NATURE

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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, MARCH 1, 1917.

CLASSICAL EDUCATION.

A Defence of Classical Education. By R. W. Livingstone. Pp. xi+278. (London: Macmillan and Co., Ltd., 1916.) Price 4*s.* 6*d.* net.

THIS book is, unfortunately, based upon two misconceptions, both of which are common amongst classicists. In the first place, it is assumed that an attempt is being made at the present time to abolish classics from general education and to replace them by scientific studies. This is far from the truth. Men of science claim no privileges for their own subject which they are not prepared to grant equally to classics and to the other branches of learning. Narrow specialisation in any one department, whether classical or scientific, we hold to be thoroughly bad from an educational point of view.

The author has little knowledge of the aims of those who wish to reform modern education. From the frequent references to the conference held last May on the neglect of science he has evidently taken the report of these proceedings as his basis. He then proceeds to isolate statements and phrases from their contexts, and from such he builds up an entirely erroneous and hypothetical attack which he attempts to demolish to his own satisfaction.

What is the system of classical education in force at the present time? At an early age a boy goes to a preparatory school where education has classics as its dominating note from the outset; in many cases twelve hours a week are devoted to Latin alone. Since the great majority of entrance scholarships to public schools are virtually awarded on a knowledge of classics, the able boys are then further hot-housed in this subject, practically to the exclusion of all other branches. On arrival at a public school, and having attained a certain proficiency in classics, boys are unlikely to wish to change to other subjects or to be allowed to do so if they wish. Thus the most clever boys are diverted from science quite early in their lives, and consequently we get all the evils of early specialisation, which results in boys of fourteen and fifteen devoting as much as twenty-five hours a week to this one branch of learning—classics.

This is education as at present interpreted in our public schools; this is the system which is being attacked so strenuously; this is the ground which, we venture to suggest, needs an abler pen than that of Mr. Livingstone to defend successfully. As a matter of fact, the title of the book is a misnomer, for the work is not a defence of classical education at all. Not a single argument is adduced to support the conclusion that "the first stage of classical education may be left alone. It is as satisfactory as most things in education are likely to be."

As a plea for the retention of classics in a general scheme of education, the book is excellent. Where Mr. Livingstone is dealing with facts he is on safe ground, and the majority of the work is a "hymn of praise" which is wholly admirable. His assumptions, however, are nearly always erroneous, and his conclusions illogical; one cannot help thinking that a little knowledge of scientific method would have saved him from many pitfalls.

The truth is that, although he does not admit it, and although, possibly, he does not know it, he is almost as much a reformer as the present-day advocate of science. Let us quote:—"The world is far more intelligible to us if we have studied literature." "The value of history is even more obvious." "To be ignorant of the world in which we live, to have no idea of how plants and animals grow, to know nothing of electricity and chemistry, is to deny ourselves whole provinces of knowledge." "Physical science corrects the vices of a literary training, its tendency to make men retrospective, critical, inactive spectators of the world." "Obviously any good education will include the teaching of science." "It ought to be a first aim to avoid diverting boys with mechanical and scientific

tastes, who have no aptitude for linguistics, into studies that will be barren for them."

Such phrases as these constitute a plea for devotion of more time to literature, to history, and especially to science. If the author's ideal is to be realised, it can only be done by an alteration of the curriculum, to some extent at the expense of classical studies. If "the first stage of classical education should be left alone," how does he propose to secure the wider type of education which both he and ourselves advocate?

It is on record that the head of an Oxford college urged that, since it was desirable that clergymen should know Greek, and since it was very often late in life before a man ultimately made up his mind whether he was going to be a clergyman or not, therefore all boys and young men were to be regarded as potential clergymen until that critical age was passed. We strongly suspect the author of similar views, with the exception that he would keep only the able boys at classics and hand over the dullards to science.

The second misconception is that science means merely the acquisition of facts. Science can give far more than the classicists imagine. The division of branches of knowledge into "humanistic" and "scientific" is an error of nomenclature; for science may be made the most humane of all studies. In the words of a recent manifesto: "Imaginative power indicates new fields in which further knowledge of truth may be revealed; its full establishment depends upon accurate observation, with constant recourse to Nature for confirmation. The one aim of natural science is, in fact, the search for truth based on evidence rather than on authority. The special value of natural science in the training of mind and character lies in the fact that the history of the subject is a plain record of the search for truth for its own sake."

SCIENTIFIC ENGINEERING.

(1) *Leçons sur le Fonctionnement des Groupes Electrogènes en Régime Troublé.* By Prof. L. Barbillion. Pp. ii+306. (Paris: Gauthier-Villars et Cie, 1915.) Price 11 francs.

(2) *Electric Switch and Controlling Gear.* By Dr. C. C. Garrard. Pp. xviii+656. (London: *The Electrician* Printing and Publishing Co., Ltd., n.d.) Price 15*s.* net.

(1) THE smooth working of steam or hydraulic prime-movers directly coupled to dynamos is one of great importance to supply station engineers. In this work Prof. Barbillion, the director of the Technical Institute at Grenoble, gives us a thorough and well-reasoned discussion of the subject. Much of the discussion, we are afraid, is too mathematical to be properly understood by the ordinary English engineer, but to the specialist and the advanced student it will be interesting and instructive.

In the first chapter curves are given showing how the torques produced by steam-engines and hydraulic turbines vary with the velocity for a given admission of steam or water respectively. Expressions are then found for the "useful" torque produced by the prime-mover, and differential equations are obtained for the dynamical equilibrium of the combined set under various conditions of load. These equations admit of easy solution. The problems of regulation and the *rôle* of regulators are next discussed. The effects produced by flywheels, various types of Watt's governor, air and oil brakes, etc., are investigated mathematically and the solutions illustrated by curves.

Expressions are found for the magnitude of the variation of the velocity produced by a given disturbance, the case when the resisting torque varies as the angular velocity being specially considered. Various devices for damping out irregularities in speed are described, and finally in the last two chapters a valuable descriptive study is made of the mechanisms required to keep the engine running at constant speed, and also of the devices required to make the speed of the engine increase with the load. The book is founded on a course of lectures given by the author to technical students. It illustrates well the great practical value of mathematics to engineers.

(2) As a work of reference this book is of value. Much of the information in it is novel, and the problems discussed are those which are exercising the minds of electrical engineers at the present time. Many of the practical devices in everyday use have their limitations, and some are of very doubtful utility. Dr. Garrard's critical remarks, therefore, will be most helpful in clearing up the mystery attending their operation.

In the first chapter materials and manufacturing methods are described. It shows clearly how scientific ordinary commercial engineering is becoming. In the old days the purchaser of raw materials made a cursory inspection of all the samples, and if they appeared to be of the same quality he accepted the lowest price. This is no longer the case. Consider, for instance, the purchase of the oil used for insulating high-tension apparatus. The buyer insists on knowing the electric strength, the flash-point, the viscosity, the specific gravity, the freedom from acid and alkali, the mineral impurities and additions, and the rate at which oxidation products are formed when ozonised air is passed through the oil. Similarly, other materials used in construction will have to conform—or will soon have to conform—to rigid and highly scientific specifications. In this connection the work done by the Engineering Standards Committee and by the many committees of the Institution of Electrical Engineers is worthy of high commendation. The co-operation between engineers, business men, mathematicians, physicists, and chemists is in every way satisfactory, and promises well for the future industrial welfare of the country.

Descriptions are given of apparatus for making and breaking electrical circuits, for obviating danger, for regulating the current and pressure, for starting and controlling running machinery,

and for protecting electrical machines and cables against abnormal electrical conditions due to faults or atmospheric disturbances. A discussion is also given of the design of switchboards. In almost every chapter many interesting and important practical researches are suggested. Some of these researches have already been begun and valuable results have been obtained. The industry is already beginning to feel the benefit of co-operative research.

On p. 553 a formula is given for the maximum electric stress between the horns of a lightning arrester. It is, however, merely the formula for the maximum electric stress between two infinitely long cylindrical wires. Apparently the assumption is made that the bending of these wires into the shape of horns does not appreciably alter the electric stress. The further assumption is made that the value of the disruptive stress in air is 25 kilovolts per cm. This is not true. For two parallel wires in air, if r be the radius of either measured in centimetres, the greatest possible value of the electric stress is $30+9/r^{\frac{1}{2}}$ kv. approximately at 25° C. and 76 cm. pressure (1·013 millibars). It is therefore not independent of the thickness of the wires. Before we can compute the breakdown voltage we need to know the formulæ for the disruptive stress with the given size of wire and for the maximum electric stress. The latter is a definite mathematical problem which has not yet been solved.

The diagrammatic symbols employed by the author are good, although in a few cases he is not consistent. In an appendix the symbols recommended by the British Electrical and Applied Manufacturers' Association (known as the Beama) are given. We have good grounds for hoping, however, that agreement on all the diagrammatic symbols used in electrical work—some 200—between all the English-speaking races will shortly be obtained. A. RUSSELL.

AN AGRICULTURAL POLICY.

British Agriculture: The Nation's Opportunity. Being the Minority Report of the Departmental Committee on the Employment of Sailors and Soldiers on the Land. By the Hon. E. G. Strutt, Leslie Scott, and G. H. Roberts. With a preface, and appendix on the Reclamation of Land, by A. D. Hall. Pp. xi+168. (London: John Murray, 1917.) Price 3*s.* 6*d.* net.

IN July, 1915, a Departmental Committee was set up "to consider what steps could be taken to promote the settlement and employment on the land in England and Wales of sailors and soldiers, whether disabled or otherwise." Within six months Part i. of the report was published, urging a policy of closer land settlement by the creation of more small holdings and the carrying out of various minor reforms. Before Part ii. was published certain changes were made in the *personnel* of the committee, and a minority report was drawn up by Messrs. the Hon. Edward Strutt, Leslie Scott, and G. H. Roberts, who felt unable to sign the majority report. This minority report forms the subject of the present book.

A considerable portion of the book is occupied by the preliminary section on the "policy of the plough," by an anonymous author styling himself "Free Trader," who attempts to justify the establishment of a State policy towards agriculture. In the past, as he points out, cheapness was the main consideration. The only thing the country cared about was that its bread and meat should be cheap, and it was supposed to be immaterial whether the commodities were produced here or elsewhere. And for a variety of reasons, which we need not now discuss, they tended more and more to be raised elsewhere, until the outbreak of war found us producing only about half our total food, and only about one-fifth of the wheat we need. Had the submarine menace been really effective we must have been starved out. Thoughtful people of all political views are therefore asking what is being done to ensure a stronger and better developed agriculture.

The minority do not consider that the recommendations of the majority report go far enough, and not being given to half-measures, they have evolved a scheme of their own. Their aim has not been to make farming more prosperous, but to make it more effective as a means of producing food and supporting a vigorous population. Three conditions are laid down as being necessary to success. First, the level of prices must be put sufficiently high to make farming a safe and remunerative occupation for men and capital; secondly, the position of the labourer must be improved as regards wages, housing, and the amenities of life; and, lastly, the landowner must realise that he has a responsibility to the community.

All this is, of course, entirely subversive of the old *laissez-faire* policy. "It is the duty of the nation," say the authors, "to provide for its sailors and soldiers. It is to its interest that the rural population and our home output of food should be increased. We believe that the end of this war will afford an absolutely unique opportunity of achieving these great ends." An adequate wage, a good cottage, the attractions of a living community, and the chance of rising are necessary so far as the men are concerned, and must be provided by State action. No uniform wage is suggested, but the establishment is recommended of district wage-boards, having power to see that wages do not fall below such a minimum standard as will enable the industrious man to keep himself and his family in physical health and efficiency. The chance of rising is to be provided by small holdings, which, however, will require to be on a sound basis.

But this plan can only succeed if the farmer's interest is made identical with that of the State; at present it is not. The farmer might meet the demands for higher wages as his predecessors did in the early 'eighties—by dismissing his men

and laying the land down to grass. This, of course, would be disastrous. To avoid it, a guaranteed minimum price of 40*s*. to 42*s*. per quarter for wheat should be offered for the next ten years; in addition, a bonus of 2*l*. should be given for each acre of grassland ploughed up. Possibly an import duty would be needed to pay the cost of the guarantee, but the authors prefer not to discuss the details too minutely. The Board of Agriculture should take over several grass farms in different parts of the country and run them as demonstration farms, showing how best they may be broken up and converted into arable land. As minor reforms the authors suggest that some of the munition works should be turned on to produce agricultural machinery after the war, and that special attention should be devoted to the sugar-beet and potato industries, both of which are capable of considerable development.

It is gratifying that agriculture is now receiving so much attention, and one can only hope that something will emerge to give it direction and impetus. There is a growing tendency in favour of definite State action, and everything is gained by having the matter well discussed beforehand.

OUR BOOKSHELF.

