THURSDAY, JANUARY 24, 1918.

THE ELEMENTS OF REFRIGERATION.

The Elements of Refrigeration. A Text-book for Students, Engineers, and Warehousemen. By Prof. A. M. Greene, jun. Pp. vi+472. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 18*s*. 6*d*. net.

THIS book is another striking example of the thoroughness of American (U.S.) technical educational methods, as shown by many excellent text-books—the scientific, the applied scientific, and the practical (including cost) being combined in a manner quite refreshing to British engineering students.

The table of contents discloses an excellent arrangement of matter, viz.: (1) Physical phenomena; (2) methods of refrigeration; (3) thermodynamics of refrigerating apparatus; (4) types of machines and apparatus; (5) heat transfer, insulation, and amount of heat; (6) cold storage; (7) ice-making; (8) other applications of refrigeration; (9) costs of insulation and operating costs; (10) problems.

We think, however, this arrangement would have been further improved by placing the thermodynamic section just before the problems, particularly as the author is a little disconcerting in his detailed methods. Thus, on p. 55, we have the end of a number of formulæ dealing with the air machine. The last formula is numbered (62), and is given as follows:—

$$W_c = Mc_p(T_2 - T_1) + m(q_2 + x_2r_2 - q_1 - x_1r_1)$$
$$= Mc_p(T_2 - T_1) + m(i_2 - i_1),$$

where W_c = work done in compressor.

The author then gives an example:—"To apply these formulæ, it is desired to cool a room to 0°, with cooling water at 60° F., and the data for 1 ton of refrigeration is [*sic*] to be found. With a 10° rise in the water, a 10° difference between air and cooler and a counter-current air-cooler, the temperature of the air will be reduced to 70° F. The air in the refrigerator will be −10° F."

In this problem the temperature differences are pure assumptions, but of the order generally employed by the practical man in his approximations. It would have been much better if the author had *either* kept such a problem for the last chapter, *or* taken a set of actually observed temperatures and then applied them in the formula, showing—and accounting for—the difference in the work done, as given by the formula, and the actual expenditure of energy as registered by the ordinary practical methods. If this had been done, the student would not get so hopelessly mixed between the refinements of a thermodynamic equation and the everyday approximations and assumptions of the engineer. It would further have shown the value of comparing the ideal with the actual.

It is interesting to note that the author in his tables has used the excellent material on the properties of NH_3, CO_2, and SO_2 provided by the Refrigeration Research Committee of the Institution of Mechanical Engineers (Sir Alfred Ewing, chairman). It is to be regretted, however, that he has not mentioned the recommendations of that committee respecting the unit of refrigeration.

The author states: "Refrigeration is usually measured in tons of ice-melting capacity per twenty-four hours. Since the latent heat of fusion of ice is 143·4 B.Th.U. per pound, according to the latest experiments, this unit means the removal of 286,800 B.Th.U. per twenty-four hours, or 199·2 B.Th.U. per minute."

The first of five specific recommendations of Sir Alfred Ewing's committee surmounts this difficulty of the "latest" value by suggesting "that the refrigeration produced by a refrigerating machine be expressed in calories per second." Standard conditions of temperature are then laid down in the report, and the term "rated capacity" is proposed, the following explanation being given: "Thus, a machine may be classed as having a *rated capacity of one unit* if it produces a refrigeration of one calory per second (say 342,860 B.Th.U. per day) in steady working under the standard conditions specified."

At the present moment each country takes its own unit, and as this country differs from the United States in the value of the ton (2240 lb. and 2000 lb.), initial troubles begin. Added to this is the fact that "ice-making capacity" (in addition to "ice-melting") is often used, while no two makers of refrigerating machines assume the same temperature differences.

The author should have informed his readers of these differences and put them on their guard, incidentally mentioning the British recommendations. In any case, we express the hope that this unit—one calorie per second—will become a universal standard. It is absurd for any standard or unit to be changing with the "latest" research results.

The most disappointing point in an unusually good book is to be found in the opening words of chap. vi., on "cold storage": "The purpose of cold storage is to prevent the development of life which would cause decay of living tissue; it is also used to prevent the development of living organisms." This statement is calculated to make our men of pure science see that it is time they took some interest in low-temperature effects and their practical application in the cold-storage industry. It further indicates the spade-work necessary to link up science with the preservation of foodstuffs; but, the gulf once bridged, the field of research opened out will be boundless, while the merchant and the engineer will be able to get correct fundamental ideas that will be of the greatest value in the development of an industry that is scientifically sound.

Despite the fact that the book is based on American practice, it should prove of great value to students of refrigeration in this country.

J. Wemyss Anderson.

NEW GUINEA AS A CENTRE FOR PLANT DISTRIBUTION.

Dutch N.W. New Guinea. A Contribution to the Phytogeography and Flora of the Arfak Mountains, etc. By L. S. Gibbs. Pp. iv+226. (London: Taylor and Francis, 1917.) Price 12*s*. 6*d*.

THE north-western portion of New Guinea is still a very little known region, owing to the great difficulty of penetrating into the interior mountains, which rise fairly abruptly from the coast to a height of 5000 ft. to 7000 ft.

The first collection of plants from this region was made by Lesson in 1824; Beccari collected there in 1872 and 1875; Gjellerup in 1912 made extensive botanical collections; and the most recent contribution to our knowledge of the botany of this interesting country comes from Miss L. S. Gibbs, who is well known for the important work she has done in investigating the flora of Mount Kinabalu, Borneo, in particular. The object of her travels in New Guinea was to study the flora of the Arfak Mountains and to compare it with that of Kinabalu and the mountains of Malaya on one hand, and with the Australian flora on the other. The account of her hazardous journey and her conclusions as to the affinities of the flora are of great scientific interest. Owing to New Guinea being so little known, its importance as a centre for plant distribution has never been properly realised. Interest has always been concentrated either on Malaya or on Australia, whereas the results obtained by Miss Gibbs and by the Wollaston expedition in Dutch New Guinea go far to prove that New Guinea is really the focus of distribution for many types hitherto considered Polynesian or Australian. This applies to some extent also to Malayan types, of which the Papuan species appear to be not only older in type, but also very highly differentiated.

The endemic mountain types of New Guinea are found to have a wide distribution, and the low mountain forest flora shows marked affinity with that of the ridge formation of Kinabalu and the Philippines. In the forest region such interesting coniferous trees as *Araucaria Beccarii*, *Libocedrus arfakensis*—the genus being new to Dutch New Guinea—several species of Podocarpus and Phyllocladus, and a Dacrydium are commonly met with. Some good photographs of the Araucaria are reproduced. Six Rhododendrons, two being new species, and seven species of Vaccinium serve to indicate the northern affinities of the high mountain flora and its connection with that of Kinabalu.

During her short stay on the island Miss Gibbs collected 330 plants, 100 of which have proved to be new to science. Among genera not previously known from New Guinea may be cited Hibbertia, hitherto considered Australian and New Caledonian; Centrolepis, which connects the country with Borneo, the Philippines, and southern China on one hand, and with Australia and New Zealand on the other; and Patersonia, which, with the exception of southern China, shows a similar distribution, but was formerly considered to be a purely Australian genus.

Many of the new species are figured, but it is to be regretted that there are no proper references to the plates, and that the map and plan are so inadequate.

A. W. H.

HISTOLOGY OF VEGETABLE DRUGS.

Histology of Medicinal Plants. By Prof. W. Mansfield. Pp. xi+305. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 13*s*. 6*d*. net.

DURING the last few years a considerable amount of attention has been given to the histology of medicinal plants, or perhaps more correctly to the histology of organised vegetable drugs, and the importance of the subject is becoming more adequately recognised. Prof. Mansfield's work is the latest addition to the text-books on this section of vegetable histology, and on that account demands careful attention.

The author divides his work into three parts. Part i. deals with the simple and compound microscope, part ii. with tissues, cells, and cell-contents, and part iii. with the histology of roots, rhizomes, etc.

In part i. the usual details and illustrations of simple and compound microscopes are to be found, together with brief details on the mounting and preservation of slides. In part ii. various tissues, cells, and cell-contents are enumerated, and brief allusion is made to the differences between similar cells in certain drugs. This part is very fully illustrated with original drawings that have been carefully executed and that certainly do not err on the side of insufficient magnification. Part iii. deals in a similar way with the sections and powders of a very limited number of drugs.

There is nothing in the arrangement or general treatment of the details in these three parts that calls for special remark; it remains to be seen to what extent the author has been successful in attaining the object with which the book was written, and whether it can be recommended as a "practical scientific course . . . for the use of teachers and scholars in schools and colleges."

Now the essence of a practical course is instruction in the best methods of carrying out certain systematically arranged operations. It is much to be regretted that such instruction is not to be found in the book, and that there is no systematic course, progressing from simple to more difficult operations, outlined for the student. Meagre details occur here and there. The index affords little or no assistance, and it is to be doubted whether the object the author has in view will be attained until the work has been entirely remodelled. Should he take this task in hand, he would be well advised to submit many of his statements to searching revision, to correct inaccuracies, to introduce greater precision, and to make himself further acquainted with relevant literature. As an example, the statements on p. 85, lines 1 to 20, may be critically considered:

"The presence of cork enables one to distinguish Spanish from Russian licorice." It really only enables one to distinguish unpeeled from peeled root, and there are several varieties of each. "In *Canella alba* the periderm is replaced by stone cell-cork." This "cell-cork" is not cork at all, but phelloderm. "The cells . . . are of a typical cork shape, but the walls are lignified, unequally thickened. . . ." The walls of typical cork cells are very frequently lignified and often unequally thickened. "The inner or thicker walls are strongly porous." From the illustration it would appear that the outer walls are the thicker. "The cork periderm which fissures and scales off as the root increases in diameter." *Canella alba* bark is obtained from the stem and not from the root; the cork periderm does not scale off, but has to be loosened by beating.

It is to be regretted that in its present form the book cannot be recommended for either teacher or student. It possesses, however, some elements of a useful work, notably the carefully executed illustrations.

OUR BOOKSHELF.

Bedfordshire. By C. Gore Chambers. Pp. x + 195. (Cambridge: At the University Press, 1917.) Price 1s. 6d. net.

THOUGH one of the smallest English counties and with nearly nine-tenths of its area lying in one river basin, Bedfordshire possesses considerable geographical interest. Travellers by the Midland Railway, which traverses its length from Luton to near Wellingborough, cross five geological belts and can recognise each in passing by characteristic features of contour, tree flora, agriculture, and building material. In the churches, manor houses, and "motte and baileys" there is a wealth of archæological interest. Moreover, it was in this county that James Wyatt and, later, Worthington Smith obtained their evidence of the existence of Palæolithic man in Britain.

This and much more finds adequate description in Mr. Gore Chambers's book. It follows the lines of the Cambridge County Geographies, and well maintains the standard of that series. The best sections are those dealing with ecclesiastical architecture, history, and antiquities, though, under the last-named, one looks in vain for any reference to the "lynches" of the northern escarpment of the Chilterns. Considering the varied flora and fauna, the natural history section is rather disappointing and needs revision. Under "Industries" a good historical account is given of the straw-hat manufacture.

Though the author did not live to see its publication, the book has been well edited and illustrated. "Father" for "fat-hen," as a local name for goosefoot, is the only misprint noticed. As a record it brings us down to 1914. Since then geographical change has been rapid. The gale of March, 1916, swept away the great walnut orchard noted on p. 55. The war is bringing changes far more profound: new industries into country places, steam cultivators into the grass-lands, sawmills into the woods. A new era has begun, and it is all to the good that the book gives us a faithful picture of the county at the close of an era which has passed away. T. S. D.

The Pupil's Class-book of Geography: Scotland; Asia, with special reference to India. Each by Ed. J. S. Lay. Pp. 96 and pp. 128. (London: Macmillan and Co., Ltd., 1917.) Price 7d. and 8d. respectively.

IT is no easy matter to present geographical principles in a way that can readily be grasped by the average child of nine or ten years of age, but Mr. Lay has been fairly successful in his attempt, apart from a few lapses into the old-time memorising of place-names. The volumes are intended for study by the children themselves. With this end in view, they contain numerous questions, all of which can be answered from the text and the maps, and simple exercises in map- and diagram-drawing. Each book contains many diagrams and black-and-white maps, most of which are excellent, so that it is complete in itself and does not entail the use of an atlas. In the two volumes named above the author has been more successful in that dealing with Scotland. Asia is a more difficult task, and as half the volume is devoted to the Indian Empire the sense of proportion is lost—a serious defect in all geographical study. Climate is treated simply in accordance with the general plan: in Scotland the author has successfully evaded most pitfalls in his simplification, but in the case of Asia the treatment is less happy. The low price of the books is noteworthy. R. N. R. B.

The Historical Register of the University of Cambridge. Edited by Dr. J. R. Tanner. Pp. xii + 1186. (Cambridge: At the University Press, 1917.) Price 12s. 6d. net.

