NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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No. 2399, VOL. 96] THURSDAY, OCTOBER 21, 1915 [PRICE SIXPENCE

Registered as a Newspaper at the General Post Office.]

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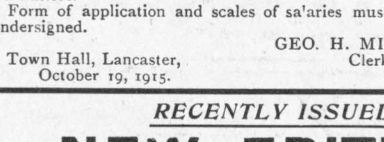

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THURSDAY, OCTOBER 21, 1915.

SCIENCE IN NATIONAL AFFAIRS.

WE printed last week a valuable address by Prof. J. A. Fleming on "Science in the War and after the War." Though the address was an introductory lecture at University College, London, and was open to the public without fee or ticket, only the briefest mention of it appeared in the periodical Press, and the points of national importance dealt with in it were unrecorded, except in our columns, in which it was our privilege to publish the address almost in full. We understand, of course, that the demands made upon the space available in the daily papers are many and insistent, yet we should have supposed that during the progress of a war in which victory will depend as much upon science and machinery as upon men, a summary of some of the points made by a leading authority upon applied science would be of greater public interest and importance than much of the unsubstantial chatter with which we are supplied daily.

In the course of his address, Prof. Fleming himself supplied a reason for the neglect of scientific aspects of national affairs, in comparison with the attention given to the superficial views of politicians and other publicists. While success in science is measured solely by discovery of facts or relationships, in politics and public life generally it is secured by fluent speech and facile pen. In scientific work attention must be concentrated upon material fact, but the politician and the writer attach greater importance to persuasive words and phrases, and by their oratory or literary style are able to exert an influence upon public affairs altogether out of proportion to their position as determined by true standards of national value. Power, as regards government of the affairs of the nation, does not come from knowledge, but from dialectics: it is the lawyer who rules, with mind obsessed by the virtues of precedent and expediency, and to him men of science and inventors are but hewers of wood and drawers of water.

Under a democratic constitution it is perhaps too much to expect that Parliament will pay much attention to scientific men or methods; yet, as was shown in the debate upon the scheme for the institution of an advisory council of scientific and industrial research last May, the members of the House of Commons are ready to support plans for bringing science in closer connection with industry. The monies provided by Parliament for this purpose are to be under the control of a committee of the Privy Council, which will be advised by a council constituted of scientific and industrial experts. The scheme was conceived rightly enough, but when it passed into the hands of officials of the Board of Education much of its early promise was lost. Most people would regard it as essential that the executive officers of a council concerned with the promotion of industrial research should know what is done in this direction in other countries, and have sufficient knowledge of science and industry to formulate profitable schemes of work. The success of such a body depends largely upon the initiative of the secretary; and in an active and effective council we should expect him to be selected because of close acquaintance with problems of industrial development along scientific lines. But what is the position in this case? The scheme is issued by the President of the Board of Education, Mr. Arthur Henderson, a Labour member, who owes his post entirely to political exigencies, the secretary to the committee of the Privy Council is the Secretary of the Board, Sir Amherst Selby-Bigge, whose amiability is above reproach, but who knows no more of practical science and technology than a schoolboy, and the secretary of the Advisory Council is Dr. H. F. Heath, whose interests are similarly in other fields than those of science.

The belief that the expert—whether scientific or industrial—has to be controlled or guided by permanent officials having no special knowledge of the particular subject in hand is typical of our executive system. While such a state of things exists, most of the advantages of enlisting men of science for national services must remain unfulfilled. The various scientific committees which have been appointed recently have, we believe, been able to give valuable aid in connection with problems submitted to them, but they would be far more effective if the chiefs of the departments with which they are associated possessed a practical knowledge of scientific work and methods. Without such experience the executive is at the mercy of every assertive paradoxer and cannot discriminate between impracticable devices and the judgment of science upon them. While, therefore, the country has at its disposal the work—either voluntary or nearly so—of experts in all branches of applied science, it cannot use these services to the best advantage unless the departments concerned with them have scientific men among the permanent officials; and that is not the case at present.

The unbusinesslike methods of Government departments have received severe criticism lately, but nothing has been said about the unscientific method of appointing committees of experts without well-qualified officers to direct or coordinate their work. The reason is that, with scarcely an exception, no daily paper has anyone on its staff possessing the most elementary knowledge of the meaning of scientific research. Our guides and counsellors, both on the political platform and in the periodical Press, can scarcely be expected to interest themselves greatly in subjects beyond their mental horizon, so when scientific matters are involved they confine themselves to a few platitudes, or say nothing at all. They are unable to distinguish a quack from a leading authority in science, and prefer to exercise their imaginations upon sensational announcements, rather than discuss the possibilities of sober scientific discovery. In all that relates to the interests of science—and that means in the end the interests of the nation—the men who influence public opinion and control the public Services are mostly unenlightened and therefore unsympathetic.

The tacit assumption that public committees or departments concerned with scientific problems must have at their head officers of the Army, Navy, or Civil Service is responsible for delay in taking advantage of available expert knowledge and for the neglect to make effective use of science in national affairs, whether in times of war or peace. Just as a member of the Government may serve in turn as president of the Board of Education, Board of Agriculture, Board of Trade, or any other department, without possessing any special qualifications to comprehend the work of either, so a public official may be placed in a position to dominate activities of which he cannot understand the significance. Some day we hope that this mad system will be swept away, and that the men who exert control in all Government offices will be those whose training or experience make them most capable of doing so effectively.

Neither the political nor the official mind in this country yet realises the power which science can give to the modern State; because classical and literary studies still form the chief high-road to preferment in Parliament or in public offices. From the elementary school to the university truly scientific work occupies but a very secondary position in comparison with the humanities. In these days the material advancement of a nation must depend upon the developments of science and technology; and care should be taken, therefore, to create interest in these subjects and foster attention to them throughout the curriculum or course of school and college. Many people no doubt believe that this is being done, but it is far from being the case, and the promise of a generation ago is likely to be unfulfilled while the power over expenditure upon practical education remains in the hands of men who have no sympathy with it. Men who are distinguished for their scientific work, or have had a practical training in science, are on the staff of the Board of Education, but they are all subordinate to officers whose interests are in other fields; and scientific education suffers accordingly. Thus it comes about that Mr. C. A. Buckmaster, late Assistant Secretary under the Board of Education, could say in an address to the Educational Science Section of the British Association last year:—

"There can be no doubt that there is less real systematic science teaching in our elementary schools than was the case twenty years ago, and that the proportion of the total expenditure on elementary education which can be looked upon as spent in promoting science instruction is decidedly less, not only in proportion, but in amount. . . . It is not too much to say that the weight of official recognition has passed from the scientific to the literary side of the secondary school, and that the time and energy devoted to instruction and practical work in science have shown a remarkable decrease."

Was there ever a more severe indictment of the literary official's inability to prepare the citizens of a modern State for the struggles before them than is contained in these conclusions as to the position of science in our schools? A quarter of a century ago scientific studies were gaining increased attention in the curriculum, and there was reason to hope that one generation would succeed another with greater ability to compete with other progressive peoples, and with increased distrust of political obscurantists and the pretensions of literary culture. We have not gained this power because the control of our educational system from bottom to top has been, and is, in the hands of men without knowledge of modern needs or of the essential difference between the study of words and of things. To the deadening influence of these official representatives of the humanities must be ascribed the deplorable fact that public interest in scientific matters or appreciation of the worth of scientific research is less intelligent, and relatively less extensive, than it was fifty years ago.

To the literary mind, a man of science is a callous necromancer who has cut himself off from communion with his fellows, and has thereby lost the throbbing and compassionate heart of a full life; he is a Faust who has not yet made a bargain with Mephistopheles, and is therefore without human interest. Scientific and humanistic studies are, indeed, supposed to be antipathetic and to represent opposing qualities; so that it has become common to associate science with all that is cold and mechanistic in our being, and to believe that the development of the more spiritual parts of man's nature belongs essentially to other departments of intellectual activity.

When scientific work is undertaken solely with the object of commercial gain, its correlative is selfishness; when it is confined to the path of narrow specialisation, it leads to arrogance; and when its purpose is materialistic domination, without regard to the nobler deeds of humanity, it is a social danger and may become an excuse for learned barbarity. But research is rarely inspired by these motives, nor does devotion to it necessarily inhibit interest in other notes with which a well-balanced mind should be in resonance. Direct contact with Nature and inquiry into her laws do, however, produce a habit of mind which cannot be acquired in literary fields, and they are associated with a wide outlook on life more often than is popularly supposed. Science is not only able to increase the comforts of life and add to material welfare, but also to inspire the highest ethical thought and action; and a prominent place should be given to it in all stages of educational work as much on account of its ennobling influence as because it is a creator of riches.

Success in science means the birth of new knowledge. Patient observation and productive thinking are what the world needs for progress, and what true scientific study demands. There are now so many opportunities of obtaining ready-made opinions that the habits of independent thought, caution in accepting assertion, and critical inquiry into evidence, are suffering atrophy by disuse. *Vox populi, vox Dei*, may be a sound democratic principle for political platforms, but it stands for nothing in science. The men who have advanced the human race throughout the ages are they who have stood for individuality as against the voice of the crowd. We need such leaders now, men who will guide the people instead of waiting for a mandate from them before embarking upon any enterprise; and we need, above all, that the chief officials of departments of State should have had a training in scientific methods before being entrusted with the control of national affairs. While indifference to these things is the distinguishing characteristic of our statesmen and administrative officers, it is useless to expect that the nation's business will be conducted efficiently or its scientific forces be organised on the large scale which modern conditions demand.

ANALYTICAL CONTROL OF MODERN DYES.

The Analysis of Dyestuffs and their Identification in Dyed and Coloured Materials, Lake Pigments, Foodstuffs, etc. By Prof. A. G. Green. Pp. ix+144. (London: C. Griffin and Co., Ltd., 1915.) Price 8*s*. 6*d*. net.

MODERN developments in the manufacture of synthetic colouring matters have now rendered it possible for the dyer to obtain any desired shade of colour in many different ways, but the suitability of the colour to the conditions under which the dyed material is to be employed depends entirely on the blend of dyes selected. It is evident that some analytical control is desirable in order that the most favourable result can be guaranteed.

Largely owing to the labours, extending over many years, of the author and his collaborators, a method has now been devised which is sufficiently comprehensive and elastic to cope not only with all the known dyes, but also with mixtures of these substances.

The three introductory chapters of this work treat of the chemistry of colouring matters and of the classification of these materials according to their chemical and tinctorial properties. In regard to theories of the colour of organic dyes, Prof. Green seems still to be a faithful adherent of the "quinonoid" hypothesis, in spite of the fact that he has himself discovered at least one dyestuff, namely, primuline (p. 21), to which he has not ascribed a "quinonoid" chemical constitution. It should, however, be added that the practical scheme of analysis presented in this manual is based on the tinctorial properties of the dyes, and not on hypothetical views in regard to their chemical structure. An interesting table serves as the summary of these introductory chapters, in which the chief series of colouring matters are doubly classified in accordance with their chemical nature and their dyeing properties. This tabulation indicates in a striking manner the lines along which future research may lead to many still missing groups of dyes.

The analysis of the dyes in bulk leads to a division into four main classes, in which solubility in water, affinity for unmordanted cotton, and precipitation by tannin form the distinctive properties. Further subdivision is effected by successive experiments on the reduction of the dyes and the oxidisability of their reduction products. Owing to recent intense activity in the manufacture of synthetic dyes, each subdivision nowadays contains apparently many members, but, on the other hand, many of the names under which dyes appear are only synonyms employed by different firms.

Although it is sometimes practically impossible to identify the specific dyes on any fabric, yet the author's scheme of analysis enables the analyst to refer these substances to their appropriate classes, after which complete identification may be achieved by comparative dye-tests with standard dyes of known constitution.

After a reference to the detection of artificial dyestuffs in articles of food, the scheme for identifying colouring matters on animal fibres is elaborated. The dyed fabric is subjected to "stripping tests," and also to the action of a reducing agent—in this instance, sodium formaldehyde-sulphoxylate (Rongalite). Separate tests are described for indigoid dyes and for mordants, and a few principles are laid down for the examination of woollen fabrics dyed with mixtures of dyes. In such cases, fractional reduction and "stripping" tests are useful, together with fractional separation by means of solvents.

The problem presented by dyed vegetable fibres is much more complicated than that arising from dyed wool. Many basic dyes, which, when applied to wool, are readily reduced by sodium hydrosulphite, are scarcely attacked by this reagent when they are fixed on tannin-mordanted cotton. Accordingly, the tannin mordant must first be removed by boiling the fabric with caustic soda solution saturated with sodium chloride, the latter compound being added to avoid stripping off the dye.

Certain azo-colours, especially the insoluble "ingrain" azo-derivatives formed on the fibre, offer considerable resistance to the reducing action of ordinary hydrosulphite, and are decolorised very slowly and imperfectly. To overcome this difficulty the reducing agent is rendered more active by the addition of a very small quantity of reducible compound or colouring matter. The most convenient catalyst or sensitiser for this purpose is anthraquinone, a small quantity of which is added to the sodium formaldehyde-sulphoxylate solution.

Indigo is still the premier blue dye, and on account of its high price and valuable tinctorial properties, the estimation of pure indigotin either in bulk or on the fibre is a matter of considerable commercial importance. Special attention may be directed to the method for estimating quantitatively the indigotin on animal fibres worked out by the author in collaboration with Gardner, Lloyd, and Frank, since this process affords an accurate means of detecting the great abuses obtaining in the prevalent practice of "topping" or "bottoming" indigo-dyed materials with other inferior colouring matters.

The identification of organic colouring matters, when carried out in the systematic manner advocated by the author, becomes an important branch of analytical chemistry, so that this handbook may be recommended not only to the makers and users of dyes, but also to all students of organic chemistry. The educational value of the treatise is well exemplified in the chapter on the determination of the constitution of azo-dyes, for the methods adopted would go far towards enabling the analyst to identify any one of the very large number of azo-colouring matters at present on the market.

An index of the principal colouring matters shows the position of these dyes in the analytical separations, which are arranged in twenty-six tables.

The present condition of military warfare existing between the principal industrial nations will, in all probability, be succeeded by a period of strenuous industrial competition between the belligerents. During this period the discoverers of new dyes will, for obvious reasons, no longer, as hitherto, endeavour to protect their discoveries by patents, but will rely rather on keeping secret the methods of manufacture and the chemical nature of the products. At this stage the analytical methods systematised by the author will acquire additional importance in their application to the investigation of new dyes of undisclosed constitution.

G. T. M.

RUDIMENTARY SCIENCE FOR COAL-MINERS.

An Introduction to Mining Science. A Theoretical and Practical Text-book for Mining Students. By J. B. Coppock and G. A. Lodge. Pp. x+230. (London: Longmans, Green and Co., 1915.) Price 2*s*. net.

THE object of this little book is to put before the young coal-miner a certain number of facts in elementary science, mainly chemistry and physics, in such a way as to impress them upon him more readily than can be done through the medium of ordinary text-books upon these sciences. Such subjects as combustion, flame, explosion, the atmosphere, mine gases, coal, etc., are treated, each in a short chapter, which commences with a few elementary scientific facts, generally illustrated by reference to phenomena which may fairly be expected to have come under the notice of an average youth, and by a few simple experiments, which the student is intended to repeat; the second part of each chapter indicates the application of the scientific facts thus inculcated to some portion of the miner's experience in the pit. Like all books that set out to teach only such portions of a science as find direct application in any particular branch of technology, this work deliberately sacrifices the educational value of science in order to arrive more rapidly and more easily at the results derived from the acquisition of scientific facts. It is undoubtedly a very good thing that a coal-miner should be thoroughly familiar with the fact that a combustible material intimately mixed with air forms an explosive mixture, but the acquisition of any number of such fragments of knowledge, however valuable in themselves, does not provide the mental training that is obtained by the systematic study of any branch of science. Such a book as the one under discussion should not therefore be regarded as an adequate substitute for scientific education, but at best as an introduction and an incentive to further and more regular study of the sciences involved. It is a book that may fairly be recommended to the higher classes of an elementary school in a coal-mining district, with the hope that it may give the lads a desire to pursue their scientific studies further in evening continuation schools, where they would take a regular course of easy chemistry or physics, or both.

The work upon the whole is well done; the main pitfalls in such a book lie in the direction of slipshod statements on the one hand and over-elaboration on the other. As an example of the former we may quote the statement on page 118 that hydrogen "is a colourless gas, violently explosive," and of the latter the attempt to teach the molecular structure of gases on page 2. The authors have, however, generally succeeded in steering their course fairly between either extreme, and the result is a book which should, as already said, be quite useful to beginners, and will leave them very little indeed to unlearn when they begin to advance further in their scientific studies.

MATHEMATICAL SCHOOL-BOOKS.

