THURSDAY, JULY 5, 1917.

THE CLASSICAL SYSTEM OF EDUCATION.

Higher Education and the War. By Prof. John Burnet. Pp. x+238. (London: Macmillan and Co., Ltd., 1917.) Price 4*s.* 6*d.* net.

PROF. BURNET'S book is entitled "Higher Education and the War." He states that most of his criticisms were published in 1913 and "are not, therefore, unduly influenced by the war." That they have been somewhat influenced thereby is thus admitted; this is the chief way the war comes in, for the work is mainly an appreciative account of the German system of higher education.

As such it will be useful if only to show those people who are ignorant of the fact—and they are legion, as the letters from clergymen and others which so frequently appear in the newspapers indicate—that this system is more completely based on the "humanities" than that of any other country—was, in fact, until the end of the nineteenth century practically confined to them. Until the present century no one in Germany could enter a university, or become a member of the Civil Service, or embrace any of the learned professions without a passing-out or maturity certificate from one of the "Gymnasien." The curriculum in these is almost purely classical, for of the nine years spent in these schools all have to be devoted to the acquisition of Latin and six to that of Greek, other subjects being allowed to play a very subsidiary part in the scheme of education, whilst science teaching is practically nil. This is an ideal "humanistic" education, carried out with all the disciplinary thoroughness of the German. All the governing classes of Germany of the present day were reared upon it—with the results which we are now experiencing. Prof. Burnet seriously suggests that we should adhere to such a plan of education for this country; and there are many people who agree with him. Did not the *Times* critic describe his book as "so good that it is difficult to review," and discover "nothing to find fault with" in it?

Prof. Burnet's work is an obvious attempt to counteract the "Neglect of Science" agitation. Yet he is constrained to admit that very few of the greatest scientific discoveries have been made by Germans (he might almost have said, none); what they have done is to organise scientific work. He states that for ourselves "what is wanted is really a better education for the leaders of commerce and industry, so that they may gain a rather wider outlook than they have at present." And for this wider outlook Prof. Burnet offers this German system. He tells us that the Prussians understand these things better than we do; that they organised their educational system to train an *élite* to do the highest work of the nation. "We have been furnished with such an *élite* by the public schools and by Oxford and Cambridge," which "do much of the best educational work that is done in this country to-day, and we should be careful not to meddle rashly with institutions which are more and more becoming the envy and admiration of Europe and America."

Since the beginning of the present century some modification has been introduced into the German system, admission to the universities and the rest being possible through schools other than the Gymnasien proper. But although these devote less time to Latin than the Gymnasien, and still less to Greek, the education of the boys is almost entirely confined to languages and literature, so that it remains emphatically literary in character. And it may be added that these alternative schools, perhaps because they are new, are looked down upon by the higher social classes in Germany, so that the purely classical Gymnasien are yet by far the most frequented by those who desire to enter the universities, the Civil Service, and the learned professions. The whole German system, in fact, even with the modification alluded to, is based upon the idea—which Prof. Burnet strongly upholds—that the mind can be trained only by the study of languages and literature—preferably those of extinct races—as distinct from the modern English and American view that the intelligence can be developed as well, if not better, by the study of natural science, and that it is inexpedient to put all boys and girls through the self-same educational mill irrespective of their innate tendencies, and regardless of the fact that the particular mill which the humanists advocate is neither more nor less than abhorrent to the majority of healthy-minded children. Indeed, like most other humanists, Prof. Burnet holds that an education based upon the acquisition of knowledge which is of no value in after life is more useful than one based on knowledge which is of permanent value, and regards the sarcastic definition of education as "the sum of all we have forgotten" as a not altogether unjust appreciation of what education really should be. He considers that "the right of children to be treated as human beings," which in his view is to have their school training based entirely upon "humanistic" studies, is now seriously threatened by those who hold that the future of education may, and must, be strengthened by the introduction of a basis of natural science.

Prof. Burnet's contentions are not without such discrepancies as are inseparable from the pursuit of a weak line of argument. For while he contends that the Latin rather than the English grammar ought to be taught first, "when the memory is strong and the reasoning powers undeveloped. Children love to learn things by heart, whether they understand them or not. . . . On the other hand, they resent, and quite rightly, all appeals to their reasoning powers," he states, a little further on, that "the Humanist ideal of education . . . is that the pupils should above all be led to feel the meaning and worth of what they are studying." This, one would have thought, is very much the ideal of those who advocate the introduction of the study of natural science into general education. Incidentally, one wonders to what kind of children Prof. Burnet alludes in the sentence above quoted, for the experience of most people surely is that an intelligent child wants to know the how and the why of everything!

Prof. Burnet's conclusions are that all boys (and girls?) should be educated on strictly classical lines until the age of seventeen, and that during the next three years the "humanistic" character of the education should be continued by compelling philosophy to hold the central place in the scheme. The rest of the organisation of their education would then present no difficulty to Prof. Burnet, but if the student continues with the "humanities," he ought to have a smattering ("know something") of science; if he goes in for science, he ought to continue with the "humanities." Prof. Burnet admits that at present students who are to proceed with the "humanities" show little desire to add a knowledge of science to their attainments, and certainly most students who have adopted science show no desire at all to continue with the "humanities"! At the end of the three years of philosophy, *plus* the "humanities," *plus* science, he would give an Arts degree, which must be a preliminary to all other degrees and would "mark the commencement of university work proper"; this degree would, in fact, be the equivalent of the German school leaving certificate. Even the study of Medicine is not to be commenced until the Arts degree is attained—a crude reversion to the old, abandoned Oxford system.

Prof. Burnet admits that his scheme for students of medicine is not in accordance with professional opinion in this country, and contrasts this with the expressed opinion of German medical faculties in favour of their own system. "There can," he says, "be no doubt, I suppose, that the *average* qualifications of medical men in Germany are much higher than in this country, and the most natural explanation of this seems to be that they are better educated and more mature when they begin the study of Medicine." From extensive personal knowledge of medical men in both countries I may venture to differ entirely from Prof. Burnet as to the correctness of his supposition—the reverse being, in my opinion, true—but I would be diffident in ascribing this to differences in scholastic training, seeing how much better organised is the teaching in our medical schools as compared with that in German universities. The superiority of the latter institutions has hitherto lain in the opportunities afforded in them for research—but that is another story.

E. A. SCHÄFER.

APPLIED CHEMISTRY IN THE UNITED STATES.

Annual Chemical Directory of the United States. Edited by B. F. Lovelace. Pp. 305. (Baltimore, U.S.A.: Williams and Wilkins Co.) Price 5 dollars.

THIS book, although primarily intended for circulation in the United States, has many features of interest deserving the attention of those who are concerned in the production of similar works in this country. It is a trade directory on a very broad gauge, and appeals to every section that is interested, even remotely, in chemical science and the chemical arts—industrial organisations of various kinds, scientific societies, colleges, professional analysts, consultants, chemical engineers, patent agents, manufacturers of chemical plant, etc. In view of the rapidly extending trade relations of America with the rest of the world, and especially with Europe, it affords a considerable amount of useful information on chemical matters in Continental countries. So far as we have been able to judge, it has been carefully compiled, although, as might have been anticipated in a work of this magnitude, a few omissions and occasional press errors are to be met with. Certain of the agricultural colleges and stations in this country are omitted from a list which professes to be comprehensive. No mention is made of several important schools of chemistry in Great Britain, and the list of technical colleges is incomplete. The list of officers of some of our scientific societies is also out of date. There are a few mistakes in the spelling of proper names, *e.g.* Brulington House for Burlington House, Wil for Will, etc.; but, considering the large amount of material to be dealt with, the number of such errors is remarkably small.

A valuable addition to the work is an annual review of progress in applied chemistry in the States during the year preceding publication. This for 1916 presents many features of interest. As might be expected, the war has had a profound influence on the course of development of the chemical arts in America, and there has been a great extension of chemical industry in that country. In 1914 the United States, like Great Britain, suddenly realised that it had grown to be largely dependent on Germany for hundreds of things of a chemical nature that were necessary for its daily comfort and convenience. This domestic demand, as well as the effort to meet the enormous foreign demand for munitions, etc., greatly stimulated all chemical industries in that country. The older concerns largely increased and improved their output, and in many cases branched out into new lines, and a number of new companies were organised and are now firmly established. So great is the demand for chemists that factories are offering attractive salaries to young men who have scarcely completed their academic training. This revival is, of course, reacting upon the colleges and schools of chemistry throughout the country, and cannot fail to exercise an influence upon the progress of chemical research. Industries that have now been undertaken by American manufacturers cannot be permanently maintained unless continually fostered by research.

The Government has not been unmindful of its opportunity. Considerable "appropriations" have been made in support of the dye-stuff industry, the recovery of potash salts, the extraction of radium from carnotite ores, etc. A National Research Council has been founded, consisting of leading American investigators, and representatives of the defensive forces, the various scientific bureaux of the State, educational institutions, and the research departments of industrial and manufacturing establishments. The Chemistry Committee of the council has evidently been carefully organised, and contains within its body, as well as in its numerous sub-committees, dealing with practically every branch of applied chemistry, almost every representative man in the States. An immediate result is seen in the extraordinary development of the synthetic colour industry, a great variety of dye-stuffs hitherto made only in Germany being now manufactured in the States. It is not too much to say that America is now independent of German production. This extension has, of course, reacted on the coal-tar products industry and on the manufacture of "intermediates," acids, alkalies, ammonia, and a great variety of chemical substances. It has influenced, indeed, almost every branch of applied science and has affected the manufacture of all kinds of appliances, both for research and for technical processes. American instrument makers are now turning out ammeters, voltmeters and wattmeters, thermometers, scientific and industrial, pyrometers, glass-ware, silica apparatus, porcelain goods, etc., of a kind in no wise inferior, and in some cases actually much superior, to the best German and Austrian production.

This widespread activity has, it need scarcely be said, greatly stimulated the innate inventive genius of the American, and last year saw several novelties on the market of interest to chemists and physicists. Among them is *rhotanium*, an alloy of rare metals, having a specific gravity about half that of platinum, and capable of replacing that metal in the manufacture of crucibles, dishes, etc. Another new alloy is *canadium*, which is said to be specially suitable as resistance material in electric furnace windings, contact and spark points, and other electrical uses. *Clebrium*, another alloy, is said to be unacted upon by nitric, sulphuric, or acetic acid, and to be readily machined. New uses have also been found for *alundum* and *bakelite*.

Altogether the record of progress during 1916 is most satisfactory. We have reason to know that its rate is being maintained, and we shall look forward, therefore, with interest to the appearance of the second volume of what is undoubtedly a most useful compilation.

WAR MEDICINE AND SURGERY.

(1) *Les Dysenteries, Le Choléra Asiatique, Le Typhus Exanthématique.* Par H. Vincent et L. Muratet. Pp. 184. (Paris: Masson et Cie, 1917.) Price 4 francs.

(2) *Le Traitement des Plates Infectées.* Par A. Carrel et G. Dehelly. Pp. 177. (Paris: Masson et Cie, 1917.) Price 4 francs.

THESE two volumes belong to a series planned to deal with the medicine and surgery of war. War medicine and surgery differ considerably from civil practice, so that there is room for such a series.

(1) In this volume dysentery, cholera, and typhus fever are considered, not altogether a logical mixture, though all three diseases are of considerable importance under war conditions.

Each disease is dealt with under two divisions, the clinical features and the epidemiology and prophylaxis. Under the former the symptoms, diagnosis, and treatment are discussed, not at any length, but on the whole sufficient for the busy practitioner.

The two principal forms of dysentery, the bacillary and the amœbic, are described, and the causal agents and their principal characters detailed.

Under cholera the methods for the detection of the vibrio in the stools are described. Prophylaxis in each case is well done, and these sections are perhaps the best in the book. Vaccination for the prevention of dysentery and of cholera is dealt with at some length, but no mention is made of Castellani's mixed vaccines. Under typhus fever considerable space is devoted to the louse and methods for dealing with it. The weakest sections are those in which treatment is discussed. For bacillary dysentery practically no mention is made of the saline treatment, and for the amœbic variety the ipecacuanha treatment is very imperfectly described, and no reference is made to emetine-bismuth iodide. Similarly for cholera, while Rogers's hypertonic salt treatment is mentioned, the details given respecting it are too scanty to be of much value.

(2) Some months ago a system of treatment of septic wounds was described by Dr. Carrel. It consists, in brief, in the irrigation of the wounds every two hours with a hypochlorite antiseptic solution (Dakin's), tubes being inserted into the wound and retained there so that the irrigation may be carried out without disturbing the wound or patient. Considerable success is claimed for this method of treatment, and in this volume Drs. Carrel and Dehelly give full particulars how it is applied. Reproductions of photographs clearly illustrate the methods of arranging the irrigation tubes, so that every part of the wound shall be subjected to the irrigating fluid, and charts show the alterations in the microbic flora and the rate of healing of the wounds during the course of the treatment.

For those who have to deal with the wounded in the present war we strongly recommend a perusal of this book. R. T. H.

