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PLANNING REBUILDING AND DEVELOPMENT

THE interim report of the Uthwatt Committee on Compensation and Betterment has rightly been hailed as marking a definite stage in dealing with those problems of physical reconstruction in Great Britain which are now generally recognized as urgent. There is little dissent from Lord Reith's own view that they are urgent and pressing and that without diverting energies from the prosecution of the war, preparations must be made now to plan the rebuilding of Britain, and to consider the reconstruction of devastated areas, the location of industry, the preservation of the countryside and the conservation of natural resources. Only by planning now can we be ready to use the opportunities of rebuilding on better lines when the War comes to an end, and avoid mistakes made after 1918 which are now everywhere admitted.

The urgency of planning arises from two sources. The ground has to be prepared both with knowledge, without which future planning will not be equipped to serve any useful purpose, and with the machinery without which it will not operate at all. The first consideration involves research, the second legislation ; and unless both are ready when the time comes, the opportunity will be missed, because the wrong forces may take control and plans are made hurriedly to meet partial difficulties without reference to wider or ultimate purposes. The real obstacles to planning have not been removed by bombing, and the main and urgent task is to see that they do not operate as before through lack of technical data, confusion of social and economic values, or the absence of legislative and administrative machinery.

Research for this purpose involves both technical and social study. As an admirable article in the June issue of the *Architectural Review* points out, architects do not know nearly enough about the new materials of their art, the new resources of modern science, or the needs their work has to meet. Minimum standards require translation into ideal standards based on profound scientific and social research. The sequence from this point of view is first the investigation of actual needs, then of available ways of meeting those needs and finally legislation to enable the resulting plans to be put into effect with efficient organization of the work.

On one point there is widespread agreement—the absolute necessity for an overriding authority. From the report of the Barlow Commission to that of the Uthwatt Committee itself, all the numerous bodies attacking the problems of reconstruction have assumed the establishment of a central planning authority, which would proceed to work out a national plan. The same point was strongly made by Lord Zetland at the recent annual meeting of the National Trust. The only

differences of opinion lie in the exact nature of the authority and the extent of its powers.

Much has already been done to prepare the ground. Following on the attention directed to problems of planning by the P E P report on the location of industry, and by the subsequent report of the Barlow Commission, many excellent articles and pamphlets have served to educate public opinion in the steps required. Among the more recent of such may be mentioned a further article on problems of reconstruction in the *Round Table* of June, the "Rebuilding Britain Series", the first of which, "Overture to Planning", by F. J. Osborn, has just been published*, and the admirable survey number (July) of the *Architectural Review*, devoted to the subject. Valuable features of the latter survey are the introductory account of the work of the Ministry of Reconstruction under Lord Addison during and after the War of 1914–18, and the account of the activities of a number of the bodies already at work in the field.

A number of these have already reported. The Architectural Science Group of the Royal Institute of British Architects has issued a report on the steps to be taken to foster a scientific approach on the part of the architect to his professional duties. The Council of the Garden Cities and Town Planning Association has submitted to the Cabinet a memorandum on "Town Planning in Relation to the Present Emergency and After-War Reconstruction". The Town Planning Institute has furnished two memoranda to the Uthwatt Committee, and has also prepared a report on compensation and betterment indicating the necessary developments of the general law of town and country planning. Memoranda already circulated by the Social Reconstruction Survey set up by Nuffield College include a "Note on the Shift of Population in the Great War", by M. P. Fogarty, a "Survey of Industrial Development in Great Britain Planned since the Commencement of the War", by P. W. S. Andrews, and a further memorandum by M. P. Fogarty on "Demobilisation and Transfer of Industry to a Peace Basis". Various relevant reports have also been issued by the Association of Architects, Surveyors and Technical Assistants.

A good example of the work which is being done in examining the problems of reconstruction in good time is provided by a report which has been published by the Oxford Preservation Trust giving the recommendations of its Committee on Planning and Reconstruction on some general aspects of the post-war problem. The future of the university city is still under consideration and will be the subject of an elaborate study already in preparation. In the present report the Committee, carrying on an inquiry initiated in peace-time, covers ground of interest to many areas all over the country, and discusses the problems involved in the future of Oxford as a great shopping, entertainment and distributing town and the administrative centre of public services over two counties and beyond.

The report indicates concisely some of the points upon which agreed conclusions by the planning authorities in Oxford and the surrounding district are essential; for example, the desirable ultimate population of a district within a radius of six miles of Carfax, having regard to essential public services, traffic relief or congestion in the central area, the conservation of urban amenities, agricultural land and a green girdle, and the provision of subsidiary community centres. Decisions as to the amount of industry desirable in the district, the maintenance of the balance of industry, the exclusion from the city of industries for which it was not planned and for which it is physically unsuitable, and the segregation of any industries in properly designed factory areas or small industrial estates are also imperative. The Committee also recognizes that, if a planning authority is to have freedom and initiative, the difficulties created by the multiplicity of private land ownerships and questions of compensation must be removed.

The Committee recommends the establishment of a regional planning board for an area comprising the City of Oxford, the County of Oxford, less the borough and rural district of Henley, and the part of Berkshire that lies north of the Berkshire Downs watershed. The board would plan the whole area, working to a single general plan and giving full consideration to the interests of agriculture and rural community life in general. The report stresses the importance of preventing ribbon building and makes concrete suggestions to remedy this situation as well as that arising out of private ownership of land and questions of compensation. It suggests a national planning fund to promote the creation of national parks as well as for the preservation of the coast line and its amenities; and it strongly emphasizes the need for a single Government department dealing with town and county planning, emphatically endorsing the unanimous conclusions of the Royal Commission on the Distribution of the Industrial Population regarding a central planning authority.