(1) *Arithmetic. Parts I., II., and III., complete with Answers.* By C. Godfrey and E. A. Price. Pp. xiii + 467. (Cambridge: At the University Press, 1915.) Price 4*s.*; without answers, 3*s.* 6*d.*

(2) *Pendlebury's New Concrete Arithmetic. Sixth Year.* By C. Pendlebury and H. Leather. Pp. 80. (London: G. Bell and Sons, Ltd.) Price 6*d.*

(3) *Plane Trigonometry.* By H. Leslie Reed. Pp. xiii + 290 + xvi. (London: G. Bell and Sons, Ltd., 1915.) Price 3*s.* 6*d.*

(4) *Statics. Part II.* By F. C. Fawdry. Pp. 159–305 + viii. (London: G. Bell and Sons, Ltd., 1915.) Price 2*s.*

(5) *Numerical Examples in Physics.* By H. S. Jones. Pp. xii + 332. (London: G. Bell and Sons, Ltd., 1915.) Price 3*s.* 6*d.*

(6) *Exercises in Laboratory Mathematics.* By A. W. Lucy. Pp. 245. (Oxford: At the Clarendon Press, 1915.) Price 3*s.* 6*d.*

THE ideal text-book of arithmetic still remains to be written, and the time has not yet come when the ideal book would be a financial success. It will equip the boy or girl with the knowledge of the subject necessary for his other studies and his after-life. It will drop some branches which have in the past had usefulness but are now useless, and it will refrain from dealing with problems the subject-matter of which is outside a boy's experience and unintelligible to him, even if the calculation involved is simple once the subject-matter is understood. The ideal book with our present imperial system of weights and measures will easily be comprised within a hundred pages, and when the imperial system is dropped and the metric system becomes general the length will be further reduced.

The discussion of prime factors, greatest common measure, and least common multiple leads up to the extraction of square and cube roots, the reduction of fractions to their lowest terms, the addition of fractions, and the simplification of complicated expressions. Now the final convenient form for any fraction (except the very simplest) is the decimal form, and instead of reducing a fraction to its lowest terms we turn it straight away into a decimal. For the addition of fractions, in place of the vulgar method with all the labour of common denominators, we convert each fraction to a decimal (to as many significant figures as we need), and then add. Complicated expressions rarely turn up in natural problems; they are in the main the invention of examiners and text-book writers. Very little time, therefore, need be spent upon prime factors, greatest common measure, and least common multiple, and these will occupy little space in the ideal text-book.

"Stocks and shares" should also be omitted. The arithmetic is of the simplest. The trouble is partly in the difficulty of the subject-matter, partly in the unfamiliarity of the subject-matter, and partly in the unsuitable nomenclature, so poor in distinctions between face value and selling value, and so full of terms among which master and boys are equally at sea.

Some schools neglect arithmetic sadly, while others give it far more time than its real worth deserves. The latter group are responsible for the bulk of the present-day text-book, in their demand for endless examples. In these schools the correction of the overcrowded time-table will in time reduce the number of periods allotted to arithmetic, and the text-book will be reduced to a fraction of its present size.

(1) Meantime we have to make the best of present conditions, and Messrs. Godfrey and Price have produced a most usable arithmetic. While compelled to run to above four hundred pages and include all the customary items and tricks (except recurring decimals, for which omission we are thankful), they show in the preface how they would prefer to use the boy's time. Their explanations of difficult points are accurate, concise, and clear; see, for instance, their discussion of fractions. They have regard also to the recommendations of various open-minded and wise bodies, such as the Headmasters' Conference, the British Association Committee on type in school-books, and the Mathematical Association Committee. The book is to be highly recommended; it provides work for the most lavish use of time, and the wise master who limits the time for arithmetic has a wide choice in his selection of work.

There is much gain in clearness of type by the use of the solidus, for instance, in printing "19/20" to stand for nineteen-twentieths, but it is a pity to use the symbol to denote shillings in the same book.

In elementary schools, also, arithmetic is in a bad way. Not that the boys don't do it well. They do it only too well, and can tackle the most abstruse questions which, if done at all, ought to be done by algebra. Further, they can (or are expected to) tackle questions which are unintelligible to the plain, well-educated man; in these questions conventional meanings, used only in schools, are put upon phrases which are otherwise meaningless. That abomination, the recurring decimal, is firmly entrenched in the elementary school, and children are told to commit to memory the expressions as recurring decimals of all proper fractions with denominator 7. After such enormities it seems quite natural to find the children required to add together 6 days and 23 seconds, or 16 kilometres and 2 millimetres.

(2) In the "New Concrete Arithmetic" the authors are doing the best that is possible in the circumstances. The whole gamut of absurdities must be included if the book is to sell, and so long as the present excessive allowance of time is given to the subject it is difficult to provide a sufficient number of varied questions without degenerating at times into unsuitabilities. The idea of first presenting every rule in concrete form is good; it might be carried further, and require every question to be such as naturally arises in human life. It would be still better to require every question to be such as arises in the pupil's own environment, so that there might be a rural arithmetic for the country school and various kinds of industrial arithmetics for town schools. Before such arithmetics are possible, however, the time allotted to the subject must be severely cut down. For to restrict the book to natural human problems and such bookwork as is necessary for their treatment, means the excision of many whole sections.

Let us repeat that we impute no blame to Mr. Pendlebury and Mr. Leather, who do the best that circumstances allow. In everything the book is as good as others of the kind, and in beginning from the concrete it is miles ahead of the bulk of them.

(3) In trigonometry also the mathematical master—or the headmaster or somebody—sets apart too much time for the subject. The time has to be filled in, but how can it be done without "Identities"? Identities being fashionable must be included in any book that is to be a success on the market. Mr. Reed is not to blame; he cannot help himself. First let the time allowed in the school for mathematics as a whole, or for trigonometry, be cut down, and Mr. Reed will write you a good book. He will discard identities, and identities being gone he will discover that secants and cosecants and tangents have no use except for the specialist and for the making of identities, and he will drop them.

In the meantime Mr. Reed does what is possible. He begins the solution of triangles by formulas most of which result immediately from geometrical properties. In the only case that presents any difficulty, that in which three sides are given, the method of solution is due to Prof. Bryan; expressions are found for the sum and difference of the two portions into which a side is divided by a perpendicular from the opposite vertex.

The variety of the questions which are taken from human life deserves high praise; it is only by long-continued effort that they could have been collected.

We regret, however, to find results left in surd form, as on pages 140 and 141, with the remark that they "may be worked decimally." We should have expected Mr. Reed to set a good example by "working them decimally" himself.

(4) This book—"Statics," by F. C. Fawdry—can be confidently recommended. The problems dealt with come from house-building, bridge-building, engineering, and other human activities. We no longer meet the ridiculous and perfectly smooth elephant who balances himself on a perfectly rough cricket ball. The good and simple methods of the engineer, hitherto excluded from the school-book, now come to their own, and the book discusses within the limits of 150 pages the link polygon, Bow's notation, the bending of beams, brake horse-power, and three dimensional problems, and discusses them well. The only fault we have to find is that the author cannot spell *parallelepiped*.

(5) We scarcely know what to say about this book of Examples in Physics. It is most virtuous in drawing all its exercises from human life, or at least from the laboratory. There are none of the wicked old questions that prevailed when an irresistible projectile used to impinge on an immovable obstacle. But, after all, what shall it profit a man to work through all these virtuous questions and be unable to tell a galvanometer from a lens? The examples should surely go with work in the laboratory; and if a man works in a laboratory he finds his own data there, and does not want to have them supplied in a book.

(6) This is a good, honest, plodding book, providing all the intellectual apparatus we are entitled to get under the name of "Laboratory Mathematics," but scarcely with the clearness of statement and crispness of effect that the ideal book would have. The attempt to consider weight and mass separately is somewhat ambitious for a book of this range; until quite an advanced stage it is better for the student to be content with one of them. Again the term "specific density" is unfortunately like "density" to use for so different a meaning as the author gives it, and the distinction between "specific density" and "specific gravity" is too subtle for the ordinary mortal.

D. B. M.

OUR BOOKSHELF.

Amoebiasis and the Dysenteries. By Prof. L. P. Phillips. Pp. xi+147. (London: H. K. Lewis, 1915.) Price 6*s.* 6*d.* net.

DYSENTERY is a clinical term used to denote disease conditions running more or less the same course, but dependent upon various ætiological agents. The subject is one of great and growing importance, and the advance in our knowledge of it has of late been considerable, but the literature is much scattered. In the volume under review Dr. Phillips has summarised the whole subject, and has compiled a book which should be of considerable value and assistance to all those who have to deal with this disease.

The various forms of dysentery are discussed from the point of view of their causation, viz., amœbiasis or amœbic infection, ciliate and flagellate dysentery, bilharzial dysentery, and bacillary dysentery. Amœbic dysentery is caused by infection with an amœbiform protozoon, now known as the *Entamoeba histolytica.* A full description is given of this parasite and of its differentiation from other forms of amœbæ. There is so far as at present known only one organism causing amœbic dysentery, and this cannot be artificially cultivated, though several saprophytic forms seem to have been grown in the laboratory.

There is undoubtedly a form of dysentery due to infection by a ciliate organism, *Balantidium coli*, and the disease is probably not so rare as the published cases seem to show. Several flagellate protozoa are also under suspicion as causal agents in dysentery or dysenteric diarrhœa.

A very chronic form of dysentery is associated with bilharzial infection of the large intestine, particularly in Egypt; the parasite in this case is a worm. Lastly, there is the bacillary form of the disease, due to a bacillus of world-wide distribution, and apt to occur in epidemics, thus differing from amœbic dysentery.

Under each section, besides the description of the parasites, the symptoms and treatment are detailed so that this work forms a complete handbook on the subject of dysentery. A useful bibliography is appended.

R. T. H.

Alcoholometric Tables. By Sir Edward Thorpe. Pp. xiv+91. (London: Longmans, Green and Co., 1915.) Price 3*s.* 6*d.* net.

THE handy little book of alcohol tables prepared by the late Dr. Stevenson has been out of print now for several years, and a convenient volume, arranged on similar lines and brought up to date, has been a long-felt want. This is fully supplied by the tables under notice, which were compiled under Sir Edward Thorpe's directions at the Government Laboratory. They are based, as regards their main portion, upon the work of Blagden and Gilpin, Drinkwater, Mendeléeff, and the Kaiserliche Normal Eichungs Kommission. The first table shows the percentage of alcohol by weight and by volume, and the percentage of fiscal proof spirit, in aqueous solutions of ethyl alcohol of different specific gravities. The latter are given to four places of decimals, but for the even numbers only (*e.g.*, 0·9172, 0·9174, etc.). The one criticism suggested is whether it would not have been worth while to include the odd numbers as well. True, this would have made the book about half as large again, but it would have saved the user many small calculations.

The other tables serve for the comparison of the spirit values adopted for fiscal purposes in this country with those of the principal foreign countries. They show the indications of Sikes's hydrometer, with the corresponding percentages of British proof spirit, American proof spirit, and alcohol as evaluated on the French, German, and

Tralles systems. They give also the corresponding indications of the hydrometers used in Russia, Holland, Spain, and Switzerland.

All the tables are well arranged, well printed, and well spaced, with figures in large type: this all makes for accuracy and convenience in use.

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.*]

Rule for Determining Direction of Precessional Movement.

THE method of determining the sense of the precession is usually given in the following way:—"If the axis of angular momentum and the torque axis are drawn in the same sense (that is, for the same direction of turning), then the axis of angular momentum sets itself towards the torque axis."

By this method we must imagine the axis of rotation and torque, which cannot be seen directly. By the following method this is not necessary:—

"If you stand at one end of the axle of the gyroscope, it will precess in the same sense to the rotation of the wheel, as seen by yourself." Here, the moment of force due to your own weight determines the tilting couple. According to my experience, this is a very convenient and practical rule for the direction of precession of a gyroscope. W. WATANABE.

34 Waldegrave Park, Twickenham, September 28.

I AM obliged by your courtesy in allowing me to see Prof. Watanabe's communication. He sent me his rule some little time ago, but by an accident which I regret his letter did not receive immediate attention.

I take it that what Prof. Watanabe's very concise statement suggests is the following. Imagine the gyrostat, supported, let us say, at a point on its axis of symmetry, with that axis inclined at an angle θ to the upward vertical, and precessing under a couple produced by a gravity force applied at a point on the axis of symmetry. If that force be due to the weight of an observer standing on the axle and looking towards the spinning flywheel, the axle, with the observer, will be carried round in azimuth in the direction in which he sees the part of the wheel looked at carried by the rotation.

This is quite correct and convenient if it is the upper part of the wheel that is looked at, and if the precession is, as it is almost always taken to be, and usually is, that given by the numerically smaller root of the quadratic equation which determines the steady motion of the gyrostat for a given value of θ. But, except in the case of $\theta=90^\circ$, when the larger root is infinite, it is possible, by properly starting the gyrostat, to realise the precession given by the numerically larger root. This is the "adynamic" precession, so called because to a first rough approximation, this precession, if the gyrostat is rapidly rotating, is independent of the applied couple. In this case, when also θ is greater than 90°, and the roots are therefore opposite in sign, Prof. Watanabe's rule must be reversed. But it is to be noted also that, in these unusual circumstances, neither does the rule hold that the axis of spin follows the couple axis. A. GRAY.

The University, Glasgow, October 7.

The Meaning of "Chincough."

IN the notice (NATURE, October 7, p. 141) of the book, "A Chaplet of Herbs," the expression "chincough" is explained in parenthesis as "(hiccough)." The word is in everyday use in this country, and never in any other sense than the whooping-cough; its etymology being understood as connected with the French *chien*=a dog.

The popularly recognised cure for hiccup in children used to be, and may be still, to "frighten it away" by some sudden and discomposing question. It often proved to be quite efficacious. W. E. HART.

Kilderry, Londonderry, Ireland, October 10.

FELLOWSHIPS FOR INDUSTRIAL RESEARCH.[1]

THE subject of the pamphlet referred to below is one of first-rate importance, especially at the present time of crisis in certain branches of manufacture, the cause of which has been attributed to failure to link science and industry.

The experiment referred to is one devised by the late Prof. Duncan, of the University of Kansas (and later of Pittsburgh). It begins by insisting that technical training should not cut into the full graduate course in pure science. The failure to co-ordinate academic training with industrial methods is attributed to mistakes on both sides. It is urged on the side of industry that current industrial practice is always ahead of text-book presentation, that academic methods are too minute and cumbersome, and that whilst strict scientific accuracy is essential in a pre-graduate course, it must give place to less accurate time-saving processes in the factory.

The university professor is also accused of regarding the utilisation of science for human needs as more or less degrading to science itself, and that in consequence he is careless in selecting a chemist possessing the right qualifications; for as Dr. Duncan asserts, industrial research demands all the qualities which are necessary for success in pure science, together with ability to control workmen.

The case against industry is much more searching. Dr. Duncan considers that the failure on the part of the factory to appreciate the advantage of applied science is due to an incapacity to select chemists, inexperience in dealing with them, and ignorance of the facilities in the way of laboratories and libraries which should be placed at their disposal. He states that he has met with instances of chemists of high training, creative power, and practical character who are overburdened with routine drudgery and subjected to the interference of factory foremen, and are working under an entire misapprehension on the part of the officials of the company as to their possibilities and value. Moreover, it is pointed out that the manufacturer may not know the real nature of the problems which have to be solved, their relative importance, or the kind of knowledge required for their solution. He has no means of judging the qualifications of the men available for his researches

1 "An Experiment in Industrial Research." By T. L. Humberstone. Board of Education: Educational Pamphlets, No. 30. (London: Wyman and Sons, Ltd.) Price 4*d*.

or the expenditure on laboratories and equipment which the work would entail. He has had no experience of co-ordinating research work with the operations of the factory or of estimating the progress made. In short, though the pamphlet does not say so in so many words, the manufacturer is accused of ignorance of the scientific side of his industry.

Having thus presented the difficulties on both sides, Mr. Humberstone, the author of the report, proceeds to formulate Dr. Duncan's scheme of industrial research fellowships.

"Under this scheme a contract is entered into between the manufacturer and the university in which the object of the research is precisely defined. The contract provides that the fellow selected to conduct the investigation desired shall devote his whole time to the research with the exception of three hours a week, which he may devote to instructional work in the chemical department. The fellow is a member of the university, and pays all the regular fees with the exception of fees for laboratory and supplies, for which the instruction he gives in the university is accepted in lieu, unless in the opinion of the university his demands become excessive, in which case the manufacturer who provides the funds for the fellowship is expected to reimburse the university.

"In some instances the manufacturer makes a specific grant for expenditure on apparatus. The contract further provides that the fellow shall work under the direction of the professor of industrial chemistry, and shall forward to the manufacturer periodically through the professor reports on the progress of the work. The manufacturer agrees to pay to the university an annual sum for the emoluments of the fellow during the tenure of the fellowship, which ordinarily extends to two years."

A clause follows relating to the proprietorship of inventions made by the fellow, providing usually for a payment of ten or some other percentage of the net profits arising from discoveries, to be commuted at the desire of either party for a sum fixed by arbitration, and there are certain other details in regard to the publication and use of the discovery.

The advantages claimed under this scheme are that the university profits by the presence of men engaged in researches, which, though utilitarian in their object, may often throw light on questions of purely scientific interest. The university also secures the services of post-graduate students as instructors, and the influence of such a body of men who are keen on their particular work and enthusiastic as to the value of research, is an asset of considerable value. The manufacturer derives advantage from the resources of the well-equipped laboratories, museums, and libraries, and from the facilities offered to the fellow for consulting the staff of his own and other departments of the university when unforeseen difficulties present themselves, whilst at the same time the manufacturer is free from the responsibility of selecting the specialist (which is done by the university) or of supervising his researches.

