THURSDAY, SEPTEMBER 28, 1916.

INDUSTRIAL ASSOCIATIONS.

WITHIN the last few days we have been given further evidence by manufacturers and commercial men of their intention to organise themselves for the protection and development of British trade and industry, and to provide substantial funds for the promotion of these objects. A circular has been issued by the Executive Council of the Federation of British Industries, which includes many leading representatives of manufacturing and producing industries, inviting firms to join the federation, and to pay an annual subscription of 100*l.* until at least the year 1919. The main objects of the federation are the organisation and development of industry now and after the war, in co-operation with labour and in conjunction with the Government and Government departments. In furtherance of like interests, the Committee of Financial Facilities for Trade has just recommended to the President of the Board of Trade that a British Trade Bank should be established with a capital of 10,000,000*l.*, with the objects, among others, of establishing an information bureau, co-operating with merchants and manufacturers, and affording financial support to promising enterprises. It is suggested that any financial assistance given by the Government to undertakings in connection with what are known as "key" industries should be granted through the medium of the commercial information bureau. A couple of months ago we described the formation of the Association of British Chemical Manufacturers, with a subscription based *pro rata* on the size of the subscribing undertakings; and the steps taken to organise the British engineering industry into an association were outlined in our issue of August 24. At a meeting held at the Mansion House on September 20 to promote the organisation of British electrical and allied manufactures it was pointed out that the approximate aggregate capitalisation of our engineering works is now 400,000,000*l.*, so that an annual subscription of one-tenth of 1 per cent. of the capital would provide an income of 400,000*l.*

These and other signs show that our leading business men are prepared to do their part towards strengthening British industry and commerce for the competitive struggles of the future. In the case of most of the recent organisations reference is made to the necessity of providing facilities for scientific research; and this point was particularly mentioned by Sir Oliver Lodge at the Mansion House meeting. The inter-connection between science and every branch of engineering is already largely recognised, but we still await the production of a scheme which will show exactly what should be done to promote their practical co-operation. We have had a number of committees and advisory councils appointed, but most of them have devoted themselves chiefly to the collection and collation of opinions, and have originated little in the way of constructive plans of procedure. It is perhaps not so necessary now as it was to convince men of business that scientific research is the basis of progressive industry; what is now required of scientific men and their committees is the preparation of practical plans of campaign which can be placed before associations of manufacturers. We believe that when these schemes are available there will be little difficulty in securing the funds to put them into practice.

One such plan, national in scope and bold in conception, was sketched by Dr. Kenneth Mees in an address printed in NATURE of July 13 and 20. It asked for the establishment of a national industrial research laboratory with a staff of two thousand men, half of whom would be scientifically trained, while the other half would be assistants and workmen. The annual upkeep was estimated to cost about 800,000*l.*, but after a few years the laboratory would probably be self-supporting, and might, indeed, make an annual profit on the original investment. Several years ago Sir Oliver Lodge showed how the University of Birmingham alone could make profitable use of five millions, one million of which would be for a real attempt at scientific research in all departments. He pointed out that hitherto the ideas of this country in education and scientific research have been conceived on a wholly inadequate scale, and without proper appreciation of the vast extent of territory awaiting exploration. The most useful thing that could be done at the present time would be to concentrate attention upon the construction and details of schemes of this kind instead of lamenting the assumed indifference of manufacturers to the help which science can give them. The various committees now in existence would then be in the position of boards of directors having before them for consideration definite plans for the development of their businesses, instead of mere letters of complaint at want of enterprise.

There must, of course, be a joining up of those who are attacking the industrial reorganisation of the Empire with those who are working for educational reconstruction; and we look to the Science Committee recently appointed by the Government to assist in this end. The Right Hon. F. Huth Jackson, who was one of the members of the committee recommending the formation of the British

Trade Bank already mentioned, acknowledged in his speech at the meeting on the neglect of science held last May at the Linnean Society that, as a banker, he had found it a serious drawback to be ignorant of even the most elementary knowledge of the natural sciences. "Perhaps," he added, "if my education had not been neglected on those lines, I should in some cases have been able to avoid supporting some processes of manufacture which were in themselves wrong, or futile, while in other cases I might have been tempted to depart from the very rigid banker's attitude of refusing to give support to any new idea." It is to be hoped that the day is near when no educational course will be considered to be complete unless it includes instruction in the broad facts and principles of natural science, so that men in all walks of life may be able to appreciate possible directions of advance. Scientific thoroughness in detail, and sound factory management, are no doubt two of the conditions of industrial success, but banking facilities are another, and whether they are rightly or wrongly offered often depends, as Mr. Huth Jackson said, upon the possession of sufficient scientific knowledge either to discriminate between undertakings, or to know when to call for expert advice.

It is neither desirable nor necessary that every pupil in school or student at college should be compelled to take up science courses of a specialised kind, but it is essential that they should understand something of the place of science in modern life. Business cannot be learnt in a university or in a technical college, but breadth of view can be gained there, and all can learn that the attitude of mind induced by scientific education is just what is required for the successful development of industry. The changes which have taken place in the condition and needs of business life in recent years render it absolutely necessary to employ men of scientifically trained minds, not only among the captains of industry, but also among what may be termed the non-commissioned officers, and even in the rank and file. Our manufacturers are combining in their own interests, and are prepared to co-operate with education and science in national reconstruction. The time has come for the production of schemes of scientific instruction and research, practical enough to appeal to manufacturers and commercial men, and intended to promote the advance of the organised community. We look to the various committees, boards, and advisory councils lately established to see that the opportunity is not wasted in the further statement of axioms and postulates which are now taken for granted by all intelligent people.

SCIENCE AND THE SAVANT.

Les Allemands et la Science. By Prof. Gabriel Petit d'*Alfort* et Maurice Leudet du *Figaro*. Préface de M. Paul Deschanel. Pp. xx + 374. (Paris: Librairie Félix Alcan, 1916.) Price 3.50 francs.

THE articles collected in this volume were written by twenty-eight prominent representatives of science and art in France to amplify and enforce for the general public the protest made by the Academy of Sciences in November, 1914, against the German manifesto of October 30 of that year, wherein ninety-three "German intellectuals" claimed for their *Kultur* the hegemony of the world of science.

The book reminds one of an "air with variations." The theme is an oft-quoted remark of Pasteur's: "La science n'a point de patrie; mais l'homme de science en a une." The aria is the admirable preface by M. Paul Deschanel, President of the Chamber of Deputies. In the twenty-eight variations, along with a good deal of repetition about scientific ideas as distinguished from scientific material, there are very marked differences of treatment according as the writer envisages *la science* or *l'homme de science*. The tone ranges from extreme bitterness in an article on "La Thérapeutique Commerciale des Allemands," by Gaucher, and mordant irony in Delage's "Histoire Naturelle du Doctus Bochensis," to an amiable letter by Grasset, who insists that science has no country and will not follow the German savants in their excursion outside the region of science into that in which political or national animus is possible. In the circumstances it is difficult to regard so cosmopolitan an attitude as quite fitting the case. There is more ring of sympathetic resonance in Prof. A. Dastre's views about German mysticism and materialism in relation to science and its progress.

Emile Picard raises the practical question of international co-operation in science after the war, and thereby reminds us that science is not independent of the savant. Science has no country, but the progress of science can only find expression through organisations which have national characteristics. In the long run, truth is the only consideration; but the truths of science are not recognisable at all while they are still in embryo in the researcher's brain, and are not always recognised when they have reached the stage of manuscript or print. The spectacles of prejudice may bring some aspects of truth into brilliant focus, but may distort others beyond recognition; and prejudice may be characteristic of nations as of men. It never helps the progress of science; but unfortunately it may affect the development of the truths of science in other ways. The life of true genius may be too short for the struggle against prejudice, for genius is not always sufficiently self-conscious and self-assertive to make headway in a prejudiced environment.

Even genius must begin its scientific career with education; and facilities for education, which include the beginnings of research, afford an opportunity for discouraging genius that is not in line with national prejudice. Science cannot disregard the prejudices of men of science, and these essays show to what disastrous conditions the neglect o: that fact has led.

While we in this country were priding ourselves upon our institutions for higher education untrammelled by any consideration except money, and the petty rivalries of corporate bodies, without any formal co-ordination or collective responsibility for meeting the country's requirements, the German State provided ample facilities for education which necessarily attracted students from all countries not so well provided—our own, France, the United States, Japan, and everywhere else. Like the French, we regarded these facilities as an admirable example of magnanimous self-interest and public spirit. We have made a mistake; and our national educational authority, when we get one, would do well to take note of the contribution to the history of science which these nine-and-twenty brief essays provide.

STAR-BEARINGS FOR NIGHT-MARCHING.

(1) *Steering by the Stars for Night-flying, Night-marching, and Night Boat-work between Latitude* 40° *N. and* 60° *N.* With Sketch-maps and Directions for finding the Selected Stars. By Dr. J. D. White. Pp. 32. (London: J. D. Potter, n.d.) Price 1*s*.

(2) *The Stars as Guides for Night-marching in North Latitude* 50°. By E. Walter Maunder. Pp. 72. (London: Charles H. Kelly, 1916.) Price 2*s*. net.

MOST persons who spend any considerable time out in the open during the night not only may at times admire the splendour of the vault of heaven on a clear night, but also learn to recognise the principal features of stellar distribution, and even gain familiarity with the effects of the diurnal and annual apparent motions. Such first-hand knowledge may perhaps be somewhat vague, but a little tuition can render it precise and useful. The necessities of the present time have emphasised one practical application. The heavens encircle the sky-line as with a vast compass-card that with a little skill he who runs may read. We have before us two little books, both written with the identical intention of facilitating the employment of this compass. The only difficulty arises in middle latitudes from the rotation of what is termed in old books the oblique sphere. This difficulty is surmounted in both in the same way, namely, that recently advocated by Lieut.-Col. Tilney, which requires that the progressive true bearings of a few selected conspicuous stars shall be provided. The two books present the data very differently.

(1) In "Steering by the Stars" the true bearings are tabulated for twenty guide stars for five different latitudes, and for each hour of sidereal time linked to G.M.T. by an auxiliary table. The bearings are given in whole degrees clockwise from N=0° to 360°. By some curious accident the bearing of Spica at setting is twice given incorrectly (pp. 17 and 23). The sketch-maps showing the selected stars are too small to be useful, but probably those whom this very practical book may assist already know the stars.

(2) In "The Stars as Guides" the data, prepared solely for latitude 50° N. and referred to local time, are introduced in descriptive text, gathered in tables, and, again, shown in map form, always subdivided in a way to help assimilation. Separate tables for the eight chief compass bearings give the day of the month for each hour of the night at which the guide stars come on the bearing. The twenty-four maps are the chief feature of the book. The stars are boldly shown in white on a black ground, plotted on bearings (both compass-card and angular). The year is divided into six bi-monthly periods on six series of maps. Each series contains four maps showing the stars in the N., E., S., and W. The apparent paths of sixteen guide stars are represented, with hourly positions marked. The use of the maps is straightforward and is explained on one page of the book. We have noticed only a single slip. Aldebaran is not at the *point* of the Hyades.

The theory is simple; accidents of topography are complications even on the best starlit nights. There is no doubt that a continent might be crossed with the aid of the stars, but a night-march from, let us say, Balham to Fulham might be fraught with unpleasant surprises if sole reliance were placed on stellar guidance.

H. E. GOODSON.

GENERAL CHEMISTRY.

(1) *A Senior Experimental Chemistry.* By Dr. A. E. Dunstan and Dr. F. B. Thole. Pp. xiii+522. (London: Methuen and Co., Ltd., 1916.) Price 5*s*.

(2) *A Class-book of Chemistry.* By G. C. Donington. Part iv., *Metals.* Pp. vii+401 to 534. (London: Macmillan and Co., Ltd., 1916.) Price 2*s*.

(3) *Physical Chemistry for Schools.* By Dr. Henry Hortsman Fenton. Pp. viii+215. (Cambridge: At the University Press, 1916.) Price 3*s*. 6*d*. net.

(1) YET another text-book of inorganic chemistry! This one is intended for "boys in the upper forms of secondary schools and students in technical institutes." It will be found useful by many others also. It is difficult nowadays to present a systematic course of inorganic and general chemistry with any novelty, nor is the ground covered by the present book very different from that covered by others. What is characteristic is the experimental nature of the treat-

ment. Although the course is systematic the endeavour has been made, and made with considerable success, to bridge the gap which too often, unfortunately, separates the lecture from the laboratory. The book is written on the sound principle of uniting the lecture and the laboratory, and for that reason it will probably earn a place for itself among chemical manuals.