OUR BOOKSHELF.

Horses. By Roger Pocock. With an Introduction by Prof. J. Cossor Ewart. Pp. x+252. (London: John Murray, 1917.) Price 5*s.* net.

THIS is an entertaining little volume, written by one who has spent much of his life among horses as a ranchman; and from the ranchman's point of view he surveys horsemanship the world over. As a standard of comparison this is useful enough, but, unfortunately, it has distorted his judgment. Hence he is led to assure us that "the pleasure horse and his equipment are so highly specialised for running and jumping that they have ceased to possess the slightest value for civil and military working horsemanship." Yet, as a matter of fact, a large proportion of British cavalry has been horsed during the present war by animals taken from the hunting-field. The best bred of these animals, indeed, are generally considered to make the finest cavalry chargers in the world. The author has some pertinent criticisms on our saddles and mode of riding, and on our treatment of horses in and out of the stable, which will at least repay careful consideration from those immediately concerned.

Of his own feats in the saddle he has much to say, and some of these indeed savour of the wonderful. They are, at any rate, eminently readable. Less entertaining are his sneers at the "scientist," whom he regards as "an amateurish, unpractical sort of person, who cannot either ride or cook"—these being the only accomplishments for which he has any regard. His confidence in his powers of observation, and his knowledge of the lie of the land, even in unexplored country, are so absolute that he has no use for either the compass or maps!

In a chapter on the origin of the horse—which he owes to the "scientist"—he assures us that "the bald skin of the pig is boldly painted in splashes of pink and brown to imitate the lights and shadows of forest undergrowth. The forest ancestors of the horse were bald and painted in the same way. . . ." Pink pigs may be seen in our farmyards in plenty, but we know of no wild race similarly coloured, and there is no reason for supposing that the forest ancestors of the horse were "bald."

If the author had adopted a less superior attitude his book would have been even more readable than it is.

Bacon's New Series of Physical Wall Atlases: British Isles. Scale 1:1,187,000 (18·7 miles to an inch). (London: G. W. Bacon and Co., Ltd.) Price 26*s.*

THE seven maps in this series vary a great deal in value. The orographical map, with layers in two colours and showing also trunk railways and Roman roads, the geological map, and the rainfall map are all clear and useful. The isotherm map would be improved by the omission of the mean annual isotherm, which is not only confusing when on the same map as the January and July ones, but of little or no value in geographical teaching. The map showing vegetation and productions is not a success. The large letters to indicate the location of various industries are crowded and somewhat arbitrarily selected. Thus Aberdeen is given no granite industry, while Ballater is; Leeds has no indication of its leather factories, or Elgin of its distilling and brewing. The West Riding coalfield extends much further east than shown. In the population map the many colours employed give a bad impression and make a confused map. The last map, that of communications, might well have been omitted. It shows some of the lines of the various railway companies all differentiated from one another. There seems to be little object in teaching the ownership of each line, but the great objection to the map is the want of any indication of relief. Without this there is no sense in teaching lines of communication. Moreover, the orographical map does all that is required in this matter.

All the maps have the same names printed in ground colour for the use of the teachers. It is useful to have the series all on the same scale, but we are at a loss to understand why this particular scale should have been selected. It does not facilitate comparison with maps on other scales.

Météorologie du Brésil. By C. M. Delgado de Carvalho. Pp. xix+527. (London: John Bale, Sons, and Danielsson, Ltd., 1917.) Price 25*s.* net.

THE publication of this work is very welcome, not only to meteorologists, but also to those having interests in this progressive Republic. Few except those who have had occasion to deal with South American meteorological observations can appreciate the onerous nature of the task which the author set himself in the preparation of this comprehensive climatology of his native country. In most cases the difficulties have been successfully surmounted, with the result that we have put before us in a very readable and instructive form a series of pictures showing not only the diverse character of the climates of Brazil, but also the interconnection that exists between climatic conditions and migration, immigration, and public health. The work opens with a summary of the broad climatic features, and of the local and general conditions affecting them. An interesting section deals with the "action centres" of the atmosphere, and of the genesis of the tropical rains. Nearly two-thirds of the book are devoted to an analysis of climatological data, this section including no fewer than thirty-four separate studies of local climate, the stations selected ranging from Para, near the equator, to Pelotus, in lat. 32° S. In some areas, such as the State of San Paulo, where stations are numerous, much additional information is given, especially regarding the diurnal range of the climatic elements. The unique position which Brazil occupies for a study of various meteorological problems of the first importance is pointed out by Sir Napier Shaw in the preface, and we trust that the wished-for extension of stations into wide areas not yet represented in the *Réseau Mondial* will materialise before long.

The work concludes with an excellent bibliography of the 160 memoirs consulted by the author. There are numerous illustrations, including plates showing the seasonal isotherms, and isopleths for four typical stations. This book will remain a standard work of reference on Brazilian meteorology for many years to come. R. C. M.

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.*]

The Radiation of the Stars.

THE law $T \propto M^{\frac{1}{2}}\rho^{\frac{1}{6}}$ given by Prof. Eddington in NATURE of June 14 is so neat that one feels reluctance to cast any doubt on it, but since it is notoriously difficult to destroy a scientific error which has once obtained a fair start, I feel that whatever is to be said against the law ought to be said now.

The law is derived from Prof. Eddington's supposed equation, radiation-pressure = gravity. It must first be noticed that the two sides of this equation are of different physical dimensions ($ML^{-1}T^{-2}$ and LT^{-2} respectively), so that neither the arguments on which the equation is based nor the laws derived from it can carry much conviction. If p_G and p_R denote gas-pressure and radiation-pressure, the true equation of equilibrium is

$$\frac{\partial}{\partial r}(p_G+p_R) = -\rho g,$$

g being gravity, and when p_G is neglected in comparison with p_R, g does not become equal to p_R, but to $-\frac{1}{\rho}\frac{\partial p_R}{\partial r}$.

It is true that in his original paper on this subject (*M.N.*, November, 1916) Prof. Eddington obtains a relation of the form $p_R = Rg$, where R is a constant, but this equation is not based on the physical conceptions put forward in the article in NATURE. The outward flow of radiation from a star of radius r and effective temperature T is, of course, $4\pi r^2 \times \sigma T^4$. Where does the energy of this radiation come from? Prof. Eddington assumes that it is a transformation of radio-active energy, initially emitted at a uniform rate $4\pi\epsilon$ per unit mass throughout the whole star. The star is assumed to be in a steady state, so that the rate of generation of energy, $4\pi M\epsilon$, is equal to the rate of emission $4\pi r^2\sigma T^4$, whence $\sigma T^4 = M\epsilon/r^2$.

This equation is of the form $p_R = Rg$, and on eliminating r by means of the relation $M = \frac{4}{3}\pi\rho r^3$, we find that $T \propto M^{\frac{1}{2}}\rho^{\frac{1}{6}}$. (Prof. Eddington's complicated analysis, boiled down to its essentials, comes merely to this.) But it now appears that the supposed law is not, as might be thought from a casual reading of the article in NATURE, a deduction from already known laws of Nature; it is a transformation of the very special assumptions that all stellar matter is equally and uniformly radio-active, and that this radio-activity is the origin of all the energy radiated from a star.

The second supposed law, that the total emission of radiation from a star depends only on its mass, is a still more thinly veiled repetition of the same assumptions. The radiation is *assumed* to be $4\pi M\epsilon$, and ϵ is assumed to be a universal constant. When these assumptions have been made, it is scarcely worth announcing as a new law that the radiation depends only on M.

I venture to think that few physicists will be ready to accept these assumptions; in any case it is important that they should be clearly stated. It may be remarked that if the assumptions are true for giant stars they might be expected to be equally true for dwarf; they lead, however, to the laws given by Prof. Eddington, such as that of absolute brightness depending only on mass, which are palpably untrue for dwarf stars. J. H. JEANS.

London, June 16.

MR. JEANS's criticism of the dimensions of my equation, "radiation-pressure = gravity," is clearly only a verbal matter. It may be preferable to expand the sentence so as to read, "force on material due to radiation-pressure = force on material due to gravity." But statements that radiation-pressure is x times gravity have been commonly made in connection with the theory of the repulsion of comets' tails, and I thought the reader would have no difficulty in interpreting my statement in the same sense.

The rest of Mr. Jeans's letter is based on a misconception. He states that I assume ϵ (the rate of liberation of energy per unit mass) to be a universal constant; that is not the case, and consequently his account of the mode in which my principal results arise is erroneous. My results are not "a transformation of the very special assumptions that all stellar matter is equally and uniformly radioactive. . . ."

I should be glad to take the opportunity of correcting a misprint in the article: p. 309, col. 2, l. 18 from bottom, *for* $M\rho^{\frac{2}{3}}$ *read* $M^{\frac{1}{3}}\rho^{\frac{2}{3}}$. A. S. EDDINGTON.

Cambridge, June 19.

Protection from Glare.

EFFICIENT protection of the eyes from glare is a subject of considerable importance at the present time, but unfortunately a great deal of misconception has arisen in regard to it. Most glare protectors are designed for conditions of unusually strong illumination; generally speaking, for daylight. Many industrial operations also demand the use of light filters. We will deal first with the problem of protection in sunlight.

A great deal of experimental work has been done recently on the physiological effects of ultra-violet radiation in the eye, a quartz-mercury lamp being used as a source, which is especially rich in its emission of the shorter wave-lengths. The results, unquestionable and undoubted, are that with long-continued exposure serious harm may result from the absorption of these shorter waves by the refracting media of the eye, but with low intensities of radiation regular exposures produce no permanent effect. Turning now to the effects of daylight on the eyes, we recognise that few cases occur in which the symptoms point directly to the influence of ultra-violet light as distinct from the effects of ordinary strong illumination; but the problem of nerve strain arising from glare is ever present.

Quite low intensities of light will produce glare when the eye is unadapted. The light from a gas lamp, blinding to an eye accustomed to darkness, appears feeble when viewed in full sunlight; yet its intensity of ultra-violet radiation is unchanged. Snow blindness may be caused on dull days, presumably owing to the inability of the upper part of the retina to adapt itself to the unaccustomed light from the ground. Dr. E. K. Martin[1] could detect no absorption by the refracting media of the eye in the visible spectrum, but he found that in the ultra-violet absorption begins at about 0·38 μ, and becomes complete for 0·35 μ and shorter wave-lengths. As the solar spectrum stops short at 0·29 μ (owing to the absorption of the atmosphere), we see that there is a short region from 0·35 μ to 0·29 μ, which may be absorbed and produce some physiological action. Therefore in cases where considerable sunlight or skylight must enter the eye, it is a good precaution to use a filter which will stop these ultra-violet rays, but at the same time it must be remembered that the main symptoms known as glare are not due to ultra-violet light at all, but simply to an illumination too intense for an unadapted retina.

To the normal eye the maximum luminosity in the solar spectrum lies in the region near the yellow. A great many filters now being supplied for anti-glare purposes are of a yellowish colour. They transmit 80 per cent. or so of the red, yellow, and green, and absorb the violet and ultra-violet fairly completely. It would seem at first sight as if such filters were very desirable to eliminate possibly harmful rays, and to reduce slightly the brightness of transmitted light. On using the screen, however, the apparent brightness of most objects seems to be increased, and glare is as evident as before. The phenomenon of adaptation is not yet fully understood, but we may refer in this connection to the work of Broca and Sulzer,[2] who found, in measuring the growth of visual sensation with time, and using various colours, that in every case there is an overshooting of sensation beyond its final value. With blue light the maximum sensation is at least five times, and with white light twice, the final value. If, then, the removal of the shorter wavelengths interferes with adaptation, the apparent increase of brightness when using a yellow filter is explained. Obviously as an anti-glare glass the screen is worse than useless. This does not apply to the greenish glasses which actually reduce the apparent luminosity. In passing, it may be noted that a coloured filter of this nature is often useful for increasing contrast, eliminating blue light from haze, and increasing visual acuity. 'Amber' and 'red' filters are sometimes used. These generally absorb the green and blue parts of the spectrum, transmission again beginning in the violet. If fairly deep in colour they effectually stop glare, and may be exceedingly useful for special contrast work.

Neutral-tinted glasses have a comparatively uniform transmission over the whole spectrum. The use of such filters in practice immediately reduces any glare, and a proper balance of adaptation is established. It is curious to note in this connection that many of these neutral-tinted glasses, when about 1 mm. thick, transmit the ultra-violet from 0·39 μ to 0·32 μ almost as well as ordinary glass. They have often a slight increase of transmission in the green, and in the extreme red and infra-red they again show little absorption beyond that expected from glass of equivalent thickness. Light transmitted by a bundle of such glasses is found to consist of the extreme red, a little green, and the extreme violet; the sky, viewed through the bundle, appears of a deep purple colour.

[1] Proc. Roy. Soc., B., lxxxv., p. 319.
[2] *Compt. rend.*, cxxxvii., 1903.