The advantages of the scheme to the selected fellow are obvious. He is brought into direct contact with a manufacturer and a specific problem, and carries on his investigation under the advantage of being free from interference by foremen or managers. He has also opportunities of consulting a well-appointed library, of obtaining assistance from colleagues, and occasion to test his process under industrial conditions. Moreover, the researches may be put forward in his candidature for the doctorate of the university. The report concludes with an account of the practical working of the scheme, and the remarkable variety of problems which have been submitted to investigation.

The only point which the writer regards as open to serious criticism is that the industrial research of whatever character, whether connected with organic, inorganic, or physical chemistry or physics, is conducted in a special laboratory under the absolute jurisdiction of the director of the industrial research laboratories, instead of being carried out in that department which is specially concerned with the particular problem. Apart from this, the scheme appears to offer many advantages in the present condition of the scientific industries in this country, as well as in America. Whether it is an ideal scheme is another question. It is true that in Germany there are chemists working out in the university laboratories problems which have an industrial object, but the great bulk of such research is restricted to the splendidly equipped works laboratories. The reason for this is a simple one. The managers are trained men of science (as many are in this country) who know the methods of research and the value of the research chemist. They have no need of a director of industrial research. They are in a position to direct it themselves.

J. B. C.

CONSTRUCTIONAL DATA OF SMALL TELESCOPE OBJECTIVES.

THE National Physical Laboratory has recently published through Messrs. Harrison and Sons a pamphlet with the above title. This has been prepared at the request of the Director-General of Munition Supplies, and is primarily intended for the assistance of manufacturers of optical instruments who are engaged in the production of optical munitions. The glasses on which the calculations are based are in all cases taken from the most recent catalogue of optical glasses issued by Messrs. Chance Bros. and Co., of Birmingham (February, 1915). The comprehensive character of the tables may be gauged from the fact that all the dense flints of this catalogue are severally combined with all the crowns, two dense barium crowns of high refractive index alone being excepted.

Although the theoretical conditions which it is desired to satisfy in the case of these small objectives are identical with those which determine the construction of large telescope objectives, other considerations which are of little importance in the one case can by no means be neglected in the other, and it thus happens that the objectives described in these tables are not given the forms determined by the astronomical telescope conditions—freedom from colour, central spherical aberration, and coma—but one of these is deliberately sacrificed to enable the crown and flint components to be cemented together. This leads to the consideration of six forms of objective, three of which have the crown lens before the flint and three with these lenses in the reverse order, two forms of each set of three being free from colour and from central spherical aberration, and one free from colour and from coma. Each of these forms is described in a separate group of tables.

With most of the glass combinations one of the forms with the crown lens placed before the flint has the two surfaces of the crown lens of nearly equal curvature, and a set of tables is included devoted to lenses in which these curvatures are exactly equal. Such lenses offer the very considerable advantage when rapid output and low cost is of importance, of requiring only two sets of tools for their production, one set corresponding to the equal curvatures of the crown lens and the surface of the flint lens which will be cemented to a face of the crown component, the other set being, of course, for the second surface of the flint lens.

To each group of tables giving the constructional details of its own particular type of lens is added a table showing the amount of the aberration—coma or spherical aberration, as the case may be—which has unavoidably been retained in consequence of the restraint imposed by the condition that the two components are to be cemented to one another. A glance at these tables shows which form of objective and what combinations of glasses are the most suitable to employ in various circumstances. The physical interpretation to be placed on these quantities is explained in a note which prefaces the tables. For convenience in reference all the tables relating to one form of objective are placed on a single opening of the pamphlet.

The fundamental tables relate to lenses in which the thicknesses are negligible. A second set of tables is added, showing the alterations in focal length produced by standard thicknesses, which are taken to be 1/40th of the focal length for the crown component and 1/80th of the focal length for the flint lens, and also the corrections to the curvatures which are necessary to give the thick lenses the same focal length as those of negligible thickness. For convenience in making such corrections the principal set of tables give the curvatures of each lens surface in addition to their radii of curvature. The foregoing particulars suffice to show that the pamphlet should not only be of immediate use to those for whom it has more especially been prepared, but should prove of permanent value to all who are engaged in the construction of small objectives. It may be obtained from the publishers, Messrs. Harrison and Sons, 45 St. Martin's Lane, London, W.C.; price 2*s*. 6*d*., plus postage.

The laboratory authorities state that it is hoped later to supplement this publication by a further paper dealing with the corrections which may be necessary for object glasses of somewhat larger size. They may also undertake further optical calculations needed to perfect instruments required by the naval and military authorities if it seems to them desirable.

T. SMITH.
R. W. CHESHIRE.

JEAN-HENRI FABRE.

IT is more than half a century since Darwin quoted Fabre in his "Origin of Species" and called him "that inimitable observer." Yet he has been with us and working till the other day—a resolute veteran, in spite of his extraordinarily hard and strenuous life, from which he wrung out the joys of discovery and devotion. In this sense he lived a successful life, and he had other rewards—the appreciative esteem of expert entomologists; the admiration of those who have enjoyed his intimate descriptions of the life and work of insects and his singularly vivid style; the encouragement of good friends, such as John Stuart Mill and Mistral; but one cannot escape the regret that, through imperfections in contemporary social organisation, his genius, which was marked by a unique blend of observing power and sympathetic insight, was through a large part of his life unduly distracted and inhibited by the cares of keeping up the supply of daily bread. Perhaps on his own side he carried the spirit of independence to an extreme. In any case there is a pathetic ring in his own words, a short time ago, about his life, that it "had not been exempt from many cares, nor very fruitful in incidents or great vicissitudes, since it had been passed very largely, especially during the last thirty years, in the most absolute retirement and the completest silence." The ten volumes of the "Souvenirs Entomologiques," many of the best chapters of which have been translated into English, remain as Fabre's lasting monument. They show us an observer of insects, second only to Réaumur, who was able, in a way all his own, "instinct pursuing instinct," as has been well said, to get at the insect's point of view.

After a somewhat disappointing early struggle as a professor at Ajaccio and Avignon, Fabre recoiled from conventionalities and settled down on a little desert corner near Orange, in the lower Rhone, and subsequently at Sérignan, and gave himself up to entomology. His studies were occasionally anatomical and physiological, and he watched many life-histories; but he was pre-eminently the student of animal behaviour. His work is marked by strong vitalistic convictions, organism to him transcending all mechanism; by a belief in instinct as a big underivable fact, quite different from intelligence; and by a strong prejudice against Darwinism, even against evolutionism. "The facts that I observe," he said, "are of such a kind that they force me to dissent from Darwin's theories." It is not evident that he studied these theories, or those that have developed from them, with the open mind and carefulness with which he approached his insects in the Orange wilderness, but he felt that they were all too mechanical, and perhaps he was not far wrong. He did not, however, criticise constructively, or take account, so far as we know, of evolutionist yet not Darwinian positions, such as that of Samuel Butler, with whom he would have found himself, in his recoil from the mechanistic, in hearty sympathy.

While Fabre's aloofness from evolutionist interpretation must be regarded as a defect in his scientific work, there is surely truth in what has been said, that "in his sense of the dignity of facts; in his high standard of precision; in his appreciation of the trivial, Fabre came, in spite of himself, into fellowship with Darwin." Perhaps he occasionally read too much of the man into the insect—and he was himself as much a man of feeling as a man of science—but he made a big contribution to the interpretation of animate nature by his convincing evidence of its pervasive mentality and purposiveness. Fabre was a Chevalier of the Legion of Honour and a corresponding member of the Institute.

NOTES.

As an outcome of the recent Manchester meeting, the British Association has invited the following gentlement to serve on a committee to consider and report upon the question of fuel economy (utilisation of coal and smoke prevention), from a national point of view:—Prof. W. A. Bone, of the Imperial College of Science and Technology, London (chairman); Mr. E. D. Simon, chairman of the Manchester Air Pollution Committee (secretary); Profs. P. P. Bedson (Armstrong College, Newcastle-on-Tyne), J. W. Cobb and J. B. Cohen (Leeds University), H. B. Dixon (Manchester University), Thomas Gray (Royal Technical College, Glasgow), H. S. Hele-Shaw (London), L. T. O'Shea and W. P. Wynne (Sheffield University), and Richard Threlfall (Birmingham), together with Dr. G. T. Beilby (Glasgow), Mr. Ernest Bury, and Dr. J. E. Stead (Middlesbrough and the Cleveland district). The committee, which is empowered to add if necessary to its members, has been selected so as to include representative chemists, engineers, and technologists from all the principal industrial areas.

WE are informed that the council of the University of Manchester has received from an anonymous benefactor the sum of 1368*l.* to pay off the debt which remained on the new extension of the museum that was added recently for the housing of the Egyptian antiquities and of collections of minerals.

AN exhibition of photographs in monochrome and natural colours, by Mr. H. Essenhigh Corke, will be open free to the public, on presentation of visiting card, at the Royal Photographic Society of Great Britain, 35 Russell Square, W.C., until Saturday, November 27, daily from 11 a.m. until 5 p.m.

THE death is announced, in his eighty-six year, of Mr. Charles Fortey, who was for many years honorary curator of the Ludlow Natural History Society's Museum. He is gratefully remembered by many geologists and palæontologists for the manner in which he made the unique collection of Upper Silurian fossils in his charge available for purposes of research.

THE death is announced in *Science,* in his eighty-second year, of Prof. W. Watson, from 1865 to 1873 professor of mechanical engineering and descriptive geometry in the Massachusetts Institute of Technology, and since 1884 recording secretary of the American Academy of Arts and Sciences.

IN 1903, at the International Geological Congress, Mr. Emmons, supported by the late Prof. E. Suess, proposed the establishment of an institute for the study of geological physics. A preliminary meeting was held on October 14, with Prof. Benjamin Moore in the chair, at which it was decided to form forthwith a society for the encouragement and study of geological physics, commencing with the subject of segregation in rocks. Under the presidency of Prof. Moore the society hopes to do good work by the exchange of specimens, photographs, and literature between its members. An annual subscription of 2*s.* 6*d.* has been fixed for the first two years. Communications are invited by the hon. sec. *pro. tem.,* Mr. G. Abbott, 2 Rusthall Park, Tunbridge Wells.

WE mentioned in our issue of July 8 (p. 514) the case of an officer who had sent to the Natural History Museum at South Kensington the skins of some small animals trapped by him in the trenches in northern France. Dr. Ugolini, of the Royal Technical Institute at Brescia, Italy, writes to tell us that one of his four sons serving in the Italian Army, a doctor of natural science, has been able amid the perils of war on the high mountains of the Trentino, to make valuable geological observations, and to collect and dry plants of particular botanical interest. The keen naturalist always makes use of opportunities of acquiring knowledge; and no doubt many other instances could be given of the persistence of this ruling passion under conditions in which scientific work would scarcely be expected.

THE death is announced, in the *Engineer* for October 15, of Mr. J. S. Graham, the general manager and a director of the Northumberland Shipbuilding Company, Ltd., of Howden-on-Tyne. Mr. Graham was born at Kingborn, Fifeshire, in 1864, and had varied experience in shipbuilding. A notable piece of work under his charge was the construction and delivery of the Havana pontoon dock. During the Spanish-American war he returned to this country, where he joined the Northumberland Shipbuilding Company in 1898.

THE Aristotelian Society will begin its session on November 1 with the inaugural address by the president, Dr. Wildon Carr, on "The Moment of Experience." At the second meeting on December 6, Lord Haldane will read a paper on "Progress in Philosophical Research." Some papers of specially scientific interest are announced, including one by Prof.

Whitehead, on "Space, Time, and Relativity," and one by Prof. Nunn, on "Sense-data and the Physical Object." There will be two symposia, one on "Recognition and Memory," and one on "The Theory of the State."

THE death is announced, at eighty-two years of age, of Colonel T. E. Vickers, C.B., who played a leading part in the development of the great steel firm of that name. He was (says the *Times*) among the pioneers in the early 'seventies of the open-hearth process of melting steel, and achieved a great success, notwithstanding the paucity of scientific knowledge and the lack of instruments for ensuring precision in regard to temperature, etc. The River Don works, now one of the great industrial establishments of the country, were inaugurated in 1866, in order to meet the increased demands resulting from early successes, and since then developments have followed each other in rapid succession in connection with heavy forgings, gun-making, armour manufacture, shipbuilding, and corresponding industries, so that long before Colonel Vickers's retirement in 1909 the firm had become one of the most renowned in the world. Colonel Vickers was awarded the Howard quinquennial prize by the Institution of Civil Engineers, "in recognition of the part taken during his career in developing and improving the production of steel for important engineering purposes."

IN view of the possibility of fires which may arise from further attacks by hostile aircraft, the Commissioner of Police of the metropolis directs attention to the warning published in June last, recommending that a supply of water and sand be kept readily available for dealing with incendiary fires. It is suggested that chemical liquid fire extinguishers should not be purchased without a written guarantee that they comply with official specifications. The specification issued by the Board of Trade (Circular 1560) has reference to the ordinary type of extincteur in which water charged with carbonic acid gas is used as the extinguishing liquid; it indicates the chief points of construction, testing, and maintenance to which attention should be directed in connection with such apparatus. As regards dry powder fire extinguishers, the public is warned that no trust can be placed in them for effectively controlling fires such as are likely to be caused by bombs, whether explosive or incendiary. In dealing with such outbreaks of fire, the prompt and intelligent use of water or sand, or of both, is considered to be the best, simplest, and most economical procedure.

WE regret to announce the death of Dr. Charles Callaway, of Cheltenham, who was one of the pioneers in the study of the Archæan rocks of the British Isles. Dr. Callaway was born at Bristol in 1838, and was educated for the Nonconformist ministry, which he afterwards relinquished for education work and geology. In 1874, when he read his first paper before the Geological Society, much remained to be done in distinguishing the Cambrian rocks from those of earlier date, and in establishing the broader grouping of the latter. The extent of his geological work is shown by the fact that more than twenty papers by him have been published in the Quarterly Journal of the Geological Society, descriptive of the older rocks of Shropshire, the Malverns, Anglesey, Assynt and other regions in the north-west Highlands of Scotland, and parts of Ireland. In some of these regions he was the first to identify the occurrence of subdivisions of the Cambrian rocks and to ascertain their relation to the Archæan groups. In the latter he introduced the terms Uriconian and Longmyndian. The value of his work was recognised by the award to him in 1885 of the Wollaston Fund of the Geological Society, and in 1903 by the award of the Murchison medal. Among the more important of his papers in the Quarterly Journal of the Geological Society may be mentioned "The Pre-Cambrian Rocks of Shropshire" (1879–1882) and "The Age of the Newer Gneissic Rocks of the Northern Highlands" (1883), but many others have been published in the *Geological Magazine* and in the Proceedings of the Cotteswold Naturalists' Field Club, of which he was a past-president. Dr. Callaway was also a writer on ethical subjects.

To the October number of the *Fortnightly Review* Mr. J. B. C. Kershaw contributes an article on the scientific and engineering aspects of the war. It is pointed out that this is the first great war in which the striking advances of scientific knowledge of recent years have been allowed full play, and how great has been the influence in every direction. The subject is dealt with under four headings—the petrol motor and its application to land transport and aviation; smokeless powders and high explosives; the use of inflammable liquids and poisonous gases; the legal and moral aspects of some of these recent developments. The combination of high power with lightness in weight of the petrol motor rendered possible, first, the automobile, and then the dirigible balloon and aeroplane. The automobile has revolutionised the question of supplies to the front, and warfare on its present scale would otherwise have been impossible; troops fighting in districts long since denuded of food supplies are remarkably well catered for, and the inhabitants saved from starvation. The haulage of heavy siege guns, the use of armoured motor-cars, the rapid movement of troops, and the efficient motor ambulance service, all emphasise the utility of the petrol motor. The results from aviation are of immense importance—in directing and controlling artillery fire, and in observation work. Discussing explosives, the writer, having described briefly the compositon and characters of smokeless and high explosives, points out how the invisibility on discharge in daylight enables batteries to be hidden, and how the sniper is able to perform his deadly work undetected. The section on the use of inflammable liquids is largely historical, "Germany's step forward in this direction, however, in reality is a step backwards towards barbarism," the use of such methods dating back to very early times.

A VALUABLE memoir on the evolution and morphology of the Palæozoic star-fishes and brittle stars has just been published by the United States National Museum (Bulletin 88). The author, Mr. Charles Schuchert, remarks that throughout the Cambrian system not a single star-fish has yet been discovered, from which he infers that the skeleton was not evolved until the Lower Ordovician, "where they will surely be found." The Ordovician Hudsonaster he regards as the ancestor of the asterids of the Phanerozonia type. Numerous diagrams in the text and several excellent plates illustrate this difficult theme.

THE autumn number of *Bird Notes and News* contains much readable matter in regard to the effect of the war on bird-life in France and Flanders. Swallows returning this spring to their accustomed nesting sites only too often found them reduced to a heap of ruined masonry. In such cases huts erected for military purposes have been adopted as substitutes. This fact shows the tenacity with which these birds cling to their old haunts. Birds roosting between the lines of the opposing forces have on more than one occasion given timely warning to the sleeping men of the near approach of poison gas fumes, by the rustle of their wings and low cries as they passed over our trenches. Except, indeed, when actually within the zone of fire the birds have shown themselves strangely indifferent to the strife around them. Some valuable data in regard to birds in relation to agriculture are also given in this number.