Highways and Byways in Nottinghamshire. By J. B. Firth. With illustrations by Frederick L. Griggs. Pp. xviii+426. (London: Macmillan and Co., Ltd., 1916.) Price 6*s*. net.

ALTHOUGH the county of Nottingham cannot perhaps claim a place among the most picturesque of the English shires, it can nevertheless show many attractive landscapes, more especially in the valley of the Trent and in the splendid remnant of the ancient forest of Sherwood. While mainly concerned with the towns and villages, the castles, abbeys, churches, and mansions of the county and the historical associations attached to them, Mr. Firth has done full justice to its physical features, and has produced what is certainly one of the best books yet written on Nottinghamshire.

Perhaps the best chapters are those on the forest and parks of Sherwood, full of "the glamour of a romantic past and the charm of living immemorial beauty. As a district of enchantment, of old oaks, of noble names, of great memories, of high romance, it has not its peer in England. The New Forest may vie with it in the beauty of its woodlands, but it has few associations to match those of Sherwood."

Sherwood Forest, moreover, is full of interest to the naturalist, as might be expected in a region of primeval woodland; many of the constituents of its fauna are, indeed, peculiar to it. Such matters, however, would be out of place in a work of this kind, and as a matter of fact there is not a word in the book on the geology or natural history of the county, unless we except the reference to the Nottingham crocuses and the forest flies of Sherwood. In describing the Nottingham meadows in spring as "ablaze with fairy gold," Mr. Firth makes a curious slip, for the Nottingham crocus is, of course, the purple-flowered species!

The book is profusely and beautifully illustrated, and the large-scale maps will be invaluable to the explorer of the byways of Nottinghamshire.

Index of Genera and Species referred to, and an Index to the Plates in "The Ibis" (seventh, eighth, and ninth series), 1895–1912. Edited by William Lutley Sclater. Pp. 513. (British Ornithologists' Union: sold by W. Wesley and Son, 1916.) Price 1*l*. 12*s*. 6*d*.

THOSE who study or refer to the more recent volumes of the *Ibis* will welcome the successful completion and issue of the third index of genera and species referred to, and an index to the plates. This covers the seventh, eighth, and ninth series, or eighteen volumes, and saves a tedious reference to a corresponding number of separate indexes. The two previous indexes, each covering fifteen years, published in 1879 and 1897 respectively, contained 431 and 471 pages. The present volume contains 513. This increase is chiefly caused by the adoption of the trinomial system of nomenclature, which necessitates three references to each bird mentioned under its generic, specific, and subspecific names respectively. The compilation of this great index was entrusted by the committee of the British Ornithologists' Union to Mr. Henry Peavot and Mr. Thomas Wells, and they are to be congratulated upon the able manner in which they have carried out their laborious task. The general supervision of the work, as well as the reading of the proof-sheets, a toilsome and tedious business, was undertaken by Mr. W. L. Sclater, the editor of the *Ibis*. The list of plates occupies eleven pages, showing that the later series of the *Ibis* have been well illustrated, though the coloured portraits of species may be relatively fewer than in the earlier volumes.

Macmillan's Geographical Exercise Books. With Questions by B. C. Wallis. I. *The British Isles*. II. *Europe*. III. *The British Empire*. IV. *The Americas*. V. *Asia and Australasia*. Pp. 48 each. (London: Macmillan and Co., Ltd., 1916.) 7*d*. each. Keys, 2*s*. 6*d*. net each.

THE plan of these books is to enable pupils to learn geography by doing something for themselves. Each left-hand page provides a clear outline map—quarto size—either suitably contoured or showing political divisions, which the pupil is to fill up by answering carefully graded questions of a sensible kind, which are printed on the right-hand page. In the keys, intended for the use of the busy teacher, the maps are correctly filled in, and the questions are annotated where necessary with hints to the teacher on points he should emphasise and amplify when discussing the questions with his pupils.

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.*]

British Optical Science.

THE following paragraph is taken from a report on national instruction in Technical Optics, published recently under the auspices of the Board of Scientific Societies :—

"A further need, which is urgent, is the supply of standard text-books dealing with those parts of Optics which at present are greatly neglected in this country; this includes practically the whole of Geometrical Optics and a large part of Technical Optics. In our opinion the quickest and most effective method of dealing with this requirement is by publishing translations of existing foreign books and abstracts of important papers on the subject."

The recommendation contained in the last part of this extract is admirable if carefully carried out, and applies to all substantial scientific literature, as well as to Geometrical Optics. But the reason assigned, though doubtless prompted only by our national habit of self-depreciation, is unwittingly a reflection on the numerous treatises on the subject, some of them of high originality, and of Continental repute to judge from the references to them, that exist in the English language. If the reason advanced had been that many of these treatises are weak on the technical side, which is important, not on account of scientific principle, but solely or mainly through its connection with workshop practice, it would have struck the mark. It is in British optical manufacture, not in British University instruction and discovery, that there has been lack of appreciation, until recent years, of what organisation, and co-operation between theory and practice, can do, and have done in other countries. It is in the trade that we had fallen behind, for the usual reason that it is easy and profitable to hold an agency for an efficient and pushing foreign organisation, but quite another matter to compete with it. The works of Heath, Herman, C. S. Hastings, Schuster, R. W. Wood, and many others dealing with Geometrical Optics (not to mention the encyclopædia articles of Lord Rayleigh and other writers) do not seem to be in any way inferior to Continental books, themselves not very numerous; as regards the substantial number of recent works on the technical side of the subject by English and American writers I am not much in a position to judge, for the reason indicated above, but I see no ground to doubt their value. Nor, within my own knowledge, is there any ignorance of the higher development of Geometrical Optics in such a technical school as the Northampton Institute at Clerkenwell.

In fact, one may be pardoned for what otherwise might seem an invidious remark, that in the vast expansion of optical science and practice during the last century this country has had more than its share. The evolution of the spectroscope, the mightiest modern weapon of astronomical and ultimate physical research, has been effected mainly in England and America: names such as Rayleigh, Rowland, and Michelson at once occur to mind. For a long period the construction of the great telescopes of the world was a British and Irish speciality; it has now gone largely to America because it is there that they are wanted. One need only glance at the references in Czapski's admirable book—itself an excerpt from a German Encyclopædia of Physics—to see that the treatment of aberrations was set on a scientific basis mainly by J. Herschel and Airy and Coddington. The early theoretical work of Roger Cotes and R. Smith was indeed largely anticipated in Holland by Huygens; but one can imagine what a gap would be made in the science if the Geometrical Optical work of Thomas Young, Sir W. Rowan Hamilton, and others named above, and more of comparable merit still happily in active production, were excluded.

On the other hand, there is the old Munich school of Fraunhofer and Steinheil, with their theorist in aberrations, von Seidel, of supreme rank, though now a thing of the past. But the great modern object-lesson is the scientific organisation and commercial success of the firm at Jena under the direction of Zeiss and Abbe, apparent mainly in the smaller optical appliances which are commercial articles. It has been due, as is well known, largely to their enterprise in making experimentally all the kinds of glass that had a chance of proving useful, and tabulating their optical qualities. But the very same problem was attacked in this country more than half a century ago by a solitary scientific worker—the Rev. W. Vernon Harcourt—and pursued for many years into practical results with the unrivalled advisory collaboration of Sir George Stokes; and it is understood to be generally admitted that, with the aid of even a very small subsidy from public sources, their neglected labours would have solved the problem that in other hands has carried so much *éclat*. Nor should the public-spirited work of British glass-makers be forgotten, in our new-born and most praiseworthy zeal; the improvements effected at Chance's works at Birmingham under the direction of John Hopkinson are classical, and the inspiring energy of Sir David Gill promised just before his death fruitful developments in the astronomical direction, both there and at Blackfriars.

JOSEPH LARMOR.

Cambridge, February 17.

The Bursting of Bubbles.

THE interesting letter appearing under the above title in the issue of NATURE for February 15 reminds me of a different, but equally simple, method of producing the same phenomenon, described in the Proceedings of the Physical Society, vol. xxviii., p. 59, 1915. There, in order to avoid obscuring the issue, the bubbles are said to discharge minute clouds of smoke; but, as often as not, smoke-rings like those described by Mr. Campbell Swinton and Miss Beale were obtained by Mr. Moss. In this method bubbles (of air) of any desired size can be used. These are filled with smoke by placing a wire, conveying a current of appropriate strength (easily determined by trial), above the end of the tube through which they enter the oil. A similar phenomenon is exhibited, very effectively, in a well-known experiment with phosphoretted hydrogen.

S. W. J. SMITH.

Imperial College of Science and Technology,
February 16.

Thermodynamics and Gravitation: A Suggestion.

THE recent experiments of Dr. P. E. Shaw (*Phil. Trans.*, ccxvi., 1916) seem to show that the "gravitation constant" has a temperature coefficient. It is remarkable, too, that G seems to be only appreciably influenced by increasing the temperature of the larger attracting mass.

The application of the principles of thermodynamics, while affording no explanation of gravitation itself, may offer an explanation of the temperature coefficient if it exists. One assumption only is required, namely,

that the approach of an attracted mass towards an attracting centre is accompanied by a rise in temperature, or, for the approach to be isothermal, heat must be taken away from the approaching mass.

Let us suppose a mass m grams is attracted with a force F dynes by an attracting mass M grams at a distance r cm. On an F,r diagram draw the Carnot cycle ABCD, AB and CD being isothermals at absolute temperatures θ and $(\theta-\delta\theta)$ respectively, BC and DA being adiabatic changes in the distance between the attracting centres. Take the mass m round the cycle. Let the heat supplied along AB be $m.\delta Q$ ergs, where δQ is the heat required to keep the temperature of 1 gm. constant when the distance changes from r to $r+\delta r$.

By the second law of thermodynamics the work done in the cycle is $m.\delta Q.\frac{\delta\theta}{\theta}$ ergs. The work is also given by the area ABCD, *i.e.* $\left(\frac{d\mathrm{F}}{d\theta}\right)_{r\ \mathrm{const.}} \times \delta\theta \times \delta r$ ergs.

Hence $$m.\delta Q=\theta\left(\frac{d\mathrm{F}}{d\theta}\right)_r.\delta r,$$

which means that

$$m\frac{\partial Q}{\partial r}=\theta\frac{\partial \mathrm{F}}{\partial\theta} \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Let the Newtonian law hold for isothermal changes in the distance between the attracting centres, then

$$\frac{\partial \mathrm{F}}{\partial r}=-\frac{2\mathrm{G}\mathrm{M}m}{r^3} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Also, if s is the specific heat of m in ergs we have for r constant

$$\frac{\partial Q}{\partial\theta}=s \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

From (3) we get

$$\frac{\partial^2 Q}{\partial r.\partial\theta}=0.$$

From (1) we get

$$\frac{\partial}{\partial\theta}\left(\frac{\theta}{m}\cdot\frac{\partial \mathrm{F}}{\partial\theta}\right)=\frac{\partial^2 Q}{\partial r.\partial\theta}=0,$$

$$\therefore \frac{\theta}{m}\frac{\partial \mathrm{F}}{\partial\theta}=f(r),$$

whence $$\mathrm{F}=m.f(r).\log\theta+\phi(r).$$

Putting this in (2) gives

$$m.f'(r).\log\theta+\phi'(r)=-\frac{2\mathrm{G}\mathrm{M}m}{r^3}.$$

This requires that

$$f'(r)=0, \text{ and } \phi'(r)=-\frac{2\mathrm{G}\mathrm{M}m}{r^3}.$$

Hence $$f(r)=\mathrm{A} \text{ and } \phi(r)=\mathrm{G}\frac{\mathrm{M}m}{r^2},$$

which give $$\mathrm{F}=\mathrm{G}\frac{\mathrm{M}m}{r^2}+\mathrm{A}.m.\log\theta,$$

i.e. the greater the mass the temperature of which is raised, the greater the correction due to temperature.

If the force of attraction between two masses at constant distance is F_1 when one of them is at a temperature of θ_1, and F_2 when that same one is at θ_2, then, other things being constant, we have

$$\mathrm{F}_2-\mathrm{F}_1=\mathrm{A}.m.\log\frac{\theta_2}{\theta_1},$$

where m is the mass the temperature of which is raised.

Calculating A from Dr. Shaw's results gives the approximate value of $1{\cdot}4\times10^{-12}$. Poynting and Phillips (Proc. Roy. Soc., A 76) used 208 grams attracted by the earth and the temperature was varied between $-186°$ C. and $+100°$ C. Hence the change in the attracting force would be

$$\mathrm{A}.m.\log\frac{\theta_2}{\theta_1}=1{\cdot}4\times10^{-12}\times208\times\log_e\frac{373}{87} \text{ dynes}$$
$$=4\times10^{-10},$$

or a change of 1 in 5×10^{14}, which Poynting and Phillips could not possibly detect.

GEORGE W. TODD.

Newcastle-upon-Tyne.