(2) This is the fourth and concluding part of the late Mr. Donington's well-known "Class-book of Chemistry." It contains a more extensive and detailed treatment of metals than that already given in an earlier part. The descriptions are lucid, and numerous illustrative experiments have been inserted. The concept of ions in solution, and of reversible reactions, are early introduced, and good accounts are given of electro-chemical processes of extraction and refining. The earlier parts have rendered useful service to the teaching of elementary chemistry, and the present volume is up to the level of those previously issued.

(3) Dr. Fenton's book is significant in being the first serious attempt to deal with a problem of importance—namely, that of introducing a certain amount of instruction in physical chemistry into the school curriculum. Hitherto physical chemistry has suffered not a little from the general impression that it is only for those who possess a more or less advanced knowledge of mathematics. The present work ought to do much to remove this erroneous impression. Of course, one has to bear in mind the immaturity of the pupil, and there are aspects of the subject which should not be attempted. There is no reason, however, why the elements of the kinetic theory and its simpler applications should not be taught. Thermodynamical relations, in the reviewer's opinion, are much too abstract to be dealt with adequately at this stage. This is exemplified in one or two places in the present work, where an attempt is made to deal with them. Thus on p. 25 the logarithmic expression for work done in the expansion of a gas is given, but it is not pointed out that this is the *maximum* work, and that as a matter of fact the work might be anything from zero up to this limit. This would necessitate an account of what is meant by maximum work, and this in turn a statement of what is meant by thermodynamic reversibility. No mention of these points is made, although on p. 169 the term "maximum work" is used in connection with the calculation of the p.d. of an electrode. The greater part of the book is of course devoted to kinetic molecular conceptions, and the treatment is highly successful. The concluding chapter on technical applications is of special importance, as it will serve to do away to a certain extent with another very erroneous idea about physical chemistry, that it has nothing to do with practical problems. As a matter of fact it has everything to do with such problems, and the attempt to inculcate this upon the youthful mind is as praiseworthy as it is necessary.

W. C. McC. L.

INDUSTRY AND COMMERCE.

(1) *Factories and Great Industries, with some Account of Trade Unions, Old-Age Pensions, State Insurance, the Relief of Distress, Hospitals.* By F. A. Farrar. Pp. 90.

(2) *Trade and Commerce, with some Account of our Coinage, Weights and Measures, Banks and Exchanges.* By A. J. Dicks. Pp. 94.

(3) *Ships, Shipping, and Fishing, with some Account of our Seaports and their Industries.* By G. F. Bosworth. Pp. 86. (Cambridge: At the University Press, 1916.) Price 1*s.* 6*d.* each.

THESE three books are the first of a series which is designed to give children information on the industrial and commercial condition of their own country. They deal, generally on historical lines, with the nature of the principal industries, with the machinery of commerce, and with the development of shipping; while forthcoming volumes are announced on agriculture and mining.

The first volume under notice contains brief accounts of the Industrial Revolution; the textile industries; leather, paper, and printing; some great manufacturing towns; trade unionism; factory legislation; and provision for unemployment, sickness, and poverty. The second describes weights, measures, and the coinage; the Post Office; food supply; imports and exports; banking and exchange; trade marks, patents, limited liability, underwriting, the customs and excise. The third volume traces the growth of the ship from early times; the mercantile marine and the great ocean highways; the Royal Navy and its dockyards; the fishing industry; Lloyd's and its work; Trinity House and the lighting of the coast; the Port of London and other great ports. The writing is simple without being very inspiring; the books are well printed on good paper; and each volume contains some twenty illustrations, comprising half-tones, line drawings, and maps.

The series is suitable for boys of fourteen years of age or thereabouts, and the books may be used as supplementary readers in the upper classes of elementary schools and in the lower classes of evening schools. It is to be welcomed as supplying just that information which is necessary to create a sane outlook upon the problems of industry and commerce which, as citizens, boys will be called upon to exercise judgment. It is no use treating citizenship as a collection of ethical principles tacked on to a description of representative government and the administration of justice. The deeper problems of politics are even now, and to a still greater extent in the future will be, technical problems, requiring for their comprehension an adequate knowledge of the way in which this industrial system of ours has come into being, and a general sense of the direction in which it is tending.

Our only fear is that the price of the books will lead to their being used singly, and the pupils will obtain only a partial view. The whole series will be equivalent to a single volume of about 120,000 words, but will compare unfavourably with such a volume in unity and coherence. It is unfortunate that there is so much freedom of choice and so narrow a range of price in books for elementary schools; for unless we can have a more definite practical aim in this and other types of education we must expect variety of training and outlook to give us a babel of tongues instead of a clear, resonant voice upon matters of national welfare.

OUR BOOKSHELF.

The Thermodynamic Properties of Ammonia. Computed for the use of Engineers from new experimental data derived from investigations made at the Massachusetts Institute of Technology. By F. G. Keyes and R. B. Brownlee. Pp. v+73. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 4*s.* 6*d.* net.

THIS book contains the results of an experimental investigation carried out during the course of several years in the Research Laboratory of Physical Chemistry of the Massachusetts Institute of Technology. The object of the research has been to determine the vapour-pressure curve and the specific heat-capacity of liquid ammonia and the isotherms of the substance, so that the already existing data might be critically examined and supplemented and the results obtained used as a basis for the computation of a new table of the thermodynamic properties of ammonia which would prove useful in controlling the performance of refrigerating machines.

The first part of the book deals with the fundamental thermodynamic relations and a discussion of the data and the computations. The various formulæ involving the relations between the entropy, Gibbs's heat-function, the latent heat, the specific heats along the saturation line, the ordinary specific heats, etc., are obtained and tabulated for convenience. There are discussions on the methods employed to calculate the heat of vaporisation, the specific heat of liquid ammonia, and the entropy and specific heat of ammonia vapour.

The second part of the book gives some forty pages of tables, in which the thermodynamic properties of the saturated and superheated vapour are given with the temperature as independent variable in one set and the pressure in another. A Mollier diagram, in which heat-content is plotted against entropy, is added at the end of the volume.

The book should prove of the greatest service in engineering practice, especially for those who have to deal with refrigerating machines. The tables are given in a very convenient form, and the explanatory matter at the beginning is adequate and lucid. J. R.

The Journal of the Institute of Metals. Vol. xv. Edited by G. Shaw Scott. Pp. viii+392. (London: Published by the Institute of Metals, 1916.) Price 21*s.* net.

THIS volume contains the papers presented at the annual meeting of the institute, with the discussion and correspondence to which they gave rise, together with abstracts of papers relating to the non-ferrous metals and the industries connected therewith. Among the papers is the Third Report to the Corrosion Committee, of which an account was given in NATURE on April 6. The paper by Mr. Withey on the analysis of aluminium and its alloys is a very good piece of work which will probably constitute the standard of reference for some years. The aluminium of to-day is liable to contain copper, iron, zinc, silicon, silica, nitrogen, and sodium. It contains notably more copper than the metal produced ten years ago, but in other respects is a purer metal.

Prof. Stansfield's paper on electric furnaces as applied to non-ferrous metallurgy contains much interesting and valuable information. Furnaces are classified under two main headings: (*a*) those in which metals are reduced from their ores; (*b*) those in which metals are heated, melted, refined, and distilled. The former are electrolytic furnaces, and are used for the production of metals by the electrolysis of their fused salts. Aluminium, sodium, potassium, magnesium, calcium, barium and strontium are produced largely, if not exclusively, in this manner; and other metals, such as zinc, are occasionally so obtained. The latter are electrothermic smelting furnaces, and are used for the production of metals from their ores with the aid of electrically generated heat. Occasionally the metal is present in the ore in the native state, but usually it is found as an oxide or other chemical compound, from which it must be liberated by a chemical reaction involving the use of carbon or some other reagent in addition to the necessary electrical heat.

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.*]

Science in Education.

WE hear much of the place of science in education, but it seems sometimes as if its advocates would say: "When I mention science I mean experimental science, and not only experimental science, but industrial science, and not only industrial science, but paying science"—to paraphrase Thwackum.

Let us look at the French conception of science, as summarised in two fat volumes describing its progress in France, for the San Francisco Exhibition. In one volume are philosophy, sociology, education, mathematics, astronomy, physics, chemistry, mineralogy, geology, palæontology, biology, medicine, and geography. In an equal volume are Egyptology, classical archæology, history, art, linguistics, Indics, Sinics, Hellenics, philology (Latin and Celtic), French language and literature, Italian, Spanish, English, German, law, and economics.

Now, this is what science means to France. How shall we give it honour here? The study of man holds as large a place as the study of Nature. And in this study of man language is the servant, and not the exclusive master, as it has been made in England.

One of the first steps required seems to be to put the study of man in its place as part of the essential education for all, quite independent of the minority who specialise in dead languages. We need to teach in every school the course of civilisation, its successes and its failures, the grandeur of the characters and thoughts which have stimulated action, to show man as the most potent and ruling influence upon Nature. At present, to even the small minority who master dead languages for effective use, most of the literature is unknown, and the physical facts of civilisation are ignored. The time spent in general education upon dead languages—mostly ineffective—would suffice for a fair acquaintance with both man and Nature, if practically used. F.R.S.; F.B.A.

The Third Fossil Tsetse-Fly.

AMONG some fossil insects collected in the Miocene shales of Florissant, Colorado, by Mr. Geo. Wilson, and transmitted to me by Mr. F. H. Ward, I find a beautifully preserved tsetse-fly. The insect is intermediate in size between the two fossil species previously found (both of which may be seen in the British Museum), and is evidently distinct. It may be called *Glossina veterna*, n.sp., and will be best distinguished by the following measurements in millimetres: length 12·5, length of wing 10·9, length of proboscis 4·1, length and width of abdomen each 5·6. The body and legs are brown or black, the abdomen without dark bands; the wings are hyaline, faintly brownish. The scutellum has long marginal and apical bristles, exactly as in the living species. The post-alar and first dorso-central bristles are also well preserved and normal. The anterior basal cell of the wing is about 0·6 mm. broad at end, its truncate apical end is short, and the lower margin does not bulge much near the end. The abdomen is hairy, as in living species. This excellent specimen affords additional evidence for the existence of two tsetse-flies in the American Miocene, astonishing as the fact is. The new species is nearest to *G. osborni*, but is too large to be the female of that form.

T. D. A. COCKERELL.

University of Colorado, Boulder, August 31.

The Designation of Hours.

A PROPOS the alteration of official time, now imminent: would it not be a good plan to suggest a modification of time nomenclature? As follows: Midday is 12 noon; well and good. Half an hour later is 12.30 p.m., and we have the confusing spectacle of 11.30 p.m. arriving eleven hours *afterwards*! I suggest, as long as the 24-hour system is followed, that each 12-hour cycle be definitely marked off. Thus half-past 12 (day-time) would be 0.30 p.m., to be followed, quite logically, by 1 p.m., 1.30 p.m., etc., up to 12 p.m. Half-past 12 at night would be 0.30 a.m. Comparison could then be made with the 24-hour system, unless indeed the powers that be are foolish enough to label the first half-hour of each new day 24.30 a.m.—to be followed by 1 a.m. C. H. COLLINGS.

3 Tollington Place, Tollington Park, N.,
September 18.

ARCHÆOLOGY OF THE MIDDLE AMERICAS.[1]

THE work before us is the third volume of a series devoted to the archæology of the Latin Americas, in which the author contrives to give a general account of this enormous field, mainly based upon a widely scattered and not always easily accessible literature, from the earliest Spanish chronists to the present plethora of Americanists. There are few readable works which take a wider and more scientific view of the main questions, whilst the flood of the more professional publications deals with smaller areas and often intensely with abstruse detail of one or other of the numerous problems.

In this quarter of the globe, from Mexico and the Antilles, and extending far down in western South America, a peculiar and unique kind of civilisation developed, and culminated in two widely separated centres, not in the steamy-hot tropical lands, but literally above them, in the uplands, where a more invigorating climate still repaid agricultural toil. Having dealt first with the Mexican-Maya civilisation, which has spread its influence in ever-weakening waves down to Panama, the author devoted his second volume to South America, the civilisation of which centred in the Peruvian highlands.

FIG. 1.—Greater Antilles: Wooden idol. (Scale, one-sixth.) From "Central American and West Indian Archæology."

Having first treated these north and south centres, with their radiating influence into the Middle Americas, he has shorn these by anticipation. From a broad point of view the present volume could therefore deal only with what was left over, and this residue is of minor importance, since it applies to peoples with a civilisation not exactly degenerate, but approaching the original stratum, which had not risen to anything great of its own.