The establishment of such a central planning authority and the enactment of legislation dealing with compensation and land values are the points

* Overture to Planning. By F. J. Osborn. (Rebuilding Britain Series, No. 1.) Pp. 29. (London: Faber and Faber, Ltd., 1941.) 1s. net.

upon which opinion is clearly agreed as urgent. They are the keynote in the recommendations of the Uthwatt Committee itself, which assumes the establishment without delay of a central planning Authority which will proceed to work out a national plan. The Expert Committee then recommends that the Government should now announce, as a general principle, that compensation ultimately payable in respect of public acquisition of land or of the public control of land will not exceed sums based on the standard of "pre-war values", that is, values at March 31, 1939. This maximum should be adopted for the whole period required to determine the long-term policy of planning and to work out any alterations in the present principles governing compensation.

The Committee then recommends that the legislation to be introduced to establish the central planning authority should vest in that authority the power of controlling building and all other developments throughout Great Britain by reference to national planning considerations and with the view of preventing work being undertaken which might be prejudicial to reconstruction. Such power should come into operation forthwith and continue while the broad lines of reconstruction are being worked out. Areas which may possibly form the subject of a reconstruction scheme should be defined by the competent authority, and the areas prescribed, without waiting for the end of hostilities, so soon as a reasonable judgment can be formed upon the matter by the competent authority. The Committee further recommends that from the date when the controls recommended cease to be operative over all developed areas, no works of reconstruction or development within the specified "reconstruction areas" should be permitted, except with the licence of the central planning authority, for a further reasonable period after the end of hostilities while detailed schemes of reconstruction are being worked out and the areas to which they apply are finally determined.

The essence of the Uthwatt report is accordingly the note of urgency and the establishment of a central planning authority. The principle of the latter has already been accepted by the Government, as was announced by Lord Reith on February 26 and again in the House of Lords on July 27, when he said the Government had accepted the recommendation of the Uthwatt Committee that the cost of land required for rebuilding under a public planning scheme shall not exceed its pre-war value and also the principle that reconstruction areas should be planned as a whole and defined as early as possible. Financial gain by individuals out of landed property by reason of war conditions or post-war reconstruction is to be excluded, as well as a piecemeal patching up of damaged areas.

A central planning authority is required as an urgent emergency measure in order to secure the main purpose and to control rebuilding from that point of view as well as in regard to conservation of labour and materials. This step the Government has postponed in favour of a council of three Ministers consisting of the Secretary of State for Scotland, the Minister of Health, and the Minister of Works and Buildings as chairman. This Council is intended to function until a central planning authority is set up in its final form. This proposal has indeed been welcomed by Sir Montague Barlow as a definite step forward, on the grounds that a long-term planning policy will develop progressively, and that the Council is charged with the duty of ensuring that the administration of town-planning legislation and of legislation implementing the Uthwatt Committee's proposals shall march in step with such long-term planning policy. As the debate in the House of Lords showed, such confidence does not appear to be general. The apparent shelving of the primary recommendation of the Uthwatt Committee has led to widespread disappointment and criticism. It suggests that a forward planning policy is still very much in the clouds, and doubts may very legitimately be entertained as to whether the proposed Council of Ministers already heavily burdened with departmental duties will be able to rise above the level of an interdepartmental committee, the members of which primarily hold a watching brief on behalf of the rights and powers of their own departments.

In the event, of course, such fears may prove to be groundless. Lord Reith's own statement showed that the Government is alive to the importance of having planning systems and plans ready at the end of the War, and of the obvious consequences of being unprepared for peace. Those who are most anxious to see Lord Reith at the head of a central planning ministry with an adequate staff will only be too glad if the present step does avert definite evils before the War is ended and implement the surveying of the ground so that active reconstruction can proceed when the moment arrives. They should find some further reassurance in the attention to research which is already being given by Lord Reith. There has been nothing in his statements to warrant the belief that he will lose great opportunities by small thinking.

There are indeed other fields to which attention must be given. As the *Round Table* points out, there is general agreement that the structure of our system of local government is in many respects out of date. The old boundaries do not fit modern

conditions, and the areas are often too small for present-day services. The creation of a network of regional planning authorities is generally recognized as essential, and this step might in turn assist in dealing with the difficult boundary question as well as in the devolution of authority between central Government and local authorities. There is the further thorny question of the granting to planning authorities of very large powers of land purchase, sufficient to carry out the most comprehensive schemes. Again, positive rather than negative policy is required to eliminate ribbon development, while as the Oxford Preservation Trust emphasizes, agriculture, too, must be represented on the planning authorities and such interests fully safeguarded.

What matters most may well be the kind of stand made in the next few months by those who can speak with authority and experience on the subject of planning. Whatever their preoccupation with war-time tasks, those who have thought for years about the wider issues of town and country must guide the tremendous public interest which the Uthwatt report and Lord Reith's statement have further stimulated. Unless the fundamental issues are made plain and kept unconfused before the public, the old mistakes will be repeated and the future planning of Britain, which is already being shaped, will crystallize in forms defeating once more the high hopes now entertained.

That task of sane, clear thinking and patient, fearless, unprejudiced exposition is one which demands the co-operation of all men and women of good will who look for the building of a nobler and better Britain. They must supply the driving force to ensure that the strategy of planning which can start from the decisions already taken by the Government is made ready for immediate application. Their interest and support can well inspire the Uthwatt Committee as it proceeds with its investigations, and stimulate the rapid framing and placing before Parliament of the legislation already required. They can assist to bring local authorities together in conferences and encourage them to prepare for the duties and developments which the future holds for them.