DESTRUCTIVE WILD BIRDS.

ONE of the evidences of the awakening in the public mind to the importance of the subject of the status of wild birds in relation to agriculture, horticulture, forestry, and fisheries is the annual newspaper correspondence. The subject has been dealt with year by year in a large number of papers, from the *Times* to the local village weekly. Unfortunately the attitude assumed by the majority of the correspondents is one based largely upon want of knowledge and a misconception of the subject under discussion. Whilst one section of writers presupposes that the majority of wild birds are distinctly injurious and should be ruthlessly destroyed, the other regards all birds as beneficial and advocates stringent measures for their protection. Such extreme views are both wrong and retard rather than aid a true understanding of a most complicated, but all-important, subject.

At a time when it is almost imperative that the land should be made to produce its maximum yield, it is doubly important that any factor that acts as a deterrent should be better understood and receive more than passing attention. The vexed question of the economic status of our wild birds is indeed a matter that calls for a very thorough, exhaustive, and continued inquiry.

From the first class of writers mentioned above one would conclude that little or no trustworthy evidence is forthcoming, and that we possess no exact knowledge of the feeding habits of any wild birds, the changes in feeding habits, their relation to the destruction and distribution of weeds, etc. Such, however, is far from the truth. Whilst, unfortunately, we have no State department or organisation engaged upon an investigation of the subject, tabulating records and results year by year, and spreading the information thus obtained amongst the people most interested, for more than thirty years there has been a small but enthusiastic number of private workers whose cumulative work has provided us with a most valuable mass of facts and original observations, and, thanks to these workers, it is now possible to state definitely that at the present time there is ample evidence of a far-reaching kind to prove:—

(i.) That no quarter should be shown to the wood-pigeon, which is one of the most destructive birds with which the agriculturist is confronted, and that every means should be taken to destroy it.

(ii.) The results of an investigation carried out by the writer in 1907–8–9 upon the feeding

habits of the rook, supplemented by similar work by Thring, Florence, and Hammond, clearly go to prove that this bird is far too plentiful at the present time, that it prefers a grain diet, and that it is injurious.

(iii.) In a like manner it has been shown that the starling has increased in numbers enormously during the last twelve years, and so long as these numbers are maintained this bird must prove a source of considerable loss to the farmer.

(iv.) The bullfinch and the blackbird in fruit-growing districts are most destructive, and cause great losses to growers. Both species demand drastic measures for their reduction.

Further instances might be quoted, but the above will suffice to show that definite and indisputable evidence can be obtained with reference to the feeding habits of any particular species of wild bird.

If the results obtained in investigations of this kind are to be of any practical value, the evidence must be thorough and overwhelming. Elsewhere [1] I have set forth in detail the procedure that is necessary in order to obtain this information, and nothing short of the greatest thoroughness and accuracy can lay claim to thoughtful consideration.

The statement is frequently made that notwithstanding a little harm that certain birds occasionally do at particular seasons of the year, as a class they are beneficial. If this be so, it seems to me most important that we should know which species are the culprits, the extent of the damage or loss they occasion, and the frequency with which they occur throughout the country, in order that so beneficial a class of animals should be rid of their "black sheep," and their fair repute remain impeccable.

Unfortunately such a statement is only partly true, and in the present state of our knowledge it cannot be denied or upheld upon practical evidence. This, at least, we do know: that many species of wild birds are protected that are distinctly injurious, in consequence of which hundreds of thousands of pounds' worth of food is annually destroyed by them; that there are many species of wild birds which are annually destroyed in large numbers, and that the food of these species has been proved to consist almost entirely of farm vermin, which latter exact an enormous toll upon the produce of the land; finally, that there are a number of species with reference to which we know comparatively very little as regards the nature of their food and feeding habits, and before they can be said to be beneficial, injurious, or neutral, much more detailed information is required.

At the present time farmers and fruit-growers throughout the land are indiscriminately destroying wild birds, so that a recent writer states: "Some of the very greatest friends that our nation has are being destroyed without mercy. . . . If the British Navy were threatened with destruction, a great cry would rise from the people, but only whispers are heard now and then about the slow destruction of a defensive force upon which most of our prosperity depends."

The hands of our legislators are tied, for, as I have elsewhere stated,[2] "the need of continued investigation upon a subject so intimately related to our food supply must be patent to even the most casual inquirer, for without a thoroughly reliable and extensive knowledge of the subject it is impossible to frame wise and beneficial laws relating thereto."

Hitherto the State has not thought the subject worthy of serious attention (if it has acted it has done so too late or inefficiently), but the exigencies of the present abnormal times may compel it to do so, and to rue that it has been so apathetic and neglectful of the subject in the past.

WALTER E. COLLINGE.

[1] Journ. Roy. Hort. Soc., 1917, xlii., part 1; and more briefly in NATURE, January 7, 1915.

[2] Journ. Roy. Hort. Soc., 1917, xlii., part 1.

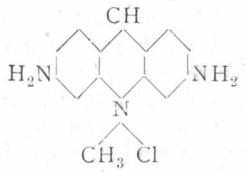
NEW ANTISEPTICS.

NOT the least important feature of the present war is the interest which has been concentrated on the effective treatment of septic wounds. Attention has already been directed (NATURE, February 10, 1916) to the use of the hypochlorite solutions of Dakin and Lorraine Smith, and to that of chloramine-T of Dakin, Cohen, Daufresne, and Kenyon. These substances, whilst they possess strong bactericidal properties, have little or no irritant or toxic action in antiseptic strength, and have in consequence found very general and successful application. The latest contribution to the subject, by Messrs. Browning, Kennaway, and Thornton, and Miss Gulbrausen, of the Bland-Sutton Institute of Pathology of the Middlesex Hospital, is embodied in a report to the Medical Research Committee. It was published in the *British Medical Journal* of January 20; and the daily papers have lately devoted attention to the subject.

The defects of most antiseptics lie in the fact that, whilst they act chemically on proteins and so destroy bacteria, they also affect the serum, which has itself powerful antiseptic properties. This probably explains the large reduction in bactericidal action of most antiseptics in presence of serum. Furthermore, most antiseptics inhibit phagocytosis and so deprive the body of one of its most important weapons in combating local infection. An ideal antiseptic should therefore combine powerful bactericidal action along with the absence of deleterious effect on phagocytosis or on the nature of the serum. It should further be without irritant or toxic action, whilst stimulating healthy granulation.

Among the substances which the authors have examined are a number of triphenylmethane dyes (malachite green, brilliant green, crystal violet, and ethyl violet) and the yellow colouring matter

known as flavine or diaminomethylacridinium chloride.



The latter was originally tried by Ehrlich on trypanosome infections, and was found to have a very marked therapeutic effect.

The authors claim that whereas the bactericidal action of flavine is stimulated by the presence of serum (*Staphylococcus aureus* is killed in dilution of 1 : 20,000 in water, but in 1 : 200,000 in serum), its power of inhibiting phagocytosis is not high, a concentration of 1 : 500, as compared with 1 : 625 for chloramine-T, 1 : 13 for eusol, and 1 : 9 for Dakin's solution, being required. For a true comparison, however, it is necessary to determine the relation of the bactericidal action (*i.e.* the minimum strength of solution required to kill the bacteria) to the phagocytosis action (*i.e.* the strength of antiseptic required to reduce the number of leucocytes to half that of the pure serum control), and this ratio, which the authors call the therapeutic coefficient, is much higher than that given by any of the older antiseptics or the dyes referred to. The irritating effect was compared by placing three or four drops of the solution on the conjunctiva (rabbit) for three minutes. Flavine produced no effect in a concentration of 1 : 200, mercuric chloride 1 : 500, and chloramine-T 1 : 25. It thus appears that though flavine does not compare very favourably with chloramine-T in its irritant action, or with the absolute values of the hypochlorites in phagocytosis, its interest appears to lie in its exceptional bactericidal properties, and more especially in the enhanced effect said to be produced by the presence of serum.

The value of the antiseptic seems to centre round this fact, and it will be interesting to learn what special property attaches to flavine whereby it is able to destroy bacteria, whilst not only leaving untouched, but materially activating the antiseptic properties of serum.

In summarising their results, the authors claim that flavine has been found to possess extremely powerful bactericidal and antiseptic properties, which are enhanced rather than diminished by admixture with serum; that in presence of serum flavine is the most potent bactericide of all those investigated for both Staphylococcus and *B. coli*, and it is equally efficient for the enterococcus and for anaerobes, such as *B. oedematis maligni*; that flavine, in relation to its bactericidal power, is very much less detrimental to the process of phagocytosis and less harmful to the tissues than the other substances; hence much higher effective concentrations can be employed without damaging the tissues or interfering with the natural defensive mechanisms. The clinical observations recorded by Dr. Ligat and others at the Middlesex Hospital are very encouraging, and hold out the promise of an extended use of the new antiseptic. It will now be necessary to find a means of supplying the antiseptic at a reasonable cost. J. B. C.

THE SCHOOL OF ORIENTAL STUDIES.

THE daily papers have given a full account of the formal opening, on February 23, of the new School of Oriental Studies in Finsbury Circus, and have reported Sir John Hewett's loyal address, the gracious reply of his Majesty the King, and Lord Curzon's speech describing the objects and ambitions of the school. A brief mention of an occasion so historic seems to be called for even in the pages of a scientific journal. We are interested in all sound and scientific teaching, and the teaching of Oriental languages may ultimately affect the progress of science in Asia and Africa.

It has been objected that the opening of a new and expensive school, costing 14,000*l.* a year, besides the expense of adding a fine block of classrooms to the old London Institution, was not very consistent with the economies which war has imposed upon us. The answer to this objection is easy and, indeed, obvious. The scheme to establish an Oriental school in London fitted to be a rival of the famous schools in Berlin, Petrograd, and Paris was set on foot ten years ago, and the funds now expended were promised or given before war broke out. Moreover, war has opened our eyes to the necessity of making an effort to compete vigorously with the activities—political, commercial, and even scientific and linguistic—of the Germans in Asia and Africa. We have discovered that their industry was rarely disinterested, and that political propaganda was too often at the root of "peaceful penetration" in the field of missionary, scientific, and linguistic effort.

Even if that were not the case, it was a reproach and a shame to us that our present enemies had all but secured a monopoly in Oriental learning. Our own Oriental scholars looked to Berlin for recognition, instruction, and aid. Many of them are justly proud of German honorary degrees conferred upon them at a time when Germans were admittedly at the head of the Indianists of the world. They pursued and rewarded not only the classical learning of the East, but the newer studies, ethnological and linguistic, which are scarcely known to our own universities. It was an Austrian priest, Pater Schmidt, who discovered that the speech of the Khasis in Assam, once supposed to be as unique and isolated as that of the Basques in Europe, in fact extends right across the Pacific Ocean to Easter Island. It was in Germany that all the best research was done, all the most learned periodicals printed. It was the Germans who inherited the tradition of Oriental learning set up by Sir William Jones. It was time that this monopoly should be contested.

It is to be hoped that the new school will act in concert with indigenous scholars in India.

Many of these are endeavouring to make the greater India languages fit vehicles for the imparting of scientific teaching. For example, the Vangiya Sahitya Parisat, a learned society in Calcutta, has for some fifteen years past been compiling a vocabulary of chemical and botanical terminology in the vernacular. This is a task in which the help of Western scholars is plainly required, lest there should be misunderstandings and overlapping of effort. So is it also in the field of comparative philology, in which native students are apt to ignore the acquisitions of Western scholarship.

Finally, H.M. the King was happily inspired in suggesting that the pupils of the school may hereafter be "teachers of unselfish government and civilised commerce." Scholarship and science should be disinterested, while commerce should be a loyal and friendly exchange to the benefit of both parties to the transaction. It was, once more, time that the great City of London should recognise that a sound and scientific knowledge of Asiatic and African languages, literary and other, is a necessary part of the extension of British influence in lands where our sole object is to improve the social and physical condition of races which have fallen behind our own standard of civilisation.

At the opening of the school the King was accompanied by the Queen and Princess Mary. On arriving at the school their Majesties were received by Lord and Lady Curzon and Sir John Hewett, chairman of the governing body. The opening ceremony took place in the library, where Sir John Hewett, addressing the King, said they took the King's presence as a sign that his Majesty was fully cognisant of the importance to the Empire of the study of Oriental and African languages and civilisations on a scale which Great Britain, alone among great countries of the world interested in the East, had not hitherto regarded as necessary; and they had planned that the school should be at least equal to the Oriental schools in foreign capitals, and adequate to Imperial needs.

The King, in the course of his reply, said: "I am glad to be the patron of the School of Oriental Studies, and it gives me particular gratification to take part to-day in the ceremony of opening this fine building in which the school is henceforth to carry on its work.