THIS volume forms a supplement to the "Cambridge University Calendar," and provides a record of University offices, honours, and distinctions to the year 1910. Up to 1913, when it had grown to 1547 pages, the "Calendar" itself contained historical information; but in that year the Syndics of the Press decided to transfer the historical particulars to a separate "Historical Register," to be published less frequently. This rearrangement has made it possible to publish additional historical data, and among the added matter in the present volume may be mentioned lists of holders of University offices, professorships, and so on, from the earliest date of which there is any record; sections on the historical jurisdiction and procedure of the University courts, ceremonies, costume and discipline, as well as on the history of the Mathematical Tripos; and enlarged indexes. The Tripos lists in the old "Calendar," moreover, have been collated with the original sources, *aegrotats* and *honorary optimes* have also been included, and the footnotes have been rewritten.

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.]*

Ice Thistles.

IN NATURE for January 11, 1917, Dr. R. T. Gunther directed attention to the beautiful form assumed by the air bubbles which separate from water which is allowed to freeze in a small jar. I was able in the issue of February 15 last to describe some larger examples of the same phenomenon.

On December 26 last the ice on the Legs of Mutton Pond in Bushey Park and on the Cardinal's River, which flows through it, was very clear, and the bubbles, separated in the course of freezing, were very obviously arranged along lines of flow. In the pond they converged towards the outflow sill communicating with the river, and in the river they were in lines parallel to the banks. In one or two cases where the stem of a weed was frozen into the ice the course of the water as diverted on either side of it was made clear by curves of bubbles.

On the following day I managed to melt some of the ice over its own water, by the heat of the hand, in a bottle with the bottom cut off and a graduated tube inserted in the neck. Knowing the capacity of the bottle, and measuring the volume of water required to fill it when packed with ice, I got a fairly accurate measurement of the ice. The bottle was then put in a tin can with water, and the gas as it was liberated from the ice passed into the graduated tube.

From 104 c.c. of ice I obtained 1·86 c.c. of gas, of which 0·76 c.c. was absorbed by alkaline pyrogallate. A litre of this ice would therefore yield 7·18 c.c. of oxygen and 10·30 c.c. of nitrogen and argon, apart from any gases which might still be *dissolved* in the ice. The pond water under the ice yielded 31·2 parts of solid residue on evaporation and 2·35 parts of chlorine, and the melted ice (after settlement of suspended matter) 10·0 parts and 0·39 part respectively.

That the salts yielded by melting ice are no real part of it, but are derived from watery inclusions only, can be shown very beautifully by carrying out Dr. Gunther's "ice-thistle" experiment with water tinted with methylene-blue, or, better, potassium permanganate. A characteristic "thistle" with white silvery rays of air bubbles in a clear hyaline, and a central blue or crimson "egg" of solution much deeper in colour than the original solution, is obtained. This becomes smaller as freezing proceeds. Sometimes coloured veins are seen in the colourless ice, and some of the air bubbles are associated at their inner ends with coloured liquid. This experiment, as showing the separation of dissolved matters, both gases and solids, when a portion of a liquid freezes, seems to be worth noting, especially as it also illustrates the course of the freezing.

J. H. COSTE.

Teddington, January 11.

SCIENCE IN INDUSTRIAL RECONSTRUCTION.

WITHIN the past year or two, frequent reference has been made in these columns to measures of national reconstruction recommended by various committees. There is now a Ministry of Reconstruction, and its advisory committees are so many that we have almost lost count of them; whilst scarcely a week passes without a report appearing in which promising schemes of industrial organisation and development are projected. The material value of scientific research is usually given due recognition, at any rate on paper; and if we may take these signs as an earnest of things to come, they give us confidence in a progressive future based upon a just and intimate co-ordination of brain and hand.

Though manual and mental workers are often considered to belong to different classes, and an indefensible social distinction is usually made between them, no such separation can be recognised in scientific fields, where fine manipulation, and skill in the use of instruments, are frequently as valuable as fertility in idea and ingenuity in design. Industrial advance seems, indeed, to depend upon three main factors, in all of which brain and hand are related, though in different degrees. First there is the creative investigator whose work reveals new properties and relationships; then comes the inventor or industrial researcher who seeks to apply knowledge to useful ends; and when a practical process or machine has been devised, the artisan is needed to make it fulfil its technical purpose. Each of these three classes has an essential place in national polity; and the correlation of their interests and activities must be the chief aim of all schemes of reconstruction.

Several recent reports and manifestoes are concerned with the combination of these different groups. The Interim Report on Joint Standing Industrial Councils (Cd. 8606, price 1*d.* net), submitted to the Prime Minister by a sub-committee of the Reconstruction Committee, and referred to as the "Whitley" report, suggests the establishment of district and national councils which should deal, among other matters, with technical education and training and with industrial research and the full utilisation of its results. There has lately been established, under the presidency of Sir Wilfrid Stokes and the chairmanship of Mr. Ernest J. P. Benn, an Industrial Reconstruction Council to encourage the formation of national industrial councils in the several trades, and to offer guidance when necessary. Moreover, the draft constitution of the new Labour Party, which has just been submitted to the Nottingham Conference, has in the forefront of the party objects, "to secure for the producers by hand or by brain the full fruits of their industry"; and the secretary of the party, the Right Hon. Arthur Henderson, informs us that "the term 'producers by hand or by brain' would include scientific workers if they are prepared to accept our constitution and programme. The object in widening the basis of the party is to obtain the assistance of all who depend upon their own exertions for the means of livelihood."

Scientific workers are thus offered facilities for representation in Parliament if they are prepared to associate themselves with the Labour Party. Much can be said in favour of such co-operation, for the influence of direct representatives of labour upon national affairs is likely to increase, and it would be unwise to stand altogether apart from the organisation which will control it. It was stated in the *British Medical Journal* a few weeks ago that the Labour candidates to be adopted for the next general election may include some members of the medical profession pledged to support the scheme for a State Medical Service. We suggest that the British Science Guild, which exists to promote the adoption of scientific methods in all national affairs, should consider at an early date whether steps should be taken to secure similar representation of scientific workers. The efficiency and progress of the modern State depend upon scientific knowledge. The Representation of the People Bill makes it possible to give that knowledge power in Parliament, and scientific workers should take active measures to attain that end, by association with other groups concerned with problems of national reconstruction.

What is to be the principal feature of the industrial reconstruction contemplated? Those who have thought much on the subject will probably reply in one word, "self-management." This implies, in the first instance, that each trade or group of trades has an aspect in which it is to be regarded as a corporate whole. We have been familiar with this kind of unity in the Church, the medical and legal professions, and, to a certain extent, in the combination which is known *par excellence* as "The Trade." The Bar comprises a great number of individuals each of whom has his private interests and competes with many others in the humbler or the higher ranks of the profession; but to the outer world the Bar is a corporate unity prepared to defend its privileges against all comers, and possessing its own machinery for self-management and even for discipline. A trade, on the other hand, consists of the several companies, firms, or individuals whose names are to be found in the trade directory, together with their employees, and, as a rule, there is no connecting link whatever between these scattered units, while in each firm the interests of capital, brains, and labour are regarded as distinct. The war has introduced many new phases. We have seen whole industries placed under Government control. Each firm has retained its integrity, but it has been required to work in co-operation with other firms, so as to secure, on the whole, the maximum output of the goods required at the time to meet the exigencies of war. When this demand ceases Government control will also cease, but great efforts will be made to secure that the advantages of a central guidance of each industry shall not be lost.

This guidance must come from the industry itself, and from the industry as a whole. Labour and capital are to meet at the same board on equal terms. The Whitley report recommends that these councils shall be "composed of representatives of employers and employed, regard being paid to the various sections of the industry and the various classes of labour engaged." The various classes of labour must include those who work mainly with their brains, as well as those who work mainly with their hands. It is true that the Food Controller, in specifying voluntary rations, makes a broad distinction between these two classes, and does not admit that hard thinking produces as much metabolism as an expenditure of energy which can be more readily measured in foot-pounds, but the new Labour Party, in its draft constitution, makes no such distinction. The modern psychologist recognises not only that the brain controls the hand, but also that the use of the hand develops the brain, and that sometimes in an unexpected direction, as when the power of speech is developed by manual training. The Labour Party recognises the unity between hand and brain, and is prepared to admit the brain-worker to all the advantages which it hopes to derive from reorganised industry.

The suggested industrial councils should each form an Upper Chamber in the interest of its industry. They should consist of representatives, not of particular firms or individuals, but of associations of employers and employed wherever such exist, and care must be taken to secure the fair representation of all such associations. At the meetings of the councils the representatives of labour will unite with employers in the consideration of the most difficult problems which the trade has to face. If it be true that the industrial unrest of the past has been largely due to a feeling on the part of labour that it has been kept in ignorance of trade politics, the remedy is here provided, for labour will be given seats in the industrial House of Lords. The national industrial councils will be in touch with district councils, and these with works committees. Through this machinery the industrial councils will exert their influence in particular works.

The Whitley report indicates under eleven heads some of the questions with which the industrial councils should deal. Reference may here be made to the better utilisation of the knowledge and experience of the workpeople, securing to them more responsibility for the conditions under which their work is carried on, technical education and training, industrial research and the utilisation of its results and of inventions and improvements designed by workpeople. Besides these and the other points for consideration indicated in the report, a number of very important problems will arise immediately on the cessation of the war, and these make it imperative that the councils should be formed at once, or the opportunity of organising British industry on a basis on which it can meet foreign competition without a handicap may be postponed indefinitely. The council will be the parliament of the trade. At its meetings all questions affecting the trade will be discussed, and the results of the discussion will be public to the whole trade, so that the smallest manufacturers will have the advantage of the knowledge and experience of the largest, while the latter will benefit by the combined knowledge, experience, and advice of all the rest of the trade. In many cases new sources of raw materials will have to be found and new methods of finance devised. The problem of the best way to secure adequate representation of British industry in foreign markets will have to be solved, and the best way of utilising the new part-time continuation schools considered. In all these questions labour will be consulted, and the employed will take an equal part with employers. The watchword of reorganisation is "Unity of industrial interest."

The general principles voiced by the Whitley report have received recognition on all hands, but some organising force is necessary to give them practical effect. This is the purpose of the Industrial Reconstruction Council. It is desirable that some obviously disinterested body should take the first step towards establishing a council in a particular trade. The I.R.C. is prepared to send representatives to a meeting, large or small, of any association of employers or employed in order fully to explain the mode of formation and functions of an industrial council. The Ministry of Reconstruction can be approached at a later stage when the scheme has been drafted by the industry. An industrial council consisting of equal numbers of employers and employed has already been formed for the pottery industry. This council will establish committees for dealing with special branches, and may co-opt outside experts upon them. Among its special duties will be that of making the manufacture of pottery as hygienic as possible.

The aims of the Labour Party, of course, go far beyond the organisation of particular trades. The chief appears to be to form the dominant party in the House of Commons. Unfortunately, the promoters look forward to a perpetuation of the system of party government; but if all the workers by brain, as well as by hand, combine into one party for the government of the State on democratic lines, party government will practically cease, because one party is equivalent to no party. Scientific men will certainly not be disposed to support any system of party politics, and they would be more likely to take part in the new programme if it were made clear that the Labour Party signified a federation or organisation in which brain and hand were united for common welfare rather than the narrow interests of one particular section of the country's life. The question has been asked, "Will the brain-worker secure adequate representation in the councils of the Labour Party?" Provided that the community of interest between hand and brain is fully recognised, the hand may be trusted to make use of the brain, and the brain will not suffer from failure to take part in the work of the world. May we not hope that government by dialectics will belong to History?

THE FERTILISER SITUATION IN THE UNITED STATES.

FOR some time after the war had opened, and in particular when the unrestricted submarine campaign began to assume important dimensions, the United States found that its supplies of the three most important fertilisers were seriously compromised: instead of being, as many had imagined, wholly a producing country, it was found to be dependent on other countries for these vital raw materials. Chile supplied nitrate of soda, the most potent nitrogenous fertiliser; Spain sent the pyrites necessary for the manufacture of sulphuric acid, which in turn forms the basis of the superphosphate and sulphate of ammonia industries; while Germany sent potassium salts, without which many mixed fertilisers are incomplete. With characteristic promptitude the situation was carefully reviewed, and a statement has been issued by the Smithsonian Institution[1] showing in as much detail as is judicious how the United States now stands in the matter.

The situation in regard to phosphatic fertilisers is rather peculiar. The United States claims to possess within its borders the largest known deposits of rock phosphate in the world. The annual output is three million tons. Most of this (about 75 per cent.) comes from Florida, where there are three types of deposits: rock phosphate, pebble phosphate, and soft phosphate, all superficial horizontal beds of solid rock or loose pebbles representing a residue of phosphate left after the associated rock had been dissolved and washed away. These deposits can be worked by large open pits, and being situated near the coast, the material can be readily transported to other parts of the country or to Europe.

Other deposits occur in South Carolina, Tennessee, Kentucky, and Arkansas, but by reason of their smaller output and less favourable situation for transport they are less important than those in Florida.

