THURSDAY, NOVEMBER 22, 1917.

CLASS-BOOKS ON ELEMENTARY CHEMISTRY.

(1) *A Class-book of Organic Chemistry.* By Prof. J. B. Cohen. Pp. viii+344. (London: Macmillan and Co., Ltd., 1917.) Price 4*s.* 6*d.* net.

(2) *Practical Chemistry for Medical Students.* By Dr. A. C. Cumming. With preface by Prof. J. Walker. Second edition. Pp. 8+165. (Edinburgh: James Thin, 1917.)

(1) DESPITE the systematic basis of organic chemistry, it is always difficult to initiate students in the study of the subject, and especially to get them to grasp the general principles of the science as a precedent to further study. The majority of elementary text-books are burdened with far too much preliminary detail of an abstract character, so far as the beginner is concerned, before he is brought into touch with the materials and methods of the science, with the result that he finds his studies lacking in interest and objective. This defect is very successfully avoided in Prof. Cohen's book. It bears, in every respect, the mark of the experienced teacher, and is most suitably adapted to the requirements of first-year medical students and of senior science students in schools, for whom it is designed.

The volume is divided into three parts, in the first of which the principles of the subject are illustrated by a detailed elementary study of ethyl and methyl alcohols. By means of these examples typical methods of experiment and investigation employed in the examination of organic compounds and in the determination of their structure are described. A more systematic account of the chief aliphatic compounds forms the second portion of the book, which is concluded with a brief description of the more important cyclic compounds. A series of practical exercises is included in each section, and a set of questions appended to each chapter. These exercises are well chosen, and do much to keep the theoretical work within the scope of experimental knowledge. A few fuller explanations of some reactions and structural relations might be usefully added—for instance, in regard to the acidity of aniline hydrochloride, the relation of azo-colours to their mother-substance, azobenzene, the diazonium formula, and the proof of the presence of the two hydroxyl groups in alizarin. Also, in view of the book being designed for the use of medical students, their interest would have been stimulated by a little more specific detail of the therapeutic properties of such substances as salicylic acid, salol, antifebrin, and phenacetin.

(2) Although a course of practical chemistry for medical students need not differ in character from the instruction required for other students in the more elementary stages of the subject, it is advantageous if the material selected is restricted to such methods of experiment and to descriptions of the properties of such substances as will serve as a helpful introduction to subsequent medical study. From this point of view the experiments described in Dr. Cumming's book are very suitably selected and their sequence is well arranged. The first exercises deal with the manipulation of apparatus, solubility, crystallisation and its value in the purification of compounds. These are followed by an account of the properties of the commoner acids and alkalis, of the preparation and properties of the more important gases, and of the properties of sulphur, iodine, and carbon. These descriptions are accompanied by a series of instructions for qualitative experiments, to which a few simple quantitative exercises—for instance, in the case of carbon dioxide and of hydrogen—might have been added with advantage.

The succeeding sections deal with the preparation of salts, elementary volumetric analysis, and the qualitative reactions of inorganic and of the commoner organic compounds, including the more important alkaloids. In this new edition the subject-matter of the previous issue has been carefully revised and a few additional experiments with bread, potatoes, and fats, the fermentation of glucose, and the action of saliva on starch have been introduced. The descriptions of the experiments and of the associated details of manipulation are throughout direct and concise, so that the course should form a really practical help to the study of the general principles of chemistry.

C. A. K.

AMERICAN GUNNERY.

Stresses in Wire-wrapped Guns and in Gun-carriages. By Lt.-Col. Colden L'H. Ruggles. Pp. xi+259. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 13*s.* 6*d.* net.

THE preface to this the second edition explains that the text was originally prepared for the cadets of the U.S. Military Academy. The title does not fully indicate the contents. The elastic stresses in wire-wrapped guns are the subject only of chap. i., pp. 1–36. Chaps ii. and iii., pp. 37–105, deal with the forces which the firing of the gun occasions in the principal parts of the carriage, the 3-in. field carriage, the 5-in. barbette carriage, and the 6-in. disappearing carriage being taken as examples. The problems are dealt with in these two chapters as problems in ordinary statics and dynamics. Chap. iv., pp. 106–73, treats of the elastic stresses in parts of gun-carriages. Chap. v., pp. 174-227, if not very obviously connected with the professed subject of the book, gives a clear descriptive account of "toothed gearing." The subject of the last chapter, vi., counter recoil springs, has more connection with guns than might appear at first sight.

The numerous illustrations, which form a great feature of the book, are generally very clear. Some, especially those relating to toothed gearing —for instance, Figs. 78, 80, 89, and 93—are quite works of art. If scarcely necessary for the

information of those who have actually to handle the objects illustrated, they at least adorn the book. Another great feature is the number of numerical illustrations of the formulæ. Even if the student does not properly understand the formulæ, or the physical principles on which they depend, the guidance afforded by the numerical illustrations will probably enable him to deal with concrete cases. The book, in short, seems intended for the man for whom facts are a necessity, but reasons a luxury. If the form and contents of the book were dictated, as one would naturally suppose, by the wants of U.S. military cadets, the most natural inference is that when the cadet commences the study of ordnance he does not possess that knowledge either of mathematical analysis or of the mathematical theory of elasticity desirable for a critical study of the problems presented by wire-wrapped guns and recoil springs.

The author begins his treatment of wire-wrapped guns by quoting from Lissak's "Ordnance and Gunnery" formulæ for the strains and stresses in a hollow circular cylinder. The first formula, as ill-luck will have it, suffers from a printer's error, R_0 for R_0^2. The differences between stresses and strains and the relations between them are not made altogether clear, the expressions for the strains being multiplied by E, Young's modulus, and there being no explicit reference to Poisson's ratio, which is tacitly assumed to be 1/3. This, no doubt, simplifies the mathematics, and a further simplification is effected by accepting a common value of E for the forged steel of the tube, the steel wire of the winding, and the cast steel of the jacket. These materials are supposed to differ only in their "elastic limits." These assumptions may be necessary to bring the problem within the powers of the average cadet, but there are, it is to be hoped, superior cadets who would benefit by having the limitations of the formulæ pointed out. It is to be feared that the reader will find the way of reaching the formulæ relating to the elastic strains and stresses produced by wire-wrapping rather a feat of jugglery. He is also not unlikely to miss the fact that the inferences as to elastic limits are generally based on a greatest strain theory.

The student who will derive benefit from the treatment of elementary elastic problems given on pp. 106–20 has not reached the stage of knowledge desirable when tackling wire-wrapped guns. There is, moreover, no clear statement of principles. Formulæ are quoted from various sources, apparently simply that they may be available for reference in connection with the numerical illustrations. No warning seems to be given as to the risks in applying to short and irregularly shaped beams formulæ based on the Euler-Bernoulli treatment of bending.

The treatment of helical springs in the last chapter, though very arbitrary, seems fairly satisfactory so far as concerns springs in which the section of the original bar is circular: but the extension to cases in which the section is rectangular invites criticism. The formulæ obtained for the circular section involve a quantity I_p, what is called the "polar moment of inertia" (otherwise $\pi d^4/32$, where d is the diameter). The same formulæ are applied to springs coiled from bars of rectangular section, $h \times b$, with the following explanation: "As first shown by Saint-Venant . . . a plane section whose axes are unequal becomes a warped surface when subjected to great torsional strain. . . . Reuleaux states that the polar moment of inertia of a rectangle when subjected to great torsional strain is

$$I_p = (hb)^3 \div \{3(h^2 + b^2)\},$$

and that the distance from the centre of gravity to the point of the section most distant from it is $r = hb(h^2 + b^2)^{-\frac{1}{2}}$." The author then inserts these expressions for I_p and r in the formulæ deduced for the circular section. The student will naturally infer that the "warping" appears only when the torsional couple is large, and his ideas as to the geometry of a rectangle must receive something of a shock. The author does not seem well advised in using the same letter E to denote the rigidity and Young's modulus.

A work which contains so much information about U.S. ordnance, even if not the absolutely latest patterns, and the methods employed by U.S. ordnance experts will naturally appeal to an unusually wide circle at present.

ISAAC BARROW.

The Geometrical Lectures of Isaac Barrow. Translated, with Notes and Proofs, by J. M. Child. Pp. xiv+218. (Chicago and London: Open Court Publishing Co., 1916.) Price 4*s.* 6*d.* net.

MR. CHILD begins by laying down the startling thesis that "Isaac Barrow was the first inventor of the Infinitesimal Calculus; Newton got the main idea of it from Barrow by personal communication; and Leibniz also was in some measure indebted to Barrow's work." To interpret this according to the writer's intention we must use the term "calculus" to mean a set of analytical rules applied to analytical expressions; with this restriction, Mr. Child has made out a case that is convincing enough in this sense, that if Barrow had been given any function likely to be constructed in his time, he would have been able to differentiate it by applying a few standard rules.

It is extremely interesting to read Barrow's lectures, because they were written at a time when the power of the new analysis was becoming apparent, whereas every mathematician of note had been thoroughly grounded in the classical geometry of the Greeks. Barrow makes considerable use of algebraic symbols—otherwise we could only say that he generalised the methods of Fermat and others; even the fact that he practically gives rules for differentiating a sum, product, quotient, etc., would not make him the inventor of the calculus. At the same time Barrow's treatment is, in the main, geometrical, and we feel that he would like to make it completely so, if he could.

The outstanding features of the lectures may be summarised as follows:—Barrow regards a curve as the locus of a moving point, and makes its velocity at any moment the resultant of two velocities parallel to two fixed axes; one of these velocities is taken to be constant, and then the nature of the curve determines the other component velocity for any position of the moving point. Barrow does *not*, like Newton, consider the calculation of the variable velocity ($\dot{y}$); he constructs an infinitesimal triangle, and from this determines, generally by a sort of method of "exhaustion," the value of the subtangent, or some such finite segment, from which the position of the tangent can be inferred. Barrow's rule for differentiating a product accordingly appears in a form equivalent to

$$d(uv)/uvdx = du/udx + dv/vdx,$$

and similarly for a quotient. It may be added that Barrow gives (Lect. x., ex. 5) an analytical proof of a proposition equivalent to

$$d \tan x/dx = \sec^2 x,$$

and in this he neglects small quantities of higher order than the first. It is, therefore, practically certain that, if he had chosen to do so, Barrow could have written an algebraic treatise on the differential calculus; and to this extent Mr. Child's contention seems to us to be fully justified. Barrow was probably too enamoured of the old geometry to wish to do anything of the kind; and we may venture to think that he had no conception of the immense importance of an abstract, arithmetical calculus for mathematics in general. It is here that the value of Leibniz's contributions becomes so manifest, and it matters little how far he was really indebted to Barrow's lectures, of which he was known to have had a copy.

Mr. Child gives paraphrases (in modern notation) of the most important parts of the lectures, with notes of his own in different type. At the end we have a reduced facsimile of two pages of the original, and of a sheet of the original diagrams. So far as we have tested it, the paraphrase is satisfactory; p. 57, ll. 14, 16, "decreasing" and "decrease" should be "increasing" and "increase," and p. 66, last line, "that I know" should be "so far as I know," and there may be other similar slips. Altogether, Mr. Child may be heartily congratulated on the result of his six months' research. G. B. M.

OUR BOOKSHELF.

The Distances, Absolute Magnitudes, and Spectra of 734 Stars. Arranged for Use with Ordinary Star Maps by T. E. Heath. Pp. iv+52. (Tenby: Sold by Miss Crealock, South Cliff Street, Tenby, n.d.) Price 2*s.* 6*d.* net.

THE determination of the distance of a star, by measuring its minute change of position when seen from opposite points of the earth's orbit, is an extremely laborious work. According to Mr. Heath's pamphlet, the parallaxes of about 700 stars constitute the total output up to now from the various observatories of the world; and for many of these the only information obtained is that the star is at a great but unknown distance beyond the reach of the method. The general fate of these data is to fall into the hands of some mathematical astronomer, apparently actuated by an irresistible impulse to add things up and take the mean; then comes a sudden jump to mathematical formulæ; integrals gather in formidable array, and the error-function makes its inevitable appearance; and so the riddle of the universe is slowly disentangled—or knots itself tighter—to the great satisfaction of those who have any notion what it is all about.

Mr. Heath is one of those who would rescue the precious knowledge from this socialistic use. For him the stars each have their individuality; they are personal acquaintances, not mere items on a census-form. When he looks at the Great Dog, in his mind's eye he sees Sirius a modest star of 30 sun-power eight miles away (to use his "Road-Book" scale), and its less conspicuous neighbour Beta, a brilliant globe of 750 sun-power 223 miles distant. Then turning to the gleaming belt of the Milky Way, on the same scale, "if we took ship to America we might probably come to the beginning of the Milky Way before we arrived, and get through it before we came to the Pacific." And so he places out the stars at their different distances and gives the true measure of their brightness.

There must be many watchers of the skies to whom the stars will acquire a new interest from the information here set out. It has hitherto been practically inaccessible except to specialists. Mr. Heath does not conceal the fact that the individual results are often very uncertain; they are taken from the best authorities, but it is only for exceptionally near stars that the distances are known at all closely. But we can agree with him that on the whole a true general view is conveyed. We are glad to learn that the author has presented a large number of copies to the Admiralty for distribution among the Fleet. A. S. E.

The Road and the Inn. By James John Hissey. Pp. xviii+435. (London: Macmillan and Co., Ltd., 1917.) Price 10*s.* net.