Scientific workers have their own special part to play. For some there may be participation in the technical side of planning, in the scientific and sound research which must form its basis. For others there may well be response to the appeal in the *Round Table* for a larger number of men and women of character, energy and ability to accept the burdens of the indispensable form of public service represented by the local authorities; and there can be few who could not make some use of such an exposition of the subject as is given in the *Architectural Review*, with its analysis of the main questions and issues, to take part in the task of educating themselves and their fellow-citizens as to the decisions to be taken, the problems to be solved and the efforts demanded of all if Britain is to be replanned and rebuilt on lines worthy of the sacrifices now being made.

SCIENCE IN THE SIXTEENTH CENTURY

A History of Magic and Experimental Science Vols. 5 and 6: The Sixteenth Century. By Prof. Lynn Thorndike. (History of Science Society Publications, New Series 4.) Vol. 5. Pp. xxii+695. Vol. 6. Pp. xviii+766. (New York: Columbia University Press; London: Oxford University Press, 1941.) 66*s*. 6*d*. net.

THE sixteenth century is commonly regarded as marking the birth of modern science. It owes this distinction mainly to the achievements of a small number of men, of whom Copernicus, Vesalius, Gilbert, Tycho Brahe, Gesner, Libavius, Bruno, Fracastoro and Porta are the most famous. These constituted a very small percentage of the authors who enjoyed some sort of reputation among their contemporaries for their views on natural phenomena. Prof. Thorndike deals with about 1,200 such writers. The vast majority of them were of little, if any, scientific importance.

As a whole, the sixteenth century was more medieval than modern, and showed great credulity rather than an appreciation of the spirit and method of science. Of originality it showed extremely little. Most of its more sensible ideas, and nearly all its superstitions, were derived from earlier times. Although there was some diversity in the sort of superstitions which the various authors adopted from their predecessors, the diversity was neither great nor important. The practice of magic rites declined, but the belief in magic, astrology and all kinds of 'mancies' (aeromancy, geomancy, hydromancy, necromancy, etc.) continued to go strong. Even sceptics or atheists like Sanchez and Vanini could not escape the coils of superstition; and the few pioneers to whom the age owed its place in the history of scientific progress shared to an amazing extent in the credulity of their contemporaries,

though fortunately they managed to keep their best work sufficiently free from unscientific encumbrances. The intellectual atmosphere of the environment influences even great men. It would ill become us to be severe on them, considering the alarming extent to which astrology, alchemy, etc., still continue to engage the interests of the twentieth century, the intellectual and moral instability of which recent events have exposed only too glaringly.

Some readers may wonder whether it was worth while devoting two big volumes to a horde of writers, most of whom were little more than parrots, or plagiarists, or charlatans. But a scholar has a right to determine his own field of research. Prof. Thorndike is obviously interested in the sixteenth century as such, and he has succeeded in portraying its mentality with the aid of the large sample he has surveyed. The picture is not exhilarating, but it is true to life. The average historian of science is not concerned with any period as such, only with the *progress* of science in it, so he ignores the authors who have not contributed to that progress. This likewise is a justifiable attitude. There is no reason for quarrelling over this difference in attitude, as Prof. Thorndike occasionally seems inclined to do. The sensible historian will not retort by deprecating Prof. Thorndike's 'antiquarianism', but will know what use to make of it. The very possibility of writing history, as, indeed, of most studies, depends on selection ; and selection always involves the risk of important omissions. By examining, and reporting on, such masses of frequently neglected material, scholars like Prof. Thorndike render a real service to the historian of science. At best, the result may be additional information, or correction ; at worst, the historian will at least have the feeling that he may ignore so much with a good conscience.

Prof. Thorndike's volumes have "experimental science" as part of their title. The expression usually means "the systematic study of natural phenomena under conditions controlled by the investigator". The author, however, must be using it in the older sense of "any kind of alleged knowledge professing to be based on experience". For the amount of experimentation dealt with in these volumes is quite negligible. The experiments reported are extremely few and simple, and even the merely observational verifications referred to are mostly of a poor scientific standard. The best experiment cited is that by which Carpi showed, by injecting water with a syringe, that there is no sieve in the kidneys. The most amusing one is that by which Henry VII refuted a certain astrologer who had predicted the king's death before Christmas. He summoned the astrologer and asked him where, according to his astrological knowledge, he expected to spend Christmas. The astrologer replied that he would be at home. Thereupon the king had him imprisoned in the Tower of London until after Christmas. It is regrettable to find that Queen Elizabeth did not profit from this royal refutation of astrology, but was rather addicted to it, and taken in by charlatans.

Prof. Thorndike does not give a full account of the scientific work of the major pioneers, nor does he add much to our information about them. But he does sometimes throw a little new sidelight on them, or suggests new ways of regarding them. As an example of this, some of his comments in connexion with Copernicus may be indicated briefly. Ideas of a moving earth were spreading already, before and independently of Copernicus, so that even some of his ecclesiastical contemporaries were prepared for the appearance of his "De revolutionibus", and so far from opposing its publication, actually tried to hasten it. Partly, it is true, this interest was prompted by the hope of a new astrology to be based on the new astronomy ; but that is a detail. The main obstacle to the early spread of Copernicanism was not religious opposition, but the lack of a suitable text-book for beginners. The writers of the many introductory books on the rudiments of astronomy found it much easier to follow the conventional methods of presenting Ptolemaic astronomy than to follow the intricate novelties of Copernicus. The result was that few really understood the new astronomy ; and people generally tend to condemn what they fail to understand. If Galileo had used his great gifts to write a graphic elementary account of Copernican astronomy, instead of writing his provocative "Dialogue concerning the Two Chief Systems of the World, the Ptolemaic and the Copernican", things might have been very different.