In course of time these supplies must become exhausted, and rather gloomy pictures have been drawn of the days when lack of phosphates would jeopardise, and finally terminate, man's existence on this globe. Great interest, therefore, attaches to the discovery made in 1906, and since confirmed, that a belt of country stretching from Salt Lake City, in Utah, to Helena, in Montana, contains a number of beds of phosphatic rock. The amount is said to be larger than in any other known deposits.

So far, therefore, as the rock phosphate is concerned, the United States is in a very strong position. But, unfortunately, rock phosphate alone is not wholly suitable as a fertiliser. In some instances, especially where the soil is rather acid, it acts very well, and Dr. Cyril Hopkins and other well-known agricultural experimenters have studied these cases in some detail, thus accumulating very valuable information.

In many other cases, however, better results

1 "The Mineral Industries of the United States." By J. E. Pogue Smithsonian Institution Bulletin No. 102, 1917.

are obtained when the phosphates are treated with sulphuric acid. But this requires pyrites from Spain, which is no longer easy to get, and in any case the resulting sulphuric acid is also needed for making explosives. Other sources of sulphur are, therefore, being exploited, in particular the pyrites and the pyrrhotic deposits of the Eastern States and the sulphur deposits of Louisiana and Texas.

The nitrogen problem is extremely urgent. Chilean nitrates are largely used for making explosives, and are practically unobtainable for agricultural purposes. Prior to the war the largest source of fertiliser nitrogen in the United States had been the various organic products, such as tankage, fish scrap, and cotton-seed meal, produced in the country. With the coming of the war, however, other demands have been put upon most of these, and their prices have risen; thus cotton-seed meal is now used as animal food.

Coal is a satisfactory source of nitrogen, one ton of American coal containing on an average 20 lb. of nitrogen. The proportion actually recovered, however, is only small, corresponding in 1913 with 3 per cent. of the total quantity of coal mined, but a higher recovery is said to be obtained to-day. In 1913 about 12 per cent. of the coal (or 69,000,000 tons) was made into coke, but three-quarters of this was done in the old bee-hive oven, and only a quarter in the more modern ovens from which recovery of the nitrogen is possible. This proportion, however, is steadily increasing.

All these methods are essentially transitory; they come to an end in that indefinite time when coal and nitrate of soda are both exhausted. The permanent, never-failing supply is the atmosphere. Already calcium nitrate, cyanamide, and ammonia are produced synthetically, but of these only cyanamide is as yet made in North America, and that only on the Canadian side of Niagara. The need, however, is fully recognised, and the work is being vigorously pushed forward. The sum of twenty million dollars was appropriated in 1916 for the construction of the plant, and although the scheme is not yet in working order, we may be sure that it will materialise. The peculiar and profound importance of these synthetic processes as the central feature of the war is fully recognised, and, as the author of the Bulletin justly remarks: "It is significant that war was declared directly after the successful development of the Haber and cyanamide processes in Germany."

The dependence of the civilised world on Stassfurt for its necessary potash was accepted as a natural and fundamental fact prior to the war, and very little was done to obviate it. Potassium is extremely common; only seven other elements are more abundant, and it is calculated that there is more potash in the earth's crust than water. But, unfortunately, workable deposits are rare, and only the one at Stassfurt is actually worked to any notable extent. For some time before the war the United States Government recognised the drawbacks of the position, and caused a systematic search to be made for potash within its own borders. A limited amount of potash can be obtained from the wood-ashes of the lumber industry in Michigan and Wisconsin. Another source is the mineral alunite, a potassium aluminium sulphate occurring in moderate-sized deposits in Utah. Another, again, is kelp produced from the giant seaweed of the Pacific coast from Lower California to Alaska. A more important source is the flue-dust obtained from Portland cement works and from blast-furnaces. Still more important from the point of view of immediate production are the alkali lakes of the West, which at present yield most of the American supply: Jesse Lake, in western Nebraska, supposed to derive its potash from the forests burnt on the adjacent plains; Searles Lake, in California, reputed to contain great quantities of potash, though there are so many other salts as well that the extraction is by no means simple; Owen's Lake, also in California, several lakes in Oregon and elsewhere. In addition, there are salt beds in Texas, Oklahoma, and other places where some of the underlying strata were formed in arid climates.

There are still other possibilities which have not yet come to anything, though they are not without promise for the future: felspar, which occurs in scattered and rather small deposits; leucite, forming a conspicuous component in a rock mass of considerable size in Wyoming; sericite, which forms extensive beds in Georgia; and greensand, found widespread in the Atlantic coastal plain, especially in New Jersey. All these are open to exploitation.

But what will be the future of these new fertiliser industries, assuming they mature? Will they disappear after the war, choked by the competition of German products, or will they be kept alive by artificial support? This is a political question scarcely less important than the chemical and engineering problems involved, and one which we may be sure will receive serious and systematic consideration.

E. J. RUSSELL.

WHAT DETERMINES STATURE? [1]

DR. C. B. DAVENPORT has collected data in regard to human stature, and analysed them by modern methods of studying heredity. Some of the data refer to 2354 children of parents whose height is recorded, but the precision of this recording was very unequal. The other data refer to the inheritance of stature in families, and these, while less numerous, are more uniformly precise.

For the class of people dealt with, it appears that nutrition is not of much importance in determining stature. It is improbable that insufficient or improper food counts for much in determining eventual height; "temporary starvation has little or no effect on the end result. So, likewise,

[1] Bulletin No. 18, "Inheritance of Stature." Pp. 313-89+33 tables and 19 figs. (Eugenics Record Office, Cold Spring Harbour, N.Y., 1917.) Price 40 cents.

overfeeding, however much it may affect weight, has probably little effect on adult stature, though it may hasten growth and thus enable a man to reach precociously his predestined stature." Of great importance, however, are the internal secretions of the gonads, the thyroid, the pituitary body, and other endocrine glands. The degree of activity exhibited by these glands is a variable and heritable constitutional character, but it is also modifiable by severe diseases and accidental extrinsic influences. In two ways, therefore, stature is affected by the degree of activity of the ductless glands, and "experience points strongly to the conclusion that internal constitutional factors are more important than the ordinary environmental differences."

The following are among the most important conclusions which Dr. Davenport has reached. One of the factors determining variation in stature is variation in the age of the onset of puberty. Parents deviating from the mean in the same direction have on the average less variable offspring than those of one short and one tall parent. The offspring of two tall parents are less variable in stature than those of two short parents. When the stature of both parents is very much above or below the average, the children tend to repeat it, especially in the direction of tallness. When the parents are much below the average the offspring regress towards mediocrity, but there is no (or little) filial regression when the parents are much above the average. It seems that parents of all statures are somewhat heterozygous (or "impure") as regards their peculiarity, but there is evidence in favour of the theory that in tall parents the gametes are more nearly homogeneous (in lacking most of the shortening factors) than are those of "short" parents. Shortness seems to be due to certain positive factors which inhibit the growth of various parts. It appears that "growth-as-a-whole" factors are present, but there is a large degree of independence in the variability of the four segments of stature (head and neck, torso, thigh, and lower leg); and this makes impossible any simple "Mendelian" laws of the inheritance of stature as a whole.

There is evidence that peculiarities in the separate segments of stature are independently heritable, and the combinations of types with different proportions (though similar in total stature) may give curious, but readily intelligible, results. The proportional shortness of any segment depends on more than one shortening factor —just how many cannot be said. It is probable that in all forms of dwarfing there are multiple dominant inhibiting factors. In the case of gigantism in both parents all the children are tall; "this indicates that the factors for tallness are mostly recessive—probably due to the absence of inhibitions to prolonged growth." "Persons of similar stature tend to marry each other; and extremes are more particular in this respect than those of medium statures."

These are the most important conclusions of this interesting piece of work, but it is evident that "the classic topic of the heredity of human stature" must be subjected to further analysis with even larger bodies of data. In admitting the provisional character of his investigation, Dr. Davenport says: "If the work has done nothing more than prove, what might have been anticipated, that the apparent blending inheritance of stature is due merely to the presence of multiple factors, it may be justified."

NOTES.

In various parts of the country camouflaged houses and hangars and vessels are to be seen by those who have eyes to see, and it was stated officially on January 14 that the Admiralty had tested many methods of disguising mercantile shipping. One of these methods is to paint the ship with various quaint combinations of different colours. But this does not appear to have proved much of a success, though we know in Nature of conspicuously patterned creatures, such as the hoopoe, which are, in certain situations and poses, endowed with what amounts to a garment of invisibility. Another method, well illustrated by a model in the British Museum (Natural History), depends on what is sometimes called Thayer's law, the announcement of which was first made in NATURE of April 24, 1902, by Prof. E. B. Poulton. A further illustrated description of the principle was given in an article in our issue of October 27, 1910. Mr. Abbott H. Thayer, an American artist, was one of the first to recognise that a high degree of invisibility is conferred on certain birds by the simple adaptation of being dark above and whitish below. He took two wooden decoy ducks, and placed them against a sandbank. One was coloured like the sand, or coated with sand; the other was coloured on its upper parts darker than the surrounding sand, and graded below to pure white. At a short distance the first was still clearly visible, but the second was quite lost against its background. The first bird was revealed by the dark shadow below it; the second was made invisible because the light lower parts were neutralised by the shadow, while the dark upper parts were toned down by the strong direct light. The result is technically described as obliteration by counter-shading. Some modification of this experiment has been tried on ships by differential painting, but this device has not proved so successful as had been hoped by those who knew how obliterative it was in some birds and fishes. On some other quite different line, it is said, the Admiralty has discovered a system of camouflage which will go far to baffle the eyes of submarines.

It would appear from some recent statements by the Ministry of Munitions that the production of mineral oil from native sources is engaging the close attention of the Department of Mineral Oil Production. It may be inferred that boring for petroleum in Great Britain has not yet been attended with any success, and so far the opinions of the large body of British geologists who were opposed to these boring operations appear to have been justified. Oil has, of course, continued to be produced in Scotland by the distillation of the so-called oil shales of the Carboniferous Measures, and it appears that the output of this oil is being pressed to the utmost. It has been known for many years that the Kimmeridge shales of Liassic age in the south of England are in places quite rich in oil, and a succession of companies has attempted in the past to create there a shale-oil industry on the same lines as in Scotland; all these attempts proved, however, to be commercial failures, and it would seem that no better fate has attended the more recent efforts of the Ministry of Munitions. The latter has accordingly turned its attention to the production of oil by the low-temperature distillation of coal by practically the same process as that patented by Dr. James Young in 1850, a process that was worked on a commercial scale for a good many years until it was displaced by the far cheaper production of natural petroleum in the United States. To-day, however, when commercial results are in a sense less important than technical ones, this process may well be revived in this country, and it would seem that this is being done, coals that are especially suited to it, such as cannel coal, being selected for the purpose. No doubt experiments are being tried in many other directions, but there are obvious reasons why the nature of these, or the results obtained by them, should not be made public at present.

WITH the continuance of the war the production of zinc from ores mined in the Empire has undergone a satisfactory development. For a time much of the ore could not be absorbed in the reduction works until the necessary plant had been erected and was in running order, the labour mobilised and trained, and the transport organised. During this period some of the Australian Broken Hill concentrates were shipped to the United States of America and smelted there. Great Britain raised her smelting capacity, but rather slowly. Canada has made a notable contribution of metallic zinc in the last two years, and is now producing substantial amounts. Some of this is obtained by the electrolytic process. Considerable sources of electric power are available in Tasmania, and it is not surprising to learn that Broken Hill concentrates are shipped for treatment there. Satisfactory results have recently been reported from the electrolytic plant erected at Risden. This plant has a daily capacity of fifteen tons, which, it is said, can be increased tenfold, corresponding to a potential production of more than 50,000 tons per annum. The power is obtained from the States Great Bear hydroelectric installation. That electrolytic zinc is now being produced in considerable quantities in various parts of the world is likely to prove of much importance to industry.

AN important scheme for the reorganisation of the Board of Trade is summarised in a memorandum (Cd. 8912) issued on January 17. The memorandum embodies the results of consultation with an informal committee consisting of Sir Clarendon Hyde, Sir Algernon Firth, Mr. Mackinder, M.P., and Mr. C. T. Needham, M.P., and its recommendations are supplementary to the action already taken in the formation of the Joint Department of Overseas Trade, recently set up by the Board of Trade and the Foreign Office. It is proposed that the work of the Board of Trade should be organised in two main divisions: (i) the Department of Commerce and Industry, and (ii) the Department of Public Services Administration. The Department of Commerce and Industry will comprise sections dealing with (*a*) commercial relations and treaties; (*b*) Overseas trade; (*c*) home industries and manufactures; (*d*) industrial property (including the Patent Office); (*e*) industrial power and transport; (*f*) statistics; and (*g*) general economics. There will be a strong Advisory Council attached to this department, and it is proposed to constitute representative trade committees for each important group of trades. Certain changes and rearrangements will apply to the work of the branches of the Board of Trade falling within the Department of Public Services Administration. The work will, as before, involve the administration of a number of statutes, such as the Railway Regulation Acts, Merchant Shipping Acts, General Harbour Acts, Electric Lighting Acts, Weights and Measures Acts, Companies Acts, and Bankruptcy Acts. The department will also deal generally with the services concerned (railways, shipping, electric lighting, etc.). The two joint permanent secretaries are Sir Llewellyn Smith, K.C.B., and Sir W. F. Marwood, K.C.B.