THE latest addition to Mr. Hissey's already long list of travel books will delight every lover of English byways. In a small motor-car, provided with camera and brush, Mr. Hissey went from lane to lane from Eastbourne to the Dukeries, Rugby being his most westerly, and Dunwich his most easterly, visit. There was no hurry and no bustle; and he preferred the country inn to the town hotel, for his "aim was to get into the heart of the real country." The serenity and charm of his gossipy narrative show how well he succeeded in securing the quiet holiday he desired; and the beauty of his photographs and drawings indicates his re-discovery of some of the hidden glories of the English countryside.

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.]*

On the Theory of Magneto-ionisation.

I BEG permission to make a few remarks on the note in NATURE of September 13, p. 32, in which one of my latest papers is criticised, the one in which I gave, I think, a direct proof of magneto-ionisation.

In the experiment which the writer of the note takes into consideration the intensity of the current in the air ionised by a beam of X-rays between two parallel metal plates is measured. I find that a magnetic field directed perpendicularly to the electric field, and the intensity of which is below a certain value, causes an increase of current, although the deviations of the ions and electrons tend to produce a decrease. This effect is uncertain in the case of small potential differences, but it becomes considerable when ionisation by collision begins.

The writer of the note remarked that "when a magnetic field of 430 gauss is superimposed, there is found a current decrease . . ." Now, the numerical table to which he alludes is not the only one given in the paper, and it shows such a decrease (which is very small) in one case only, which may be considered as accounted for by experimental error, since nothing of the kind is found in the other numerical tables. That, of course, leads one to suppose that the writer is not fully acquainted with certain parts of my work, and what he says farther on seems to confirm this supposition: "In the opinion of the writer of this note Prof. Righi's interpretation of his results is by no means the only one which is possible, and though his ingenious experiments are of great interest, his theory will need further support before it obtains general acceptance. In particular, it will be necessary to show that the increase of current is not caused by the oblique, and therefore longer, paths of the ions under the joint actions of the two fields."

The writer then offers a new theory, or, more exactly, he states a general idea, which he seems to consider to be preferable to my theory. But this idea cannot be admitted, as I now propose to show.

Apart from the fact that the writer appears to believe that the effect of the magnetic field is simply the obliquity of the trajectory of the ions, whereas these trajectories become certain well-known curves (which may be deduced from the formulæ given in the third paragraph of the note added to my paper), I at once make the fundamental objection that it is not sufficient to increase the distance travelled over by an ion in order that the latter may become capable of ionising a larger number of atoms. In fact, as in ionisation by collision an ion loses a part of its kinetic energy, it would be necessary to prove that the magnetic field causes the said energy to increase. Now this is not at all the case, since by means of the formulæ of the movement of an ion in an electric and magnetic field it is demonstrated that when the ion traverses a plane perpendicular to the electric field it possesses exactly the same velocity, be the magnetic field existent or not.

It may be added that when the magnetic field does exist, the speed of the ion may increase only to a maximum value, after which it decreases again, the ion retroceding in respect of the lines of electric force, while if the magnetic field does not exist, the velocity may increase without limit, provided it be not stopped by the electrode which attracts it or by collision with molecules. All this is clearly understood when one knows that, apart from the velocity parallel to the magnetic force, which remains constant, the trajectory of the ion is nothing but the curve described by a point travelling at a constant speed over a circumference, while the latter is itself travelling uniformly in a straight line in a direction perpendicular to the two fields.

Finally, I wish to point out that, even if the idea expressed by the writer of the note did not lack a basis, my theory could not easily be rejected. It is, in fact, but a direct consequence of the conceptions already accepted by most physicists, nor does it need the addition of any subsidiary hypothesis.

As a matter of fact, it being admitted that atoms have satellite electrons, they must tend to orient themselves in the magnetic field as if the orbits of such electrons were closed electric currents. Now the sense of this orientation is such that the force due to the field, and acting on the electrons, is directed towards the outside of the orbits, which causes a decrease of the energy required to detach them from the rest of the atoms.

It is this facility of ionisation produced by the magnetic field that constitutes "magneto-ionisation."

AUGUSTO RIGHI.

Bologna (Italy), September 27.

I AM sorry if, owing perhaps to the brevity of my note, I have led Prof. Righi to think that, in my opinion, his theory of magneto-ionisation can be "easily rejected." Nothing was further from my intention. I believe I have read all Prof. Righi's papers on the subject as they have appeared, and have repeated some of his experiments. The impression they have left on my mind is that, although Prof. Righi's theory gives a plausible explanation of the complex phenomena investigated, yet it is not the only one possible, and further work is necessary before a final conclusion can be reached. I did not express a *preference* for another theory. I merely suggested objections that would have to be met before the theory under discussion could be unhesitatingly accepted. The question as to whether I have given a fair account of the numerical results must be left to the decision of the readers of the memoir.

THE WRITER OF THE NOTE.

The Introduction of the Word "Magneton."

THE word "magneton" is now so frequently used that it has seemed worth while to me to seek to learn to whom is due this addition to the vocabulary of physics.

So far as I can find, Dr. L. A. Bauer was the first to employ the word. In the weekly journal, *Science* (June 10, 1910, vol. xxxi., p. 920), is a report of a meeting of the Philosophical Society of Washington, D.C., held on May 7, 1910. There is included an abstract of a paper by Dr. Bauer entitled "Is there an Emanation from a Magnetised Substance?" in which the following occurs:—"The corpuscles in magnetism might be atomic systems in which the electron is revolving about an inner nucleus consisting, for example, of a positive ion, such as assumed by Righi for the formation of his so-called 'magnetic rays.' . . . Since the system creates an atomic magnetic field the axis of which passes through the centre of rotation of the electron and perpendicular to the plane of rotation, the speaker suggested calling such systems 'magnetons.'"

In a letter to me Dr. Bauer says:—"The term was used not only in my paper before the Philosophical Society of Washington on May 7, 1910, but also in my

lectures on terrestrial magnetism at the Johns Hopkins University a month or so previously."

Because Prof. R. Gans had used the same word quite early, I wrote to him to ask his aid in locating its earliest occurrence. He replied to me from Argentina, saying:—"Auch mich interessirt es zu wissen wer das Wort 'Magneton' zum ersten Male gebraucht hat. Ich selbst habe wohl das Wort zuerst in der von Ihnen erwaehnten Arbeit in den *Göttinger Nachrichten*, 1910, verwendet. Die Arbeit von Bauer, den Sie zitieren, kenne ich nicht." The article referred to by Prof. Gans in *Göttinger Nachrichten*, 1910, p. 200, was presented at the session of May 28, 1910, by C. Runge. In the course of the discussion we find this: "Die lage jedes Molekularmagneten, oder wie wir kuerzer sagen wollen, jeden Magnetons. . . ."

Since Prof. Pierre Weiss conferred on the word under investigation the quantitative meaning which it seems likely to retain, I turned to him also for assistance. He wrote me in reply:—"J'ai imaginé le nom de 'magnéton' à la suite de mes recherches expérimentales. L'analogie avec l'électron s'imposait. J'ai eu connaissance plus tard que M. Gans avait fait usage antérieurement du même terme dans un sens différent. Il me semble que, dans ce sens, l'expression de molécule magnétique convient tout aussi bien. Je n'avais pas connaissance jusqu'à présent de l'emploi fait de ce terme par M. L. A. Bauer et je vous remercie du renseignement."

In the *Comptes rendus* of the Paris Academy of Sciences, vol. cliii., p. 189, session of January 23, 1911, occurs the first use of the word by the Zurich physicist in an article called "Sur la rationalité des rapports des moments magnétiques des atomes et un nouveau constituant universel de la matière." Near the close we come upon the following:—"Le nombre d'atomes dans l'atome-gramme est $N=70\times10^{22}$ (Perrin). Le quotient m; $N=15{\cdot}94\times10^{-22}$ est le moment de l'aimant élémentaire lui-même, correspondant à la partie aliquote des moments des atomes-grammes. Je l'appelerai magnéton. . . . Le magnéton est donc un constituant universel de la matière."

It is surely interesting to note that three physicists in as many different countries independently introduced the word within a year. Priority appears to belong to Dr. Bauer.

As some uncertainty can be observed in the pronunciation of "magneton," I appealed to its sponsor, Dr. Bauer, for a decision. He replied: "I hesitate greatly desiring to appear competent to pass on the official pronunciation of the word 'magneton.' I prefer the accent on the second syllable, and giving the sound of *e* as in 'thee,' thus—magneeton. Still, I should not quarrel with anyone who wishes to put the accent on the first syllable and pronounce the *e* as in 'met.' Usage alone will decide." GEORGE F. STRADLING.

Northeast High School, Philadelphia.

An Optical Phenomenon.

A DESCRIPTION of the phenomenon mentioned by Capt. Cave in NATURE of October 18 will also be found in NATURE, vol. lxx., p. 107 (1904), and vol. lxxviii., pp. 255, 277, and 305 (1908). J. W. GILTAY.

Delft, November 9.

THE NICKEL INDUSTRY.

THE complete report of the Royal Ontario Nickel Commission, of which a summary was published in March last, has recently been received in this country. It is a document of absorbing interest and exceptional importance. The commission was appointed on September 9, 1915, and asked to inquire into, and investigate and report upon, the resources, industries, and capacities, both present and future, of the Province of Ontario in connection with nickel and its ores. Its reference also included an inquiry into the system of taxation by the province of its mines, minerals, and mineral industries. There were four commissioners, Messrs. Holloway, Miller, Young, and Gibson, representing metallurgy, geology, law, and administration respectively. They set to work at once and completed their labours in eighteen months—a remarkably short time considering what they did. Their report contains nearly 600 pages, and the appendix more than 200. It is a model of lucidity of exposition, and displays such a complete grasp of the subject in all its bearings and details, and such shrewdness of judgment in regard to its recommendations, that it will certainly rank as the most authoritative monograph on the nickel industry that has ever been published. The commissioners have rendered to Canada a service of remarkable value.

It appears that, so recently as 1900, as much as 65 per cent. of the world's market was supplied by nickel made from the New Caledonia ores, the balance being furnished by Canadian ores. New Caledonia, although discovered and named by Capt. Cook in 1774, was not claimed by any European country until 1854. In that year it is said that a French and a British frigate sailed simultaneously from Sydney (Australia) to take possession of it. The former was the first to find a way through the barrier reef and thus secured the island for France. The commissioners comment on the striking fact that "two countries so widely separated as are Ontario and New Caledonia, not only by distance, but in almost every other way, should alone be rivals, not merely in the production of nickel, but in that of cobalt as well."

For many years nickel from New Caledonia had an established world market. It was included in all British Government specifications where nickel was required. When the Mond Nickel Co., working on Sudbury ores, entered the field, it found an immensely strong prejudice both in Government departments and the trade against them, which was overcome only after elaborate and expensive trials and tests. Moreover, the New Caledonia nickel had for many years a tied market among the principal consumers in Europe, owing to the close business connections of the leading French producer—Le Nickel—with the great armament firms. This company has the financial backing of the Rothschilds and is the chief rival of the Canadian companies.

Since 1900 Ontario has forged ahead with its production. The world's output has increased sixfold since that time, and of this Ontario now furnishes about 80 per cent. The main factor in this change is the great difference in the size of the ore-bodies in the two countries. Whereas those of New Caledonia are reckoned in at most hundreds of thousands of tons, the Sudbury (Ontario) deposits are measured in millions. In spite of its apparently favourable position, how-

ever, the main questions which the commissioners had to answer were not easy. They were: (1) Are the nickel deposits of Ontario of such a character that this province can compete successfully as a nickel producer with any other country? (2) Can nickel be economically refined in Ontario? When they took up their work they were faced with the opinion of the companies interested that the answer to the latter question was in the negative. They also found that "for nearly fifteen years the whole of the great and highly profitable industry connected with the production of refined nickel from the vast deposits of nickel-copper ores in the Sudbury district has been divided between two powerful corporations. Both companies mine, smelt, and refine their own ore, and possess their own process of refining; both produce their refined metal product outside of Canada, and neither is a Canadian company. Other companies, British, American, and Canadian, some of them with excellent promise of success, have operated mines, erected plants, or have been otherwise engaged in the industry. *In no case has any of their undertakings been permanent or successful.*" They had also to reckon with the fact that there is no certainty that large profits can be made every year from the nickel industry. It is neither a necessity of life nor an article of universal consumption or use. Its uses may be classified under four headings: (1) as a component of alloys; (2) as a surface coating for other metals; (3) as a chemical or catalytic reagent; (4) as a pure metal. In the past the output has had to be curtailed at times.

In spite of these facts, the commissioners have had "no hesitation" in answering both the above questions in the affirmative. They say that the nickel deposits of Ontario are much more extensive and offer better facilities for the production of nickel at low cost than do those of any other country. Nickel-bearing ores occur in many parts of the world, but the great extent of the deposits in this province, their richness and uniformity of metal contents, and the success of the industry point strongly to the conclusion that Ontario nickel has little to fear from competition. They say also that any of the processes now in use for refining nickel could be successfully worked in Ontario, and conditions and facilities are at least as good in this province as in any other part of Canada. There is now an "assured prospect" of the erection in Ontario of two large plants for the refining of nickel—one by the International Nickel Co. of Canada at Port Colborne (Lake Erie), and the other by the British America Nickel Corporation, probably at Sudbury. The latter company, in which the British Government is a large shareholder, has been formed since the outbreak of the war. For special reasons the Mond Nickel Co. will continue to refine at Clydach, near Swansea. In its business the manufacture of copper sulphate is almost as important as that of nickel, and this is marketed chiefly at Mediterranean ports.

H. C. H. CARPENTER.

STUDIES IN INFANT AND CHILD MORTALITY.

IN view of the importance which must be ascribed at the present time to the saving of child life (see NATURE, October 26, p. 146), the Medical Research Committee has been well advised to institute an inquiry into the causes of death in infancy and childhood. The results of this inquiry have now been published in a series of essays,[1] which, it is pointed out in an introduction, have been written primarily with a view to the planning of future lines of research rather than for publication as finished reports.