Prof. Thorndike's work contains also a considerable amount of bibliographical and kindred information. It is noteworthy that of the authors discussed the British are fewer than the Spanish. Of the three hundred printers and publishers referred to only nine were in London, whereas Venice could boast about fifty, and Paris about thirty-five. Apparently through some oversight, the list of printers in Appendix 6 does not include the famous Elzevir.

No one can fail to appreciate the labour, patience and learning that have gone to the writing of these volumes, which, together with four earlier ones, complete a remarkable survey of sixteen centuries of thought about natural phenomena. Prof. Thorndike richly deserves the warm congratulations and gratitude of all who are interested in the history of human thought.

A. WOLF.

GROWTH OF SCIENCE IN CANADA

History of Science in Canada

By Frank Dawson Adams, W. Lash Miller, Frère Marie-Victorin, J. R. Dymond, Leo E. Pariseau, J. J. Heagerty, W. E. Harper, Samuel Beatty, A. Norman Shaw. Edited by H. M. Tory. Pp. vi+152. (Toronto: The Ryerson Press, 1939.) 2.50 dollars.

IT is likely that in most of the new countries of the world science takes dominant place alike in the educational field and in popular esteem. Circumstances combine to promote the development of scientific knowledge of one kind or another. Not only does the development of new resources give a direct economic stimulus to science but also there is probably a deeper influence at work and that is the stirring phenomenon of growth of a young country. New cities springing up, oil discovered here, minerals there, new industries born, railroads built, forests cut—these things make their mark upon the minds of the people so that they have an urge towards fresh knowledge. It is not the study of the old, not classics, nor even literature or history, but science which has the widest popular appeal and to which young students turn in ever-increasing numbers. Factors such as these lie behind the long story of the remarkable development of science in Canada which is told here.

The book consists of nine papers presented to the American Association for the Advancement of Science in 1938 to direct the attention of the Association to the growth of science in the Dominion. These papers, written by leading Canadian men of science, are edited and introduced by H. M. Tory, past-president of the Canadian National Research Council. He stresses the rapidity with which science progressed in the past sixty years in both Government departments and teaching and research institutions. The foundations of Canadian science were of necessity laid by men from overseas (whether as pioneers or trained scientists) but in course of time Canadian-trained scientists took their part in both research and teaching, until to-day Canada supplies a fair quota of scientific work and leadership.

Chapter i, by F. D. Adams, is devoted to the history of geology in Canada, from the 1820's onwards. The first work was done by officers of the British army and navy stationed in Canada. Amongst these was John Bigsby (the founder of the Bigsby Medal) who prepared one of the very earliest geological maps of North America. The next stage was the appointment of W. S. Logan as Government geologist in 1842. There was then no staff, equipment, laboratory or library. Undaunted, Logan acquired a few assistants and started the Geological Survey of Canada on its course. Among the earliest work undertaken were studies of the pre-Cambrian rocks of the Canadian Shield, work which was—and is—among the foremost contributions to geological knowledge. Economic developments within the Dominion are reflected in the economic aspects of the publications of the Geological Survey. The winning of ores, the opening of coal- and oil-fields, all are events in which it has played a leading part. The work of geologists in the universities is also outlined. Naturally, the demand for trained geologists has greatly stimulated the teaching of this subject.

Lash Miller writes amusingly about the early days of chemistry in the universities and also touches upon some of the major developments in chemical industry. A brief chapter on Canada's contribution to the science of botany, by Frère Marie-Victorin, is somewhat disappointing. The botanists may well feel that their work has not been adequately described and much more might have been said about agriculture's debt to botanical research. J. R. Dymond gives succinct account of the growth and recent developments in zoology and stresses the happy relations which exist to-day between university and Government laboratories. University biologists derive great benefit from opportunity to work in biological stations during the summer months.

The piecemeal effect, although unavoidable in a book of this kind, is a defect in connexion with the natural sciences, for their development really should be one connected story. It was the observations of pioneers and explorers which laid the foundation on which were built the detailed studies of the present day. It is a long story which starts in a note-book about unexplored country and ends in the modern laboratories of a great Dominion.

The history of medicine is treated in two chapters—Canadian medicine and biology under the French regime, by L. E. Pariseau, and medical practice under the British regime, described by J. J. Heagerty. Events of those early days make interesting reading, but little is said of recent medical work or the development of the medical schools.

The last three chapters cover astronomy, mathematics and physics respectively. W. E. Harper's clear account of astronomical work is interesting. Canada has reason to be proud of the enterprise which has given her the two great telescopes, one at Victoria and one on the outskirts of Toronto. Important and original work has been done at the observatories. The chapter on mathematics is

somewhat weak. The author writes rather as one defending the subject than as an historian of its progress, and too much emphasis is given to minor work. In the concluding chapter, on the advance of physics in Canada, A. N. Shaw gives a good general survey, outlining the present work in physics and the date of establishing laboratories, etc., at each of the Canadian universities. He points out the influence of the Cavendish Laboratory at which so many of the Canadian physicists have been trained. The history of physics in Canada is, of course, bound up with that of the late Lord Rutherford who in his ten years at McGill gave such a profound impulse to physics in the Dominion. The writer says: "Undoubtedly Lord Rutherford may claim sole responsibility for the greatest outburst of original research in Canada and the subsequent influence of his personality and works is beyond assessment."

