical aberration may exist in oblique pencils independently of that on the optical axis, but it is a fifth-order aberration which has nothing to do with coma.

There are many other cases of a type similar to the above examples.

The book is beautifully printed on paper of extraordinary thickness, and the translator and editor may be congratulated on the excellence of his part of the work. A. E. C.

THE MEGALITHIC CULTURE OF INDONESIA.

The Megalithic Culture of Indonesia. By W. J. Perry. Pp. xiii+198. (Manchester: At the University Press; London: Longmans, Green, and Co., 1918.) Price 12*s*. 6*d*. net.

IN his presidential address to Section H (see NATURE, vol. lxxxvii., p. 356), at the meeting of the British Association at Portsmouth in 1911, Dr. Rivers explained how he had been led to reject the popular dogma of "spontaneous generation" in ethnology, which is wrongly claimed to be "evolution," and to realise the vast importance in the development of civilisation of the influence exerted by the contact of peoples and the diffusion of culture. When he recognised that the germs of the megalithic culture of Melanesia had been introduced from the west it was clear that the immediate problem for investigation was to determine whether the Malay Archipelago, the scattered islands of which convert the great waterway linking the Indian and Pacific Oceans into a sort of sieve, had preserved any records of the earliest of the cultural streams which must have been filtering through it for twenty-five centuries. He therefore recommended Mr. W. J. Perry (who had been sent by Dr. A. C. Haddon to seek his advice as to the choice of a subject for investigation in ethnology) to learn the Dutch language and to search the voluminous, though scattered, literature of Indonesian ethnology for any evidence of the easterly diffusion of megalithic culture.

The book before us is the first substantial instalment of the results of this investigation; and it is certain to become a landmark in the history of ethnology. For it represents a noteworthy advance in the process of introducing the true methods of exact science into a domain of knowledge which for fifty years has been rendered increasingly chaotic by the misuse of biological terms and the misunderstanding of psychology.

An incursion into this maze of confusion by a man fresh from the severe discipline of the Mathematical Tripos might be expected to produce surprising results—and this expectation is fully justified in Mr. Perry's book. For he has impartially collected all the available facts, and based his explanation of them on the evidence they provide, without attempting to force them into any ready-made scheme, such as Waitz, Bastian, and Tylor have constructed, or to evade the issues so raised by taking refuge behind the blessed phrases "animism," "totemism," "intertribal barter," "sympathetic magic," "similarity of the working of the human mind," or any of the other catchwords that the modern ethnologist has been taught to use as substitutes for inquiring into the real meaning of things.

Mr. Perry was able not only to realise Dr. Rivers's expectations by finding the megalithic culture-complex in Indonesia, but he has also made wholly unexpected discoveries of far-reaching importance to the student of human nature and for the interpretation of the history of civilisation of the whole world.

With quite exceptional skill and insight he has been able to discover a pathway through the amazing jungle of Indonesian customs and beliefs, and to arrive at certain general conclusions which are of fundamental importance.

The most striking of these generalisations is the recognition of the fact that the irregular distribution of megalithic monuments is explained by their association with the localities where ancient gold-mines or pearl beds are found. This discovery made it plain that it was the search for special forms of wealth which attracted ancient miners and pearl-divers to certain places, and not to others, in Indonesia (and throughout the world). These immigrants introduced a distinctive group of customs and beliefs wherever they settled—not merely peculiar methods of burial, but also terraced cultivation and irrigation, a system of chieftainship and a priesthood, the belief in a sky-heaven, habits of warfare and head-hunting, and a host of other peculiar practices which will enable the investigator to determine whence the wanderers came and the dates of the diffusions of culture of which they were the bearers.

But the magnitude of Mr. Perry's achievement is not to be measured merely by his demonstration of the motives which prompted the spreading abroad of the elements of civilisation twenty-five centuries ago and his explanation of the geographical distribution of certain phases of culture. The searching analysis in his book reveals the fact that before the coming of the stone-using people the indigenous population of Indonesia was leading an unexpectedly simple and idyllic life of peace and contentment singularly free from any display of inventiveness. It sheds a new light upon the factors which determine material and intellectual progress and upon the meaning of civilisation.

The work of Dr. Rivers and Mr. Perry is transforming ethnology from an incoherent jumble of fairy tales into a real science.

G. ELLIOT SMITH.

WAR WORK OF THE BRITISH MEDICAL SERVICES.

British Medicine in the War, 1914–17. Being Essays on Problems of Medicine, Surgery, and Pathology arising among the British Armed Forces engaged in this War, and the Manner of their Solution. Collected out of the *British Medical Journal,* April–October, 1917. (London: British Medical Association, 1917.) Price *2s. 6d.*

THIS reprint of collected papers from the *British Medical Journal* is of very great interest, demonstrating as it does the rapid progress made in the medical services of the Navy and Army during the war. Although the articles were published at various dates between April and October, 1917, the methods described in some instances prove less than a year later to be only of historical interest: conditions and disease problems are discussed which are no longer confronting the armies in the field. The editor's preface eloquently directs the reader's attention to these points, so that we never lose sight of the view that medicine and surgery in this war are not, and cannot be allowed to become, stationary. Used as a guide and handbook of practice in the field, this collection of articles would soon be found out of date, but, carefully read, one can trace clearly the landmarks on the road that has been traversed.

The medical departments of the Navy and Army have, fortunately, been characterised by broad-minded elasticity. Innovations have been welcomed and powers of adaptation displayed by the authorities which had scarcely been anticipated. This volume contains many articles which demonstrate the encouragement given to new ideas and new methods. A public which was shocked by the revelations from Mesopotamia will turn with relief and satisfaction to this story of constant improvements in treating wounds and dealing with disease. Perhaps barely sufficient justice is done to the administrative officers of the medical services, upon whom falls the ultimate burden of almost daily reorganisation in order to give effect to improvements and discoveries brought under their notice.

The remodelling of casualty clearing stations into first-rate surgical units is an outstanding example of the revolutions necessary and possible during the war. An admirable description of this development is given in chap. vi. ("The Development of British Surgery at the Front") by Major-Gens. Sir A. Bowlby and C. Wallace.

In chap. v. ("Medicine and the Sea Affair") graphic accounts are given of how the sick and wounded are handled in the Navy. The illustrations in this chapter are particularly good, and help the reader to appreciate a side of the war which few have seen. Fleet-Surgeon R. C. Munday, R.N., has contributed a most readable paper on hygiene, dealing, *inter alia,* with that most difficult problem, the ventilation of warships.

Chap. iv. ("Bio-chemistry and War Problems") lifts for us a corner of the curtain, revealing a wonderland of science and infinite fields of experiment and research beyond. Dr. H. D. Dakin can only touch on the fringe of his subject, but on all sides it is admitted that through bio-chemistry lies the road to further progress. In no branch of warfare have chemists, physicists, and physiologists played a more valuable part than in that connected with poisonous gases. At present, for obvious reasons, "Gas Warfare" cannot be discussed in detail. Hence the very high grade of scientific work that is being done in this direction must of necessity be almost unknown to the public.

Chap. viii. ("Military Orthopædic Hospitals"), by Dr. W. Colin Mackenzie, reminds us of one of the principal needs of the wounded soldier. Brilliant operations at the front which save lives and limbs are invested with a glamour of their own. There is, however, an immense branch of surgery carried on out of the limelight which is worthy of the increasing attention it is now receiving.

The name "orthopædic" is unfortunate in itself. Few medical readers and fewer still amongst non-medical readers realise all that the term implies. Briefly, "orthopædic surgery" includes every possible operative and other device which is designed to restore function in injured parts. This chapter is well worth reading, none the less so because the history of orthopædic surgery is the history of a branch of surgery entirely British in its origin. The importance of "orthopædics" will continue long after the war, when "war-surgery," properly so-called, is being forgotten without regrets.

Chap. xiii. ("The Part Played by British Medical Women in the War") may be remarkable to some readers who have not had the opportunity of witnessing at first hand the increasing importance of women in medicine and surgery. Gradually, as it becomes obvious that a man's proper place is in the fighting line, the anomaly of a woman taking charge of the sick and wounded is, in fact, less striking than the anomaly of a man occupied thus instead of in fighting. The chapter on the R.A.M.C. and its work (including a short paper on the Canadian Army Medical Service) is graphically written and well illustrated. With the increase in air activity, and especially since the bombing of medical units and hospitals seems to have become an integral part in the German art of war, the illustrations and descriptions already require modification in many details.

One outstanding omission there is in this volume—namely, the dental services. The dental services of the C.A.M.C. are shortly described, and their immense value in saving sick wastage rightly insisted upon. Is all mention of the R.A.M.C. dental services omitted because they have not been developed and their potentialities recognised?

OUR BOOKSHELF.

Wireless Telegraphy and Telephony: A Handbook of Formulae, Data, and Information. By Dr. W. H. Eccles. Second edition, revised and enlarged. Pp. xxiv+514. (London: Benn Bros., Ltd., 1918.) Price 22s.

THIS book is written mainly for the technical expert, but the amateur who dips into it will find much to interest him. The theories hitherto advanced to explain the transmission of "wireless" signals are by no means complete, and some of them are very far from convincing. It is satisfactory, therefore, to notice that the author adopts generally a neutral attitude. In few industries is there greater scope for theoretical speculation, or a more crying need for it. The operator listening to the mysterious sounds sometimes heard in the telephone of his receiving apparatus, due often to cosmical influences, has every incitement to find out their causes.

In the second edition of his book the author has made some interesting additions. We have noticed descriptions of Heyland's alternator, of the oscillion telephone and telegraph transmitter for aeroplanes, and of the Darien system of the United States Navy. The author acknowledges his debt to the Proceedings of the American Institute of Radio Engineers, to which society practically every wireless expert belongs. We have also noticed an interesting account of the upper atmosphere. A useful glossary of technical terms is included. We learn, for example, that "radiophare" is a radio-telegraphic lighthouse which aids navigation by emitting characteristic signals. By estimating the bearings of two charted radiophares the navigator can readily determine the position of his ship.

As a heraldic device for his book, or possibly for radio-telegraphy in general, the author had the happy inspiration to choose the graph of two superposed electric waves of different frequencies with the axis vertical. The effect is not altogether unlike that of the rod of Mercury with its intertwined serpents. There are not many misprints. On p. 54, however, the formula for the capacity of an ellipsoid is still given incorrectly—possibly because no one uses it. The u^2 should be u.

Sir William Ramsay as a Scientist and Man. By Prof. T. C. Chaudhuri. With an Introduction by Prof. P. Neogi. Pp. ix+66. (Calcutta and London: Butterworth and Co., 1918.) Price 1.8 rupees net.

THIS little book opens with a short but appreciative account of Sir William Ramsay's early life, education, and career, special attention being directed to his earnest efforts to impress on the Government the importance of scientific education and research and the necessity for co-operation between the Government and the scientific societies in connection with the war.

After a brief reference to Ramsay's early work on organic chemistry, and to his researches on physical and inorganic chemistry, there is a fuller account of the discovery of the inert gases.

The last three chapters are devoted to radioactivity, modern views on electrons and elements, and the question of the transmutation of elements, with especial reference to Ramsay's researches and views.

Readers will obtain a clear idea of the great part played by Sir William Ramsay in the development of chemistry, but the portrait is not well reproduced, and there are a few inaccuracies.

S. Y.

The Practice of Soft Cheesemaking. Fourth revision. By C. W. Walker-Tisdale and T. R. Robinson. Pp. 106. (London: John North, 1918.) Price 3*s.* net.

THE revised edition of this small volume appears at an opportune time, as there is a considerable demand for information as to the best means of utilising small quantities of milk. Full working details concerning the manufacture of soft cheeses are given along with chapters upon the production of clean milk, the preparation of cream, and the packing and marketing of the soft cheese. Those unacquainted with the terms used in dairying will find the explanations given in one of the sections of great help, whilst the regulations of the Board of Agriculture will be found useful for reference purposes.

This handbook can be strongly recommended to anybody who proposes to make soft cheese; and whilst some practical instruction is desirable, the directions are given so clearly and concisely that a beginner need not fear to make a start. The authors also give instructions how to make soft cheese from goats' milk.

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.]*

Substitutes for Platinum.

L'INFORMATION donnée dans *Metall und Erz*, et qui est reproduite dans votre numéro du 15 août, souffre d'une insuffisance de documentation qu'il me paraît utile de relever.

L'alliage nommé "platinite," employé dans les lampes à incandescence, n'est pas né de la guerre; sa découverte a fait partie de l'ensemble des recherches que j'ai effectuées au Bureau international des Poids et Mesures, à partir de l'année 1896, et pour l'exécution desquelles j'ai reçu l'aide la plus dévouée de la Société de Commentry-Fourchambault et Decazeville. Le platinite est entré dans l'usage courant de certaines usines françaises dès l'année 1900, et s'est répandu peu à peu dans les autres pays. Le détail de cet emploi est donné dans mon ouvrage, "Les applications des aciers au nickel," paru en 1904; je ne crois pas exagérer en disant que l'économie de platine réalisée jusqu'ici grâce au platinite dépasse cinquante millions de francs.

C'est également la Société de Commentry-Fourchambault et Decazeville qui a réalisé pour la première fois, dans ses aciéries d'Imphy, les alliages de nickel à fortes additions de chrome; leurs propriétés sont décrites dans l'ouvrage de M. L. Dumas, "Recherches sur les aciers au nickel à haute teneur" (1902); d'intéressantes applications en ont été faites.