An introductory historical note is contributed by Dr. Chalmers, in which he remarks that deliberate effort to conserve infant life can be said only to have begun with the recognition of the contrast which the movement in the death-rate of infants presents when compared with that of the general death-rate. Whereas the latter fell continuously and considerably during the fourth quarter of the last century, fluctuations of the infant-mortality rate remained fairly constant and without very marked indication of a corresponding decrease.

The first report, by Dr. Brend, deals with the relative importance of pre-natal and post-natal conditions as causes of infant mortality.[2] He concludes that under the term "infant mortality" we are classing together two radically different types of deaths, which are brought about by different causes and are governed by different influences. The first type consists of deaths due to developmental factors which vary but little in place, time, and class of the population, and appear to be caused by fundamental influences which we neither understand nor are able to control. The second type consists of deaths mainly due to respiratory diseases and enteritis caused by the influence of the post-natal environment—overcrowding, atmospheric pollution, etc.—and probably entirely preventable. These two types of death overlap somewhat in time, but the end of the first month after birth provides a fairly sharp line of division. Some three-quarters of the mortality during the first month represents a bedrock loss of life which we have hitherto failed to reduce and which is mainly due to developmental conditions, while mortality after the first month is part and parcel of the general mortality of childhood, due to the same causes and demanding for its reduction the same measures.

Dr. Brend suggests that it might be of advantage to divide "infant mortality" into "birth mortality," the deaths during the first month, and "mortality of early childhood," the deaths from the end of the first month to the end of the third year.

In the second report Dr. Findlay discusses the causes of infantile mortality. He brings out the importance of environment (housing, etc.) as a factor in causing the present high infantile mortality, and he urges the need for a more scientific

1 "The Mortalities of Birth, Infancy, and Childhood." Medical Research Committee, Special Report Series, No. 10, October, 1917.

2 In vital statistics the term "infant mortality" is used to denote the deaths of infants up to one year of age.

investigation of the results following schemes of infant welfare if their true effects are to be determined. With regard to the latter, the danger of "overdoing it" is emphasised. For instance, in Poplar, in spite of an extensive infant welfare scheme in being, the infantile death-rate has risen. It is suggested that this disappointing result may be traceable to the people being harassed by a multitude of health visitors, which upsets them and makes them disinclined to adopt the measures urged upon them.

The third and final report is a statistical study by Dr. Brownlee of some of the data relating to infantile mortality. It is shown that the growth of the child is a continuous process from a period at least six months prior to birth up to the age of about four years, a process which is not interrupted either by the act of birth or by the act of weaning.

Certain disease conditions have also been investigated. Convulsions diminish in a perfectly definite manner from the age of two months to that of four years. In the group of premature births and wasting diseases some considerable saving of infantile life seems to be possible. The group of diarrhœal diseases is found to be a homogeneous statistical group, though it undoubtedly includes several distinct specific infections, from which it is inferred that the reason for the frequency of these diseases at the ages at which they occur must be sought for in the development of the child rather than in the type of parasite. Scarlet fever, measles, bronchitis, and pneumonia have also been investigated.

From the foregoing brief summary it will be seen that this report contains matter of much importance, and its appearance at this time is most opportune. R. T. H.

BARON DAIROKU KIKUCHI.

BARON KIKUCHI, whose death took place on August 19, was one of the most conspicuous among the band of men who modernised education in Japan. He was born in Yedo (now Tokyo) on March 17, 1855, and came of a family of noted scholars. Both his father and grandfather were specially interested in Western learning, and Kikuchi himself early received a strong bias in the direction of scientific study. He was the youngest member of a small group of promising students whom the old Shogunate Government sent to Europe in 1866. Owing to the revolutionary change of government which occurred in Japan in 1868, Kikuchi was recalled home; but two years later he was again ordered abroad, this time to England. After some years spent at school he entered the London University College in 1873, but ere long passed on to Cambridge, where he graduated as nineteenth wrangler in 1877.

Returning home, he became professor of mathematics in the college where he had been himself a young pupil, which had developed gradually to the standard of a university. Originally known as the Kaisei-gakko, this school grew into what was afterwards known as the Tokyo University, and this in due course amalgamated with the Kobu-daigakko, or College of Engineering, and became the highly organised Imperial University of Japan.

It was in the Tokyo University that Principal Sir J. A. Ewing, then professor of engineering and physics, carried out his well-known experiments on magnetic hysteresis; and associated with Kikuchi in these and later days were Edward Divers, professor of chemistry, C. D. West, professor of mechanical engineering, John Milne, the famous seismologist, as well as others, including the writer of this notice. Our intercourse with Kikuchi was marked with cordiality and mutual appreciation from the first, in great measure due, no doubt, to his experience as a schoolboy and student in London and Cambridge. He greatly admired the English genius for self-imposed discipline, and used to say that if he had not been a Japanese he would have desired above everything to be an Englishman.

From 1881 Kikuchi added to his professorial duties the office of the Dean of the College of Science, a highly responsible post at that time of strenuous educational development. As one of the members of the House of Peers under the new Constitution he was of great service in advancing various Bills of educational and economic importance, and rapidly established for himself a high reputation as a man of sagacity and administrative power. The mere enumeration of the public offices which he filled is a tribute to the confidence his fellow-countrymen reposed in him. In succession he held the posts of Vice-Minister of Education (1897–98), President of the Imperial University, Tokyo (1898–1901), and Minister of Education (1901–3).

As one of the representatives of the Imperial Academy of Japan, he attended the meeting of the International Association of Academies at Vienna in 1907, and thereafter spent a considerable time in this country. His course of lectures on Japanese education, delivered in that year under the auspices of the University of London, were published in English in 1909. This book contains the first systematic account of the history of education in Japan given to the world at large, and will ever remain a work of great value to the educational historian. A remarkably succinct sketch of the fundamental characteristics of the old Japanese civilisation, and of the way in which it proved itself equal to the absorption of Western learning, was given in an address delivered before the Royal Society of Edinburgh in June, 1907, and published in the Proceedings (vol. xxvii.).

After this stay in Europe, where Kikuchi renewed acquaintance with many former friends and made many new ones, he returned to Japan to take up again responsible educational duties. Up to the day of his last illness he was in the midst of all movements which were making for efficiency in education. In March of this year, for example, he was appointed director of the newly established National Physico-Chemical Institute.

Called comparatively early in life to take a great

and ever-increasing share in shaping the destinies of his country in regard to science and higher education, Kikuchi had scant leisure for mathematical research. His chief work as an investigator was historical, and he contributed a number of papers to the Tokyo Mathematical Society on the mathematics of the old Japanese school. He also wrote a text-book on elementary geometry for use in Japanese schools and colleges. Of far greater moment to his country, however, was his disinterested devotion to the cause of the higher learning in science and morals. It was for this that he was created a Baron in 1902. His successive honours came to him simply because he was indispensable to his country and to his sovereign. But to the end he retained all the characteristics which endeared him to us—modest, courteous, gracious, always acting from the highest motives, strong in purpose yet never aggressive, and combining in a singular degree the finest traits of the Japanese Samurai with the best qualities of the youth of England. At the most impressionable time of life Kikuchi lived under the full influence of the best culture our island kingdom can offer; and we may be pardoned for regarding his pre-eminent success as in no small measure due to his unconscious training in a land where liberty, individuality, and zeal for the common good are of the very air we breathe. C. G. KNOTT.

NOTES.

IN three Chadwick public lectures on the part of hygiene in the European war Dr. Woods Hutchinson gave some noteworthy facts in connection with the progress of military hygiene. The present world-struggle is probably one of the least deadly ever fought in proportion to the numbers engaged. Less than 5 per cent. of the wastage of former wars was due to wounds or deaths in battle; the other 95 per cent. was caused by disease. In the armies themselves the ratio was six to nine deaths by disease to one in battle or from wounds. In this war the ratio is sixteen deaths in battle to one from disease. Of the wounded who survive six hours 90 per cent. recover, of those who reach the field hospitals 95 per cent. recover, and of those who arrive at the base hospitals 98 per cent. get well. Barely 5 per cent. of the wounded are crippled or permanently disabled. There is good reason to believe that the death-rate of this war does not exceed 5 per cent. per annum. The subjects of food and diseases of an army were also discussed. The superb health and vigour of our armies on the Western front are due largely to the rich and abundant supply of food. These armies had less sickness and fewer deaths from pneumonia and other diseases than they used to have in barracks in times of peace. The old plagues of army camps—cholera, Black Death, and spotted typhus—all lifted their heads in Italy, in Serbia, and in Russia, but all were promptly stamped out by modern sanitary science. The total number of cases of serious or lasting "shell-shock," so called, and mental disturbance, during 1916 in the trenches in France, was 2600, fewer than one per 1000 of the armies in the field, and fewer than half of the ordinary insanity rate in men of military ages in times of peace. Modern nerves had stood the fearful strain of this war superbly.

AN appeal to the Local Government Board to take action towards establishing a Ministry of Health was made by a deputation from the Standing Joint Committee of Industrial Women's Organisations which waited on the President of the Board (Mr. Hayes Fisher) on November 16. Mr. Stephen Walsh (Parliamentary Secretary) was also present. The organisations represented were the Women's Trade Union League, the Women's Co-operative Guild, the Women's Labour League, the National Federation of Women Workers, and the Railway Women's Guild. It was urged that the new department's basis must be the public health side of the Local Government Board, and that it would not serve merely to re-name that Board the Ministry of Health. Such a Ministry should take into partnership the National Insurance Commissioners, and it was absolutely essential that it should be dissociated from the old Poor Law system. On the same day Mr. Hayes Fisher received a deputation on the same subject from the Society of Medical Officers of Health, and the Association of County Medical Officers of Health. Mr. Hayes Fisher, in replying, said that the Local Government Board was asking for a Bill that would enable local authorities in England and Wales to do all the things that were being asked of the new Ministry of Health. This Bill had not been able to go any further because the National Insurance Commissioners were asking for similar powers in respect of infant welfare and maternity. Whoever might obtain the powers, the responsibility for carrying them out would rest with the medical officers of health.

THE stress of war has brought success sooner than was anticipated to the efforts which have been made for many years to secure the establishment of a National Seed-testing Station for England and Wales. Scotland and Ireland have for several years had the advantage of such stations, and now England has at last fallen into line. The new station, which is associated with the Food Production Department of the Board of Agriculture, was formally opened on November 14 by the President of the Board, whilst the same evening the text of the Testing of Seeds Order was issued by the Ministry of Food. This Order becomes operative on January 1, 1918, and institutes a close control over the sale of the more important seeds The testing of samples in connection with the Order will be carried out in the new station, which is fully equipped for the purpose, and will further undertake the testing of seeds for farmers and allotment-holders at a nominal fee of threepence per sample, and for seed traders at half a crown per sample. The station is located at 70 Victoria Street, S.W.1, and is under the direction of Mr. R. G. Stapledon, advisory botanist of University College, Aberystwyth, who for some time has been actively associated with the work of the Food Production Department at headquarters. In declaring the station open, Mr. Prothero expressed the hope that in years to come there would be associated with it an Institute of Applied Botany, which would be of great service to agriculture.

AN interesting and important report of the Nitrate Supply Committee (appointed by the United States Secretary of War) is summarised in *Science* for September 14. The chief recommendations made are as follows:—That out of the 4,000,000*l.* nitrate supply appropriation the following sums be made available for the purposes indicated:—(1) 600,000*l.* to be used in building a synthetic ammonia plant (best in south-west Virginia or a contiguous region), contingent upon the completion of satisfactory negotiations with the General Chemical Co. for the rights to use its synthetic ammonia process; (2) 120,000*l.* to be placed at the disposal of the War Department for building a plant for the oxidation of ammonia to nitric acid and concentrating the latter; (3) 40,000*l.* to be allotted to

experimentation in the industrial development of the Bucher process for the production of sodium cyanide and ammonia, contingent upon a satisfactory arrangement being made with the Nitrogen Products Co.; (4) 20,000*l.* to be made available for the active prosecution of investigations into processes for the industrial production of such nitrogen compounds as are required in the manufacture of explosives and fertilisers. The committee further recommends that the War Department proceed with the construction of the plants mentioned under (1) and (2) above at the earliest practicable date, that the Government promote the installation of by-product coke-ovens in order to increase the production of ammonia and toluol, and that a decision regarding the more extensive installation of nitrogen processes be postponed until the plants now recommended are in operation. The committee is of opinion that the immediate accumulation and permanent maintenance of a reserve of Chile saltpetre of not fewer than 500,000 tons is a measure urgently necessary.

WE learn from *Science* that upon the recommendation of the U.S. National Research Council Dr. A. Trowbridge, of Princeton University, and Prof. T. Lyman, of Harvard University, have received commissions in the Signal Corps, U.S.A., for work in sound-ranging. They have sailed for France to investigate conditions at the front in this subject. The sound-ranging service which will be developed under their direction will utilise in the near future more than fifty men. A meteorological service has been organised under the Signal Corps, U.S.A., in which about one hundred physicists and engineers will be engaged in aerological observational work under the direction of Dr. W. H. Blair, of the U.S. Weather Bureau, who has sailed for France to investigate conditions abroad. Forecasting work for the American Expeditionary Force in France will be in charge of Mr. E. H. Bowie, of the U.S. Weather Bureau. Prof. C. E. Mendenhall, of the University of Wisconsin, has been placed in charge of the development of aeronautical instruments. All the work of these services, sound-ranging, meteorology, and aeronautical instruments, is included within the scope of the Science and Research Division of the Signal Corps, which, in accordance with a recent order of the chief signal officer, has been established and placed under the direction of the National Research Council, of which Major R. A. Millikan is the executive officer. The functions of this division of the Signal Corps are twofold, namely: (1) to furnish *personnel* of the research sort to the other divisions when the situation warrants the assignment of men of this type to these divisions, and (2) to have a *personnel* of its own which maintains intimate contact with all research and development work in other divisions, and distributes research problems to university, industrial, and governmental research laboratories with which it is associated. Similar, though in some cases less formal, relations have been established with other technical bureaux of the War and Navy Departments. Upon request of the French High Commission a number of American physicists and chemists are being sent to France to assist in various war problems in which technically trained men are needed. Upon the recommendation of the National Research Council Prof. R. W. Wood, of Johns Hopkins University, Prof. E. Bartow, of the University of Illinois, Prof. R. Stevenson, of the College of the City of New York, and other men of science are receiving commissions in this connection, and a number of them have already sailed for France.