Intense infra-red radiation also seems to produce well-marked effects on the eyes when exposure is regular and long-continued, but here again the amount ordinarily received by an eye exposed to daylight appears to be incapable of causing harm. It is uncertain how much (if any) of the discomfort of glare from the ground experienced in bright sunshine is due to the action of these rays. A correspondent of Sir W. Crookes describes the effect produced by spectacles of a glass containing ferrous iron, and absorbing the infra-red, as producing a marked cooling effect on the vision. This sensation may, of course, be merely the result of the relief from glare which the blue-green tint of the glass would secure. Manifestly, however, in circumstances where it may be necessary to look directly at or near the sun, an efficient filter is desirable to reduce intensity in all parts of the spectrum.

Some glasses show marked absorption in the infra-red in the neighbourhood of 1μ, notably those containing ferrous iron, cupric oxide, or ferric iron and cobalt together; these are blue to blue-green in colour. Interesting substitutes are metallic films on glass, suitably protected, which, for the most trying conditions, should make ideal glare glasses. As most of the radiation would be reflected, the glasses would tend to keep cool.

The problems arising in industrial work are relatively simple. For dealing with arc lamps, and sources extremely rich in ultra-violet light, dark green or brown-green glasses will be most suitable. For welding operations efficient protection from ultra-violet, visible light, and infra-red is important, as in this case it is necessary to watch the source of light intently. It is important also to select a filter which will not greatly distort the colour of the emitted light, as temperatures are judged in this way. A fairly dark neutral glass of good thickness will generally answer all practical purposes, but a highly efficient protector could be made by depositing a silver film of suitable thickness on a plate of heavy lead glass. This would be, as previously suggested, very effective in reflecting the heat rays, but the film would have to be protected.

A gold film can be made to transmit green light while reflecting almost all other radiations. Spectacles of this nature could be used with great advantage if it were necessary to work close to molten metal, or in many other circumstances.

It is hoped that this short summary of the subject may be of use to those dealing with problems in this connection. An extended series of tests on certain filters has been made by the present writer, and the results are now in course of publication in the Proceedings of the Optical Society. Filters for various purposes can thus be chosen, but their most important test will be their efficiency in actual use.

L. C. MARTIN.

Electric Discharge from Scythe.

IN reference to Mr. Pannell's observations recorded in NATURE of June 21 (p. 324), Mr. William Wilson more than a hundred years ago discovered that when dry wood is chipped with a knife the chips and knife become oppositely electrified.

There is no need of darkness to test the phenomenon in the case of dry grass cutting with the scythe. An ordinary gold-leaf electroscope held in the mower's hand, and having a wire attachment with the metal of the scythe, would scarcely fail to give indications if the electrification is actually sufficient to produce disruptive discharges. CHARLES E. BENHAM.

Colchester, June 23.

THE FUTURE OF EDUCATION.

SIR NAPIER SHAW has done good service to the cause of education by the timely publication of his trenchant "Open Letter" and other essays,[1] and although the brochure is a small one, its intrinsic value is not to be measured by the exiguity of its pages. The author writes with first-hand knowledge, gained partly in earlier years at Cambridge, and partly in the course of his experience as head of the Meteorological Office. In the latter capacity he is naturally brought into contact not only with newly finished products of the university mill who are seeking employment, but with men of affairs to whom the science of common life ought to be as generally familiar as, actually, it is not.

Thoughtful persons who happen to be conversant with the anomalies and anachronisms so obvious in the educational systems of this country will find themselves, although not perhaps in complete agreement, at any rate in sympathy with much that is so admirably set forth in this little volume. Of course, some effective shots are fired at the universities in which compulsory classics are still so strongly entrenched. The defenders of a position rapidly becoming hopeless might perhaps have been expected long ago to have recognised the common sense of the shrewd old poet who laughed at their prototypes in his own days:—

> . . . nisi quæ terris semota suisque
> Temporibus defuncta videt, fastidit et odit.

Perhaps in their hearts they may have done so, but custom and vested interests have always proved serious obstacles in the way of progress. Things are changing now, but whilst we want to destroy the loaded dice which have enabled the classical side of the great schools unfairly to win a wholly undue proportion of the ablest boys, we do not desire to see the aggrandisement of the modern side effected by the establishment of countervailing malpractices of a similar kind.

As soon, however, as we attempt to arrive at any conclusion as to what part science is to play in the education of the future, we encounter a distracting diversity of opinion. The war has brought many things home to us, and few things more forcibly than a recognition of the immense importance of science to the national safety. But on what lines are we going to move in the future? Sir Napier has pungent things to say about much of the stuff that passes for science in too many of our schools and colleges. He makes a strong appeal, based on utilitarian as well as on educational grounds, for the more adequate recognition of the "observational sciences." Those who have had to do with ordinary boys and girls are likely to agree with him in the main, and, as a matter of fact, beginnings have been already made in more than one of our great schools. The results have shown how well suited for young people a properly devised course of education on these lines can be made.

[1] "The Lack of Science in Modern Education, with Some Hints of What Might Be." By Sir Napier Shaw. Pp. 42. (London: Lamley and Co., 1916.) Price 1s. net.

A deplorable ignorance of the common, though fundamental, facts of Nature is by no means so rare as it ought to be amongst those who have acquired their knowledge of science in the laboratory. Perhaps this need not excite surprise, for even in high quarters we find curricula in science recommended which, although admirably adapted to enable a boy to win a scholarship under the existing defective methods of selection, are assuredly not calculated to stimulate his interest in the big experimental laboratory of Nature.

A distinguished professor has urged, in a recently published book, that the ideal school curriculum in science should begin with mathematics, to be followed by physics, chemistry, and mechanics, "and that wholly subordinate importance should be attached to the biological sciences, because [*sic*] the elementary stages of these latter subjects, necessarily largely descriptive, are insusceptible to broad treatment as illustrative of scientific reasoning and method." Perhaps it would not be easy to find a more complete lack of appreciation of the psychology of the ordinary boy and girl, or a more profound misapprehension of the relative values of the various branches of natural knowledge in earlier school education compressed into fewer words. A moderate amount of the physical sciences (particularly such parts as do not demand a broad treatment illustrative of scientific reasoning and method) is certainly desirable. What is, however, most needed for the average boy or girl is a training in accurate observation and elementary analysis of natural phenomena, not the formal science of the laboratory—that should come later—but in the field, on the hillside, in the cloud, and in the river. The good teacher will see to it that scientific reasoning will inevitably develop in the minds of the children. They will, and practice shows they do, become interested in common branches of natural knowledge, the very existence of which escapes so many grown-up people who were not shown how to observe these things when they themselves were young.

There is just as much danger of falling into a groove in the teaching of science as in that of other subjects, and it behoves all who have the interests of higher as well as school education at heart to keep a sharp eye on the specialist fiend. Mathematics is not the only gateway to science, any more than Greek grammar is the only avenue to the best literature. It takes all sorts of people to make a world, and it needs an acquaintance, elementary perhaps, but certainly not superficial, with all sorts of subjects to make an educated man or woman. It is the business of education to stimulate the development of all sides of the healthy mentality of boys and girls (whilst not neglecting their own natural bias) before the imperious needs of specialising in order to equip them for particular paths of life impose limitations on the area covered by instruction. Properly considered, if the foundations have been well and truly laid, and on a broad basis, it would seem that specialised instruction may be justly likened to the rising edifice, and it should form the natural and proper continuation of earlier work. But for young people, whether they are going to be scholars or scientific investigators, men of affairs or ordinary citizens, what is preeminently needed is an education on broad lines, not a sham education, warped by early specialisation, whether in the direction of physical science or in that of the dead languages.

Of course, it is easy to say these things, but, as Sir Napier Shaw reminds us in an effective piece of criticism, we are up against many difficulties, amongst which there loom largely the systems of examinations and all that these imply. Like Frankenstein's monster, they have developed unexpected powers of strangulation, and, as with some forms of arbitrary legislation, have strengthened the very abuses they were designed to destroy. Are, then, examinations bad in themselves, or are the evil results, of which so much is everywhere heard, incidental rather than essential? Some sort of test of ability and efficiency will always have to be imposed, and it seems to be a fact that those to whom examinations are anathema have hitherto failed to present a workable substitute.

We may admit that many of the evils alleged to flow from the examination system are real, and especially the desiccating influence it has too often exerted on the training of those selected as payable candidates to be forced for competition for scholarships and other still more valuable prizes of life. But the root of the mischief is not altogether simple; it ramifies in more than one direction. In the first place, the system itself naturally tends to become stereotyped. Instead of providing a suitable test of the progress of those who have extended their studies in varied lines, it is apt to unify direction and stifle initiative. It is so much more easy to arrange examinations for one type of curriculum, and that by no means necessarily the best. So examination becomes a department of administration, where hard cases make bad law; and by a natural process of development the examination tends to become, in fact, the "final cause" of education itself—a complete reversal of its true position.

But to attack a thing because abuses have grown up around it is not necessarily sound practice, and it certainly is not good logic. It is true that the attempts hitherto made to check the evil effects of the system have not been very successful. This is due partly to the complex multiplicity of the examinations themselves, partly to a defective conception of the function to be discharged, but partly also to insufficiently recognised defects in the examiners.

The call for a reduction in the number of the various tests for entrance to the universities and for professional courses is urgent. We hope to see some practical scheme put forward by the Committee on Science appointed by the late Government some months ago. The chief desideratum is a sufficiently elastic system which, while not throttling the individuality of the school and the teacher, will ensure that those who pass the test do possess attainments enough to qualify them to enter on the next stage of their academic or professional career. The growing practice of accepting examinations "in lieu" has already paved the way for the introduction of a more comprehensive scheme in which the principle might be embodied on a large scale.

It is not so easy to find remedies for defects arising from the personality of the examiner, nor is it perhaps likely that all would even admit the existence of these defects, much less the need for remedies. But that we are here face to face with a real difficulty must, in fact, be perfectly well known to all who have had wide experience in these matters. Some of the evils, partly personal, partly dependent on administration, are more glaring than others. For example, in scholarship examinations it often happens that the successful candidate is selected without undergoing any oral test at all. Sometimes this is entirely the fault of those responsible for the general arrangements; sometimes the examiner avoids any real contact with the examinees. While such a practice may be defended in the case of a pass test, it ought never to be allowed when evidence of genuine ability constitutes the principal criterion for deciding between the competitors. A good examiner will easily appraise the value of written work in the course of a conversational oral examination. If he cannot, or if he only succeeds in scaring a candidate, he is not fit to discharge the duties of an examiner, however eminent he may be in other directions. Thus it would appear that it is with the system and with the examiner that the quarrel of the reformer really lies, rather than with examination *per se*. Don Quixote is not the only man who has wasted energy in tilting at windmills owing, let us say, to a lack of sense of proportion and of clear vision.

Amongst the expedients devised for obviating the deficiencies of badly conducted examinations, that of inspection has perhaps turned out to be the best. But the personal qualities and qualifications of the inspectorate are even more important here than they are in the examiner. A bad official can do immense harm, whilst, on the other hand, a capable one is of great value, inasmuch as the inspector exerts so powerful an influence for good or evil on the teaching.

But, whatever their faults, the inspectorate and the examination systems have a great mass of good results to be placed to their credit, and they do tend to weed out at least some types of incompetent teachers. Everyone who has had experience of schools is perfectly well aware of the real reason why the pupils at one centre are almost uniformly bad, while in another they appear to be almost as uniformly good. The difference, clearly, is not inherent in the children. Furthermore, it is quite intelligible, from their own point of view, why more than a thousand private and preparatory schools continue to refuse all inspection: the curious thing is that such unregulated experiments on the minds of children should be tolerated at all by the public of a country which claims to be enlightened. Perhaps it is because the sheer business aspect of the matter has been hitherto insufficiently apprehended.

Many people will probably hesitate to follow the author in his proposals for an Educational Authority, and especially in the suggestion that it should be a committee formed, not by the Board of Education, but within the Privy Council. It would be interesting to observe the attitude of the Nonconformists if the Archbishops were alone to represent the educational policy for theologians; and, indeed, even in science the President of the Royal Society would probably find it beyond even his powers to represent so vast a series of subjects.

What seems to be really wanted is perhaps not so very remote, after all, from the essential elements of the proposed scheme. The general lines of educational policy will have to be laid down by people who are in contact with both education and affairs, and the means for giving effect to such policy will have to be provided. The carrying out of the policy, when the general plan is settled, will have to be left to the teachers, who ought not to be hampered in working out the details according to individual predilection. No doubt, a considerable overhauling of vested interests will be called for, abuses will have to be checked, and care will have to be taken that a proper balance is preserved between educational efficiency and the tendency towards early and excessive specialisation, whether at the school or at the university.

The danger of undue specialisation is a real one, especially among a people which, like ourselves, prides itself on being practical. It must not be forgotten that it is, and will continue to be, the business of schools, as well as of the universities, to train citizens as well as specialists, and that, while some will become specialists, all ought to be good citizens. Intelligent citizenship implies an intelligent outlook on the conditions that make for, and are involved in, our national and corporate life, and it becomes the more urgent to consider carefully, among the wide range of subjects, what things are, and what things are not, of immediate value in securing the satisfaction of this paramount need. In our great schools it is a matter of common complaint that too much time has been devoted in the past, with astonishingly small apparent result, to a very limited section of the "humanities," too little—sometimes none at all—to the great organised mass of knowledge commonly called science. And yet it is to the advance of science that we owe not only almost all our material progress, but nearly all our modern outlook on life and on the great problems that life holds for each one of us. J. B. FARMER.