Les métallurgistes américains de leur côté fabriquent, depuis quelques années, sur la même donnée, l'alliage "nichrome," dont l'usage s'est beaucoup répandu pour la chauffe électrique des appareils de laboratoire.

CH.-ED. GUILLAUME.

Pavillon de Breteuil, Sèvres (S.-&-O.), 10 septembre 1918.

Future Treatment of German Scientific Men.

I HAVE just read Lord Walsingham's excellent letter in NATURE of September 5, and agree with all he says as to what should be our line of action towards the scientific men of Germany. It is impossible we can meet them just as if nothing had happened since 1914. I quote this sentence (how true it is!):—"It is impossible to dissociate the mental attitude of the population of that country, by no means excepting the highly educated and scientific classes, from the world-conquering aspirations of their rulers, or from the barbarous atrocities committed by them in pursuit of that national ideal."

I have not heard of a single letter from the very large number of the above scientific classes in Germany to acquaintances in this country in which such acts have been denounced, nor have I seen any protest or condemnation of German methods coming from the Germans in our midst, of whom there are many who have enjoyed in this country friendship, hospitality, and even protection, such as no British subject could hope to receive in Germany. Any expressions of this kind would be well known, quoted, and notorious. I think I should have heard of them, although I now lead a very retired country life.

Instead of protecting objects of science and art by leaving them intact for the benefit of other nations and the world in general, the German has raised looting and destruction into a devilish art. Soldiers are trained, and even the officers led by them, to commit useless destruction, combined with every conceivable atrocity on man, woman, and child. It is lamentable to think of the geological and natural-history collections which have been destroyed in Belgium alone—a country famous for its scientific men, the work of their lives gone for ever. I trust all this will not be forgotten when the war is fought out to a proper issue, and that all Lord Walsingham suggests will come about and just punishment be thus meted out.

The German scientific man has been spoilt by success in the past; he was first in the field in many countries, particularly our own. I knew him in days gone by in India, when he filled the best appointments in the Geological Survey, the Forestry Department, etc. Many were friends of my own. In those days they were quite different men in every way from those of to-day. so complete a change has come over the whole German population. It is sincerely to be hoped they will never be employed again in any capacity. H. H. GODWIN-AUSTEN.

Nore, Godalming, September 17.

The South Georgia Whale Fishery.

A NOTE on p. 470 of NATURE for August 15 contains the statement that scientific experts have, until now, not been consulted in the matter of the South Georgia whale fishery, which has been administered entirely by the Colonial Office. There is at present a considerable tendency to criticise Government Departments for failing to make use of scientific opinion, but I feel sure that you will allow me to point out that this particular criticism is not justifiable. The Colonial Office has for some years been fully alive to the fact that the regulation of sub-Antarctic whaling is a scientific problem, and since 1910 it has been in constant communication on the subject with the Natural History Museum. Under arrangements thus made the museum receives detailed statistics from the companies operating at South Georgia, each individual whale caught being separately recorded. Similar statistics are beginning to come in from the South Shetlands (a district almost as important as South Georgia) and from some of the African companies; while promises of returns from other whaling centres have also been received. In addition to this, the Colonial Office furnishes half-yearly and other reports on the whaling operations at the districts under its jurisdiction, and it has received many reports from the museum commenting on the facts thus recorded, and offering advice on the various questions raised.

In the course of 1913 the Colonial Office proposed that a biologist should be sent to South Georgia to make investigations which might contribute towards the solution of the whaling problem. In consultation with the museum, the work was offered to Major G. E. H. Barrett-Hamilton, who accepted the task, and reached South Georgia in November, 1913. News of his untimely death, on January 17, 1914, while strenuously occupied with his observations on whales, was shortly afterwards received in London. The manuscript notes which he left behind show that the investigation had been placed in most competent hands, and they have formed the basis of an important report, which is at present under consideration at the Colonial Office. The appointment of Major Barrett-Hamilton had been made as an initial step in a much larger scheme for the investigation of the problems connected with whaling by means of a scientific station to be established for several years on the Antarctic continent. The preparations for carrying out this idea were interrupted by the war.

That the urgency of the question was recognised by Government Departments, and that the need for obtaining scientific opinion was felt, was further shown by the appointment of an Inter-Departmental Committee on Whaling and the Protection of Whales. In August, 1913, the Colonial Office wrote to the Natural History Museum asking for information with regard to the scientific aspects of whaling for the use of this Committee, and a memorandum on the subject was submitted by the museum in due course. The Committee was engaged in hearing evidence during the first half of 1914, but its labours were discontinued on the outbreak of war.

Early in the present year a new Committee was appointed to facilitate prompt action at the conclusion of the war in regard to the preservation of the whaling industry in the Dependencies of the Falkland Islands. This Committee, on which the Natural History Museum is represented, is actively engaged in collecting information, under the auspices of the Colonial Office.

It is sometimes assumed that expert scientific advice is capable of settling any difficult question which may arise within its own province. The solution of the problem of protecting whales is, however, no easy matter; and I doubt whether there is at present unanimity on the subject among scientific experts. The trustees of the British Museum have for some years been convinced of its importance and urgency, and they have welcomed the opportunities afforded them by the Colonial Office of expressing their views and tendering their advice, based on the study which has been given to the subject in the museum. Assistance from those competent to give it would be cordially received, and I am glad to have this opportunity of inviting scientific experts to communicate their views on the protection of whales to the Natural History Museum, and thus to assist in a matter which is not only of great zoological interest, but also one which may be described without exaggeration as of supreme national importance. SIDNEY F. HARMER.

British Museum (Natural History),
Cromwell Road, S.W.7.

Vitality of Gorse-seed.

ASSERTIONS regarding the length of vitality of certain seeds are frequently made, but these, when investigated, often lack proof. Hence it may be worth while to put on record a clear case of the seeds of the gorse (*Ulex europaeus*) retaining their germinating power for twenty-five years.

Some forty acres of gorse- and heather-covered land situated near my home in the plain of Cumberland were drained, cleaned, and ploughed out in 1893. This area was kept in arable rotation for a number of years; then part of it was laid down in grass in 1904, and the remainder in 1906. It soon became evident that this new pasture would rapidly revert to a gorse-covered common unless drastic measures were taken to rid the ground of the numerous gorse seedlings, which had sprung up from the seeds brought to the surface by the last ploughing. These were stubbed out, and in two or three years' time the ground was entirely free of gorse plants, and has continued so for the ten or more years it has been allowed to remain in permanent pasture.

Last winter this land was again brought under the plough by order of the local War Agricultural Committee, and was sown with oats. The crop has now been reaped, and gorse seedlings, 6 in. or more in height, are to be seen scattered over the stubble, being especially abundant where originally the gorse grew strongest. Evidently, then, the last ploughing has brought to the surface a fresh lot of seed which, though having lain buried in the soil for a quarter of a century, has retained its germinating capacity.

JOHN PARKIN.

The Gill, Brayton, Cumberland,
September 9.

Rock-disintegration by Salts.

THE reference in NATURE for September 19, p. 50, to Mr. J. T. Jutson's paper dealing with the influence of the crystallisation of soluble salts in promoting the weathering of rocks reminds me of Il Fungo, an isolated mushroom-shaped rock opposite Lacco Almeno, on the north shore of Ischia. Formed of porous volcanic tuff. the sea-water rapidly ascends by capillarity, and, being evaporated, large crystals of salt are produced on the face of the rock. As these natural processes are most active over an area about midway between the sea and the summit, the sides there are being hollowed out very rapidly, large flakes of rock constantly falling.

In 1892 the late Dr. Johnston-Lavis gave me a photograph of, and much valuable information respecting, this rock.

C. CARUS-WILSON.

September 20.

GERMAN INDUSTRY AND THE WAR.

I.

A RECENT issue of the Bulletin de la Société d'Encouragement pour l'Industrie Nationale[1]—the French counterpart of our Journal of the Society of Arts—contains two interesting and important articles on the present and future influence of the war on German industry, written by MM. Jaureguy, Froment, and Stephen, which make known a number of facts concerning the means by which Germany has attempted, with more or less success, to evade efforts to isolate her during the war. In spite of the rigour of the blockade to which she has been subjected, there can be little doubt that, thanks to the knowledge, skill, and ingenuity of her chemists and engineers, encouraged and aided financially by the State, she has hitherto managed to provide herself with the means of carrying on the war—not only as regards munitions, in which she has been eminently successful, but also in regard to the alimentation of her people, in which, of course, owing to the complexity of the problem and to natural conditions beyond her control, her success has been less conspicuous. The new industries which have been created, and the great development of those already in existence, would, apparently, enable Germany to prosecute the war almost indefinitely. The determining factors will be the exhaustion of her man-power and the gradual weakening of her *moral*. Both these causes are beginning to tell, and it is abundantly evident from a variety of signs that the Higher Command is realising that the rot has set in. Junkerdom is now fighting only for its existence. The steady and persistent pressure of the Allies will accelerate the advent of the inevitable *débâcle*. The end will come when the remnants of the German armies are driven back to the Rhine.

[1] Bulletin de la Société d'Encouragement pour l'Industrie Nationale, 129, 416. (Paris, 1918.)

In the meantime it is instructive to note what Germany is doing in her efforts to stave off the disaster which assuredly awaits her. It is always wise to learn from your enemies when you can, and Germany has much to teach us concerning the manner in which Science may be made subservient to War and to the conditions which war produces.

We have already dwelt, on former occasions, on the importance of the nitrogen problem in the war, and have given some account, in the light of such information as was available, of the methods by which Germany has attempted to solve it. The communication before us contains a number of statistical statements respecting the development and present position of the several synthetic processes of utilising atmospheric nitrogen which are of interest at this present juncture. It appears that the Birkeland-Eyde process, which in 1913 furnished Germany with some 5000 tons of calcium nitrate from the Norwegian factories, is still worked to a limited extent in Saxony, where a manufactory was established before the war at Muldenstein, employing lignite as a source of power. Ostwald's process of oxidising ammonia catalytically—or rather the Frank-Caro modification of it—is in operation at Spandau, Höchst, Griesheim, and at works belonging to the Badische Aniline Company. Kayser, at Spandau, employs apparatus capable of oxidising 370 kilos. of ammonia in twenty-four hours with a yield of from 90 to 95 per cent. The Badische Company makes use of plant constructed by the Berlin-Anhaltische Maschinenbau, oxidising about 750 kilos. of ammonia in twenty-four hours. The heat furnished by the reaction suffices to maintain the catalyser at a constant temperature of 700° C. The main catalytic agent is said to be one of the oxides of the iron group containing bismuth or one of its salts. During 1915 some thirty installations of this system were erected, each capable of oxidising more than 12 million kilos. of ammonia annually. In the more recent forms of the apparatus the yield has been increased to 17 million kilos. Before the war the main source of supply of ammonia was from coke-ovens and from the gasworks, which in the aggregate furnished about 500,000 tons of sulphate of ammonia, of which agriculture absorbed 450,000 tons.

The Haber process of combining nitrogen, obtained by the fractional distillation of liquid air, with hydrogen procured by the electrolysis of water, as worked out by Bosch and Mittasch, chemists of the Badische Company, was already in operation before the war, but has now been greatly extended. The factory at Oppau has been much enlarged at the Government expense, and other factories have been erected. The capital of the Badische Company has been increased from 14 to 90 million marks. The firms of Bayer, Meister Lucius, Casella, Weiler-Termeer, Kalle, and the Griesheim-Elektron Company have also augmented their capital, and are working in a consortium representing a capital of upwards of 1 milliard of marks.

In addition to the Haber process, ammonia is being produced by the cyanamide method. The factories employing this process are mainly erected in the neighbourhood of lignite deposits, in localities furnishing supplies of natural gas, or where hydraulic power is available. Before the war the principal factories were the Bayerische Stickstoffwerke at Trostberg, the A.G. für Stickstoffdünger at Knapsack, and the Mitteldeutsche Stickstoffwerke at Gross-Kayna (Geiseltal). The development of the cyanamide industry is encouraged by the Government. The Bavarian Company received a subsidy of 40 million marks and undertook the erection of two large factories in proximity to deposits of coal and lignite. These were completed towards the end of November, 1915. The net profits of the Bayerische Stickstoffwerke in 1914-15 were 653,185 marks; in 1916-17 they were 1,547,261 marks. In 1915 the company at Knapsack raised its capital from 3 to 8 million marks. In 1916 the total production of cyanamide had increased to 400,000 tons, practically a hundred times greater than it was in 1913. There is no doubt that it has since been considerably augmented.

Such are the means by which Germany has meanwhile rendered herself independent of Chile saltpetre, or, indeed, of any outside source of nitric acid or ammonia, and has provided herself with one of the essential munitions of war. So absolutely necessary is the production of nitric acid that, in its absence, no army could hold together for a week under modern conditions. This enormous development of the synthetic production of ammonia and nitric acid is of great economic interest, and is bound to have a profound effect on industry after the war. The economic aspect of the matter, however, does not now concern us. We may return to its consideration on another occasion.