THE *Psychological Bulletin* (vol. xii., No. 8) contains a valuable summary of recent literature on habit formation, imitation, and higher capacities, in animals. The difficult task of summarising the work done in this field has been skilfully performed by Mr. John Shepard. All kinds of animals have been experimented on, from fiddler-crabs to monkeys. A series of studies carried out with pigs, by Messrs. Yerkes and Coyurn, on the multiple choice method, convince the authors that they have established an approach to "free ideas" in that animal. Though visual and kinæsthetic factors in the main determine the responses, the pig, they consider, is more independent of the particular situation than is the crow. The same number also contains a similar summary, by Mr. K. S. Lashley, on sensory discrimination in animals. The experiments recorded are mainly those concerned with responses to light, sound, touch, and smell. Echinoderms, molluscs, and insects, frogs, birds, and various mammals furnished the material for these investigations.

THE October number of *Irish Gardening* contains some extracts of letters written in August by Mr. C. F. Ball, the editor, to Sir F. W. Moore, in which some interesting accounts of the vegetation on the Gallipoli peninsula are given. It is with great regret that we have received the news that Mr. Ball was recently killed in action in the Dardanelles. Mr. Ball, who received his horticultural training at Kew, was assistant to the keeper of the Royal Botanic Gardens, Glasnevin, and, on the outbreak of the war, volunteered for service, and enlisted in the 7th Royal Dublin Fusiliers.

THE new garden plants described in English and foreign botanical and horticultural publications during the year 1914 are brought together in a complete list in appendix iii. of the Kew Bulletin. Some 350 new plants, varieties and hybrids, are enumerated. In the case of hybrids the parentage, where known, is given, and the place of origin. In the case of new plants a brief description is appended, the country of origin stated, and the name of the introducer. This publication, which is produced annually at Kew, should prove indispensable to the maintenance of a correct nomenclature, and affords valuable information in a concise form respecting new plants under cultivation, abstracted from a very large number of scattered publications.

A CENSUS report on the mosses of Ireland occupies No. 7, section B, of vol. xxxii. of the Proceedings of the Royal Irish Academy. As far as possible the earliest and latest known records are given for each species, except in the case of the commonest and widely distributed species. The divisions of Ireland adopted in Mr. Praeger's "Irish Topographical Botany" are used. Since the publication of David Moore's "Synopsis of the Mosses of Ireland" in 1872, 118 mosses new to Ireland have been recorded, and forty-two of these are recorded for the first time in the present report. The list of records is preceded by a very interesting account of the progress of muscology of Ireland, giving details of the various collectors and their contributions. John Ray is the first to mention mosses in Ireland, and these were probably collected by William Sherard, of Oxford. To David Moore our knowledge of the mosses of Ireland is very largely due, and he added sixty-seven species and varieties to the Irish flora. A useful bibliography of papers dealing with Irish mosses is also included in the report.

THE second part of Father E. Blatter's "Flora of Aden" has recently been published as vol. vii., No. 2, of the Records of the Botanical Survey of India. Part i., which appeared in 1914, consisted of a general account of the flora and of the physical aspects of the country, and was accompanied by a large scale map of the district; the present part deals entirely with a systematic account of the flora. A synopsis of the natural orders—Ranunculaceæ to Urticaceæ—is given, and the families, genera, and species are fully described; keys are also given for the genera and species. The indigenous species number 250, distributed under 138 genera; 33 of these species belong to the grasses, 32 to the Leguminosæ, 18 to the Capparidaceæ, 13 to the Euphorbiaceæ, 11 to the Chenopodiaceæ and Boraginaceæ, and 10 to the Compositæ. Most of the other families are represented by only one or two species. It is of interest to notice that the three plants belonging to the family Burseraceæ found at Aden are the well-known myrrh, *Commiphora abyssinica*; balm of Gilead, *Commiphora opobalsamum*; and frankincense, *Boswellia Carterii*, about which Father Blatter gives some interesting historical details. Much of our information about the flora of Aden is due to the collections of passing travellers, who may have spent only a few hours on shore, but their labours brought together in systematic form make a valuable contribution to our knowledge of the little-known vegetation of southern Arabia.

THE origin of certain valleys in Cleveland, Cumberland, and elsewhere, which have generally been attributed to overflow streams from ice-dammed lakes, has been investigated by Prof. T. G. Bonney. His conclusions are published in a pamphlet ("On Certain Channels," Bowes and Bowes, Cambridge, 1915). Prof. Bonney contends that these channels are relics of an ancient drainage system, in the case of the Cleveland ones, post-Jurassic, if not post-Cretaceous, and in the case of the Cumberland ones, probably pre-Triassic; but, at any rate, in all cases long anterior to the Ice age.

IN the Bulletin of the American Geographical Society (vol. xlvii., pp. 672–80) Prof. R. de C. Ward returns to the discussion of the climatic subdivisions of the United States. Such divisions must be chosen in relation to cyclonic and anticyclonic tracks and movements, and local and characteristic weather distribution around high and low pressures. Changes in climate in the United States are met with in going east and west, and not north and south. The climatic subdivisions must therefore be separated by meridional and not latitudinal lines. East and west boundaries are largely arbitrary. The main divisions arrived at are five, an eastern province and a gulf province, both bounded on the west by the 2000-ft. contour, that is, about 100° W., a plateau province extending west to the generalised line of the main Rocky divide, a plateau province bounded on the west by the Sierra Nevada-Cascade divide, and a Pacific province. The last three are subdivided into northern and southern regions about 43° N.

THE use of a new type of submarine for hydrographical work is described by Mr. Simon Lake in the *Scientific American* (vol. cxiii., No. 13, September 25). The submarine employed is connected with a surface vessel by an access tube. Power is transmitted from a dynamo on the surface vessel to the submarine, which is provided with a single pair of toothed driving wheels at its bows, capable of being turned in any direction. From the air chamber in the submarine a diver can leave the vessel to examine the sea bottom. The author advocates the use of this type of vessel in pairs for harbour contouring. Two such vessels, each with its surface vessel, and linked together by two wires, the upper for telephoning purposes, and the lower one to locate obstructions, steer parallel courses half a mile apart. Any obstruction between the submarines would cause a pull on the wire, and the rock could then be located by one of the vessels steering towards it, reeling in the wires as it went. Mr. Lake omits to say whether his method has proved practicable. If successful it would certainly give more accurate hydrographical data than can be obtained by the sounding machine alone.

AN earthquake was felt throughout a large part of Cumberland and in the surrounding counties on October 2 at about 3.15 a.m. The disturbed area, which extends from Newcastleton in Dumfriesshire on the north to Langdale and Troutbeck on the south, and from Silloth on the west to beyond Kirkoswald on the east, is about fifty-five miles long from north to south, and about thirty-seven miles wide, and contains about 1600 square miles. It thus seems almost co-extensive with the disturbed area of the Carlisle earthquake of July 9, 1901 (Quart. Journ. Geol. Soc., vol lviii., 1902, pp. 371–6). This earthquake, according to Dr. Davison, was a twin earthquake, originating in a long deep-seated fault directed N. 5° E., underlying the complicated formations of the Lake District. The principal focus was situated seven miles south-south-west of Carlisle, the other more than twenty miles to the south.

PROF. A. McADIE discusses temperature inversions in relation to frost (Blue Hill Meteorological Observations, Cambridge, U.S.A., 1915). He seems to find more difficulty in explaining the radiation frosts that occur in sheltered valleys than there really is, for the commonly given explanation is quite simple and meets the facts so far as they are known perfectly. The first requirement is free radiation, which means absence of cloud of any kind and also absence of water vapour in the overlying air strata; the second is absence of wind. Given free radiation, the ground is rapidly cooled, and imparts its coldness to the bottom layer of air. When this occurs on the summit or slope of a hill the cold air simply runs off down the slope just as water would do, and its place is taken by warmer air from above; hence on the summit or slope there is no great fall of temperature. But on a plane or in a valley bottom the case is different, because the chilled air cannot run off and the chilling effect of radiation is continued upon the same air, which therefore reaches a low temperature. Under such conditions there is naturally a sharp temperature inversion a short distance above the ground. Absence of wind is a further requisite because wind would mix up the different layers of air, thus warming the lower and cooling the higher, but with free radiation at night there is generally a calm on the surface, though there may be a good breeze a little way up. Prof. McAdie then discusses the artificial means by which damage to growing crops may be reduced or avoided.

PROF. E. BUCKINGHAM, of the Washington Bureau of Standards, sends us several recent papers by him dealing with the principle of similarity and the method of dimensions as applied to the formulation of equations representing physical results. Two of these papers are published in the *Physical Review*, iv., 4 (October, 1914), and the Journal of the Washington Academy of Sciences, iv., 13 (July, 1914). In addition, we have a communication to the American Society of Mechanical Engineers, read in June, 1915, and a letter to the *Electrician* (January 15, 1915) criticising Becker's formula for the windage of fly-wheels, on the ground that the terms are not all of the same dimensions. It is remarkable how prone not only students, but experienced mathematicians and engineers are to write down equations which are obviously of wrong dimensions. After giving numerous illustrations of the method, Prof. Buckingham points out that the method is purely formal and algebraical. If certain quantities and no others are connected by a physical relation, the equation connecting them must necessarily be of a certain form. Any mistake must be due to overlooking one of the

NATURE.

The number for **last week (Oct. 14)** contained :—

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NOTICE.

For the convenience of readers of NATURE wishing to inspect books *published abroad* which have been reviewed in NATURE such volumes are kept for the period of six months at the publishing office of the journal. The books are retained for the purpose of examination free of charge. The display of books began with those reviewed in NATURE of January 7.

St. Martin's Street, London, W.C.

PRINTED IN GREAT BRITAIN BY R. CLAY AND SONS, LTD., BRUNSWICK STREET, STAMFORD STREET, S.E., AND BUNGAY, SUFFOLK.

variables on which the result depends. The process cannot supply any new facts. We only get out what we put in, but this is generally in a much more useful form than the original assumptions. It is to be hoped that a study of Prof. Buckingham's papers may lead to a diminution of the mass of unwarrantable deductions and unsound formulæ that now finds its way into scientific and more especially technical literature. We need only instance the rule that "no purely arithmetical operator such as log or sin can be applied to an operand which is not a pure number," as one of the laws which is most often overlooked.

THE leading article in *Engineering* for October 15 discusses the second and final report, just issued, of the Departmental Committee on bulkheads and watertight compartments presided over by Sir Archibald Denny. The report deals with passenger steamers trading to the Continent between the limits of Brest and the Elbe, in the channels surrounding the British Isles, also those plying on short excursions round the coast, and on rivers, estuaries, lakes, and canals. The fundamental principle underlying the recommendations is the same as that in the first report dealing with ocean-going vessels. A difficulty arises in dealing with the classes of ship to which the second report refers, owing to the overlapping in the principal features of design of the respective types; also the sizes of vessels vary greatly. These considerations involved difficulty in stringently applying rules general to all types. It seems probable, however, that the general recommendations of the committee will be acceptable to all; no doubt the exceptions will be considered on their merits by the authorities. It is of interest to note that Channel steamers are treated more severely than oversea passenger steamers in the matter of bulkhead doors—doors worked from the bridge alone are permitted.

MR. JOHN MURRAY's new announcements include:—Vegetable Fibres, by Dr. E. Goulding (in the "Imperial Institute Handbooks"); A History of the Gold Coast and Ashanti from the Earliest Times to the Beginning of the Twentieth Century, by W. W. Claridge, 2 vols.; and new editions of The Study of Animal Life, by Prof. J. Arthur Thomson, illustrated, and Geometry: an Elementary Treatise on Theory and Practice, by S. O. Andrew.

OUR ASTRONOMICAL COLUMN.

SELENIUM CELL PHOTOMETRY OF δ ORIONIS.—Some years ago Prof. Joel Stebbins announced that measures of the light of δ Orionis by means of the selenium photometer indicated that this remarkable stellar system was also an eclipse-variable, although visual observation had failed to establish any alteration of magnitude. An extensive series of measures of the feeble fluctuations of its light was secured during the years 1910–11–12 (*Astrophys. Journ.*, September). The only spectroscopic orbit then available was Hartmann's memorable determination which revealed the first example of fixed calcium lines. These elements were used in deducing the light-curve, but the complete discussion was held up whilst Prof. R. H. Curtiss re-investigated the radial velocity variations, and these new elements have been employed in the discussion of the dimensions of the system. The variation of brightness is only 0·15m., of which 0·08m. is considered due to eclipses. The presence of a resisting medium such as the calcium envelope suggested by Hartmann's discovery would help to explain the brightness near periastron, which is a feature of the light-curve. It is only possible to fix limits for the dimensions of the system. The minimal values possible for the radii of the two bodies are 5 times and 1·4 times solar, and the mean density of the system is found to be 0·006 solar.

THE PLANE OF THE SOLAR MOTION.—Criticism of the hypothesis of star-streaming has led to several attempts to develop a gravitational idea of the stellar universe. Thus Prof. H. H. Turner, in 1912, and just about a year earlier Prof. von S. Oppenheim, both suggested that stellar motions were orbital in character, the stars oscillating or revolving about an ideal centre distant from the sun. The solar system itself contains a model closely representing Prof. Oppenheim's conception in the swarm of minor planets viewed from the earth. This fact has again been made of use in an investigation of the solar motion (No. 4813, *Astronomische Nachrichten*), affording means of testing the formulæ employed in deducing the plane of the sun's path from astrometric data by permitting a determination of the known plane of the earth's orbit from the geocentric movements of the minor planets. Ephemerides of 265 minor planets gave mean motions, etc., of the bodies comprised in every two hours of R.A. Reduction by the Bessel-Kobold method hence gave twelve pairs of values of the position of node and inclination of the earth's orbit; eleven showed fair agreement, and yielded the highly satisfactory mean values ☊$=0° 44'$, $i=22° 0'$, instead of 0° and 23° 27′ respectively. The application to the case of the solar motion was made on the basis of data from Charlier's second memoir. The resulting mean values for all Charlier's areas taken together were ☊$=234° 45'$ and $i=50° 15'$, corresponding solar apex R.A. 267° 58′, declination +31·56; whilst for the galactic areas considered apart the mean values were ☊$=245° 30'$ and $i=58° 25'$, apex R.A., 261° 4′, declination, +23° 27′. Charlier's values were based, it may be recalled, on the proper motions in the P.G.C. of Boss.

DISPLACEMENT OF PHOTOGRAPHIC STELLAR IMAGES.—A curious announcement by M. J. Comas Sola (*Astr. Nach.*, 4814) states that among the stars recorded in successive slightly displaced exposures on the same plate and stellar region, occasionally some pairs of images indicate considerable real or apparent movement in the corresponding star. An example is given. It is added that it is extremely rare that such a displacement appears twice in the same star.

THE SOLAR ECLIPSE, AUGUST 21, 1914.—Prof. Störmer, together with several colleagues, went to Vefsen to observe the eclipse (*Vid. Selk. Forh.*, No. 5, 1915, Christiania). The observers took up stations at Laksfors and 35 km. to the south at Svennigviken, prepared to secure, should the opportunity arise, parallax photographs of auroræ. Favoured by fine weather and clear skies, unfortunately no auroræ were seen, but the cameras were used in taking a large number of snapshots of the corona, including seventy exposures with a kinematograph. Considering the extremely small scale of the pictures, the form of the corona is very well shown in the reproductions.

UPPER AIR TEMPERATURES.[1]

THIS interesting publication of fifty-eight pages gives an account of some fifty to sixty ascents made at Batavia, Java, and over the neighbouring seas. Batavia lies in the latitude of 5° S., and observations from a place so near the equator are of especial value; these observations also were designed for the purpose of giving information on several interesting points.

The first half of the book gives the detailed account of each ascent, that is to say, the temperature and relative humidity at each 100 metres both on the ascent and descent, and the second half discusses the results obtained. The first point discussed is the thickness of the land wind at night and the temperature inversion. The highest temperature was found at 170 metres, and the depth of the land breeze was 130 metres. The high pressure which prevails over Australia in winter, the winter, that is, of the southern hemisphere, sometimes stretches as far northwards as Batavia, and interesting figures relating to one of these periods are given. Very similar conditions seem to prevail there as in Europe in anticyclonic areas; on rising from the surface, a decrease of temperature with an increasing humidity is met with, but at a height between 2·0 and 3·0 km. excessive dryness with a temperature inversion, or at least a great slackening in the temperature gradient, occurs.

These observations do not depend on kite or balloon observations alone, since the summits of some of the mountains are high enough to give similar records.

In England, the dreary type of anticyclonic cloud that so often covers the sky for days together in winter nearly always, perhaps always, lies just under a sharp inversion of temperature and a layer of excessively dry air, but the height of this inversion seldom reaches 2 km. In Batavia, the cloud layer is replaced by a sheet of moist air in which small cumuli prevail (in the daytime). In both cases the damp and the dry strata are sharply divided, and Dr. Braak discusses the reasons of this arrangement. There cannot be much doubt that the extreme dryness is due to the air having descended from a colder, and therefore dryer, level, dryer, that is, in the sense of having a smaller amount of water vapour; but dry air, as Tyndall pointed out long since, cannot radiate or absorb radiation with any freedom. Probably radiation from the vapour of the damp strata, which can occur freely through the dry air above, has a good deal to do with the formation of the cloud, especially the sea, but they are not numerous enough to show the magnitude with any certainty.