THE WORK OF THE MINISTRY OF MUNITIONS.

LITTLE more than two years ago a small party of men met together at 6 Whitehall Gardens, under the chairmanship of the present Prime Minister, to form a Munitions Department. In the words of Dr. Addison, the present Minister of Munitions, speaking in the House of Commons on June 28: "There was to be one aim and one aim only—to obtain the goods and make delivery of them to the Army." The story, if it is ever told, of the creation of an organisation which is responsible to-day for the employment of two million persons, and for keeping the products of their exertions up to a level which continually rises, will certainly be astonishing, possibly one of the most wonderful in the history of this country, for the Ministry presents, perhaps, the most remarkable aggregation of men and women of diverse qualifications and attainments that has ever been got together in this country or in the world. Men from every branch of commerce and industry are serving, men of science, lawyers, literary men, travellers, soldiers and sailors, many of them as volunteers. The story, when told, will be one of improvisations connected with many disappointments, manifold and unexpected difficulties, and endless expedients, resulting in the creation of an organisation which, assuming, or having forced upon it, first this function and then that, became at last as prodigious in its proportions as in its output of munitions, and now constitutes an imperishable monument to British genius and resource.

On June 28, however, Dr. Addison reviewed the work of the various departments of the Ministry in plain and moderate language. He dealt with those which are concerned with the production of completed ammunition and the guns which use it, then with those which require the use either of steam or of internal-combustion engines, those which deal with the provision and working up of minerals and metals, certain common services, the trench warfare and other specialised departments, and those of labour and finance. A brief reference will be made to one or two of the most important activities of these departments.

Before the war this country was entirely dependent on Germany for its supplies of potash. This substance is required in both the agricultural and the glass industries. With regard to this Dr. Addison states: "Thanks to the ingenuity of Mr. Kenneth Chance and other gentlemen working with him, a process has been discovered whereby great quantities of potash may be obtained, and the development of the scheme is now in operation with the assistance of the Ministry. We shall be able to provide every ounce of potash that the glass trade requires, as well as very largely to meet the needs of agriculture."

Previous to the outbreak of war the output of steel in this country was about seven million tons per annum, and had remained almost stationary for some years. The output to-day is at the rate of nearly ten million tons, and a scheme is being worked out by which it is hoped to raise the production to twelve million tons by the end of 1918. The production of sulphuric acid has undergone great developments both in private works and in Government factories. A section of the Explosives Supply Department has been set up for the provision of all the artificial manures that are required, and the Ministry contemplates supplying at least a million tons of superphosphate, half a million tons of basic slag, and a quarter of a million tons of ammonium sulphate. The capacity for the production of high explosive was in March, 1917, more than four times that of March, 1916, and twenty-eight times that of March, 1915.

DR. ROBERT BELL, F.R.S.

DR. ROBERT BELL, who died at Ottawa on June 19, was one of the pioneers in the geographical and geological exploration of Canada. Born at Toronto on June 3, 1841, he studied natural science and medicine at McGill and Edinburgh Universities, and graduated both as M.D. and as D.Sc at the former university. In 1857 he joined the Geological Survey of Canada, of which he became assistant director and eventually acting director shortly before his retirement. In the early part of his career he was also for a short time (1863–68) professor of chemistry and geology in Queen's University, Kingston, Ont.

Dr. Bell's most important work was the exploration and mapping of both sides of Hudson Bay and the Straits, and of the rivers entering Hudson Bay from the south. He also conducted the first surveys of Great Slave Lake, Lake Nipigon, and several other inland waters. As a geologist he paid special attention to the oldest rocks of the Laurentian and Huronian periods, but also made valuable contributions to our knowledge of the Pleistocene glacial deposits of Canada. As a naturalist he was a keen and skilled observer in many directions, but was especially interested in matters concerning forestry. As a medical man his services were at the disposal of several expeditions. Most of his reports were published officially by the Canadian Geological Survey and bear witness to the thoroughness of his researches; while many papers on more general questions were contributed by him to various societies and journals.

Dr. Bell was one of the original fellows of the Royal Society of Canada, and was elected a fellow of the Royal Society of London in 1897. He received the honorary degree of Sc.D. from the University of Cambridge, and in 1906 he was awarded the Patron's medal by the Royal Geographical Society. In 1906 he also received the Cullum gold medal from the American Geographical Society.

NOTES.

THE *Times* correspondent reports the discovery of the skeleton of a mammoth, in association with flint implements, in the neighbourhood of Bapaume, within the lines of the British Army in France. We understand that the British Commander-in-Chief has communicated the fact to the French Government, and that steps have been taken to preserve the specimen until the line of battle is sufficiently far removed to allow of careful excavations being made. The deposit in which the skeleton occurs has already yielded fragmentary remains of the mammoth.

IN reply to a question about the suspension of the publication of the *Kew Bulletin,* asked by Sir W. Byles in the House of Commons on June 26, Mr. Prothero said that the matter was now being reconsidered by the Publications Committee at the request of the Board of Agriculture. He hoped it might prove possible to resume publication.

WE regret to see the announcement of the death at Brussels, in his fifty-third year, of Prof. H. Van Laer, professor of chemistry at Mons, and president of the Chemical Society of Belgium.

NEWS has just reached this country of the death on June 2, at Pusa, Bihar, of Prof. J. H. Barnes, Agricultural Chemist to the Government of India, and late principal of the Government College of Agriculture, Lyallpur, Punjab; and also of Prof. E. G. Hill, principal of Muir College, University of Allahabad.

LIEUT. J. B. JONES, whose death in action on May 31, at twenty-six years of age, is announced, was educated at the University College of Wales, Aberystwyth, and was a B.Sc. in chemistry, physics, mathematics, and geology; he was student-assistant in geology at the above college, and had assisted in the Geological and Soil Survey of West Wales.

ANNOUNCEMENT is made in the *Times* that the Government has been reluctantly forced to the conclusion that it will be impossible to pass a Bill establishing a Ministry of Health during the present session of Parliament. It is possible that the measure may be introduced in the House of Lords, and certain steps taken which will facilitate its progress next session.

THE list of pensions granted during the year ended March 31 last, and payable under the provisions of the Civil List Act, 1910, includes the following:—Mrs. Charlton Bastian, in consideration of the services to science of her late husband, Dr. Charlton Bastian, and of her straitened circumstances, 100*l.*; Mrs. Minchin, in consideration of the scientific work of her late husband, Prof. E. A. Minchin, and of her straitened circumstances, 75*l.*; Mrs. Albert Günther, in consideration of the scientific work of her late husband, Dr. Albert Günther, and of his distinguished services to the British Museum as keeper of zoology, 70*l.*; and Mrs. Roland Trimen, in consideration of the eminent services of her late husband to biological science, and of her straitened circumstances, 75*l.*

BY the death of Sir George Birdwood, on June 28, at the age of eighty-four, the Anglo-Indian services have lost a notable personality. He joined the Indian Medical Service in 1854, and after taking part in the expedition to the Persian Gulf, he was appointed to a professorship in the Grant Medical College at Bombay, which was destined to be the scene of his Indian official life. He cultivated friendly relations with all classes of natives, and contributed to the *Times of India.* Finally, after serving as Sheriff of Bombay, his health broke down, and he left India in 1868, never to return. His administrative ability and fine taste in Indian art secured him a post at the India Office, where he was occupied in organising several exhibitions in which Oriental arts and crafts took a prominent place. For these services he was rewarded with a knighthood and the order of K.C.I.E. His scientific reputation rests on his work on the flora of Bombay, and his researches into the varieties of Boswellia and other sources of Oriental gums and resins. He left few contributions to literature of permanent value, but he was a clever journalist, able to discuss many subjects with wit and vivacity, though his views on history, linguistics, and ethnology were often lacking in the learning of the true scholar. Some of his less ephemeral work was published about two years ago, under the title of "Sva" ("Myself"). His services to the Empire in promoting kindly relations between the European and the natives of India are his best monument.

THE eleventh annual report of the British Science Guild, together with the account of the proceedings at the annual meeting on April 30, has now been published in booklet form. In addition to particulars of the work of the Guild during the past year, the report contains a summary of progress in regard to the promotion of scientific and industrial research, and a series of appendices refers, among other matters, to "The Metric System and the Textile Industries," "Endowment of Education and Research," and "National Instruction in Technical Optics." The report of the eleventh annual meeting of the Guild includes the addresses by Lord Sydenham on national reconstruction, the Rt. Hon. H. A. L. Fisher on science in education and industry, and Mr. H. G. Wells on science in the curricula of our schools and universities. Lord Sydenham makes a number of stimulating suggestions in regard to the reform of education and the development of the material resources of the Empire with the view of solving the many crucial problems that may be expected to arise after the war; Mr. Fisher points out that education in scientific knowledge and method need not be divorced from the study of "humanistic" subjects; while Mr. Wells pleads for the removal of the barriers set up against the latter studies by insistence on the acquirement of such knowledge solely through the medium of the Greek and Latin languages. The booklet is obtainable from the offices of the Guild, 199 Piccadilly, W.1, at the price of 1s.

NOTWITHSTANDING the great loss of life caused by the explosion at Ashton-under-Lyne on June 13, the area over which the sound was heard was remarkably small. All the recorded observations lie within a continuous area, extending chiefly in the north-north-west direction to the village of Church, near Accrington, distant twenty-one miles from Ashton. In the opposite direction, the sound-area is not well defined, but the boundary probably passes about six miles from the source of sound. There is no evidence of the observation of multiple reports, the sound at all places more than a few miles from Ashton being a single boom. The shaking of windows immediately after the report points to the existence of long-period air-waves travelling with a velocity slightly less than that of the sound-waves. Though the number of British explosions which have been investigated is small, it is worth noticing that those with double sound-areas occurred during the winter months (namely, Spithead minute-guns on February 1, 1901: Hayle explosion on January 5, 1904; and East London explosion on January 19, 1917), and those with single sound-areas during the summer months (namely, Spithead reviews on July 17, 1887, and June 26, 1897; St. Helens explosion on May 12, 1897, and Ashton-under-Lyne explosion on June 13, 1917). In Japan, according to Prof. Omori, nine out of eleven recent Asama-yama explosions with double sound-areas occurred in the winter, while ten out of eleven explosions with single sound-areas occurred in the summer months.

IN the *Revue Scientifique* for June 9 Prof. Jean Massart advocates the formation of "Une Organisation Scientifique Interalliée," in order to facilitate the exchange of books, students, and men of science amongst the Allied countries, for the publication of *résumés* of scientific work, and for the establishment of scientific institutes. For some years international scientific exchanges have arranged the dispatch of scientific publications from one country to its neighbours post free. It is suggested that this system should be extended so as to permit the free transport of all scientific publications which have no commercial character. Many countries provide travelling scholarships for students who have completed a course of study, but if the annual programmes of work in all universities were equalised it would be possible for a student to take part of his degree course in one country and another part in an Allied country. Prof. Massart also advocates the exchange not only of professors (an example which America has set), but also of librarians, keepers of museums, astronomers, doctors and surgeons of large hospitals, etc Finally, the creation of purely scientific institutes by the co-ordinate action of the Allies is recommended. These research institutes should be independent of teaching, and would be attached to neither schools nor museums. For many sciences the precise situation of the research centre would be immaterial. For such sciences as botany, zoology, meteorology, etc., separate institutes would be required in each of the large climatic and geographical zones of the earth. Thus for biology there might be an Arctic Institute in the north of Russia, equatorial institutes in Ceylon, the Congo, and Brazil, and so on. The strengthening of commercial, industrial, and political relations between the Allies is being urged upon us; as the author says, it is not less important to exchange "ideas and men."

SIR HENRY TRUEMAN WOOD will retire in September next from the post of secretary of the Royal Society of Arts, which he has held since 1879, having previously been editor of the Journal and assistant secretary. He will be succeeded by Mr. G. K. Menzies, who has been assistant secretary of the society since 1908. The council has decided to institute an annual lecture dealing with the application of science to industry in order to commemorate Sir Henry Wood's long association with the society. The Albert medal of the society for the current year has been awarded to Orville Wright, "in recognition of the value of the contributions of Wilbur and Orville Wright to the solution of the problem of mechanical flight." Referring to this award, the report of the council says:—"In 1896 the Wrights began to experiment with gliding machines, continuing the work of Lilienthal and Pilcher, which had been cut short by their deaths. Having obtained considerable success with 'gliders'—for Orville Wright on one occasion succeeded in making a soaring flight of ten minutes—in 1903 they fitted an engine and propeller to their machine, and with this apparatus they were able to make short flights. Inasmuch as this was the first apparatus in which a man was carried in the air by mechanical power, though Langley and others had previously made small mechanical flying machines, it may fairly be considered the first aeroplane in the present acceptation of the word. The machine was patented in 1907. The validity of the patent has never been confirmed by any legal decision, but practically the British Government admitted its validity by a payment to the inventors in 1914 of 15,000*l*. After the initial difficulties had been overcome by the patient labours of the Wrights, the machine developed rapidly. It may be true that in the present aeroplane not much is left of the machine described in the 1907 patent, but the changes, apart from the improvements in the engine on which the modern aeroplane mainly depends for its success, have all been legitimate developments of the ideas of the original inventors, and in no way detract from their credit. It remains, therefore, certain that, whatever value may attach to the contributions of others, the largest share in the honour of having invented the aeroplane must always be given to the two brothers, Wilbur and Orville Wright."