Scarcely less important, in view of the war, is the problem of sulphur and sulphuric acid, to which we have already directed attention. Our blockade practically suppressed all German importation of pyrites, of which in time of peace she received upwards of 10 million quintals, 8½ millions coming from Spain. Germany was thus restricted to her own poor deposits in Thuringia, in the Lahn basin, at Tessenberg in Bavaria, and at Meggen in Westphalia. The important deposits of cupreous pyrites of Styria and Hungary were at once exploited, as were those of sulphur in Anatolia. The roasting of blende at Vieille-Montagne and in Silesia had already furnished considerable quantities of sulphuric acid before the war: by intensive working the yield was considerably increased. Processes like those of Schaffner and Helbig and of Chance and Claus were worked on a large scale. The Badische Company utilised the method of Walther Feld, in which crude coal-gas is made to yield its ammonia and sulphur in the form of ammonium sulphate. This is effected by agitating the gas with a solution of ammonium tetrathionate, which absorbs the hydrogen sulphide and ammonia, giving ammonium sulphate, hyposulphite, and free sulphur. By boiling the ammonium tetrathionate with the hyposulphite, ammonium sulphate, sulphurous acid, and sulphur are obtained. By making the two last-named substances react upon the hyposulphite arising from the purification, the tetrathionate is regenerated. The Badische Company has also attempted to prepare sulphuric acid from gypsum or anhydrite, of which Germany has considerable deposits, by roasting the gypsum either alone or mixed with coke, whereby it is transformed into calcium sulphide, which can then be treated by any of the established sulphur-recovery processes, or converted into lime or sulphurous acid, to be either utilised in the manufacture of wood-pulp for paper-making or transformed into oil of vitriol.

So important is sulphuric acid for the purposes of war that its production is controlled by a War Committee, and the Society for the Production of War Chemicals has created a special section known as the Department of the Administration of Sulphur. As in the case of other chemical products, the manufacture and sale are regulated, and fixed prices have been legalised.

In a subsequent article we propose to show how Germany has dealt with the problems of combustibles, metals, alcohol, oils, fats, soap and glycerin, textiles, wood and wood-pulp, caoutchouc, turpentine and lubricants, food, fodder and manures—all of which are more or less essential to her, and of which she has been largely deprived by her own action in embarking upon a war which will prove her ruin.

MEDICAL EDUCATION IN ENGLAND.[1]

THE issue of the modestly named paper before us marks a new stage in the relation of the State to English education. In no merely official style, but with the breadth and freshness of outlook proper to a prophet of reform, Sir George Newman reviews the "undone vast" in the training of medical practitioners for national service. He gives due credit to the great achievements of English medicine, as they have been wrought out by private enterprise, for until comparatively late years the schools of medical craftsmanship were in their essence proprietary, and their system was but a modified apprenticeship. In Scotland doctors were trained at the universities and caught something of the university spirit. The last generation has seen a change, in provincial England at least: London is still in the stage of painful emergence. When grants to the medical schools were first made by the Board of Education in 1908, the State necessarily assumed the duty of watching their application to productive uses. A universities branch of the Board was formed, and Sir George Newman became its medical

1 "Some Notes on Medical Education in England." A Memorandum addressed to the President of the Board of Education by Sir George Newman, K.C.B., Chief Medical Officer, Principal Assistant Secretary of the Board of Education, etc. Presented to both Houses of Parliament by command of His Majesty. (Cd. 9124.) (London: Stationery Office, 1918. Price 9*d*.

assessor. His admirable contribution to "Reconstruction" is the fruit of his official surveys of the present state and future needs of the English schools.

The relation of the community to the doctor has altered. The latter is no longer merely a private craftsman dealing with private clients. Before the war called the main body of practitioners into war service, the State as such claimed the whole-time or part-time service of some 20,000 of them, and imposed heavy civic responsibilities upon the rest. The doctors were called to a wider ministry than heretofore; the State by implication must needs concern itself with the question of seeing that they were fitted to serve it. In the words of the paper, "medicine has become a quasi-public profession; . . . the citizen, as legislator and as taxpayer no less than as patient, is interested in the maintenance of a high standard of medical education. . . . The commonwealth does not require two standards of medical man. . . . All medical education should be fundamentally one and the same in regard to basis, technique, and spirit." Sir George Newman without hesitation pronounces that there is only one education which will meet the requirements of the nation; "in a word, it is a university education in medicine. And the foundation of such an education is science."

He is well aware that the present five years' curriculum is overloaded; but it can be lightened to some extent when all secondary schools teach science efficiently. The student would not, as now, begin his medical course ignorant of the essential propædeutic of chemistry, physics, and biology. If the elements of these were already familiar to him, the university professors of the first-year stage might limit themselves to senior courses on the medical bearings of these subjects. Anatomy and physiology, now taught to an ever-increasing degree in the true scientific spirit, should be more closely related with clinical medicine and surgery. The laboratory and the demonstration-lecture must displace the "systematic" lecture. Pharmacology, from which "materia medica" and pharmacy may now be severed, should link up physiology with clinical therapeutics, and have its laboratories and special staffs. Therapeutics should constitute a distinct department, in direct relation with the hospital ward and out-patient room. Pathology, which has of late "come to its own," must all over the country have its hospital "institute," under its own professor and assistants, and be worked as an indispensable factor in ward-work, and planned on the basis of "cases" rather than "specimens."

It is in the clinical subjects and in preventive medicine that English schools are most defective. The English system treats medicine too much as an art, too little as a science. It gives small chance for the study of prophylaxis or of incipient disease; its ward-cases are too often the "finished article." It is ill organised, for its professors are only part-time men, whose bread-winning work is their private practice, not their teaching. As an eminent physician has said: "Harley Street is the grave of the clinical teacher." "A man cannot serve two masters," says Sir George Newman. "That is the predicament of the clinical teacher in England. And there is only one solution. *He must be paid as a teacher.*" This means, as has been pointed out authoritatively by many who have a right to speak, the establishment and endowment of whole-time professors of the "final" subjects, medicine, surgery, and obstetrics, each with his "unit" of wards, laboratories, and staff, co-ordinated, freed from the compulsion of outside practice, bound to devote himself not only to teaching, but also to research. "The need of English medicine above all others at the present time is the opportunity for the cultivation of the laboratory method and the scientific spirit." For preventive medicine the like is required; the ordinary practitioner need not be a professional or specialist medical officer of health, but he must know enough to articulate his own work with the State services that touch it at innumerable points; and he must interfuse prevention with all his curing. Hence, in his training, it is the interest of the nation to ensure that the purpose and spirit of preventive medicine should pervade the entire curriculum—for all the branches and departments of the latter need its inspiration. The General Medical Council last May took the first step along this path of progress.

"The Place of Research in Medical Schools" is the subject of a moving chapter, in which the verdict of the London University Commission (1913) is cited as an aphorism: "It is a necessary condition of the work of university teachers that they should be systematically engaged in original work," with the pithy comment that "he only is the great teacher who is inspired by the spirit of discovery."

The urgent need for organised and efficient "post-graduate" instruction, to enable the practitioner to supplement his general knowledge by specialities, and to keep himself abreast, by periodic study at the fountain-heads, of modern advances, is eloquently expounded, not for the first time. But it has been brought home with new insistence by the pressure of recent experience. The men of the medical services—Army, Navy, Indian, Colonial—clamour for such opportunities; graduates from the Overseas Dominions, from the United States, and from the Allied countries, are asking for the chance to study in Britain rather than in Germany or Austria. Are we ready for them in London, in England? Sir George Newman sets forth what is still lacking in our equipment, and the list of shortcomings is not small. The cost in money will be considerable: we have the men; we require the organisation. But the President of the Board of Education and "both Houses of Parliament" are told frankly that "it would handsomely repay the State to encourage and to aid" a regular system of post-graduate study, "so rapid and profound are the advances in medicine."

In his conclusions the author finds that, for remedial action, two fundamental necessities exist. There is the need for further financial assistance; there is the need for guidance and direction. The first implies substantial aid from the State; for the second, trust is placed in "the predominant authority of the university . . . as against the claim of proprietary interest," the State assuming only the functions of supervision and advice, "with due regard to the freedom of the university." How far such "due regard" can persist side by side with subvention and supervision it is not easy to say. But if departments and officials were endowed with Sir George Newman's knowledge, and imbued with his temper of sweet reasonableness, a way would be found of reconciling the bureaucratic and the academic points of view. That a way must be found for advance, along the lines of his vividly clear and deeply wise survey, is certain, unless England is, in the Reconstruction, to lose her opportunity and miss the lessons of her time of trial and testing.

THE DYNAMICS OF CYCLONIC DEPRESSIONS.[1]

THE publication in 1906 of Shaw and Lempfert's "Life-History of Surface Air-Currents" marked the passing of a milestone in the progress of our knowledge concerning the mechanism of travelling cyclonic depressions, and it is a matter of surprise that so little further advance along the same lines has been made since that time. This lack of progress obviously could not continue for ever, and two recent publications by Sir Napier Shaw suggest that the next milestone has now been passed.

In the earlier of the two papers[2] a travelling rotating disc of air was considered in which all the air particles had the same relative tangential velocity around the centre. This hypothesis led to valuable conclusions concerning the "secondaries" which so frequently form upon the southern side of the centre, but did not throw much light upon the cyclone as a whole. On consideration it became evident that the mathematics would be much more manageable if the disc of air were assumed to have uniform vorticity ζ, so that the relative velocity $v = \zeta . r$, and, working on this assumption, valuable results have been obtained. This hypothesis implies a disc of air revolving about its centre as a solid like a cartwheel, and the "normal cyclone" considered in the present paper has within itself a circulation of this type. The air particles will trace out trochoids formed by the rolling of the disc of relative motion along the line of motion of the instantaneous centre, and, if sufficiently extended in all directions, the mass will possess intrinsically two centres, (1) a centre of instantaneous motion, or *kinematic centre*, about which the resultant winds shown upon the map at any instant will be revolving (surface incurvature being neglected), and (2) a centre of revolving fluid or *tornado centre*—that is, the centre of the "cartwheel"—which is found at a distance V/ζ on the right-hand side of the path of the instantaneous centre, where V is the velocity of travel of the depression as a whole.

The "normal cyclone" has, however, yet a third centre. If upon the pressure field of a stationary circular depression a uniform pressure gradient from N. (high) to S. (low) be superposed, it is shown that every air particle will commence to follow its appropriate trochoid curve, and the effect will be that the depression will advance across the map from W. to E. with a speed V, while at the same time the system of isobars will be displaced a distance $V/(2\omega . \sin\phi + \zeta)$ to the south from the centre of instantaneous motion (ω equals angular velocity of the earth, ϕ equals latitude). This centre of isobars is termed the *dynamic centre*, and forms the third centre of the travelling depression. As a numerical example, if the rotation of the disc be such that a velocity of 20 m./sec. (gale force) is found 200 km. from the centre of instantaneous motion, and if the eastward speed of progression of the depression be 10 m./sec. in our latitude, the tornado centre will be 100 km., and the dynamic centre 45 km., to the south of the instantaneous or kinematic centre.

Viewed in another way, the pressure system may be taken to be compounded of a set of circular isobars round the tornado or "cartwheel" centre, and a uniform pressure gradient from S. to N., when the rate of advance V of the depression will equal the geostrophic wind corresponding with this field. Since this superposed field may reasonably be taken to be the same as the general field surrounding an isolated cyclonic depression, the conclusion is reached that the speed of progression of such a depression will depend directly upon the strength of the surrounding field, and in certain examples shown this is satisfactorily confirmed. One of the most interesting results reached is undoubtedly that the winds shown on a map for an eastward moving depression will circulate, not about the isobaric centre, but about a point to the north which may be of the order of 50 km. distant. Practical examples of this are also adduced. Other conclusions of importance, such as the probability of secondaries developing at the tornado centre, cannot be more than alluded to in a short notice like the present. The demonstration of the fact that a normal travelling cyclonic depression has three distinct "centres" is the outstanding feature of the paper.

To the reader the treatment appears a little disjointed and to lack mathematical sequence, but the author has forestalled criticism on this point by explaining that he considered it better to set out the matter in the order in which it was developed, since this method would bring directly under review the various aspects of the subject that are presented to the student of weather maps. A straightforward theoretical discussion would lack this advantage.

J. S. D.

1 "The Travel of Circular Depressions and Tornadoes and the Relation of Pressure to Wind for Circular Isobars." By Sir Napier Shaw. Meteorological Office. Geophysical Memoirs, No. 12, 1918.

2 "Revolving Fluid in the Atmosphere." Proc. Roy. Soc., A, vol. xciv., p. 34, 1917.

NOTES.

WE are glad to be able to announce that Stonehenge has been offered to the nation, and accepted on behalf of the Government by the First Commissioner of Works. The munificent donor is Mr. C. H. E. Chubb, of Salisbury, who bought Stonehenge in 1915. For the duration of the war the income of the property is to be handed to the British Red Cross Society.

THE following Food Council to consider general questions of policy affecting the administration of the Ministry of Food has been constituted:—The Rt. Hon. J. R. Clynes (Food Controller), chairman; Major the Hon. Waldorf Astor (Parliamentary Secretary to the Ministry of Food), deputy-chairman; Sir Alan Anderson, K.B.E., vice-chairman; Sir J. F. Beale, K.B.E. (First Secretary to the Ministry of Food); Mr. W. H. Beveridge (Second Secretary to the Ministry of Food); Mr. W. H. Peat; Capt. S. G. Tallents; and Mr. E. F. Wise. Mr. F. L. Turner will act as secretary. The following special Boards in connection with the Council are being constituted:—Imports Board, Home Supplies Board, and Joint Finance Board.

NOTICE has been given that summer time will cease and normal time be restored at 3 a.m. (summer time) in the morning of Monday next, September 30, when the clock will be put back to 2 a.m. The hour 2–3 a.m. summer time will thus be followed by the hour 2–3 a.m. Greenwich time.

DR. W. W. CAMPBELL, the director of the Lick Observatory, of the University of California, has been elected a correspondant of the Institute of France in the section of astronomy.