The daily temperature change by day over the sea and the nightly change over the land are also discussed. Dr. Braak finds over the land in the early afternoon a gradient from 0 to 300 m. of 1·34° per 100 m. Over the sea he finds practically no daily change at the sea surface, the amplitude being about one-third of a degree, but the value increases somewhat up to 600 m. The observations suffice to show that there is little daily change of temperature over the sea, but are not numerous enough to show the magnitude with any certainty.

Some interesting remarks are made on the fall of temperature at night, and on an irregularity in the change. The double daily oscillation of the barometer in low latitudes is quite sufficient to produce measurable changes of temperature. It is so commonly stated that the adiabatic change of temperature in air is produced by change of height that one is apt to overlook the fact that change of height by itself is absolutely without effect upon temperature, and that the rise or fall is due to pressure changes only, change of pressure being usually, but by no means always, due to change of height. W. H. DINES.

[1] "Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia.' Verhandelingen No. 3. Drachen Freiballon- und Fesselballon-berbachtungen. Von Dr. C. Braak. Pp. 58. (Batavia: Javasche Boekhandel en Drukkerij.)

A MANX TRIBUTE TO EDWARD FORBES.

THE London Manx Society has issued a report of the meetings held in London on February 13 to celebrate the centenary of the birth of Edward Forbes. The report ("Edward Forbes, Great Manx Naturalist, Botanist, Geologist, Zoologist," 45 pp., 1*s*.) contains an address by Sir Archibald Geikie, Forbes's biographer, on his life and geological work, appreciations of his zoological work by Prof. Ewart, Prof. McIntosh, and Prof. Herdman, and of his botanical work by Prof. Bottomley; also contributions by Prof. Boyd Dawkins, Mr. Whitaker, and Dr. J. W. Evans, a letter by Mr. Ulrich on behalf of the Palæontological Society of the United States, and the words of Forbes's "Dredging Song." Forbes was born in 1815 in the Isle of Man, and was educated in Edinburgh; in 1841 he was appointed naturalist to H.M.S. *Beacon* during her survey of the Ægean Sea and coasts of Asia Minor. The following year he became Professor of Botany at King's College, which he held, for part of the time, together with the appointments of Palæontologist to the Geological Survey and Lecturer on "Natural History as applied to Geology" at the Royal School of Mines, until his election to the chair of Natural History in Edinburgh in 1854. His death a few months later was, according to Sir Archibald Geikie, "one of the most grievous losses which British science has sustained in our time." His work was remarkable for its wide range, brilliant originality, and philosophic insight. Huxley wrote of him in 1851 that "he has more claims to the title of a philosophic naturalist than any man I know in England." Some of his conclusions on the relations of the British flora to fauna were rejected by his contemporaries and immediate successors, but, according to Prof. McIntosh and Dr. Scharff, they have been established in the main. Mr. E. V. Ulrich, of Washington, reports that Forbes's teaching has "exerted a profound influence on palæontologists the world over," that the principles he enunciated now "assume a commanding importance," and that probably no British author on his subjects has been more followed and quoted in America than Forbes. Forbes was a man of great literary distinction; he was a first-class humorist, and a frequent contributor to *Punch*; and Sir Joseph Hooker has recorded that owing to his talents and his personality "he was beloved and admired beyond any natural historian of his day."

EDUCATION AND INDUSTRY.[1]

I.

THE British Association, by establishing Section L, has recognised education as a branch of science and made provision for its advancement.

But education—I am speaking of that part of it in which human educators intervene—is still regarded as belonging to politics and literature, rather than to economics and physiology. To many people the very title of this paper, "Education and Industry," will appear incongruous. Is there not a great gulf fixed, say they, between hazy views of education high in the clouds above, and the hard facts of science or technology far in the depths beneath?

[1] Abridged from a paper read to the Educational Science Section (L) of the British Association on September 11, by Principal J. C. Maxwell Garnett.

And yet the intimate relation of education to industry is obvious enough. Of all that goes to make industry possible, let alone prosperous, the human element is the most important. We are careful to select suitable land, we know that capital or credit is essential to us, and we take pains to see that our capital is represented by the most suitable works, machinery, and material. But we commonly take little interest in producing the necessary men to undertake, design, direct, and manipulate the work.

It is true that industry exists for men, not men for industry; and it follows that to train men for industry cannot be the whole end of education. How far the specific training of men for their particular occupations is legitimate can only be decided when we know what the true aim of education really is. Upon the answer to this fundamental question educators are not agreed.

But agreement should not be altogether out of reach if only we would treat education as a natural science. We should then endeavour to keep our thought about education in the closet possible touch with facts, especially physiological facts; we should think and speak, not only of the mind or soul, but also of the cortex of the cerebrum, through which alone the soul can be reached by human educators. When facts are available we should use them, and follow George Eliot's advice not to replace them by metaphors, or mixed metaphors like that of the broad foundation of general culture. When facts are not available we should, if possible, ascertain them by direct experiment; and, if that is not possible, we should have faith—that is, we should ascertain the facts indirectly by acting on an hypothesis with a view to its verification or modification by subsequent experience. That is how progress has been made in other branches of knowledge, and that is how the advancement of the science of education must also be effected. Moreover, the ground so won must be consolidated by the use of some esoteric or symbolic language; for at present our most precise conceptions, being expressed in words that are used every day with many different meanings, receive from each of our hearers or readers a different interpretation.

Consider, for example, the word "character." Perhaps the most generally accepted statement of the aim of education is that of the opening sentence of the introduction to the public elementary school code: "The purpose . . . is to form and strengthen the character. . . ." But this statement fails to produce any clear conception, because it does not define "character," a word which means different things to different people, and which to most people, perhaps, conveys no clear meaning at all. If, however, we reflect that since two men who, when placed in the same circumstances, always did the same thing, would, for practical purposes, be indistinguishable, we realise that men are characterised by their actions: by their fruits they are known. If then we inquire what it is that determines an individual's actions we find—as I have attempted to show in a recent paper [2]—that in addition to the sensory stimuli arising from the environment of the moment, the determining factors are interest, instinct, and will, together with the habits they have helped to form. These, then, are the foundations of character. A further inquiry shows that, if character is to be strong, two conditions must be fulfilled: in the first place, interest must be single and wide, combining the whole range of the individual's experience into one group of inter-associated ideas and including central ideas which strongly move the emotions (instincts); and secondly, the will must co-operate with this single wide interest and its central group of instincts in guiding thought and action.

2 Published in *Manual Training* for May, 1915.

It follows that if the purpose of education is to form and strengthen character, the proximate aim of education must be to develop a single wide interest—a single complex of inter-connected neurograms.

If the citizens we are educating are to have characters that are not only strong, but also good—that is, if each citizen is to be anxious to serve his neighbours—the emotional element at the heart of his wide interest must be rich in brotherly love. Education without religion is impossible.

If the individual citizens are to be not only anxious, but also able, to serve each other, they must be prepared to divide labour among themselves so as to minister to the economic well-being of the community. The more a man's knowledge or skill differs from that of other people the better in general can he serve his fellow-men. As the occupations of different individuals must differ, and as all the ideas that come to each in the course of his daily work are to form part of his single wide interest, it follows that the single wide interests of different individuals must differ according to their different occupations; and the great interest which each man will then take in his work will incidentally make for his economic efficiency. It is true that these single wide interests must also overlap, so that different individuals may share as far as possible each other's interests and have at least their interest in the State in common. The extent of this overlapping of interests should be limited only by the consideration that during the educand's last two or three years at school—or, if he proceeds to college, then during his university course—his education should have the specific aim of preparing him for his particular work in life, including not only the work for which he is paid, but the whole of what Kim would call his "great game." The need for this application to education of the principle of continuity, so familiar in other branches of natural science, has been thus expressed by the Board of Education's Consultative Committee: "The nearer a pupil is to his entrance into life, the more steadily must the actual practical needs of his occupation be kept in view, and the more decided, therefore, must be the bent of his education to that end." [3]

Finally, education must train the will. The power of the will to focus attention—to direct nerve impulses into a particular system of nervous arcs—is the supreme intellectual faculty, and the only faculty that can be trained. Whoever is to have most creative or abstract thinking to do, most needs this skill in thinking.

II.

These conclusions have been separately proclaimed by several high authorities.

"Milton," said Prof. Perry last year from the presidential chair of this section, "taught me the true notion of education, that the greatest mistake is in teaching subjects in water-tight compartments" [4]; in fact, education must aim at building up a *single* wide interest.

"Thorough knowledge of one subject and practice in it," said Goethe, "produces higher culture than incomplete knowledge of a hundred subjects." [5]

Ruskin had no doubt about the need for specific education. "The idea," he wrote, "of a general education that is to fit everybody to be Emperor of Russia . . . is the most entirely and directly diabolical of all the countless stupidities into which the British nation has of late been betrayed." [6]

"The whole evolution of educational theory," according to Prof. Adams, "may be said to be a

3 Report on Higher Elementary Schools (1906), p. 11.
4 NATURE, October 1, 1914.
5 Quoted by Dr. Kerschensteiner, "Schools and the Nation," p. 256.
6 "Fors Clavigera," p. 254.

great sweep from specific education back to specific education, through a long period during which formal training held the field."[7]

Finally, William James maintained that "The faculty of voluntarily bringing back a wandering attention over and over again, is the very root of judgment, character, and will. . . . An education which should improve this faculty would be the education *par excellence*."[8]

III.

We shall now assume the truth of these conclusions and proceed to discuss the problem of so educating every individual that he shall possess, in the first place, the single wide interest which his particular service to the community most needs for its efficiency; and secondly, skill in thinking—the capacity of voluntarily focusing his attention.

We have first to investigate the qualities—the type of single wide interest and the degree of skill in thinking—required by those who are to be engaged in various classes of industrial occupation; and afterwards to indicate a means of developing the required qualities in a sufficient number of persons, selected on account of their innate aptitudes for each different kind of work.

The first classification to suggest itself is that of the various branches of industry, such as engineering, building, chemical manufacture, the textile industry, and the like. But the qualities required in the manager of an engineering works have more in common with those needed by the manager of a chemical works or of a cotton mill than with the qualities sought for in the lowest grades of labour employed in any of these industries. In the same way the designer of electrical machinery will generally have more in common with the professional physicist than he has with the engineering tradesman who makes what he designs.

We shall find it convenient to adopt the following classification:—

Class A.—Industrial statesmen; chief designers; research engineers, chemists, etc.; consulting engineers, etc.

Class B.—Works managers and heads of departments; junior members of designing, testing, and managerial staff.

Class C.—Foremen and leading hands; skilled tradesmen.

Class D.—Machinemen and repetition workers; unskilled labourers.

No essential discontinuities are to be imagined between these classes; nor are the occupations named to be regarded as forming complete lists of the classes of work they are intended to indicate.

We have already remarked that every occupation includes that of citizen. We have next to consider the special, or distinguishing, features of each different class of occupation.

It is clear that each class is concerned, in the course of daily work, with a greater *variety* of ideas than the class next below it. Accordingly, trains of thought of members of class A must on the average be fresher, and therefore less governed by habit, than those of members of classes B, C, or D. "The controllers of the great industry," writes Mr. Graham Wallas, "are always on the look out for that type of man whom Americans call 'a live wire.' For such a man secretaries and typists and foremen carry on all that punctual performance of habitual acts which took up so much of the time and labour of a merchant or manufacturer even fifty years ago. He is set to form a habit of non-habituation. . . ."[9] Such a man requires more emotional drive than one who is engaged in mere routine work. And since his ideas cover so wide a range, they are not so naturally associated together as those which their daily work brings to members of classes B or C or D. He therefore needs to weld his various ideas into a single wide interest by making voluntary associations between them; and in order to make such associations, especially between dissimilar ideas, he needs skill in thinking.

So, then, class A requires a wider interest, a stronger emotional element in that interest, and more skill in thinking—but not necessarily more pay—than class B, class B than class C, and class C than class D.

Let us now look more closely at each of these classes. The first named on our list is that of the industrial statesman. We know him already as the captain of industry. But he has lately changed his name, for the title of captain does not indicate with sufficient clearness the fact that the head of a great industrial firm must needs concern himself with much that is happening outside the establishments which he controls. Not only must he be familiar with the state of the markets from which he draws his supplies and in which he disposes of his products, but, by grasping the significance of economic, social, and political changes all over the world, he must be able to foresee opportunities for developing his business according to a far-reaching policy, and to indicate the lines of technological research which are most likely to lead to such developments. Work of this kind involves the widest sort of knowledge. But beware of the professional administrator who is prepared to administer anything at a moment's notice. The statesman—whether industrial or not—must possess, in addition to a wide range of knowledge and much skill in thinking, a very special interest in the particular concern he is directing, whether that concern is his own small business or an empire the destinies of which are under his control. He must see that concern as a whole, and must love it. "Without passion," said Lord Haldane to the students of Edinburgh University, "nothing great is, or ever has been, accomplished."[10]

Lord Haldane went on to compare the statesman with the expert, greatly to the latter's disadvantage. Much that has happened lately would probably cause Lord Haldane to express himself differently now. In any case we shall not follow him here. We shall instead place the expert in the same class as the industrial statesman because the former requires an equally high degree of skill in thinking and at least as complex (if not so widely varied or so emotional) an interest as the latter. The industrial statesman may be compared to the astronomer who uses the telescope to increase his grasp of the whole, while the expert rather resembles the naturalist whose microscope enables him to see the parts in great detail. It is evident that the successful development of industry demands not only the expert in special branches of science or technology, but also the industrial statesman who co-ordinates the work of experts in different fields, and who is himself enough of a specialist fully to understand his experts, to command their confidence, and, when necessary, to decide between them. Whoever has authority must also have knowledge.

The members of class B require fewer associations to connect the ideas which constitute their single wide interests. They need less skill in thinking than members of class A. They require, on the other hand, a very wide descriptive knowledge of material

7 "Evolution of Educational Theory," p. 225.
8 "Principles of Psychology," vol. ii., p. 424.
9 "The Great Society," p. 87.
10 "The Conduct of Life," p. 25.

things, and as much of this knowledge as possible they should have acquired at first hand from direct sense impressions. Last, but by no means least, the works manager and his immediate assistants need to interest themselves in the social and economic welfare—including the further education, recreation, and housing—of all their employees, and this interest will help to form the nucleus of those single wide interests which are to include all the activities of members of class B.

Foremen and leading hands have hitherto been generally recruited from among skilled tradesmen. They are therefore presumed to be qualified themselves to perform every task they have to supervise, and even to perform it better than the men who are actually doing the work. Upon this presumption is based the claim that the shop foreman must be paid a higher wage than any workman under him. This view, accepted as it generally is by employers and employed alike, is responsible for no small restriction of output. But it is based on a misconception, since the foreman is paid for supervising men, and the workman for manipulating material—two quite incommensurate processes. There are, however, signs of change. Technically trained foremen whose wages may (to start with) be much less than those of the men they have to look after, are already being employed, especially in shops where much repetition work is done. Yet it remains true that the qualities now most sought for in foremen and leading hands are those of the craftsman whose interest is centred in his manual work.

The operative skilled tradesman whom, for this reason, we have placed in the same class as his foreman is distinguished from the machine man in class D in that the operative in class C has a *variety* of skilled work to do, while the members of class D who may do skilled work, *repeat* the same process over and over again until its performance is governed by habit, so that it almost ceases to receive attention. On the one hand, ideas connected with *doing*, like ideas associated with a strong instinct, are peculiarly liable to receive attention, so that the work of the skilled tradesman in class C is well able to form a strong centre for his single wide interest. On the other hand, ideas connected with the repetition work of class D tend to become circumscribed and cut off from other interests. There is, however, reason to believe that repetition work is not altogether uninteresting to a certain type of mind. It is, indeed, actually preferred by some people, including many women. Such work may, therefore, form a substantial, if not a dominant, part of an interest that is not rich in exciting ideas. The remaining part of the single wide interest is of special importance in the case of class D. When an eight-hours day is universal it may be that the artisan or labourer who leaves work with much of his day still before him and feeling pleasantly exercised rather than unduly tired by his somewhat monotonous but by no means exacting labour, will devote himself increasingly to national and municipal affairs. With that end in view we must see to it that the average member of class D receives —not only in maturity through the Workers' Educational Association, but also in youth through vocational part-time classes—the kind of training which shall best develop a single interest, wide enough to include the highest ideals of patriotism as well as loyalty to a particular industrial class.

IV.

We have next to consider how to develop in a sufficient number of suitably selected persons the qualities which we have indicated as specially needed in each class of industrial occupation.

Childhood up to, say, twelve years of age has few organised interests. Accordingly, the need for a coherent curriculum, aiming at developing a single wide interest, does not obtrude itself until adolescence begins. The future member of classes A and B will normally spend much of his adolescence in a secondary school. Of these schools it is convenient to distinguish two types, named "Higher" and "Lower" respectively in the accompanying diagram.