MR. E. SIDNEY HARTLAND, president of the Bristol and Gloucestershire Archæological Society, devoted his annual address, published in vol. xxxix. of the society's Transactions, to a discussion of the legend of St. Kenelm, the boy-saint, whose shrine at the ancient Abbey of Winchcombe, in a beautiful little dale at the foot of the Cotswold Hills, was a famous place of pilgrimage until the Reformation. To-day not one stone upon another of this great religious building remains. The abbey was founded about the end of the first decade of the ninth century by Kenwulf, king of the Mercians and father of the honoured saint, whose remains were probably interred there. But, as is the case with many elaborate legends of this kind, the story of his life fails to stand the detailed historical criticism which Mr. Hartland has devoted to it. The paper, which is very interesting, may be regarded as a study of the value, for historical purposes, of local tradition, and will be valuable both to the antiquary and to the student of folklore.

MUCH progress has been made during the last century in the scientific treatment of the geography of Ptolemy. But the standard edition by C. Mueller, continued by C. Th. Fischer, is still incomplete, and the condition of the MSS. offers an opportunity for much useful work. In a paper contributed to vol. xxxvii., part i., of the Journal of Hellenic Studies for 1917, Mr. L. O. T. Tudeer examines the maps attached to various MSS., especially that known as the "Codex Constantinopolitanus Chartaceus," which has been assigned to the fourteenth or fifteenth century. At first sight the maps of this MS. give a pleasing impression, but more careful examination discloses various difficulties and discrepancies which it is not easy to explain. Either a copyist has first copied the maps without writing down the names from his authority, and after finishing his work has added names from the text, not from his model, or else the maps did not originally belong to the text, but some draughtsman afterwards traced them, and he has not always been careful to avoid faults and inconsistencies. Mr. Tudeer's careful examination of the MS. material should prove to be of value in clearing up the many difficulties of this great early contribution to scientific geography.

IN the *Scientific Monthly* for June, 1917, vol. iv., No. 6, Dr. Jonathan Wright contributes an article entitled "Demonology and Bacteriology in Medicine." He begins with a survey of the beliefs of various savage races, which consider that all, or most, kinds of disease are due to the action of demons or malevolent spirits. This account would be more useful to the student if the writer had not adopted the careless method of quoting his authorities without precise references. He remarks that we may venture to assert that primitive men were right in supposing that "some external agent, demon or bacterium, introduced from without, is the cause of most disease. Indeed, in pointing out the conception of a conflict of the evil spirits of disease with the good spirits that defend the body within, we are perhaps within hailing distance of the time when Hippocrates defined disease as a conflict between opposing forces waged in the bodies of men and animals. It persists as the best definition of disease modern science can give, but the concept did not originate with Metchnikoff, nor even with Hippocrates. For, of the people of the Lower Niger, to whom neither Socratic nor Hippocratic wisdom seems to have penetrated, it is said that 'every medicine to be of any use must have within it a spiritual essence to defeat the operations of the aggressive invader.'"

AN admirable survey of the American warblers and their value to the agriculturist appears in the *National Geographic Magazine* (vol. xxxi., No. 4). The author, Mr. Henry Henshaw, described some thirty-six species of these birds, giving details of their nesting habits, distribution, and migration. His essay is supplemented by thirty-two exquisitely coloured figures, drawn by Louis Fuertes, the finest bird artist America has yet produced. His work, indeed, compares favourably with that of the best European artists—and they are very limited in number.

THE great snowstorm which crossed Ireland from N.E. to S.W. during January of this year seems to have exterminated a number of resident species of birds throughout the area covered by the storm. A long account of the havoc wrought is given in the *Irish Naturalist* for June by Mr. C. B. Moffat. The thrush was the first to succumb, then the blackbird, stone-chat, golden-crested wren, long-tailed titmouse, grey wagtail, and meadow-pipit. Scarcely any meadow-pipits survived, and the number of summer visitants to the islands seems to be far below the average. This will mean that very few young will be reared this year, since the meadow-pipit is the favourite dupe of the cuckoo, which will in consequence monopolise most of the nests of this bird to the exclusion of the rightful occupants.

PROF. G. H. F. NUTTALL, The Museums, Cambridge, is engaged in an investigation on human lice, and desires to obtain specimens and accurate information concerning these parasites from different parts of the world. The specimens should be killed and well preserved in 70 per cent. alcohol; about fifty adults, besides larvæ, if obtainable, are desired from each locality. Head-lice and body-lice should be kept apart. They should be accompanied by brief notes regarding their prevalence on the races or inhabitants of the region whence they are sent. Where specimens are not procurable, any written communication on the subject will be welcomed by Prof. Nuttall, and references to the mention of lice in works of travel may prove useful. Communications may be written in any European language, according to the convenience of the correspondent.

AN urgent plea for the establishment of a chair of economic ornithology at one of our universities is made by Mr. W. Berry in the *Scottish Naturalist* for June. By way of illustrating his arguments he gives analyses of the crop contents of a number of sparrows, wood-pigeons, and pheasants. While admitting, as all must, that the house-sparrow sadly needs thinning, he re-directs attention to the fact that these birds do assist in keeping down insect pests. Black game and pheasants are recommended, he remarks, by the Board of Agriculture for wholesale destruction, without distinction of district or topography. Yet an analysis of the crop contents of 183 pheasants made in 1893 disclosed the remains of more than 100,000 injurious beetles and other insects, larvæ, and slugs, while the total number of husks and fragments of corn of any kind was thirty-seven. In another case the crop contents of a single cock pheasant from Argyllshire yielded no fewer than 2286 specimens of Bibio, and 508 of the heather beetle, which plays so prominent a part in the spread of grouse disease, besides tubers of the lesser celandine and fragments of leaves of many species of noxious weeds.

MR. R. J. TILLYARD, of the University of Sydney, has sent us a communication regarding the systematic position of Dunstania, a genus of Triassic insects, founded on a wing described by him in Publication 253 of the Queensland Geological Survey, which has attracted much interest among entomologists in these countries (see, *e.g.*, NATURE of September 28, 1916, p. 75). Mr. Tillyard referred the wing provisionally to a moth, but some of our homeland students have advocated that its affinities are with the Homoptera, or with the Psychodid Diptera, especially with the New Zealand genus Exsul. Close study of further material has now convinced Mr. Tillyard that Dunstania is a dipteron with affinities to Exsul, though he would not place the two genera in the same family, and regards them, not as Psychodids, but as primitive Muscoids. "If, then, I am right in my opinion," he says, "we have to face the remarkable possibility of the existence of muscoid types in Australia in the Trias. This would place the origin of the Diptera much further back in geologic time than has hitherto been deemed at all possible." In concluding his letter, Mr. Tillyard mentions the exceedingly interesting fact that he has "quite recently discovered two well-preserved Panorpid wings in the Permo-Carboniferous Coal Measures of Newcastle, New South Wales." The existence of Holometabolous insects in Palæozoic times may therefore be taken as established.

AN interesting paper on "Herb-growing in the British Empire: its Past, Present, and Future," is published in the Journal of the Royal Society of Arts (No. 3363, vol. lxv.), being a paper read by Mr. J. C. Shenstone on May 2. It is pointed out that the cultivated herbs have always driven the wild products from the market, and it is asserted, no doubt truly, that there is a considerable future for such an industry generally throughout the Empire. Ginger-growing in Jamaica and the clove industry in Zanzibar are both examples of successful enterprises, and it is suggested that gum-yielding acacias and gum Tragacanth, among other things, should be subjected to cultivation.

WE learn from the *Botanical Gazette* for May that the Botanical Station at Cinchona, in the Blue Mountains of Jamaica, has now been leased to the Smithsonian Institution on behalf of fourteen American botanists and botanical institutions that have contributed the rental. It will be remembered that an article on the Cinchona Gardens and Stations was published in NATURE of June 17, 1915, when an agreement was come to between the Jamaican Government and a committee of the British Association for the annual tenancy of the Cinchona Bungalow as a laboratory for botanical research in the tropics. Unfortunately the war has prevented the laboratory being used, as was hoped, by British botanists, but no doubt American botanists will not be slow to recognise the stimulus of such a station for botanical work. The station has already been in American hands, as it was held under lease by the New York Botanical Garden from 1903–13.

A TIMELY article on "Grassland and Ploughed Land," by Mr. R. G. Stapledon, adviser in agricultural botany, University College, Aberystwyth, is published as a supplement (No. 17) to the May issue of the *Journal of the Board of Agriculture*. The national need for a great increase in the home production of corn and potatoes renders inevitable the breaking-up of very large areas of grassland, and throws a correspondingly heavier burden upon such grass as remains, if our stocks of cattle and sheep are not to suffer a serious reduction. In his lucid summary Mr. Stapledon indicates the directions in which grassland can be improved and what is its real significance in a rational system of agriculture designed to secure a maximum production of food. The various types of grassland are characterised, and the appropriate lines of improvement of each type are indicated. Guidance is furnished as to the characteristics of the more desirable grasses and clovers, and suitable mixtures for different conditions are given.

MR. MARTIN H. F. SUTTON has carried out a careful series of experiments with "Humogen" in comparison with other fertilisers, and the results are published as a special bulletin (No. 8) by Messrs Sutton and Sons, Reading. The first series of experiments was carried out on dwarf French beans, potatoes, and red clover, and the supply of "Humogen," or bacterised peat, was obtained from Manchester, where it was being manufactured for Prof. Bottomley. The experiments proved failures, the plants treated with "Humogen," having a stunted and scorched appearance, while those with other fertilisers or farmyard manure grew vigorously. As some toxic or inhibiting factor seemed to be present in the Manchester "Humogen," a fresh and larger series of trials was made later in the year with "Humogen" prepared at Prof. Bottomley's laboratory at Greenford, and with Manchester "Humogen" supposed to be rectified. The results with the latter were as unsatisfactory as in the first series of experiments, but the Greenford "Humogen" gave far better results, and were second only in merit to those dressed with a complete fertiliser. The bulletin is illustrated with an excellent series of photographs.

WE learn from the *Geographical Review* (vol. iii., No. 5) that a strong movement is under way in the United States to develop a survey of the air over North America and adjoining waters. The objects are to observe and chart the irregularities of air currents, to establish aerological stations for observers, not only at the earth's surface, but also aloft to 10,000 ft. or more, and thereby to safeguard aircraft and the lives of aviators. The National Advisory Committee for Aeronautics is fostering the movement, and has the support of the Aero Club of America. The hope is expressed that this survey may in time be put on the same footing as the Hydrographic Survey, the Coast and Geodetic Survey, and the Geological Survey.

A WAR map of Palestine at the low price of 6*d*. has been published by Messrs. W. and A. K. Johnston. The map is in black and white, except for an outline of colour round the chief districts. Relief is shown by hachures, and is fairly successful as regards a general impression, but does not admit of analysis of any small area. There is an abundance of names without overcrowding, but some are difficult to read across the hachures. A list of the chief Arabic terms occurring in geographical names is added. The chief criticism of the map must be as regards the scale, for while the map itself has the extraordinary scale of 1:714,649 (11·279 miles to an inch), the inset of Lower Egypt has the scale of 1:2,800,000. These are serious blemishes, inasmuch as they prevent ready comparison.

AN interesting presidential address by Prof. W. H. Hobbs to the Michigan Academy of Science in March last on "The Making of Scientific Theories" is printed in *Science* for May 11. The object of this address is to show that "scientific theories, as they are constructed even to-day, with the aid of all modern equipment and inheritance, may contain fatal elements of weakness, though they be promulgated by scientific men of the highest rank and attainments." Men of science are, of course, subject to the limitations of prejudice, undue reverence for authority, and so on, and also they and their critics often fail to distinguish clearly between legitimate theory within those fields where views may be rigidly tested and audacious conjecture. Prof. Hobbs then reviews by means of examples the position of science from the earliest times down to the memorable defeat of Bishop Wilberforce by Huxley in 1860. In the fifth century we read, what sounds like a pessimistic prophecy, that "with the invasions of the barbarian Huns and the Germanic tribes there ensued the eclipse of civilisation. . . ." In this sketch the attempts at the control of scientific theory by the Church were shown gradually to decline, although in this respect the Church was quite powerful even fairly lately. Prof. Hobbs then selects some examples from geology in order "to discuss what may perhaps be called the psychology of theories and the conditions which determine their acceptance": the effect of certain features of Mallet's theory of earthquakes in removing seismology from the field of geology for the period of nearly half a century, and giving it over to the elasticians; the mistaken deductions from the aerothermic and geothermic gradients; Ferrel's mistaken deduction of whirls about the geographic poles, and so on.