[1] "Central American and West Indian Archæology: Being an Introduction to the Archæology of the States of Nicaragua, Costa Rica, Panama, and the West Indies." By T. A Joyce. Pp. xvi+270.—(London: Philip Lee Warner, 1916.) Price 12s. 6d. net.

The first and larger portion of the book deals with the archæology, ethnology, linguistic divisions, habits, and beliefs of the ancient inhabitants of the present States of Nicaragua, Costa Rica, and Panama. The people belong to the same stock, with modifications, which stretched from the Sonoran region through the whole of Central America far into the western—let us say Andine—portion of the southern continent, leaving the bulk of the latter to what may be called the typical neo-tropical races, notably Guarani, Tupi, Arawak, and Caribs. In conformity with the configuration of the isthmus, the influence from the Inca centre was insignificant in comparison with that from the Maya-Mexican. It is the reverse with the fauna and flora, which naturally date from much earlier epochs with broader contact.

The last hundred pages are devoted to the West Indies. These fairest and most fertile islands being subject to earthquakes, volcanic eruptions, and hurricanes, it is, according to our author, not surprising that their inhabitants developed a religious system which consisted in the main of a propitiation of the powers of Nature. Nevertheless, according to the testimony of C. and F. Columbus, father and son, they seem to have been a kindly, honest, and generous folk, to whom contact with the Spaniards meant speedy extermination.

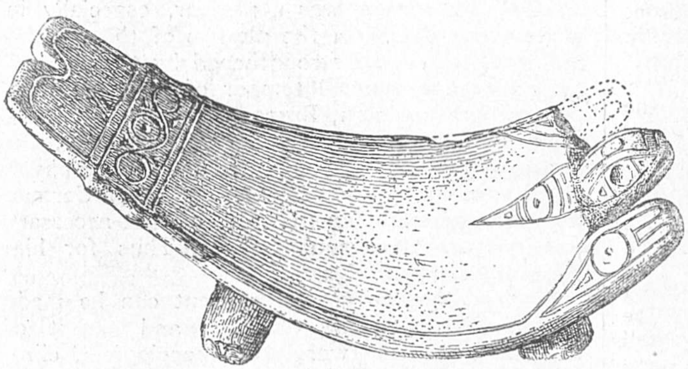

FIG. 2.—Porto Rico: Stone seat. (Scale, one-third.) From "Central American and West Indian Archæology."

The original stock of the whole archipelago were Arawaks from the southern continent, and were in turn followed by the more bellicose Caribs, who at the time of their discovery were in possession of the Lesser Antilles and fast extending into some of the greater islands. They had a patriarchal system, with caciques or small chiefs. A tie of friendship was the mutual exchange of their names. They practised the couvade. The Arawaks were armed with sword-clubs and javelins, hurled by means of ornamented spear-throwers. The chief weapon of the Caribs was the bow. The male prisoners were eaten. There is no evidence that stone weapons were used, the blades of stone found being tools. Charms were made of wood and stone, images of man and animals. Interesting are the stone collars which are said to be the translation into stone of originally a wooden hoop, a tree-fork bent and fixed by bandages into this shape. The enclosing of a spirit in such a circle is connected with tree-worship. Beautiful stone collars are found also in the Maya-Mexican countries.

But there is very little known about such and similar curiosities beyond the often gratuitous accounts of the old chronists, and the same applies to the beliefs and habits of these vanished people. Some are no doubt of genuine indigenous origin; others point to the western or to the southern mainland, just as one would expect. Since these islanders used dug-outs, large enough for even long voyages, it is not surprising that their kind of civilisation—as shown by their weapons, ornaments, stone masks, figurines, pottery, etc.—was more or less alike all over the archipelago.

THE ABNORMAL PROPAGATION OF SOUND BY THE ATMOSPHERE.

MR. S. FUJIWHARA has recently published a second valuable memoir on the abnormal propagation of sound-waves in the atmosphere (Bull. Centr. Meteor. Observatory of Japan, vol. ii., 1916, pp. 1-82). As in his previous paper (NATURE, vol. xcii., 1914, p. 592), he ascribes the peculiarities investigated to variations of the air-temperature and of the velocity and direction of the wind, and he concludes that the structure of the upper atmosphere may be inferred from the form of the region of audibility.

The present memoir consists of two chapters. The first is theoretical, and deals with the modes of propagation of sound-waves through the atmosphere, the structure of which may be one of the five types observed by Capt. C. J. P. Cave at Ditcham Park, Petersfield, Hants. He shows that the region of audibility, including the sound-source (or proximate region), may in many cases be of triangular, or rather fish-tail, form, the axial direction of which may be not only in the direction of the wind then prevailing, but also in any other direction, at right angles or even opposite to that of the wind; for it depends chiefly on the direction of the wind in the lower stratum of the atmosphere with respect to that at the earth's surface. In other cases the proximate region may assume a spiral form, with the vertex at the source of sound and extending in the sense of the veering of the wind in the upper atmosphere. The regions of audibility due to winds at different heights may overlap one another. Detached regions of audibility may appear in a zone subtending an angle of less than two right angles at the sound-source, and they may be of any form. If the wind remains steady in direction and velocity in the upper layers, or if there is a decrease in velocity in the upper atmosphere, detached regions should not occur. With an increase of velocity in the upper atmosphere, detached regions may occur in the same direction as the proximate region. But if there should be a reversal or great change of direction in the upper layers, or if the upper wind should blow from a distant low-pressure centre with frequent reversal in the lower layers, detached regions should be more often present than absent.

In the second chapter Mr. Fujiwhara compares his theoretical investigations with the results of sixty-five explosions during the years 1912 and 1913, for the most part those of the Asama-yama, in Central Japan. These show that the axis of the region of audibility may or may not agree with the direction of the wind at a moderate height; that in some cases the regions of audibility are triangular or spiral in form; that detached regions may occur on the same side of the source, while sometimes a very large detached region may be found in company with a very small one at the source; and, lastly, that detached regions of audibility and a silent region may appear in any direction and at any distance according to the prevailing condition of the weather. In Japan the monsoon exercises a powerful influence on the propagation of sound-waves in the atmosphere, and this accounts for the observed differences in summer and winter. In summer the formation of the detached region of audibility is rather common, and takes place towards the west or south-west of the source, while in winter the phenomenon occurs more rarely and is then caused by an approaching cyclone. C. DAVISON.

SIR LAUDER BRUNTON, BT., F.R.S.

ON the 16th of the month this distinguished physician passed away after a long illness, borne with rare fortitude. Although retired from private practice, Brunton was far indeed from retirement in respect of those public causes to which, with the pious tenacity of his race, he devoted much of his life, and a fervour almost religious in its depth and constancy. Some weeks before his death the present writer had visited Lauder Brunton, and witnessed both the distress under which he laboured and the ingenious methods he had devised for keeping the evil at bay; not in the desire of a mere prolongation of life, though this indeed were no unworthy intention, but in order to cherish the fire of its last embers for those humane ends which he had so ardently at heart. It was therefore with admiration that, about three weeks before his decease, the writer received from his friend now silent a long and important letter covering certain documents and proposals on the subject of physical education, a movement to which, in his later years, Brunton had given no little energy and guidance, especially for the sake of children and young people, and which he was pressing forward almost with his latest breath. Fortunately, he has worked with comrades and assistants who will not fail to keep his lamp alight, nor let any of his last counsels be forgotten.

At St. Bartholomew's Brunton proved to be not only a distinguished man of science, but also of much accomplishment and success in the practice of his art. Like James Goodhart of Guy's, who died but a short while before him, he won the faith and attachment of a large *clientèle* by merit pure of all self-seeking. Although these great teachers were not quite alike in the ways of their medical observation, yet to the particular skill of each were added kindliness of heart and an earnest sympathy which won the confidence of the sufferers who sought their aid. If Brunton had not the imposing personal presence of certain eminent physicians of the past, no one could speak with him without being affected by his gentle, persuasive enthusiasm, and that faith in his art and in mankind which engendered alike faith and hope in those who only too often sorely needed these blessings.

Lauder Brunton was one of the first of the scientific practising physicians who used no empirical remedies without seeking to discover their mode of action, and by pharmacological and other research endeavoured to add to their number. Bence Jones, Golding Bird, Pavy, were of the generation before him, it is true; but few physicians whose interests before all else were, and still remained, clinical, had likewise followed scientific investigation so systematically and in so disinterested a spirit. Moreover, in his particular departments of science Brunton was a pioneer, especially in pharmacology and in the physics of the circulation. With a mind strengthened by the seriousness and philosophical temper of his great university of Edinburgh, Brunton, after graduation, spent two or three years in foreign study, for the most part in Germany; and no British physician had a better knowledge than he of German teachers, German industry, and of that necessary condition—the German tongue. Thus for him the war was full of sadness.

In this brief tribute no attempt can be made even to indicate the character and extent of Brunton's scientific work, pharmacological, clinical, and hygienic. His contributions are only partially presented, indeed, in the two or three portly octavos in which many of them were recently reprinted. But if to the chief or to the more familiar of his works some allusion may be made, it would be to his researches with Fayrer into venoms—a successful attempt to clarify a very ancient and chequered story, as the historian of medicine well knows; to his part as one of the Commission which reported on Pasteur's treatment of hydrophobia; to his services on the Hyderabad Commission on the effects of chloroform, by which, if its results were doubted in some quarters and in others enlarged, nevertheless the whole problem was raised to the plane of its infinite importance; to his work on tuberculosis, which was informed by the spirit of a social prophet; and to his researches on the dynamics of the circulation. Herein he made the beneficent discovery of the nitrites as palliative, or better than palliative, in that awful malady angina pectoris, a discovery deserving to rank with that of Peruvian bark in the cure of ague. If, as the present writer has remarked elsewhere,[1] the discovery arose accidentally from

[1] "Diseases of the Arteries," 1915.

the use of a graphic curve which betrayed the inadequacy of the sphygmograph to follow the finer movements of the artery, yet how many brilliant discoveries have arisen from accidents of manipulation or interpretation! To have discovered the means of controlling one of the most cruel ills to which man is subject is perhaps the laurel wreath amid the many memorials of one who, in his humanity, would have prized this above all rewards.

By academic and official decorations Lauder Brunton was richly distinguished; but perhaps, in his loyal and patriotic heart, the honour of none of these was to be compared with the glory of his younger son, a promising Cambridge medical graduate, who last year gave his life on the field of battle for his country—a glory, but also a sorrow which, falling but a brief five years after Lady Brunton's death, deepened the shadows of his latter days. Happily his elder son, also on military service, and his devoted daughters were still spared to him. C. A.

The death of Sir Lauder Brunton on September 16, in his seventy-third year, has deprived the world of a great physician, and brought sorrow to a wide circle of friends. Largely by his vivifying studies and teaching, pharmacology has become a definite branch of science. Practical medicine depends on physiology, pharmacology, and pathology, and all three tend more and more to become subdivisions of the all-embracing science of chemistry. In no departments of the healing art is the influence of laboratory methods more apparent than in those directed to the study of disorders of digestion and diseases of the circulation; and in both these directions Sir Lauder Brunton was a pioneer worker. He had the clearest conceptions of clinical facts, and possessed to an unusual degree the practical quality of being able to apply extensive knowledge of physiological medicine to the work of the hour. His stimulating personality will be widely missed by his professional brethren as well as by many who have benefited by his work and advice.

Thomas Lauder Brunton was born at Hiltons Hill, Roxburgh, in 1844, and received his medical training at the University of Edinburgh, where he had a distinguished academic career, and graduated M.B., C.M. with honours in 1866, receiving also the gold medal for his thesis. In the following year he became B.Sc., in 1868 he obtained the M.D., and two years later the D.Sc., in the meanwhile having also studied at Paris, Vienna, Berlin, and Leipzig. Settling in London, he became lecturer on materia medica at the Middlesex Hospital in 1870 and assistant physician at St. Bartholomew's Hospital in 1875, to which school he remained attached as lecturer, physician, and consulting physician.

Early in his career Brunton's inclinations leaned towards the scientific side of medicine, and at the early age of thirty he was elected F.R.S. in recognition of his admirable work on the physiology of digestion and secretion, on the chemical composition of the blood, and on the actions of the two drugs, digitalis and mercury.

Brunton's post at St. Bartholomew's carried with it the lectureship on materia medica and therapeutics, and he turned his attention to the effects of medicines and instituted many experimental investigations on the actions of drugs upon himself and upon animals. In 1885 he published his well-known book on "Pharmacology, Materia Medica, and Therapeutics," which passed through many editions in this country and abroad. This appeared at an opportune moment, and largely owing to his work and writings pharmacology became separated from materia medica and established as a branch of physiology.