The chief function of the secondary school, the school for adolescents, is to foster the growth of true religion—"not theology nor yet ethics, but personal and experimenetal [11]—and around this centre to build up, out of the miscellaneous information obtained in childhood and the coherent curriculum which the secondary school should itself provide, the beginnings of that single wide interest which should continue to grow throughout maturity. The skill in thinking which the secondary school must also cultivate is best practised upon a number of closely associated ideas—a coherent interest—because, unless the idea before consciousness at any moment calls up *many* others, from which the will can select that which is next to receive attention, this faculty cannot be practised; and without practice skill in thinking cannot be developed.

The broad foundation metaphor, of which Dr. Kerschensteiner [12] has made such fine fun, is probably responsible for the fact that most secondary schools aim in theory, and some lower secondary schools (unfortunately) in practice also, at comprehensiveness rather than at coherence of interest: they have failed to realise that coherence at seventeen is the surest way to comprehensiveness at twenty-seven. Concentration has, however, been practised by the classical sides of English public schools. But in many of the newer secondary schools six or seven distinct subjects are taught out of all relation to one another by as many separate specialists, and the form master himself is almost unknown!

The future member of class A should remain at his higher secondary school and enter the university at, or soon after, the age of eighteen. It is true that the future engineer often spends some time in works between school and college; but there is a growing consensus of opinion that this period should not be too long. Perhaps from Christmas until the following October would be ideal if both school-leaving and university-entrance scholarships could be awarded, as those of some Oxford and Cambridge colleges already are, just before Christmas.

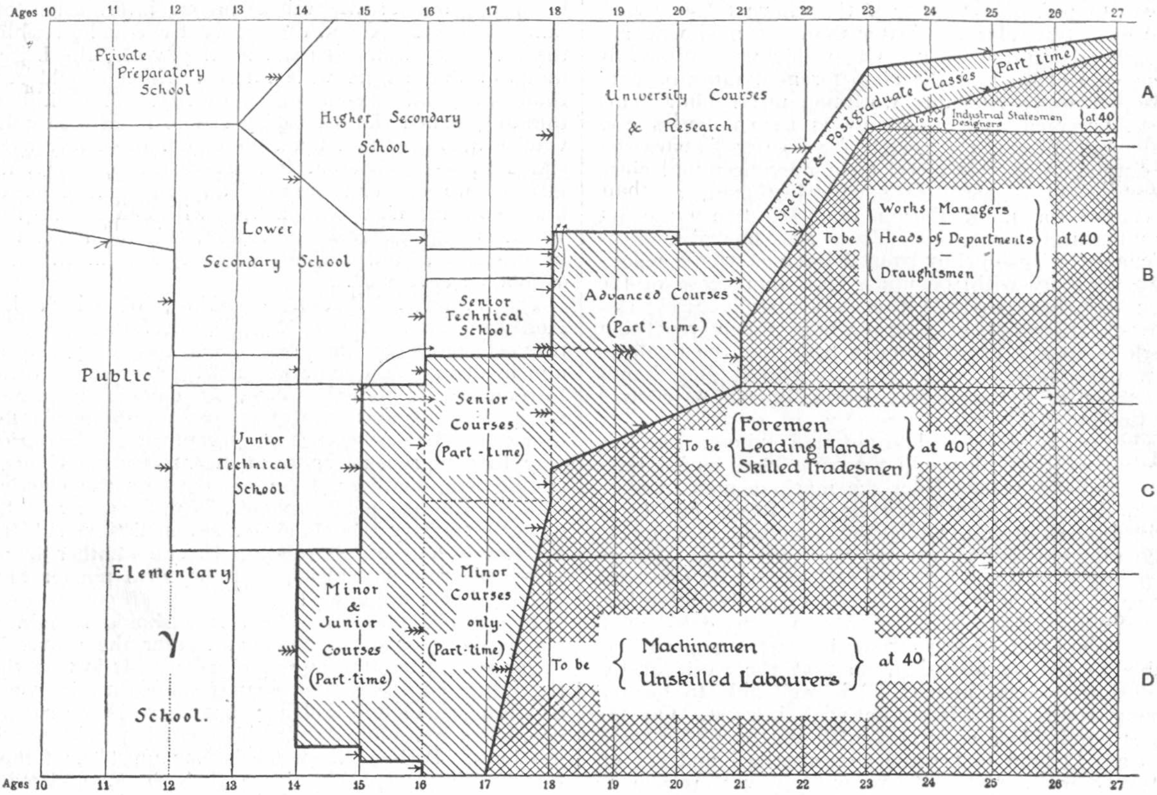
It is to the university that we shall principally look in the future for an essential part of the specific training of members of class A, for the men with creative minds, inventors of new appliances and processes, men who shall not merely be able to follow existing practice but also to cope with new problems and even to lead in new lines of advance. And our university courses, if they succeed in producing men of this type, will do so, not because of the knowledge they impart, wide though it be, but because of the stress they lay on the acquisition of skill in thinking along with knowledge. It is skill in thinking—skill in applying old knowledge to new situations—rather than knowledge itself without such skill, that now, as always, marks the really practical man. If, in fact, his university course can, in Huxley's phrase, give him "real, precise, thorough, and practical knowledge of fundamentals," the candidate for membership of class A may well wait for subsequent works experience, post-graduate evening classes, and private reading, to develop further his *technical* information to a marketable standard. Whatever letters he may

11 G. Stanley Hall, "Adolescence," vol. ii., p. 326.
12 "Schools and the Nation," p. 275.

be able to write after his name, his undergraduate course should have aimed at making him a bachelor of arts, skilled in the art of learning, and only incidentally have given him a body of scientific knowledge capable of immediate application.

This view of the chief aim of a university course insists that there shall not be overmuch lecturing; that information shall be acquired because it is immediately and urgently needed for the solution of some practical problem; that a larger proportion of the most able students shall remain "up" after taking their degrees for the purpose of undertaking original course must be at all detached from practical things. It is no more possible to develop skill in thinking without knowledge than to acquire skill in the use of tools without material to work upon. Technical knowledge is, in fact, a most excellent foundation and medium for cultivating skill in thinking.

England is fortunate in that most of her highest study and research in technology form part of the work of her universities. For a university is more than a university course or an aggregate of such courses. The opportunities which a university affords for studying elective



EDUCATION AND INDUSTRY.

Diagram illustrating proposed modification of present organisation.

HORIZONTAL SCALE: The spaces between adjacent vertical lines represent one year.
VERTICAL SCALE: The vertical scale increases from the bottom of the diagram to the top. The intercept made on any ordinate by the enclosed area which corresponds to any course varies with (but not strictly in proportion to) the number of students of the corresponding age who should be following the course in question.

—>>> } indicates that { the great majority of the / —>> a constant supply of systematically selected / —> a few exceptional } persons leaving the course which corresponds to the area in which the arrow-head lies should proceed to the course towards which it points.

The unshaded portion of the diagram is concerned with "full-time" education; that is, with schools and classes meeting in the daytime and occupying all the working hours of those by whom they are attended. The central singly shaded area relates to part-time classes: classes meeting either in the day or in the evening, and intended for persons whose employment occupies the greater part of their time. The doubly shaded region on the right of the diagram corresponds to those later years of industrial practice when a man has ceased to attend organised courses of study bearing upon his trade or profession.

research; and that, while the most distinguished professors shall take part in the teaching of the undergraduates from the outset, they shall do so, not because of the knowledge they are peculiarly able to impart, but because "the personal influence of the man doing original work in his subject inspires belief in it, awakens enthusiasm, and gains disciples." [13]

In urging that the chief aim of a university course must be to cultivate skill in thinking rather than to impart information, we do not mean that such a subjects are important. But far more important is the intimate and constant association in the various students' societies, as well as in the lecture rooms, drawing offices, or laboratories, between students in different faculties, from different countries, and with entirely different outlooks.[14]

But the State cannot afford to provide a university training for all its citizens. The majority, even of class B, will be compelled by economic pressure to begin earning money before they are twenty years

13 Final Report of the Royal Commission on University Education in London, p. 29.

14 See Newman's eloquent words quoted by the Royal Commission on University Education in London (*loc. cit.*, pp. 26, 27).

old. Where a suitable senior technical school exists, they will do well to receive in it the specific training which should occupy the last two years before their entry into industrial life. The very important place which a senior technical school should fill in the educational system of an industrial district is, as yet, hardly realised.

The future member of class C should be transferred from the public elementary school to the junior technical school when other children are transferred to the lower secondary school. The junior technical school should prepare him for entering one of a group of allied trades at or about the age of fifteen. It is not, however, the function of the junior technical school to teach him a trade, but rather to develop his manual skill in work that is closely related to that of the trade to which he is looking forward, and to extend the great interest which he cannot help feeling in such work so as also to include so-called "general" subjects. Experience has shown that he will thus make more progress in these "general" subjects than if he were studying them in a school which has no specific aim.

When the future members of classes A, B, and C have been transferred from the public elementary schools at the age of twelve, the work of the future members of class D who are left behind should differ [15] somewhat from the general work done by all children below the age of twelve. It might well be centred in (but not, of course, be confined to) handwork during these last two years, and so have much in common with the training of Boy Scouts.

Even when the last two years of whole-time education have been admirably adapted to prepare the educand for his imminent vocation, some educational discontinuity must always occur as he leaves whole-time school or college to continue his education in industrial life. Part-time classes afford the best means of reducing this discontinuity to a minimum. Accordingly, every boy or man, as he first enters upon industrial work, should attend suitable part-time classes. No feature of English education is more striking to the foreign observer than the system of part-time courses in all our great centres of industry. At the present time most part-time courses involve attendance on three evenings a week for several successive years. Although they cannot cover the whole ground of university courses, they aim (for the most part) at affording an alternative means of training men to occupy positions of responsibility in industrial affairs.

While, however, our part-time classes are thus training technical men, they are neglecting manual workers. Instead of attending these technical classes, the boy who enters works at fourteen or fifteen years of age requires (at least until he is seventeen years old) a special type of part-time course, to which the name "minor course" has lately been given. One of the principal objects of such a course is to provide instruction in those matters which the trade apprentice in bygone days learned by close association with a master craftsman, and which are commonly lost to him under modern industrial conditions. The minor course will therefore "have as its central subject the trade processes or craft in which the students are engaged." [16] But so-called "citizenship" subjects—such as history and economics, the study of which will make for a better understanding of problems concerning wages and hours of labour—also form an essential part of a minor course. It remains to add that the need for minor courses is not yet sufficiently appreciated, with the result that a great opportunity of educating during the critical years of adolescence the numerous members of class C and class D is being neglected.

[15] The difference is marked by the dotted line at γ in the diagram.
[16] Board of Education Circular 894.

V.

The system of education, the outline of which I have thus described, is represented on paper in the diagram. Its realisation in any English industrial district—say, Manchester—would need some, but not much, co-ordination; for the diagram represents neither what is nor what might be under ideal conditions, but what could be made out of what is with the maximum of advantage in proportion to the effort spent in making the change. The co-operation of local education authorities, universities, the Government, employers, and parents would be required in order to complete this change.

But already there are signs that all the necessary co-operation is forthcoming. Many striking instances might be cited in support of this statement did time permit. I must, however, be content to mention only two: Mr. Henderson's new scheme for the organisation and development of industrial research, and a similar scheme recently prepared by a committee of the Manchester Engineers' Club. This latter scheme provides for organised co-operation between schools, colleges, and engineering firms in the education of engineers and for the encouragement of research in the following, among other ways:—

> By developing co-operation between engineering firms on the one hand and universities and technical colleges on the other, so as to establish such "schools of thought" as exist in the research departments of great Continental and American engineering firms, but cannot be fostered in the comparatively small establishments (and smaller research departments) of most British engineering firms.

VI.

The co-ordinated system of schools, colleges, and works represented in the diagram will not be satisfactory unless it is thoroughly democratic. It is true that innate differences between individuals cannot well be distinguished from differences produced by home surroundings. But whoever is best fitted by nature and nurture for any particular class of occupation should be selected to receive, if necessary at the State's expense, the training which will best prepare him for it. Education authorities should see that the number of persons so selected is sufficient—but not much more than sufficient—to supply whatever demand is also a need.

VII.

At present the supply of men for the highest classes of work falls very far short of the demand. Every year the number of appointments offered to School of Technology graduates greatly exceeds the number of these graduates. Not only is this true of posts in chemical works, but also of electrical and other engineering appointments. Although the number of undergraduates in the School of Technology (Faculty of Technology in Manchester University) increased by 50 per cent. in the two years before the war, the demand for their services after graduation increased in a still larger proportion.

Such facts need to be realised by boys and by their parents. But it is even more important that they should realise that the highest kind of technological work is noble work, worthy of a lifetime's duration. The profession of applying science to industry is rich in opportunities for helping to bring about the ideal future of the human race. While it is the glory of the medical profession, for example, that it assists in preventing a wastage of life that could not but retard human progress, we must remember that technology helps to produce what medicine and surgery help to preserve. The great increase in population which began in the middle of the eighteenth century was directly due to mechanical invention. Indeed, the application of science to industry not only renders possible a rapid growth of population, but it exempts an ever-growing proportion of this increasing population from the need for incessant physical toil. Moreover, all that acceleration of human progress which results from the increasing national expenditure on the education of the people would cease with any interruption of the march of technological invention.

Every improvement, then, which the technologist may be able to make in the direction of cheapening production—reducing, for example, the cost of a brake horse-power hour—will help to increase the number of men whom the community can spare for the study of classical literature in order to keep the thought of our time in touch with the best of the thought of ancient Greece and Rome; it will help to increase, too, the number of those who can be spared by this generation to devote their lives to scientific research, to widen the scope of human thought, to teach men more of the works and ways of God, and to obtain the knowledge which technologists of the future will apply for the benefit of generations not yet born; and, most important of all, it will help to support the seers and the prophets on whom we so largely depend in the weightiest affairs of human life.

THE BRITISH ASSOCIATION.

SECTION M.

AGRICULTURE.

OPENING ADDRESS BY R. H. REW,[1] C.B., PRESIDENT OF THE SECTION.

Farming and Food Supplies in Time of War.

BEFORE considering the position of farming in the present war, we may briefly glance at its position when a century ago the nation was similarly engaged in a vital struggle.

From February, 1793, until 1815, with two brief intervals, we were at war, and the conflict embraced not only practically all Europe but America as well. The latter half of the eighteenth century had witnessed a revolution of British agriculture. The work of Jethro Tull, "Turnip" Townshend, Robert Bakewell, and their disciples, had established the principles of modern farming. Coke of Holkham had begun his missionary work; Arthur Young was preaching the gospel of progress; and in 1803 Humphry Davy delivered his epoch-making lectures on agricultural chemistry. Common-field cultivation, with all its hindrances to progress, was rapidly being extinguished, accelerated by the General Inclosure Act of 1801. A general idea of the state of agriculture may be obtained from the estimates made by W. T. Comber of the area in England and Wales under different crops in 1808. There were then no official returns, which, indeed, were not started until 1866; but these estimates have been generally accepted as approximately accurate, and are at any rate the nearest approach we have to definite information.

I give for comparison the figures from the agricultural returns of 1914, which approximately correspond to those of the earlier date:—

	1808 Acres	1914 Acres
Wheat	3,160,000	1,807,498
Barley and rye	861,000	1,558,670
Oats and beans	2,872,000	2,223,642
Clover, rye-grass, etc.	1,149,000	2,558,735
Roots and cabbages cultivated by the plough...	1,150,000	2,077,487
Fallow	2,297,000	340,737
Hop grounds	36,000	36,661
Land depastured by cattle ...	17,479,000	16,115,750

The returns in 1914 comprise a larger variety of crops than were cultivated in 1808. Potatoes, for instance, were then only just beginning to be grown as a field-crop, and I have included them, together with Kohl-rabi and rape, among "roots and cabbages."

The population of England and Wales in 1801 was 8,892,536, so that there were $35\frac{1}{2}$ acres under wheat for every hundred inhabitants. In 1914 the population was 37,302,983, and for every hundred inhabitants there were 5 acres under wheat.

The yield of wheat during the twenty years ending 1795 was estimated at 3 qr. per acre[2]; in 1914 it was 4 qr. per acre. The quantity of home-grown wheat per head of population was therefore $8\frac{1}{2}$ bushels in 1808, and $1\frac{1}{2}$ bushels in 1914. Nevertheless, even at that time, the country was not self-supporting in breadstuffs. In 1810, 1,305,000 qr. of wheat and 473,000 cwt. of flour were imported. The average annual imports of wheat from 1801 to 1810 were 601,000 qr., and from 1811 to 1820 458,000 qr. Up to the last decade of the eighteenth century England was an exporting rather than an importing country, and bounties on exports were offered when prices were low, from 1689 to 1814, though none were, in fact, paid after 1792.