IN an article on modern methods for the storage of coal in *Engineering* for January 18, Mr. G. F. Zimmer states that storing coal under water is probably the most expensive method, but undoubtedly the most economical in the long run. About the year 1905 the first experiments made in this country on this method proved to be perfectly successful, as the coal thus stored suffered no deterioration. There was a prevailing idea at the time that only sea-water would preserve coal thus, but it was found afterwards that the coal would keep equally as well in fresh-water. Underwater storage prevents loss of heating value, and is not accompanied by deterioration in physical properties, such as slacking. The water retained by the coal upon removal is substantially only that held by adhesion or capillarity. The first large plant of this kind was installed at Chicago, where 14,000 tons of coal are stored under water. The largest installation has recently been erected by the Duquesne Light Company at Pittsburg, and consists of a pit 800 ft. long, 150 ft. wide, and 25 ft. 6 in. deep, with the sides sloping at 45°. The capacity is 100,000 tons of coal. It is interesting to note that the coal recovered from the battleship *Maine*, which had been submerged for fourteen years, showed on analysis a heating value (a moisture, ash, and sulphur-free basis) of 8588 calories. It is believed that this was coal from the New River District, West Virginia, and if this be the case the deterioration in fourteen years was about 160 calories, or 1·9 per cent.

SIR ANTHONY A. BOWLBY has been appointed Hunterian orator of the Royal College of Surgeons of England for the year 1919.

PROF. V. GIUFFRIDA-RUGGERI, professor of anthropology in the University of Naples, has been elected an honorary member of the Royal Anthropological Institute of Great Britain and Ireland.

WE learn with much regret that Miss Ethel Sargant, F.L.S., hon. fellow of Girton College, and president of the Section of Botany of the British Association for the Birmingham meeting, 1913, died at Sidmouth on January 16, at fifty-four years of age.

THE annual general meeting of the Institute of Metals will be held on Wednesday, March 13, and Thursday, March 14. The presidential address will be delivered and several papers read and discussed on March 13, whilst further papers, including the fourth corrosion report, will be read on the following day.

AT the annual general meeting of the Royal Meteorological Society held on January 16 the Symons Memorial medal, which is awarded biennially for distinguished work in connection with meteorological science, was presented to Dr. H. R. Mill, director of the British Rainfall Organisation. The council for 1918 was duly elected, with Sir Napier Shaw as the new president.

MR. J. S. SELLON, whose death in London on January 18, at the age of eighty-one, we regret to record, was the fifth son of Capt. W. B. Sellon, R.N.

At an early age Mr. Sellon joined the well-known business house of Messrs. Johnson, Matthey, and Co., assayers and refiners to the Bank of England and Royal Mint, metallurgists, etc., founded by his uncle, Percival Norton Johnson, in 1822. He played a prominent part in the researches and industrial developments connected with the platinum and other groups of rarer metals, with which the name of his firm is closely associated; indeed, the now numerous and important commercial applications of platinum and its allied metals may be said to be chiefly due to the initiative and efforts of himself and his co-workers, George and Edward Matthey. During the concluding quarter of last century he also took an active share, both in the fields of technical discovery and industrial development, in the then new sphere of electrical engineering, and was associated with Faure, Brush, Swan, Lane-Fox, Volckmar, and others in their early work on electric lighting and storage.

WE regret to note that the death of Mr. Frederic Eliot Duckham is recorded in *Engineering* for January 18. Mr. Duckham was born at Falmouth in 1841, and his early engineering experience was obtained in the construction of docks. He was appointed engineer-in-chief of the Millwall Dock in 1868, and steadily advanced in the service of the dock authorities, becoming general manager in 1899. He held the dual appointment until his retirement in 1905, when he was elected a director, a position he held until the property was taken over by the Port of London Authority. His name is best known on account of his successful inventions, of which the most important was his pneumatic grain elevator, which saved the Millwall Company 8000*l*. per annum. Mr. Duckham became an associate of the Institution of Civil Engineers in 1875, and was elected a full member in 1878; he was awarded the Telford gold medal and two premiums for papers read before the institution.

AT the meeting of the Illuminating Engineering Society on January 15 an address was delivered by Mr. L. Gaster on "Ten Years of Illuminating Engineering: its Lessons and Future Prospects." Mr. Gaster recalled that it was just ten years since the proposal to form an Illuminating Engineering Society was made. A feature of its work had been the opportunities afforded for co-operation with other societies; for example, in dealing with such matters as school, library, and street lighting. While the war had naturally restricted their activities in some fields, in others they had found new channels of usefulness; he might mention their special work on the illuminating value of star-shells and parachute lights, and researches on the brightness of radium paint for gun-sights, to which allusion had been made in the presidential address. It was desirable that better facilities should be provided for co-operation between scientific and technical societies and the State. Much useful information might be obtained in the present exceptional circumstances; fuller data were needed on the effect of inadequate lighting in causing street accidents and the influence of various conditions of lighting in Government factories on the quality and output of work. In order to illustrate how such data might be obtained, several tables were presented relating to accidents in streets and factories enabling information to be acquired on a uniform and systematic plan so as to trace the relation between such accidents and inadequate illumination.

WEATHER conditions in 1917 were at many times exceptional, although the mean results for the several elements for the whole year were not very different from the normal. At Greenwich the mean temperature was 49°, which is 0·5° deficient in comparison with the average for previous years. The highest monthly mean temperature was 63·3° in June and July. The warmest day temperatures occurred in June, when the mean was 74·9°, but the warmest nights were in August with a mean minimum reading of 54·3°. The lowest monthly mean temperature was 35·3° in January and February. In April the deficiency of the mean temperature was 4·5°, whilst in May the excess was 4·5°. There were 127 days with ground frost during the year; the greatest number in any month was twenty-seven in December. Rainfall at the national observatory totalled to 25·3 in., which is 1·5 in. more than the average, and 4·5 in. less than the total in 1916. There was an excess of rain in the spring and summer months, and a deficiency in the autumn and winter. The heaviest monthly fall was 4·3 in. in August, and in July the fall was 4·2 in. February was the driest month with 0·8 in. There was precipitation on 163 days, which is thirty days fewer than in 1916. August had twenty-three days with rain, whilst June had only seven, and December eight. Snow was unusually frequent, falling at Greenwich on fifty-one days. January had as many as sixteen days with snow, and the opening month of 1918 bids fair almost to equal it. Duration of bright sunshine for the year amounted to 4·14 hours per day, which is in excess of the normal, and is nearly forty minutes per day greater than in 1916. June was the brightest month, with an average of 7·5 hours per day of sunshine. January was the least sunny, with a daily average of 0·5 hour of sunshine.

IN *Science Progress* for January Mr. J. Reid Moir discusses pre-Palæolithic man in England. He points out that in East Anglia the greatest facilities exist for recovering evidence of this period. He bases the existence of pre-Palæolithic man on the following considerations:—"(1) The discovery in various parts of England of different kinds of flint implements in deposits which are of greater antiquity than those containing the earliest palæoliths. (2) The discovery at Piltdown, in Sussex, of the remains of a very primitive type of human being in intimate association with certain definite Pliocene mammalian forms, and the earliest kind of flint implements known to science." He adds that "the Neolithic and Palæolithic stages in this country are fairly well known, but the vast pre-Palæolithic periods await examination. These periods are fully represented in England, and the flint implements, etc., contained in the deposits laid down during these epochs must be collected and investigated."

IT is an indication of improvement in the political situation of Mexico that, according to the *Mexican Review*, vol. ii., No. 2, the exploration of the famous ruins of San Juan Teotihuacan, which had been suspended during the revolutionary period, has now been resumed under the direction of the Secretary of Fomento, and it is believed that some very interesting and important discoveries will be made. Prescott describes these ruins, with the possible exception of Cholula, as the most ancient remains on Mexican soil. They were found, it is said, by the Aztecs on their arrival in the country, when Teotihuacan, "the habitation of the gods," now a petty village, was a flourishing city, the rival of Tula, the great Toltec capital. The two principal pyramids were dedicated to Tonatiuh, the sun, and Mezlli, the moon. The former, which has recently been restored, is 652 ft. in length at the base, and 182 ft. in height, thus rivalling some of the kindred monuments in Egypt. There is at present no building on the summit, but the photograph accompanying the article shows what seem to be processional roads used for some ceremonial purpose.

WE have received copies of the official tide-tables of the Pacific and Eastern Coasts of Canada for 1918, issued free by the Dominion Department of Naval Service. The eastern tables are based on records varying from seven to twenty years. The Pacific tables are naturally based on shorter series of records, but it is claimed that in accuracy they are superior to the tide-tables for any ports in the Pacific Ocean in America, Asia, or Australia. Next to these Canadian ports is San Francisco, which is based on the longest record at any harbour on the Pacific coast of the United States.

A STUDY of the nationalities of Hungary is of great importance in relation to the Slav claims on that country. In the December (1917) number of the *Geographical Review* (vol. iv., No. 6) Mr. B. C. Wallis has a detailed paper on the subject, accompanied by several small but admirably clear maps, two of which deal with density of population and distribution of nationalities respectively. Mr. Wallis's analysis of the population gives little support to the claim of the northern Slavs, Slovaks, Czechs, and Poles, for union with the southern Slavs by a corridor of territory along the border-lands between Austria and Hungary. The population of the Austrian part of that corridor is entirely German, and of the Hungarian part chiefly German. The Jugo-Slav claims to the Bačka have more foundation, but cannot be admitted as a whole on a basis of nationality.

CAPT. J. K. DAVIS contributes to the *Geographical Journal* for January (vol. li., No. 1) a short account of the *Aurora* Relief Expedition to the Ross Sea in December, 1916, and January, 1917. The *Aurora* left Port Chalmers with Sir Ernest Shackleton on board on December 20, 1916. After entering the Ross Sea Capt. Davis skilfully avoided heavy ice by keeping to the west, and did not enter the pack until he reached 70° 20′ S., 175° 20′ E. Then followed five difficult days spent in traversing a belt of pack, 104 miles wide, after which the *Aurora* emerged into the open sea, and reached McMurdo Sound. Off Cape Barne fast ice extended across the sound on January 10. After the seven survivors of the expedition had been embarked, the ship crossed to Butter Point, where Sir Ernest Shackleton searched the coast fruitlessly for the two missing men. A further search at Cape Barne and Glacier Tongue resulted in no clue, and it was decided to return to New Zealand. Off Cape Adare heavy ice was encountered, to avoid which Capt. Davis returned southward and bore northward further to the east, thus passing through the pack and out of the Ross Sea. The *Aurora* returned to Wellington on February 9, 1917, and in June left New Zealand, homeward bound *viâ* Cape Horn. We regret to hear that no definite news has been received of her since her departure from New Zealand, and that there is little hope of her arriving in port. On her homeward voyage the *Aurora* was in command of Capt. Reeves.

THE thirty-first annual report of the Marine Biological Station at Port Erin shows that twenty-one workers have occupied tables in the laboratory during the past year, twelve of these being students who attended the course of instruction during the Easter vacation. The usual operations were carried on in the plaice and the lobster hatcheries. Nineteen plaice, hatched and reared during the season of 1914, and afterwards kept in the pond, spawned this season. These fish had attained an average length of 10½ in. It was noticed that their eggs were smaller than the average egg of the plaice, the proportions being as 5 to 6·5, but otherwise were normal. Appended to the report is an interesting address (30 pp.) by Prof. Herdman on "Sir John Murray, the Pioneer of Modern Oceanography."

THE annual report of the Scottish Marine Biological Association for 1916 gives an account of the work of the marine laboratory at Millport. During the year nine workers, in addition to students attending courses of instruction, occupied tables in the laboratory, and the report contains notes on some of the results of their investigations, especially noteworthy being those of Messrs. J. H. Paul and J. S. Sharpe on the deposition of lime salts in the integument of decapod crustacea, and the observations of Dr. J. F. Gemmill on the development of certain starfishes and sea anemones. The eggs of three species of anemones were obtained in the aquarium, and the larvæ reared either to the stage of fixation or to the final form in separate hatching vessels under aeration. In *Adamsia palliata* and *Actinoloba dianthus* it was found that the formation of the endoderm takes place by invagination, and that in the formation of the blastula of Tealia a much-folded stage occurs which does not appear to have been noticed previously.