In 1886 he was appointed a member of the Commission to report upon Pasteur's system of inoculation for hydrophobia, and in 1889 a member of the Nizam of Hyderabad's Chloroform Commission. For the latter a considerable amount of experimental work was carried out and a valuable report issued, though no very definite conclusions as to the action of chloroform were arrived at. In the meantime, Brunton had become one of the best-known consulting physicians in the country, and in the art of treatment he was most resourceful. He introduced a new class of remedies, the vaso-dilators, into medicine, and by the use of amyl nitrite for angina pectoris was the first to employ a remedy because its physiological action was opposed to the pathological condition existing in this disease, viz. rise of blood-pressure.

In 1900 he was knighted, and nine years later was given a baronetcy, and he was the recipient of many honours from universities and societies at home and abroad. He was also Gulstonian and Croonian lecturer and Harveian orator of the Royal College of Physicians of London. Several works emanated from his pen, notably the "Introduction to Modern Therapeutics," illustrating the connection between the chemical structure and physiological action of drugs, "Disorders of Assimilation," and "Therapeutics of the Circulation."

Sir Lauder Brunton, outside his professional work, was keenly interested in all schemes in favour of national health, of school hygiene, of physical culture and military training, in the furtherance of which he gave bountifully of his time and energies.

NOTES.

GEOLOGISTS will regret to hear of the death of Mr. R. J. L. Guppy at his home in the island of Trinidad on August 5, and within a few days of celebrating his eightieth birthday, Mr. Guppy having been born in London on August 15, 1836. In early life he qualified as a civil engineer, and afterwards travelled through Australia, Tasmania, and New Zealand. On joining his family in Trinidad in 1859, he took part in the construction of the Cipero Railway, but later becoming interested in the educational work of the colony, he was appointed Chief Inspector of Schools. Mr. Guppy, however, will be better remembered for his researches on the geology of Trinidad and the other West Indian islands. On this subject he contributed upwards of fifty papers, several of which were published by the Geological Society of London. He accumulated a great knowledge of the Tertiary faunas of that region, and did much towards rendering a correlation of the various horizons represented. His earlier memoirs dealt with the San Fernando deposits of Trinidad containing Orbitoidal and other fossils, which at first he regarded as of older Miocene age, but which afterwards he more correctly assigned to the younger Eocene or Lower Oligocene. He was always an ardent student of natural history, being particularly interested in the recent and fossil mollusca, and was also an authority on the rich deposits of petroleum which have made Trinidad so famous. Some years ago he was instrumental in acquiring for the British Museum the second largest known Pleurotomaria, possessing a height of 150 millimetres, which was discovered off the island of Tobago. Mr. Guppy was a corresponding member of the Zoological Society of London, and of the New York and Philadelphia Academies of Science. He had served as president of the Scientific Association of Trinidad, and was the first presiding officer of the Royal Victoria Institute Board. Much work yet remains to be accomplished among the Tertiary rocks of Trinidad, as many of the geological horizons are still in confusion and imperfectly understood; but whatever is attempted in the future, there is no doubt that Mr. Guppy's valuable memoirs will always furnish us with an important basis for later investigations on so interesting a subject.

MR. E. G. KENSIT, who fell in action at Delville Wood on July 17, was a great-nephew of the late Dr. Harry Bolus, and became a member of the staff of the Bolus Herbarium in the Botanical Department of the South African College in 1912. In August, 1915, he enlisted in the South African contingent for service overseas. After a period of training at Potchefstroom, he was sent to Egypt, and served through the Senussi campaign. The circumstances of the death are described in the following extract from the *Cape Times* of August 30:—"On the colonel of his regiment calling for a volunteer for the purpose of reconnoitring the enemy's line and securing certain information, Kensit was among those who stepped forward, and his offer was accepted. He was seen to be hit as he crawled away, but he continued with his task, and after an interval crept slowly back, hampered by his wound. On reaching the parapet he was assisted to surmount it. He was able to give the officer all the information that was wanted, but he had no sooner done so than he rolled over—dead."

WE regret to learn that Mr. Gustav Mann died at Munich on June 22, in his eighty-first year. To him we owe our knowledge of the botany of the Cameroon Mountain, for he was the pioneer of botanical exploration in this region when he was attached to Dr. Baikie's Niger Expedition in 1859 as botanical collector for Kew. He ascended Clarence Peak, in Fernando Po, and made extensive collections of plants from the mountains of western tropical Africa, which have been described in papers presented to the Linnean Society. He then went out to India, and after serving for a year as assistant in the Government cinchona plantations was transferred in 1864 to the Bengal Forestry Department. From 1868 he served in Assam, and in 1882 was appointed Conservator of Forests, which position he held with distinction until his retirement in 1891.

WE learn from the *British Medical Journal* that Lieut.-Col. G. M. J. Giles, Bengal Medical Service (retired), died at Plymouth on August 24, aged sixty-two. In his early service he spent some years as surgeon naturalist in the Indian survey ship, the Royal Indian Marine steamer *Investigator*, and in 1886–87 accompanied the late General Sir William Lockhart on an exploring expedition in the Pamirs. He was the author of works on kala-azar and beri-beri, mosquitoes, climate and health in hot countries, and tropical climatology.

A FEDERATION of British Industries has been formed to provide a body capable of representing the interests of the British manufacturing and producing industries. The objects of the federation may be summed up briefly as the organisation and development of industry now and after the war, in co-operation with labour and in conjunction with the Government and Government departments. The federation will at once concern itself with the reconstruction of British trade after the war; the development of sources of supply of raw materials; and questions arising out of the transition from war to peace, such as measures to mitigate possible unemployment during that period. Every effort is to be made to ensure that in future no important action affecting British industry shall be taken by the Government without due weight being given to the views of manufacturers. A condition of membership is an annual subscription of 100*l*. a year, with an obligation to continue such subscription until June 30, 1919. Mr. F. Dudley Docker, C.B., is the president of the federation.

THE recently issued report (Cd. 8346) of the Committee on Financial Facilities for Trade to the President of the Board of Trade recommends the establishment of a British Trade Bank, constituted under Royal Charter, to fill the gap between the home banks and the Colonial and British-foreign banking houses, and to develop facilities not provided by the present system. It is proposed that the bank should have a capital of 10,000,000*l*., and should, among other activities, inaugurate an information bureau, co-operate with merchant and manufacturer, and become a centre for syndicate operations. The bureau, it is suggested, should be independent of the Commercial Intelligence Branch of the Board of Trade, and would not necessarily deal only with schemes in which the bank proposed to take financial interests, but might be made a centre for the investigation of other projects. The report urges that if financial assistance is given by the Government to undertakings in connection with what are known as "key" industries, the business should be done through the new bank. The committee thinks that such a bank would, with efficient management, not only be a great boon to British trade, but also should prove a commercial success.

AN important addition to the art collections of the Philadelphia Museum is reported in the Museum Journal for last March. Mrs. Dillwyn Parrish, of London, has presented five Roman mosaics in memory of her late husband. Of these, the two most interesting specimens from the point of view of size come from Carthage; the other three, smaller, but charming, examples, are said to have been obtained in Rome. The Carthage mosaics are examples of *opus vermiculatum*—cubes of marble or other material disposed so as to attain to a pictorial effect. One of the Italian pieces, representing a duck, has much in common with some of the mosaics found in the House of the Faun in Pompeii. Another, considerably later in date, represents two griffins facing an urn, and is an example of the stiff, conventional, unimaginative work of the second century A.D. On the other hand, the lack of imagination is in some degree made up by the great technical skill shown in the treatment of the griffins, the colour being obtained by the use of cubes of opaque glass applied to the wings and tongues of the beasts.

THE deficiencies of modern India in the matters of house building and sanitation are a cause almost of despair to the authorities. No problem is so difficult as that of sanitation, because the official runs the constant risk of offending some religious or social prejudice. But it is not because their own writers have neglected the subject that the present condition of things has arisen. In the June issue of the Journal of the Bihar and Orissa Research Society Dr. Mahamahopadhyaya Ganga Nath Jha has collected the ancient Sanskrit laws on the subject. They deal with the sanitation of houses, and provide minute directions on the right uses of food and drink. Much of this is, no doubt, academic, and the rules on these subjects are the speculations of philosophers which in many cases could not have been brought into actual practice. But many of them are judicious, and may help the officer of health in preaching the value of sanitation. The pandit ends by saying:—"From the above it will be seen that the old people of this country knew and practised many laws of health and sanitation which have been forgotten, with results that all deplore."

THE *Indian Journal of Medical Research* for July (vol. iv., No. 1) contains several important papers. Dr. Soparkar describes a method for cultivating the tubercle bacillus from sputum after destruction of adventitious micro-organisms by treatment with caustic soda. Dr. Agnes Scott writes on osteomalachia, and Major McCarrison, I.M.S., describes the successful experimental production of congenital goitre in goats by feeding them with cultures of micro-organisms grown from the fæces of goitrous individuals (goats). He concludes, therefore, that congenital goitre is due to the action on the fœtal thyroid of toxic substances derived from the maternal intestine.

ON July 29, 1915, the Government passed the Milk and Dairies (Consolidation) Act, 1915, which consolidated in one Act the 1914 Bill and previous Acts of Parliament. The Act, however, does not come into force until such date as the Local Government Board may by Order appoint. As the Bill was passed by mutual consent of all sections of both Houses, it cannot be expected to include far-reaching improvements in the milk supply. It does, however, provide that the Local Government Board may issue "Orders," upon which the success of the Act will almost entirely depend. With the view of defining what may be considered the requirements necessary to improve the milk supply, representatives of the National Clean Milk Society, the Society of Medical Officers of Health, and the Sanitary Inspectors' Association have formulated a series of recommendations which have been forwarded to the President of the Local Government Board, and a copy of which we have received. These recommendations have been conceived in a moderate spirit, and their adoption would do much to improve the general milk supply. They do not, however, include a clause prohibiting the addition of skimmed milk to milk, a matter of some importance.

BEFORE the war the United States imported annually from Germany as much as 300,000 tons of potash. The failure of this source of supply has induced the Department of Agriculture to make the experiment of extracting potash from kelp. It is believed that the vast beds of this weed off the coast of California will suffice to furnish all the future needs of the country, and large quantities are already being placed on the market from this source. But, according to *California Fish and Game* for July, fears have been expressed that the cutting of the kelp will have an injurious effect upon the fisheries of the State, and this because of the protection afforded by the weed to the beaches, and the danger of exterminating the clams and spiny lobsters which live more or less within the protection of the kelp. They also fear that the young fish, especially barracuda, which are in the habit of seeking refuge here, will be driven away, and further that such fish as spawn here will similarly be destroyed. These several objections have now, however, been carefully examined, and it is pointed out that the kelp-cutters, or reapers, do not cut below 6 ft., thus leaving ample shelter. It may be, indeed, that the cutting will prove actually beneficial, since it will be less easily torn up by storms. The species of kelp which is thus being harvested is *Macrocystis pyrifera*, a plant which ranges in length from 100 to 300 ft.

IN the *Journ. Agric. Research* (vi., No. 14) Mr. V. L. Wildermuth describes the life-history of a lacewing fly (*Chrysopa californica*). The larvæ of Chrysopa are well known as beneficial insects on account of their habit of feeding on "greenfly" (aphids). *C. californica* lives as a larva for about sixteen days, during which it undergoes two moults, and eats from 74 to 160 full-grown aphids, besides a still larger number of young ones.

AN excellent twenty-page pamphlet by the Rev. Jas. Waterston on "Fleas as a Menace to Man and Domestic Animals" forms No. 3 of the British Museum's Economic Series. The structure and life-history of the insects are described in sufficient detail, and readers are warned of the great danger to be feared from those species which act as carriers of the plague-bacillus between rats and human beings. There are many instructive and illuminating statements, such as an observation quoted from Prof. Osborn, who once collected a teaspoonful of fleas' eggs from the dress of a lady who had been fondling a kitten!

IN the *Entomologists' Monthly Magazine* for August Mr. E. Meyrick publishes a "Note on Some Fossil Insects," dealing particularly with a hindwing, of Upper Triassic age, from Queensland, which has been named *Dunstania pulchra* and referred to the Lepidoptera by Mr. R. J. Tillyard. Mr. Meyrick points out that the nervuration of this hindwing would indicate a highly specialised Lepidopteran type, if the insect to which it belongs were really a moth. As the wing further possesses a corneous margin "altogether abnormal, no other Lepidoptera showing a trace of it," he is inclined, though with some hesitation, to suggest that it must be referred to a Homopterous insect. Incidentally he supports the Lepidopteran nature of Butler's *Palaeontina oolitica*, emphasising its affinity to the family of the "swift-moths" (Hepialidæ).