AT a time when the supply of our food is controlled by men who probably know little of the science of nutrition, and nothing at all of physiological chemistry, the appearance (in the *Revue Scientifique* for June 9) of an article by Prof. E. Gley, entitled "Le Besoin d'Aliments Spéciaux," is particularly opportune. Probably the vast majority of people in this country think that if there is a shortage of any particular article of food it can, in all cases, be replaced by another without detriment to the health of the consumer. As Prof. Gley points out, however, of the four principal forms of nutritive material, mineral salts, carbohydrates, fats, and proteins, mineral salts will not replace, and cannot be replaced by, any of the others. Carbohydrates and fats, which supply energy, are to a certain extent interchangeable, but neither of them is a substitute for proteins, which in their turn will not replace either carbohydrates or fats. Further, vegetable proteins will not replace animal proteins. It has been shown by the researches of various workers that neither animals nor man will maintain their nitrogen balance or their body weight when their protein food consists of the zein of maize or of the globulin of lupins. Other proteins, *e.g.* the gliadin of wheat and the hordeine of barley, whilst sufficient to maintain bodily equilibrium, will not promote growth. These two phenomena have been proved to be due, the first to the absence of tryptophane from zein and globulin, the second to the absence of lysin from gliadin and hordeine. In order to maintain the nitrogen balance and to promote growth the protein nutriment of man must contain tryptophane and lysin. It is because meat contains all the necessary amino-acids, and contains them in suitable proportion, that it is so valuable as a food. For the efficient working of the digestive system cellulose is an indispensable constituent of food. Rabbits fed on rations containing no cellulose die of intestinal obstruction. The green vegetables ordinarily eaten with meat are valuable as supplying the necessary cellulose. Prof. Gley advocates the consumption of dried fruits for the same reason. These have the advantages over green vegetables that they contain more cellulose and can be obtained independently of the season.

DR. J. S. HALDANE submitted a paper to the recent meeting of the Institution of Mining Engineers upon "The Spontaneous Firing of Coal," in which he summarised the results of the researches carried on during the last four years at the Doncaster Coal Owners' Research Laboratory. Even apart from their purely technical importance, some of the results obtained form a valuable contribution to our knowledge of the physico-chemistry of coal. Thus it has been shown that coal, even in thin slices, is highly impervious to the passage of gas, so that changes of atmospheric pressure can have no appreciable influence on the evolution of gas by solid coal. On the other hand, it is found that coal has an extraordinarily high solvent power for gases, the ordinary atmospheric gases being far more soluble in coal than in water, and, further, the rate of solution of these gases follows Henry's law, just as though they were in solution in a liquid. In the case of oxygen some of the gas is thus dissolved or adsorbed, while some enters into chemical combination with certain of the constituents of the coal. The rationale of the oxidation of coal has been investigated, and the part played by pyrites in such oxidation has been determined, but more research is needed in order to settle the exact nature of the substances most readily attacked by oxygen and of the products of such oxidation.

THE growing interest in special acid-resisting alloys and the many uses found for them has stimulated both the search for efficient materials of this nature and the study of the causes underlying their inertness. The alloys developed by Prof. S. W. Parr for use in calorimeter construction have shown this quality of high resistance to corrosion to a marked degree. The almost perfect insolubility of these alloys in nitric and other acids seems to be conditioned upon a proper mixture of chromium, copper, and nickel, together with smaller quantities of such added metals as tungsten and molybdenum. These additions have so marked an effect in improving both the acid-resisting and casting qualities of the alloys that it has seemed desirable to study their effects more systematically in order that they may be used to the best advantage. This study has been undertaken by McFarland and Harder, and the results of their preliminary investigation have been published in Bulletin No. 93, University of Illinois. The complexity of the mixtures used has made the problem difficult, and has shown the necessity for first obtaining a more complete knowledge of the ternary alloys of chromium, copper, and nickel, and also of the three binary systems underlying them. It is quite obvious from this preliminary study that much more work requires to be done to establish the copper-chromium and nickel-chromium equilibria on a satisfactory basis.

Engineering for June 29 contains an illustrated account of the new Cunard liner *Aurania*, which has just been put on the North Atlantic service. This vessel has extensive second- and third-class passenger accommodation, and has also large cargo holds. The dimensions are 538 ft. 6 in. long, 65 ft. 4 in. beam, and 46 ft. 6 in. depth. The gross tonnage is 13,936, and with geared turbines of approximately 7200 shaft-horse-power she will have a sea speed of fourteen knots when displacing 21,405 tons. The calculated coal consumption is only about four tons per hour, hence the propelling expense will be very favourable in view of the large earning power indicated by the passenger and cargo capacity. The vessel has been constructed under the Convention regulations by Messrs. Swan, Hunter, and Wigham Richardson, and the machinery by the Wallsend Shipway and Engineering Company.

THE Board of Agriculture and Fisheries announces the publication of a second edition of vol. iv. of the special reports on the mineral resources of Great Britain, which have been prepared by the director of the Geological Survey in response to numerous inquiries that have arisen through the conditions brought about by the war. In the main it is a reprint of the first edition, wherein the properties, sources, and uses of fluorspar, and details of all workings in Britain, active and inactive, are given.

OUR ASTRONOMICAL COLUMN.

COMET 1916*b* (WOLF).—The following ephemeris for Greenwich midnight is given by Messrs. Crawford and Alter in Lick Observatory Bulletin No. 295. It is based upon revised elements, calculated from observations made by Barnard on 1916 April 24, 1916 December 31, and 1917 April 21:—

1917	R.A. h. m. s.	Decl. ° ′ ″	Log Δ	Brightness
July 6	22 57 3	24 40 7	0·0496	
8	23 0 15	40 13	0·0461	2·48
10	3 21	38 31	0·0426	
12	6 19	34 58	0·0391	2·53
14	9 11	29 32	0·0357	
16	11 55	22 10	0·0324	2·57
18	14 32	12 50	0·0291	
20	17 1	24 1 30	0·0259	2·61
22	19 23	23 48 8	0·0228	
24	21 37	32 43	0·0198	2·64
26	23 43	23 15 13	0·0168	
28	25 41	22 55 39	0·0140	2·67
30	27 31	33 59	0·0114	
Aug. 1	23 29 14	22 10 13	0·0088	2·68

The unit of brightness is that on April 21, 1917, when the comet was observed by Barnard to be not brighter than 12th magnitude. It is quite improbable that the comet will become visible to the naked eye, as was at one time anticipated.

COMET 1917*a* (MELLISH).—Prof. E. Strömgren sends us the following communication from Copenhagen Observatory:—"Prof. S. S. Hough, director of the Cape Observatory, writes:—The discovery of a new naked-eye comet by Warren was announced to us by telephone on April 15. From observations made in this observatory on April 18, 20, and 22 the following elements of the orbit have been derived:—

$$T = 1917 \text{ April } 10{\cdot}8043$$

$$\text{Elements:}\ \left.\begin{aligned} \omega &= 124^\circ\ 32{\cdot}6' \\ \Omega &= 85^\circ\ 42{\cdot}9' \\ i &= 32^\circ\ \ 6{\cdot}1' \end{aligned}\right\}\text{For equinox of date}$$

$$q = 0{\cdot}1975$$

"The comet is 1917*a* (Mellish)."

COMET 1917*b* (SCHAUMASSE).—The following continued ephemeris for this comet, by Messrs. Fayet and Schaumasse, is based upon elements calculated from observations made at the Nice Observatory:—

1917	R.A. h. m. s.	Decl. ° ′	Log Δ	Log *r*	Brightness
July 4	9 40 50	+10 55	0·2357	0·0691	0·3
8	42 51	9 59	0·2659	0·0885	0·2
12	44 46	9 8	0·2929	0·1073	0·2
16	46 35	8 22	0·3171	0·1255	0·1
20	48 21	7 40	0·3389	0·1431	0·1
24	50 3	7 0	0·3585	0·1601	0·1
28	9 51 45	+6 23	0·3762	0·1765	0·1

The ephemeris is for Greenwich midnight (*Journ. des Observateurs,* No. 18). The comet is now rapidly receding from the earth.

ROTATION IN PLANETARY NEBULÆ.—In continuation of their previous investigations (NATURE, vol. xcvii., p. 268), Prof. W. W. Campbell and Mr. W. H. Moore have announced that the planetary nebula N.G.C. 7662 shows rotational effects very definitely in its spectrum, and that the bright nebular lines are doubled in the parts corresponding to the central region of the nebula. The most satisfactory interpretation is considered to be that the lines are widened by the differential radial velocities in the central part of the nebula, and that an outer stratum of absorbing nebulosity, with a slower rotation, is responsible for an absorption line lying nearly centrally along each bright line (*Popular Astronomy,* vol. xxv., p. 313). The nebula N.G.C. 7026, the general outline of which is a relatively flat ellipse, is also rotating rapidly and the evidence is fairly conclusive that there is an outer equatorial zone of absorbing matter. A further example of high angular speed of rotation has been found in the nebula Jonckheere 320.

THE USE OF ZIRCONIA AS A REFRACTORY MATERIAL.

THE Transactions of the Ceramic Society, vol. xvi., part i., contain an interesting article by Mr. J. A. Audley on the above title. This substance, ZrO_2, occurs somewhat widely distributed, chiefly in the form of the mineral zircon, in which it is combined with silica. A more abundant source has recently been found in the mineral Baddeleyite, which contains from about 80 to 94, and even 98, per cent. of zirconia. This mineral was discovered in 1892 almost simultaneously by Hussak in southern Brazil and by L. Fletcher in Ceylon, the former deposit being much the more extensive and valuable. It also occurs in North America, Australia, and the Ural Mountains. Zirconia is also a by-product of monazite sands. Baddeleyite has a hardness of 6·5 and a specific gravity of 4·4 to 6. It is insoluble in acids, except hydrofluoric acid, but is easily attacked by fused potassium hydrogen sulphate. The melting point of raw zirconia is in the neighbourhood of 2000° C., that of the purified material being considerably higher. It can be both melted and volatilised in the electric furnace. It is a "neutral" substance of the same type as alumina and is said to have a high resistance to the fluxing action of both acid and basic slags. Its heat conductivity is remarkably low, and its coefficient of expansion on heating is nearly as low as that of quartz glass, both of which are very valuable properties. It resists the action of fused cyanides and alkalies.

Dr. J. A. Harker was one of the first in this country to direct attention to the valuable properties of zirconia, but the matter has only recently been taken up for investigation, and much more attention has been paid to it abroad, particularly in Germany, where numerous patents have been taken out. It was applied to the manufacture of muffles, retorts, and tubes by Pyfahl in 1904, and two years later by the Heraeus Company for crucibles in which quartz was to be fused. The suggestion has also been made to replace thoria or yttria as an inner coating for the iridium tube in the Heraeus iridium furnace.

As a lining for electric arc furnaces the natural product is good enough, its high melting point, low thermal conductivity, and small coefficient of expansion making it particularly suitable for this purpose. Now that it is obtainable at comparatively reasonable prices, it can be used for the manufacture of refractory bricks. The market price in Germany before the war varied from 31*l.* per metric ton for the crude mineral to 50*l.* for the 98 per cent. variety. It has been found that a zirconia-lined hearth of an open-hearth steel-making furnace at Remscheid was still in good condition after four months' continuous working at high temperatures. Calculations based on the same tests showed in actual maintenance costs a saving of more than 50 per cent. in favour of zirconia as compared with the refractory lining ordinarily used. Ferrozirconium, containing up to 35 per cent. zirconium, obtained by reducing a mixture of the oxides with aluminium, has been prepared and used as the basis of introduction of the metal into steel for armour-plates, armour-piercing projectiles, and bullet-proof steel.

Zirconia also finds application as an addition to melted quartz to prepare "siloxide glass," a product resembling quartz opaque glass, but harder, less fragile, more resistant to mechanical stresses and basic oxides (excepting alkalies), and less easily devitrified than quartz glass.

Recently Ruff and Lauschke have investigated the refractoriness and other properties of zirconia, alone, and mixed with certain other oxides.

HYDRO-GEOLOGY IN THE UNITED STATES.[1]

DIPPING into a bundle of recently issued reports of the United States Geological Survey, all exhibiting evidence of the scrupulous care and unwearied industry of those responsible for the collection of data relating to the water-bearing capacities of the several regions under observation, we extract from a considerable mass of information one or two items which seem to possess some general, as well as local, interest.