"I cannot sufficiently emphasise the wide scope and vast importance of that work. The school will afford fresh opportunities of study to those services which have been the pioneer of progress and the instrument of good government in India and Egypt. It will furnish with a fuller technical equipment the pioneers of commerce and industry who in each successive generation undertake the duty of upholding the honoured fame of British trade in the East. Its work will serve to develop the sympathy which already so happily exists between my subjects and those of my Far Eastern ally, Japan. But more than this is to be looked for from the school.

"If it happily succeeds in imparting to the pupils sent out as teachers of unselfish government and civilised commerce a clearer comprehension of the thoughts and lives of the diverse races of the East, the good effects of that success will extend far beyond the immediate and tangible results. The ancient literature and the art of India are of unique interest in the history of human endeavour. I look to the school to quicken public interest in the intellectual tradition of that great continent and to promote and assist the labours of the students in these departments of knowledge, to the mutual advantage of both countries."

After the termination of the proceedings their Majesties inspected the new school. They were accompanied by the Lord Mayor, Lord and Lady Curzon, Mr. H. A. L. Fisher, Sir John Hewett, Mr. P. J. Hartog, and Dr. Denison Ross, the director of the school.

GEORGE MASSEE.

MYCOLOGISTS in all parts of the world will learn with great regret of the death of Mr. G. Massee, which occurred at Sevenoaks, on February 17, after a brief illness. George Edward Massee was born at Scampston, in Yorkshire, about 1850, and at the age of ten was sent to school in York. He early showed a taste for drawing and natural history. At the York School of Art he gained the national medal for the year, and when about seventeen years old published a paper on woodpeckers in the *Intellectual Observer*. Later he studied botany under Spruce, a relative of his mother. It was intended that he should follow his father's steps as a farmer, but, always ready for adventure, he readily accepted Spruce's suggestion to visit the West Indies and South America. He travelled in both the eastern and western countries of that continent, and, in addition to making botanical collections, sent home living plants in bulk.

On his return Massee's artistic talent became further manifest through the publication of his drawings in Spruce's "Hepaticæ Amazonicæ et Andinæ." He took up teaching and returned to the study of botany, specialising in fungi and plant diseases. He also got into touch with the late Dr. M. C. Cooke, and after working as a volunteer at Kew for some years he succeeded Cooke in 1893 as head of the Cryptogamic Department of the Herbarium, a post which he held until his retirement in 1915.

Amongst his earlier volumes may be mentioned "British Fungi, Phycomycetes and Ustilagineæ" (1891), and "A Monograph of the Myxogastres" (1892). Between that year and 1895 four volumes of his "British Fungus Flora" were issued, the work remaining incomplete. The descriptions in this flora were detailed and comprehensive, and the book has proved indispensable to all British students.

Massee's serious pathological investigations began about 1895, and from that date until his retirement a continuous stream of contributions to this subject flowed from his pen. His "Text-book of Plant Diseases" (1899), in which he made a wise selection from the best work of others, was a really good and useful book, and had perhaps a higher reputation than any other. Its publication marked a distinct epoch in the history of plant pathology in this country. In his larger work, "Diseases of Cultivated Plants and Trees" (1910), many of the author's own views, not always

shared by others, are included. As a work of reference the later treatise is, however, unique and invaluable. In spite of his energies in the field of pathology, taxonomy still received attention, as is testified by the volumes, "European Agaricaceæ" (1902), "British Fungi and Lichens" (1911), and "British Mildews, Rusts, and Smuts" (1913). Massee was a fellow of the Linnean Society from 1895 to 1915. He was elected an associate in 1916. In 1902 he received the Victoria Medal of Horticulture of the Royal Horticultural Society.

Massee's talent as a systematist lay perhaps mostly in his genius for recognising the affinities of a fungus and his remarkable memory. He wrote fluently and forcibly, and being full of energy and industry, was therefore an extremely rapid worker. His artistic powers were quite exceptional, and his drawings, many of which were extraordinarily beautiful, were usually executed with astonishing rapidity. His power of recalling the precise appearance of individual specimens was so great that he could with the greatest ease portray from memory a whole series of Agarics or other fungi. As to detail he was impatient, his style being always bold and vivid. Massee was a remarkable personality. Quick, shrewd, and outspoken, he was misunderstood by some. Those who knew him well understood and appreciated him, and mourn the loss of an old and valued friend. A. D. C.

THE PROMOTION OF TECHNICAL OPTICS.

THE attention of all interested in the subject of technical optics, the importance of which we have emphasised repeatedly during the last few years, is directed to the subjoined valuable and interesting report, issued by the Board of Scientific Societies, having been approved by the Board on January 24. It will be recalled that the board was formed some time ago by the Royal Society after conferences with the learned and professional societies of the kingdom with the object of investigating scientific and technological problems arising out of the war. It is an additional testimony to the importance of the subject that this should be the first formal report issued by the board.

The committee upon whose labours the report is based was exceptionally well qualified to deal with its reference "to consider and report upon national instruction in technical optics." It comprised well-known representatives of the scientific, the industrial, and the educational aspects of optics, and included a high official of the Ministry of Munitions, which has had such good cause to realise thoroughly the disasters brought upon the nation by previous neglect.

The report is, we think advisedly at this stage, not overburdened with details, but deals with the matter in hand on broad lines, both as to the necessity for immediate action and the direction that action should take, but we are pleased to note that the "committee is willing," and, we assume, prepared, "to give further advice with respect to . . . matters connected with subjects referred to in the report."

The necessity for immediate action is emphasised in weighty sentences, especially in regard to the numerous scientific and industrial interests involved. The report asserts that "the next few years are the years which will determine the future of the [optical] industries of the country."

The actual recommendations for action are directed towards concentration and appear to focus on two points—the provision of the "man" and of the "home"—though other matters of outstanding importance are not overlooked. The first point can be dealt with without any great delay by the appointment of a "director," as he is provisionally termed, whose initial duty will be the organisation and direction of the whole of the teaching, and who, assisted by a qualified staff, should, from the start, be able to advise "the trade in any difficulties they may encounter" until "a sufficient supply of men thoroughly trained" can be evolved. But such an appointment involves an appointing body, and this the board proposes to set up in the form of an independent "supervising representative council," which, although it is sometimes referred to as an "advisory council," obviously must have executive powers and the control of funds, and, presumably, would be a statutory body, although the report does not say so. It is strongly advocated that the council should be independent of any existing institution or governing body, as dependence would seem "to perpetuate what . . . should only be a transitional stage." Similarly, the director should not be a member of the staff or responsible to the governing body of any existing institution.

One of the dangers which the board appears to anticipate in too close a connection with, say, the Imperial College is the tendency to allocate all higher research to the favoured college. But higher research in any subject, and not least in such a subject as optics, grows naturally out of opportunities and predilections in any suitable soil, and it would be a mistake to endeavour to confine it to any one college or institution, especially if the favoured place has already many wider and diverse interests in other directions. The recent history of research in this very subject illustrates the point. We need only refer to what has been accomplished by Prof. H. Jackson at King's College, London, by the University of Sheffield, and by the Glass Research Committee of the Institute of Chemistry. Such researches are essentially strongly individualistic and not made to order, whilst, for the organised research involved in the investigation of particular industrial problems, there is the National Physical Laboratory created for this very purpose.

The other point referred to above—the provision of a "home"—is regarded by the board as of vital importance, and to be proceeded with "as soon as the preliminary work of organisation permits."

Such a home, provided not only with lecture-rooms and laboratories, but also with meeting-places for societies, traders, and students, and especially with an adequate library, "would concentrate the efforts of all who are concerned with the manufacture or use of optical instruments." We have ourselves more than once advocated such a project, and it is to be hoped that those entrusted with the administration of the large public funds which are, and will be, we hope, more in the future, devoted to similar objects, will not, as in a scheme criticised in the report, take the line of least apparent resistance and relegate the establishment of an optical institute to the dim and distant future. Such a course would be, we assert, simply disastrous. It may not be inopportune to recall that the establishment of such an institute received, only a few months ago, the cordial approval of the present Prime Minister, who was doubtless influenced by his experience as Minister of Munitions.

Space does not permit us to dwell in detail on other valuable suggestions in the report, but there is one of great importance which may be mentioned in conclusion. We refer to the provision of suitable optical text-books, the translation, in the first instance, of suitable foreign books, and to the abstracting of important publications on technical optics.

NATIONAL INSTRUCTION IN TECHNICAL OPTICS.[1]

SEVERAL attempts have been made during recent years to provide systematic training in technical optics, and a scheme prepared by the London County Council will be referred to in this report. But, before discussing the details of any proposals, it is advisable to form a clear conception of the requirements of the optical trade, and of the organisation of the teaching best adapted to promote the interests of that trade without regard to existing conditions, which no doubt will place some difficulties in the way of the immediate adoption of a thorough-going and satisfactory scheme.

It is necessary at the outset to emphasise one point which is of vital importance. If a perfect organisation for instruction and research in optics could instantaneously be called into being, some years would necessarily elapse before the trade would appreciably benefit by it, because that trade requires above everything a sufficient supply of men thoroughly trained in the scientific principles underlying the proper construction of optical appliances. Such men are not obtainable at the present moment; they will have to be trained, and this requires time. But the next few years are the years which will determine the future of the industries of the country. To avoid a delay which might prove fatal, it is essential that provision should be made at once to give the trade such assistance and advice as will ultimately be supplied by the body of trained men which, it is hoped, will be available in a few years.

This leads us to our first recommendation. Whatever scheme be adopted, it is essential that it should include the appointment of a highly qualified scientific man, who will be charged with the organisation and direction of the whole of the teaching. This man, to whom we shall refer as the "director"—whatever title he may subsequently receive—ought to be appointed at once. Among the duties specially assigned to him in the preliminary period should be that of advising the trade in any difficulties they may encounter. A sufficient staff should be assigned to him for the purpose. The director should not be attached exclusively to any of the existing institutions.

A further need, which is urgent, is the supply of standard text-books dealing with those parts of optics which at present are greatly neglected in this country; this includes practically the whole of geometrical optics and a large part of technical optics. In our opinion, the quickest and most effective manner of dealing with this requirement is by publishing translations of existing foreign books and abstracts of important papers on the subject.

In defining the range of teaching to be provided, and forming an estimate of the number and type of the students who may avail themselves of the opportunities offered, we must keep in mind that the use of a knowledge of optics is not confined to those intending to enter the optical trade. The Army, the Navy, the Patent Office, and other Government departments employ optical experts. We are informed that the Royal Naval College habitually sends some of its ablest young officers to an optical firm, to be instructed in the principles and designs of range-finders, gun-sights, and other optical instruments. Medical men, bacteriologists, surveyors, and nautical men would also, in many cases, welcome instruction in special branches of optics. We may here refer to the School of Economics, an institution mainly devoted, as its name implies, to a highly specialised branch of knowledge, which derives its practical importance from its connection with matters affecting the welfare of the country. In these respects, it presents a certain analogy with the proposed school of optics. Experience in this case shows that the instruction given has attracted, from much wider circles than was originally contemplated, students desiring instruction in special departments of economics. It is, therefore, well not to take too narrow a view, but to look upon the practical application of optics as being one of the many points of contact between the industries and pure science. Any advance in its study will hence react beneficially on the advance of the science on which it is based.

We therefore look forward to the establishment of an optical institute which would concentrate the efforts of all who are concerned with the manufacture or use of optical instruments. It would bring together the several optical societies, which might find a home within its building; it would be the centre for the co-operation of the trade with students and teachers; it should contain a library with periodicals and books on optics.

The general direction of the courses of study should —as is the case in the scheme of the London County Council—be vested in an Advisory Council on which the trade, as well as the optical and learned societies, is represented. It has already been insisted upon that there should be a principal or director who is highly qualified on both the theoretical and the practical side, and who would be responsible to the Advisory Council. Full courses of instruction, in both day and evening classes, will be required. The day departments would consist mainly of youths between the ages of fifteen and twenty, who would receive general and technical instruction, including mathematics, physics, chemistry, and practical optical work.

The evening work would be adapted to the requirements—

(1) Of students engaged in the trade during the daytime;

(2) Of advanced students, some of whom would have

[1] Report approved by the Board of Scientific Societies of a Sub-Committee consisting of Mr. Conrad Beck, Mr. F. J. Cheshire, Mr. E. B. Knobel, Sir Philip Magnus, Prof. H. Jackson, and Prof. A. Schuster (chairman).

graduated in science, and would be preparing to occupy the position of managers in optical works;

(3) Of other persons interested in learning the scientific construction or use of optical instruments.

Provision should be made for research work not requiring a highly specialised or expensive plant. Special investigations might be referred to the National Physical Laboratory, or any other laboratory suitable for the purpose.

It is also worth considering whether a good journal or paper should not be published, devoted to scientific instruments and other matters concerned with optics.

We are aware of the difficulties which stand in the way of putting into immediate operation a scheme which would satisfy in a comprehensive manner all the above conditions. It will therefore be necessary to contemplate a transitional period leading up to what we ultimately hope to obtain.