THE courtship and subsequent events in the life-history of the moorhen during the breeding season are briefly and skilfully summarised by Miss Frances Pitt in *British Birds* for January. The aggressiveness of this species in asserting its territorial rights is well known. After observations extending over three seasons, Miss Pitt is confident that these rights are challenged, for the most part, by the young of the previous year. This is what one would have expected. Incubation appears to begin long before the clutch is complete, and during the whole period of sitting new material is constantly added to the nest, so that it has reached a considerable size by the time the last chick has hatched. The young remain for some days in the nest, where they are assiduously fed on insects by both parents. But they will drop out of the nest into the water on the slightest alarm; this leads to considerable and hitherto unsuspected mortality, for frequently the nursery is placed on the bough of a tree at some distance above the water. In such cases the nestlings are unable to return when danger is past, and speedily die of starvation. A second, supplementary, nest appears generally to be built for the use of the young, presumably after they have left the first to acquire the art of feeding themselves. Finally, some interesting observations are made on the loss of the brilliant coloration of the head which characterises the nestling of this species, in common with that of its ally, the coot.

WE have received vol. xiv., part ii., of the Proceedings of the Birmingham Natural History and Philosophical Society, which contains several interesting papers, and in particular "A Survey of the Flora of East Worcestershire," by Mr. John Humphreys, to which we would direct the attention of botanists and geologists in particular. A great number of different geological formations are represented in this district from Archæan rocks to the Lias, with several limestones of different ages, and the effect on the flora is very marked. This is especially noticeable on the calcareous rocks of the Lias, where a great collection of new forms crop up. At Droitwich, Hartlebury Common, and the Salwarpe valley an interesting set of maritime plants occurs, and though the theory that in late Pleistocene times the sea penetrated to the present 100-ft. level is not now generally accepted, the presence of such plants is difficult to explain. Birds and insects afford similar evidence, and certainly lend support to the view that estuarine conditions prevailed in the Severn Valley in recent geological times. Hartlebury

Common is a remarkable spot for the botanist, and is still fortunately an untouched and unspoilt piece of country. For this and other interesting places careful lists of the more uncommon plants are given.

CAPT. T. S. MASTERSON read a paper on "The Petroleum Industry of Rumania" before the meeting of the Institution of Petroleum Technologists on January 15, in which he presented a very useful summary of the position of this industry up to the time of the entry of Rumania into the European war. He gives a brief account of the geography and geology of the Rumanian oilfields, and discusses at some length the methods of exploitation employed. He shows why the American method of drilling has proved a comparative failure, whilst the Canadian method has proved very successful, and is preferred by most Rumanian operators. The percussive water-flush method has not fared much better than the American method, but, on the other hand, the modern rotary system has been highly successful in the loose sandy marls met with in certain areas. The author concludes that no one system can be advocated for general use in Rumania, but that in each case the system best adapted to the conditions must be selected, wherever these conditions are known; in unexplored fields he recommends the use of the percussion system. He states that Rumania possessed sixty-one refineries with a total capacity of 4½ million tons, whereas the highest output of crude oil obtained in any year was only 1·9 millions. He further directs attention to the fact that practically the whole of the plant for these refineries was supplied from Germany, together with most of the raw materials employed in the construction of drilling rigs. In November, 1916, when the retreat of the Rumanian Army became inevitable, the wells and refineries were destroyed as completely as possible, and the paper concludes with an expression of the hope that when the times comes for reconstruction Great Britain will take steps to see that she shall be in the position to furnish the requisite materials.

A NEW type of differential dilatometer for thermal investigations on steels is described in the September-October *Revue de Métallurgie*. The author, M. Pierre Chevenard, claims that the instrument is well adapted for use in a steel works laboratory on account of trustworthiness and simplicity of design. Only small quantities of metal are necessary; the instrument is easy to set up, and the readings are unaffected by vibrations. An instrument of the type he describes has been used for some time for routine tests in a large steel works in France. It provides a useful complement to the chemical and micrographic examination of certain steels and their constituents, such as cementite, etc. Finally, it has proved of value in the qualitative examination of slight modifications in the dilatability of metals due to thermal or mechanical influences. The author remarks, in conclusion, that the examination of these and certain other phenomena rightly comes within the scope of precise metrology.

THE following volumes are announced for early appearance in the "Collection Horizon" of Messrs. Masson et Cie., Paris:—"Les premières heures du Blessé de Guerre," P. Bertein and A. Nimier; "L'Evolution de la Plaie de Guerre," Prof. A. Policard; "Commotions et Emotions de Guerre," Prof. A. Léri and Th. Beck; "Traitement des Psychonévroses de Guerre," G. Roussy, J. Boisseau, and M. d'Œlsnitz; "Blessures du Crâne," T. de Martel (revised edition); "Blessures du Cerveau," C. Chatelin (revised edition); "Prothèse fonctionnelle en Chirurgie de Guerre," Ducroquet; and "Blessures de la Moelle et de la Queue de Cheval," Prof. G. Roussy and J. Lhermitte.

OUR ASTRONOMICAL COLUMN.

ENCKE'S COMET.—The following continuation of the ephemeris of Encke's comet is from Mr. Viljev's elements, and is for Greenwich midnight:—

	R.A. h. m. s.	N. Decl. ° ′
Jan. 31	23 37 33	6 21
Feb. 4	23 44 6	6 55
8	23 51 4	7 32
12	23 58 27	8 10
16	0 6 15	8 49
20	0 14 30	9 30
24	0 23 12	10 12
28	0 32 21	10 48
Mar. 4	0 41 28	11 23

The magnitude was 15·0 on December 30, but may be expected to reach at least 9·0 by the end of February. In 1852, when perihelion was at about the same time of the year, the comet was visible in bright twilight in February, but it has probably declined in physical brightness since that date.

SOLAR OBSERVATIONS AT MADRID.—In addition to the usual convenient astronomical and meteorological tables, the "Anuario" of the Madrid Observatory for 1918 includes the detailed results derived from direct photographs of the sun, observations of solar prominences, and spectroheliograms of the sun's disc taken in calcium light. The sun-spot record is for 1916, and gives the heliographic latitude and longitude of each spot, together with its duration, area, and classification. The prominence catalogue is also for 1916, and includes position, extent of base, height, and brightness of each prominence observed. A similar catalogue of calcium flocculi covers the period from October 1, 1916, to September 30, 1917. In addition, there are valuable discussions of the distribution of each group of phenomena in regard to time and position on the sun. In the case of calcium flocculi, the discussion covers the whole period of observation at Madrid, and is of particular interest because so few data have hitherto been published. The unit of time adopted is that of the sun's rotation, and the following mean daily numbers of flocculi for approximate years have been calculated from the table given:—

Period	Rotations	Days of observation	Mean daily number
1912, Apr. 4–1912, Dec. 5	1–9	131	1·247
1912, Dec. 5–1914, Jan. 18	10–24	169	0·704
1914, Jan. 18–1914, Dec. 12	25–36	128	1·499
1914, Dec. 12–1915, Nov. 4	37–48	134	4·782
1915, Nov. 4–1916, Dec. 17	49–63	149	7·506

SPECTRA OF JUPITER AND SATURN.—A photographic investigation of the spectra of the planets Jupiter and Saturn has been made at Glasgow by Dr. L. Becker (Monthly Notices R.A.S., lxxviii., 77). The spectra extended from B in the red to K in the extreme violet, and were about 11 cm. in length. Apparent absorption bands introduced by the dyes used to sensitise the plates were eliminated by the superposition of a positive photograph of the lunar spectrum. The only absorption band discernible in the spectra of the two planets is the well-known band in the red, which Dr. Becker finds to extend from λ 6174 to λ 6214. The supposition that water vapour is present in the atmospheres of these planets is not supported by the photographs in question, as the water-vapour lines near D do not differ in appearance in the spectra of the moon and planets.

THE SETTING OF CEMENTS.

A GENERAL discussion on the setting of cements and plasters was held by the Faraday Society on Monday, January 14, when several interesting papers were contributed. The subject is one of great technical importance, in view of the large and continually increasing application of calcareous cements, especially of the Portland class, in engineering and building work. Although this country leads in the manufacture of Portland cement, very little attention has been given to its chemical study by British chemists, and it is not surprising that the most important papers in the discussion came from France and the United States.

Whilst the setting of plaster of Paris is now agreed to be brought about by the crystallisation of a supersaturated solution, there still exists a difference of opinion as to the mechanism of the process in the case of Portland cement. The recent work of the U.S. Bureau of Standards, as described in a paper by Mr. A. A. Klein, supports the view, originally due to Michaëlis, that the products of hydrolysis are colloidal in nature, and that the desiccation and induration of gelatinous aluminates and silicates, and even of free alumina and silica, are responsible for the mechanical strength of the cement when set. On the other hand, the veteran cement chemist, Prof. Le Chatelier, to whom the first explanation of setting is due, reiterated his opinion that the process is essentially identical with the setting of plaster, the hardness being caused by crystallisation. Incidentally Prof. Le Chatelier offered some criticisms of the tendency, observable in much of the literature dealing with colloids, to use new technical terms as if they afforded an explanation in themselves, whereas they only express known facts in new language.

Dr. C. H. Desch, who opened the discussion, and Mr. Hatschek pointed out that the difference between the two schools is in great part one of terminology. It is agreed that the particles of the hydration products are usually too small to be distinguished, so that they fall within the region of ultramicroscopic dimensions, and surface forces become comparable with those which bring about the crystalline arrangement. Under such conditions it is almost immaterial whether the particles be described as crystalline or colloidal, especially in view of the work of von Weimarn, who has done much to show the continuity of the passage from one condition to the other with diminishing size of particles.

The contributions of Prof. Donnan, Dr. Lowry, and Mr. Hemming dealt with the agglomeration and disintegration of simple salts, and it was shown that these phenomena have a close connection with those of setting. In both cases the greater solubility of unstable as compared with stable solid phases plays a part. Dr. Rosenhain carried the discussion a step further by comparing the hardening of plasters and salts with the process of solidification of a metal. The solid formed in each case is a crystalline aggregate, which breaks more readily, under ordinary conditions, across the individual crystals than between their boundaries. This has been attributed to the formation of an amorphous intercrystalline layer, and it is possible that the strength of hydrated plaster may be due, not merely to friction between the interlocking radiating needles of adjacent spherulites, or to their simple adhesion, but to the presence of such amorphous material. Portland cement would presumably contain a much higher proportion of the amorphous products.

Another group of papers dealt with questions more closely allied to engineering practice, and the discussion rendered evident the fact, well known to those who have studied the somewhat complex subject of the chemistry of cement, that there are numerous unsolved problems in connection with the setting and hardening processes, some of which bear in the most direct manner on the utility of cement and concrete as structural materials. Mr. Blount spoke of these difficulties from the point of view of the technical chemist, and Mr. Caröe from that of the architect. For the physical chemist some of the most interesting of these problems concern the spontaneous changes of setting time and their acceleration or inhibition in the presence of catalysts. The chemical constitution of Portland cement clinker is now established, thanks to the splendid work of the Geophysical Laboratory in Washington, a summary of which was given by Mr. Rankin, who was responsible for the investigation. The exact part played by impurities, such as magnesia, iron, and alkalis, still remains to be determined.

The addition of puzzolanic materials, containing soluble silica, has been practised since ancient times as a means of improving the qualities of lime mortar, and similar additions to Portland cement have been recommended. The work of the Bureau of Standards indicates that the strength after setting should be improved by such additions, and the practical question was directly raised in a paper by Messrs. Lewis and Deny, who showed a marked improvement in the strength of good brands of Portland cement, due to the addition of finely ground blast-furnace slag of suitable composition. The discussion brought out the fact that a difference of opinion exists on this question, although the evidence for improvement is very strong. Blast-furnace slag as a raw material for Portland cement manufacture has received little attention from chemists in this country, although the industry is now becoming an important one, and the utilisation of such a troublesome waste product deserves much closer study.

Discussions of this kind do a great service in reviewing the field for investigation in the branch of science or industry discussed, and also in bringing together work undertaken from quite independent viewpoints, the relations between which may have been quite unsuspected by the original investigators. Portland cement was an English invention, and this country has always led in its manufacture; it would be of advantage to the industry and to engineering if it were to receive more attention from British chemists than it has hitherto obtained.

C. H. D.

SECONDARY-SCHOOL EXAMINATIONS AND ADVANCED COURSES.