THE Montyon prize of the Paris Académie des Sciences, of the value of 100*l*., has been awarded to Drs. H. Guillemard and A. Labat for their researches on asphyxiating gases

THE annual Thomas Hawksley lecture of the Institution of Mechanical Engineers will be delivered in the hall of the Institution of Civil Engineers on Friday, October 4, by Dr. W. C. Unwin, who will take as his subject "The Experimental Study of the Mechanical Properties of Materials."

AN address on "Commerce and Industry after the War" will be given, under the auspices of the Industrial Reconstruction Council, by Sir Albert Stanley, President of the Board of Trade, on Wednesday, October 2, at 4.30, in the Saddlers' Hall, Cheapside, tickets of admission to which can be obtained from 2 and 4 Tudor Street, E.C.4. At the recent annual meeting of the Council the following new members were elected to the executive committee:—Sir C. McLeod, Miss L. Dawson, Mr. G. Selby, Mr. J. Baker, Mr. T. O. Jacobsen, Miss M. F. Peake, Mr. E. W. Mundy, and Lieut. H. V. Roe.

THE Meteorological Office has given notice that it will not issue further copies of the Daily Weather Report, the Weekly Weather Report, and the Monthly Weather Report during the war. Subscribers and others are notified that, by arrangement with the director, copies can be retained for them and delivered after the war. Observations will be made as hitherto, and doubtless all the reports will be promptly prepared and printed, but they are no longer available except for public service, where all meteorological information is at present of the highest value.

A MONUMENT in bronze has been erected to Oswaldo Cruz at Rio de Janeiro. It represents Cruz in a sitting posture, and bears the following inscription:—"A Oswaldo Cruz, Homenagem do pessoal da Directoria Geral de Saude Publica, 23-III-1903—19-VIII-1909," the dates marking the period of his most productive work, the eradication of yellow fever from Rio.

IN accordance with the decision arrived at at the extraordinary general meeting of the Institute of Chemistry held on April 27, local sections are now being formed in various important centres. The inaugural meeting of the Liverpool and North-Western section of the institute was held on Thursday, September 12. The registrar, who was in attendance by the direction of the council, referred to the objects to be attained by the establishment of local sections. It is anticipated that local sections will be inaugurated during the coming session at Manchester, Birmingham, Edinburgh, Glasgow, Gretna, and probably other centres.

THE twenty-second annual autumn foray of the British Mycological Society was held, in conjunction with the Yorkshire Naturalists' Union, at Selby from September 9 to 14, under the presidency of the Very Rev. Dr. David Paul. On September 9 Dr. Harold Wager delivered a popular address on fungi. On September 11 Dr. Paul gave his presidential address on "The Earlier Study of Fungi in Britain," dealing with mycological work up to the time of Berkeley. Other papers contributed during the week were two by Dr. Wager on "Spore Coloration in the Fungi" and on "A Fluorescent Colouring Matter from *Leptonia incana*"; "New or Rare British Parasitic Fungi," by Mr. A. D. Cotton; and "Observations on some Sand-dune Fungi," by Mr. H. J. Wheldon. At the general business meeting the officers for the ensuing year were elected as follows:—President, Dr. Harold Wager; vice-president, Miss G. Lister; general secretary and editor, Mr. C. Rea; secretary and recorder, Miss E. M. Wakefield; treasurer and foray secretary, Mr. A. A. Pearson. These, with the following elected members, Mr. W. N. Cheesman, Dr. B. Elliot, Prof. M. C. Potter, and Miss A. Lorrain Smith, will form a council for the general management of the society.

WE learn from *Science* that news has been received by Prof. R. F. Griggs, director of the Katmai expeditions of the U.S. National Geographic Society, announcing the termination and giving particulars of the work of this year's field party, composed of Messrs. J. Sayre and P. R. Hagelbarger, in the Valley of Ten Thousand Smokes. The topographic survey begun last year was extended to the shore of the Bering Sea, adding some 1500 square miles to the map, and completing a section across the base of the Alaska Peninsula from Katmai Bay to Naknek. This survey will furnish the data for the construction of a topographic map on the scale of 1/250,000 of the same standard of accuracy as the work of the United States Geological Survey on maps of this scale.

A BI-MONTHLY periodical entitled the *Journal of General Physiology* is about to be started by the Rockefeller Institute for Medical Research, New York. It will be edited by Dr. Jacques Loeb and Prof. W. J. V. Osterhout. Its aim is to serve as an organ of publication for papers devoted to the investigation of life-processes from a physico-chemical viewpoint.

IT has been decided to found a medical journal in Mexico for the publication of contributions by Mexican physicians and surgeons and information concerning the progress of the medical sciences in other parts of the world. Dr. F. Bello, of Puebla, has been appointed editor.

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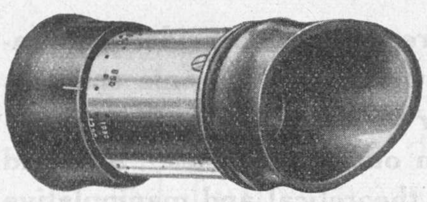

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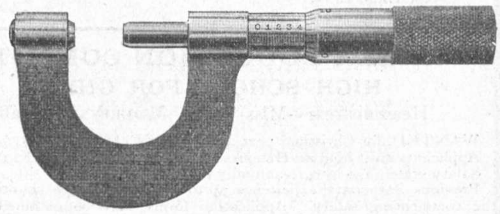

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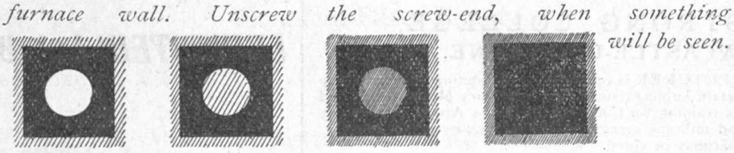

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WE note with regret that the name of Capt. H. A. Renwick has been added to the growing list of young men who have sacrificed their lives in the development of experimental aerodynamics. Capt. Renwick was killed in a flying accident on August 19. After having been a student of Pembroke, and taking Seconds in the Mechanical Science Tripos, he entered Messrs. Yarrow's as an apprentice. In the first month of the war Capt. Renwick was gazetted to a pioneer battalion of the South Wales Borderers, and served for some time in France. Having been severely wounded, he was, early in 1916, attached to the Royal Aircraft Factory. Here he found a congenial opening for his scientific powers, and was soon placed in charge of the instruments and apparatus used in experimental flights. Then, as chief of the corps of observers engaged in aero-dynamical experiments in the air, he was closely associated with all the full-scale work carried out at Farnborough, and made valuable contributions to this rapidly developing science. He learned to fly, and made a number of solo experimental flights. Capt. Renwick was a keen and enthusiastic observer, and his incidental observations of physical and meteorological conditions in the air constitute additions of permanent value to the data now being collected towards a fuller knowledge of the physics of the atmosphere.

AN appreciative obituary notice of the late Prof. G. Archibald Clarke, who died on April 27 last, appears in *Science* for August 30. We are glad to see that full justice has been done to his memory in regard to his work as secretary of the International Fur Seal Commission, the findings and policy of which he profoundly influenced. Prof. Clarke was a man who possessed the faculty to an unusual degree of seizing upon essentials and of taking wide views. Hence, as a consequence of his numerous visits to the Pribiloffs on the work of the Commission, he brought together an immense store of facts in regard to the life-history of the fur seal which will form a lasting monument to his memory. Careful of the smallest detail in regard to every aspect of this subject, he ever kept before him the fact that his observations were also to be used by those who had a purely commercial interest in these herds and their preservation. During 1912–13 he carried on investigations designed to extend over a period of four or five years for the purpose of arriving at data as to the rate of increase of such herds, then apparently rapidly diminishing. But, unfortunately, changes in method and *personnel* since 1913 have made this ideal well-nigh hopeless. Fortunately, Prof. Clarke has left a fine record of his many-sided studies of the fur seal problem in numerous memoirs and articles published in *Science* and other scientific and popular magazines. In his capacity as academic secretary to Stanford University he displayed business talent of a high order; hence his services to the University during its early years of existence cannot be overestimated.

THE March part of the *Museum Journal* of the University of Philadelphia (vol. ix., No. 1, 1918) is entirely devoted to the study of American art, the native production untouched by outside influences. We know little about the mythology of the Mayas represented in their painting, sculpture, and other decorative arts, but a faint notion of some of its traits, if not of its contents, may be gathered from the folk tales still current in remote districts of Central America. As leading examples of this indigenous art, Mr. G. B. Gordon describes a remarkable piece of sculpture entitled "A King in all his glory," from the ancient city of Copan, in Honduras, and one of "The Captives," found a few years ago on the Usumacinta River. While in motif and method these carvings will look strange to artists trained under European traditions, they display a remarkable power of characterisation and execution, which are well illustrated by Mr. Gordon's interpretation. Other noteworthy specimens of local American art described in this pamphlet are a fine Maya vase, a pair of fine totem-poles, and beautiful examples of Huron quill-work and of the decorative arts of the Indians of the Amazon.

THE report for the year 1917 of the Museums of the Brooklyn Institute of Arts and Sciences contains some striking figures in regard to the attendance of children, for whom, as in all the American museums, special rooms and collections are set apart. During the year 6226 school-children, with 239 teachers, visited the museum for special instruction. "One thousand four hundred and fifty-six boys and girls of high-school age consulted scientific and literary books and periodicals, and prepared for debates." The juvenile visitors and students are catered for by a special staff, and there can be no doubt that extremely valuable educational work is achieved by this branch of the museum's activities.

THE Corporation of Hull has formed a special museum for the illustration of the shipping and fishing industries. An interesting part of the collection is a series of coins and tokens illustrating the evolution of shipping. Typical examples of medieval ships are shown on the seals of Scarborough, Hedon, and many other places. The seventeenth-century tokens, which are so eagerly sought for, show many representations of ships, anchors, etc. The token of Earl Howe (1705) bears on the reverse, "The Wooden Walls of Old England," with a typical example of a fighting ship with tall masts. The collection is described by Mr. T. Sheppard in vol. ii., part 2, of the Transactions of the Yorkshire Numismatic Society.

ALL who are interested in the anatomy of the Cetacea will welcome a memoir on the skull of Cuvier's whale (*Ziphius cavirostris*) which appears in the Bulletin of the American Museum of Natural History (vol. xxxviii., p. 349). The author bases his study on two skulls—one of a young adult female, the other of a ripe fœtus which had been disarticulated. These he describes in detail, and his descriptions will prove of great value to future workers, as well as to those who desire to use his results in comparative work. In the course of his memoir he advances some interesting speculations as to the factors which have brought about the very remarkable changes which have taken place in the morphology of the cetacean skull, and these are worthy of careful consideration.

IN *Sudan Notes and Records* (vol. i., No. 3, July, 1918) a plea is made on behalf of the white ant, which has naturally acquired a bad reputation among European residents. The characteristic feature of the climate of the Sudan is the rapid growth of vegetation promoted by seasonal rains or artificial irrigation, followed by a period of drought and desiccation. The white ant attacks vegetation only when it is weakened by drought or disease, and in that case the sooner it is destroyed the better. But for the activity of the white ant the whole of the fertile parts of the Sudan would, in a very few years, be covered with an impenetrable layer of dead vegetation; and the only alternative method to clear it off would be by the agency of fire, the dangers of which are obvious.

A SECOND edition of vol. v. of "Special Reports on the Mineral Resources of Great Britain," dealing with potash-felspar, phosphate of lime, alum shales, plumbago or graphite, molybdenite, chromite, talc and steatite (soapstone, soap-rock, and potstone), and diatomite, has just been issued by the Ordnance Survey Office, Southampton, and in London by Messrs. T. Fisher Unwin, Ltd. It is mainly a reprint of the first edition, but gives additional information respecting potash-felspars, steatite, and diatomite.

THE *National Geographic Magazine* for June last contains a very fine series of instantaneous photographs illustrating the processes of coastal erosion and accumulation. We do not think that anything is gained by the comparisons with military operations, made by Mr. La Gorce in a series of journalistic titles and descriptions. These tend, indeed, to divert attention from the interesting records that he has brought together.

STILL further exactitude is given to our knowledge of the minerals of the silica series by Messrs. J. B. Ferguson and H. E. Merwin (*Amer. Journ. Sci.*, vol. xlvi., 1918, p. 417). The melting-point of tridymite has now been determined for the first time, and is given as $1670° \pm 10°$, while that of cristobalite proves to be $1710° \pm 10°$, thus justifying Bowen's comments on previous results in 1914.

THE occurrence of copper at certain stratigraphical horizons has been attributed to the accumulation of salts of the metal in the blood of organisms, and Mr. A. H. Phillips, of Princeton, now advances a similar suggestion for vanadium (*Amer. Journ. Sci.*, vol. xlvi., 1918, p. 473). This element has been found in certain ascidians and holothurians. Although it may be detected in almost all igneous rocks, its commercial sources are sedimentary rocks or coals.

THE conclusion that two distinct epochs of drift-deposition are well marked in Iowa is still further strengthened by Messrs. W. C. Alden and M. M. Leighton in the annual report of the Iowa Geological Survey for 1915, p. 49. The strong clay or "gumbo" produced by prolonged weathering of the underlying Kansan drift is overlain by the drift of the Iowan epoch. We must now be prepared for the perpetuation of the quaint term "gumbo," as well as G. F. Kay's "gumbotil," in glacial geology.