T. ALTY.

UNIVERSAL ALGEBRA

The Calculus of Extension

By Prof. Henry George Forder, including Examples by Robert William Genese. Pp. xvi+490. (Cambridge: At the University Press, 1941.) 30*s*. net.

ABOUT a hundred years ago, when Boole and Hamilton were extending algebra by symbolizing logical and physical entities, a similar but independent investigation was begun in Germany by Grassmann. Unlike the quaternions of Hamilton, which aroused considerable interest and became very well known, the calculus of extensive magnitudes of Grassmann attracted very little attention until the close of the nineteenth century. The appearance of Whitehead's "Universal Algebra" first made this theory well known to English readers, and the book still remains a classic, by providing an interesting and readable approach to the philosophy both of Boolean and Grassmannian algebra. The aim of the work now under review is to give a more detailed account of Grassmann's methods, and particularly to exhibit their power in all forms of geometry, metrical, kinematical and projective. The book is the outcome of many years experience and appreciation of the methods: it was begun twelve years ago as a result of perusing some mathematical notes on Grassmann left by the late Prof. Genese, and its publication has tarried through no fault of the author. The book, which goes far beyond the scope of the original notes, is full of information, and shows very clearly the power of the method and its surprisingly wide range of applications.

The calculus of extension is a form of non-commutative algebra which includes and absorbs ordinary vector theory. It can be developed in the abstract, and then applied, by means of its wealth of identities, to concrete problems in the theory of determinants, in nearly all forms of geometry, and in physics. In this respect it resembles analytical geometry, where the same algebraic form may represent at one time the locus of a point, and at another time the envelope of a line, according to the interpretation of the variables. This capacity for varied geometrical usage is, however, considerably greater in Grassmann's algebra than in co-ordinate geometry. It differs from the latter in discarding as unnecessary a co-ordinate frame of reference; and in this respect it returns to the earliest traditions of geometry.

The chapters run as follows: (i) Plane geometry, preceded by a page of bare axiomatic statements on extensive magnitudes, immediately interpreted as points and vectors. This leads to the use of similarity operators which provide neat proofs of remarkable theorems such as the Cayley Clifford problem of three-bar motion; (ii) Geometry of three dimensions, including spherical trigonometry; (iii) More axiomatic statements leading to projective geometry, where the richness of the method begins to be manifest; (iv) The theory of screws and the linear complex; (v) Differentiation and motion; (vi) Projective transformations. In Chapters vii–xv we have the general theory for any number of dimensions, including a discussion on matrices, and applications to quadrics in general, to circles, spheres and spherical 'spreads'. The final chapter, which bears on canonical forms, deals with the theory of algebraic products, recently developed by Müller, one of the chief exponents of Grassmann on the Continent.

The book is written most carefully and consistently; and it is evident that the author appreciates the value of a simple notation as an aid to thought. But it is doubtful whether the unfamiliar capital Gothic type for matrices is a happy choice in a work which seeks to persuade the reader to adopt a new outlook and new methods. The author endorses the motto adopted from Leibniz by Grassmann: *etsi omnis methodus licita est, tamen non omnis expedit*. It is surprising that a method of algebraic geometry can be pursued through so long a book without the mention of invariants and with the briefest allusion to the theory of groups. Nevertheless algebraists and geometers will find the book stimulating.

H. W. TURNBULL.

Textbook of Light.

By Dr. R. Wallace Stewart and Prof. John Satterly. Seventh edition, revised by Prof. C. T. Archer. Pp. vii+365. (London: University Tutorial Press, Ltd., 1941.) 7*s*. 6*d*.

IT is not an easy task to set about revising a well-known book, since the characteristic features must be preserved, and yet the contents must be brought into line with modern development. This task has, however, been successfully accomplished by Prof. Archer in the revised version of Stewart and Satterly's "Textbook of Light". The book contains a treatment of the elements of geometrical optics of a fairly wide scope, and the mathematics is easily within the compass of Intermediate Science students for whom the book is intended; the methods of the calculus, however, might surely have been used, especially in certain cases.

In connexion with a book of such merit as this, one hesitates to offer any criticism, however slight, but two topics may be mentioned. Thus the use of pins for experimental work on mirrors and lenses is still retained, although it is probably much more convincing for students to use narrow parallel pencils of light; such procedure also saves time in experimental work. Again, so painstaking is the author to drive home facts that there is a tendency for over-emphasis; for example, having established the relationship $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$ for mirrors, why trouble to express this result in words?

The book has been brought up to date (though one misses any reference to photo-electric methods in photometry), and it can certainly be recommended.

The Practical Application of Aluminium Bronze

By C. H. Meigh. Pp. xiii+112. (London and New York: McGraw-Hill Publishing Co., Ltd., 1941.) 17*s*. 6*d*.

THE alloys of copper with aluminium, with or without the addition of manganese, iron, or nickel, are commonly known as aluminium bronze. They have a high tensile strength and other good mechanical properties, and are highly resistant to corrosion. The handsome French franc and 2-franc pieces of this alloy, which had the appearance of gold and retained their colour permanently, will be remembered. Trouble owing to the entanglement of particles of alumina long retarded the general use of the alloys, but these difficulties have been overcome, and the advantages of the material can be fully utilized.