THE Consultative Committee of the Board of Education some years ago prepared a report on examinations in secondary schools, and this was published by the Board in 1911. Following the Committee's recommendation, the Board of Education invited the English universities to confer with representatives of the Board on the whole subject. These conferences took place during 1913, and in the same year the Board explained the general nature of the proposals it was about to make to representatives of local education authorities and of associations of secondary-school teachers. In July, 1914, the Board issued the now well-known Circular 849, on "Examinations in Secondary Schools," and invited criticisms from responsible authorities upon the scheme proposed in it. The scheme provides for the annual examination of grant-earning schools in connection with the Board. Two examinations are proposed, and they are to be conducted by one of the recognised university examining bodies. The first examination is to be suitable for forms in which the average age of the pupils ranges from about sixteen years to sixteen years eight months. The second examination will be designed for those who have continued their studies for about two years after the stage of the first examination. The first examination is intended to test the pupil's general education before he begins his school specialisation. It should, under certain conditions, serve the purposes of a matriculation examination, and it is hoped that eventually it will replace the numerous entrance and preliminary examinations to which pupils leaving the secondary school have had to submit themselves. The second examination will be based on the view that older pupils should have enjoyed a more concentrated study of a connected group of subjects, and the courses suggested in the Circular are (*a*) classics and modern history, (*b*) modern "humanistic" studies, and (*c*) science and mathematics. The Board's scheme naturally involves increased expenditure by the schools, and in Circular 849 the Board promised further financial aid, but in a later circular of December, 1915, it was announced that proposals involving increased financial aid were to be considered in abeyance. Circular 996, issued on May 25, 1917, however, announced the Board's ability to take up its examination scheme again, and the appointment of the "Secondary-School Examinations Council" to assist the Board to undertake its functions as the co-ordinating authority for secondary-school examinations. This council is at work, and the schools are awaiting its first report.

Closely connected with the two examinations which are being instituted by the Board of Education for pupils in grant-earning secondary schools is the scheme for the provision of advanced courses in such schools outlined in the "Regulations for Secondary Schools" issued by the Board last year. The Board states that the secondary schools are not sending forward to institutions of higher education and research a number of properly qualified students adequate to the national need. The Board regards this deficiency as due partly to an insufficient provision for advanced work in secondary schools, and to meet this need the new advanced courses have been planned. They are intended for pupils of about sixteen who have reached the standard of the Board's first school examination, and are to last for two years. The advanced course must be in one or other of three groups of subjects, the Regulations state:—(i) Science and mathematics, in which preponderance may be given to either; (ii) classics, *i.e.* the Latin and Greek languages, together with the literature, history, and civilisation of Rome and Greece; (iii) modern studies, which must include the study of (*a*) two languages other than English, with their literature, (*b*) modern history on broad lines, and including the history of England and of Greater Britain, but also bearing special relation to the two languages chosen. Two, or even three, of these advanced courses may be organised in a large school, where pupils enough normally remain until about eighteen, but probably the number of advanced pupils in the school will not allow of more than one course. An additional grant for each of these courses is promised; it will not be calculated on the number of pupils and will in no case exceed 400*l*. Up to the middle of November last between 270 and 280 applications for recognition of advanced courses were received by the Board. About half of the applications were in respect of courses in science and mathematics; of the remaining half, those for courses in classics were little more than one-third of those for courses in modern studies. Up to the same date sixty-three courses in science, thirteen in classics, and nineteen in modern studies have been recognised. Nearly fifty were still undetermined. In the remainder (about 130) recognition was withheld, because the syllabus of instruction submitted was unsatisfactory, or because it was not shown that it could be satisfactorily carried out, or because a reasonable number of pupils qualified to enter on the course was not forthcoming.

GERMAN ECONOMICS AND TECHNOLOGY.

THE first meeting was recently held of the German Union of Technical Scientific Societies, formed by a combination of thirteen associations and unions, when problems involving economics and technology during and after the war were discussed. Prof. Dr. Wiedenfeld, of Halle, spoke on the subject, and showed that whilst, during recent pre-war years, Germany had become more and more dependent upon foreign countries for many articles of prime necessity, the blockade had thrown her back upon her own resources, and technical science had been called upon to furnish her requirements out of these, under conditions which were so far novel in that the question of cost of production became one of secondary importance. The problem had been met in three different ways:—

(1) By re-establishing industries that had been rendered unremunerative by foreign competition, such as the production of manganese, the increased production of iron, the production of sulphur, and the intensification of agriculture.

(2) By the increased utilisation of what had been waste products so much that the term "non-utilisable substance" had been eliminated by the war, examples being the production of lubricants from coal-tar and of clothing materials from various waste products.

(3) By the production of substitutes and of various substances by synthetic processes, as of nitro-compounds from atmospheric nitrogen, and of cattle feed from straw.

It is interesting to note that this speaker objected to the multiplicity of Government authorities controlling production, and holds that the production of materials in large quantities can be assured after the war only by means of monopolies, though not necessarily State monopolies. Finally, he insisted upon the immense importance of close co-operation between technical science and industry, neither of which can exist without the other. It need scarcely be added that many of these observations apply quite as forcibly to conditions in this country as to those in Germany.

THE NEW INTEGRAL CALCULUS.

THE ancient Greeks determined various areas and volumes by a method known as that of exhaustion; but they had no integral calculus properly so called, any more than (*pace* Prof. Burnet) they had a differential calculus, although they were familiar enough with the idea of a locus described by the motion (or flow) of a point. Even Fermat missed the analytical method devised by Barrow, Newton, and Leibniz. This was so rapidly developed as to assume a form which (except in notation) remained practically unaltered for a century and a half. The reason of this quiescence—a sort of dormant vitality—was the neglect of function-theory, or, rather, its non-existence. The appearance of Fourier's work on the theory of heat compelled mathematicians to study the properties of trigonometrical series, and the conditions under which they could be used for the representation of so-called arbitrary functions. Dirichlet and Riemann shed a flood of light upon the matter; and Riemann gave a definition of a definite integral which could be applied to functions more general than those that could be integrated according to the older (say Newtonian) definition. In particular, the function to be integrated might have a finite number of isolated discontinuities in the range of integration; isolated, that is, in the sense of being separated by finite intervals. Thus a new type of integrals, the Riemann integrals, had come under observation.

Quite recently the whole theory of integration has entered upon a new phase, mainly through the development of the theory of sets of points, and the enlarged notion of "function" now established. To Lebesgue is due a definition of a definite integral which is applicable in certain cases even when Riemann's is not. The Lebesgue integral agrees in value with the Riemann integral when the latter exists; just as the Riemann integral agrees in value with the ordinary integral when the latter exists. The very latest contributions to the theory are mainly due to Vallée Poussin and Baire, and apparently a kind of finality has been reached in the mathematical notion of an integral, at least in the light of our present mathematical knowledge. Students will find an excellent summary in Prof. G. A. Bliss's lecture, "Integrals of Lebesgue," published in the Bulletin of the American Mathematical Society for October, 1917. The reader must have a fair acquaintance with the theory of sets (including the notions of measure and content); otherwise the lecture is self-contained. References to recent works on the subject are also given.

Few things are more remarkable than the mathematical discoveries of the present generation, discoveries which have profoundly affected the very rudiments and foundations of logic, analysis, and geometry. They cannot be ignored even by the elementary teacher, and the problem of making them familiar to students is one that must be resolutely faced. G. B. M.

METEOROLOGY IN THE ARGENTINE REPUBLIC.

A COPY has reached us of the *Boletin Mensual* of the Argentine Meteorological Office—a new monthly weather review that has now been running for more than a year. The data summarised refer to the year 1916, and are given in useful form. The tri-daily meteorological observations for twenty-five stations are printed *in extenso*, and an abstract of these, along with returns from other fifty-two stations, are given in an extended table. The elements summarised are pressure, temperature, relative and absolute humidity, direction of the wind, rainfall, cloud, and the number of frosts experienced.

The stations range in latitude from 55° S. to 22° S., and in height from 4 to 3447 metres, so that all climates are represented. Tables of *daily* rainfall are given for more than 1400 stations. The distribution, as is to be expected in a country like Argentina, where the meteorological posts are in general also railway stations, is very irregular. In the province of Buenos Aires, which embraces an area equal to that of the United Kingdom without Wales, there are 556 rain-gauge stations, but in the equally large territory of Santa Cruz there are only eleven stations. The results are shown in six coloured maps, giving the rainfall, the departure of the rainfall from the average, the accumulated rainfall since the beginning of the agricultural year, viz. July 1, with departures from the average, the mean temperature, pressure, and prevailing winds, and the extremes of temperature. Detailed hourly values of declination, horizontal force, and vertical force as recorded at the Central Magnetic Observatory at Pilar (lat. 31° 40′ S., long. 63° 53′ W.) also appear, along with a summary of the seismic phenomena recorded at several points with the Milne or Bosch-Omori seismographs.

The hydrometric branch of the service gives in each number of the *Boletin* the daily height of the principal rivers and lakes of the Republic as observed at fifty-eight places, with the departure from the average, also a special study month by month of the conditions at an individual station. So far the discussions refer to gauges at various points on the River Parana, where there are more than thirty years' observations available. Various interesting articles by members of the staff appear from time to time, and it is to be hoped that the prompt issue of meteorological data initiated by Mr. Wiggin, director of the Argentine service, will extend to other South American weather bureaux.

THE NEEDS OF OUR EDUCATION AT THE PRESENT DAY, WITH SPECIAL REFERENCE TO SCIENCE TEACHING.[1]

EARLY in the past year a work was published by a recently retired Ambassador which was understood in a special way to reflect the opinion of the Foreign Office. In this book he set forth the "necessary qualifications" for the diplomatic career, which in his opinion were "good birth, good breeding, good looks, and good health," and went on to say:—"Science is not necessary. Geography beyond elementary notions is not of great value. The diplomatist will acquire what geographical knowledge he needs of the country to which he is appointed while residing at the post. Few men can know it in sufficient detail beforehand."

We drifted into this war through sheer lack of expert knowledge of foreign countries and foreign languages. We have muddled and misconducted our war operations on sea and land through lack of expert knowledge, of science, on the part of those commanding at home, and sometimes—happily not always—of those commanding abroad. If by the proverbial good luck which saves Great Britain ever and again; if, still more, by the unparalleled bravery of our men in all branches of the combatant Services, by their innate common sense and coolness, and by the occasional streak of genius among their leaders, which not even a War Office or an Admiralty can occlude, we are sufficiently victorious to make peace on satisfactory terms, we shall need more than ever to reform our system of education and the general curriculum to be applied in all schools to the children and youth of both sexes. We shall not, I believe, conquer the Germans sufficiently in this round to be sure they will remain in the sphere allotted to them. We shall at best be able with the help of our Allies to turn them out of France, Belgium, and Italy, Serbia and Rumania, and leave them temporarily exhausted behind a frontier they only intend to respect until they regain strength. The one sure way to beat the Germans and keep them in their place is to become better educated than they are, and apply our new education to developing the resources of our own land and of the four or five million square miles in the tropics dependent on the London Government for direction.

Prior to the war, because of our contempt of a scientific education, we offered little or no inducement to our young men and women to serve the Home Country and the Empire in the application of science to industry, commerce, and the enlargement of the national intelligence. Therefore, we had to recruit our science teachers frequently from Germany. A great influx of clever men came to Britain from Germany under the ægis of the Prince Consort and from

1 From the presidential address delivered before the Association of Public-School Science Masters on January 8 by Sir H. H. Johnston, G.C.M.G., K.C.B.

the awakened interest in art and science he left behind him. They became scientific pioneers in African exploration, professors of philology, of Sanskrit, of Celtic languages, of forestry, botany, zoology, chemistry, and history. They excelled in Oriental studies, in botany, and in chemistry, and rendered yeoman service to British industrial and mental development. Most of them are dead—happily dead before this horrible war revealed the dreadful, the unforgivably cruel side of Imperial Germany. A few are pensioned off, but their names are indelibly inscribed in the history of the British Empire, if that history be truly written. A few have returned to Germany. But never again, within the lifetime of the youngest man present, shall we send to Germany for instructors in any branch of learning.

Consequently, it is more than ever vitally necessary that we should reorganise our education, and produce as home-bred articles all the botanists, philologists, foresters, zoologists, entomologists, chemists, astronomers, translators of Oriental manuscripts, and musicians we require for our home needs and for the Empire dependent on our initiative. We shall not do this efficiently with our existing ideals of education at the great and small schools.

But we require not only to train British biologists, astronomers, ethnologists, philologists, historians, chemists, and a hundred other diverse types of specialists, but equally we need to give a glimmer, a general idea of these branches of science to all the people of the realm. Geography must bulk largely in popular education; some idea should be given of the earth's age and structure; elementary notions of astronomy, zoology, and botany are highly necessary to the mental equipment of the masses; and ethnology is of equal importance with geography. The history of Great Britain and Ireland should be taught intelligibly and truly, not in the Mrs. Markham style, nor with the prejudices of Macaulay or Father Benson. Something of human anatomy and much about the laws of health should be in the curriculum of even the humblest school. An elementary knowledge of arithmetic and a thorough knowledge of the English language—its origins, its right conventional pronunciation, and its weird and wicked orthography; an introduction to the masterpieces of English literature; smatterings of Latin, Greek, and French—sufficient to understand the part these languages have played in the formation of our vocabulary; a generalised explanation of electricity and the simplest and most important facts of chemistry: these, it seems to me, with the teaching of a good handwriting and the clear expression of thoughts on paper and a little freehand drawing, are the essential subjects of the basic education which should be given to every child in the kingdom between the ages of six and fourteen.