In considering the provisional arrangements, regard must be had to the fact that already some very good work in the training of operatives of different classes is being done at the Northampton Polytechnic Institute, where a certain amount of modern machinery and apparatus has been provided, and young men and women are receiving useful training, the value of which has been recognised by the Government. We may also direct attention to the valuable research work being carried out in King's College, London, under the Glass Research Committee of the Institute of Chemistry. The instruction given at the Northampton Institute should, however, at once be supplemented by more advanced teaching in some convenient institution of university rank. Stress has already been laid on the immediate appointment of a principal or director, and there is no reason for delaying the formation of the Advisory Council. So soon as the preliminary work of organisation permits, plans should be prepared for a new building, which, in our opinion, is essential.

The scheme of the London County Council represents a carefully considered attempt to utilise and extend the teaching given in existing institutions, and to reconcile conflicting interests. Its object is, therefore, the same as that which we contemplate in the transitional period, and in its main features it seems to differ little from our proposals. It is not with the object of making any captious criticism, but merely to prevent possible misunderstanding, that we desire to point out what seem to us to be serious defects in the details of the scheme.

It is provided that the Imperial College of Science should institute a separate Department of Technical Optics, with a head who is also to exercise some undefined powers of general supervision over the whole scheme. Being a member of the staff of the Imperial College, he would presumably be appointed by the governing body of that institution, and primarily be responsible to it. He would have at the same time powers over the course of instruction at another institution that had no voice in his appointment. His relationship to the Advisory Council is not defined, and the proposal in its present form does not seem to us to be conducive to harmonious working. It also seems to perpetuate what, in our opinion, should only be a transitional stage. Our own proposal contemplates that the appointment of the Director of Studies should be primarily vested in whatever body is constituted as the main governing body.

Another fundamental defect of the scheme is implied in the wording defining the distribution of the work between the Imperial College and the Northampton Institute. Stress appears to be laid on post-graduate work conducted at the Imperial College, and research work is confined to that institution. If it be meant that the normal course of instruction should begin with a degree course in pure science, and the higher technical teaching should only begin after such a course is completed, we must express our dissent from that view. There may be some cases, no doubt, where a graduate in science will turn his mind towards technical optics, and provision should be made for him; but the centre of gravity of the institution must be a course extending over two or three years, in which teaching in science is, *ab initio*, directed towards the necessities of its optical applications. As regards research work, the teachers in any institution which may be built, or during the transitional period at the Northampton Institute, should be of sufficient standing to be able to conduct research work, and though no expensive or elaborate plant need be supplied, and such research work need not form a prominent part of the activity of the institute, it is not advisable to lay down any hard-and-fast lines as to where researches are to be carried out. Special investigations, as has already been said, will probably be largely concentrated at the National Physical Laboratory, but they also should not necessarily be confined to any one place.

In conclusion, we may sum up the requirements which appear to us to require immediate attention:—

(1) The appointment of a supervising representative council.

(2) The appointment, under the proposed supervising council, of an administrating director, with special duties during the transitional period, which will include advice to the trade and the organisation of the different parts of the curriculum.

(3) The translation of suitable works and the abstracting of other important publications on technical optics.

(4) Pending the erection of a suitable building, the organisation of day and evening courses at the Northampton Institute, and arrangements for higher instruction at some other institution of university rank.

The term "technical optics" throughout the report is intended to include the chemical composition and manufacture of glass

The committee is willing to give further advice with respect to the selection of books for translating or abstracting, and any other matters connected with subjects referred to in the report.

NOTES.

WE notice with much regret the announcement of the death, at seventy-four years of age, of Prof. J. G. Darboux, permanent secretary of the Paris Academy of Sciences, professor of higher geometry at the Sorbonne, and a foreign member of the Royal Society.

THE following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society: Dr. J. H. Ashworth, Mr. L. Bairstow, Prof. G. A. J. Cole, Mr. C. F. Cross, Dr. H. D. Dakin, Prof. A. S. Eve, Prof. H. Jackson, Prof. J. S. Macdonald, Prof. J. W. Nicholson, Dr. R. H. Pickard, Mr. C. T. Regan, Dr. R. Robertson, Dr. E. J. Russell, Mr. S. G. Shattock, and Prof. F. E. Weiss.

THE *Times* announces the death, on February 24, of Prof. Jules Courmont, professor of hygiene and deputy doyen of Lyons University.

MR. W. H. H. JESSOP, senior ophthalmic surgeon to St. Bartholomew's Hospital and president of the Ophthalmological Society of the United Kingdom, died on February 16 at the age of sixty-four. In 1885, soon

after the introduction of cocaine by Koller, he investigated the action of this drug upon the eye. He devoted himself chiefly to the clinical side of his subject, and with great success. He was a member of several foreign ophthalmological societies and a constant visitor to international congresses. In this manner he became well known amongst Continental ophthalmic surgeons, and they were always made welcome as his guests. At the time of his death he was engaged upon two very important projects. The foundation of a really representative *British Journal of Ophthalmology* has already been successfully accomplished, chiefly as the result of his energy and enthusiasm. He was also actively promoting the affiliation of certain provincial ophthalmic societies with the London Society. Mr. Jessop was a lover of the arts, and his collection of Whistler prints is unique.

BY the death, in his seventieth year, of Dr. J. F. Fleet, India has lost one of the most learned members of the Civil Service. At an early period of his career in the Bombay Presidency he acquired a profound knowledge of Sanskrit and of the local dialects, particularly of the ancient Kanarese. His most important work, published in 1888, was vol. iii. of the "Corpus Inscriptionum Indicarum," in which, for the first time, the chronology of the Gupta period, one of the most difficult problems in the history of ancient India, was finally settled. Besides numerous papers in scientific journals, he contributed the article on epigraphy to the last edition of the "Imperial Gazetteer of India," and those on "Hindu Chronology" and "Indian Inscriptions" to the eleventh edition of the "Encyclopædia Britannica." He also engaged in the controversy, not yet finally settled, on the date of the Kushan Emperor Kanishka.

BY the death of Mr. R. H. Tiddeman on February 20, we have lost a field geologist of long experience and rare sagacity. Born on February 11, 1842, he was appointed by Sir R. Murchison an assistant geologist on the Geological Survey of the United Kingdom in 1864. He was promoted to geologist in 1870, and retired in 1902. For more than twenty years Tiddeman was engaged in surveying the Carboniferous rocks of Westmorland, Lancashire, and Yorkshire, and during this period he made the observations which enabled him to lay before the Geological Society in 1872 a classic paper of far-reaching consequence on the evidence for an ice-sheet in those counties. Later on he was temporarily engaged in North Wales, where he determined the Carboniferous age of some red rocks in the Vale of Clwyd, which had previously been regarded as Trias. From 1895 until his retirement he assisted in surveying the southern part of Glamorganshire. He was author of the Geological Survey memoir on the water-supply of Oxfordshire, a task for which his residence at Oxford after his retirement proved convenient, and was editor and in part author of the memoir on the Burnley coalfield. Contributions were furnished by him to upwards of nine other memoirs dealing with the north-west of England and North and South Wales. In his unofficial work his investigations in the Victoria Cave, and his philosophic work on reef-knolls and succession of episodes in the Carboniferous limestone, take first place. His views on the relative age of the deposits of the Victoria Cave and the Boulder Clay were long in receiving the appreciation due to them. In 1911, partly in consideration of his long record of useful work, but especially in recognition of his observations on the fauna and structures of reef-knolls, he was awarded the Murchison medal. He was elected president of the Yorkshire Geological Society in 1914, and served on the council of the Geological Society of London in 1905–10. He leaves a widow and two daughters.

THE Minister of Munitions, after consultation with the Admiralty and the Home Office, has appointed two committees—an owners' committee and a workmen's committee—to deal with certain problems connected with the Scottish shale industry. Prof. John Cadman will represent the Ministry, and will act as chairman of the two committees when they meet in joint session. Sir George Beilby has been appointed to act as technical adviser, and Mr. Hugh Johnstone will be a member of the committee and act as secretary.

THE annual general meeting of the Institute of Metals is to be held on Wednesday, March 21, and Thursday, March 22, in the rooms of the Chemical Society. The meeting on the Wednesday will commence at 8 p.m. and that on Thursday at 4.30 p.m. A special feature of the meeting will be a general discussion on metal melting, over which the president of the institute, Sir George Beilby, the head of the new Government Board of Fuel Research, will preside. The seventh annual May lecture of the institute will be given at the Institution of Civil Engineers, Great George Street, Westminster, on May 3, at 8.30 p.m., by Prof. W. E. Dalby, on "Researches made Possible by the Autographic Load-Extension Optical Indicator."

AN important programme of mining development is being undertaken by the Duchy of Cornwall, the principal object being the recovery of wolfram. This mineral is at present in great demand for the production of tungsten, a metal which constitutes from 18 to 20 per cent. of the modern high-speed cutting tool. The scene of the operations is on the extreme eastern edge of Cornwall, a few miles to the west of Tavistock, and the work on which the Duchy is engaged falls into three parts. The first is at Kit Hill, which forms the westerly part of Hingston Down, and rises nearly 1100 ft. above sea-level. Here a cutting is being driven north and south across the surface of the hill. For the greater part of the course it runs through granite, and in this section it has cut through a number of promising lodes of wolfram and tin. These lodes, which run roughly east and west, are vertical, and contain a varying number of veins of mineral. The largest disclosed so far is about 20 ft. wide. The second area on which the Duchy authorities are working is further east on Hingston Down. At the Plantation shaft a considerable quantity of wolfram has been blocked out, and work is to be pressed forward vigorously. The third part of the enterprise is represented by the mine and ore-dressing works at Gunnislake Clitters, situated on a steep bank beside the river Tamar, a mile or so from the Hingston Down Mines. Work will be resumed on the mine in due course, but at present attention is being paid to the remodelling of the mill, which stopped work in 1909, being idle until recently, and consequently deteriorated.

THE extent to which aluminium, which thirty years ago was merely a scientific curiosity, has become a war metal of the first importance is well illustrated by a recent order made by the Minister of Munitions under the Defence of the Realm Acts and the Munitions Acts, requiring that all persons shall in the first seven days of each month, beginning in March, send in to the Director of Materials, Hotel Victoria, S.W., monthly returns of all aluminium (*a*) held by them in stock or otherwise under their control on the last day of the preceding month; (*b*) purchased or sold by them for future delivery and not yet delivered on such last day; (*c*) delivered to

them during the preceding month; (*d*) scrap or swarf produced by them. No return, however, is required from any person whose total stock of aluminium in hand, and on order for future delivery to him, has not at any time during the preceding month exceeded 56 lb. The variety of uses in which aluminium now finds application is shown by the fact that for the purpose of the order the expression includes ingots, notched bars, slabs, billets, bars, rods, tubes, wire, strand, cable, plates, sheets, circles, and strip. The Air Service claims in one way or another at the present time the bulk of the aluminium production. It is interesting to note, as a temporary phase of the disturbances caused by the war, that a number of aluminium transmission lines were taken down in the latter part of 1915 and replaced by copper.

MR. G. F. HILL contributes to vol. xxxvi., part ii., of the Journal of the Hellenic Society, 1916, an elaborate paper on Apollo and St. Michael. He finds a parallelism between them as destroyers of an evil principle, as light controlling darkness, as the controlling agency of plague. Incidentally, he protests against the common view that the worship of saints is always a mere relic of paganism. There is no doubt that the medieval or modern worship is often engrafted on an old pagan stock, and the choice of the stock may have been assisted by some likeness of name or other association. "But the fact that we must not lose sight of is that, even had the pagan worship never existed, medieval Christianity was perfectly capable of inventing its own cults and legends."

THE Journal of the Bihar and Orissa Research Society is doing excellent work in examining the manners and customs of the forest tribes of the province. In vol. ii., part iii., the Santals, with their peculiar marriage customs, receive special attention. Among them, according to the Rev. P. O. Bodding, "the original, and even now theoretically accepted, idea of woman seems to be that she is a kind of irresponsible and untrustworthy being, a necessary and useful, but somewhat inferior, member of human society." The Birhors, according to Mr. Sarat Chandra Roy, have an elaborate totemistic system, one peculiar feature of which is the belief in the magical power of certain clans over wind and rain. But the tribe is not at the present day organised, like the Arunta, as a co-operative supply association, composed of groups of magicians, each group charged with the management of particular departments of Nature. Birhor totemism has little influence on the growth of their religion, but its most noteworthy feature appears to be the belief in the vital connection between the human clan, their totem, the hill which is reputed to have been their original home, and the presiding spirit of this hill.