This book contains a number of practical notes on the composition and properties of the group of alloys, and detailed accounts of foundry and workshop practice, which will be found useful by all who have to make or work aluminium bronze. It is weaker on the scientific side, the accounts of crystal structure and of such phenomena as fatigue being marred by numerous errors. The tables at the end of the book include comparisons with steel and with brass and bronze, but the important high-tensile brasses are not included, although the comparison with them would have been fairer.

The term "de-aluminification" is not to be welcomed as an addition to the language, and is unnecessary.

There are some good illustrations of castings in aluminium bronze. C. H. D.

Higher Chemical Calculations

By A. J. Mee. Pp. viii+184. (London: J. M. Dent and Sons, Ltd., 1940.) 5*s*.

THIS book provides about 600 numerical problems on the principles of physical chemistry (including analyses) up to the standard of the Intermediate B.Sc. examination. Some of the examples are taken from the Higher Certificate, First M.B., Intermediate B.Sc. and University Open Scholarship examinations, but the majority are either original or taken from the researches which have laid the foundations of physical chemistry. The answers to these problems are given at the end of the book, together with logarithm tables and a useful index.

The subject-matter is well arranged. Thus the principles underlying the calculations are classified into ten main groups each of which forms the basis of a complete chapter. Clear and concise details of the principles are provided, and these are illustrated by worked-out examples so that the student can become familiar with the application of the principle before attempting the problems. The worked-out examples are generally satisfactory, but it is unfortunate that the answers to some of them are given to a greater number of significant figures than the measurements. Obsolete and misleading problems on the degree of dissociation and ionization of strong electrolytes are also worked out or given for solution; for example, sodium nitrate is calculated to be "63·3 per cent ionised" from the freezing point of its aqueous solution (p. 122). Apart from these criticisms, the book can be recommended for the use of sixth-form pupils and first-year university students.

A. C. C.

British Water Beetles

By Frank Balfour-Browne. Vol. 1. (Ray Society Vol. 127 for 1939.) Pp. xx+376+5 plates. (London: Bernard Quaritch, Ltd., 1940.) 25*s*.

AQUATIC Coleoptera have long been favourite objects of study, especially by the biologist and the physiologist. Dytiscus, Gyrinus and Hydrophilus, for example, have alone attracted the attention of many investigators and a bibliography of their written contributions on these creatures would fill many printed pages. The present volume deals with members of the Haliplidæ, Hygrobiidæ and part of the Dytiscidæ. It is concerned more especially with the habits and distribution of their species and is not intended as a systematic treatise. It will be noted that keys, therefore, take the place of detailed descriptions as aids to the identification of the various species. Prof. Balfour-Browne has devoted many years to the study of water beetles and is probably better qualified than anyone else in England to describe their natural history and where to find them. Coleopterists will welcome the appearance of this well-produced volume and look forward to the completion of the work when circumstances permit.

CHANGES IN THE GOVERNMENT OF INDIA

By Sir Denys Bray, K.C.S.I., K.C.I.E., C.B.E.
Formerly, Foreign Secretary, Government of India

ON July 22 the Viceroy of India made an announcement that came as a great relief to many in Great Britain who had been chafing under our apparent inability to do anything to relieve the political deadlock in India. It was a notable announcement; yet its wording was studiously matter-of-fact. It merely stated that as a result of the increased pressure of work in connexion with the War it had been decided to enlarge the Executive Council of the Governor-General of India, and to establish a National Defence Council in order to associate Indian non-official opinion so far as possible with the prosecution of the war; and then followed the names of seven Indians who were to join the former and of twenty Indians who (with two non-Indians) were to represent British India on the latter.

To those in Great Britain with no knowledge of the working of the Government of India, the Viceroy's announcement can have conveyed little of its true significance. When Mr. Amery in a weighty speech expounded these changes in the House of Commons, his statement was received with calm satisfaction, tempered only by expressions of regret that they did not go further. The House seemed scarcely conscious that anything out of the way had been enacted; indeed the Secretary of State was at pains to emphasize that the changes involved no alteration in the constitution but were merely administrative changes, interim measures taken within the existing framework. Yet it may be doubted whether these changes will not figure in history as in some ways an even more significant milestone on India's road to full nationhood than the great constitutional change embodied in the Government of India Act of 1935 after months of heated debate. For that Act, while it brought self-government to the eleven Provinces of British India, left the Central Government for the time being untouched. But the changes now so modestly introduced affect the working of the Central Government itself.

For the Viceroy's Council is no mere advisory body. In the Governor-General in Council, to use the technical term, is vested the supreme authority in India. The Council is in fact a Cabinet with collective work and responsibility, composed of Ministers—or Members as they are called—each in control of one of the great Government departments, the Viceroy himself being member for foreign affairs. During the first fifty years of its being the Council was purely British in composition. Not until 1909 was an Indian appointed; not until 1920 was the number of Indians raised to three; and now the Viceroy is to preside over a Cabinet with Indians in a majority of two to one. It is a transformation that would have made Lord Curzon stare and gasp. That it evoked not a word of dissent in Parliament (except on the score that it did not go far enough) and scarcely a word of criticism in the Press is significant of the wholesale and very wholesome change that in half a dozen years has come over political thought in Great Britain. It is to be hoped that a very full report of the debate and the subsequent Press comments was telegraphed to India. The warm-hearted spirit in which the changes have been welcomed in Great Britain is likely to prove more acceptable to political India than the changes themselves.