Building on such a base, we can then branch out along the lines of specialist education: Shorthand, after longhand; the phonetic writing of English, after the preposterous artificiality of conventional spelling; foreign languages after our own; drawing and painting for those who incline to the pictile arts; music for all who are musical; anthropology and ethnology in their diverse ramifications for the future traveller, clergyman, administrator, or police-court magistrate; geometry, geodesy, mechanics, hydrostatics, and physics, and the higher mathematics for the predestined surveyor, builder, engineer, or astronomer; chemistry and agriculture, animal pathology for the farmer-in-grain; chemistry, again, and all the outgrowths of that mighty chapter in the New Bible for the intended manufacturer and tradesman; ballistics for the cadet; botany, entomology, sociology, modern history, law, and languages for the future statesman; and the differential calculus for those who crave an opportunity of applying it to some more practical purpose than merely passing as Senior Wrangler.

Education, it seems to me, comes under three heads: (1) That which deals with the necessities of man's body—gymnastics, training of the eye and ear, the development of the muscles, skill with weapons or utensils, the strengthening of the nerves, the making of each girl and boy into as healthy and fit a member of the community as is possible; the teaching of all the mechanical and constructive arts that go to feeding our bodies and minds, sheltering us, transporting us from place to place, and clothing us. (2) That which supplies the requirements of man's mind, all useful learning regarding the past, the place of our planet in the Cosmos, the other forms of life that share the earth with man, the interpretation of the great New Bible—in short, the Book of the Earth—itself, which we are just learning to read, and those other lesser books, the products of the human mind; not only the documents left to us from the pre-Christian Mediterranean world, but also the great literatures of India, of Scandinavia, of China and Japan, of Renascent Italy, England, France, of the Aztecs in Mexico, and of the Semitic and Hamitic peoples. (3) That of the education of the soul.

This last is a much-abused word, the precise meaning of which no one can define to the liking of his neighbour. It is the imponderable, "insaisissable," imperishable spirit of the race which we also call "character" and "disposition"; which is referred to poetically as "heart" in contradistinction to "head." It is almost universally agreed that the education of the impressionable young cannot be confined to the cultivation of muscles and the steadying of nerves, to the care of the teeth and the removal of adenoids, to the initiation into the mechanical arts and the decorative arts; nor to the filling of the mind with an encyclopædia of useful information. You have, in addition to caring for mind and body, to impart such education as may—here with great, there with only partial, success—turn the raw material of your pupils into good men and women, honest servants of the State, enthusiastic patriots, and law-abiding citizens, obeying, however, wise and humane laws which they are competent to frame or to understand.

Into this third great branch of education science, founded on demonstrable truth, alone must enter; superstition must be banned. The scientific basis and authority for temperance and chastity must be explained; children must be shown that wrongdoing against one's self or the community does not pay in the long run—that against one's own body and mind it is rapidly punished; that against the community not only are there unpleasant consequences through the enforcement of laws which we have made for the protection of the community, but also that the wrongdoer himself would suffer in security and happiness were there no such laws.

THE METEOROLOGICAL RESOURCES OF THE EMPIRE.[1]

IN many directions steps are being taken to survey the resources of the Empire and to plan how these may best be utilised in the general reconstruction which must undoubtedly be taken in hand on the cessation of hostilities. In meteorology the same should be done, for within the Empire we may meet every type of climate. The great Overseas Dominions, India, the Colonies, and especially the oceanic islands, not only afford the means for extend-

[1] Abstract of the presidential address delivered before the Royal Meteorological Society on January 16 by Major H. G. Lyons, F.R.S.

ing our knowledge of the direction and velocity of the currents of the upper air, to meet the demands of aviation, which will become greater in the near future, but with a very moderate increase in the resources of their existing institutions, and more active co-operation, they may powerfully aid in the solution of many meteorological problems of theoretical and practical importance.

But the organisation of the Empire's meteorology at the present time is very far from being adequate, for the provision of stations has grown out of local needs or individual initiative, not from a considered plan. When we examine the meteorological organisations of the Empire we may well be astonished at their extent and their development, but as we look further into the matter we shall see that we are still far from utilising them to the best advantage, for reasons which will appear.

In all countries where there is a meteorological service the network of climatological stations is controlled by one or more first-order stations, or meteorological observatories, at which continuous records or hourly readings of pressure, temperature, wind, sunshine, rain, etc., are taken, but none as yet exist in the great Colonial regions of East Africa, West Africa, or in the West Indian Islands, though there are eighteen institutions of this class in other parts of the Empire.

The work of the meteorologist does not end with recording the pressure, or the temperature, or the monthly amount of the rainfall, but meteorological observations, after being taken, must be worked up into the various forms in which they will be most useful for shipping, agriculture, water-supply, engineering, sanitation and health, and now, also, aerial transport. The same form will not suffice for all, and meteorology itself has its own especial needs, but the important thing is that this information, however accurate and detailed it may be, will not be available in exactly the forms that answer to different requirements unless there is a sufficient staff of trained meteorologists to handle it and to supervise its preparation.

Nor is the study of a single region sufficient in itself. India, in preparing the monsoon forecast, draws upon data from Egypt, St. Helena, Brazil, etc.; Egypt, in forming each year an estimate of the coming Nile flood, utilises information from India, Uganda, the South Atlantic, and so on. The East Indian Islands need warnings of their hurricanes from the more eastward islands of their archipelago, and must utilise all that Asia and Africa can tell them about the development and movement of tropical storms before their precautions can be considered to have exhausted all the means available. All lands which lie near the subtropical zones of scanty rainfall are vitally interested in the problems of forecasting the probable sufficiency or failure of their rainy season. The droughts of the pastoral regions of Australia and South Africa are well known, and the same occur in the Sudan, though from its retarded development less has been heard of them up to the present time, but in the future, as the population increases and becomes more settled, the same considerations will demand attention. Similarly, the countries in temperate zones find some of their most urgent problems in the adequacy or inadequacy of the summer heat for the ripening of cereal crops.

We are far from having solved these problems, but we know enough to say definitely that they cannot be solved from the study of a single region, but that they are world-problems in which the meteorological conditions of the whole world must be considered, and for studies of such vast importance the British Empire offers unequalled opportunities, which must be seized and fully utilised. It is in the development of our science within the Empire that there are opportunities by which we have hitherto profited inadequately.

In East and West Africa we have two large groups of Colonial possessions having closely related climates and being already in possession of a number of meteorological stations with records extending over a considerable number of years. It should not be beyond the wit of man to devise a workable system of co-operation for these stations so as to form for each a service which should have a meteorological observatory as its technical centre, with one or more trained meteorologists to direct its energies and to utilise the collected information for the use of the Colonies themselves and of the Empire as a whole.

Already a secular decrease in the annual rainfall of Nigeria has been not merely suggested as being indicated, but also announced by some as a fact, so that the confirmation or confutation of this contention is a matter of very urgent importance to the Colony. Such questions as these are best investigated on the spot by a trained meteorologist in the first instance, even though the final stages in the inquiry may require reference to the meteorological authorities of other regions for the results of their investigation into similar or related questions.

After considering in detail our meteorological organisation we find that within the Empire there are already upwards of 1000 climatological stations distributed all over the world, from lat. 60° N. to lat. 54° S., near the equator, within the tropics, and in the temperate zone. They are on coast-lines, in the heart of continents, and on oceanic islands. Some few, especially in India, are at high altitudes above sea-level. They therefore furnish us with opportunities for investigating almost any problem that may arise in meteorology if competent meteorologists make full and proper use of them.

We come, then, to the conclusion that, in order to provide trustworthy and adequate information regarding the climate of the Empire, and the meteorological phenomena which play so important a part in the lives of all the inhabitants of the earth, a more efficient organisation of our meteorological resources is necessary. In the first place, men will be required who have received a good training in modern meteorology, and have such a knowledge of physics and mathematics as will enable them to deal with the problems which they meet. Hitherto there have been very few of these men in this country, but the present needs have brought a number into direct contact with the subject, and if the meteorological services of the Empire are going to offer a career to an able meteorologist, some of them may elect to adopt it. Co-operation and intercommunication will be all the more essential and valuable when the meteorological work is entrusted to specially trained men who have seriously studied the subject, and this society should be able by means of its meetings, and especially by its Journal, to aid powerfully in the attainment of this desirable object.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Leeds.—The Department of Physiology is about to undergo extension. The work of the teachers of physiology has been divided. Dr. H. S. Raper has been appointed professor of physiology and biochemistry, and Dr. C. L. Evans has been appointed to a new chair as professor of experimental physiology, or, as it will probably be called, "experimental physiology and experimental pharmacology." This change illustrates the trend of modern medicine and surgery. It is becoming evident that an increasing contribution to their progress is rendered possible by a detailed study of the chemical processes met with in health and disease, and the influence upon them of substances of known chemical composition. Recent investigations furnish an example. Antiseptic action of substances containing active chlorine was undertaken early in the war by the University in conjunction with Dr. H. D. Dakin. These researches led to the introduction of two antiseptics, chloramine-T and dichloramine-T, which have been widely used in the treatment of war wounds. To carry out efficiently the new schemes involved in the above changes, increased laboratory accommodation for research will be necessary, and additions to the apparatus in the Department of Physiology must also be provided. Prof. Raper was appointed, in 1910, lecturer in pathological chemistry at the University of Toronto, and held that post until his appointment in 1913 as lecturer in physiological chemistry at Leeds University. He is now on military service. Prof. Evans is also on military service. His published works comprise a number of valuable papers on subjects of physiology and chemical physiology. In the important branch of the medical school—that which relates to pathology and bacteriology—there are also likely to be interesting developments in the near future.

A COURSE of four advanced lectures on "The Electrical Examination and Treatment of Affections of the Nervous System" will be given by Dr. A. D. Waller and Miss M. D. Waller in the Physiological Laboratory of the University of London, South Kensington, on February 5, 12, 19, and 26, the admission to which will be free, without tickets.

A COURSE of nine public lectures on "Animal Life and Human Progress," arranged in conjunction with the Imperial Studies Committee of the University of London, to be given on Wednesdays at 5.30, will open at King's College on January 30 with a lecture on "Man's Account with the Lower Animals," by Prof. Arthur Dendy. The other lectures to the end of February will be:—Some educational and moral aspects of zoology, Prof. G. C. Bourne; Museums and research, C. Tate Regan; Man and the web of life, Prof. J. Arthur Thomson; The origin of man, Prof. F. Wood Jones. Admission to the lectures is free. Cards for the course may be obtained from the Publications Secretary, King's College, Strand, W.C.2.

IN connection with the work of the Imperial Studies Committee of the University of London, a course of public lectures on "Some Biological Problems of To-day" is being delivered at University College on Mondays at 4 p.m. The course began on January 21, and the first five lectures are:—(1) The problem of food, Prof. W. M. Bayliss; (2) War bread and its constituents, Prof. F. G. Hopkins; (3) Accessory food factors (vitamines) in war-time diets, Miss E. Margaret Hume; (4) Alcoholic and other beverages, Prof. A. R. Cushny; (5) The possibilities of increased crop production, Dr. E. J. Russell. The lectures are open to the public without fee or ticket.

THE early introduction by Mr. Fisher of an amended Education Bill, referred to last week, shorn of the more objectionable administrative features of the original Bill, has given general satisfaction. It says much for the credit and courage, no less than for the sincerity, of Mr. Fisher and his educational ideals that he has not failed to take note of the strong feeling evinced, throughout the country during his educational campaign, against any further increase of bureaucratic control with respect to the Board of Education. Parliament is justified in declaring a policy, but it must be left to the local authorities to give it full effect. The Act of 1902, whilst it made the county and borough councils responsible for all forms of education within their areas, failed to make the obligation mandatory. In the present Bill this is remedied, and now they must submit schemes for the approval of the Board to give effect to its requirements, and since the Board commands under the proposed system of consolidated grants large financial control up to 50 per cent. of the total local expenditure, it can readily call upon recalcitrant authorities to fulfil the conditions laid down. Probably the most difficult will be, having regard to industrial conditions, to the requirements of agriculture, and to the scattered and remote character of certain rural areas, to make satisfactory arrangements in respect of the clauses of the Bill which are designed to secure the continued education of young people between fourteen and eighteen. Many different solutions will be required according to the special circumstances of industries and localities. Wide and far-reaching as are the provisions of the Bill, it is, after all, a tentative measure, leading, it is to be hoped, to further developments, in the near future, alike in the provision of maintenance for children declared fit for fuller educational opportunities, in ensuring more complete measures for the care of child-life from the earliest age, and in the raising of the compulsory school age to fifteen, as in the Scottish Bill. The educational features of Mr. Fisher's Bill have met with general approval, and it may be now anticipated with confidence that early in the new session Parliament will give the Bill legal effect.