THE bulletins of several seismological observatories have reached us recently. The most complete are naturally those published in neutral countries, such as those of the Dutch station of De Bilt, near Utrecht, for the years 1914 and 1915 (*Konink. Nederl. Meteor. Inst.*, No. 108), and of Zi-ka-wei (China) for February to May of the present year. Instead of the annual volume of "Notizie sui terremoti osservati in Italia," the Central Geodynamic Office at Rome has issued a list of Italian earthquakes felt during the year 1916 (*Boll. Soc. Sismol. Ital.*, vol. xx., for 1916, pp. 228–45). The bulletin of the seismological station at Georgetown, U.S.A. (Georgetown University Publication, Bull. of the Seismog. Station, No. 2, 1918), contains the records for the year 1917, and also a list of earthquakes during the same year compiled from newspaper notices and from materials communicated from the Italian observatory of Rocca di Papa. The incompleteness of this list, due to war conditions, is evident from the fact that 90 per cent. of the earthquakes noticed occurred in Italy and the United States.

A REPORT of the Meteorological Committee for the year ended March, 1918, the sixty-third year of the Meteorological Office, has been submitted to the Lords Commissioners of his Majesty's Treasury. The report is in a very condensed form. No change has occurred during the period in the membership of the Committee, Sir Napier Shaw continuing as director, but "a large number of changes have taken place in the office staff," many being due to the exigencies of the time. Greatly increased demands are made upon the Office by the Naval, Military, and Air Services, which immensely outweigh the claims of the general public prior to the war. The demand for meteorological instruments, for instance, has risen from 3000*l*. a year to 12,000*l*. The chief feature mentioned is "the great development of pressing demands for expert meteorological assistance, and the prospect of still larger demands in the future." A Naval Meteorological Service is now attached to the Hydrographic Office of the Admiralty, and there has been a large extension of the Meteorological Section of the Royal Engineers, as well as in the Royal Air Force. Post-war problems have involved correspondence with the Ministry of Reconstruction. A knowledge of the weather is stated to be necessary now, not only at the earth's surface in many parts of the globe, but also at elevations. It is stated that among the immediate requirements of the science is the compilation in a reference form of "the information that is at present scattered in scientific journals, and of which the existence is only known to a few experienced meteorologists." The investigation of atmospheric pollution is another branch of work now allied to the Meteorological Office, and there are also the numerous observatories scattered over different parts of the British Isles, all doing admirable and useful work.

Symons's Meteorological Magazine for September seems meagre to those accustomed to the remarkably complete statistical details and the useful and interesting map of the rainfall in the Thames Valley. The magazine has now been issued for fifty-two years, and this is the first time that it has "failed to contain statistical data of the preceding month." The difficulties arising from the war are referred to, and mention is made of the increased labour and strain. "The last difficulty, however, springs from one of those conditions against which 'the gods themselves fight in vain,' and we have to submit. Time will, no doubt, overcome this difficulty also, and when it does so the tables and maps missing will be forwarded to all subscribers." In the current number an article is given on "The Water-power of the British Empire," based on the Preliminary Report of the Water-power Committee. Speaking for the editors of *Symons's Meteorological Magazine*, the article claims that "in the *Geographical Journal* for April, 1896, more than twenty years ago, we elaborated a scheme for the complete geographical description of the British Isles, with special reference to the survey of natural resources, and the time estimated for the completion of the work was twenty years. Had the scheme, which perished in a general chorus of praise of its promise, been carried out, the Ministry of Reconstruction would now have before it a mass of elaborated data, the like of which cannot now be obtained in time to guide the after-war development of the country." The correspondence on "Ashdown Forest Climatology," suggested by a walk of two meteorologists, is interesting, dealing with rain and mist formation, and it calls to mind meteorological work in the neighbourhood by Prince, of Crowborough.

IN an interesting article on "Pure Science and the Humanities" (*Queen's Quarterly*, vol. xxvi., 1918, pp. 54–65) Mr. J. K. Robertson acts as a daysman between two disciplines which ought never to have been at variance. The student of the humanities has chiefly to do with man and his activities, intellectual, literary, artistic, social, and political, in the past and the present. But he uses scientific methods; he cannot abstract man from his cosmic stage and its scenery; and he knows how scientific discoveries affect human thought and life. Therefore, when he is wise, he looks on science as in natural alliance, not in hostility. The student of science has, in the main, to do with the order of Nature. But he cannot exclude man and his works, not even his dreams; he has to study the history of his science, which often shows itself as a social phenomenon; he has his "formal discipline" as rigorous as that of the classics; his everyday work stirs the imagination, and is often rich in æsthetic stimulus; and he knows that his science may contribute, not only to the glory of the Creator, but also to the relief of man's estate, as Bacon put it. Moreover, both kinds of discipline require the same qualities of intellectual conscience—accuracy, veracity, patience, and courage. There is no sense in trying to make things that are different seem the same, but the author shows that what should be looked for, in the name of common sense, is sympathetic co-operation. For the two disciplines are complementary, equally natural and equally necessary.

THE U.S. Bureau of Standards will supply on request Technologic Paper No. 113, which contains a description of the Bureau's method of determining the permeability of balloon fabrics, together with a discussion of the effect of various experimental conditions on the results obtained. The method is essentially an elaboration of Frenzel's modification of the N.P.L. method. The fabric is in contact on one side with a stream of hydrogen; over the other side air is passed at a measured rate, the concentration of hydrogen in it being determined by a one-meter Rayleigh-Zeiss gas interferometer. By reducing the depth of the gas- and air-chambers of the permeability cell to 2 mm. and 4 mm. respectively, the period required for the attainment of equilibrium conditions is shortened to about thirty minutes; the results are accurate to about 5 per cent. Curves are given for the effect of temperature and of hydrogen excess pressure on the permeability. The standard temperature adopted is 25° C.; the permeability at 15° C. is about 65 per cent. of that at 25° C. The influence of aqueous vapour is noted, dried gases giving an observed permeability about 5 per cent. greater than when they are two-thirds saturated. Vapours of rubber solvent may affect the readings; if necessary, a correction is applied from blank tests. The permeability of balloon fabric by air is found, by a suitable variation of the interferometer method, to be on the average 1/3·8 of the permeability by hydrogen.

THE column of smoke usually emitted by a steamer is a vital factor in betraying her presence to an enemy. Thus a tramp steamer with the usual type of funnel emits a column of smoke to a height of 150 ft., which is visible to an observer whose eye is 15 ft. above sea-level and 17·4 nautical miles from the steamer. The danger is reduced considerably by a smoke system developed by Messrs. Yarrow and Co., Ltd., and described in the *Engineer* for September 13. The device consists of two smoke-ducts leading from the funnel to each side of the ship, the exit-mouths of the ducts being inclined downwards towards the surface of the sea. A damper in the funnel and other dampers in the ducts permit the funnel to be closed and the ducts opened. Each duct has an internal water-spray, which delivers a conical spray arranged just to touch the exit edges of the ducts. The effect of this spray is to cool the hot gases so as to cause them to fall to sea-level, and to absorb a large proportion of the solid particles of carbon in the smoke, thus reducing its blackness, and therefore its visibility. In actual use, the smoke never rises above the level of the bridge, and its appearance is similar to that emitted by a locomotive, which is black only for a minute or two after the furnace-fires have been stoked afresh. The control of the air supply to the furnaces is also improved by the device.

THE successful testing last month of the new Quebec Bridge marks the completion of a great work which has claimed the attention of engineers for many years past. An interesting article will be found in *Engineering* for September 13, which includes many excellent illustrations from photographs, showing the construction of the bridge and the methods employed in erection. The structure is of the cantilever type resting on two piers, 1800 ft. centre to centre; the two cantilever arms are each 580 ft., and the span is completed by a central suspended girder of 640 ft. span, under which there is a free headway at high water of 150 ft. The two anchor-arm spans are each 515 ft., and the total length of the whole structure, including approach spans, is 3239 ft. There are two railway tracks, and outside these two footpaths. The collapse of the first bridge during erection in August, 1907, has undoubtedly influenced American bridge design for the good. A contributory cause to the accident was the ridiculously small sum set aside for professional advice, which made the provision of an adequate scientific staff impossible. This lesson was taken to heart in the design of the new bridge; the preparation of the plans for the official design of the new structure is said to have cost 100,000*l*., and a board of engineers was constituted to supervise the plans and erection. Numerous tests were made on models of the lower chord compression members (which were the cause of the disaster to the first bridge), and it is of interest to note that some of these "models" exceeded in size the principals of most bridges.

A NEW series of monographs on experimental biology and general physiology is announced by the J. B. Lippincott Co. The general editors will be Dr. J. Loeb, Prof. T. H. Morgan, and Prof. W. J. V. Osterhout. Among the volumes arranged for are "The Chromosome Theory of Heredity," Prof. T. H. Morgan; "In-breeding and Out-breeding," E. M. East and D. F. Jones; "Localisation of Morphogenic Substances in the Egg," Prof. E. G. Conklin; "Tissue Culture," R. G. Harrison; "Permeability and Electrical Conductivity of Living Tissue," Prof. W. J. V. Osterhout; "The Equilibrium between Acids and Bases in Organism and Environment," L. J. Henderson; "Chemical Basis of Growth," Prof. T. B. Robertson; "Primitive Nervous System," Prof. G. H. Parker; and "Co-ordination in Locomotion," A. R. Moore.

Mr. Edward Arnold announces "Petrol and Petroleum Spirits," by Capt. W. E. Guttentag, with a preface by Sir John Cadman; *Messrs. Longmans and Co.'s* list includes a new and enlarged edition of "Liquid Steel: Its Manufacture and Cost," by Col. D. Carnegie and S. C. Gladwin; *Messrs. Crosby Lockwood and Son* promise "The Aircraft Identification Book for 1918: A Concise Guide to the Recognition of Different Types and Makes of all Kinds of Aeroplanes and Airships," by R. B. Matthews and G. T. Clarkson, and a new edition of the "Naval Architect's, Shipbuilder's, and Marine Engineer's Pocket Book," by C. Mackrow and L. Woollard; *Messrs. G. Routledge and Sons, Ltd.*, have in preparation for their New Industrial Efficiency Books series a translation by E. Butterworth of "The Human Motor and the Scientific Foundations of Labour," by Dr. J. Amar, "The Science of Labour and its Organisation," by Dr. J. Ioteyko, and "The Taylor System in Franklin Management," by Major G. D. Babcock.

OUR ASTRONOMICAL COLUMN.

TWENTY-FOUR-HOUR TIME IN THE ARMY.—An Army Order issued last week states that from October 1 the system of twenty-four-hour time reckoning, starting from midnight, will be adopted throughout the British Army. This system is already in general use at sea, and we hope that its introduction into the Army is a step towards its adoption by the general public. Attempts were made in this direction thirty years ago; Sir W. Christie had the gate-clock at Greenwich arranged to show this time, and it was suggested that astronomers should change the commencement of their day from noon to midnight, so as to have a single system for all purposes. Both proposals collapsed at that time owing to insufficient driving-power, but they are now being revived with better prospects of success. There is a great probability that the various astronomical ephemerides will from the year 1925 use the day commencing at midnight; the necessity of preparing these ephemerides many years in advance makes an earlier change impracticable. But there is no reason why the general use of twenty-four-hour reckoning should not begin sooner. If the railway companies could be induced to use it in their time-tables it would prevent all confusion between a.m. and p.m., and would also accustom the public to the system. The Army Order states that four figures are always to be used for hours and minutes; for example, 4.7 a.m. will be written as 0407. This is a convention already familiar to American astronomers.

WOLF'S COMET.—The following ephemeris for Greenwich midnight is by M. Kamensky (*Astr. Journ.*, No. 738):—

Date		R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
Oct.	1	20 12 33	13 11	0·2416	0·0242
	5	20 17 0	11 46	0·2375	0·0267
	9	20 22 6	10 22	0·2336	0·0299
	13	20 27 51	8 59	0·2298	0·0337
	17	20 34 10	7 39	0·2262	0·0380
	21	20 41 8	6 22	0·2228	0·0430
	25	20 48 35	5 7	0·2196	0·0485
	29	20 56 34	3 56	0·2166	0·0544

The theoretical brightness is greatest on October 12, but the physical brightness is likely to increase up to the time of perihelion.

BORRELLY'S COMET.—The following ephemeris for Greenwich midnight is by L. v. Tolnay (*Astr. Nach.*, No. 4955):—

Date		R.A. h. m. s.	S. Decl. ° ′	Log r	Log Δ
Oct.	1	5 38 8	9 38	0·1733	9·9614
	5	5 45 51	8 44	0·1689	9·9424
	9	5 52 21	7 42	0·1648	9·9229
	13	6 0 39	6 32	0·1610	9·9029
	17	6 7 42	5 13	0·1576	9·8825
	21	6 14 29	3 42	0·1545	9·8616
	25	6 21 0	1 58	0·1518	9·8403
	29	6 27 12	0 0	0·1496	9·8189

The comet is likely to be an easy telescopic object at the end of October and in November.