No one with any knowledge of the political currents in India to-day could be so sanguine as to expect a general welcome from India for any changes which do not involve a formal change in the constitution. We in Great Britain pride ourselves on the vitality and unseen growth of our own unwritten constitution, and are inclined to eye written constitutions not a little impatiently—if indeed we can bring ourselves to study them at all—and to judge them not by the written letter but solely by the spirit in which they are worked. Naturally enough, it is otherwise with Indians. Accustomed as they are to a written constitution, they look jealously at every letter in it, and are apt to assume that the checks and safeguards every written constitution must perforce contain are a faithful reflex of its everyday working. Though the present changes, as Mr. Amery told the House, are a signal "earnest of our desire to transfer to Indian hands a steadily increasing share in the control of India's destiny", they are interim adjustments only, pending the day when Indians are able to accept our invitation "by agreement among themselves to devise the framework of the Indian constitution in accordance with the social, economic and political structure of Indian life". The changes mark an abiding and far-reaching change in the spirit of the constitution; and it is history's lesson that in the life of a nation it is the spirit that quickens. But great though the change in the spirit, the letter of the constitution remains unchanged. The Governor-

General in Council, though the supreme authority in India, is still responsible to the Secretary of State for India and ultimately to Parliament. However responsive the Council may be to the Indian Assembly—and with Indians in an overwhelming majority it is a foregone conclusion that its responsiveness will be very sensibly quickened—its members are not responsible to it ; nor can the Assembly turn them out of office. Hence, with the constitution left unaltered, the All India Congress declined to have anything to do with these interim measures or to allow its adherents to join the Council. The Muslim League, though glad enough that the constitution has been left for the time being as it is, laid down conditions for its own participation too exacting for acceptance.

It is, of course, a misfortune for India and for the British Commonwealth that neither of the two leading parties is formally represented on the Executive Council. Yet the Council will contain men who, abating nothing of their robust nationalist patriotism, have only dissociated themselves from their party over the non-constructive tactics it is pursuing. Happily, India has no dearth of public men of ability ; and among the new members—of whom three are Hindus, bringing the number of Hindus on the Council to four, three are Muslims and one a Parsee—are men who have made their mark in India, and are not unknown in Great Britain and in the United States and at Geneva. Together they form a strong reinforcement to the Council.

How well off India is for public men may be seen from the names in the long list of appointments to the National Defence Council. This is an entirely new body. Unlike the Viceroy's Council it is not an executive but an advisory body, designed to bring the war effort in the Provinces and States into more direct and effective touch with the Central Government. Except for one representative of European commerce and another of the resident Anglo-Indian community, it is purely Indian in composition. It includes the Prime Ministers of four of the Provinces, representatives of labour, capital and agriculture, and well-tried champions of the depressed classes. Perhaps its most striking feature is the inclusion of a gifted Muslim lady—a wise appointment justified by a fine record of public service, and a fitting recognition of the swift and splendid awakening of India's womanhood.

These representatives of British India are to be joined on the Defence Council by representatives of the Indian States—that vast Indian India which, though an integral part of India, is not British India at all but under the rule of hereditary chiefs and princes. Who can doubt that India's war effort, already far greater than any one could have prophesied two years ago, will rapidly increase in vigour and magnitude, now that some of the best minds in the Provinces and the Indian States are to combine in a joint endeavour to stimulate it ?

But the strengthening of the Central Government and the intensification of India's war effort are not all that may be looked for from this influx of Indians into the Viceroy's Council and this gathering of Indians from Provinces and States in a National Defence Council. It is not too sanguine to hope that these innovations will help to prepare the ground for the even more difficult task of constitution-building that lies ahead of India. To-day what stands in the way of India's self-government and evolution to her full status is, as Mr. Amery put it, "the absence of any willingness among Indians themselves to agree upon the lines on which they will govern themselves". Hitherto the rock of stumbling has been India's intolerance of her own diversity. But we in Britain have learnt that there is nothing like joint work for a supreme cause in a supreme crisis to bring about understanding of our political opponents, tolerance of their views, and a silent revolution in our own ; and Executive Council and Defence Council alike will afford such joint work in plenty.

The characteristics of English-speaking peoples —and political India, be it remembered, is an English-speaking people—were summed up in memorable words by a statesman speaking in London a few weeks ago. "English-speaking countries are peopled by men and women of diverse nationalities and different religions. Their strength comes from diversity, and their freedom is born of tolerance—tolerance of other people's origins, other people's religions, other people's ideas. It is the crowning virtue of English-speaking countries that they recognize and respect virtue wherever they find it, and are not inclined to beguile themselves with a primitive and barbaric idea that they themselves have a monopoly of it."

These are the words of one whom many Indians in the ranks both of labour and capital know well. They are not the words of an Englishman. They are the words of the late head of the International Labour Office, now the American Ambassador in London. No words could better sum up the spirit in which all lovers of India long to see political India set itself to the task of working out India's salvation. The future of India, that great cosmos of nations, cannot lie in any one race or religion or party claiming for itself the monopoly of political wisdom and authority. India's salvation can only lie in the Indian's tolerance of other Indians' origins, religions, ideas. In India's rich diversity, in India's triumphant unity in diversity lies—who can doubt it ?—her future strength.

THE PRICKLY-PEAR PROBLEM IN AUSTRALIA

By Dr. A. D. Imms, F.R.S.