THE Annals of Tropical Medicine and Parasitology for February (vol. x., No. 4) contains two lengthy papers on intestinal protozoa. The first, by Messrs. Malins Smith and Matthews, deals with these organisms in 250 non-dysenteric cases, of whom twenty were found to be carriers of the dysenteric amœba. The second, by the same observers, together with Mr. H. F. Carter and Dr. Doris Mackinnon, discusses the protozoal findings in 910 cases of dysentery examined at the Liverpool School of Tropical Medicine, of whom 410 were found to have protozoal infections. Of these, ninety-four were infected with the dysentery amœba, 231 with the non-pathogenic *Entamoeba coli*, and 207 with other protozoa. In some of the cases double and triple infections existed.

MR. E. E. LOWE, the hon. secretary of the Museums Association, has for some time past been endeavouring to induce glass manufacturers in this country to take up the production of rectangular glass jars, such as are used in museums and other scientific institutions, since these have hitherto been made in Germany. The results of his labours in this good cause, which have been by no means light, he gives in the *Museums Journal* for February. Messrs. Baird and Tatlock alone have responded to the invitation to supply our needs in this direction. This they have been induced to do as the result of undertakings secured by Mr. Lowe from institutions in this country, India, and America. France, South Africa, and Australia will also, it seems, be glad to turn to this country for their needs in this regard, so that the demand for jars of this description should justify the initial outlay in the matter of making the moulds, the high cost of which has served as a deterrent with other manufacturers. To save this trade from falling again into the hands of the Germans it is to be hoped that all institutions using these jars will, as soon as possible, place orders with Messrs. Baird and Tatlock to encourage them in their venture.

IN a pamphlet entitled "The High Price of Sugar and How to Reduce It" (London: Bale, Sons and Danielsson, Ltd.; 1s. net) Mr. Hamel Smith, editor of *Tropical Life*, directs attention to one of the results of our failure to think out and put into operation in normal times an Imperial scheme for providing necessary supplies of food. There was perhaps some excuse for our failure to encourage the production of corn and meat in this country, but there was none for our neglect to stimulate the production of such materials as sugar in our tropical possessions before the war. The fact of our dependence on foreign countries for sugar was notorious long before the war, yet practically nothing was done, nor apparently is anything of great importance being now done, to alter this state of things. Almost everywhere throughout the Empire where sugar is grown the yields are low, the chief causes being failure to grow the best canes available, neglect of intensive cultivation, and adherence to obsolete methods of manufacture. Perhaps the most notorious case is that of India, which, with 2,500,000 acres under sugar-cane, is able to produce only 2,600,000 tons of inferior cane-sugar, an average production of about one ton per acre, against a production of about four tons per acre in Java and nine tons per acre in Hawaii. Mr. Smith's proposals briefly are that the improvement of cane cultivation and of sugar-cane manufacture should receive immediate attention from the Imperial, Colonial, and Indian Governments, and he shows that we could without difficulty produce within the Empire all the sugar we require and have a considerable surplus for export.

IN a paper published by the Commonwealth Bureau of Meteorology (Bulletin No. 14) Dr. Griffith Taylor makes a contribution on somewhat novel lines to the much-debated question of acclimatisation. The paper, which is entitled "The Control of Settlement by Humidity and Temperature," discusses the limits of comfortable settlement for the white races. This, Dr. Taylor maintains, is decided mainly by the humidity and wet-bulb temperature. Other elements are rainfall and wind velocity, but as the present investigation deals with colonisation from the point of view of comfort rather than from that of wealth, the influence of rainfall has been omitted. Dr. Taylor has drawn a graph with the twelve monthly means of wet-bulb temperatures and relative humidity at a given place plotted as a twelve-sided polygon, with wet-bulb ordinates and humidity abscissæ. This he terms a climograph. In height and area the climograph shows the range of

temperature. In order to find the typical white climograph the author takes five towns in the southern, and seven in the northern, hemisphere, where white energy appears at its highest development. The resulting figure he uses as a criterion in all the climograph charts. He then takes Herbertson's natural region and draws a typical climograph for each, which in every case is compared with the white climograph. Applying the results more particularly to Australia, Dr. Taylor confirms the generally accepted opinion that the hinterlands of tropical Australia can develop only on pastoral lines, and that the coast lands of the north are useless for white settlement. The paper is a valuable scientific reply to the advocates of a white Australia.

METEOROLOGICAL information of a varied character is given in the Quarterly Journal of the Royal Meteorological Society for January. Among the papers communicated are "A Meteorologist in China," by C. E. P. Brooks; "Discontinuities in Meteorological Phenomena," by Prof. H. H. Turner; and a lucid communication by Sir Napier Shaw, director of the Meteorological Office, on "Meteorology for Schools and Colleges"; also a communication on "The Measurement of Rainfall Duration," by Carle Salter, assistant-director, British Rainfall Organisation. Records from self-recording gauges for fifty-eight stations scattered over the United Kingdom are as yet obtainable. Many of the records are for a short period, for a year or two only, and the recording gauges are of various patterns. The author acknowledges that many difficulties have to be contended with and he hints that possibly a standard type of recording instrument may eventually have to be insisted on, in the same way as in official sunshine returns. Mr. Salter has done good work in dealing with the method and preliminary difficulties encountered. A discussion on "The Forms of Clouds," by Capt. C. J. P. Cave, R.E., is of considerable interest. The paper is illustrated with beautiful photographs of the forms of cloud, and the author explains the different forms, and combats freely the forms suggested by many earlier writers on the subject. Much information is given on the different layers of air and the measurements of the heights of clouds. This cloud paper is in many ways suggestive to the would-be observer.

WE have received from Messrs. Flatters and Garnett, Ltd., Oxford Road, Manchester, a specimen of their cedarwood oil for use with oil-immersion microscopic objectives. As the result of tests we find that the oil is of good consistence and colour, does not become cloudy in cold weather, and has a high refractive index. The refractive index is stated to be 1·510, but that of the specimen sent to us was well above this, viz. 1·518. Immersion oil has hitherto been supplied from the Continent, and we are glad to direct attention to this British-made oil, which seems to fulfil every requirement. It is supplied in bottles at from 9*d*. to 4*s*. each, or in bulk.

THE sixth part of vol. v. of the Transactions of the Royal Society of South Africa contains a paper by Prof. J. C. Beattie, of Cape Town, in which are embodied the whole of the determinations of the deviation of the compass from true north and of the magnetic dip at 667 stations in South Africa. The two large maps show that the lines of equal deviation run across the country from north-west to south-east, the greatest deviation—27° to the west—occurring at the south-western corner of the country near Cape Town, and the least—14° west—at Beira. The lines of equal dip run from south-west to north-east in the south-eastern portion of the country, and show a tendency to run more nearly east and west in the northern districts. The dip is nearly 63° south in the south-east near East London, and diminishes to 52° south in the neighbourhood of the Victoria Falls in lat. 18° south. During the last ten years the deviation to the west has decreased a degree and a half to two degrees, while the dip has increased by a degree or a degree and a half.

PROF. MACMILLAN BROWN, in a recent number of the *Press* of New Zealand, discusses the appearance and disappearance of islands amid the western insular fringe of the Pacific. He recognises two curves of vulcanism, an outer, extending from the Aleutian Islands to Malay and New Zealand, and an inner, passing through the Marianne, Caroline, Gilbert, Ellice, Samoa, Tahiti, and Paumotu archipelagos to Easter Island. The outer curve lies off the enclosing continental shelf of the ocean, while the inner curve is parallel with the trend of the ancient continental shelf. The "main longitudinal crescent of vulcanism" has shifted from the inner to the outer curve, and with this shifting much archipelagic land between the two curves has disappeared. The main interest of the theory lies in the suggestion that this shifting has taken place in human times. The elevation of Rota in the N. Mariannes is dated to the Japanese Bronze age, 4000 years ago, by bronze bosses in the elevated coral. Ocean Island has risen and sunk several times, and in a previous elevation was inhabited by Polynesians, who made the regular Maori ovens. Ponape is supposed to have been a central point in a large archipelago with a great population. A considerable forest area with a dense population is required to account for the megaliths of Easter Island. In any case, those who speculate on migration routes must not assume as their basis the same areas and distribution of land in the Western Pacific as now exists. Prof. Brown, if the subsidence theory of atoll formation (which he assumes to be the only applicable theory) is applicable to the Western Pacific, must find much further and more direct evidence of those great archipelagos which he postulates as existing such a short time ago in what are now deep oceans with comparatively level beds. Existing coral formations do not point to the former existence of great islands. The animals and plants of still existing high lands should be more varied in genera and species if such lands were formerly parts of considerable archipelagos.

THE new technical journal, *Air*, does not appear to be a great innovation, judging from No. 3, which is in our hands. There is, however, in this number, one interesting article by Mr. E. A. Sperry, on "Aerial Navigation over Water," which describes very clearly and simply the methods which are in use for measuring the wind-drift of an aeroplane moving over the earth, and the various ways in which the pilot can obtain information as to his actual direction of flight relative to the earth. The construction and use of the drift indicator are explained; and the way in which the direction and velocity of motion of wave crests, and their distance from crest to crest, can be used to afford information as to the flight path is clearly dealt with. Another article, on "The Fundamental Equations of an Aeroplane," succeeds, after three pages of involved argument, in arriving at a simple aerodynamic conclusion which could be stated in as many lines. The reasoning reads as if the main object had been to make an exceedingly simple argument look as complicated as possible.

THE youthful Society of Glass Technology has begun its career with every indication of a vigorous and useful future. At the meeting on January 18, held at Leeds, two papers were read on the subject of British glass sands. The first, by Dr. P. G. H. Boswell, on "British Sands: their Location and Characteristics," dealt with the chemical, mechanical, and mineral analysis of sands. The author stated that the analysis of British sands had proved their value. The proof of the pudding, however, is in the eating, and Mr. C. J. Peddle, in the second paper, "British Glass Sands: the Substitution of Foreign Sands by British Sands for High-grade Glass-making," demonstrated by actual melts made from native sands what could be done with the material. A good glass sand should attain the requisite degree of purity; it should be evenly graded, and the grains should be angular; consignments should not vary in character and should be ready for use when they reach the manufacturer. The author pointed out that all these essentials are fulfilled by Fontainebleau sand, but not all by British sand as at present supplied. That some British sands compare favourably with those of Fontainebleau as regards purity and grading has been established by the author, whose results in general were in agreement with those of Dr. Boswell. Much depends upon the treatment of the sand for the market. Excellent results were obtainable with properly prepared British sands, as was shown by the samples of glasses made from them, some of which could not be distinguished from similar melts made from Fontainebleau sand. The question of transport charges is one which closely affects the home sand industry; in the past, on account of through rates for carriage, foreign sands have frequently been delivered at the works at a lower cost than it was possible to supply the British material.

WE have received from the Cambridge Scientific Instrument Co., Ltd., a new list of their resistance pyrometers for indicating or recording temperatures from −200° to 1200° C. They all depend on the platinum thermometer, of which four types suitable for different purposes are figured and described. The temperature is shown either on a Whipple indicator or on a Callendar recorder. A sample chart shows a continuous record of the temperature of a hot blast in an ironworks during twenty-five hours. The information given is sufficient to enable anyone with an elementary knowledge of electricity to set up and understand the working of the instruments.

MESSRS. HENRY HOLT AND CO. (New York) are publishing very shortly new and revised editions of Prof. A. L. Kimball's "College Text-book of Physics" and Prof. Martin's "The Human Body: Advanced Course."

THE new list of announcements of Messrs. John Wiley and Sons, Inc. (New York) (London: Messrs. Chapman and Hall, Ltd.) includes: "The Sun's Radiation and other Solar Phenomena," F. H. Bigelow; "Interior Wiring and Systems for Electric Light and Power Service," A. L. Cook; "Irrigation Works Constructed by the United States Government," A. P. Davis; "Bio-Chemical Catalysts," J. Effront (being vol. ii. of "Enzymes and their Applications"), translated by Prof. S. C. Prescott; "Microscopic Examination of Steel," Prof. H. Fay; "Fats and Fatty Degeneration," Prof. M. H. Fischer and Dr. M. O. Hooper; "Agricultural Chemistry," Prof. T. E. Keitt; "The Essentials of American Timber Law," J. P. Kinney; "Elements of Hydrology," Prof. A. F. Meyer; "A German-English Dictionary for Chemists," Dr. A. M. Patterson; "Mechanical Equipment of Buildings"—part ii., "Power Plants and Refrigeration," L. A. Harding and Prof. A. C. Willard; "Printing: A Text-book for Printers, Apprentices, Continuation Classes in Printing, and General Use in Schools and Colleges," F. S. Henry; "The Efficient Purchase and Utilization of Mine Supplies," H. N. Stronck and J. R. Billyard; "Stresses in Structural Steel Angles," Prof. L. A. Waterbury; "Sanitation Practically Applied," H. B. Wood; and "French Forests and Forestry," T. S. Woolsey, jun.