THE NEW STAR IN AQUILA.—Preliminary accounts of photographs of the spectrum of Nova Aquilæ obtained at the Lick and Mount Wilson observatories have been given by Dr. G. F. Paddock and by Messrs. W. S. Adams and A. H. Joy (Pub. Ast. Soc. Pac., vol. xxx., No. 176). Observations were commenced at Mount Hamilton on June 10, and at Mount Wilson on June 8, and in each case the plates include the visual as well as the photographic part of the spectrum. The descriptions of the spectra are in general accord with previous accounts, and show that the nova followed the usual spectral transformation. Among other details Dr. Paddock refers to the extraordinary changes in position and intensity which took place in a pair of absorption lines at wave-lengths 4058 and 4064. The green nebular line was first recorded on June 23, and the line 4363 on June 22. A table of bands measured on a plate taken on June 21 includes lines in the red at 6299, 6367, 6467, besides Hα, and lines in the yellow at 5876 (D_3), 5753, and 5675. The Mount Wilson observers classify the earliest spectrum of the nova as of type A, with very broad hazy bands of hydrogen, displaced about 20A to the violet. The magnesium line 4481 was also present, and displaced by the same amount. Of special interest is the observation that a large number of the absorption lines on June 11 could be identified with lines in α Cygni, when allowance was made for a displacement of the nova spectrum amounting to 20A at Hγ, and directly proportional to the wave-length in the case of other lines. The nebular bands at 4363 and 5007 were indicated as early as June 20, and the latter had become well marked by June 23.

Numerous observations of the nova are summarised in Circular No. 208 of the Harvard College Observatory. The first record at Harvard was on May 22, 1888, when the photographic magnitude of the star was 10·5, and from that date to June 3, 1918, as shown on 405 plates, the brightness was subject to small but undoubted changes. On June 7 the star was of the 6th magnitude, and on the following night brighter than 1st magnitude. Subsequent observations are tabulated to July 22, and show that after the star began to fade the light fluctuated by half a magnitude at intervals of about ten days. The oscillations were accompanied by marked changes in a line at 4059 in the spectrum of the nova.

A large number of estimates of the brightness of the nova are also included in an interesting article by M. Flammarion which appears in the August issue of *L'Astronomie*.

THE METALLOGRAPHY OF TUNGSTEN STEELS.

MANY investigations of tungsten steels have been made, but there has, as yet, been no systematic study of them, and their structural constitution is almost unknown. The steels themselves have long been important in an industrial sense, in that tungsten is an essential constituent of many magnet and rapid-cutting tool steels. The remarkable fact that the initial temperature from which they are cooled and the rate of cooling determine the position of the critical points has long been familiar to metallurgists, but hitherto there has been no completely satisfactory explanation of it. The publication of a systematic study of the magnetic qualities and metallography, not only of the tungsten steels, but also of carbonless iron-tungsten alloys, by Honda and Murakami in the recently issued science report (vol. vi., No. 5) of the Tohoku University is therefore to be welcomed.

The authors have constructed a preliminary equilibrium diagram of the iron-tungsten system, from which it appears that only one compound, Fe_2W, as put forward by Arnold and Read, exists. At ordinary temperatures iron dissolves this tungstide up to a concentration corresponding with 9 per cent. of tungsten. In steels which contain tungsten above this concentration the tungstide appears as small globules scattered through the crystals, which were formerly considered to be a double carbide of iron and tungsten.

In tungsten steels the tungsten exists either as the carbide, WC, or the tungstide, Fe_2W, or in both forms according to the percentage of tungsten and carbon. In the normal state the tungsten carbide and iron carbide exist as a double carbide, $4Fe_3C.WC$, which has its critical point at 400° C. as compared with 725° C. for pure iron carbide. Above the Ac_1 point this double carbide dissociates into its components, but if the maximum temperature is not very high these recombine during cooling, and are deposited from solid solution at 400° C., forming a eutectoid with the ferrite. Above 1100° C. the following reaction occurs,

$$WC + 5Fe = Fe_3C + Fe_2W,$$

and during cooling the lowering of the transformation points occurs in consequence of the dissolved tungstide in austenite. The greater the carbon concentration in the system, however, the less does the above reaction proceed.

The lowering of the Ar_1 transformation due to heating increases with maximum temperature, and this depends on the tungsten, but not on the carbon content. Above 9 per cent. of tungsten, however, corresponding with the maximum solubility of this metal in iron, the lowered Ar_1 point is constant at about 440° C. If, now, a specimen which has a lowered Ar_1 point be reheated just beyond the Ac_1 point (about 900° C.), and then cooled, the transformation takes place at the normal point. This is due to the fact that tungsten carbide is formed in the Ac_1 range according to the reaction,

$$Fe_3C + Fe_2W = WC + 5Fe,$$

and during cooling the recombination of the tungsten carbide with the remaining iron carbide occurs. The authors are to be congratulated on their careful magnetic and metallographic analyses, which have enabled them to present a clear and very plausible conception of the chemical, structural, and phase changes which occur in tungsten steels both on heating and cooling.

H. C. H. C.

FUEL ECONOMY.

THE economical use of coal has been referred to frequently in these columns, but with all the various proposals for its more efficient application for power production the possibilities of effecting marked economies with existing boiler-plants have not been fully appreciated. In the columns of *Engineering* (July 12 and 19) Mr. D. Brownlie gives data of the examination of 250 boiler-plants, comprising 1000 boilers and using annually more than two million tons of coal. Seventy-six per cent. of the plants were hand-fired, the average net efficiency being 57·8 per cent.; the remainder, mechanically fired, show an efficiency of only 61·4 per cent. Only 9·6 per cent. of the plants show a higher efficiency than 70 per cent. Certainly these figures indicate very bad practice, for a net working efficiency of 75 per cent. may well be aimed at. Reorganisation of the plants examined to reach this figure would alone entail a saving of 430,000 tons of coal annually; throughout the country it would possibly lead to a saving of 15,000,000 to 20,000,000 tons. As Mr. Brownlie points out, "the question of the economical generation of steam will always be a very important part of the greater national scheme of coal economy, even if all the power of the country is generated by gas-engines and the by-products of the distillation of coal." As a large part of the power will undoubtedly be steam-generated in existing plants for many years to come, the improvement of the efficiency of these plants is urgently called for during the period which must elapse before the general reorganisation of the whole system of power production can be carried out.

Further evidence on fuel economy is contained in Bulletin No. 31, Circular 7, of the University of Illinois Engineering Experiment Station. This bulletin deals with the operation of hand-fired power plants, and the matter is presented in a manner readily understood by those who are not experienced engineers. About 6,000,000 tons of coal are consumed annually in Illinois in operating hand-fired power plants, and it is believed to be within the limits of practical attainment to effect a saving of from 12 to 15 per cent. of this fuel. Descriptions and drawings are given of simple appliances and the methods of using them explained, whereby the men who fire the coal may obtain precise information regarding the best working conditions for given steam consumptions. With proper attention these appliances enable the correct working conditions to be reproduced at any time, and also give evidence which leads to the detection of defects in the plant which would not otherwise be suspected. The section dealing with the storage of coal is of interest, and contains a very suggestive statement:—"Do not undertake to store coal until you are sure you know how to do it properly and safely." The circular has been compiled by a committee of the University authorities, aided by an advisory committee including several well-known names, and can be commended to the notice of all who desire to introduce scientific control in their boiler plants.

SALARIES IN SECONDARY AND TECHNICAL SCHOOLS, ETC.[1]

THE chief duty of this Committee, as defined in the terms of reference, was "to inquire into the principles which should determine the fixing of salaries for teachers in secondary and technical schools, schools of art, training colleges, and other institutions for higher education (other than university institutions)." They were specifically asked not "to consider the question of the amounts by which existing salaries should be improved."

Progress in the higher education of the nation depends, in the first instance, upon attracting and retaining, by means of adequate salaries and suitable salary scales, the services of the most capable and highly qualified teachers. The present rates of payment fail to secure this. The report states (p. 52) that the average salary of 3350 full-time assistant masters in 404 grant-aided boys' secondary schools in England and Wales on January 31, 1917, was only 187*l.* per annum. The average salary of 4294 assistant mistresses in similar schools was 130*l.* per annum. Out of 1050 secondary schools in England and Wales receiving grants from the Board of Education, in only 460 of these schools were salaries regulated by definite scales in January, 1917. Salary scales were, in general, only short scales covering a period of five or six years, the average maximum for graduates (men) being only 196*l.* 7*s.* The information in the report respecting salaries in technical schools, polytechnics, etc., is much less detailed and precise (p. 41). It would appear, however, that on March 31, 1914, the average salary of heads of departments and assistant teachers in these institutions was about 180*l.* per annum.

In view of the inadequate salaries just mentioned, especially with the higher cost of living, increased taxation, and the more generous remuneration now offered by commerce, industry, and the State services, it is no wonder, even allowing for certain recent improvements, notably in London, that the Committee

[1] Report of the Departmental Committee on Salaries in Secondary Schools, Technical Schools, etc. (Cd. 9140.) (H.M. Stationery Office.) Price 6*d.* net.

reports:—"We have no doubt that a very great increase of salaries is necessary . . . it has been brought home to us that the teaching services are experiencing increasing difficulties in attracting a reasonable share of the young men and women who give evidence of outstanding ability." This is felt more particularly in the technical schools, where the leakage from the profession and the difficulty of obtaining new teachers, due to the low salaries, the absence of salary scales, and the higher payment offered in industry, is raising serious obstacles to the development of technical education.

The principal recommendations of the Committee are as follows:—

(*a*) *Secondary Schools* (p. 25).—A minimum initial salary for (graduate) teachers in all secondary schools in receipt of public money should be fixed by the Central Authority, and a minimum amount prescribed at a later stage in the teacher's career. Salaries of assistant teachers should be regulated by scales. They should be such that teachers receive a substantial salary at the age of thirty-two or thirty-three, with increments continuing up to the age of about forty-two or forty-three. Normally, increments should be annual and automatic (subject to reasonable conditions as to efficiency). Equality of pay for the two sexes would, in existing circumstances, lead to one being underpaid and the other overpaid. No differences in salary should be made upon the basis of the subject taught or the size of the school. The possession of a high degree or other special qualification of a scholastic character may be recognised by placing its holder at a point on the scale above that which he would otherwise occupy. Heads of departments and assistants performing special duties should be remunerated by additions to their salary.

(*b*) *Technical Schools*.—Full-time assistant teachers of senior and advanced students, who are graduates or have qualifications equivalent to graduation, should be paid by scale at as high a rate at least as is paid in secondary schools, higher remuneration being given in exceptional cases where a teacher's qualification consists of long works experience and high technical knowledge. The salary may be determined by what will induce him to leave his occupation, otherwise the scale should be similar to that of the secondary-school teacher. The salaries of artisan teachers will be settled in the main by competition with industry.

The above recommendations respecting salaries in technical schools, bringing the payment of the full-time assistant lecturer up to that of the secondary-school teacher, would mean a great advance if carried into practice. Thus in London the assistant lecturer in a technical school or polytechnic rarely rises above 250*l*., whereas the secondary-school teacher may rise to 400*l*., or 450*l*. in special cases.

The Committee deals also with salary scales in schools of art, training colleges, etc., in a similar manner to its proposals relating to secondary and technical schools. An important general recommendation respecting the application of new scales to existing teachers states that this should not be too long drawn out, and there should be no avoidable delay in giving to every teacher some immediate and substantial instalment of any intended advance.

The proposals of the Committee, if carried into effect, would go far to remove one of the chief obstacles to the improvement of the higher education of the nation. There still remains, however, as regards salaries, the not unimportant question of the salaries of assistant lecturers in university colleges and similar institutions. Despite much criticism and a certain amount of agitation, these salaries still remain in a most unsatisfactory condition, even when compared with the new maximum salary of the L.C.C. elementary-school class-teacher (240*l*. or 300*l*.), or that of the London secondary-school assistant teacher (300*l*. non-graduate, 400*l*. or 450*l*. graduate).

J. WILSON.

HIGH-TEMPERATURE PROCESSES AND PRODUCTS.[1]

IN comparing workshop processes at present in use with those employed twenty years ago, many striking changes may be noted, all tending to cheaper and more rapid production. It will be found, on examination, that some of the most important of these changes are due to the utilisation of high-temperature processes, or to appliances in which new materials produced at high temperatures are employed.

At the present time, when the economic generation of electricity in this country by the aid of large, central power-stations is under consideration, the present and future importance of high-temperature processes and products cannot be too strongly emphasised. In any scheme that may be evolved, provision should be made for electric-furnace work on the large scale, as otherwise we shall remain, as heretofore, dependent upon other countries for many essential materials.

One of the most recent applications of the oxy-hydrogen flame is to the spraying of metals on to cold surfaces. In what is known as the Schoop process the metal, in the form of wire, is fed into the interior of the flame, where it is melted and then blown by compressed air, in a state of very fine division, on to the surface to be coated. The arrangement is such that when the size of the flame is increased or decreased, the feed of wire is changed simultaneously, so that the rate of deposit per unit area is constant. The finely divided metal fills all the interstices of the surface upon which it impinges, and becomes firmly attached; and by continuing the process any desired thickness may be deposited.

The thermit reaction has also been applied to the production of pure metals, and has proved of great value in cases where it is necessary to secure a product free from carbon. In the manufacture of special classes of steel in which manganese or chromium is used, it is desirable that these elements should be free from carbon, in order that the final carbon content may be regulated to any desired amount in the finished product. As prepared by furnace methods, these metals always contain carbon to a greater or less extent, and hence for high-class steel the carbon-free metals produced by the thermit method are preferable, although more costly.

Before the war the thermit industry was in German hands, and it is a matter for congratulation that the present British proprietors have been able to reproduce practically all the compositions which previously were imported. This is an excellent example of the value of research in applied science.

The rapid increase in the output of electric steel is due to several causes, chief amongst which are (1) the superior properties of the product, (2) the possibility of producing steels according to a given formula without difficulty, (3) the greatly reduced loss from oxidation of light steel scrap fed into the mixture, and (4), which applies specially to Britain, the possibility of obtaining a cheap supply of energy in certain localities. When all these factors are taken into account, high-grade steel can be produced more

[1] Abridged from Cantor Lectures delivered before the Royal Society o. Arts in January and February, 1918, by Mr. C. R. Darling.

economically by the electric furnace than by the aid of fuel.