THE Committee of the Loutreuil Foundation has reported to the Paris Academy of Sciences (*Comptes rendus*, October 22) that it has recommended the following grants:—The National Natural History Museum, 3000 francs to Prof. Louis Roule for assistance in his researches on the migrations of the Salmonidæ. Central Council of the Observatories: 8000 francs to the Observatory of Lyons for the installation of a telephone line; 1500 francs to Henry Bourget, director of the Marseilles Observatory, for assisting in the publication of the *Journal des Observateurs*. Ecole Polytechnique; 1000 francs to Prof. A. Colson for his physico-chemical researches on the theory of solutions. National Veterinary College of Lyons: 5000 francs for the installation of radiological apparatus; 350 francs to Prof. Charles Porcher for the purchase of apparatus for researches on milk. National Veterinary College of Toulouse: 5000 francs for the purchase of a projection apparatus capable of utilising kinematographic films. Conservatoire des Arts et Métiers: 5000 francs to Prof. Léon Guillet for the organisation of a metallographic laboratory. In reply to demands addressed direct: 5000 francs to Charles Alluaud and R. Jeannel; 1000 francs to Henri Blondel; 5000 francs to the Institute of Hydrology and Climatology; 2000 francs to R. Ledoux-Lebard and A. Dauvillier for their X-ray researches; 2000 francs to A. Paillot for the purchase of material required for bacteriological researches; 1000 francs to J. de Thézac; and 3000 francs to Albert Portevin and Marcel Garvin. The grants proposed amount to 47,850 francs, and the committee considers it necessary to carry forward a large balance, in view of probable demands at the close of the war.

PROF. J. A. FLEMING will deliver a Christmas course of six illustrated lectures (adapted to a juvenile auditory) at the Royal Institution, on "Our Useful Servants: Magnetism and Electricity."

A GENERAL meeting of the Geological Physics Society will be held in the rooms of the Geological Society, Burlington House, on Wednesday, November 28, at 3.30 p.m., at which a lecture will be delivered by Mr. C. Carus-Wilson on "Theories and Problems relating to Musical Sands," illustrated by experiments. The meeting will be open to visitors.

THE Thomas Hawksley lecture, 1917, of the Institution of Mechanical Engineers will be delivered at six o'clock on Friday, November 30, in the hall of the Institution of Civil Engineers, Great George Street, Westminster, by Capt. H. R. Sankey, who will take as his subject "Heat Engines." An invitation is given to visitors.

AT a meeting of the Chemical Society held on November 15 the following exhibits were shown:—Laboratory glass apparatus and specimens of chemicals, by Messrs. Baird and Tatlock; laboratory ware, by Messrs. Doulton and Co., and by the Royal Worcester Porcelain Co.; specimens of dyes used in the clothing of the Armies of the Allies, and medicinal agents and antiseptics, by Messrs. Levinstein, Ltd.; balances and weights, by Mr. L. Oertling; and laboratory glass apparatus, by Messrs. Wood Bros. Glass Co., Ltd.

As the subject of the metric system was very fully discussed at the Institution of Civil Engineers in the early part of the year, especially from the point of view of the relative merits of that system and the British, it may be well to state that the main object of the discussion to be held at the Institution of Electrical Engineers on December 13 is to consider the effect on the British electrical trade of the introduction of the metric system at the present time, especially in those markets in which the British system is at present in vogue, with the view of determining whether the compulsory introduction of metrical measures should be pressed for or resisted. It is hoped

that it may be found possible to take steps after the discussion to obtain some authoritative pronouncement on the matter from the trade as a whole that will put an end to the present hesitating and unsatisfactory attitude towards the question.

WE regret to record the death of Mr. Wilson Noble on October 31, at sixty-two years of age. Mr. Wilson Noble was a fellow of Trinity College, Cambridge. From 1886 to 1895 he was Conservative M.P. for Hastings. He devoted much of his time to electrical investigations, particularly in connection with X-rays, and having a very fully equipped laboratory was able to render great service in the medical applications of radiography in the early days of the discovery. He held the position of president of the Röntgen Society in 1900, and was the author of some important papers on X-ray technique.

NEWS has been received of the sudden death last week, at fifty-nine years of age, of Prof. Emile Durkheim, the distinguished philosopher and sociologist, editor of the *Année Sociologique*, and professor of pedagogics at the Sorbonne. The loss of his only son, a young philosopher of great promise, in the fighting at Salonica at the end of 1915, and a long uncertainty as to his fate, had visibly affected Prof. Durkheim's health, but he was able to continue his courses to the end of the scholastic year. In November, 1916, a nervous breakdown obliged him to discontinue his work, and in spite of temporary improvements he never recovered.

2ND LIEUT. L. P. SIDNEY, whose death, at twenty-four years of age, is reported in the *Times*, was an observer in the Royal Flying Corps. He was the son of Mr. L. P. Sidney, assistant secretary of the Iron and Steel Institute, and studied for a time at the National Physical Laboratory, Teddington, in the engineering department under Dr. Stanton, and in the metallurgical department under Dr. Rosenhain. On leaving Teddington he spent a year in iron and steel analysis with Mr. F. W. Harbord, and when the war broke out he was in the service of Messrs. Bell Brothers, Middlesbrough, as metallurgist.

WE learn from *Science* that Mr. J. Y. Bergen, author of several well-known text-books of botany and physics, died at his home in Cambridge, Mass., on October 10, at sixty-six years of age. In 1887 Mr. Bergen became teacher of physics in the Boston Latin School, and later for many years he was instructor in biology in the Boston English High School. In collaboration with Prof. E. H. Hall, of Harvard University, he was the author of "A Text-book of Physics," which has passed through several editions. He was also the author of "Elements of Botany," "Essentials of Botany," and "Foundations of Botany," including a condensed flora for school use. Other successful text-books with special adaptation for schools of particular grades of scientific equipment were prepared by Mr. Bergen in collaboration with Dr. O. W. Caldwell and Prof. B. M. Davis.

THE inaugural lecture in connection with the George Herdman chair of geology at the University of Liverpool was delivered by Prof. P. G. H. Boswell on Friday last, November 16. In a short introductory address, the Vice-Chancellor (Sir Alfred Dale), who presided, remarked that many of the University chairs were memorials of those who had done their work or whose work was nearly done, but the chair they were now inaugurating was one established in memory of youth, and of a work that was just begun. It had been established by Prof. and Mrs. Herdman in memory of their son, George Andrew Herdman, who fell rather more than a year and a half ago in France. He was young, and an undergraduate at Cambridge. But he had already given something more than mere promise, and older men who knew him regarded him as one who not only would maintain, but also might possibly increase, the honours he had inherited with his name.—The subject of Prof. Boswell's lecture was "Sands: considered Geologically and Industrially under War Conditions."

SIR W. T. THISELTON-DYER has presented to the library of the Royal Botanic Gardens, Kew, a collection of about a hundred personal letters addressed to him by Charles Darwin between the years 1873 and 1881. Those of more general interest have been already published. In one he writes, "It is a dreadful evil to be so ignorant of botany as I am," and many of them contain allusions to experiments and discoveries of the utmost interest. These letters constitute a very valuable addition to the now extensive collection of original documents to the Kew Library.

WE learn from *Kew Bulletin*, No. 6, that the island of Ascension has suddenly been clothed with verdure, a grass, *Enneapogon mollis*, having appeared in great abundance on the lower parts of the island. The account is illustrated by a photograph showing men cutting a luxuriant crop of the grass, which has converted what Sir Joseph Hooker described as a "scorched mass of volcanic matter, in part resembling bottle-glass and in part coke and cinders," into a comparative paradise. The grass, which is apparently an annual, has not been reported from the island before, but is a native of tropical Africa, and seeds may have reached the island through the agency of birds, or have been wind-borne. It appeared after some good showers, rain being of very rare occurrence in Ascension.

DURING the present war more use has been made of electrical treatment than at any previous time. Cases that are seldom or never seen in times of peace, such as shell-shock and trench-foot, are receiving their trial of electric treatment, as well as neurasthenia and various neuroses, so that more detailed information of the value of this form of treatment will be obtained. Cases of nerve injury are also numerous, and much experience is being obtained of the uses of electricity in their diagnosis and treatment. The *Archives of Radiology and Electrotherapy* proposes to publish reports from the electrical departments of various war hospitals, and in the October number (vol. xxii., No. 5) an account is given by Lieut. Burke of that of the Horton War Hospital, Epsom. The report of the Radium Institute of work from January, 1915, to December, 1916, is also included. Of 580 cases of cancerous disease treated (excluding rodent ulcer) twenty-six were apparently cured.

THE West Indian colonies, in common with the rest of the world, have their bread problem. How this is to be met is the subject of an official inquiry, and an interim report of the British Guiana Flour Substitutes Committee, published in the Bulletin of the Department of Agriculture, Trinidad and Tobago (vol. xvi., part 2), indicates the lines upon which action can be most usefully taken. Analyses collated by the committee show that the products of tropical origin which most nearly approach wheat flour in food value are rice, guinea-corn, and maize. These materials can be employed alone only in the preparation of cakes. Without wheat flour they do not give a satisfactory bread. Other products of relatively higher starch content which are of local origin, *e.g.* cassava, sweet potatoes, tannias, and eddoes, can also be employed in this way, but they yield an article of lower food value and wider nutrient ratio. It is possible, however, by the addition of a proportion of meal obtainable from

locally grown pulses, *e.g.* pigeon-peas, black-eye peas, lima, and bonavist beans, to bring the nutrient ratio of these more starchy products up to the desired standard. Action upon these lines is recommended, and a proposal is put forward for the establishment of a factory, or factories, for converting the locally grown raw materials into non-perishable and marketable products. The same number of the bulletin contains also papers by Mr. R. O. Williams and Mr. H. Meaden, in which more detailed information on the various suggested flour substitutes is given.

SINCE the war began it has become apparent that the resources of the Empire in food and raw materials have not hitherto been used to meet the needs of the Empire itself to anything like the extent that is desirable. Rice is a striking example of this state of things. Thus India, which produces (principally from Burma) about 40 per cent. of the world's exportable surplus of rice, distributed its exports in 1913–14 in the following proportions: to British countries 42·6 per cent., to foreign countries 57·4 per cent. The gross imports into the British Empire were little less than the total exports of rice from India, so that it would be quite possible to find a market within the Empire for nearly all the rice India can spare for export. While this country occupied a relatively unimportant position as a direct importer of rice from India, it imported considerable quantities of rice from Holland and Germany, which had been first exported from India to those countries, and, after being milled and polished there, had been re-exported to England. It is clear that there is much leeway to make up in the way of developing inter-Imperial trade in food and raw materials. In the new number of the Bulletin of the Imperial Institute is published an exhaustive article on the "Production and Uses of Rice" (British literature on which subject has hitherto been practically non-existent), which, it is hoped, will assist in that direction. It gives precise information as to the present production of rice throughout the world and the demand for this grain within the Empire, the general tendencies of the trade, the directions in which markets should be sought, and various uses to which rice is freely applied in certain countries, though not, as yet, within the Empire.

IN a paper on the testing and standardisation of motor fuel, read at the Institution of Petroleum Technologists on October 16, Mr. E. L. Lomax described an improvement of the Engler process for determining the degree of volatility of motor fuels. The method consists essentially in the adaptation of a jacketed dephlegmator column to the usual apparatus, and is designed to give results similar to those obtained by the original method of distillation, but with greater rapidity and easier manipulation. In connection with this subject attention is directed to the gradual change in the composition of motor-spirits corresponding with the development of motor engines during the last decade. Whereas formerly the average proportion of these spirits volatile below 100° C. was about 60 to 70 per cent., it is now only about 20 to 40 per cent., with a correspondingly greater proportion of higher boiling hydrocarbons. This is important, since it means that motor engines have been so improved that they can utilise more of the heavier fractions of petroleum than formerly; the present-day automobile engine will run quite well on spirit which would have given much trouble with the engine of earlier days. It is for motor engineers to see that the engine of the future will run well on even a less volatile mixture than that now employed. The world's supply of petroleum products suitable for use in internal-combustion engines is strictly limited, and development on the lines indicated is one of the means by which the petroleum industry may be enabled to meet the growing demands. At the present time it is a waste of valuable products to use spirit containing an unduly large percentage of the more volatile compounds for road and water vehicles, as these light fractions assist the vaporisation of heavier hydrocarbons which are not by themselves satisfactory fuels for internal-combustion engines, but which can be used for the purpose when mixed with the lighter fractions. Thus utilised, they serve greatly to increase the available supplies of motor fuel.