THE classified list of second-hand instruments for sale or hire, just received from Messrs. C. Baker, 244 High Holborn, London, includes particulars of hundreds of microscopes, surveying and drawing instruments, telescopes, spectroscopes, optical lanterns, and other apparatus and accessories. The list is well arranged, and should be of real service to intending purchasers of second-hand optical instruments.

OUR ASTRONOMICAL COLUMN.

DETERMINATION OF STAR COLOURS.—An expeditious photographic method of investigating the colour-indices of stars has been tested by Mr. F. H. Seares at Mt. Wilson (Proc. Nat. Acad. Sci., vol. iii., p. 29). The method consists of making a series of exposures with graduated exposure-times, first through a yellow filter and then without filter. In this way the ratio of exposure-times necessary to give images of the same size in yellow and blue light is determined. The colour-indices are then derived by reference to a curve showing similar ratios for standard polar stars, the colours of which have already been ascertained by a comparison of their photographic and visual magnitudes. In general, the method of exposure-ratios gives excellent results, showing no systematic errors of any importance which depend upon stellar magnitude. The probable error of a colour-index derived from a single exposure-ratio is 0·07 magnitude. The method would appear to be of special value on account of its independence of stellar magnitude, and because it gives a direct measure of the colour. The results obviously include that part of the colour which is a function of the star's intrinsic luminosity, and also such colour effect as may be due to the scattering of light in space. An interesting outcome of the new observations is the confirmation of the previously reported conclusion that there are no faint white stars in the vicinity of the pole, though this is apparently not true of all parts of the sky.

MANCHESTER ASTRONOMICAL SOCIETY.—It is gratifying to note that the activity of the Manchester Astronomical Society has been well maintained. The journal for the session 1915–16 indicates a membership of about 120, and an average attendance at the meetings of forty-seven, while no fewer than eighteen members contributed papers relating to their own observations. A summary of the proceedings is given, and the papers printed at length include "The Colours and Spectra of the Stars," by Father Cortie; "Satellite Systems," by Prof. R. A. Sampson; and "Astronomical Drawings," by W. Porthouse.

CANADIAN OBSERVER'S HANDBOOK.—The Royal Astronomical Society of Canada renders a valuable service to amateur astronomers in the Dominion by the annual issue of "The Observer's Handbook." The volume for 1917 includes the usual astronomical information in a convenient form, and an extensive set of tables by means of which the times of sunrise and sunset in any part of the country can very readily be determined. Another feature calling for special mention is a catalogue giving the chief known facts regarding 276 stars and 13 nebulæ, including proper motion, parallax, spectral type, and radial velocity. There is also a simple guide to the constellations, with maps. The price of the handbook is 25 cents.

EDUCATIONAL REFORM.

MR. H. A. L. FISHER, the new President of the Board of Education, has not wasted much time in submitting his proposals for educational reform to the Cabinet, with a view to immediate legislation. The most urgent and necessary demand is that the compulsory school age for the children of the elementary schools shall be made effective until the age of fourteen at least is reached, and that all exemptions permitting the child to escape from school before that age shall be abolished. One of the greatest impediments in the way of this long-needed reform is to be found in the half-time system which prevails almost entirely in the well-paid textile districts of Lancashire and Yorkshire, to the abolition of which, despite the pleadings of trade-union leaders and of the Workers' Educational Association, the majority of the workers and even some employers are steadily opposed. It is a case where the Government ought to ignore merely political considerations in the best interests of the child and of the nation as a whole, and take a strong lead. Those concerned with this vital reform must either convert their constituents or urge the Government to immediate and drastic action.

The question of the number and efficiency of the male teaching staff of the elementary schools is scarcely less significant and urgent, especially as there would be a very large accession to the number and quality of the pupils if all exemptions were abolished and the compulsory school age raised to fourteen, thereby retaining in the schools the cleverer pupils, who by reason of their ability have hitherto been allowed to leave school at an earlier age than the average scholar. Such children, where they are boys, will need as they approach adolescence more of the experience and control of the trained male teacher, whose numbers, if the schools are to be maintained effectively, must be materially increased.

But to secure such a body of trained and educated men (and the estimated number required is not nearly sufficient, especially if the size of the classes be largely reduced, as it should be), the attractions of the profession, alike in respect of status, salary, prospects, and pension, must be greatly improved. The measures above mentioned will inevitably result in a demand for a better quality of teaching and of education for the scholars, and will react favourably upon the secondary school and its work, inducing a larger number at an earlier age to seek its advantages. These changes will require a much larger expenditure; now is the time to embark upon it, and it is to be hoped that Mr. Fisher, with his wide educational experience and authority, may be able to induce his colleagues to view them with sympathy and Parliament to give them immediate effect.

PRODUCTION OF IRON AND STEEL IN CANADA.

THE Canadian Department of Mines has issued the usual advance chapter of the annual report dealing with the production of iron and steel in the Dominion in 1915, and simultaneously an approximate estimate of the production of iron, steel, and coal in 1916. It appears from these statistics that the output of iron and steel has increased considerably in both years. The total production of pig-iron for 1916 is given as 1,046,185 long tons, as against 815,870 long tons in 1915, and 699,256 long tons in 1914, the pre-war level being thus exceeded. The steel production for 1916 is also the highest on record, namely, 1,270,969 long tons of ingots and 27,356 long tons of direct castings, as against 876,591 long tons of ingots and 27,739 long tons of direct castings in 1915. It is very interesting to note that in 1916 no fewer than 39,098 tons of steel were produced in the electric furnace, as against 61 tons in 1915, so that this new process has made important advances, and appears to have found a permanent footing in Canada. A noteworthy feature of Canadian steel manufacture is the large proportion of old scrap that is worked up, this amounting to about 55 per cent. of the pig-iron charged. The ores used in the manufacture of pig-iron in 1915 were 293,305 short tons of native ore, which, together with 623,094 short tons of Lake Superior ore, imported from the United States, were smelted in the province of Ontario, almost wholly with coke imported also from the United States; practically all the balance of the pig-iron was produced in Nova Scotia from Wabana ore, imported from Newfoundland, the imports amounting to 802,128 short tons.

The coal production of Canada for 1916 is given as 14,365,000 short tons, as against 13,267,023 short tons in 1915. The main increase comes from Alberta, being there about one million tons; British Columbia shows an increase of about half a million tons, and Nova Scotia a decrease of practically the same amount.

THE "SEI" WHALE.[1]

THE profusely illustrated monograph before us is the second of a series, the first of which dealt with the Californian grey whale, *Rhachianectes glaucus*. In the same thorough way that he initiated in describing Rhachianectes Mr. R. S. Andrews now deals with the rorqual, *Balaenoptera borealis*. The result of his work is a much larger volume, which is due, first, to the greater mass of information which has accumulated concerning the better-known *Balaenoptera borealis*, and in the second place to an appendix in which Mr. Schulte publishes the data acquired by the investigation of a young fœtus of this whale. The two sections are approximately equal in length.

The author uses throughout the vernacular name for the whale which is common among the Norwegians, slightly anglicising it from "Sejhval" to "Sei Whale." This, he maintains, and with justice, is less cumbrous than the really pseudo-vernacular term of "Rudolphi's Rorqual," which finds a place in so many English treatises and memoirs. The origin of the Norwegian whalers' name is derived from the fact that this rorqual, formerly at any rate, arrived upon the coast of Finmark in company with the "coalfish," known to the fishermen as "Seje." From this it will be rightly inferred that the fishery of this whale is prominently a Norwegian industry, and Dr. Andrews takes occasion to deal very fully with the late and well-known Norwegian naturalist, Dr. Collett's exhaustive memoir upon this whale in its various aspects, scientific and industrial; this memoir was published some years ago in the Proceedings of the Zoological Society of London. Dr. Andrews himself acquired most of his first-hand knowledge of *Balaenoptera borealis* at the Japanese fisheries, most of which stations he would seem to have visited.

A comparison of the careful work done at these two regions, so far separated from each other, leads Dr. Andrews to the conclusion accepted to-day by, as we imagine, most persons: that this whale, like so many others, has a vast range in space, and that the occurrence of a given whale in areas so remote mutually

[1] "Monographs of the Pacific Cetacea." By R. S. Andrews. II. "The Sei Whale (*Balaenoptera borealis*, Lesson)." Mem. Amer. Mus. Nat. Hist., n.s., vol. i.

as the eastern Atlantic and the western Pacific is by no means evidence of specific distinctness. The list of synonyms of this whale—and indeed of most—is a proof of the existence of an earlier opinion, promulgated by Dr. J. E. Gray and others of his time, that whales were coped within much narrower boundaries than we now think. To the solution of this question Dr. Andrews has added a number of facts; he has dwelt upon the colour variability, which he declares to be "enormous," and not at all influenced by age or sex. He has furthermore made the important observation that parasites taken from whales killed near Japan are at times infested with parasites representing an Antarctic species, which they must have acquired during a soiourn in those southern seas. The parasite in question is the Copepod, *Penella antarctica*.

A short time ago an alleged new species of Ballænoptera admittedly near to *B. borealis*, and named *B. brydei*, was described from the Cape region in a paper published by the Zoological Society. Dr. Andrews carefully considers this whale, and is disinclined to believe in its distinctness, but considers the matter incapable of settlement until more information concerning structure is received; but with this possible exception, and that of *B. edeni*, it would appear that all the alleged species allied to *B. borealis* are to be regarded merely as synonyms. Dr. Schulte's account of the fœtus is full and elaborate. Kükenthal and others have of late years dealt with the adult and fœtus of this and other Balænopteras, and therefore there are not facts of very wide interest left over to be recorded in the memoir. But nevertheless it is valuable, especially for its detailed account of the skull and musculature, which are illustrated by several plates.

F. E. BEDDARD.

SCIENCE FOR THE PEOPLE.

IN this country we are only just beginning to awake to the fact that museums have a great future before them in the task of bringing home to the nation the value and importance of scientific research. In this we are a long way behind the United States, which, through numerous channels, makes strenuous efforts to enlist the interest and sympathy of the public in all that concerns science and its importance as a factor in civilisation and progress. In this the American Museum of Natural History has played, and is playing, a very important part, not only in regard to its exhibition galleries, but also by its efforts to reach those who live outside its radius. By means of the *American Museum Journal*, it gives to the world at large, month by month, a series of lucidly written and skilfully chosen articles by members of its staff and others of established reputation on the various problems which are engaging the attention of specialists.

In the December number, which may be taken as a fair average specimen, nine essays are included, covering a wide range of subjects, thus ensuring an appeal to a large number of readers, as well as an opportunity of arousing dormant interests. Dr. C. Wissler, of the anthropological department, discusses American Indian saddles and the origin and adaptations of horse-culture in the New World, while Dr. W. D. Matthew writes on elephant-ivory and the evolution of the elephant. The Gulf Stream and the effect of ocean currents of different temperatures on the life and range of marine animals, and the phenomena of the mirage, rivet the attention on very different aspects of Nature. The significance of the vivid hues which prevail among tropical fishes introduces the reader to the knotty problems which await solution in regard to animal coloration, while the brief essay on the life-histories of insects opens up yet another vista.

Finally, we may mention the very important article on game protection by Mr. J. B. Burnham, the president of the American Game Protection Association. Herein the author shows the remarkable results which have been obtained by State protection of hen pheasants in New York State, and of the does of the Virginian deer in Vermont. No more convincing vindication of legislation framed for the protection and preservation of native animals from the raids of "sportsmen" was ever penned than this. And there could be no more suitable channel devised for the dissemination of the results of this legislation than this always fascinating journal, which, unfortunately, has no counterpart in this country.

We look forward to the time when the British Museum shall undertake a similar task for Great Britain and our Empire beyond the Seas. The funds, however, for the American journal, it should be remarked, are not provided by the State, but by the generosity of those interested in the welfare of the museum and the furtherance of its work.

W. P. P.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The Huxley lecture is to be delivered by Prof. D'Arcy W. Thompson, who has chosen a morphological subject entitled "Shells" for his address.

CAMBRIDGE.—The Adams prize has been awarded to Mr. J. H. Jeans, F.R.S., formerly fellow of Trinity, for an essay on "Some Problems of Cosmogony and Stellar Dynamics."

LONDON.—The degree of D.Sc. in chemistry has been conferred on Mr. S. W. Smith, an external student, for a thesis entitled "Surface Tension of Molten Metals and its Relation to other Properties of Metals and Alloys in the Solid State," and other papers.