THE Principal, Dr. R. Mullineux Walmsley, in his report at the prize distribution of the Northampton Polytechnic Institute on January 19, said the manufacture of high-class munitions upon a commercial scale, commenced on July 1, 1915, had been continued uninterruptedly to the present time. In the Technical Optics Department the work of training women students in full-time classes in lens- and prism-grinding was vigorously prosecuted. This department has been highly successful, and the value of its work with reference to the prosecution of the war cannot be exaggerated. Attendances at other classes followed much the same course as in the preceding session, the chief feature being the continual draining off of the senior men both for actual service in the forces and for munitions work. As usual, the work has continued to receive the cordial support of the trades affected. What was described in the last report as "looking forward" work, namely, the training of disabled sailors and soldiers to take their places in the life of the country, not only now, but also after the conclusion of the war, was continued. To the end of July, 1917, eleven complete courses for training suitable men as electric power sub-station attendants were given, and the whole of the men trained were placed out. In the session now running further courses have been given, and the sixteenth course of the series has been started. Fifty-eight members of the staff, 542 members and students, and 802 students have joined the colours, and there are 104 V.A.D.'s serving in military hospitals abroad and at home. Of those joining the forces 169 have obtained commissions. Another line of work is the placing of the equipment and staff of the polytechnic at the disposal of the Government. From time to time various members of the senior staff in different departments have been requisitioned for experimental and scientific work intended to aid the prosecution of the war, and as the equipment of the laboratories is, in many directions, very complete, a considerable amount of work has been done.

THE eighteenth annual general meeting of the Association of Public School Science Masters, held on January 8 and 9 at the City of London School, was remarkable for the unanimity shown by members on certain important points. The main aim of the association at the present moment is to make it certain that every boy in the public schools should receive training in natural science. This training should be part of the general education of the boys, and should therefore be on lines suitable for those who will not afterwards make science their special study. Such lines were laid down by the association twelve months ago in a pamphlet known as "Science for All," in which prominence was given to the human and biological aspects of the subject. Since this is non-specialist training, it must be taken in the schools before the average boy reaches the age of sixteen and a half, when a certain degree of specialisation usually begins. These points were referred to by Mr. O. H. Latter, who explained to the members the far-reaching effects of university entrance examinations on curricula. The committee, he said, had been met very sympathetically by Oxford University in this matter, and negotiations were still going on with Cambridge. During the discussion which followed, the Board of Education policy of grouping science with mathematics in these examinations was severely criticised. No enthusiasm was shown for the introduction of "compulsory science" in such examinations, if the main aim can be attained in any other way; on the other hand, the general feeling of the meeting was in favour of removing compulsion (so far as this means that failure to pass in one subject alone necessarily prevents a boy from passing to the university) from all subjects, with the sole exception of English. The moderateness of the association was shown again later, when the following resolution was passed unanimously:—"That it is desirable that opportunities be given to candidates for science scholarships to offer a historical or other literary subject as subsidiary to their main one." Extracts from Sir H. H. Johnston's presidential address are given elsewhere in the present issue.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, January 9.—Dr. Alfred Harker, president, in the chair.—L. D. **Stamp**: The highest Silurian rocks of the Clun Forest District (Shropshire). Clun Forest is a district in which Upper Silurian rocks crop out over a wide area, interrupted by outliers of Old Red Sandstone. The district is separated from the typical Silurian area of Ludlow by the great line of disturbance that passes through Church Stretton and Old Radnor. The succession of beds compares closely with that in the Ludlow district. The main differences are:—(1) That the Aymestry Limestone is represented by mudstones west of the great fault-line, and (2) that all other divisions show increased thicknesses. There is no evidence of any stratigraphical break. The sequence is complete from the Lower Ludlow rocks up into the Old Red Sandstone, and the changes in lithology are gradual. The extent of Old Red Sandstone, as indicated on present maps, must be restricted, since most of the supposed Old Red Sandstone has been found to belong to the Temeside group, which here attains a great development. The Silurian age of the beds is shown by the occurrence of *Lingula minima* and of characteristic lamellibranchs. A comparison with other districts in which Upper Silurian rocks are developed shows that deposition attained its maximum along the Welsh Border, the thickness of the formations decreasing rapidly southwards and eastwards. On the east of the district—in the neighbourhood of the fault-line—the strata are folded along axes ranging north-north-eastwards parallel to the main fault. Away from the major faults the folding is gentler, and folds ranging nearly due east and west make their appearance. Farther west the north-north-eastward folding and fracturing reappear.

Mineralogical Society, January 15.—Mr. W. Barlow, president, in the chair.—Dr. J. W. **Evans**: Diagrams expressing the composition of a rock. These diagrams are intended, like those of Michel Lévy and Mügge, to indicate at a glance the significance of the analysis of a rock or complex mineral silicate. The molecular proportions of the constituents are determined in the usual manner, those of the ferrous and magnesium oxides, however, being doubled. The silica is represented by two rectangles placed side by side, the length of each being half the molecular proportion of silica. In one of these rectangles lengths equal to the molecular proportions of potash, soda, and lime are measured off in succession, and in the other those of alumina, iron oxide, and magnesia. Thus the same space represents both metallic oxide and silica, and so far as felspars, felspathoids, or ægirine are actually or potentially present, the monoxide and sesquioxide they contain are, with two molecules of silica, represented by contiguous portions of the two rectangles. The excess, if any, of lime over available alumina has the silica necessary to form wollastonite, and the excess, if any, of iron oxide over available soda and the magnesia have the silica required to form orthosilicates. The remaining silica space is then divided up to show the additional silica required or available for the felspars, felspathoids, and ægirine, and that available to convert the orthosilicates of iron and magnesium into metasilicates. The remainder represents free silica or quartz.—Dr. G. F. H. **Smith**: The use of the gnomonic projection in the calculation of crystals. If projected on to a plane at right angles to the edge of the zone containing the poles from which bi-angular measurements were made, the diagram takes the form of a net, the nodes of which represent the principal poles. The unit lengths of the net are easily calculated from the data, and once the rectangular co-ordinates of any node with respect to axes on the diagram have been determined those of the remainder follow by simple addition or subtraction; the corresponding spherical angles are deduced by a simple calculation. The accuracy of the calculations may be checked from the diagram at every step. To keep the projection corresponding with any crystal within reasonable dimensions it is sometimes convenient to project on to the faces of a cube. The direction of a zone when crossing from one face to another is very simply found from the diagram.

Mathematical Society, January 17.—Major P. A. **MacMahon**: A method for studying any convergent series.—G. H. **Hardy**: Additional note on Dirichlet's divisor problem.—J. H. **Grace**: Note on a Diophantine approximation.—K. Amanda **Rau**: A note on a theorem of Mr. Hardy's.—C. H. **Forsyth**: Super-normal curves. —Prof. H. **Hilton** and Miss D. S. **Tuck**: Plane quartic curves with a tac-node.

PARIS.

Academy of Sciences, December 31, 1917.—M. Ed. Perrier in the chair.—A. **Lacroix**: The eruption of the Quetzaltepec volcano and the earthquake that destroyed San Salvador (June–July, 1917). A detailed account of the eruption, gathered from the statements of eyewitnesses and from photographs, is given. The great loss of life and damage were mainly due to the earthquakes.—M. **Hamy**: A particular case of diffraction of the images of circular stars.—E. **Ariès**: The necessity of improving the Clausius equation of state. In the Clausius equation

$$p=\frac{RT}{v-a}-\frac{\phi(T)}{(v+\beta)^2}$$

it is proposed to replace the two constants a and β by two functions of the temperature, and it is shown that the main advantages of the original equation are not lost.—A. **Blondel**: The direct measurement of the angle of internal decalage of an alternator.—G. **Julia**: Rational substitutions.—M. **Akimoff**: Fourier-Bessel transcendentals with several variables.—M. **Mesnager**: The rigorous demonstration of the formulæ of rectangular beams and plates.—A. **Léauté**: Complement to M. Blondel's theory on the induction reaction of alternators.—F. **Delhaye** and M. **Sluys**: The erosion valley of the Congo and its tectonic antecedents.—P. **Brodin** and F. **Saint-Girons**: Researches on the leucocytes of blood from tuberculous subjects. For data to be of value, the leucocytes must be taken daily for a considerable period. The higher the proportion of polynuclear leucocytes, and the higher the total number present, the graver the prognosis.—MM. **Nicolle, Fayet,** and **Truche**: The treatment of epizootic lymphangitis by means of autolysed yeast juice. An account of the technique proposed and the results obtained.—F. **Diénert**: What are activated muds? The muds causing rapid nitrification of sewage contain chalk (50 per cent.) and albuminoids (20 per cent.), the remaining 30 per cent. being non-albuminoid.—J. **Belot** and H. **Fraudet**: The localisation of foreign bodies in the eyeball and the muscles of the eye.—A. **Cabanes**: Antiseptic treatment by chloroform. A stream of oxygen containing alcohol and chloroform vapour is circulated through the wound. Purulent secretions diminish rapidly under this treatment, and leucocytic reactions are increased.—J. **Bridré**: Leucocytotherapy or aseptic pyotherapy. Its use in lymphangitis of the horse.

BOOKS RECEIVED.

The Advanced Montessori Method. By M. Montessori. i., Spontaneous Activity in Education. Translated by F. Simmonds and L. Hutchinson. Pp. vii+357. (London: W. Heinemann.) 6*s*. net.

Annuaire Astronomique et Météorologique pour 1918. By C. Flammarion. Pp. 364. (Paris: C. Flammarion.) 3 francs.

The Wellcome Photographic Exposure Record and Diary, 1918. Northern Hemisphere and Tropics. Pp. 256. (London: Burroughs Wellcome and Co.)

Resistance of Air. By Lt.-Col. R. de Villamil. Pp. x+192. (London: E. and F. N. Spon, Ltd.) 7*s*. 6*d*. net.

Short Logarithmic and other Tables. By Dr. W. C. Unwin. Sixth edition. Pp. 43. (London: E. and F. N. Spon, Ltd.) 1*s*. 6*d*. net.

The Practice of Pharmacy. Sixth edition. By Dr. J. P. Remington, assisted by E. F. Cook. Pp. xxviii+25–1987. (London: J. B. Lippincott Co.) 35*s*. net.

The Gate of Remembrance: The Story of the Psychological Experiment which Resulted in the Discovery of the Edgar Chapel at Glastonbury. By F. B. Bond. Pp. x+176. (Oxford: B. H. Blackwell.) 6*s*. net.

Educational Reform. By the Rt. Hon. H. A. L. Fisher. Pp. 15. (London: Longmans and Co.) 2*d*. net.

Troubles Locomoteurs Consecutifs aux Plaies de Guerre. By Prof. A. Broca. Pp. 155. (Paris: Masson et Cie.) 4 francs.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 24.

ROYAL SOCIETY, at 4.30.—Graphical Solution for High-angle Fire: Prof. A. N. Whitehead.—Flocculation: Spencer Pickering.—Revolving Fluid in the Atmosphere: Dr. J. Aitken.—Ultra-violet Transparency of the Lower Atmosphere and its Relative Poverty in Ozone: Hon. R. J. Strutt.—The Presence in the Solar Spectrum of the Water-vapour Band λ 3064: Prof. A. Fowler.—The Ultra-violet Band of Ammonia and its Occurrence in the Solar Spectrum: Prof. A. Fowler and C. C. L. Gregory.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Telephone Exchange Transfers and their Organisation: F. G. C. Baldwin.

FRIDAY, JANUARY 25.

ROYAL INSTITUTION, at 5.30.—The Motion of Electrons in Gases: Prof. J. S. Townsend.

PHYSICAL SOCIETY, at 5.—Presidential Address: Prof. C. V. Boys, F.R.S.

SATURDAY, JANUARY 26.

ROYAL INSTITUTION, at 3.—The Chemical Action of Light: Prof. W. J. Pope.

MONDAY, JANUARY 28.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—East Africa: General Smuts.

ROYAL SOCIETY OF ARTS, at 4.30.—High-temperature Processes and Products: C. R. Darling.

TUESDAY, JANUARY 29.

ROYAL INSTITUTION, at 3.—Palestine and Mesopotamia: Prof. Flinders Petrie.

WEDNESDAY, JANUARY 30.

ROYAL SOCIETY OF ARTS, at 4.30.—The Manufacture of Margarine in Great Britain: Sir William G. Watson, Bart.

THURSDAY, JANUARY 31.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Growth of Trees: A. Mallock.—Action of Light Rays on Organic Compounds, and the Photosynthesis of Organic from Inorganic Compounds in Presence of Inorganic Colloids: Prof. B. Moore and T. A. Webster.—The Isolation and Serological Differentiation of *Bacillus tetani*: Capt. W. J. Tulloch.—An Investigation into the Periodicity of Measles Epidemics in the Different Districts of London for the years 1890–1912: Dr. J. Brownlee.

ROYAL INSTITUTION, at 3.—Revolving Fluid and the Weather Map: Sir Napier Shaw.

FRIDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 5.30.—Gravitation and the Principle of Relativity: Prof. A. S. Eddington.

SATURDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 3.—The Ethics of the War: P. H. Loyson.

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