THE annual report of the Dove Marine Laboratory for 1916 contains an important paper by Prof. A. Meek on the method of estimating the age of fishes by inspection of the annual growth-rings on the scales. This method was extended by Lea, Dahl, and Hjort some years ago in this way: Assuming that the growth-rates of the scale and body of the fish (the herring) are strictly proportional, it ought to be possible to determine the age of the same individual in successive years by measuring the distances between the focal point of the scale and the margins of each of the rings. But application of this method led to some apparently anomalous results, and Lea's conclusions were criticised by Miss Rosa Lee, of the English Board of Agriculture and Fisheries. It appeared as if there was a contraction of growth of scale relative to the growth of the body, and the Norwegian investigators sought to explain this by postulating elimination of the fish exhibiting the more rapidly growing scales. In the publication now noticed Prof. Meek shows that there is not exact correlation between growth of body and of scale; the latter grows at first less rapidly than, then at the same rate as, and finally more rapidly than does the body. Curves of growth are probably exponentials and show this imperfect proportionality. Selection does indeed take place; there is a tendency (in the case of the herring) for fish of the same phase of sexual maturity to shoal together, so that those which are (sexually) younger tend to join with shoals of their own phase, and *vice versâ*. In the same publication Mr. B. Storrow applies the principle to the growth-rate of other fishes.

PROF. E. W. SINNOTT contributes to the *American Naturalist* (l., No. 596) an essay on the "Comparative Rapidity of Evolution in Various Plant Types." He concludes that the most recently evolved members of the North Temperate flora are herbaceous in habit, that herbs tend to be grouped in fewer and larger genera and families than shrubs and trees, and that herbs, with their rapid multiplication of generations, must be "in most cases undergoing evolutionary development much more rapidly than are trees and shrubs." The most ancient Angiosperms were probably woody, and "herbaceous vegetation has made its appearance in comparatively recent geological time."

IN his history of Ethiopian earthquakes (*Boll. Soc. Sismol. Ital.*, vol. xix., pp. 293–350) Prof. L. Palazzo has added to our knowledge of the seismic regions of Africa. His catalogue, which closes with the year 1912, contains 142 entries, all but seven since the beginning of the nineteenth century. He shows that the seismicity of Erythræa is higher than was supposed, and that the earthquakes sometimes attain a destructive intensity, while those which occur near the coast are occasionally accompanied by sea-waves. As to their origin, some are purely volcanic, but the majority he classes under Mercalli's heading of perimetric or intervolcanic.

DR. A. CAVASINO has recently published a valuable memoir on the after-shocks of the Italian earthquake of January 13, 1915 (*Boll. Soc. Sismol. Ital.*, vol. xix., 1915, pp. 219–91). These were recorded at the geodynamic observatory of Rocca di Papa, which is about forty miles from the epicentral area. The earthquake occurred at 7.53 a.m., and, owing to the strength of the shock, all the seismographs in the observatory were suddenly thrown out of action. Within three-quarters of an hour the more sensitive instruments were repaired, including the Agamennone microseismometrograph, the records of which are here considered. The loss of the earlier records of after-shocks is of little consequence, for, at Rome, the seismogram of the principal earthquake obliterated those of the after-shocks, and, moreover, the ground during the first hour was in such a state of continual agitation that individual shocks could not be distinguished. The number of after-shocks registered during the first twenty hours was 302, and during the first six months 1280. Dr. Cavasino considers that the distribution in time of these after-shocks does not follow Omori's well-known law deduced from the after-shocks of the great Japanese earthquakes.

THE Geologists' Association (Proc., vol. xxvii., 1916, p. 1) publishes a beautifully illustrated paper by Prof. Garwood on "The Faunal Succession of the Lower Carboniferous Rocks of Westmorland and North Lancashire," which serves, with its maps, as a guide to a very attractive district, including the high moors of Shap and the picturesque fault-blocks of the Arnside shore. In the same volume (p. 79) Mr. P. G. H. Boswell describes the constitution of the North Sea drift as found across eastern England. His mechanical analyses usefully distinguish this drift from the later Glacial brick-earths; but why does he use such expressions as $\frac{1}{4}$ and 1/100 of a millimetre? The remarkable variety and beauty of the mineral fragments in this mixed material are pointed out by one who clearly loves his subject.

THE "Rainfall of India" for 1914, which is the twenty-fourth year of issue, is collected from the returns published by the various Provincial Governments, and is issued in one volume by the Meteorological Department of the Government of India under the superintendence of Dr. G. C. Simpson, officiating Director-General of Observatories. The volume gives the monthly and annual rainfall, as well as the average rainfall for about 3000 stations in India, from the records taken daily at 8 a.m. The number of rainy days is given, and although the rainfall is measured to hundredths of an inch, a "rainy day" is taken as that on which a tenth of an inch or upwards has fallen, and the normal number of rainy days given in some cases is also calculated on the same assumption. The value of a "rainy day" being ten times as great in India as in England is regrettable, and some adjustment may be found possible when a change is made to meet the registration by the new units of measurement now generally adopted in this country and elsewhere. The normals used for the comparison are those revised to 1910 for the whole of India, and are mostly for at least thirty or forty years.

THE Bureau of Standards of the Department of Commerce of Washington issues a Scientific Paper, No. 286, on "The Determination of Aluminium as Oxide." The author, Mr. William Blum, finds that, to avoid loss of alumina, a hot 2 per cent. solution of ammonium chloride should be used for washing the precipitate, as this facilitates coagulation. Methyl red is used as an indicator of the optimum condition of alkalinity, since it shows a sharp colour change at the desired point. The quantitative reasons for its selection are interestingly stated. The elimination of other substances from the precipitate is considered. A copy of the paper will be sent free on application to the Bureau of Standards.

THE new American journal, *Aviation and Aeronautical Engineering*, contains much of interest, and should prove a successful enterprise, both in the States and elsewhere. The second number is specially worthy of note on account of the scientific nature of the contents. There is an excellent article on "Aviation and Aerography," in which the importance of meteorological research as a help to aviation is strongly emphasised. A short note entitled "An English Photograph of Great Interest" shows a very keen appreciation of the merits of the Royal Aircraft Factory machines, and of their inherent stability. An article on "Steel Construction of Aeroplanes" contains an account of a method of construction which must eventually supersede wood for the larger machines. Perhaps the most interesting item from a scientific point of view is the second part of "A Course in Aerodynamics and Aeroplane Design," written from the Massachusetts Institute of Technology. The authors treat of the elements of aerodynamical theory, and if future articles of the series are as clearly written as that in the present number, they should prove of considerable value to those who need an introduction to the subject.

FROM the reports of the behaviour of the recording instruments at a number of magnetic observatories in different parts of the world during the solar eclipse of August 21, 1914, Dr. Bauer and Mr. Fisk, of the Department of Terrestrial Magnetism, Washington, have drawn some preliminary conclusions as to the effects of eclipses on solar terrestrial magnetism, which will be found in the June number of *Terrestrial Magnetism and Atmospheric Electricity*. At stations from which the eclipse was visible it appears to have changed slightly the daily march of the declination needle. At four British and Danish stations for which curves of the daily change of declination are given the normal motion of the needle to the west was arrested, and in some cases reversed, a short time before totality of the eclipse. Outside the region of visibility of the eclipse no magnetic effects were observed. These results appear to justify more extensive preparations for observing the effects of the solar eclipse due June 8, 1918.

MESSRS. KODAK, LIMITED, have issued a new and much improved edition of their "Wratten Light Filters" (1*s*.), in which they describe some ninety colour screens. Of those previously catalogued eleven are omitted and twenty-nine new filters are introduced, the latter including a series of nine made to equalise the tints of various artificial lights for facilitating photometric work. The transmissions of nearly all the filters are given in very clearly expressed curves, a vast improvement on the reproductions of spectrographs taken with a graduating wedge in front of the slit, as given in the previous editions. For those who need more exact data the actual readings obtained by the use of the spectrophotometer are given in copious tables, and will prove of great value. "The Photography of Coloured Objects," another of Messrs. Kodak's publications, has been revised, and now includes "Orthochromatic Filters," which was until now published separately. For the benefit of any who do not know this volume, we may say that it gives a clear and accurate account of the principles involved, and points out objects of many kinds that are really "coloured," though they do not appear to be.

OUR ASTRONOMICAL COLUMN.

ENCKE'S COMET.—Prof. Strömgren reports that Encke's comet was observed by Dr. Max Wolf on September 22. At 9h. 41·5m., Königstuhl mean time, its position was R.A. 22h. 28m. 39s., declination 7° 8′ 5″ S. The magnitude of the comet was 16·5.

THE NEBULA H II. 78 LEONIS.—It is interesting to note that Mrs. Isaac Roberts is continuing her detailed studies of nebulæ photographed at Crowborough by the late Dr. Isaac Roberts. The subject of a recent paper (Monthly Notices R.A.S., vol. lxxvi., p. 647) is the nebula H II. 78 Leonis (N.G.C. 3367), photographed in 1902. The nebula extends for about 2′ from north to south, and 2·5′ in the direction at right angles, and is described as a left-hand spiral with a bright stellar nucleus. The nucleus is encircled twice by the spiral arm, which shows numerous condensations. With the aid of the Roberts "pantograver," measures were made of many of the bright nebulous knots, and of nineteen stars which appear in the neighbourhood of the nebula. All the measured objects are clearly indicated in a key chart, and the tabulated data will doubtless be of considerable value in subsequent investigations of relative motions within the nebula.

PHOTOGRAPHS OF MARS.—In the September number of the *Observatory* an account of a minute examination of photographs of Mars taken at Flagstaff by Dr. Lowell and his co-workers is given by G. H. Hamilton. The photographs were studied without reference to maps of the planet, and details common to three or more of the images, of which there were sometimes as many as four dozen on a single plate, were inserted in sketches. Subsequent comparisons in all cases showed a very close agreement with the accepted maps in the observatory. One of the sketches, from photographs taken on March 15 of the present year, is reproduced, and shows an abundance of detail, including numerous canals. Mr. Hamilton is of opinion that the linear character of the canals, as represented by Dr. Lowell, is completely confirmed by the photographs. By the use of a finely divided transparent scale, it was found possible to obtain satisfactory measurements of the positions of the principal markings, due allowance being made for halation.

SPECTRUM OF THE NEBULA H IV. 39 ARGÛS.—An account of the spectrum of H IV. 39 Argûs (N.G.C. 2438) has been given by Dr. Max Wolf (*Sitz. Heidelberg Akad. d. Wiss.*, March, 1916). The spectrum was photographed at the Königstuhl Observatory, Heidelberg, on February 20, with an exposure of five hours. The nebula is very faint, and direct photographs show it to be of annular form with an eccentrically situated stellar nucleus; the eastern side of the ring is the brighter, and the nucleus lies nearer the western edge. The spectrum is almost identical with that of the ring nebula in Lyra, but much fainter. In order of brightness the lines are λ 373, 387, 434 ($H\gamma$), 469, 501, and 397; there is possibly also a faint line at 352. As in the Lyra nebula, a distribution of the different gases in layers is indicated by the varying distances to which the lines extend. The line 373 reaches furthest outwards, but has a marked minimum in the interior of the ring. The lines 387 and 434 reach further towards the centre; and, in striking contrast with the other lines, 469 (*i.e.* 4686, of "proto-helium") is brightest within the ring, and extends only a small distance from the nucleus.

THE UNITED STATES NATIONAL RESEARCH COUNCIL.

AN account of the inauguration and organisation of the National Research Council of the United States was published in our issue of August 3 last (vol. xcvii., p. 465), and the article pointed out that from the cordial interest shown by all who had learnt of the work in its early stages, it was evident that so soon as a widespread request for co-operation could be extended it would meet with general acceptance. A preliminary report of the Organising Committee to the president of the U.S. National Academy of Sciences, published in the August issue of its Proceedings, shows that this expectation has been justified, and some of the first instances of co-operation are given. Prof. G. E. Hale, chairman of the committee, has also sent to the *New York Times* an account of what is being done in the United States to mobilise science for industrial progress and military efficiency, and we reprint his letter below. It will be seen that the president of the Throop College of Technology in Pasadena, California, an institution which gives special attention to research, hearing of the plans of the Research Council, offered the assistance and co-operation of the recently endowed research laboratory of chemistry, and secured at once an additional endowment of 20,000*l*. for scientific research. In somewhat similar circumstances a gift of 100,000*l*.

has been made to the Massachusetts Institute of Technology, with the expectation that much of the income will be used for research. A resolution of the New York Engineering Foundation expresses approval of the co-ordination and federation of the research agencies of the United States undertaken by the National Academy, and also willingness to assist. The foundation has offered its entire income for the coming year—including a special gift of 1000*l.*—towards the expenses of organisation and to provide a New York office for the council. Resolutions of a similar kind are to be proposed to other scientific societies in the States.