Furnaces of thirty tons capacity have been constructed, and this is considered by some authorities to be the upper limit of economic size. One of the chief drawbacks at present is the rapid deterioration of the refractory lining; but this trouble will no doubt be overcome by the production of durable refractories by electric-furnace methods. In the event of one or more of the super-power stations proposed by the Coal Conservation Committee being erected near London, it is quite possible that the metropolis may become an important centre of the steel-refining industry.

Direct oxidation of the nitrogen in the atmosphere may be effected by the electric arc, and several types of furnace have been designed for the production of nitric acid by this means.

Two other chief methods of nitrogen fixation, involving high-temperature processes, have been introduced: the Serpek process, in which aluminium nitride is first formed, and from which ammonia is obtained by treatment with water; and the cyanamide process, in which nitrogen is passed over heated calcium carbide, yielding the compound $CaCN_2$, from which ammonia may be obtained by treatment with steam. In each case the ammonia produced may be converted by catalytic means into nitric acid.

The pre-war consumption of carbide in this country was about 30,000 tons, of which all but about 2000 tons was imported. The small quantity made at home came from the works of the British Carbide Products, Ltd., at Thornhill, where power was obtained from the Yorkshire Power Co. The demand for carbide for various purposes has greatly increased during the war, and the works of the company named have now been removed to Clayton, near Manchester, where furnaces have been installed capable of turning out 15,000 tons per annum, power being taken from the Manchester Corporation.

Whether the manufacture of carbide in Britain will become a large and profitable industry depends upon the success or otherwise of schemes for producing cheap electrical power.

The history of carborundum furnishes one of the romances of science, and shows how a small laboratory experiment may result in the establishment of a large and prosperous industry.

The main reaction in the production of carborundum is shown by the equation $SiO_2+3C=SiC+2CO$. Carborundum is therefore chemically silicon carbide. In the manufacture on the large scale a mixture of sand, coke, and a quantity of common salt is placed in the electric furnace round a core of granular carbon, through which the current passes. The portion of the mixture adjacent to the core is converted into carborundum to a certain depth, beyond which a partial conversion only takes place, forming what is known as "fire-sand."

The chief sources of carborundum are the electric furnaces of the Carborundum Co. at Niagara, and of the Norton Co., Chippewa, Ontario, the product of the latter company being designated by the trade name "Crystolon."

Abrasive articles of carborundum are now manufactured in this country by the Carborundum Co., Ltd., at Manchester, the raw material being obtained from Niagara. Carborundum grindstones are now used in most engineering works, and in the small form are employed largely by dentists.

Carborundum sand, the outer zone product, is used for lining brass furnaces, silicate of soda being used as bond. It is also used, mixed with fireclay, as a furnace lining, as a moulding sand for aluminium, and for many refractory purposes.

By using a smaller quantity of carbon, the element silicon may be prepared in large quantities in the electric furnace, the reaction being $SiO_2+2C=Si+2CO$. The formation of silicon was first noted in the carborundum furnace, in which small quantities may be found; and this led to the production of silicon as the primary substance, when desired, by reducing the proportion of carbon as shown. The element silicon thus became available in bulk, whereas previously it was more or less a laboratory curiosity. Silicon does not oxidise below 1200° C., and is useful as a resistance material for electricity, particularly when strong currents are used which make the resister very hot. Its specific resistance is about three times that of carbon.

The fusion of the mineral bauxite, an impure form of oxide of aluminium, results in the production of a crystalline material inferior in hardness to carborundum, but superior in strength. In grinding steel, or materials of high tensile strength, an abrasive material is needed which will not break under the pressure which must be applied, and in such cases it is found that grindstones made from fused bauxite are quite satisfactory, whilst carborundum wears away too quickly owing to the breaking of the crystals. Fused bauxite is manufactured into grindstones by the Norton Co. in America under the name of "Alundum," and a similar product is marketed by the Carborundum Co. of Manchester, which is termed "Aloxite."

As an abrasive for steel, fused bauxite is unrivalled, and, together with carborundum, has made possible the introduction of grinding machinery which for many purposes is preferable to steel cutting-tools, producing a better finish in a shorter time.

Whilst used primarily as an abrasive, fused bauxite may be made into an excellent refractory, and the alundum ware produced by the Norton Co. is extensively used for the tubes of small resistance furnaces, crucibles, pyrometer sheaths, etc. In making articles of this kind the powdered alundum is mixed with a suitable bond, and the object moulded from the mixture and afterwards fired. The product so obtained has a low coefficient of expansion, and withstands sudden changes of temperature far better than porcelain, but not so well as silica. It is relatively a good conductor of heat, which property fits it for the purposes named; and its high melting-point—2050° C.—renders it suitable for work at temperatures which would cause fused silica to devitrify. It has the further advantage of being inert towards platinum at high temperatures, and is, therefore, suitable for platinum-wound resistances furnaces. Ordinary alundum is porous, and this property has been put to use for filtration purposes in laboratories, the liquid to be filtered being poured into a crucible, in the pores of which the finest particles of precipitate are retained. As the alundum is unattacked by most acids, solutions may be filtered which would destroy filter-papers. In the form of various articles alundum has now become firmly established as a useful laboratory material.

Moissan was one of the first to notice that ordinary amorphous carbon could be converted into graphite by the aid of intense heat; but the commercial production of artificial graphite was due to Dr. E. G. Acheson.

The process of manufacture consists in passing a powerful electric current through coke, anthracite coal, or carbon obtained from petroleum residues, producing a temperature of 3700° C., which suffices to convert ordinary carbon into graphite. The materials are placed in a loose-walled furnace, which can easily be dismantled to remove the products; and at the temperature employed most of the impurities volatilise and escape as vapours through vents in the walls.

Artificial graphite possesses the advantage over the natural variety that it may be produced in large, homogeneous masses, and does not require any binding materials. It may be machined with ease by ordinary workshop tools; thus it may be turned in the lathe to any desired shape or size, and may be filed, drilled, and threaded. Ordinary carbon, however prepared, is much more troublesome to work, and soon destroys the tool-edge.

In the electrolysis of solutions such as common salt, in which nascent chlorine is liberated, anodes of artificial graphite are superior to others, not being attacked by chlorine. In other cases in which corrosive substances are liberated by the electrolysis, such as the recovery of copper and nickel from residues, the same superiority is shown, and consequently artificial graphite is extensively used in such cases.

The superior conductivity of graphite renders it more suitable for filling the space between the two plates of a dry cell than carbon. A further advantage is its greater purity, so that it is not liable to cause local action. Special grades of graphite powder are made for this purpose, and find a wide application in cells for flashlights, telephones, and numerous military purposes.

Artificial graphite has found a certain application as a lubricant in the forms of "oildag" and "aquadag," both of which were introduced by Dr. Acheson. The graphite used in these cases is first ground down to a powder which will pass through a sieve of 40,000 meshes to the square inch, and afterwards treated chemically so that it forms a colloidal suspension in oil or water. Graphite of this character is said to be "deflocculated," and when suspended in a liquid will pass readily through a filter-paper. When added to oil the lubricant "oildag" is formed, and its use on a bearing results in the production of a thin layer of graphite on the rubbing surfaces, which, when formed, enables efficient lubrication to be carried on with a greatly diminished feed of lubricant.

When rock-crystal or sand is heated to fusion and allowed to cool, it remains in a vitreous condition, and then possesses properties resembling those of glass.

In making tubes a current of sufficient power is passed through a graphite core surrounded by sand, which is fused to a depth determined by the time the current passes. Care must be exercised not to exceed a temperature of 2000° C., as otherwise there would be a danger of the carbon and silica reacting to form carborundum. The core is then withdrawn, and the plastic mass pulled out into tubes of the required dimensions. By arranging the shape of the core, pieces with closed ends can be made, and afterwards blown in moulds to any desired shape by means of compressed air. A weight of 200 lb. of fused silica can now be produced and manipulated, thus rendering it possible to manufacture articles for commercial processes. A similar method is now followed in making transparent silica from pure quartz.

In the best modern plant for the manufacture of nitric acid from saltpetre, the product is condensed in silica-pipes, which may be water-cooled without danger of cracking; and in concentrating sulphuric acid silica basins are now used. The production of the enormous quantities of these acids needed for the manufacture of explosives has been much facilitated by the use of silica apparatus; and, in addition, the output of vessels and pipes of various kinds has proved of advantage to chemical industries generally, in all cases where acid- and heat-resisting properties are of importance.

It will be recognised by all who have studied the matter closely that the future industrial success of any country will largely depend upon the extent to which it develops high-temperature processes.

One of the first essentials will be a cheap and abundant supply of electricity, and it is to be hoped that not only the sixteen super-power stations proposed by the Coal Conservation Committee, but also many others, will be erected, entirely apart from considerations of economy in coal.

It is now possible to purchase electric power as cheaply at Newcastle as at Niagara, the great centre for electric-furnace products; and there appears, therefore, to be no economic reason why carborundum and graphite, for example, should not be manufactured in England. The development of cheap-power schemes should lead to the establishment of many new industries in this country, provided the necessary enterprise and capital be forthcoming.

One effect of the war has been to create a general appreciation of the value of research in connection with industry, and efforts have been made in many directions to make good our previous negligence in this respect.

So far as high-temperature processes are concerned, our record is not one of which we may be proud, as, with the exception of silica ware and aluminium, we are dependent on other countries for materials which have now become indispensable. The chief reason for this has, no doubt, been the absence of cheap electricity; but now that this is to be remedied, no time should be lost in commencing high-temperature research on various lines. Amongst problems awaiting solution may be mentioned the smelting of tungsten and other metals of very high melting-points, and the formation of alloys of these metals; the production of suitable refractories for use in electric furnaces generally; and the manufacture of the diamond on the large scale for abrasive purposes. Apart from these obvious lines of research, the production of new compounds as the result of high-temperature reactions offers a boundless field for investigation, and should lead to important industrial developments. It is only necessary to consider the results which have accrued from the heating of coal and lime, coal and sand, and carbon alone, in the electric furnace, to realise the possibilities in this direction, and the imperative need for research on the lines indicated.

A good electric furnace, capable of taking charges which would enable commercial possibilities to be deduced, should be installed at all the leading centres of scientific instruction. One or more such furnaces, devoted to general research, should be established in London; and, speaking from personal knowledge, there would immediately be many firms desirous of submitting problems the solution of which would be an aid to the industries in which they are engaged.

It is to be hoped that before long high-temperature research will be flourishing in this country as it has been for some years in America. The factories at Niagara, with their enormous output of various materials, are the outcome of this research, and given adequate facilities in this country for investigation, there is no doubt that we should reap our full share of the future developments which are certain to arise in this field of work.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

UNIVERSITY OF LONDON.—The sum of 1000*l*. has been given to the University by the National Bank of South Africa for the promotion of Dutch studies.

A COURSE of three lectures on "Scientific Factory Management" will be given by Dr. A. D. Denning at the London School of Economics and Political Science on Mondays, beginning on October 28.

AT the Pharmaceutical Society of Ireland, Mr. W. H. Ashmore has been appointed professor of materia medica, in succession to Dr. M.

Thomson, resigned, and Mr. H. Norminton professor of practical chemistry.

According to *Science*, the College of Physicians and Surgeons of San Francisco has discontinued the teaching of medicine, but for the next three years it will grant diplomas to such students as shall complete their work satisfactorily in other medical schools.

At the opening of the new session of the London (Royal Free Hospital) School of Medicine for Women, the inaugural address will be given by Miss A. Maude Royden at 3.30 on Tuesday, October 1. The subject of the address will be "Revolutionary Thought."

The opening of the winter session of the medical school of the Middlesex Hospital will take place on Tuesday next, October 1, at 3 o'clock, when Lt.-Gen. T. H. J. C. Goodwin, Director-General, Army Medical Service, will occupy the chair. The prizes will be distributed by the Dowager Countess Brassey, and Dr. Browning, the director of the hospital's pathological laboratories, will deliver an address. All who are interested in the hospital and its medical school are invited to be present.

The technical colleges and schools throughout the country are now assembling for the winter session, and the prospectuses which reach us provide good evidence of their continued healthy activity. The Birkbeck College, London, opens on September 30, and has arranged day and evening courses of study for the University of London examinations in the subjects of the faculties of arts, science, laws, and economics. The West of Scotland Agricultural College, Glasgow, opens on October 10. It has arranged comprehensive courses in preparation for diplomas and degrees in agriculture, dairying, forestry, horticulture, poultry-keeping, and bee-keeping.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 9.—M. P. Painlevé in the chair.—A. **Denjoy**: Demonstration of the fundamental property of the curves of M. Jordan.—C. **Viola**: The laws of Curie and Hoüy. The law of simple rational indices, Hoüy's law, can be deduced from Curie's law.—A. **Guébhard**: Remarks on the ferrisphere.—M. **Lecointre**: The marine Pleistocene of Chaouia (Western Morocco).—L. **Léger**: Geographical distribution of the anophelic zones in the south-east of France: method of study.—R. **Leriche** and A. **Policard**: The mechanism and pathogenic *rôle* of premature osseous rarefaction in the genesis of pseudo-arthroses.