(1) The topography of certain parts of Arkansas and the adjoining States is characterised by numerous low, circular mounds, from 20 to 100 ft. in diameter, and from 1 to 4 ft. in height. It is stated that in certain districts they are present in astonishing numbers, many fields being completely covered with them. They occur indiscriminately among the unconsolidated clays, loams, marls, sands, and gravels in the lowlands, on the uplands of Cretaceous and Tertiary age, and on the slopes of Palæozoic hills. The materials of which they are composed are in some cases slightly coarser and lighter in colour than the surrounding soils, while in other cases the components are essentially similar in structure, composition, and colour. No satisfactory explanation has yet been put forward to account for these conformations. Springs and gas-vents, coastal dunes and ant-hills, wind action and human agency, have all been suggested as originating or contributory causes; but no single theory fits in convincingly with all the conditions and facts. They remain a standing puzzle to observers.

(2) The broad desert valleys of New Mexico, composed of gravel, sand, and clay, are designated "bolsons." Rising up at intervals from the level uniformity of their surfaces are narrow, rocky ridges, ranging in length from two to twenty miles, and in height from a few hundred to nearly 2500 ft. It is probable that all these ranges have an underground connection, forming in reality a single range. They represent a thick succession of sedimentary rocks of all ages, from Cambrian to Recent, overlying pre-Cambrian granite, which outcrops in some of the ridges. In places the depth of the bolson deposits runs to considerably more than 1000 ft.

(3) The chief water-bearing formations of Connecticut are the unconsolidated materials of Glacial origin which overlie the bedrock. There are two types—the unstratified and the stratified, the former a heterogeneous mixture of débris deposited directly by ice, and the latter the same ingredients, but reassorted and deposited by water. The Glacial drift is only thin, and the surface of the underlying rock rugged. This results largely in the localisation of much of the rainfall (amounting to 45 in. per annum), causing supplies, at times, to be deficient through periods of several weeks, or even months.

(4) One of the difficulties confronting settlers in the San Joaquin Valley, California, is the adverse influence on plant culture of the alkali salts in the soil. If the alkali content be in any degree excessive, growth is retarded, and possibly arrested altogether. The farmer has to control the accumulation of soluble salts near the surface of his land, if he is to obtain satisfactory results. A common practice is to flood the area with water, which dissolves the alkali salts and carries them down below the zone of influence on delicate rootlets; but this method is only partially effective, unless measures are taken to prevent surface evaporation by means of the shade afforded by trees and the cover of stands of grass or grain. B. C.

[1] (1) "Geology and Ground Waters of North-Eastern Arkansas." By L. W. Stephenson, A. F. Crider, and R. B. Dole.
(2) "Geology and Underground Water of Luna County, New Mexico." By N. H. Darton.
(3) "Ground Water in the Hartford, Stamford, Salisbury, Willimantic, and Saybrook Areas, Connecticut." By H. E. Gregory and A. J. Ellis.
(4) "Ground Water in San Joaquin Valley, California." By W. C. Mendenhall, R. B. Dole, and H. Stables.
(Published by United States Geological Survey, Washington Government Printing Office, 1916.)

SCIENCE AND INDUSTRY.

THE important and impressive review of the rise and progress of the organic chemical industry issued by Messrs. Levinstein, Ltd., of Blackley, near Manchester, and of Ellesmere Port, which appeared as a supplement to the *Manchester Guardian* of June 30, marks a welcome development of industrial enterprise. Even the most indifferent and ill-informed reader cannot but be made aware, as a result of its perusal, of the importance of the highest facilities for scientific education and training, when in so striking a fashion he is compelled to realise the fruits of it in the enormous industrial advance of Germany in all that pertains to the organic chemical industries, whether it takes the form of artificial dyestuffs, synthetic organic products, or that of chemico-therapeutics. The advent of the war quickly laid bare our serious deficiencies, not to say our utter poverty, in all three departments of chemical manufacture.

In the course of the articles, which have been written by men eminent in their respective fields of chemical science and its applications, the distinction is made absolutely clear as between industries the development of which has mainly been the result of the adoption of steam power and of mechanical appliances, and those depending upon fundamental researches of a physical and chemical character, such as are, to use the phrase of one of the writers, "built up from the depths," and require, therefore, not merely the energetic business organiser and "scientific management," with a view to output, but the highly trained scientific man capable of appreciating the discoveries of pure science and apt in their application to human needs. In this valuable review of the progress of the many departments of a vital industry—the key, indeed, to the successful prosecution of many allied and dependent industries—it is clearly revealed how remiss the nation has been in a true appreciation of what constitutes the firm foundation of industrial pre-eminence. The fault has lain not so much, as some of the writers seem to indicate, with the colleges and universities as with the industries concerned, which have hitherto offered small salaries and poor prospects to the carefully trained and competent science student; indeed, have looked upon the chemist as a necessary evil, to be avoided if possible.

One of the most important articles is that by Dr. Levinstein, inasmuch as he carefully points out the respective spheres of the university and the works in the effective training of the future industrial chemist. Once those concerned with the successful administration of our industries realise the necessity for encouraging by a liberal payment the work of the efficiently trained chemist there will be no lack in the supply of suitable men. That the nation contains such men has been shown by the fact that the demands of this devastating war for the supply of high explosives have been met with an energy and an efficiency which have surprised our chief enemy.

THE AMERICAN ASSOCIATION.

STANFORD MEETING OF THE PACIFIC DIVISION.

THE second annual meeting of the Pacific Division of the American Association for the Advancement of Science was held at Leland Stanford Junior University on April 5–7. In all a series of twenty-two sessions was provided, at which more than 130 papers were presented. At a general session on the evening of April 5 an address was given by Dr. J. C. Branner, retiring president of the Pacific Division, upon "Some of the Scientific Problems and Duties at Our Doors," and on the evening of April 6 Dr. F. J. E. Woodbridge, professor of philosophy at Columbia University, presented an address upon "History and Evolution."

One of the principal features of this meeting was a symposium arranged under the direction of Dr. D. T. MacDougal, director of the Desert Laboratory, Carnegie Institution of Washington, Tucson, Arizona, upon "Co-ordination and Co-operation in Research and in Applications of Science," at which the following addresses were given:—"Science and an Organised Civilisation," W. E. Ritter; "The National Research Council as an Agency of Co-operation," A. A. Noyes; "Plans for Co-operation in Research among the Scientific Societies of the Pacific Coast," J. C. Merriam; and "The Application of Science," W. F. Durand. Abstracts of the two written reports of the symposium are subjoined.

The ideals expressed in this symposium were given action in the formation of a Pacific Coast Research Conference, composed of the Pacific Coast Research Committee (which is a sub-committee of the Committee of One Hundred on Research of the American Association), and of representatives of societies affiliated with the Pacific Division. The purpose prompting the organisation of this conference is further expressed in the following resolution:—"Whereas it is the opinion of this conference that the important scientific problems before men of science to-day are those problems relating to preparation for war, which require scientific research, therefore be it resolved that this conference, representing the scientific interests of the Pacific Division of the American Association for the Advancement of Science, offers to the State Council of Defence already formed in California, and to such other similar State or national organisations as may be organised, the full support and assistance of this conference in so far as it may be desired for the direction of research upon problems arising out of a condition of preparation for war."

Science and an Organised Civilisation.[1]

The importance of science in Western civilisation is abundantly recognised. The dependence upon it of agriculture, manufacture, commerce, hygiene, medicine, war, etc., gives it an enormous and secure place in all modern society. Questions of its becoming still more serviceable in these ways no longer concern the fact and general principles of its usefulness, but only matters of its financial support, its special agencies and methods, and its further specialisation and organisation. My commission is to speak about science not so much as an element in civilisation as an interpreter of, and a general contributor to, the very essence of civilisation itself. The propositions supported are:—

(1) That in a catastrophic time like the present, when the social and political conventions and practices and ideas by which civilisation is guided under normal conditions are largely shattered, men are thrown back on the basic principles of their natures to a degree not approximated at other times.

(2) That such conditions are exactly those for science to take cognisance of, and to bring its methods and accumulations of knowledge to bear upon, to the end of making the new *régime* which shall supervene more in accord with the basic principles of man's nature than were those of the old *régime*.

(3) That the scientific men of the Americas, particularly of the United States, are specially well circumstanced to take a leading part in such a movement from the fact that their Governments and special institutions are avowedly (as through the Declaration of Independence, the organic law, and the Monroe Doctrine of the United States) based more on the fundamental nature of man than on political and social tradition.

(4) That in view of this it is the duty of American men of science to exert themselves to the utmost to secure due recognition and participation of science in the gigantic problems of national and international readjustment by which the world will soon be confronted.

The Application of Science.[2]

There are two fundamental motives determining interest in science: (1) a desire to know the universe, its constitution, phenomena, and laws of evolution; and (2) a desire that the facts disclosed may be applied to the service of humanity.

The broadest significance of a fact of science is only reached when it is applied to some useful end. Without such application its significance is limited to its intellectual or æsthetic appeal. With such application it takes its place as one of the factors in the life of humanity.

Not all facts of science are equally susceptible of useful application. Some possibly may have no such application. It is impossible to foresee the future, however, and it is not unreasonable to assume that, in a large way, all facts of science contain the potential of some useful application at some stage in the evolution of humanity on the earth.

The problem of the application of the facts of science is that of bridging the gap between the observed fact and the correlated demand presented by the needs of civilisation. This problem divides under two types. (1) Given a fact of science, what are its applications? (2) Given a need of civilisation, what is the foundation in science for meeting the need?

The factors most likely to be of significance in dealing with the first problem are (1) imagination or vision; (2) wide acquaintance with the needs of humanity as expressed in terms of their scientific elements. For the second typical problem there are required likewise (1) imagination or vision, and (2) wide acquaintance with the facts of science likely to bear upon the specific problem in hand.

[1] By William E. Ritter, Director, Scripps Institution for Biological Research, La Jolla, California.

[2] By Prof. W. F. Durand, professor of mechanical engineering, Stanford University, California.

In detail the field is too vast for compass by any one human mind. The situation is, moreover, becoming more and more aggravated by the rapidly growing accumulation of the facts of science. There is specific need for the development of a new branch of science, the science of the use of science. Some of the factors of such a science or scientific method are presumably (1) the development of a great clearing-house of scientific facts and human needs, with improvement in methods of classifying and storing away such facts in the record; (2) the development of a special type of mind keen to detect correspondence between the needs of humanity and the facts of science; (3) the organisation of a corps of workers under the guidance of such trained and developed minds, and whose purpose shall be the working out of the correspondences noted above.

In any exhaustive or complete sense the field seems too vast to be compassed by human effort. Both the accumulated store of science and the pressing needs presented by our modern complex civilisation have far outrun the seeming compass of any method we can imagine whereby such correspondences might be determined in a definite and assured manner. Because the field is too vast for compass in an exhaustive or complete manner, however, it does not follow that no effort whatever should be made. On the contrary, it seems clear that something should be done towards the development of a more orderly method for the establishment of correspondence between the needs of humanity and the facts of science, and we should look forward to this effort as one of the distinctive marks of progress in the twentieth century—the beginning, at least, of the development of a science of the use of science.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The Education Committee of the London County Council has approved a grant of 26,140*l.* per annum to the University for the three years 1917–20. This is an increase of 1460*l.* over the grant for 1916–17. Increased grants are given to the Evening School of History at University College, 140*l.*; to Italian, 600*l.*; to Slavonic languages, 500*l.*; and to phonetics at University College, 220*l.* It is proposed to establish a professorship in Italian, and the Senate is asked to prepare a scheme for the teaching of this language. A chair in Russian is also to be established, and the work will be concentrated at King's College. The other grants remain unaltered as to amount or purpose, including the block grant of 10,000*l.* in accordance with the Technical Education Board scheme. Importance is attached by the Senate to the development of phonetics, and it is pointed out that a large phonetic laboratory was fitted out on a lavish scale a few years ago in connection with the Colonial Institute at Hamburg. The higher sub-committee states that, "having regard to the increasing importance of a knowledge of modern European languages to those engaged in commerce, and also to the large number of languages spoken in the British Empire, it appears that the provision for the teaching of phonetics in England cannot be regarded as adequate." An increased grant of 220*l.* for the teaching of phonetics is accordingly sanctioned. The maintenance grant of 300*l.* per annum is to be continued to Bedford College for the next three years.