During the war period we are considering, the annual average price of wheat ranged from 49*s*. 3*d*. per qr. in 1793 to 126*s*. 6*d*. per qr. in 1812; the real price in the latter year, owing to the depreciation of the currency, being not more than 100*s*. In 1814 the nominal price was 74*s*. 4*d*. and the real price not more than 54*s*. per qr.[3] The extent to which these high and widely varying prices were affected by the European war has been the subject of controversy. As we mainly depended on the Continent for any addition to our own resources, the diminished production during the earlier years in the Netherlands, Germany, and Italy, and in the later years of the war in Russia, Poland, Prussia, Saxony, and the Peninsula, reduced possible supplies. At the same time the rates of freight and insurance, especially in the later years of the war, increased very considerably. Tooke mentions a freight of 30*l*. per ton on hemp from St. Petersburg in 1809. On the other hand, a powerful impetus was given to home production, which was stimulated by Government action and private enterprise. Inclosure was encouraged by the General Inclosure Act of 1801, and 1934 Inclosure Acts were passed from 1793 to 1815. The schemes for increasing and conserving food supplies were various. The Board of Agriculture, for example, offered prizes of 50, 30, and 20 guineas respectively to the persons who in the spring of 1805 cultivated the greatest number of acres—not fewer than 20—of spring wheat.[4] In 1795 a Select Committee recommended that bounties should be granted to encourage the cultivation of potatoes on

[1] Slightly abridged by the author.

[2] Report of Select Committee on the means of promoting the cultivation and improvement of the waste, uninclosed and unproductive lands of the kingdom, 1795.

[3] Porter's "Progress of the Nation," by F. W. Hirst, p. 183.

[4] "Annals of Agriculture," 1805.

"lands at present lying waste, uncultivated, or unproductive," and that means should at once be adopted to add at least 150,000 and perhaps 300,000 acres to the land under cultivation "as the only effectual means of preventing that importation of corn, and disadvantages therefrom, by which this country has already so deeply suffered."

The main cause of high prices and scarcity was the failure of the harvests. Mr. Prothero thus analyses the wheat harvests of the twenty-two years 1793–1814: "Fourteen were deficient; in seven out of the fourteen the crops failed to a remarkable extent, namely, in 1795, 1799, 1800, 1809, 1810, 1811, 1812. Six produced an average yield. Only two, 1796 and 1813, were abundant; but the latter was long regarded as the best within living memory." [5]

It appears paradoxical, but in a sense it is true, to say that the scarcity of wheat in certain years arose from the fact that the country was too largely dependent on its own crop. The risk of a bad harvest in a climate such as that of the British Isles must always be serious, and by the fortune of war this risk between 1793 and 1814 turned out to be very high. When supplies are drawn from the four quarters of the globe, it is evident that the risk of a shortage in time of peace is greatly reduced. Whether in a great war it is preferable to be more dependent on the sea than on the season is debatable.

In comparison with wars for national existence, such as that against Napoleon, and in a still sterner sense that in which we are now engaged, other conflicts appear insignificant. The Crimean War, however, did affect our food supplies and had a reflex action on British agriculture. The cessation of imports from Russia caused a rise in the price of corn. The average price of wheat rose to 72*s.* 5*d.* per qr. in 1854, 74*s.* 8*d.* in 1855, and 69*s.* 2*d.* in 1856. Only once before (in 1839) during the previous thirty-five years had it risen above 70*s.* There were then no agricultural returns, but the estimates of Lawes, which were generally accepted, put the area under wheat at a little more than 4,000,000 acres, a higher figure than has been suggested for any other period. It is, indeed, highly probable that the Crimean War marked the maximum of wheat cultivation in this country. It was a time of great agricultural activity and of rapid progress. To their astonishment, farmers had found, after an interval of panic, that the Repeal of the Corn Laws had not obliterated British agriculture, and that even the price of wheat was not invariably lower than it had often been before 1846. Caird had preached "High Farming" in 1848 and found many disciples, capital was poured into the land, and the high prices of the Crimean period stimulated enterprise and restored confidence in agriculture.

To generalise very roughly, it may be said that while the Napoleonic wars were followed by the deepest depression in agriculture, the Crimean War was followed by a heyday of agricultural prosperity which lasted for more than twenty years. What the agricultural sequel to the present war may be, I leave to others to estimate, and I turn to consider briefly some of its effects on British farming up to the present time.

Harvest had just begun when war broke out on August 4; indeed, in the earlier districts a good deal of corn was already cut. The harvest of 1914 was, in fact, with the exception of that of 1911, the earliest of recent years, as it was also one of the most quickly gathered. The agricultural situation may perhaps be concisely shown by giving the returns of the crops then in hand, *i.e.* in course of gathering or in the ground, with the numbers of live stock as returned on farms in the previous June. The figures are for the United Kingdom, and I add the average for the preceding ten years for comparison:—

	1914	Average 1904–13
	Qr.	Qr.
Wheat	7,804,000	7,094,000
Barley	8,066,000	7,965,000
Oats	20,664,000	21,564,000
Beans	1,120,000	1,059,000
Peas	374,000	525,000
	Tons	Tons
Potatoes	7,476,000	6,592,000
Turnips and swedes ...	24,196,000	26,901,000
Mangold	9,522,000	9,934,000
Hay	12,403,000	14,148,000
	Cwt.	Cwt.
Hops	507,000	354,000
	No.	No.
Cattle	12,185,000	11,756,000
Sheep	27,964,000	29,882,000
Pigs	3,953,000	3,805,000
Horses	1,851,000	2,059,000

Farmers had thus rather more than their usual supplies of nearly every crop, the chief deficiencies being in peas, roots, and hay. The shortage of the hay crop was, however, in some measure made up by the large stocks left from the unusually heavy crop of 1913. It was fortunate from the food-supply point of view that two of the most plentiful crops were wheat and potatoes. The head of cattle was very satisfactory, being the largest on record, and pigs were well above average. Sheep, always apt to fluctuate in numbers, were much below average, the total being the smallest since 1882 with the exception of 1913.

On the whole, it was a good year agriculturally, and the supply of home-grown produce at the beginning of the war was bountiful. Nature at any rate had provided for us more generously than we had a right to expect.

At first it appeared as if farmers were likely to be sufferers rather than gainers by the war. Prices of feeding-stuffs, especially linseed and cotton-cakes, maize-meal, rice-meal, and barley-meal, rose at once, recruiting affected the labour supply, and difficulties arose in the distribution of produce by rail. With one or two exceptions, such as oats, the prices of farm produce showed but little rise for three or four months after the war began. Wheat rose about 10 per cent., barley remained about normal, cattle by November had not risen more than 3 per cent., sheep and veal-calves showed no rise until December, while poultry was actually cheaper than usual, though eggs rose considerably. Butter rose slightly, and cheese remained about normal. Up to nearly the end of the year, in fact, it may be said generally that British farm-produce made very little more money than usual.

Meanwhile, the nation began to take a keen interest in the agricultural resources of the country, and farming became the object of general solicitude. We started with great energy to improvise, in truly British fashion, the means of facing the supreme crisis of our fate, but the elementary fact at once became obvious that it is impossible to improvise food. The main farm-crops take an unreasonably long time to grow, even if the land is prepared for them, and a sudden extension of the area under cultivation is not a simple proposition. It was freely pointed out—with undeniable truth—that our agricultural system had not been arranged to meet the conditions of a great European war, and many suggestions were made to meet the emergency. Some of these suggestions involved intervention by legislative or administrative action. It was decided that any attempt violently to

[5] "English Farming, Past and Present," p. 269.

divert the course of farming from its normal channels would probably not result in an increased total production from the land. The Agricultural Consultative Committee, appointed by the President of the Board of Agriculture on August 10, issued some excellent advice to farmers as to their general line of policy and the best means by which they could serve the nation, and this was supplemented by the Board and by the agricultural colleges and local organisations throughout the country. No fewer than thirty special leaflets were issued by the Board, but, while it may, I think, fairly be claimed that all the recommendations made officially were sound and reasonable, I should be the last to aver that farmers were universally guided by them. They do not accept official action effusively :—

Unkempt about those hedges blows
An English unofficial rose,

and official plants do not flourish naturally in farm hedgerows. It was, however, fairly evident that patriotism would suggest an effort to obtain the maximum production from the land, and there were good reasons to think that self-interest would indicate the same course. It must be admitted, however, that during the autumn the lure of self-interest was not very apparent. Food-prices, however, at the end of the year began to rise rapidly. English wheat in December was 25 per cent. above the July level, in January 45 per cent., in February and March 60 per cent., and in May 80 per cent. Imported wheat generally rose to a still greater extent, prices in May standing for No. 2 North Manitoba 95 per cent., and No. 2 Hard Winter 90 per cent. above July level. The greater rise in imported wheat may be noted as vindicating farmers against the charge which was made against them of unreasonably withholding their wheat from the market. Cattle and sheep rose more slowly, but in March prices of both had risen by 20 per cent., and in May and June cattle had risen by about 40 per cent. Butter rose by about 20 per cent., and cheese by about 40 per cent. Milk rose little through the winter, but when summer contracts were made prices remained generally at the winter level.

British agriculture, like the British Isles, is a comparatively small affair geographically. The 47 million acres which it occupies, compared with the 80 million acres of Germany or the 90 million acres of France, and still more the 290 million acres of the United States, represent an area which may be termed manageable, and about which one might expect to generalise without much difficulty. But, in fact, generalisation is impossible. Even on the 27 million acres of farm land in England and Wales there is probably more diversity to the square mile than in any country on earth. The variations in local conditions, class of farming, and status of occupier preclude the possibility of making any general statement without elaborate qualifications. Thus whatever one might say as to the effects of the war on agriculture would be certain to be inaccurate in some districts and as regards some farmers.

There are three main agricultural groups, corn-growing, grazing, and dairying. They overlap and intermingle indefinitely, and there are other important groups, such as fruit-growing, vegetable-growing, hop-growing, etc., which represent a very large share of the enterprise and capital engaged on the land. The receipts of the corn-growing farmer, generally speaking, were substantially increased. Probably about 50 per cent. of the wheat-crop had been sold before prices rose above 40*s*. per quarter, and there was very little left on the farms when they reached their maximum in May. Oats rose rather more quickly, but did not reach so high a level, relatively, as wheat. Barley—owing perhaps to enforced and voluntary temperance—never made exceptional prices, and, in fact, the best malting barleys were of rather less than average value. There is no doubt, however, that farmers who depended mainly on corn-growing found an exceptionally good market for their crops and made substantial profits. Farmers who depended mainly on stock were less generally fortunate, although stock were at a fairly high level of price when the war began. Sheep for some time showed no signs of getting dearer, but in the spring prices rose substantially, and a good demand for wool—which in one or two cases touched 2*s*. per lb.—made the flock-masters' returns on the whole very satisfactory. Cattle followed much the same course; stores were dear, but by the time fat stock came out of the yards or off the grass prices had risen to a very remunerative level. The large demands on imported supplies of meat for the British and French armies occasioned a distinct shortage for the civil population, but this was relieved by a reduced demand, so that the effect upon prices of native beef and mutton was not so great as might have been expected. The influence of a rise of price upon demand is more marked in the case of meat than in that of bread. While there has been a distinct reduction in the consumption of meat, there is no evidence of a reduced consumption of bread.

Dairy farmers generally found themselves in difficulties. Prices of butter and cheese increased but slightly, and milk remained for a considerable period almost unchanged. The rise in the prices of feeding-stuffs and the loss of milkers aggravated their troubles. An actual instance of the position in February as affecting a fairly typical two-hundred acre farm may be quoted. It had thirty milch cows producing about 16,500 gallons per annum. The cake bill showed an advance of 50 per cent., and wages had risen 12 per cent. It was calculated that the extra cost was 1·3*d*. per gallon of milk. Later the prices of milk, butter, and cheese rose, but on the whole it cannot be said that dairy farmers generally made exceptional profits.

While it is certain that the gross receipts by farmers were substantially increased, it is very difficult to estimate what the net pecuniary gain to agriculture has been. It can only be said generally that while some have made substantial profits, which were probably in very few cases excessive, many others have on balance (after allowing for extra cost) done no better financially, and some perhaps even worse, than in an average year of peace. With regard to one item of extra cost, that of labour, it is possible to make an approximate estimate. Agricultural labourers were among the first to respond to the call for the new armies, and, up to the end of January, 15 per cent. had joined the forces of the Crown. This considerable depletion of labour was not acutely felt by farmers during the winter, but during the spring and summer serious difficulty was experienced and many devices were suggested—some of which were adopted—for meeting it. Naturally the wages of those agricultural labourers who were left rose, the rise varying in different districts but being generally from 1*s*. 6*d*. to 3*s*. per week. Owing to the rise in the price of commodities, this increase of wages cannot be regarded as a profit to the labourers, but it is, of course, an outlay by farmers, which in England and Wales may be reckoned as amounting to an aggregate of about 2,000,000*l*.

This country has never suffered from a dearth of agricultural advisers, and in such a time as the present, when everyone is anxious to help the country, it is natural that they should be unusually plentiful. Advice was freely offered both to the Government how to deal with farmers and to farmers how to deal with the land. Whether in consequence of advice or in spite of it, it may fairly be said that farmers throughout the United Kingdom have done their duty. They have met their difficulties doggedly, and have shown an appreciation of the situation which does credit to their intelligence. It was not easy last autumn when farmers had to lay their plans for the agricultural year to forecast the future. We were all optimists then, and many thought that the war might be over before the crops then being planted were reaped. It was clear, however, that the national interest lay in maintaining and, so far as possible, increasing the produce of the land. In the quiet, determined way which is characteristic of them, farmers devoted themselves to the task, and the returns recently issued give the measure of their achievement. They have added 22 per cent. to the acreage of wheat and 7 per cent. to the acreage of oats, and they have kept the area of potatoes up to the high and sufficient level of the previous year. These are the three most important crops. They have also not only maintained the stock of cattle, which was the largest on record, but, in spite of unfavourable conditions and a bad lambing season, they have increased the stock of sheep. In view of these facts, I venture to say that British and Irish farmers have shown both patriotism and intelligence, and may fairly claim to have contributed their share to the national effort.

The share of British agriculture in the food supply of the nation is more considerable than is sometimes realised. When I last had the honour to address the British Association I ventured to emphasise this point, and I may be allowed to repeat, in a somewhat different form and for a later period, the figures then given. Taking those articles of food which are more or less produced at home, the respective proportions contributed by the United Kingdom, the rest of the Empire, and foreign countries were on the average of the five years 1910–14 as follows:—

—	United Kingdom	British Empire overseas	Foreign countries
	Per cent.	Per cent.	Per cent
Wheat	19·0	39·3	41·7
Meat	57·9	10·7	31·4
Poultry	82·7	0·2	17·1
Eggs	67·6	0·1	32·3
Butter (including margarine)	25·1	13·3	61·6
Cheese	19·5	65·4	15·1
Milk (including cream) ...	95·4	0·0	4·6
Fruit	36·3	8·3	55·4
Vegetables	91·8	1·1	7·1

The war has directly affected some of our food supplies by interposing barriers against the exports of certain countries. Fortunately we were in no way dependent for any of these foods upon our enemies, though Germany was one of our main sources of supply for sugar. We received some small quantities of wheat or flour and of eggs from Germany, Hungary, and Turkey, some poultry from Austria-Hungary, and some fruit from Germany and Turkey, but the whole amount was insignificant. The practical cessation of supplies from Russia was the most serious loss, as we drew from thence on an average 9 per cent. of our wheat, 9 per cent. of our butter, and 16 per cent. of our eggs.

Within the first few days of the war, the Government, through the Board of Agriculture, obtained returns not only of the stocks of all kinds of food-stuffs in the country, but also of the stocks of feeding-stuffs for animals and of fertilisers for the land. Powers were taken under the Articles of Commerce (Returns, etc.) Act to compel holders of stocks to make returns, but it is due to the trading community to say that in only two instances, so far the Board of Agriculture was concerned, was it necessary to have recourse to compulsion. The returns of stocks of food-stuffs, feeding-stuffs, and fertilisers have been made regularly to the Board of Agriculture[6] every month since the outbreak of war, and the loyal co-operation of the traders concerned deserves cordial recognition by those whose official duty has been rendered comparatively easy by their assistance.

A very casual glance at the national dietary suffices to show that John Bull is an omnivorous feeder, and as the whole world has eagerly catered for his table his demands are exigent. But, for various reasons, our daily bread, reluctant though most of us would be to be restricted to it, is regarded as the measure and index of our food supplies. On August 4 the Board of Agriculture published an announcement that they estimated the wheat-crop then on the verge of harvest at 7,000,000 quarters, and that, including other stocks in hand, there was at that time sufficient wheat in the country to feed the whole population for four months; and a few days later, having then obtained further information from about 160 of the principal millers, they stated that the supplies in the country were sufficient for five months' consumption. The Board also announced, on August 5, that the potato crop would furnish a full supply for a whole year's consumption without the necessity for any addition from imports. When it was further announced that the Government had taken steps to ensure against a shortage of sugar it began to be generally realised that at any rate the country was not in imminent danger of starvation. Indeed, on a broad survey of the whole situation, it was apparent that our native resources, together with the accumulated stocks of various commodities held in granaries, warehouses, and cold stores, would enable the United Kingdom to face even the unimaginable contingency of a complete blockade of all its ports for a considerable period.

In these circumstances it appeared that, provided adequate protection were given against unusual risks, commercial enterprise might in the main be relied upon to supply the demands of the people in the normal manner and in the usual course of business. It is a self-evident axiom that it is better not to interfere in business matters unless there is a paramount necessity for interference.

The machinery of modern business in a highly organised community is very complicated; the innumerable cog-wheels are hidden while the machine is running normally, but every single one of these becomes very obvious when you attempt to introduce a crowbar. With one or two exceptions the purveyors of food to the nation were left to conduct their business without official interference, though the Board of Trade took steps to ascertain what were the retail prices justified by the wholesale conditions and to disseminate the information for the protection of consumers against unreasonable charges.