At its annual meeting in April the National Academy of Sciences volunteered to organise the scientific resources of educational and research institutions in the interest of national preparedness. This offer, which was immediately accepted by President Wilson, has led to the establishment of the National Research Council.

Public welfare and national security depend upon industrial progress and military efficiency; and these, in turn, result from practical applications of scientific knowledge. A superstructure, no matter how perfect, must have firm foundations, and thus the development of our industries must go hand in hand with the advancement of knowledge through research.

It is equally true that the mobilisation of industry, so successfully undertaken by the national engineering societies in co-operation with the Naval Consulting Board, must be accompanied by the mobilisation of science. This necessity has been recognised in England by the establishment of an Advisory Council for Scientific and Industrial Research, and in Australia by the organisation of a National Institute of Science and Industry. Thus it is expected ultimately to overcome the telling advantages, both in war and in peace, which Germany has long enjoyed because of the organisation and development of her scientific resources.

Paul Deschanel has remarked of French men of science: "Ils pensent que défendre la vérité est le meilleur moyen de servir la patrie." Thus the duties of a National Research Council should not be confined to the necessities of war or the development of American industries. We should recognise, with Carty, the engineer, that when adapted to practical uses the "results of the pure men of science become of incalculable value to the industries as a whole." And we should not fail to perceive that every form of scientific research contributes to human progress.

Euclid, working out problems in pure mathematics in Alexandria, prepared the way for the calculations of the engineer. Galileo, discovering the satellites of Jupiter, convinced the world of the truth of the Copernican theory, broke down absurd medieval conceptions which prevented scientific progress, and stimulated exploration and advance in every field. Pasteur, studying the optical properties of certain crystals with no thought of practical result, was led to his investigations of bacteria and his epoch-making discoveries for the benefit of mankind.

Thus scientific research in any field, whether for the advancement of knowledge or for direct industrial or military application, is a most fundamental form of national service, which should be encouraged by every possible means. The work of the Research Council will thus relate to public welfare in times of peace even more truly than to national security in the event of war.

During our Civil War the need of scientific advice was often felt by our Government. Accordingly, the National Academy of Sciences was chartered in 1863 by Act of Congress, which stipulated that "the academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art. . . ." During the war, and frequently in later years, the academy has been consulted by Congress, by the President, and by various members of his Cabinet. It is thus the agency naturally chosen for the organisation of the National Research Council.

The purpose of the council is to bring into co-operation existing governmental, educational, industrial, and other research organisations, with the object of encouraging the investigation of natural phenomena, the increased use of scientific research in the development of American industries, the employment of scientific methods in strengthening the national defence, and such other applications of science as will promote the national security and welfare.

The council will be composed of leading American investigators and engineers, representing the Army, Navy, Smithsonian Institution, and various scientific bureaus of the Government; educational institutions and research foundations, and the research laboratories of industrial and manufacturing establishments.

Research committees of two classes will be appointed:—

Central committees, dealing with various departments of science, comprised of leading authorities in each field, selected in consultation with the president of the corresponding national society.

Local committees in universities, colleges, and other co-operating institutions engaged in scientific research.

The organising committees will recommend to the National Research Council the following plan of procedure, approved by the council of the National Academy, but open to such modification as the Research Council may deem desirable:—

(1) The preparation of a national census of equipment for research, of the men engaged in it, and of the lines of investigation pursued in co-operating Government bureaus, educational institutions, research foundations, and industrial research laboratories; this census to be prepared in harmony with any general plan adopted by the proposed Government Council of National Defence.

(2) The preparation of reports by special committees, suggesting important research problems and favourable opportunities for research in various departments of science.

(3) The promotion of co-operation in research, with the object of securing increased efficiency; but with careful avoidance of any hampering control or interference with individual freedom and initiative.

(4) Co-operation with educational institutions, by supporting their efforts to secure larger funds and more favourable conditions for the pursuit of research and the training of students in the methods and spirit of investigation.

(5) Co-operation with research foundations and other agencies desiring to secure a more effective use of funds available for investigation.

(6) The encouragement in co-operating laboratories of researches designed to strengthen the national defence and to render the United States independent of foreign sources of supply liable to be affected by war.

To meet immediate needs, the following committees have already been completely or partially organised and are at work:—

Nitric Acid Supply, appointed in co-operation with the American Chemical Society, to investigate processes for the fixation of nitrogen, in order to select the best means of preparing the nitric acid required in the manufacture of powder and high explosives.

Preventive Medicine, appointed in co-operation with the Committee of Physicians and Surgeons, to develop and utilise new methods of preventive medicine for the protection of troops in the field.

Organic Chemicals, appointed in co-operation with the American Chemical Society, to secure co-operation among chemists in researches required for the manufacture of dyestuffs, synthetic medicinals, and other chemicals made scarce by the war.

Communications, appointed in co-operation with the American Physical Society and the American Institute of Electrical Engineers, to develop and apply the most effective devices for military communications, the detection of submarines, and other similar purposes.

Committees for the promotion of research in applied mathematics, astronomy, physics, chemistry, botany, zoology, and various other branches of science will also be organised by the council.

The most cordial spirit of co-operation has been shown by every individual and institution hitherto invited to take part in the work. Universities, research foundations, and industrial laboratories, in the event of war, would place every facility at the disposal of the Government. In times of peace they will co-operate with the council in the advancement of research. The Engineering Foundation, under the auspices of the United Engineering Societies, has passed resolutions commending the purposes of the council, and offering it a New York office in the Engineers' Building and the services of an executive secretary. Substantial contributions to a general expense fund have already been received. It is evident that so soon as a general request for co-operation can be issued it will meet with the widest acceptance.

Throop College of Technology, in Pasadena, Cal., has recently afforded a striking illustration of one way in which the Research Council can secure co-operation and advance scientific investigation. This institution, with its able investigators and excellent research laboratories, could be of great service in any broad scheme of co-operation. President Scherer, hearing of the formation of the council, immediately offered to take part in its work, and with this object he secured within three days an additional research endowment of 100,000 dollars. The spirit of national service and the increased appreciation of the value of science, which have resulted from the European war, should lead to many similar gifts elsewhere.

The following letter from the President shows his approval of the council's plans and his active assistance in completing its organisation :—

"Dr. William H. Welch, President of the National Academy of Sciences, 807 St. Paul Street, Baltimore, Md. :—

"My Dear Dr. Welch,—I want to tell you with what gratification I have received the preliminary report of the National Research Council, which was formed at my request under the National Academy of Sciences. The outline of work there set forth and the evidences of remarkable progress toward the accomplishment of the object of the council are indeed gratifying. May I not take this occasion to say that the departments of the Government are ready to co-operate in every way that may be required, and that the heads of the departments most immediately concerned are now, at my request, actively engaged in considering the best methods of co-operation? Representatives of Government bureaus will be appointed as members of the Research Council as the council desires.

"Cordially and sincerely yours,

"(Signed) WOODROW WILSON."

Arrangements will be made to hold a meeting of the council soon after the appointment of the representatives of Government bureaus.

GEORGE ELLERY HALE.

THE GOVERNMENT CINCHONA PLANTATIONS IN BENGAL.

THE fifty-fourth annual report of the Government Cinchona Plantations and Factory in Bengal for the year 1915–16 is as interesting and valuable a document as that for 1914–15 noticed in these columns last year. In the previous report the scientific side of the work for the past ten years was reviewed, while in that now under notice a review of the financial side of the operations for the past sixteen years is given. Since April, 1900, to March, 1916, the total expenditure amounted to 42,65,600 rupees and total receipts to 39,30,000 rupees. The deficit of 3,35,600 rupees is, however, not a sign of financial mismanagement, but is an indication of remarkable and highly successful administrative ability. The deficit was incurred within the period 1905–14, during which time the department was being greatly improved. The explanation, which is simple, is given in the words of the report, as the excellent work which is being done by Major Gage and his staff is deserving of wider recognition.

"About the beginning of the 1905–15 period it was seen that the demand for quinine—since 1892 in excess of the yield from plantation bark—was exceeding the factory output capacity, and that as more than 90 per cent. of the world's supply of bark and quinine was in the hands respectively of Java planters and about a dozen manufacturers, the risk of the formation of a 'Trust' and the abolition of an open market was not to be taken lightly. It was foreseen that, if while there was still an open market large quantities of bark and quinine were purchased at the lowest rates ever touched, it would allow the formation of a reserve of quinine large enough to meet the increase in demand and to serve as a stand-by in case of a severe malarial epidemic, what time the plantations were being extended on a scale large enough to render the department independent of external supplies and prices.

"So during 1908–14 large sums were expended on purchase of bark and quinine at very low rates and on extra extensive plantations. Subsequent developments have thoroughly justified the then heavy expenditure. For instance, if the annual quinine yield from the plantations had remained at its 1905 figure of 9000 lb., Government would have had to pay during 1913–15 at least 7,74,000 rupees in purchase of enough bark or quinine to make up the quantity (74,000 lb.) distributed during these years, whereas it cost Government to make the quantity required above the 1905 output level less than 3,08,000 rupees. In those two years alone Government saved at least 4,66,000 rupees, which exceeds the deficit for a period of sixteen years. The deficit will speedily be replaced by a surplus yearly increasing, and meanwhile it is covered many times over by readily realisable assets."

These assets include (1) additions to factory and machinery that have quintupled its 1900 output capacity; (2) 2418 acres afforested with timber and fuel trees; (3) 2295 acres planted with cinchona 7,69,085 rupees in value; (4) a reserve of 165,000 lb. of quinine valued at 18,97,500 rupees, and other manufactured products, bark, etc., valued at 2,05,055 rupees —a total of 29,18,000 rupees. The total return for the 42,65,600 rupees expenditure is therefore in cash and assets 68,48,000 rupees. Nothing is claimed for value of factory, etc., in the estimate.

From this explanation, with conditions of presentment as stringent as few companies would think of adopting, the financial side of the department's work is seen to be as satisfactory as the scientific.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION A.

MATHEMATICAL AND PHYSICAL SCIENCE.

OPENING ADDRESS (ABRIDGED) BY PROF. A. N. WHITEHEAD, SC.D., F.R.S., PRESIDENT OF THE SECTION.

The Organisation of Thought.

THE subject of this address is the organisation of thought, a topic evidently capable of many diverse modes of treatment. I intend more particularly to give some account of that department of logical science with which some of my own studies have been connected. But I am anxious, if I can succeed in so doing, to handle this account so as to exhibit the relation with certain considerations which underlie general scientific activities.

It is no accident that an age of science has developed into an age of organisation. Organised thought is the basis of organised action. Organisation is the adjustment of diverse elements so that their mutual relations may exhibit some predetermined quality. An epic poem is a triumph of organisation—that is to say, it is a triumph in the unlikely event of it being a good epic poem. It is the successful organisation of multitudinous sounds of words, associations of words, pictorial memories of diverse events and feelings ordinarily occurring in life, combined with a special narrative of great events: the whole so disposed as to excite emotions which, as defined by Milton, are simple, sensuous, and passionate. The number of successful epic poems is commensurate, or, rather, is inversely commensurate, with the obvious difficulty of the task of organisation.

Science is the organisation of thought. But the example of the epic poem warns us that science is not any organisation of thought. It is an organisation of a certain definite type which we will endeavour to determine.

Science is a river with two sources, the practical source and the theoretical source. The practical source is the desire to direct our actions to achieve predetermined ends. For example, the British nation, fighting for justice, turns to science, which teaches it the importance of compounds of nitrogen. The theoretical source is the desire to understand. Now I am going to emphasise the importance of theory in science. But to avoid misconception I most emphatically state that I do not consider one source as in any sense nobler than the other, or intrinsically more interesting.

The importance, even in practice, of the theoretical side of science arises from the fact that action must be immediate, and takes place in circumstances which are excessively complicated. If we wait for the necessities of action before we commence to arrange our ideas, in peace we shall have lost our trade, and in war we shall have lost the battle.