ALTHOUGH the calls made on the services of the National Physical Laboratory for work connected with the war during the past two years have been exceptionally heavy, the appearance of vol. xiii. of the Collected Researches of the Laboratory shows that research work has not been neglected. The volume extends to 300 pages, and includes researches from the Froude tank, the engineering, metallurgical, optical, and magnetic departments. More than half the total number deal with optical questions of vital importance to the instrument-maker. Some of these describe new methods which instrument-makers have already adopted, while others provide material for future use. A paper on tests of fuel oils made for the Royal Commission on Oil Fuels by Messrs. Pannel and Higgins appears not to have been published previously. It deals with the flow of Mexican, Texas, Trinidad, and Scotch shale oils, and of mixtures of them through pipes of various diameters, and shows that the pressure head necessary to give a prescribed flow can be determined by the expression which has been shown to hold for the flow of water or air through pipes of different diameters. The viscosities, densities, and flash points of the above oils, and of Borneo, Persian, and Kimmeridge shale oils, and of their mixtures, were also investigated, and the advantages of certain mixtures are pointed out.

La Nature for October 27 gives some particulars of the Institute of Applied Hydraulics which has recently been inaugurated by the University of Padua. The new institute is situate at Stra, on the Padua-Venice tram route. A villa has been taken and converted into laboratories, which are provided with the usual equipment, lecture-rooms, etc. Facing the building is a long canal, which has been transformed into an experimental tank, along which runs the electrically driven carriage. The tank is 200 metres long, 10·75 metres wide at the surface, and 3·5 metres deep. Researches have already been carried out in the tank on the flow of water in tubes of various cross-sections and diameters under constant or slowly varying pressures, the motion of water in forced conduits such as are used in hydraulic plants, and so on. A tower specially erected near the main building produces a head of water for experimental purposes, *e.g.* determining the influence of change of shape of pipe and the nature of its walls, and the strength of materials used in structural work. Investigations are at present in hand on the value of the instruments used for measuring flow, such as Pitot tubes and the Woltmann mill, and the influence of their length, depth of immersion, etc., on the accuracy of measurement. The new Hydro-technical Institute will publish a bulletin periodically setting forth researches undertaken, together with the results attained. The institute will also keep in close touch with the Hydrographic Department at Venice, and thus be able to supply any information required bearing on the protection of that city from floods and the study of the lagoons along the Adriatic.

THE whirling of shafts has occupied the attention of many engineers during recent years, and a series of articles by Mr. H. A. Webb, which appears in *Engineer-*

ing for November 2, 9, and 16, will be read with interest, as it forms a valuable contribution to our knowledge of this subject. Mr. Webb has evolved a graphical method of solution for non-cylindrical shafts, in which a graph of $\sqrt{I/w}$ is drawn for the shaft, w being the weight per unit length, and I the moment of inertia of the section in bending. The whirling speed can then be estimated roughly from a set of typical curves included in the paper, or can be calculated by employing graphically Mr. Webb's two formulæ. For the purpose of checking the new method, a number of new solutions has been found by rigorous mathematics. These cases include a cylindrical shaft, a solid shaft consisting of one or more conical pieces, a hollow shaft with all its weight in the rim, and consisting of one or more conical pieces, and a solid shaft the meridian curve of which consists of one or more parabolic arcs, all of them, produced if necessary, touching the axis. For all cases the agreement is remarkably close, and shows that the new graphical method is valid if (maximum value of Iw)/(minimum value of Iw) is less than 40,000, which limit probably includes all shafts likely to be required in practice. Mr. Webb's method is based on a hitherto unpublished approximate method of attacking the general problem devised by Mr. W. H. Barling some years ago. Mr. Barling's hypothesis is that there is no transference of energy between consecutive elements of the shaft, and it gives correct results for cylindrical shafts.

MESSRS. J. M. DENT AND SONS, LTD., will shortly publish "A Complete System of Nursing," by Miss A. M. Ashdown. It is claimed for the work that it will contain all the practical information which a nurse may require during her training and in actual practice.

MESSRS. DULAU AND CO., LTD., 37 Soho Square, W.1, have just issued a valuable and interesting catalogue (No. 69, November) of more than 1600 works on Botany (Phanerogams and Cryptogams), Zoology (Vertebrates and Invertebrates), Herbals, Gardening, and Agriculture. Many of the books offered for sale are rare, and a considerable proportion, being of foreign origin, are difficult to obtain in a new condition at present. The catalogue should be of service to many of our readers.

IN the article on "Ferro-Concrete Ships" which appeared in last week's NATURE, it should have been stated that we were indebted to *Engineering* for the blocks with which the article was illustrated.

OUR ASTRONOMICAL COLUMN.

ORBITS OF COMETS.—The orbits of three comets are discussed by S. Ogura in *Annales de l'Observatoire Astronomique de Tokyo*, tome v., part 3. (1) Comet 1827 II. was discovered by Pons on June 20, 1827, and observed by him for a month; Pons used a ring micrometer, and his observations show rather large residuals. The definitive orbit is as follows:—

$$\left.\begin{array}{l} T = 1827 \text{ June } 7{\cdot}192422 \text{ G.M.T.} \\ \omega = 19^\circ\ 18'\ 56{\cdot}12'' \\ \Omega = 317^\circ\ 39'\ 39{\cdot}67'' \\ i = 136^\circ\ 26'\ 11{\cdot}00'' \end{array}\right\} 1827{\cdot}0$$

$$\log q = 9{\cdot}9067087$$
$$\log e = 9{\cdot}9774915$$
$$\text{Period} = 63{\cdot}83 \text{ years}$$

The period is considered to lie between fifty-nine and sixty-nine years. The orbit of the comet of 1500 shows a distant resemblance, but identity is improbable.

(2) The comet of 1132 was observed in Japan on October 5, 7, and 9; its motion was extremely rapid, 100° being described in four days. The following orbit is deduced:—

$$\left.\begin{array}{l} T = 1132 \text{ August } 30{\cdot}20 \text{ G.M.T.} \\ \omega = 114{\cdot}3^\circ \\ \Omega = 201{\cdot}1^\circ \\ i = 106{\cdot}4^\circ \end{array}\right\} 1132{\cdot}0$$

$$\log q = 9{\cdot}8666$$

These elements indicate a near approach to the earth, the distance being 0·045 on October 7. This comet was also observed in China and Europe, but the positions are less precisely defined than in the Japanese record.

(3) The comet of 1240 was observed with considerable precision in Japan; it passed close to Jupiter, and the head was stated to be "as big as Venus." The following orbit is deduced from the Japanese and Chinese observations:—

$$\left.\begin{array}{l} T = 1240 \text{ January } 21{\cdot}06 \text{ G.M.T.} \\ \omega = 331{\cdot}3^\circ \\ \Omega = 124{\cdot}5^\circ \\ i = 75{\cdot}4^\circ \end{array}\right\} 1240{\cdot}0$$

$$\log q = 9{\cdot}8246$$

The minimum distance from the earth was 0·36 on February 2. The orbit somewhat resembles that of comet 1863 IV.

THE IRON ARC AS A SOURCE OF STANDARD WAVE-LENGTHS.—Previous investigations have shown that the wave-lengths of many of the lines in the spectrum of the iron arc, which is in such frequent use as a source of standard wave-lengths, are subject to variations depending upon proximity to the electrodes. The possible elimination of this "pole-effect" has been the subject of an important investigation by Messrs. St. John and Babcock (*Astrophysical Journal*, vol. xlvi., p. 138). It has been shown that the effect disappears in the case of the Pfund arc *in vacuo*, and becomes negligible in a narrow central zone of the same type of arc in air when the negative pole is of carbon. The former, however, is not a convenient everyday source, and the latter is lacking in intensity. The practical outcome of the extensive experiments is to show that a Pfund arc, with both poles of iron, may be relied upon to give the "fundamental" wave-lengths of even the most sensitive lines, if the length of the arc be not less than 8 mm. and the current not more than 5 amperes; under these conditions a horizontal zone near the centre at least 1¼ mm. wide may be used with safety. This arc also has the advantage of giving sharply defined lines, and uniformity in the relative intensities. The investigation has shown that the pole effect has not been entirely eliminated in the case of the adopted international standards, and that certain supposed anomalous displacements of iron lines in the sun become normal when the fundamental wave-lengths of such lines are used for comparison.

CAPE OBSERVATORY REPORT.—The report of his Majesty's Astronomer at the Cape of Good Hope for 1916 has been received. Besides work of a more or less routine character, we note that a new programme of observations of close circumpolar stars with the reversible transit-circle has been undertaken, with special reference to the determination of the constant of aberration. Mr. J. Voûte has completed his series of observations for stellar parallaxes by means of right ascension measures, and has also made observations of double stars. The programme of observations for radial velocities of stars with the Victoria telescope and four-prism spectrograph was completed before the end of the year, and experiments with a shorter camera are in progress with a view to the extension of the observations to fainter stars. Photographs of the sun, intended to supplement the Greenwich series, were

obtained on 333 days; when possible, duplicates were taken at short intervals for the detection of spots of brief duration. In addition to the usual system of telegraphic time-signals, arrangements have been completed for the daily transmission of a wireless signal for the use of shipping in South African waters.

THE CLASSIFICATION OF THE BRITTLE-STARS.[1]

THE Ophiuroidea have long presented a problem to the systematist, and its solution was not advanced when the palæontologist joined the neontologist in council. The reason is twofold: the modern representatives of this Echinoderm class differ little in great points, but greatly in little points; the Palæozoic representatives, which do differ much, and should throw light on the origins of orders, are so preserved as to be difficult of interpretation. Twenty-five years ago Mr. Jeffrey Bell divided the recent forms according as they could only move the arms horizontally or could also coil them vertically, the latter being regarded as more primitive. Dr. J. W. Gregory extended this system by adding an order for those yet more primitive forms in which the arm-bones still consisted of the original paired elements. It was early pointed out that these divisions represented successive grades rather than divergent orders; but doubt has since been cast even on their correspondence with reality by the observations of Schöndorf, Sollas, Mortensen, and Spencer on the older fossils and on the crucial genus Ophioteresis. Now a voice from the East complains: "I found the classifications very unsatisfactory. Indeed, their imperfections became a haunt to me." From a study of recent genera, Mr. Matsumoto infers that in respect to both mouth-frame and arm-bones the forms which can only move their arms horizontally are more primitive than those which can coil them vertically. He therefore rejects any system based mainly on the joint-faces, and puts forward a classification of his own.

The difficulty presented by the Palæozoic forms is evaded by separating them as a sub-class: Œgophiuroida. Since this admits no genera with ventral arm-plates it cannot quite correspond with the Palophiuræ (Haeckel), but its difference from the Protophiuroidea (Sollas) is not obvious. Neither is it clear whether the author would regard the Œgophiuroida as a non-persistent group parallel to both Asteroidea and Ophiuroidea, or whether he would bring it into the ancestry of modern brittle-stars.

All normal Ophiuroidea with the ventral surface of the arms covered by plates are constituted a sub-class Myophiuroida. Its Palæozoic representatives have no distinct plates in the skin of the central disc, the mouth-frames are slender, dorsal arm-plates are absent or incipient, ventral arm-plates are small and depressed below the projecting edges of the side plates. Among recent forms it is the Ophiomyxinæ that come nearest to this condition, but it is also approached by those Ophiacanthidæ in which the arms are only flexible horizontally. From the Ophiomyxidæ Mr. Matsumoto derives all the Trichasteridæ and Gorgonocephalidæ, and separates the three families as an order Phrynophiurida.

From the early Ophiacanthidæ are supposed to spring all the other Ophiuroids, diverging along three lines. The first of these passes, through those Ophiacanthidæ which can coil the arms vertically, to the Hemieuryalidæ; and these two families compose the order Læmophiurida. The two other lines never attain vertical coiling. From one another they are distinguished in the articulation of the radial shield and genital plate: in the one case this is by a single ball-and-socket joint, in the other case by two condyles and sockets. The former line passes, through the Amphilepididæ, to the Amphiuridæ and Ophiotrichidæ, and, since these two families have stout mouth-frames and teeth, the whole order is called Gnathophiurida. Along the other line arises a host of forms, divergent in structure and complex in relationship, which are grouped under five families: Ophiodermatidæ, Ophiochitonidæ, Ophiocomidæ, Ophiolepididæ, and Ophioleucidæ.

Mr. Matsumoto's classification, being essentially phylogenetic, will have to be checked by the palæontologist before it can be considered established. The morphological bases, however, seem well selected and are well illustrated. F. A. B.

[1] "A Monograph of Japanese Ophiuroidea, arranged according to a New Classification." By Hikoshichiro Matsumoto. Journ. Coll. Science, Tokyo, vol. xxxviii., Article 2. Pp. 408+vii plates. (University, Tokyo, March 31, 1917.)

ATMOSPHERIC POLLUTION.

THE second report (1915–16) of the Committee on Atmospheric Pollution has just been issued in the form of a supplement to the *Lancet*, the delay in its appearance being due to lack of funds. This difficulty has now been met by the receipt from the Department of Scientific and Industrial Research of a Government grant, which provides the necessary equipment for collecting and analysing the smoke deposits at different centres. The work, moreover, has been given official approval and status by placing it under the control of the Meteorological Office, the committee being constituted as an advisory committee of that department.

Owing to the depletion of the staffs formerly collaborating in these investigations, certain stations have found it impossible to continue observations, so that the list for the year is curtailed. The general methods of analysis and tabulation of results are, with slight modifications, those previously described in the former report (NATURE, May 4, 1916, vol. xcvii., p. 203).

It is interesting to note from the point of view of fuel economy that the deposit for the year in the County of London alone, which consisted of matter derived from waste fuel in the form of smoke, amounted to 54,200 tons. The report adds that not only is it necessary to scrutinise carefully every source of waste, but it is equally necessary to conserve the health and physical energy of the people. From this point of view it refers to the fact that the average weight of air consumed per day by the adult human being is 30 lb., as compared with 7·2 lb. of solid food and water.