One measure of a drastic and widespread nature was adopted. The exportation of a large number of commodities was prohibited. This was done for two reasons: (1) to conserve stocks in this country, and (2) to prevent goods from reaching the enemy. The latter object could be attained only very partially by this method so long as any sources of supply other than the ports of the United Kingdom were open to the enemy or to adjoining neutral countries. The former object—with which we are now only concerned—was on the whole achieved. The Board of Agriculture, concerned for the maintenance of our flocks and herds, at once secured a general prohibition of the exportation

6 Returns in Scotland and Ireland are made to the Agricultural Departments of those countries and the results transmitted to the Board of Agriculture and Fisheries.

of all kinds of feeding-stuffs for animals. Many kinds of food-stuffs were at once included, and later additions were made, so that for a long time past nearly all kinds of food have been included, though in some cases the prohibition does not apply to the British Empire or to our Allies. The exportation of fertilisers, agricultural seeds, binder twine, and certain other commodities more or less directly connected with the conservation of our food supplies, was also prohibited, so that generally it may be said that the outlet for any food in the country was under effective control. This is not the time or place to discuss the reasons why in some instances limited quantities of certain articles were allowed to escape under licence. It is only necessary to remark that in all such cases there were cogent reasons in the national interest for the action taken.

Direct Government intervention in regard to food supplies was limited to three commodities—sugar, meat, and wheat. In the case of sugar the whole business of supply was taken over by the Government—a huge undertaking, but administratively a comparatively simple one, owing to the fact that there are no home-grown supplies. Intervention in the meat trade was necessitated by the fact that the enormous demands of the Allied armies had to be met by drafts upon one particular kind of meat and mainly from one particular source. The Board of Trade co-operated with the War Office, and a scheme was evolved whereby a very large part of the output of meat from South America and Australia comes under Government control.

As regards wheat, the intervention of the Government took two forms. The scheme whereby the importation of wheat from India was undertaken by the British Government, in co-operation with the Indian Government, arose primarily from conditions in India rather than from conditions in the United Kingdom, although it is hoped and believed that the results will prove to be mutually advantageous. Other than this the intervention of the Government in regard to wheat was devised as an insurance against the risk of interruption of normal supplies, its main object being to prevent the stocks of wheat in the country from falling to a dangerous level at a time when the home crop would be practically exhausted. When the home crop is just harvested there are ample reserves in the country for some months, and, as the United States and Canada are at the same time selling freely, stocks held by the trade are usually high. While home-grown wheat remains on the farms it is practically an additional reserve supplementary to the commercial reserves. When it leaves the farmer's hands, even although it may not actually go into consumption, it becomes part of the commercial reserve. This reserve in the nature of business tends to be constant, but fluctuates within rather wide limits under the influence of market conditions. If the price of wheat rises substantially and the capital represented by a given quantity increases, there is a natural tendency to reduce stocks. If also there is any indication of a falling market ahead, whether from favourable crop prospects or the release of supplies now held off the market for any reason, a prudent trader reduces his stocks to the smallest quantity on which he can keep his business running. So long as shipments reach this country, as in normal times they do, with, as a member of the Baltic once expressed it to me, "the regularity of 'buses running down Cheapside," the country may safely rely on receiving its daily bread automatically. But if any interruption occurred at a time when the trade, for the reasons just indicated, happened to be running on low stocks, the margin for contingencies might be insufficient. I am, of course, debarred from discussing the method adopted or the manner in which the scheme was carried out, but, as the cereal year for which it was devised is over, it is permissible to state that the object in view was successfully achieved.

Of the 47,000,000 people who form the population of the United Kingdom the large majority are absolutely dependent for their daily food on the organisation and regular distribution of supplies. The countryman, even if he possesses no more than a pig and a garden, might exist for a short time, but the town-dweller would speedily starve if the organisation of supplies broke down. He does not, perhaps, sufficiently realise the intricacy of the commercial arrangements which make up that organisation, or the obstacles which arise when the whole economic basis of the community is disturbed by a cataclysm such as that which came upon us thirteen months ago. The sorry catchword, "Business as usual," must have sounded very ironically in the ears of many business men confronted with unforeseen and unprecedented difficulties on every side. The indomitable spirit with which they were met, the energy and determination with which they were overcome, afford further evidence of that which has been so gloriously demonstrated on land and sea, that the traditional courage and grit of the British race have not been lost.

To the question how have our oversea food supplies been maintained during the first year of the war, the best answer can be given in figures.

Imports of the principal kinds of food during the first twelve months of the war were as under, the figures for the corresponding period of 1913–14 being shown for comparison :—

	1914–15 Thousands of cwt.	1913–14 Thousands of cwt.	Increase + or Decrease − per cent.
Wheat (including flour)	113,797	115,398	− 1·39
Meat	15,868	18,026	− 11·97
Bacon and hams...	7,452	5,975	+ 24·72
Cheese	2,766	2,386	+ 15·93
Butter (including margarine) ...	5,376	5,748	− 6·47
Fruit	18,830	17,512	+ 7·53
Rice	9,573	4,840	+ 97·79
Sugar	35,029	38,356	− 8·67

In total weight of these food-stuffs, the quantity brought to our shores was rather larger in time of war than in time of peace. Yet one still occasionally meets a purblind pessimist who plaintively asks what the Navy is doing. This is a part of the answer. It is also a measure of the success of the much-advertised German "blockade" for the starvation of England. So absolute a triumph of sea-power in the first year of war would have been treated as a wild dream by the most confirmed optimist two years ago. The debt which the nation owes to our sailor-men is already immeasurable. That before the enemy is crushed the debt will be increased we may be assured. The crisis of our fate has not yet passed, and we may be called upon to meet worse trials than have yet befallen us. But in the Navy is our sure and certain hope.

"That which they have done is but earnest of the things that they shall do."

Under the protection of that silent shield the land may yield its increase untrodden by the invading foot, the trader may pursue his business undismayed by the threats of a thwarted foe, and the nation may rely that, while common prudence enjoins strict economy in husbanding our resources, sufficient supplies of food will be forthcoming for all the reasonable needs of the people.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Oxford at the beginning of Michaelmas Term, 1915, presents an unwonted appearance. The colleges are almost denuded of undergraduates; the river, playing grounds, and other usual resorts are comparatively deserted, and many of the accustomed activities are at a standstill. The city is redeemed from utter desolation by the presence of large numbers of young officers, who are sent here from their respective units to undergo a course of instruction by the staff of the Officers Training Corps, assisted by lecturers detailed from the War Office. Accommodation for this influx of the military element has been provided by several of the colleges, notably by Trinity, Wadham, Hertford, and Keble. The current number of the *University Gazette* contains a long list of members of the University who have given their lives for their King and country. Many of the scientific staff are being employed in researches and practical operations with direct reference to the war. Among these may be mentioned the names of Mr. R. B. Bourdillon, fellow of University, Mr. H. T. Tizard, fellow of Oriel, and Mr. I. O. Griffith, fellow of St. John's, who are all engaged in most important researches in the chemistry and physics of aerial warfare. Mr. Griffith has been specially re-elected to a fellowship in virtue of his research work in this department.

The new chemical laboratory, which is being erected under the supervision of Prof. Perkin, is rapidly approaching completion.

THE Swiney lectures on geology in connection with the British Museum (Natural History) will be delivered by Dr. J. D. Falconer, in the Lecture Theatre of the Victoria and Albert Museum, South Kensington, on Mondays, Tuesdays, and Saturdays, at 3 p.m., beginning Saturday, November 13. There will be twelve lectures, and their subject will be "Ice and the Ice Age." Admission to the lectures will be free.

A COPY of the current calendar of University College, Dublin, a constituent college of the National University of Ireland, has been received. It contains detailed particulars of the various courses offered in preparation for the degrees conferred by the National University. Among such degrees we notice the bachelor of agricultural science, bachelor and master of engineering, bachelor and master of architecture, and bachelor and master of commerce. In addition to other scholarships and exhibitions, the governing body is prepared to award not more than five post-graduate scholarships in arts or science.

THE Departmental Committee appointed by Lord Selborne under the chairmanship of Sir Harry Verney, Bart., M.P., to consider what steps can be taken to promote the settlement or employment on the land in England and Wales of sailors and soldiers, whether disabled or otherwise, on discharge from the Navy or Army, has presented an interim report recommending that as an experiment fifty men who have been discharged from the Navy or Army owing to disablement should be given a course of training in an agricultural college, with the view of obtaining for them permanent employment on the land, and, in the case of those proving specially capable, fitting them to become occupiers of small holdings. This recommendation has been approved by Lord Selborne, and endorsed by the War Office, and the Treasury has agreed to place funds at the disposal of the Board of Agriculture and Fisheries to defray the cost of the experiment. It is proposed that the men selected shall be sent to the Harper Adams Agricultural College, Newport, Salop, and to the College of Agriculture and Horticulture, Holmes Chapel, Cheshire, where they will be provided with board and lodging and be given a course of training in agriculture and horticulture free of charge to themselves. Any men who have been discharged from the Navy or Army on account of disablement, and desire to receive this course of training, should apply at once to the Secretary, Board of Agriculture and Fisheries, 4 Whitehall Place, S.W., for a form of application.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 11.—M. Ed. Perrier in the chair.—The President announced the deaths of Edouard Prillieux and Philippe Hatt, members of the academy.—L. **Lecornu**: The deformation of a cylindrical tube.—Henryk **Arctowski**: The solar faculæ. An account of a statistical study of Greenwich heliographic observations. From measurements of the areas of the spots and faculæ, the maximum for the latter is nine days behind the maximum for the spots. The author, from his researches on the Greenwich data, considers the phenomenon of the variation of the frequency of the sun-spots as being only a manifestation subordinate to the phenomenon of the variation of the faculæ.—Marcel **Brillouin**: Certain problems of mathematical physics in the case of hollow bodies.—Pierre **Lesage**: Salted plants and the transmission of acquired characters. Plants watered with salt water show differences, more or less marked, from plants of the same species watered with pure water. Starting with seeds of *Lepidium sativum* arising from plants watered with weak salt solutions in 1911, it is shown that some of the acquired characters are transmitted by the seeds, although the plants arising from the latter had been watered with soft water only.—E. **Demoussy**: The localisation of the acids and sugars in fruits. Various species of fruit, both ripe and partially ripe, were subjected to gradually increasing pressure, and the juices expressed collected in fractions and analysed separately. In some cases the amounts of acid and sugar vary considerably with the pressure. These variations are marked with apricots and grapes, small for peaches, and do not appear in strawberries and melons. The cause of this variation is discussed from the point of view of the osmotic pressures in the cells. The localisation of the dissolved matter in fruits is regarded as affording an explanation of the marked difference in the taste of certain fruits in the raw and cooked states.

BOOKS RECEIVED.

Continuous and Alternating Current Machinery Problems. By Prof. W. T. Ryan. Pp. 37. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 2*s*. 6*d*. net.

Practical Shop Mechanics and Mathematics. By J. F. Johnson. Pp. ix+130. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 4*s*. 6*d*. net.

Arithmetic for Carpenters and Builders. By Prof. R. B. Dale. Pp. ix+231. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 5*s*. 6*d*. net.

The Essentials of Descriptive Geometry. By Prof. F. G. Higbee. Pp. vi+204. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s*. 9*d*. net.

Mortality Laws and Statistics. By R. Henderson. Pp. v+111. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 5*s.* 6*d.* net.

A Manual for Health Officers. By J. S. McNutt. Pp. x+650. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12*s.* 6*d.* net.

Market Gardening. By F. L. Yeaw. Pp. vi+102. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 3*s.* 6*d.* net.

How to Lay Out Suburban Home Grounds. By H. J. Kellaway. Second edition. Pp. x+134. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 8*s.* 6*d.* net.

An Introduction to the Mechanics of Fluids. By Prof. E. H. Barton. Pp. xiv+249. (London: Longmans and Co.) 6*s.* net.

The Star Pocket-Book: or How to Find Your Way at Night by the Stars. By R. Weatherhead. Pp. 92. (London: Longmans and Co.) 1*s.* net.

The Surrey Hills. By F. E. Green. Pp. x+252. (London: Chatto and Windus.) 7*s.* 6*d.* net.

New Zealand. Department of Mines. N.Z. Geological Survey. Palæontological Bulletin, No. 3: Revision of the Tertiary Mollusca of New Zealand, based on Type Material. By H. Suter. Part ii. Pp. 69. (Wellington: J. Mackay.)

New Zealand. Department of Lands and Survey. Report on the Survey Operations for the Year 1914–15. By E. H. Wilmot. Pp. 78. (Wellington: J. Mackay.)

Board of Agriculture and Fisheries. Annual Report of the Education Branch on the Distribution of Grants for Agricultural Education and Research in the Year 1914–15. Pp. x+154. (London: H.M.S.O.; Wyman and Sons, Ltd.) 8½*d.*

Transactions of the London Natural History Society for the Year 1914. Pp. 85. (London: L. Reeve and Co., Ltd.) 3*s.*

Hill Birds of Scotland. By S. Gordon. Pp. xii+300. (London: E. Arnold.) 12*s.* 6*d.* net.

Earth-Lays: Geological and other Moods. By C. Tolly. Pp. 63. (London: J. M. Dent and Sons, Ltd.) 3*s.* 6*d.* net.

The War and New British Industries. Imperial Institute Monographs. Oil Seeds and Feeding Cakes, with a Preface by Dr. W. R. Dunstan. Pp. xxv+112. (London: J. Murray.) 2*s.* 6*d.* net.

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The British Coal-Tar Industry: its Origin, Development, and Decline. Edited by Prof. W. M. Gardner. Pp. ix+437. (London: Williams and Norgate.) 10*s.* 6*d.* net.

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Manuals of Chemical Technology. IV.: Chlorine and Chlorine Products. By Dr. G. Martin. Pp. viii+100. (London: Crosby Lockwood and Son.) 7*s.* 6*d.* net.

Iowa Geological Survey. Vol. xxiii. Annual Report, 1912, with Accompanying Papers. Pp. xliii+662. (Des Moines: Iowa Geological Survey.)

Annual Report of the Board of Regents of the Smithsonian Institution for the Year ending June 30, 1914. Pp. xi+729. (Washington: Government Printing Office.)

Smithsonian Institution. U.S. National Museum. Bulletin 91: Report on the Turton Collection of South African Marine Mollusks, with additional notes on other South African Shells contained in the U.S. National Museum. By P. Bartsoh. Pp. xii+305. (Washington: Government Printing Office.)

DIARY OF SOCIETIES.

THURSDAY, OCTOBER 21.

INSTITUTION OF MINING AND METALLURGY, at 8.15.—The Geology of the Waihi Grand Junction Mine: Report upon Developments up to June 30, 1914: A. Jarman.

FRIDAY, OCTOBER 22.

PHYSICAL SOCIETY, at 5.—The Radiation and Convection from a Heated Wire in an Enclosure of Air: Dr. T. Barratt.—The Determinaton, by the Method of Diffusive Convection, of the Coefficient of Diffusion of a Salt Dissolved in Water: Dr. A. Griffiths.—The Magnitude of the Thermal Resistance Introduced at the Slightly Conical Junction of Two Solids, and its Variation with the Nature of the Surfaces in Contact: Dr. T. Barratt.

MONDAY, OCTOBER 25.

MEDICAL SOCIETY, at 8.30.—*Discussion*: Gunshot Wounds of the Peripheral Nerves. The Medical Aspect: Dr. W. Harris; the Surgical: W. Trotter.

TUESDAY, OCTOBER 26.

ZOOLOGICAL SOCIETY, at 5.30.—(1) The Distribution of Secondary Sexual Characters amongst Birds, with Relation to their Liability to the Attack of Enemies; (2) Some Observations on Pattern-blending with Reference to Obliterative Shading and Concealment of Outline: J. C. Mottram.—Fauna of West Australia. III. A New Nemertean—*Geonemertes dendyi*, sp. n.—being the First Recorded Land Nemertean from Western Australia. IV. *Palæmonetes australis*, sp. n., being the First Record of the Genus in Australia: Prof. W. J. Dakin.—A Collection of Mammals from the Coast and Islands of S.E. Siam, with an Account of the Fruit-Bats by Dr. Knud Andersen: C. Boden Kloss.—Studies on the Protozoan Parasites of the Fishes of the Georgian Bay: Dr. J. W. Mayor.—(1) A List of the Snakes of East Africa, North of the Zambesi and South of the Soudan and Somaliland, and of Nyassaland; (2) A List of the Snakes of North-East Africa, from the Tropic to the Soudan and Somaliland, including Socotra: Dr. G. A. Boulenger.—Some Notes upon the Anatomy of *Rana tigrina*: Dr. G. E. Nicholls.

FRIDAY, OCTOBER 29.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Thomas Hawksley Lecture: The World's Sources of Fuel and Motive Power: Dr. Dugald Clerk.

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Telegraphic Address: PHUSIS, LONDON.
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Printed in Great Britain by R. CLAY & SONS, LIMITED, at Brunswick Street, Stamford Street, S.E., and published by MACMILLAN AND CO., LIMITED, at St. Martin's Street, London, W.C., and THE MACMILLAN CO., 66 Fifth Avenue, New York.—THURSDAY, October 21, 1915.