The report of the Military Education Committee has been presented to the Senate. It states that the number of cadets of the University of London Officers' Training Corps who have obtained commissions up to the end of 1916 was 3010, an increase of about 750 over the corresponding number a year earlier. The distinctions obtained by these officers include: V.C., 2; D.S.O., 3; Military Cross, 131; mentioned in despatches, 151; and represent more than 10 per cent. of those who have seen active service at the Front. In the earlier days of the war 300 graduates and students of the University (not being cadets or ex-cadets of the O.T.C.) obtained commissions on the recommendation of the committee. In consequence of the Military Service Act, the work of the combatant units of the O.T.C. is now restricted to the younger men. The number of individual cadets who were members of the contingent during the training year ending September, 1916, was 2077, of whom 741 remained on the strength at the end of the year. The Medical Unit, in which all medical students permitted to continue their studies are enrolled, is at full strength. The Artillery Unit has been temporarily disbanded. The report refers also to the Officers' School of Instruction in connection with the contingent, through which 1100 young officers have passed; and to the assistance given by the committee in connection with the enlistment of trained chemists in the Royal Engineers.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 15.—Sir J. J. Thomson, president, in the chair.—Dr. J. H. **Mummery**: The structure and development of the tubular enamel of the Sparidæ and Labridæ. The author endeavours to show that the enamel of Sparidæ and Labridæ is a true tubular structure. Stains can be made to enter the tubes and traverse their finest branches.—Harriette **Chick** and E. M. M. **Hume**: (1) The distribution in wheat, rice, and maize grains of the substance the deficiency of which in a diet causes polyneuritis in birds and beri-beri in man. (2) The effect of exposure to temperature at or above 100° C. upon the substance (vitamine) the deficiency of which in a diet causes polyneuritis in birds and beri-beri in man.

Linnean Society, February 1.—Sir David Prain, president, in the chair.—C. E. **Salmon**: Some plants that might occur in Britain. Some undoubtedly native species would seem unlikely from their European distribution to occur here, such as *Sagina reuteri*, Boiss., and *Lloydia alpina*, Salisb., whilst it is manifestly uncertain what species may be ultimately found in Britain. Ten species were chosen, all well-defined plants, and recognised on the Continent, leaving out consideration of microspecies for the present.—Prof. W. A. **Herdman**: An account of a paper by Prof. W. J. **Dakin** on his exploration of the Houtman Abrolhos Islands, especially describing the formation of these coral islands. The paper is introductory to accounts of the fauna and flora. The group of islands extends between 28° 15′ and 29° S. lat., the archipelago being about fifty miles long, all four groups of islets running approximately N.N.W.–S.S.E.; they are only about six feet above sea-level, and practically destitute of water, the largest plants being mangroves on the lagoon flats. A few guano workers are the sole inhabitants.—J. **Charlesworth** and J. **Ramsbottom**: The structure of the leaves of hybrid orchids. An investigation of the anatomical characters of the leaves of the parents and their hybrids shows that a structure, when present in both parents in different amounts, appears in the hybrid intermediate in every way. This can be well seen by observing the microscopic characters of hybrids which have one parent in common; *Cochlioda noezliana* occurs as the female parent in six of the primary hybrids investigated and in the two secondary. When a character is present in one of the parents it may or may not be found in the hybrid. In general, if the character of one parent does occur in the hybrid, it is much less developed than in the parent. Sections of the leaves of thirteen primary hybrids and their parents were exhibited.

Zoological Society, February 6.—Prof. E. W. MacBride, vice-president, in the chair.—L. A. **Borradaile**: The structure and function of the mouth-parts of the Palæmonid prawns. The primitive crustacean limb is regarded as consisting of a flattened axis with a flabellum (exopodite), two or more epipodites, a series of eight endites, and an apical lobe, the flabellum standing opposite the third and fourth endites. The relation of the several jaws to this prototype was discussed. The latter part of the paper gives an account of observations upon the use of the mouth-parts during feeding; the second maxillipeds, maxillules, and mandibles were found to play more important parts than the first maxillipeds and the maxillæ.—Prof. H. G. **Plimmer**: Report on the deaths which occurred in the society's gardens during 1916, and on the blood-parasites found during the same period.

Royal Meteorological Society, February 21.—Major H. G. Lyons, president, in the chair.—W. H. **Dines**: Heat balance of the atmosphere. The paper traces the history of the solar radiation from the time it reaches the outer limit of the atmosphere until it is radiated back into space, assigning from the data available limits to the amounts absorbed, transmitted, and reflected by the air, and to the amounts mutually radiated between the earth, the air, and outer space. A note is added showing that a "grey" body in the position of the upper air should have a temperature of about 300° A.—C. E. P. **Brooks**: Continentality and temperature. The distribution of temperature over the surface of the earth is complex, being related to various factors—latitude, height, distance from the sea, etc. Further, since even smoothed isotherms reduced to sea-level often show very little relation to lines of latitude, it is evident that in some cases geographical conditions must exercise a predominant effect. This effect was investigated in the case of the distribution of temperature over Europe and western Asia during January and July. Fifty-six representative stations were selected, and by the method of partial correlation regression equations were constructed showing how the temperature of any place in the area may be built up from its height, its latitude, and the percentage of land in the area surrounding it. The function taken to represent latitude was the quantity of heat which would be received on a horizontal surface with a transmission coefficient of 0·7, on the shortest day and the longest day respectively (the last proviso allowed a lag of about three weeks in the thermal effect of the sun's radiation). That this gives a good measure of heat received is shown by the correlation coefficient of +0·944 found between it and the temperature in January. From these regression equations the temperatures of the original stations were calculated, and over a range of 50° F. in January the average error was found to be about 4°; in July the error was much less. Finally, the equations were applied to the altered geography of the early Neolithic period, and it was found that this entirely accounted for the altered climate of that period, and the various astronomical theories which have been brought in to explain it are quite unnecessary.

EDINBURGH.

Royal Society, January 22.—Dr. Horne, president, in the chair.—Lieut. C. K. M. **Douglas**: Some causes of the formation of anticyclonic stratus as observed from aeroplanes. This discussion of the problem of why the weather in anticyclonic distributions is frequently cloudy was suggested by observations made while flying in France. These stratus-clouds are of meteorological importance, preventing the development of severe frost. The tops of the clouds are usually 4000 or 5000 ft. above sea-level, and above them there is a well-marked rise of temperature, sometimes nearly 10° F. in 500 ft. This temperature increase was usually found associated with an increase of the westerly component of the wind. Along the lower margin of this western wind the stratus formed.—W. **Ritchie**: The structure, bionomics, and forest importance of *Myelophilus minor*. This destructive enemy of Scotch pine, formerly believed to be rare, exists in thousands at the tops of the trees. The damage done is of two kinds: first, by the adult boring into the young shoots and destroying them in hundreds; secondly, by the larvæ working below the bark and interfering with the passage of sap. The differences between this species and *M. pimperda* were pointed out, and new evidence was obtained of the life of the adult being extended over more generations than one.

BOOKS RECEIVED.

The Vaporizing of Paraffin for High-Speed Motors (Electric Ignition Type). By E. Butler. Pp. vi+120. (London: C. Griffin and Co., Ltd.) 3*s*. 6*d*. net.

A Text-Book of Histology. By Dr. H. E. Jordan and Dr. J. S. Ferguson. Pp. xxviii+799. (London and New York: D. Appleton and Co.) 15*s*. net.

Horses. By R. Pocock. With an Introduction by Prof. J. Cossar Ewart. Pp. x+252. (London: John Murray.) 5*s*. net.

The Land and the Empire. By C. Turnor. Pp. 144. (London: John Murray.) 3*s*. 6*d*. net.

Comptes Rendus of Observation and Reasoning. By J. Y. Buchanan. Pp. xl+452. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

Explosives. By A. Marshall. Second edition. Two vols. Vol. i., pp. xv+407. (London: J. and A. Churchill.) 3*l*. 3*s*. net the two vols.

Laboratory Manual of General Chemistry, with Exercises in the Preparation of Inorganic Substances. By A. B. Lamb. Pp. vi+166. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press.) 6*s*. net.

German and English Education: a Comparative Study. By Dr. Fr. De Hovre. Pp. 108. (London: Constable and Co., Ltd.) 2*s*. 6*d*. net.

The Permanent Values in Education. By K. Richmond. Pp. xxiii+136. (London: Constable and Co., Ltd.) 2*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 1.

ROYAL SOCIETY, at 4.30.—A Graphical Method of Drawing Trajectories for High-Angle Fire: Prof. W. E. Dalby.—Osmotic Pressures Derived from Vapour-Pressure Measurements; Aqueous Solutions of Cane Sugar and Methyl Glucoside: The Earl of Berkeley E. G. J. Hartley, and C. V. Burton.—The Complete Photo-Electric Emission from the Alloy of Sodium and Potassium: W. Wilson.

ROYAL INSTITUTION, at 3.—Memorial Art To-day: Prof. E. S. Prior.

MATHEMATICAL SOCIETY, at 5.30.

CHEMICAL SOCIETY, at 8.—Notes on the Effect of Heat and Oxidation on Linseed Oil: J. A. N. Friend.—Acyl Derivatives of Paradiazoiminobenzene: G. T. Morgan and A. W. H. Upton.

LINNEAN SOCIETY, at 5.—Some Observations on the Feeding Habits of Fish and Birds, with Special Reference to Warning Coloration: J. C. Mottram.—The Heterangiums of the British Coal Measures: Dr. D. H. Scott.

FRIDAY, MARCH 2.

ROYAL INSTITUTION, at 5.30.—Cellulose and Chemical Industry (1866-1916): C. F. Cross.

SATURDAY, MARCH 3.

ROYAL INSTITUTION, at 3.—The Pronunciation of English at the Time of Shakespeare. (Lecture II.): Daniel Jones.

MONDAY, MARCH 5.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Indian Frontier Geography: Col. Sir Francis Younghusband.

ARISTOTELIAN SOCIETY, at 8.—Fact and Truth: Prof. C. Lloyd Morgan.

ROYAL SOCIETY OF ARTS, at 4.30.—Memorials and Monuments: Lawrence Weaver.

SOCIETY OF ENGINEERS, at 5.30.—High Tensile Steel *versus* Mild Steel for Reinforced Concrete: A. W. C. Shelf.

VICTORIA INSTITUTE, at 4.30.—The Conscience: Clement C. L. Webb.

TUESDAY, MARCH 6.

ROYAL INSTITUTION, at 3.—Internal Combustion Engines: Prof. W. E. Dalby.

ZOOLOGICAL SOCIETY, at 5.30.—Work of the Beavers in the Society's Gardens: R. I. Pocock.—The Scolex in the Cestode Genus Duthiersia, and the Species of that Genus: Dr. F. E. Beddard.—An Experimental Investigation of the Migration of Woodcock Breeding in the West of Ireland: Capt. S. R. Douglas.

RÖNTGEN SOCIETY, at 8.15.

FARADAY SOCIETY, at 8.—*General Discussion:* The Training and Work of the Chemical Engineer: Opener, Sir George Beilby.—The Training of the Medical Student for Work in the Factory: Prof. F. G. Donnan.—The Training of the Works Chemist in Physics: C. R. Darling.—A Plea for the Forgotten Factor in Chemical Training: W. R. Cooper.—The Work of the Imperial College in the Training of Chemical Engineers: J. W. Hinchley.

WEDNESDAY, MARCH 7.

ROYAL SOCIETY OF ARTS, at 4.30.—German Business Methods: J. H. Vickery.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Quantitative Estimation of Mercury in Organic Compounds: J. E. Marsh and O. G. Lye.—The Composition of Milk: P. S. Arup, H. C. Huish, and H. Droop Richmond.—(1) Studies in Steam Distillation: Part 4, Propionic, Butyric, Valeric, and Caproic Acids. (2) Studies in Steam Distillation: Part 5, The Analysis of Acetic Anhydride and Alkyl-Malonic Acids: H. Droop Richmond.—Note on Salvarsan and Neo-Salvarsan: J. Webster.

THURSDAY, MARCH 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Some Effects of Growth-promoting Substances (Auximones) on the Growth of *Lemna minor* in Culture Solutions: W. B. Bottomley.—Some Effects of Growth-promoting Substances (Auximones) on the Soil Organisms concerned in the Nitrogen Cycle: Florence A. Mockeridge.

ROYAL INSTITUTION, at 3.—Sponges; a Study in Evolutionary Biology: Prof. A. Dendy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Voltage Regulation of Rotary Converters: G. A. Juhlin.

FRIDAY, MARCH 9.

ROYAL INSTITUTION, at 5.30.—The Treatment of Wounds in War: Sir Almroth Wright.

MALACOLOGICAL SOCIETY, at 7.—The Genitalia of *Neanthinula aculeata*: Dr. A. E. Boycott.—(1) The Radula of the Genus Cominella; (2) A Colony of *Purpura lapillus*, with Operculum Malformed or Absent; (3) Note on the Adventures of the Genus named Lucena; (4) Note on the Da Costa Plates adapted for Rackett's Edition of Pulteney's Catalogues: B. B. Woodward.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, MARCH 10.

ROYAL INSTITUTION, at 3.—Imperial Eugenics; Saving the Soldier: Dr. C. W. Saleeby.

CONTENTS.

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