In the section devoted to a discussion of results a comparison is drawn between the total solids deposited in the six summer and the six winter months of 1915–16 with the corresponding periods of 1914–15. Without reproducing details of the results it may suffice to say that in the larger number of centres there has been an increase in the amount, a few centres in the Manchester and Glasgow area showing a decrease in the winter months, while Birmingham Central, Bolton, Malvern, Sheffield, and York show a diminution in the summer months. Of the actual quantities, the mean monthly deposit in tons per square kilometre is tabulated for the different centres. It appears from this that Oldham has the distinction of showing the largest deposit of total solids, carbonaceous matter other than tar, and insoluble ash, while Glasgow occupies the highest place in ammonia, sulphates, and tar. Malvern shows the minimum deposits in nearly every item. If there were the same fierce rivalry between towns as existed in medieval Italy, we might hope that industrial centres might vie with Malvern in improving their atmosphere.

There seems very little prospect of any such peaceful

solution of the problem of smoke pollution. Yet this problem in industrial and sanitary reconstruction will have to be faced when peace comes, and for that reason it seems unfortunate that the Local Government Board Committee on Smoke Abatement should have indefinitely postponed its meetings on the outbreak of war.

J. B. C.

METEOROLOGICAL PERSISTENCE.

THERE is a special sense of appropriateness about the brochure entitled "Konstant auftretende secundäre Maxima und Minima im dem Jährlichen Verlauf der meteorologischen Erscheinungen," by Dr. Eli Van Rijckevorsel, published as No. 102 of the "Mededeelingen en Verhandelingen" of the Royal Meteorological Institute of the Netherlands. For the last dozen years the author has appeared to confine his published scientific activity to the subject of the persistence of secondary maxima and minima in annual meteorological phenomena, and this is his eleventh contribution on the same thesis, the last three of which have received the support of his national institute.

A detailed comparison of the whole series of "tracts" would be necessary to enable us to dogmatise as to the validity of the author's conclusions and the justification of his persistence. There is no doubt, however, that even this eleventh article taken by itself is full of interesting points. A long series of seventy-two years' barometric data from Christiania is dealt with in two thirty-six-year portions, and also as to twenty-five years allocated to sun-spot maxima and twenty-five years to minima in the same period. From the sun-spot point of view, a similar process is applied to shorter periods from Nertchinsk and Innsbruck. The main part of the data, however, consists of daily sums from thirty-three stations in the N. Hemisphere for periods ranging from forty-three years at Hapa-randa to four at Honolulu and St. Vincent (Cape Verde). The stations are well distributed, five with a mean latitude of 67° and a range in longitude of nearly 100°; eight with mean latitude 52°, and with gaps in longitude of 120° for the Pacific and 90° for the Atlantic; nine with mean latitude 42°, and again a gap of 120° in longitude for the Pacific; and eleven with mean latitude 21° in which the Pacific gap is partly bridged by Honolulu. Some of the tables appear to have had a decimal point omitted throughout, and the Honolulu table differs considerably from the others, but the principle of printing sums instead of means, when the periods vary considerably, seems to demand more explanation than the author has given, though this practice has probably been adopted and discussed in one of the ten earlier contributions which are not for the moment at hand.

An excellent series of plates shows the author's idea of the variation with latitude and longitude of the secondary oscillations with which he is dealing, and there is also a comparison of the resulting oscillations from a fifty winters' comparison of Greenwich barometer and thermometer, showing a mean lag of half a week from the barometric maximum to the temperature minimum; a similar comparison in diagrammatic form is given for Bucharest from a fifteen-year period.

Altogether there would appear to be thirty-five oscillations in the year superposed on the ordinary single solar oscillation, but having regard to the classic case of the three "icemen," now so generally discredited in this country, it may be some time before Dr. Rijckevorsel obtains much enthusiastic support among us, for though the reality of the alternations of weather is undeniable, our proverbial traditions nearly all postulate, not the same, but different conditions on a fixed date.

W. W. B.

THE SHORTAGE OF THE SUPPLY OF NON-PHOSPHORIC IRON ORE.[1]

ALREADY in the pre-war years the supplies of high-class hæmatite to the iron-smelting districts of Europe from the nearer sources were getting short, and the time was in sight when, for iron ores low in phosphorus such as are required for the production of the "hæmatite grade" of pig-iron demanded by those who make steel by the "acid" process, we shall have either to turn our attention to sources of supply which are less readily accessible, or so to improve metallurgical processes that, from ores which are abundant in closer proximity to the coalfields, trustworthy substitutes for "Bessemer-grade" acid steels can be economically produced. The thesis advanced by the author of these Howard lectures is that, notwithstanding that the low-grade phosphoric ores of the English Jurassic rocks yield a pig-iron which for steel-making requires refining upon a basic hearth, in Britain the second of the two alternatives mentioned should be chosen.

The subject-matter dealt with in the lectures was assembled under two heads. In the first of the lectures the author presented a conspectus of the various ironfields where ore production is in progress within the British Isles. In the second he passed in review the various orefields in foreign countries which, under peace conditions, sent produce, either raw or semi-manufactured, from their iron mines to supply the British market.

Within the British area there is a remarkable absence of any considerable concentration of iron ore among geological formations of pre-Carboniferous age. The non-phosphoric hæmatites of the Carboniferous Limestone district occur as veins and impregnations, and extend some little distance downwards among these older rocks, but in their distribution they are limited to a narrow belt of country which ranges north and south through the English Lake District and the Forest of Dean, and are probably of post-Carboniferous date. They are less regular in their distribution, and therefore more expensive to exploit, than are the bedded ores associated with the Coal Measures or interstratified in thicker masses among the Jurassic rocks, and the shortage of home supplies of hæmatite has already long been felt.

In former days clay-band and black-band ores, interstratified among the Coal Measures, afforded the main supply of English and Scottish iron, but when steel superseded wrought-iron as the ordinary material for constructional engineering, economic conditions brought about the diminution of iron production from these ores, and though there lie in reserve more than thirty thousand million tons of such ore among our Coal Measures, that source of supply does not at present represent to our ironmasters a national asset which has any great marketable value.

Along the outcrop of the English Jurassic rocks between the coast of Dorset and the Cleveland Hills there is nowhere any lack of low-grade iron ore. In the neighbourhood of the Humber it is the Lower Lias which carries the ore-bed, but generally the Middle Lias is the more prolific horizon. In Northamptonshire the great development of iron ore is in the basal member of the Inferior Oolite series, and at Westbury, in Wiltshire, and throughout the southern counties, the most important development is in association with Corallian rocks. "Just as the Carboniferous is the great repository of Great Britain's fuel wealth, so the Jurassic is the bank which holds our fluid reserves of iron ore. The gilt-edged securities of Cumbrian hæmatite are sound, but not unlimited in amount;

[1] Abstract of the Howard Lectures delivered before the Royal Society of Arts on April 30 and May 7 by Prof. W. G. Fearnsides, Sorby Professor of Geology in the University of Sheffield.

while the market for the vast quantities of the clay-band and black-band ores of the Coal Measures must needs be written off. Our engineers prefer the produce of the hæmatite, but there is a shortage, and the price is therefore high. There is plenty of the low-grade phosphoric ore available and cheap. Surely it is not beyond the skill of our metallurgists to make use of it, and obtain from it a product which, on its merits, will overcome the prejudice of the British engineers. This is the only domestic solution of the problem of the home shortage of non-phosphoric iron ore."

Probably it has been realised by few that the total quantity of metallic iron obtained from iron ore brought by ship to Britain, *plus* the weight of metal imported in the semi-manufactured state, has for twenty years past been in excess of the quantity smelted from ores wrought in British mines and quarries. Iron ore, as imported, is generally a fine, selected, high-percentage ore, but in the average of home ores the percentage of iron is compulsorily low, and the tendency is downwards, the average percentage of metallic iron contained in them having declined from 34·7 to 32·1 in the course of the last twenty years. In the year 1913 the cost of turning sixteen million tons of British ore into 5·1 million tons of pig-iron was 17·1 million pounds, and the cost of turning 7·4 million tons of imported ore *plus* 0·6 million tons of "purple ore," *plus* a small amount of scrap steel turnings and mill-cinder, into 5·1 million tons of pig-iron was fifteen million pounds, an advantage in favour of the foreign ore of 2·5 million pounds. The cost of the British ore at mine was 4·5 million pounds, and that of the foreign ore delivered at British ports seven million pounds, between which figures there is also a difference of 2·5 million pounds, so that the difference in cost of manufactured pig-iron made from home and from foreign ore is inconsiderable.

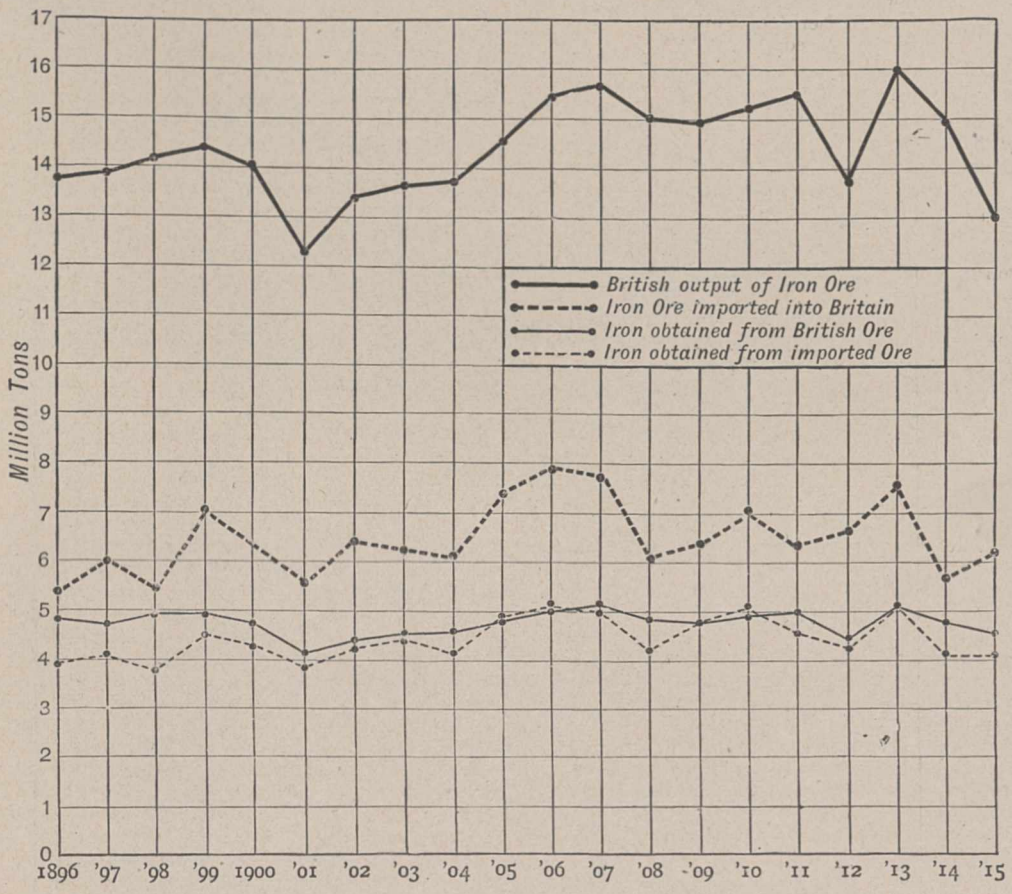

FIG. 1.—Curve showing British output of iron ore and iron obtained from British and imported ore.

In the pre-war years the demand for hæmatite among the ironmasters of the Rhineland was, as in Britain, on the increase, and in consequence the centre of gravity of the hæmatite supply showed signs of a gradual shifting southwards and eastwards. In the future, rising demand and heavier freights, due to increasing length of rail and sea passage, are likely to secure a continuously upward trend in the price of hæmatite, and though the first call for it will surely remain with the nation which wields the trident of sea supremacy, a time is coming when hæmatite obtained from scattered ore bodies will be unable to compete against the large and cheaply worked bodies of phosphoric ores of regions more convenient to the coal.

During the last decade many of those famous iron-ore bodies occurring in association with limestones equivalent in age to the upper part of the English Gault, which were opened up close to Bilbao, in northern Spain, early in the 'eighties, have become exhausted, and at the pre-war rate of depletion the known ore reserves of that district could scarcely have lasted more than another score of years. Other valuable metasomatic hæmatite masses have been discovered further to the westward, along the Pyrenean chain, and only wait for development until better means of transport to seaboard are provided. In southern Spain the present century has seen the beginning of active development of iron mining, and in the pre-war year an output equal to more than half that from Bilbao was thence exported.

The metasomatic hæmatites of Algeria, Tunis, and Morocco follow the foothills of the Atlas range. The well-known mass at Beni Saf promises to become exhausted if worked at pre-war rate for another half-dozen years, but other high-class ore bodies have been discovered along the line of the same unconformity,

where Mesozoic sediments rest upon the ancient schists and gneisses, and are ready for exploitation when railway facilities are provided. In Tunis the ores worked are often manganiferous, and some of them, though apparently true hæmatites, carry more than a trace of phosphorus.

Hæmatite masses formerly worked on the island of Elba and on various of the Grecian islands in the Ægean Sea are either exhausted or likely to become exhausted, if quarried at the pre-war rate, within the present generation.