Success in practice depends on theorists who, led by other motives of exploration, have been there before, and by some good chance have hit upon the relevant ideas. By a theorist I do not mean a man who is up in the clouds, but a man whose motive for thought is the desire to formulate correctly the rules according to which events occur. A successful theorist should be excessively interested in immediate events, otherwise he is not at all likely to formulate correctly anything about them. Of course, both sources of science exist in all men.

Now, what is this thought organisation which we call science? The first aspect of modern science which struck thoughtful observers was its inductive character. The nature of induction, its importance, and the rules of inductive logic have been considered by a long series of thinkers, especially English thinkers, Bacon, Herschel, J. S. Mill, Venn, Jevons, and others. I am not going to plunge into an analysis of the process of induction. Induction is the machinery and not the product, and it is the product which I want to consider. When we understand the product we shall be in a stronger position to improve the machinery.

First, there is one point which it is necessary to emphasise. There is a tendency in analysing scientific processes to assume a given assemblage of concepts applying to nature, and to imagine that the discovery of laws of nature consists in selecting by means of inductive logic some one out of a definite set of possible alternative relations which may hold between the things in nature answering to these obvious concepts. In a sense this assumption is fairly correct, especially in regard to the earlier stages of science. Mankind found itself in possession of certain concepts respecting nature—for example, the concept of fairly permanent material bodies—and proceeded to determine laws which related the corresponding precepts in nature. But the formulation of laws changed the concepts, sometimes gently by an added precision, sometimes violently. At first this process was not much noticed, or at least was felt to be a process curbed within narrow bounds, not touching fundamental ideas. At the stage where we now are, the formulation of the concepts can be seen to be as important as the formulation of the empirical laws connecting the events in the universe as thus conceived by us—for example, the concepts of life, of heredity, of a material body, of a molecule, of an atom, of an electron, of energy, of space, of time, of quantity, and of number.

But, for the purposes of science, what is the actual world? Has science to wait for the termination of the metaphysical debate till it can determine its own subject-matter? I suggest that science has a much more homely starting-ground. Its task is the discovery of the relations which exist within that flux of perceptions, sensations, and emotions which forms our experience of life. The panorama yielded by sight, sound, taste, smell, touch, and by more inchoate sensible feelings, is the sole field of its activity. It is in this way that science is the thought organisation of experience. The most obvious aspect of this field of actual experience is its disorderly character. It is for each person a *continuum,* fragmentary, and with elements not clearly differentiated. The comparison of the sensible experiences of diverse people brings its own difficulties. I insist on the radically untidy, ill-adjusted character of the fields of actual experience from which science starts. To grasp this fundamental truth is the first step in wisdom, when constructing a philosophy of science. This fact is concealed by the influence of language, moulded by science, which foists on us exact concepts as though they represented the immediate deliverances of experience. The result is that we imagine that we have immediate experience of a world of perfectly defined objects implicated in perfectly defined events which, as known to us by the direct deliverance of our senses, happen at exact instants of time, in a space formed by exact points, without parts and without magnitude: the neat, trim, tidy, exact world which is the goal of scientific thought.

My contention is that this world is a world of ideas, and that its internal relations are relations between abstract concepts, and that the elucidation of the precise connection between this world and the feelings of actual experience is the fundamental question of scientific philosophy. The question which I am inviting you to consider is this: How does exact thought apply to the fragmentary, vague *continua* of experience? I am not saying that it does not apply; quite the contrary. But I want to know how it applies.

The solution I am asking for is not a phrase however brilliant, but a solid branch of science, constructed with slow patience, showing in detail how the correspondence is effected.

The first great steps in the organisation of thought were due exclusively to the practical source of scientific activity, without any admixture of theoretical impulse. Their slow accomplishment was the cause and also the effect of the gradual evolution of moderately rational beings. I mean the formation of the concepts of definite material objects, of the determinate lapse of time, of simultaneity, of recurrence, of definite relative position, and of analogous fundamental ideas, according to which the flux of our experiences is mentally arranged for handy reference: in fact, the whole apparatus of common-sense thought. Consider in your mind some definite chair. The concept of that chair is simply the concept of all the interrelated experiences connected with that chair—namely, of the experiences of the folk who made it, of the folk who sold it, of the folk who have seen it or used it, of the man who is now experiencing a comfortable sense of support, combined with our expectations of an analogous future, terminated finally by a different set of experiences when the chair collapses and becomes fire-wood. The formation of that type of concept was a tremendous job, and zoologists and geologists tell us that it took many tens of millions of years. I can well believe it.

I now emphasise two points. In the first place, science is rooted in what I have just called the whole apparatus of common-sense thought. That is the *datum* from which it starts, and to which it must recur. We may speculate, if it amuses us, of other beings in other planets who have arranged analogous experiences according to an entirely different conceptual code—namely, who have directed their chief attention to different relations between their various experiences. But the task is too complex, too gigantic, to be revised in its main outlines. You may polish up common sense, you may contradict it in detail, you may surprise it. But ultimately your whole task is to satisfy it.

In the second place, neither common sense nor science can proceed with its task of thought organisation without departing in some respect from the strict consideration of what is actual in experience. Think again of the chair. Among the experiences upon which its concept is based I included our expectations of its future history. I should have gone further and included our imagination of all the possible experiences which in ordinary language we should call perceptions of the chair which might have occurred. This is a difficult question, and I do not see my way through it. But at present in the construction of a theory of space and of time there seem insuperable difficulties if we refuse to admit ideal experiences.

This imaginative perception of experiences, which, if they occurred, would be coherent with our actual experiences, seems fundamental in our lives It is neither wholly arbitrary nor yet fully determined. It is a vague background which is only made in part definite by isolated activities of thought. Consider, for example, our thoughts of the unseen flora of Brazil.

Ideal experiences are closely connected with our imaginative reproduction of the actual experiences of other people, and also with our almost inevitable conception of ourselves as receiving our impressions from an external complex reality beyond ourselves. It may be that an adequate analysis of every source and every type of experience yields demonstrative proof of such a reality and of its nature. Indeed, it is scarcely to be doubted that this is the case. The precise elucidation of this question is the problem of metaphysics. One of the points which I am urging in this address is that the basis of science does not depend on the assumption of any of the conclusions of metaphysics; but that both science and metaphysics start from the same given groundwork of immediate experience, and in the main proceed in opposite directions on their diverse tasks.

For example, metaphysics inquires how our perceptions of the chair relate us to some true reality. Science gathers up these perceptions into a determinate class, adds to them ideal perceptions of an analogous sort, which in assignable circumstances would be obtained, and this single concept of that set of perceptions is all that science needs; unless indeed you prefer that thought find its origin in some legend of those great twin brethren, the Cock and Bull.

My immediate problem is to inquire into the nature of the texture of science. Science is essentially logical. The nexus between its concepts is a logical nexus, and the grounds for its detailed assertions are logical grounds. King James said, "No bishops, no king." With greater confidence we can say, "No logic, no science." The reason for the instinctive dislike which most men of science feel towards the recognition of this truth is, I think, the barren failure of logical theory during the past three or four centuries. We may trace this failure back to the worship of authority which in some respects increased in the learned world at the time of the Renaissance. Mankind then changed its authority, and this fact temporally acted as an emancipation. But the main fact, and we can find complaints[1] of it at the very commencement of the modern movement, was the establishment of a reverential attitude towards any statement made by a classical author. Scholars became commentators on truths too fragile to bear translation. A science which hesitates to forget its founders is lost. To this hesitation I ascribe the barrenness of logic.

It will be necessary to sketch in broad outline some relevant features of modern logic. . . .

I will now break off the exposition of the function of logic in connection with the science of natural phenomena. I have endeavoured to exhibit it as the organising principle, analysing the derivation of the concepts from the immediate phenomena, examining the structure of the general propositions which are the assumed laws of nature, establishing their relations to each other in respect to reciprocal implications, deducing the phenomena we may expect in given circumstances.

Logic, properly used, does not shackle thought. It gives freedom and, above all, boldness. Illogical thought hesitates to draw conclusions, because it never knows either what it means, or what it assumes, or how far it trusts its own assumptions, or what will be the effect of any modification of assumptions. Also the mind untrained in that part of constructive logic which is relevant to the subject in hand will be ignorant of the sort of conclusions which follow from various sorts of assumptions, and will be correspondingly dull in divining the inductive laws. The fundamental training in this relevant logic is, undoubtedly, to ponder with an active mind over the known facts of the case, directly observed. But where elaborate deductions are possible, this mental activity requires for its full exercise the direct study of the abstract logical relations. This is applied mathematics.

Neither logic without observation, nor observation without logic, can move one step in the formation of science. We may conceive humanity as engaged in an internecine conflict between youth and age. Youth is not defined by years, but by the creative impulse to make something. The aged are those who, before all things, desire not to make a mistake. Logic is the olive branch from the old to the young, the wand which in the hands of youth has the magic property of creating science.

[1] *E.g.* in 155' by Italian schoolmen.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—At University College a public lecture—the first of a series of six—will be delivered by Prof. J. A. Fleming on "Long-distance Telegraphy and Telephony," on Wednesday, October 18, at 5.30 p.m. Prof. J. Norman Collie, director of the chemical laboratories, will give a lecture on Tuesday, October 31, at 5.30 p.m., on "The Scientific Work of Sir William Ramsay."

MR. A. L. MACAULAY, a son of Prof. A. MacAulay, has been appointed demonstrator in physics in the University of Melbourne.

THE next election to Beit Memorial Fellowships for Medical Research (of which there will not be more than ten awards) will take place on or before January 1, 1917. Applications must reach the hon. secretary, Beit Memorial Fellowships for Medical Research, 35 Clarges Street, W., on or before October 15.

A SERIES of popular lectures on "The Tropical Countries of the Empire," illustrated by the collections of the Imperial Institute, will be delivered by Miss Edith A. Browne on Wednesdays in October, November, and December, at the Imperial Institute, at 3 o'clock, commencing on Wednesday, October 4. Admission to the series of lectures will be free by ticket, for which application should be made to the director of the Imperial Institute, South Kensington.

IT is announced in the issue of *Science* for September 8 that a recommendation that a fund of more than 600,000*l.* for the treatment of cancerous, nervous, and disabling ailments be given to the University of Pennsylvania Hospital has been made by Dr. W. H. Smith, superintendent of the Johns Hopkins Hospital, Baltimore, who was selected by the trustees of the fund to visit Philadelphia and make a survey of its hospitals and medical work and give his opinion as to where the fortune would work the greatest benefit. The fund is the estate and its increment willed for the purpose by the late Anna J. Jeanes, a noted Friend philanthropist, who died in 1908.

THE governing body of the Northampton Polytechnic Institute, Clerkenwell, E.C., is not this year publishing the usual annual issue of its "Announcements," but will start and carry through during the current session as many of the courses and classes announced for last year as may be justified by the applications for enrolment received at the commencement of the session. It is hoped that day and evening courses will be held in civil, mechanical, and electrical engineering, in technical optics, and in horology. The engineering courses include subsections in automobile work, aeronautics, and radio-telegraphy. In addition there are to be evening courses in electrochemistry, metallurgy, and domestic economy.

THE instruction given in the evening courses in technology in the University of Leeds, a prospectus of which for the current session has been received, are co-ordinated with the city scheme for evening instruction, and Leeds students under twenty-two years of age are required to produce certificates of satisfactory attendance at preparatory classes, or give evidence of adequate preparation. Advanced technological courses are held at the University in civil, mechanical, and electrical engineering, coal-mining, textile industries, tinctorial chemistry and dyeing, leather industries, and geology. The University of Leeds, too, works in co-operation with the Bradford Technical College, from which we have also received a prospectus and time-table. Senior day students of the chemistry and dyeing department of the Bradford College may attend without payment of fee certain lecture courses at the University. University students may similarly attend for work in the college practical dye-house and finishing shed. Third-year students of engineering in the college may attend the University engineering laboratory for work on the refrigerator plant, air-compressor, and hydraulic installation without payment; and University students may similarly attend for work in the college power-house.

A MEETING of the Committee for the Management of the British Prisoners of War Book Scheme was held on Friday last at Whitehall, when the following officers were elected:—Chairman, Mr. A. T. Davies (Board of Education); treasurer, Rear-Admiral J. F. Parry, C.B., hydrographer to the Navy. The appointment of a secretary was held over. A gratifying report was read from the principal examiner to the Board of Trade (Marine Department) on the result of the recent examinations held at the camp at Groningen, in Holland. Evidence is also coming to hand from camps as far distant as Asia Minor of considerable development in the organisation of educational work among the men interned there. From these camps a continuous stream of applications for books for serious study was reported to the committee, who expressed the hope that the public will continue, by offers of suitable books (new or second-hand), to support a war charity the need for which was daily becoming more and more evident and the machinery of which was being increasingly taken advantage of by the friends and relatives of prisoners in all parts of the British Empire. Further particulars respecting this war charity and its work can be obtained on application to Mr. A. T. Davies, at the Board of Education, Whitehall, London, S.W. All communications should have the words "Prisoners of War" written in the left-hand corner of the envelope.