September 16.—M. P. Painlevé in the chair.—E. **Picard**: Some remarks on the decomposition into primary factors and the prolongation of analytical functions.—P. **Appell**: Simultaneous linear partial differential equations and cases of reduction of hypergeometric functions of two variables.—C. **Richet**, P. **Brodin**, G. **Noizet**, and F. **Saint-Girons**: Ohmhemometer for measuring the electrical resistance of the blood. Application to clinical practice. The resistance of a drop of blood is measured in a capillary tube by Kohlrausch's method. A close relation was established between the electrical resistivity, density, and number of red corpuscles.—Ch. **Depéret**: Attempt at a general chronological co-ordination of Quaternary times.—M. **Balland**: Some coffee preparations proposed for the Army. Analyses are given of coffee extracts, tabloids, and some coffee substitutes.—E. **Cartan**: Developable varieties in three dimensions.—P. **Humbert**: Electrospherical functions in the form of determinants.—A. **Guilliermond**: The mitochondrial origin of plastides.—G. **Truffaut**: The partial sterilisation of soil. Large-scale experiments, in which carbon bisulphide, calcium sulphide, and tar-oils were used for the purpose of partial sterilisation of the soil, gave results generally favourable, confirming the work of E. J. Russell and Miège.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings, vol. iv., No. 4), April, 1918.—W. J. V. **Osterhout** and A. R. C. **Haas**: Dynamical aspects of photosynthesis. Ulva, which has been kept in the dark, begins photosynthesis as soon as it is exposed to sunlight. The rate of photosynthesis steadily increases until a constant speed is attained. This may be explained by assuming that sunlight decomposes a substance the products of which catalyse photosynthesis or enter directly into the reaction. Quantitative theories are developed to account for the facts.—Kia-Lok **Yen**: Mobilities of ions in air, hydrogen, and nitrogen. Extensive experiments, the results of which are in perfect accord with the "small-ion" hypothesis, as contrasted with the "cluster" hypothesis.—E. H. **Hall**: Thermo-electric action with dual conduction of electricity. A continuation of previous papers. The hypothesis of progressive motion by the "free" electrons only has been extended to the case of dual electric conduction.—C. G. **Abbot**: Terrestrial temperature and atmospheric absorption. The earth's surface sends out 0·50 calorie per cm.^{2} per minute on the average, and of this only a small part escapes to space. Hence the atmosphere is the main radiating source, furnishing three-fourths of the output of radiation of the earth as a planet.—Kia-Lok **Yen**: Mobilities of ions in vapours. A continuation of the study of the vapours SO_2, C_2H_6O, C_2H_4O, C_5H_{12}, etc., with the conclusion that the small-ion theory is further corroborated.—J. P. **Iddings** and E. W. **Morley**: A contribution to the petrography of the South Sea Islands. Thirty detailed chemical analyses of lava from the South Pacific Islands are given, with a discussion of the results.—J. **Loeb**: The law controlling the quantity and rate of regeneration. The quantity of regeneration in an isolated piece of an organism is under equal conditions determined by the mass of material necessary for growth circulating in the sap (or blood) of the piece. The mystifying phenomenon of an isolated piece restoring its lost organs thus turns out to be the result of two plain chemical factors: the law of mass-action, and the production and giving off of inhibitory substances in the growing regions of the organism.

(Proceedings, vol. iv., No. 5), May, 1918.—W. S. **Adams** and A. H. **Joy**: Some spectral characteristics of Cepheid variables. The hydrogen lines are abnormally strong in Cepheid spectra, which are classified, first, on a basis of the hydrogen lines, and, secondly, on the more general features of the spectra.—C. **Barus**: Types of achromatic fringes.—C. **Barus**: Interference of pencils which constitute the remote divergences from a slit.—E. **Doolittle**: A study of the motions of forty-eight double stars. A classification of the stars is set up for the purpose of determining those pairs upon which observations are most urgently needed.—H. **Bateman**: The structure of an electromagnetic field. All electrical charges are supposed to travel along rectilinear paths with the velocity of light. When electricity appears to move with a smaller velocity, it is made up of different entities at different times.—O. E. **Glenn**: Invariants which are functions

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of parameters of the transformation. A general discussion of a systematic theory and interpretation of invariantive functions which contain the parameters of the linear transformations which leave invariant a binary quadratic form, including the invariants of relativity.

(Proceedings, vol. iv., No. 6), June, 1918.—F. G. **Benedict** and P. **Roth**: Effects of a prolonged reduction in diet on twenty-five men. I. Influence on basal metabolism and nitrogen excretion.—W. R. **Miles**: Effect of a prolonged reduction in diet on twenty-five men. II. Bearing on neuro-muscular processes and mental condition.—H. M. **Smith**: Effects of a prolonged reduction in diet on twenty-five men. III. Influence on efficiency during muscular work.—C. E. **McClung**: Possible action of the sex-determining mechanism.—E. **Blackwelder**: The study of the sediments as an aid to the earth historian.—G. H. **Parker**: The growth of the Alaskan fur seal herd between 1912 and 1917. Since 1912 the steady increase in the number of pups born and of harem bulls, and the decrease since 1913 of the average harem, are most favourable signs in the growth of the herd. The one unfavourable feature during this period is the considerable increase in idle bulls in 1915, 1916, and especially in 1917. This increase, which can be eventually checked, shows that active commercial killing should have been restored some years ago.—W. N. **Berg** and R. A. **Kelser**: The destruction of tetanus antitoxin by chemical agents. The results indicate that tetanus antitoxin is a substance of non-protein nature, but the stability of the antitoxin is so dependent upon that of the protein to which it is attached that whenever the protein molecule is split, the antitoxin splits with it.—G. P. **Merrill**: Tests for fluorine and tin in meteorites, with notes on maskelynite and the effect of dry heat on meteoric stones.—F. W. **Clarke**: Notes on isotopic lead. Investigations on the atomic weight of various forms of lead, and radio-active estimates of the age of minerals, are analysed for the purpose of throwing light upon isotopes and the structure of chemical elements.

(Proceedings, vol. iv., No. 7), July, 1918.—G. H. **Hardy**: The representation of a number as the sum of any number of squares, and in particular of five or seven.—A. **St. John**: The crystal structure of ice. Ice is properly assigned to the hexagonal system, and consists of four inter-penetrating triangular lattices, of which the fundamental spacings have been obtained.—W. M. **Davis**: Fringing reefs of the Philippine Islands. An interpretation of recently published large-scale charts of the United States Coast and Geodetic Survey.—W. S. **Halstead**: Dilation of the great arteries distal to partially occluding bands. The relative amount of constriction required to give the most pronounced results has been determined, so that the author is able in almost every instance to produce the dilation, and a large amount of material thereby accumulated is analysed.—A. A. **Michelson**: The correction of optical surfaces.

BOOKS RECEIVED.

The Neo-Platonists: A Study in the History of Hellenism. By T. Whittaker. Second edition, with a Supplement on the Commentaries of Proclus. Pp. xv+318. (Cambridge: At the University Press.) 12*s*. net.

Petroleum Refining. By A. Campbell. Pp. xvi+297. (London: C. Griffin and Co., Ltd.) 25*s*. net.

Practical Surveying and Field Work. By V. G. Salmon. Pp. viii+204. (London: C. Griffin and Co., Ltd.) 7*s*. 6*d*. net.

Practical Chemistry for Intermediate Classes. By Prof. H. B. Dunnicliff. Pp. xii+277. (London: Macmillan and Co., Ltd.) 5*s*.

Food Gardening for Beginners and Experts. By H. V. Davis. Second edition. Pp. viii+133. (London: G. Bell and Sons, Ltd.) 1*s*. net.

Modern Engineering Measuring Tools. By E. Pull. Pp. viii+115. (London: Crosby Lockwood and Son.) 4*s*. 6*d*. net.

Rats and Mice as Enemies of Mankind. By M. A. C. Hinton. Pp. x+63. (London: Trustees of the British Museum.) 1*s*.

Seaside Planting for Shelter, Ornament, and Profit. By A. D. Webster. Pp. 156. (London: T. Fisher Unwin, Ltd.) 18*s*. net.

Coast Erosion and Protection. By Prof. E. R. Matthews. Second edition. Pp. xvi+195+frontispiece+32 plates. (London: C. Griffin and Co., Ltd.) 12*s*. 6*d*. net.

New Reduction Methods in Volumetric Analysis. By Prof. E. Knecht and E. Hibbert. Re-issue with additions. Pp. x+135. (London: Longmans and Co.) 5*s*. net.

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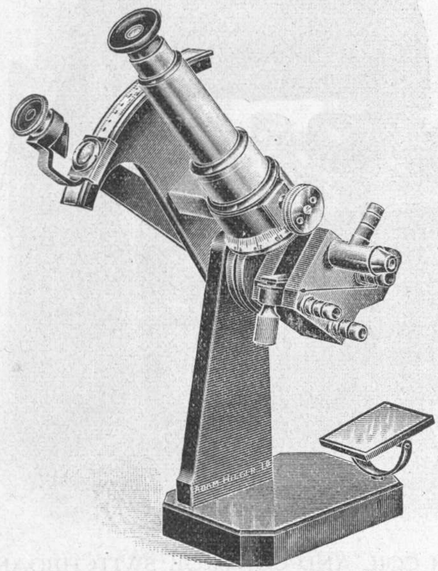

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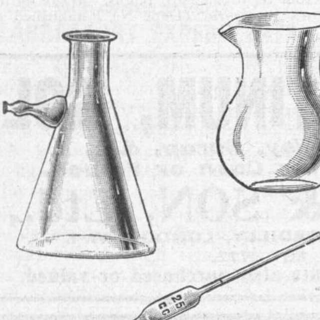

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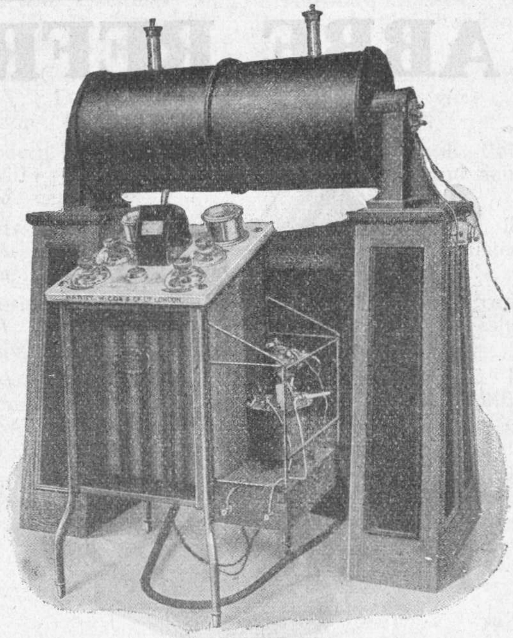

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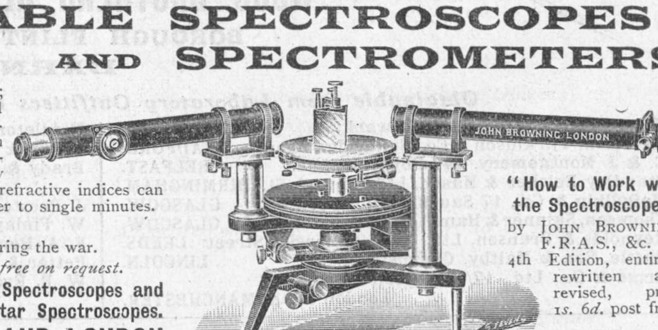

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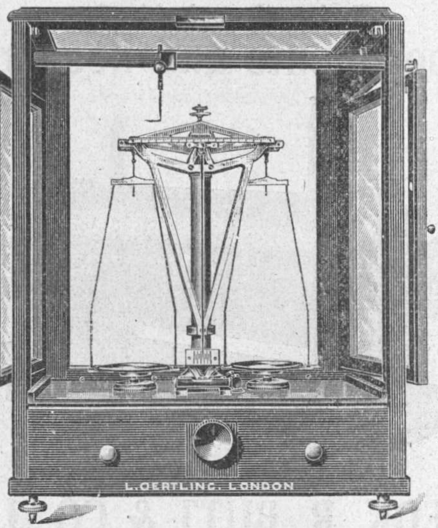

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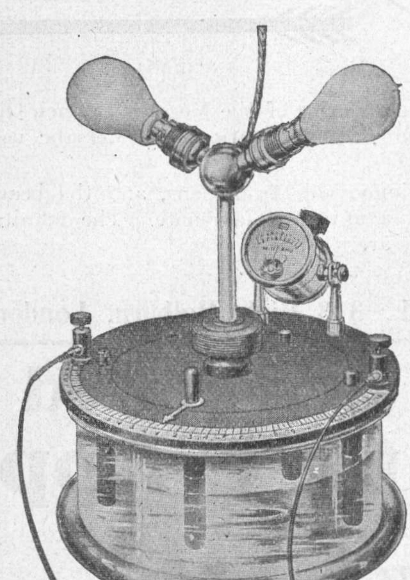

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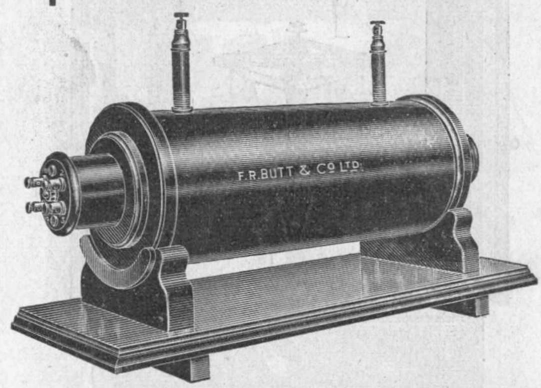

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