Produce from the Minette orefield of Lorraine has generally been converted into metal in Germany, Belgium, or France before it reached Britain, and, in consequence, the great importance of this orefield as a source of supply to British markets is often overlooked. It would appear that certainly far more than a million tons of metal brought into this country in each of several of the pre-war years might be traced back to a source of origin in the bedded Jurassic sediments of Lorraine. For the smelting of each ton of this imported metal, probably at least three tons of ore and two tons of coal (from the Hercynian belt of coalfields) must have been consumed, and it therefore appears that for quantity of mineral mined to supply the British market the area taken from France by Germany since 1870 must have held a place equal to, if not in front of, the ironfields of Spain. The iron ore wrought in Lorraine occurs as a series of beds, interstratified among Allenian (Toarcian) shales and limestones, almost identical in age with the Northamptonshire iron ores. The outcrop of the Minette formation extends from the southernmost tip of Belgium through the borders of Luxembourg with France and German Lorraine, southwards at an average distance of about three miles inside the 1914 German border as far as Metz, and crosses into France just east of Nancy.

Of the workable orefield about 160 square miles lie on the German side of the border, fourteen square miles in Luxembourg, and 208 square miles on the French side. The "Grey Bed" ores from French Lorraine are almost perfectly self-fluxing in the blast-furnace, and yield a pig-iron particularly suitable for steel-making by the basic process. According to German authorities, quite the best of the ore comes from the deeper mines beneath the Briey plateau, and had not the German ironmasters been bound by agreement to continue the payment of royalties to the owners of minerals in Germain Lorraine and Luxembourg, they would have abandoned these workings in their own

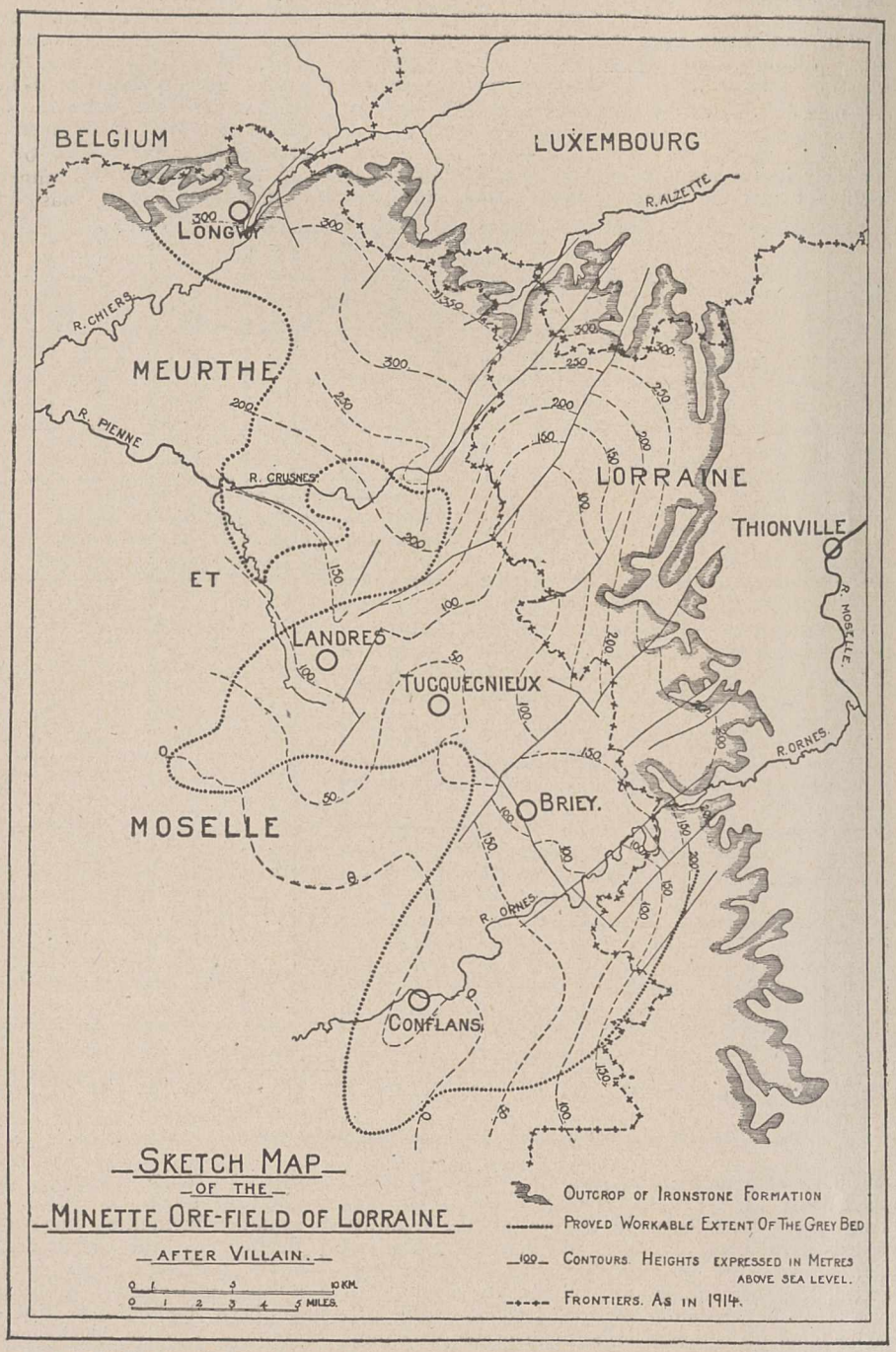

FIG. 2.

country and smelted the bulk of their pig-iron from the produce of the Briey mines. Since the late 'eighties, with the perfecting of the basic process the Lorraine district has established itself as the source of the cheapest supply of steel in Europe, and in the pre-war year the output from it was not much short of fifty million tons of ore. From German Lorraine about 300 out of 2000 million tons, and from France about 200 out of 3000 million tons proved, are won. "Truly, the Lorraine iron-ore district is an asset of the highest national importance, and there can be no doubt that, when official Germany has allowed rumours of her arrogant peace terms to be bruited, the industrialists of the Rhineland are at one with the military caste of Prussia in classing Briey and Longwy as essential strategic points."

Despite their nearness to the ports of Britain, the orefields of western France have not received from British ironmasters the attention they deserve, and more than two-thirds of their produce was, in the pre-war years, exported to Germany. The ironstone formation there is of Upper Arenig (Llanvirnian) age, and somewhat phosphoric in character. In the Normandy district, within sixty miles of the port of Caen, an ore reserve exceeding 200 million tons has been already proved, and the output of the mines of that district is expanding rapidly. The more southerly region north of the mouth of the Loire, in Anjou and Brittany, is as yet less well developed, but there is great hope of discovery of abundant rich ores of quite similar type. Western France is dependent upon English coal for fuel, and it is argued that vessels carrying coal thither should bring return cargoes of iron ore to British blast-furnaces.

For the production of "Swedish iron" the magnetite ores of central Sweden are generally selected by hand, or, after crushing, are concentrated by the wet magnetic process and briquetted. The supply of non-phosphoric magnetite in Sweden is very limited, and the immense magnetite lenticles of Norbotten, in Lapland, are of far greater importance to the Swedish export trade. The ore mass of Kirunavaara is one of the largest in the world, and is more than five miles long. In general, this, as also the other Lapland magnetite masses, carries a good deal of fluor-apatite, and being very dense requires a strong coke to carry its burden in the blast-furnace. For this reason, and because the produce from the Lapland mines requires to be converted into steel by way of the basic process, more than four-fifths of the ore exported from Sweden has found its market in Germany and Belgium.

In Norway the ore masses associated with the ancient schists are generally of lower grade than those of Sweden, and require to be crushed, concentrated, and briquetted to make them suitable for export, and few of the mines have yet advanced to the producing stage. From Sydvaranger, near the shores of the Arctic Ocean, on the borders of Russia with Norwegian Lapland, crushed ore is being successfully concentrated and exported. Some hundred million tons of available low-grade magnetite have been proved there lying in reserve.

Previous to the war produce from the orefields of North America affected the British market rather as a commercial competitor in outside markets than as an alternative source of supply. Since the outbreak of war, however, the British metal market, in former times largely supplied from the orefields of Lorraine, has had to replace its stock with steel and iron smelted in America from American ores. The "banded jasper" ironstone formations occur in the midst of Algonkian and Archæan sediments in the region of the Great Lakes, and segregation of specular iron ore in these formations has taken place along belts determined by tectonic folding. Largest of all the ore bodies in America are those of the Mesabi range, which district is responsible for nearly two-thirds of the total U.S.A. production. For magnitude of present output, as for gross quantity of metal yielded in the past, the Lake Superior region holds precedence over all the ironfields of the world. The available reserves there are enormous, and have been variously estimated at between 2000 and 3500 million tons, with a further 70,000 million tons of lower-grade specular material also in view. The Clinton oolitic ironstone of Silurian age in the eastern States has many features in common with the Minette series of Lorraine. It is worked extensively in the Birmingham district of Alabama, and as a producer of basic pig-iron its importance is increasing rapidly.

The ironfields of the Overseas Empire are separated from home furnaces by distances too vast for it to be economical to bring so low-priced and bulky a commodity as iron ore to compete with the produce from ironfields in the European countries which have no coal. In Canada, Australia, South Africa, New Zealand, and India, iron is already being smelted at a cost less than it can be brought in from Europe, and in due course we may expect to see local iron industries develop, perhaps to such an extent that outlying portions of the Empire may send manufactured or semi-manufactured metal to supply the British market.

Among the world's great ironfields which are supplying their raw material to the iron and steel industries only those in which the ore is to some extent phosphoric have been able since the beginning of the present century to increase their output on an extensive scale. The development of iron-mining in the various European countries and in America is shown on the diagram, Fig. 3.

The chief natural advantages which have enabled this country to outbid foreign rivals in the overseas markets for non-phosphoric hæmatite are the native wealth of the home supply of fuel, and the accident of geography which sited our magnificent coalfields near the harbours of our coasts. The high quality and cheapness of the fuel have enabled this country to maintain the supremacy of its mercantile marine throughout the age of steam, and this has been the dominant factor in securing to our ironmasters their ample hæmatite supplies. Meanwhile, the Germans, drawing the bulk of their ore supplies from deposits in closer proximity to their coalfields, have been able at very low prices to put on the market steel which is sufficiently satisfactory made from the Minette ores of Lorraine; and in the markets of the world this product has largely supplanted the lower grades of acid steel. British ironmasters, who were the last to feel the pinch of hæmatite shortage, have foreseen little commercial advantage to be obtained by smelting the cheaper low-grade supplies of home phosphoric ores, and have been reluctant either to reorganise or to extend their works in order to compete for low-grade trade, and only for high-quality tool and special alloy steels has the British Empire continued to supply her former proportion of the world's demands. Beaten in competition for the non-phosphoric hæmatite supplies, only available from overseas, Germany perfected the basic method of steel refining, and has certainly made the best of the mineral supplies she had at hand. America also has recognised that it is cheaper to work up ores which are abundant and occur in large masses in the neighbourhood of existing transport routes, and most of her recent steel works extensions have adopted the basic open-hearth process of steel-making. It has paid both Germany and America to adopt the basic process to provide a bulk supply of steel, and it should be equally

profitable for this country to develop a part of its steel-making practice along similar lines, and from home Jurassic ores to produce at least sufficient metal to take the place of the two or more million tons of semi-manufactured metal which until lately was imported from abroad. Probably in peace-time scarcely more than one-fifth of the total output of British pig-iron is applied to purposes which suitably refined basic iron could not serve. "Does it not, therefore, seem that when labour again becomes available for the mining or quarrying of home ores, and for handling the relatively greater bulk as it passes through the furnaces, it will be sound policy here to adopt the basic process on such a scale that, even with expanding trade, it will become unnecessary to purchase from

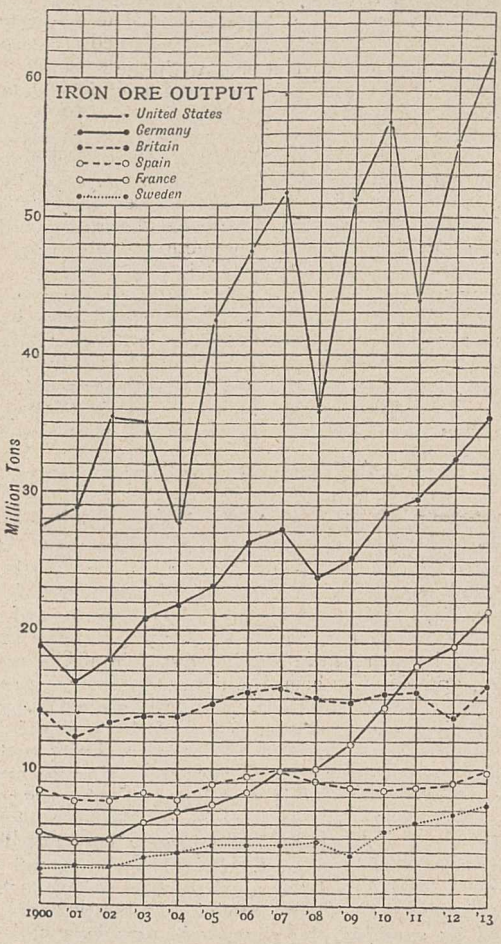

FIG. 3.—Curve of iron-ore output of the United States and Europe.

abroad so large a quantity of ore, for the carriage of which so great a proportion of our mercantile shipping tonnage has in the past been employed?"

Because of the short sea passage, the blast-furnaces near the western coalfields are likely to continue to bring ore from Spanish or Mediterranean ports, and to manufacture hæmatite pig-iron therefrom. To the Cleveland and East Midland districts the orefields of western France and Scandinavia are more convenient, and there are immense possibilities for the extension of the basic iron industry for the smelting of home Jurassic ores. This latter development has already well begun, and in Yorkshire, Lincolnshire, Derbyshire, and Nottinghamshire is proceeding rapidly.