THE somewhat novel experiment of using a private garden for educational purposes has of recent years been tried at "Westfield," Reading, by Dr. J. B. Hurry, and has excited considerable interest amongst the teachers and older school children, as well as amongst residents of that town. A number of plots have been laid out in which are grown a variety of plants used in industry and commerce. Series A includes plants used in medicine, *e.g.* eucalyptus, belladonna, aconite, stramonium, gentian, liquorice, podophyllin, asafœtida, valerian, henbane, castor oil, cinchona, and the opium poppy. Series B includes plants used for food, *e.g.* maize, millet, sugar, rice, bananas, arrowroot, ginger, chicory, pepper, olive, and cardamoms. Series C includes plants used for clothing and textiles, such as flax, hemp, cotton, jute, *Phormium tenax*, and ramie nettle. Series D includes plants that yield dyes, such as woad, indigo, madder, dyer's weed, turmeric, anatto, and alkanet. In the adjacent conservatories are exhibited more delicate economic plants, such as tea, coffee, soya beans, monkey-nuts, guava, chick pea, cinnamon, and camphor. Adjoining the conservatories is a small museum in which are collected various products made from the above-mentioned plants, every article being accompanied by a descriptive label, so that the living plant can be studied in conjunction with the economic products derived from it. Every summer the garden, conservatories, and museum are thrown open free on several half-holidays to visitors and the older school children of the borough, who in large numbers avail themselves of the privilege of seeing some of the important plants used in industry. A printed catalogue is supplied to every visitor, and from time to time demonstrations of the more interesting exhibits are given by Dr. Hurry and his assistants.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 21.—Sir J. J. Thomson, president, in the chair.—Sir Napier **Shaw**: Revolving fluid in the atmosphere. It is generally assumed, as appears particularly from a recent paper by Lord Rayleigh with reference to a former paper by Dr. J. Aitken, that the motion of air in cyclones and anticyclones may be classed as the motion of revolving fluid, symmetrical about a vertical axis. Reasons are given to show that this assumption with regard to cyclones and anticyclones of middle latitudes is erroneous; that circular isobars on the map do not indicate revolving fluid, and, *vice versa*, that travelling revolving fluid would not be indicated by a system of circular isobars. The next point for consideration is how a mass of revolving fluid travelling with a speed of translation of the same order as the speed of rotation, and of sufficient size, would be represented on a map. Diagrams are drawn showing the distribution of velocity in four cases for different ratios of the velocity of translation to the velocity of rotation, and assuming that systems of velocities could be fitted to pressure lines of the same shape, it is inferred that cases of travelling revolving fluid would be indicated by isobars similar to those which are classed meteorologically as belonging to small secondaries, or distortions of the isobars, generally on the southern side of the great cyclonic systems. Conditions are next considered which must exist if a column of rotating fluid is maintained and transported within a current represented by the isobars of a great cyclonic depression. The conditions arrived at are briefly:—(1) That the velocity of translation must be the velocity corresponding with the separation of the isobars of the main depression unaffected by the presence of the revolving mass. (2) The column must probably extend throughout the troposphere, otherwise it could not be "capped." (3) The velocity of the current transporting the revolving fluid must be the same at all heights. This condition is shown to be satisfied if the line of lapse of temperature with height in the atmosphere corresponds with an adiabatic line, and this is known to be approximately the case in a cyclonic depression where convection has been ubiquitous and vigorous.—Prof. A. **Fowler** and Hon. R. J. **Strutt**: Absorption bands of atmospheric ozone in the spectra of sun and stars. In this paper it is shown that a series of narrow bands in the ultra-violet absorption spectrum of ozone appears in the spectra of the sun and stars near the extreme end of the photographic spectrum. The atmospheric origin of these bands is proved by the increase in their intensity in the solar spectrum as the sun's altitude is diminished. The observations are considered strongly to confirm the view of Hartley that ozone is the constituent of the atmosphere which limits the spectra of celestial bodies in the ultra-violet.

Mineralogical Society, June 19.—Mr. W. Barlow, president, in the chair.—Dr. G. F. H. **Smith**: The problem of sartorite. The examination of crystals kindly supplied for the purpose by Dr. C. O. Trechmann and Mr. R. H. Solly showed that the faces fall into zones which are only partially congruent. Just as in the case of calaverite, earlier investigated by the author, there appear to be simultaneously in certain of the crystals five distinct lattices. The vertical spacing and the relative positions of the vertical planes remain unchanged, but in passing from the central lattice to the two lying on either side there is a distinct shear which varies in direction, though apparently not in amount, from crystal to crystal.—Dr. A. **Scott**: Note on a curious case of devitrification. The glass of an old bottle found in river sand about 4 ft. below the surface in Leven Shipyard, Dumbarton, has become almost completely crystallised. The crystals, which have a composition corresponding nearly to $2CaO.Na_2O.5SiO_2$, are accompanied by some dark-coloured microlites. A piece of a glass which by accident had been allowed to cool slowly showed the same crystals and microlites, and, in addition, a few small needles with high refraction and large birefringence.—Dr. G. T. **Prior**: The meteorites of Simondium, Eagle Station, and Amana. The results of analyses showed that the Amana stone belonged to the cronstadt, with some approach to the baroti type; that Eagle Station is an exception to other pallasites in containing iron richer in nickel, and olivine correspondingly richer in ferrous oxide; and that Simondium was closer to the grahamites than to the howardites, since, like other grahamites, it contained nickeliferous iron and olivine in chemical composition similar to those of the pallasites, but with pyroxene and anorthic felspar similar to those of the howardites and eucrites.

Royal Microscopical Society, June 20.—Mr. E. Heron-Allen, president, in the chair.—F. M. **Duncan**: A note on the fertilisation and deposition of ova in *Portunas depurator*. The author had recently been able to observe the repeated deposition of fertile ova by a female crab after one copulation. The first batch of ova were deposited attached to each other in the typical manner. In later depositions the ova were separated from each other, and rested on the floor of the tank like grains of sand. Every care was taken to preclude the possibility of free spermatozoa being present in the water of the tank containing the female crab. This rarely observed phenomenon had been confirmed by Dr. H. C. Williamson and Mr. H. J. Waddington.—E. **Heron-Allen** and A. **Earland**: *Nouria rugosa,* a new Foraminifer from the Shetland-Faröe Channel. This representative of a Lituoline genus hitherto recorded only by the same authors from tropical and Australian seas constructs a polythalamous shell of minute siliceous spicules of curved *oxea* type, derived from some sponge which, so far, has not been identified, and is isomorphous in structure with the perforate species, *Polymorphina angusta,* Egger, and *P. lanceolata,* Reuss.

VICTORIA.

Royal Society, April 12.—Mr. W. A. Hartnell, treasurer, in the chair.—R. T. **Patton**: Timber production and growth curves in the mountain ash (*Eucalyptus regnans*) Measurements and calculations have been made on a large series of cut timber at Powelltown, and the general conclusion regarding the annual development of wood in this species of Eucalypt is that it reaches its maximum at fifty years, and that the most profitable time for cutting is between the sixtieth and seventieth years. These appear to be the first investigations of the kind made on Australian timber. —Prof. E. W. **Skeats**: Coral-reef and dolomite problems in relation to the formation of atolls.

WASHINGTON, D.C.

National Academy of Sciences, April 15 (Proceedings. No. 4, vol. iii.).—R. A. **Millikan**: A re-determination of the value of the electron and of related constants. The values for the charge on the electron, the Avogadro constant, etc., are given, with estimates of the accuracy of the result.—J. A. **Harris,** A. F. **Blakeslee,** and D. E. **Warner**: Body pigmentation and egg production in the fowl. A strong negative correlation exists between the October ear-lobe pigmentation and the egg production of the year.—A. J. **Goldfarb**: Variability of germ-cells of sea-urchins. The varying behaviour of the eggs in the experiments of Loeb, Lillie, Wasteneys, and others was apparently due in large part to variation in the physiological condition of the eggs they used.—G. **Harrison**: Transplantation of limbs. The experiments confirm previous ones, showing that the limb bud is a self-differentiating body; they also show that the laterality of the fore-limb may be affected by its new surroundings.—I. **Langmuir**: The shapes of group molecules forming the surfaces of liquids. Cross-sections and lengths are calculated for a variety of molecules. Various theoretical conditions are developed.—F. J. **Alway** and G. R. **McDole**: The importance of the water contained in the deeper portions of the subsoil. The moisture of the deeper subsoil will be able to move upward only so slowly and through such a short distance in a single season that it will be at most of no *practical* benefit to annual crops.—W. N. **Berg**: The transformation of pseudoglobulin into euglobulin. The loss of pseudoglobulin in the heated sera corresponds almost quantitatively with the gain of euglobulin in the same sera.—H. E. **Jordan**: A case of normal embryonic atresia of the œsophagus. A description of the phenomenon for turtles.—H. **Shapley**: Studies of magnitudes in star clusters. V., Further evidence of the absence of scattering of light in space.—H. E. **Jordan**: The history of the primordial germ-cells in the loggerhead turtle embryo.—H. **Shapley**: Studies of magnitudes in star clusters. VI., The relation of blue stars and variables to galactic planes. The stellar distribution in the so-called globular clusters has an underlying elliptical symmetry; therefore not only certain nebulæ, our solar system, and the whole galactic system, but even the globular clusters have the oblateness that is general and fundamental in the dynamics of stellar groups.—L. **Spier**: Zuñi chronology. It has been found possible to establish a chronological scale with applications to American culture history.—E. W. **Berry**: The age of the Bolivian Andes. There is definite evidence that parts of the high plateau and of the eastern Cordillera stood at sea-level in the late Tertiary.—W. H. **Bucher**: Large current-ripples as indicators of palæogeography. A study of the Cincinnati anticline.—E. C. **MacDowell**: The bearing of selection experiments with Drosophila upon the frequency of germinal changes. A study of extra bristles indicates that they are primarily occasioned by one germinal unit, and that no change of evolutionary or practical significance has occurred during fifty generations.—S. **Taber**: Pressure phenomena accompanying the growth of crystals. Many phenomena connected with the metamorphism of rocks, the growth of concretions, and the formation of mineral deposits are difficult to explain under any other hypothesis than that growing crystals have made room for themselves by exerting pressure on the surrounding material.—T. B. **Johnson** and A. A. **Ticknor**: A new method of transforming esters of α-amino-acids into their corresponding isothiocyanates.—W. G. **Foye**: The geology of the Fiji Islands. It cannot be said that the modern reefs of Fiji fully support Darwin's theory.—D. F. **Jones**: Dominance of linked factors as a means of accounting for heterosis.—E. F. **Smith**: Chemically induced crown-galls. Small tumours have been produced by the application of various chemicals.—G. D. **Birkhoff**: Dynamical systems with two degrees of freedom.

BOOKS RECEIVED.

Transactions of the Royal Society of Edinburgh. Vol. li., part ii. Session 1915–16. Vol li., part iii. Sessions 1915–16–17. (Edinburgh: R. Grant and Son.) 33*s*. and 35*s*.

Modern Man and his Forerunners. By H. G. F. Spurrell. Pp. xi+192. (London: G. Bell and Sons, Ltd.) 7*s*. 6*d*. net.

A Year of Costa Rican Natural History. By A. S. Calvert and P. P. Calvert. Pp. xix+577. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 12*s*. 6*d*. net.

Microscopic Analysis of Cattle-foods. By T. N. Morris. Pp. viii+74. (Cambridge: At the University Press.) 2*s*. net.

The Biology of Dragonflies. By R. J. Tillyard. Pp. xi+396. (Cambridge: At the University Press.) 15*s*. net.

Fossil Plants: a Text-book for Students of Botany and Geology. By Prof. A. C. Seward. Vol. iii. Pp. xviii+656. (Cambridge: At the University Press.) 18*s*. net.

Explosives. By A. Marshall. Second edition. Vol. ii. Properties and Tests. Pp. ix+411 to 795. (London: J. and A. Churchill.) 3*l*. 3*s*. net two vols.

The Statesman's Year Book, 1917. Edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein. Pp. xliv+1504+4 plates. (London: Macmillan and Co., Ltd.) 12*s*. 6*d*. net.

The Standard Cyclopædia of Horticulture. By L. H. Bailey. Vol. vi., S–Z. Pp. v+3043 to 3639+plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 25*s*. net.

Health and the State. By Dr. W. A. Brend. Pp. xi+354. (London: Constable and Co., Ltd.) 10*s*. 6*d*. net.

Practical Chemistry for Medical Students. By Dr. A. C. Cumming. Second edition. Pp. 8+165. (Edinburgh: J. Thin.)

How to Know the Ferns. By S. L. Bastin. Pp. viii+136. (London: Methuen and Co., Ltd.) 1*s*. 6*d*. net.

Farm Forestry. By Prof. J. A. Ferguson. Pp. viii+241. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. net.

Introduction to the Rarer Elements. By Dr. P. E. Browning. Fourth edition. Pp. x+250. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s*. net.

Steam Turbines. By J. A. Moyer. Third edition. Pp. xi+468. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 16*s*. 6*d*. net.

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

Researches of the Department of Terrestrial Magnetism. Part iii. Oceanic Magnetic Observations, 1905–16, and Reports on Special Researches. By L. A. Bauer and others. Pp. vii+447. (Washington: Carnegie Institution.)

The Human Worth of Rigorous Thinking. By Prof. C. J. Keyser. Pp. 314. (New York: Columbia University Press; London: H. Milford.)

Soil Conditions and Plant Growth. By Dr. E. J. Russell. Third edition. Pp. viii+243+diagrams. (London: Longmans and Co.) 6*s*. 6*d*. net.

DIARY OF SOCIETIES.

FRIDAY, JULY 6.

GEOLOGISTS' ASSOCIATION, at 7.30.—Notes on Volcanic Phenomena in New Zealand: Miss M. S. Johnston.—Flint-working Sites in the Submerged Forest of Carmarthen Bay: A. L. Leach.

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