SIR CHARLES WAKEFIELD, Lord Mayor of London, announces that the council of the Lord Kitchener National Memorial Fund has resolved to found a number of scholarships which will enable young Britons destined for a commercial career to travel, study, and gain business experience in the countries of the Allied nations—viz. France, Russia, Italy, Japan, Belgium, Rumania, Portugal, and Serbia. The scholarships will be continued from year to year for all time, and will be of the annual value of about 150*l.* each. They will be for the sons of deceased and disabled officers and men of the Navy and Army, and young men from eighteen to twenty-five years of age who have served with the Forces. The intention is that those elected to hold scholarships should begin their studies almost immediately, that they should receive instruction (*a*) in Russian, French, Italian, and other languages; (*b*) in economics; (*c*) in business principles and business methods (in offices or factories as circumstances may determine), and that immediately at the close of the war they should be sent for a year to travel in one or other of the Allied countries and to continue their studies in that country with the view of gaining (1) a close familiarity with its language, and (2) an intimate knowledge of its commercial methods, needs, and opportunities. In developing this scheme the council is being advised by business men and educational experts, so that in the end it may be carried through with the highest degree of efficiency. Contributions towards the fund necessary to establish the scheme on a sound footing without delay should be sent to the Lord Kitchener National Memorial Fund, Mansion House, London. Envelopes should be marked "Kitchener Scholarships."

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 11.—M. Camille Jordan in the chair.—A. **Lacroix**: The constitution of the volcanic rocks of the extreme north of Madagascar and of Nosy bé; the ankaratrites of Madagascar in general. Five complete analyses are given of rocks from the north of Madagascar, four of rocks from the island of Nosy bé, and six of ankaratrites.—E. **Lebon**: A new table of divisors of numbers.—L. **Godeaux**: The involutions belonging to algebraic surfaces.—J. **Guillaume**: Observations of the sun, made at the Lyons Observatory during the first quarter of 1916. The results of observations made on sixty-one days are summarised in three tables, showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—D. **Eydoux**: The modifications of the phenomena of hammering in pipes of variable thickness and diameter.—P. **Zeeman**: The drift of light waves and solar phenomena.—A. **Perot**: The influence of the wind on the conditions of audibility of sound. Gunfire has been heard at a great distance from the battlefield, with an intermediate zone of silence. It is shown that this phenomenon can be explained by assuming that at a certain altitude either there is no wind, or that it is contrary in direction to the wind near the ground-level.—H. **Pellet**: The total destruction of pentoses in the course of alcoholic fermentation. In an attempt to estimate pentoses in the presence of saccharose, by fermenting the latter with yeast, it was found that some pentoses were fermented. Alternative conditions are given under which this fermentation of pentoses can be rendered either total or reduced to negligible proportions.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings No. 8, vol. ii., August 15).—C. D. **Miller**: The absorption coefficients of soft X-rays. The numerical constants in the relation between the absorption coefficients, the density, and the wave-lengths have been accurately determined. The results also indicate that the relationship holds for very much softer X-rays than those of ordinary penetrating power.—E. F. **Smith**: Further evidence as to the relation between crown gall and cancer. There are discussed: fundamental concepts, human and animal tumours for which no cause has been discovered, earlier discoveries in plants, further discoveries, other resemblances of crown gall to cancer in man and animals, possibility of the existence of carcinomas and of mixed tumours in plants, production of embryonal teratomata, and bearing of these discoveries on the cancer problem.—G. H. **Parker**: Locomotion of sea-anemones. The pedal portion of a sea-anemone, like its tentacles, must contain a neuromuscular mechanism sufficient for the activity of that part of its body.—G. H. **Parker**: The behaviour of sea-anemones. Sea-anemones are animals the momentary conditions of which are dependent upon the combined stimuli of their immediate surroundings rather than forms that are greatly influenced by their past history, and their unity is not of a pronounced type; they are more in the nature of a sum of parts than they are organic units of the type of most of the higher animals.—J. P. **Iddings** and E. W. **Morley**: A contribution to the petrography of Japan. Seventeen detailed chemical analyses are given of Japanese lavas.—J. **Loeb** and J. H. **Northrop**: Is there a temperature coefficient for the duration of life? In three series of experiments on the fruit-fly Drosophila it is found that the duration of life in the cases examined has a temperature-coefficient of the order of magnitude which is characteristic for life phenomena and chemical reactions in general.—C. E. **St. John**: The suggested mutual repulsion of Fraunhofer lines. The author is unable to find evidence of the mutual repulsion suggested, and in so far as mutual influence is a necessary corollary of anomalous dispersion in the sun, evidence of this also is lacking.—A. S. **King**: An attempt to detect the mutual influence of neighbouring lines in electric furnace spectra showing anomalous dispersion. Although the material in the investigation is limited by the scarcity of suitable pairs of lines, the lines actually tested have shown no tendency towards a repulsion.—C. A. **Rouiller**: Synthesis of the base $C_3H_4ON_2$ derived from methylaminomethyl-3 : 4-dihydroxyphenylcarbinol. A continuation of some work by Abel, with a suggestion as to a relation to work by Curtius.—W. M. **Davis**: (1) Extinguished and resurgent coral reefs. (2) The origin of certain Fiji atolls. The two papers offer a discussion of observations made during the author's Shaler Memorial voyage across the Pacific.—C. **Barus**: Interferometer methods based on the cleavage of a diffracted ray. The prismatic method of cleaving the incident beam of white light is available for the superposition of non-reversed spectra, under conditions where the paths of the component rays may have any length whatever. It is thus an essential extension of the same method as used for reserved spectra heretofore, and also of the methods in which the paths are essentially small.—F. M. **Surface**: The inheritance of certain glume characters in the cross *Avena fatua* × *A sativa*, var. *Kherson*. A study of inheritance of certain characters, particularly directed towards revealing phenomena of linkage.—C. **Zeleny**: A comparison of the rates of regeneration from old and from new tissue. The data as a whole show clearly that there is no essential difference between the rate of regeneration from new cells and from old cells. The rate of regeneration seems, therefore, to be under central control.—C. **Zeleny**: The effect of successive removal upon the rate of regeneration. Apart from the slowing due to age, there is no indication of the amount of new material that may be produced by regeneration. The actual limitation comes, not from the using up of regenerative energy, but from changes in the non-regenerating part associated with age.—E. **Blackwelder**: The geologic *rôle* of phosphorus. Phosphorus appears in Nature in many forms and in many situations. Its numerous transformations, however, follow an orderly sequence—in a broad way form a cycle which is here discussed in some detail.—J. **Barrell**: Dominantly fluviatile origin under seasonal rainfall of the Old Red Sandstone. Geologists have differed so widely in their conclusions in regard to the nature of the habitat of the early vertebrate faunas the remains of which are found in the formations of the Old Red Sandstone, that the author is led to examine critically the criteria for the interpretation of the facts. He comes to the conclusion that the deposits which make up the Old Red Sandstone, although they undoubtedly contain lacustrine beds and other beds laid down in shifting, shallow, and variable bodies of water, are dominantly fluviatile in origin. The Great Valley in California may therefore in the present epoch, both in physiography and in climate, be cited as a striking illustration of the nature of the Old Red Sandstone basins.—J. **Barrell**: The influence of Silurian-Devonian climates on the rise of air-breathing vertebrates. The evidence for the hypothesis of the continental origin of fishes has been examined, and seems to prevail over that for their marine origin. The author also believes that natural selection, although discredited as a cause determining specific variations, appears nevertheless to be a major factor in evolution.—T. W. **Richards** and C. **Wadsworth** 3d: Density of radio-lead from pure Norwegian cleveite. The density of this lead is found to be 11·273, distinctly less than the density (11·289) of Australian radio-lead, and still less than that (11·337) for ordinary lead, the decrease being almost exactly proportional to the decrease in atomic weight in these samples, so that the atomic volume (18·281) is constant.—National Research Council: A preliminary report to the president of the Academy of the Organising Committee (Messrs. E. G. Conklin, S. Flexner, R. A. Millikan, A. A. Noyes, and G. F. Hale, chairman) of the National Research Council, established by the Academy after conference with the President of the United States for the purpose of co-ordinating the research elements of the country in the interest of national security and welfare.

CAPE TOWN.

Royal Society of South Africa, August 16.—Dr. L. Péringuey, president, in the chair.—R. E. **Walker**: The granite of the Schapenberg, Somerset West. The granite of the Schapenberg is essentially a grey, biotite-granito-porphyry intrusive in fine-grained, argillaceous grits of the Malmesbury series. It is essentially an apophysis of one or other of the two large granite masses—the Kuils River granite and the Sir Lowry's Pass granite—which occur the one to the west and the other to the east of the Schapenberg; most probably of the latter. Both fine- and medium-grained varieties occur. At certain points along the contact the granite, owing to absorption of material from the invaded formation, is andalusite-bearing. The granite, particularly near its margin, has been subjected to pneumatolytic action, which has caused the formation of a series of altered granites ranging from school granite on one hand to greissen on the other. The greissen is a quartz-mica-tourmaline rock resembling, in most respects, that of Grainsgill, described by Mr. Alfred Harker in the Q.J.G.S.—J. S. v. d. **Lingen**: The radial lines in Röntgen interference patterns. The author briefly discussed the theory of radial lines, and pointed out that on Friedrich's assumption these lines ought to be present in all interference patterns. Experiments were then described, which support the view put forward by von Laue and the author, viz. radial lines are caused by weakening of the lattice of a rigid crystal. The pattern of $Mg(OH)_2$, where the water molecules were driven off, and resublimated iodine, were exhibited, as well as the pattern of sylvine obtained by Friedrich. The pattern of this iodine shows the transition stage from a three-dimensional grating to a two-dimensional grating. MgO from $Mg(OH)_2$ shows the two-dimensional grating only. "Baurite from biotite" shows the two-dimensional grating by treating biotite with acids.—E. J. **Goddard**: Some observations on *Ozobranchus branchiatus*. This paper contains an account of the leech (*Ozobranchus branchiatus*). Some historical interest attaches to the form, inasmuch as it was probably the first Annulate noted from the Australasian region. The specimens were obtained as parasites on the green turtle. The somite is represented in a very primitive condition, and it is of interest to note that the limitation of the genus to Chelonia as parasites is possibly, as in that of Branchellion to Pisces, indicative of an old association, and bearing out the morphological evidence that these forms are archaic and primitive, and ancestral to the Gnathobdellida and Herpobdellida. The paper deals with the constitution of the somite in the various regions of the body, and the conclusions to be derived from the same.

BOOKS RECEIVED.

The Flotation Process. Compiled and edited by T. A. Rickard. Pp. 364. (San Francisco: Mining and Scientific Press.) 8*s*. 6*d*. net.

A Glossary of Botanic Terms with their Derivation and Accent. By B. D. Jackson. Third edition. Pp. xi+427. (London: Duckworth and Co.) 7*s*. 6*d*. net.

British and Foreign Marbles and other Ornamental Stones. By J. Watson. Pp. x+485. (Cambridge: At the University Press.) 5*s*. net.

Alternating Currents in Theory and Practice. By W. H. N. James. Pp. vi+353. (Cambridge: At the University Press.) 10*s*. 6*d*. net.

The Royal Horticultural Society's True Work. By A Life Fellow of the Society. Pp. 23. (London: Simpkin and Co., Ltd.) 6*d*. net.

A Bibliography of British Ornithology from the Earliest Times to the End of 1912. By W. H. Mullens and H. Kirke Swann. Part iii. (London: Macmillan and Co., Ltd.) 6*s*. net.

Organic to Human: Psychological and Sociological. By Dr. H. Maudsley. Pp. viii+386. (London: Macmillan and Co., Ltd.) 12*s*. net.

Bacon's War Maps. Europe, embracing all the Countries Involved. (London: G. W. Bacon and Co., Ltd.) 6*d*. net.

The Student's Handbook to the University and Colleges of Cambridge. Fifteenth edition, revised to June 30, 1916. Pp. 14+704. (Cambridge: At the University Press.) 3*s*. net.

Memories. By E. Clodd. Pp. xi+288. (London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

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