"With five thousand million tons of ore ready for quarrying or mining within fifty miles of a region which holds at least fifty thousand million tons of the very best non-anthracitic coal, there is no valid reason for the iron and steel industries of eastern England to look forward except with confidence to the time when the price of overseas hæmatite becomes prohibitive."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The professor of anatomy has, with the consent of the Vice-Chancellor, reappointed Dr. W. L. H. Duckworth, of Jesus College, to be senior demonstrator of anatomy for five years.

A SILVER medal, which will be known as the Adami medal, in honour of Prof. J. G. Adami, F.R.S., is to be awarded annually in the department of pathology in Queen's University, Belfast. The founder of the medal is Mr. J. H. Stirling, Belfast.

IN connection with the Students' Section of the Institution of Electrical Engineers an address will be delivered to-morrow, November 23, at 7 o'clock, at the City and Guilds (Engineering) College, South Kensington, by Sir Oliver Lodge, on "Astronomical Application of the Electrical Theory of Matter."

THE Parliamentary correspondent of the *Times* states that the chances of the Education Bill passing into law this session have been materially improved. Mr. Fisher has in the last few days been in personal conference with important bodies representing local education authorities with reference to the administrative clauses of the Bill; it is understood that their support may be counted on for its second reading.

THE Maypole Dairy Company has given 1000*l.* to the governors of the Southall County School to establish a leaving scholarship in connection with the school, tenable at the Royal College of Science, London, and to be known as the "Maypole Science Scholarship." The headmaster of the school, Mr. S. Pollitt, recently appealed to local manufacturers for financial aid to establish such science scholarships, and the example of the Maypole Company, whose works are at Southall, will, it is hoped, be followed by other industrial enterprises in the district, so that the school may be able to take its part in meeting the need of the immediate future for highly trained technical chemists and other experts in science.

WE learn from *Science* that the Board of Regents of the University of Minnesota has ratified by a unanimous vote the permanent agreement making the Mayo Foundation at Rochester the absolute property of the University, to be used perpetually for higher medical education and research. Securities totalling 330,000*l.*, representing the fortunes of Drs. William J. and Charles Mayo, were turned over to the University. Expenses of the foundation will be paid by the Drs. Mayo until a fund of 400,000*l.* has accumulated. Thereafter the income from the fund will maintain it. The foundation has been affiliated with the University for two years, which was agreed upon as a trial period. Under the final agreement the headquarters of the foundation can be moved from Rochester to another point in the State after twenty-eight years.

THE report of the president of the University College, Cork, for the year 1916–17 has been received. The number of students attending the college during that year was 486, as against 422 during 1915–16, and

only three of the 486 were not studying for the degrees of the National University, of which the Cork University College is one of the constituent colleges. The report records that the city of Cork has made a grant of 150*l*. per annum to the college for the purpose of promoting the higher education of the working men of the city. Additions have been made to the physiological and pathological departments of the college to supply in some measure the accommodation for the large number of students now entering the medical faculty. Further additions are urgently necessary as soon as funds permit of their being carried out. A comprehensive list of books and papers published by members of the college staff during the session is printed at the end of the report.

A COPY of Section X., Higher Education, of the Handbook of the Education Committee of the County Council of the West Riding of Yorkshire has been received. It gives full particulars regarding the scholarships and exhibitions offered by the committee for competition in 1918. The needs of every class of deserving student appear to be catered for. We notice among these numerous aids to the prosecution of higher education the county major scholarships, of the estimated value of 60*l*. to 65*l*. per annum, to be held at universities, university colleges, or other approved institutions; the county free studentships, covering tuition fees at the University of Leeds or the University of Sheffield; the county technological scholarships, value 60*l*. per annum, tenable for day courses or for combined day and evening courses at institutions where higher technical work is carried out; and county coal-mining exhibitions, covering tuition fees for full courses in coal-mining, or in electricity applied to mining, at the University of Leeds or at the University of Sheffield. There are also scholarships for qualified women desirous of specialising in midwifery and nursing, dairy work, horticulture, and other activities. Section IX. of the same part of the handbook will be published in its revised form next January; meanwhile the committee has issued a circular summarising the particulars respecting scholarships and grants available for persons intending in 1918 to adopt the teaching profession.

AMONG other papers included in the June issue of the *South African Journal of Science* is one by the Rev. J. R. L. Kingon on native education in the Transkei. Mr. Kingon refers to the national importance of educating the native, and urges that the plain fact of the matter is that the natives are determined to have education, and will resort to private schools if they cannot get encouragement from the authorities. More than sixty years of native education have produced a rich harvest and fully vindicated the efforts of pioneer workers in this field. A new situation has arisen in South Africa, the article points out, since the consummation of the Union. The responsibilities and dangers of the white men are greater, because of the millions of black men who are now subject to one central Government. Hitherto in the Orange Free State, the Transvaal, and Natal little has been done to educate the native. Again, owing to a defective system, education in the Transkei, which is taken as a typical example, is almost wholly literary in character, though agricultural education is receiving attention apart from the schools. But for the future, Mr. Kingon says, agricultural education must be given a large place in the schools; industrial education, at present a scandal, must be developed, and facilities must be provided for commercial education. From his experience in Transkei, Mr. Kingon insists that the introduction of a liberal and far-seeing policy of native education throughout the Union of South Africa would secure the future progress and stability of the Union.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 15.—Sir J. J. Thomson, president, in the chair.—E. E. T. **Hinde**: A new gyroscopic phenomenon.—A. P. **Laurie** and C. **Ranken**: Investigation into the imbibition exhibited by some shellac derivatives. The paper deals with experiments made on the substances obtained by boiling shellac with carbonate of soda or borax. These solid substances, very similar in consistency to gutta-percha, are found to expand rapidly when placed in water. The control of the expansion by the addition of soluble salts is not the same as in the case of gelatine, since, at any rate in a large number of cases, it does not seem to depend upon the nature of the salt, but simply upon the strength of the solution, the amount of the expansion increasing with the diminution of the strength of the solution. If the expansion is allowed to become complete in cold water, it is not possible to contract the mass again, but in the case of the expansion in a salt solution it is possible to get the mass to contract again by putting it into a stronger solution. Strong salt solutions are also found to precipitate the soluble portion of the shellac borax compound.—G. I. **Taylor**: Phenomena connected with turbulence in the lower atmosphere. In a previous paper by the author it was shown theoretically that a connection should exist between the rate at which heat is conveyed into the atmosphere by means of eddies, and the amount of retardation of the velocity of the lower layers of the atmosphere behind the gradient velocity due to the friction of the ground. In the present paper the amount of the turbulence over Paris is calculated from temperature observations taken on the Eiffel Tower. It is shown that the amount is the same as that calculated from observations of the change in direction of the wind between the bottom and top of the Eiffel Tower due to the friction of the ground. The daily variation in wind velocity which depends on the daily variation in turbulence is next discussed, and it is shown that the chief characteristics of the observed phenomena of daily variation are explained, both qualitatively and, so far as is possible, quantitatively by the author's equations.—E. G. **Bilham**: The relation between barometric pressure and the water-level in a well at Kew Observatory. The water-level shows a well-marked response to changes of barometric pressure at all times of the year. Under similar conditions a given increase of pressure, δp, will depress the water-level in the well by an amount δu, which is proportional to δp. The value of $\delta u/\delta p$ varies with the mean level of the water, but is always negative. The validity of the equation $\delta u = a.\delta p$ was established between limits given by $dp/dt > 0{\cdot}5$ mb./hr., and the value of a was determined in the case of three groups of months representing high, intermediate, and low levels. The sensitiveness of the water-level to pressure was found to increase rapidly with the height of the water, the value of a for a height of 360 cm. above M.S.L. being four times as great as for a height of 200 cm. The change of sensitiveness appears to be entirely due to the change in the condition of the soil. The average value of a is 1·1 mm./mb. There appears to be no lag in the response of the well to changes of pressure, and under favourable conditions the most rapid fluctuations of pressure are shown on the water-level trace.

Zoological Society, November 6.—Dr. A. Smith Woodward, vice-president, in the chair.—Lieut. F. F. **Laidlaw**: Some additions to the known dragonfly fauna of Borneo, with an account of new species of the genus Cœliccia.—Dr. G. A. **Boulenger**: The use of the names Plesiosauria and Sauropterygia.—Dr. J. C. **Mottram**: Some observations upon concealment by the apparent disruption of surface in a plane at right angles to the surface.

PARIS.

Academy of Sciences, November 5.—M. Camille Jordan in the chair.—H. **Douvillé**: The lower Eocene of Aquitaine and its fauna of Nummulites.—E. L. **Bouvier**: The classification of the Eupotamonea, fresh-water crabs of the family of Potamonidæ.—G. **Lemoine**: Free agricultural education. An account of the institutions giving free agricultural teaching in France, most of which are due to private initiative.—W. de **Tannenberg**: A functional equation and spherical unicursal curves.—E. **Camichel**, D. **Eydoux**, and M. **Gariel**: The strokes of an hydraulic ram: calculation of the pressures at any point in the pipe.—A. **Véronnet**: The absorption of water on the moon and planets. If the constitution of the moon is analogous with that of the earth, it is both possible and probable that the rocks of the moon's crust have absorbed all the water by slow diffusion.—P. **Mercanton**: The magnetic state of the Greenland basalts. Under certain conditions, the magnetometric examination of a specimen of lava containing magnetite, the geographical orientation of the specimen having been carefully determined, may indicate the direction of the terrestrial field at the time of cooling of the lava. But the cases in which the theoretical conditions are perfectly fulfilled are rare, and much discrimination is required. Some basalts from Disco (West Greenland), like certain diabases from Isfjord, in Spitsbergen, possess a magnetisation in the sense opposed to the magnetic field existing to-day.—P. **Mahler**: The amount of nitrogen in oxidised coals. Samples of Decazeville coal, from the Combes outcrop, show varying states of oxidation, the calorific values ranging between 8000 and 5200 calories. Analyses of eight specimens are given; the nitrogen content is not much altered by the oxidation.—E. **Maury**: The present conditions and remote origin of the Triassic lignites of the Maritime Alps.—J. **Deprat**: The presence of the Permian at Hongay, and the structure of the edge of the Rhætian of the Tonkin coast in the bays of Along and Fai-tsi-long.—M. **Mirande**: The metachromatine and the chondriome of Chara.—L. **Roule**: The habitat of the tunny-fish (*Orcynus thynnus*) and its coast displacements in the western French Mediterranean.—F. **Mesnil** and M. **Caullery**: A new type of evolutive dimorphism in a polychetal Annelid, *Spio martinensis*.—M. **Marage**: The form of intralaryngeal vibrating air.—J. **Wolff** and B. **Geslin**: The diastatic degradation of inulin in chicory root.

BOOKS RECEIVED.

Organic Evolution. By Prof. R. S. Lull. Pp. xviii+729. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 3 dollars.

Volcanic Studies in Many Lands, being Reproductions of Photographs taken by the Author, Dr. Tempest Anderson, the Text by Prof. T. G. Bonney. Second series. Pp. xv+88. (London: J. Murray.) 15s. net.

On the Eves of the World. By R. Farrer. In two vols. Vol. i., pp. xii+311+illustrations and map. Vol. ii., pp. viii+328+illustrations and map. (London: E. Arnold.) 30s. net.

The Conduction of the Nervous Impulse. By Dr. K. Lucas. Revised by E. D. Adrian. Pp. xi+102. (London: Longmans and Co.) 5s. net.

Lloyd's Diagram for Calculations. By H. G. Lloyd. (London: E. and F. N. Spon, Ltd.) 2s. 6d.

The Yearbook of the Universities of the Empire, 1916 and 1917. Pp. xiii+412. (London: H. Jenkins, Ltd.) 7s. 6d. net.

Origenes y Tendencias de la Eugenia Moderna. By J. Bonilla. Pp. 96. (Liverpool: *Daily Post*.) 3s. 6d. net.

Cotton and other Vegetable Fibres: Their Production and Utilisation. By Dr. E. Goulding. Pp. x+231. (London: J. Murray.) 6s. net.

The Anatomy of Woody Plants. By E. C. Jeffrey. Pp. x+478. (Chicago: University of Chicago Press; London: Cambridge University Press.) 4 dollars net.

The Cambridge University Calendar for the Year 1917–18. Pp. xxvi+1065. (Cambridge: At the University Press.) 8s. net.

Originality: A Popular Study of the Creative Mind. By T. Sharnol. Pp. xvi+304. (London: T. Werner Laurie, Ltd.) 15s. net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 22.

ROYAL SOCIETY, at 4.—Special General Meeting to receive the Annual Report of the Council.—At 4.30.—Bactericidal Properties conferred on the Blood by Intravenous Injections of Diamino-acridine-sulphate: C. H. Browning and R. Sulbransen.—The Pelmatoporinæ, an Essay on the Evolution of a Group of Cretaceous Polyzoa: W. D. Lang.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Gas-firing Boilers: T. M. Hunter.

FRIDAY, NOVEMBER 23.

PHYSICAL SOCIETY, at 5.—Some Problems of Stability of Atoms and Molecules: Prof. J. W. Nicholson.—Uses of Certain Methods of Classification in Optics: T. H. Blakesley.

MONDAY, NOVEMBER 26.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geography of the Italian Front: Dr. Filippo De Filippi.

ROYAL SOCIETY OF ARTS, at 4.30.—Land Settlement within the Empire: Sir John McCall.

WEDNESDAY, NOVEMBER 28.

ROYAL SOCIETY OF ARTS, at 4.30.—Aerial Transport after the War: G. Holt Thomas.

FRIDAY, NOVEMBER 30.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—"Thomas Hawksley" Lecture; Heat Engines: Captain H. Riall Sankey.

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