THE entry of the prickly-pear into Australia dates from about 1787, when the species *Opuntia monacantha* was introduced from Rio de Janeiro. The object was to establish the cochineal industry in that land since prickly-pears constitute the host for this particular kind of insect. Some twenty-five other species of Opuntia have found their way into Australia, but their origins cannot be traced. All have become naturalized either as serious pests, minor pests or as garden escapes. The two major pest species in Australia are *Opuntia inermis* and *O. stricta*. At one time landowners grew hedges of prickly-pear around their homesteads until they got out of hand and then the hedges were cut down. The rapidity with which these pests have increased is one of the botanical wonders of the world. Their original home is the coastal sector of Texas and Florida where the mean rainfall is 40–50 in. Yet in Australia the plants have adapted themselves to a very different environment and with a precipitation of only 20–30 in. annually. In 1900 an area of about 10,000,000 acres was affected in Queensland and New South Wales. The invasion advanced with such celerity that at the peak, in 1925, the affected area must have been greater than 60,000,000 acres : in some years the annual increase in infested territory exceeded 2,500,000 acres. The main distribution takes place by seeds, but every broken-off segment of the plant is liable to take root.

The problem of the control and eradication of the pest has been a matter of cost. The great bulk of the infested territory, stretching 900 miles between lat. 20° S. at Mackay, Queensland, to lat. 33° S. at Newcastle, N.S.W., is natural grazing land generally worth less than £1 per acre. Biological control of prickly-pear was first advocated in Australia in 1899. In 1912 the Queensland Government appointed a Travelling Commission to investigate possibilities of biological control in view of the increasing difficulties facing mechanical and chemical methods of eradication. The Commission comprised Dr. T. Harvey Johnston, professor of biology at the University of Queensland, and Mr. Henry Tryon, Government Entomologist to the State. They visited many countries where prickly-pears were indigenous or had become acclimatized and made valuable recommendations for the introduction of insects and diseases affecting Cactaceæ. During these travels small stocks of the cochineals, *Dactylopius ceylonicus* and *D. greenii*, were forwarded to Australia. The first-named was liberated in the field and in a few years it almost completely eradicated *Opuntia monacantha* and this achievement gave a stimulus to efforts in biological control.

In 1920 the Commonwealth Prickly Pear Board came into being with Prof. T. Harvey Johnston as scientific controller. It was established to investigate the whole question of the biological control of prickly-pear, being supported by the Commonwealth Advisory Council of Science and Industry and by the Governments of Queensland and New South Wales. Mr. Alan P. Dodd's report* is an official record of the campaign and its progress from the Board's inception in 1920 up to the year 1940. The Board, it may be added, has been an independent body from its start, exercising complete control over its investigations, finances and staff. During the nineteen-year period June 1920 to May 1939 the sums actually spent on prickly-pear control amounted approximately to £168,600.

The operations of the Board were governed by the fact that in America insects, diseases and other agencies keep the prickly-pear within reasonable bounds, whereas in Australia such natural controlling agencies are wanting and there is little check on the spread and reproduction of the pest. The Prickly Pear Board was concerned with an attempt to bring about a condition of biological equilibrium by the introduction of insects and diseases likely to provide natural checks. The control aimed at depended upon the introduction of a complex of organisms working collectively in destructive unison. Officers of the Board studied insects affecting Opuntia in many lands, covering widespread areas of cactus growth in North America, South America and the West Indies. In work of this character it is important to study on the spot, not only those insects actually attacking prickly-pear, but also the natural parasites and predators affecting them. The exclusion of such restraining agents from Australia, if their hosts are to multiply freely and vigorously attack the prickly-pear in the new surroundings, is of prime importance.

The Board established a station at Urvalde, Texas, where extensive preliminary biological work has been carried out and the most promising cactus-feeding insects bred under caged conditions. Also, such insects were tested by starvation and other means regarding the possibilities of their attacking cultivated plants of economic value. The selected

* The Biological Campaign against Prickly-Pear. By Alan P. Dodd. Published under the authority of the Commonwealth Prickly Pear Board. Pp. iv+177+37 plates. (Brisbane: Government Printer, 1940.)

Fig. 1.
DENSE PRICKLY-PEAR, *Opuntia inermis*, PRIOR TO ATTACK BY INSECTS, CHINCHILLA, QUEENSLAND, OCTOBER 1926.

species received from America were shipped to quarantine buildings at Sherwood, near Brisbane. Here they were again bred through one or more generations in order to preclude the escape of any parasites that might have been accidentally introduced at the same time. Also, additional tests were undertaken in order further to explore any possibility that the introduced insects might attack crops or other useful plants and not confine their activities to prickly-pear. From Sherwood, species that were deemed promising and that had withstood the foregoing testing, were eventually forwarded to acclimatizing and breeding centres where the first liberations into the open country were usually carried out.

In all, twelve species of prickly-pear insects were introduced and established in Australia. On the other hand, 150 species of cactus-feeding insects were discovered in America and of these about 50 species were imported into Australia. It will be noted that the greater number were rejected for various reasons. Many were confined to cacti other than Opuntia ; others caused too little damage to be of potential value, while some forms were discarded because they did not pass the stringent tests as regards their feeding propensities. Lastly, the unexpected and overwhelming success attending the introduction of a single species of insect rendered further importations of other kinds superfluous.

Of the various species that have become acclimatized to Australian conditions the moth *Cactoblastis cactorum*, the larvæ of which tunnel through the tissues, is the most important. The cochineal became distributed almost everywhere in the prickly-pear country and the plant-sucking bug, *Chelinidea tubulata*, spread in countless millions over various localities. The red spider, *Tetranychus opuntiæ*, said to be only a biological race of the European *T. telarius*, also spread over many thousands of square miles. In his 1929 report Dodd stated that the established complex of insect enemies was already bringing about a considerable degree of prickly-pear control. In the heart of the infested country it was possible to travel for 100 miles without seeing any healthy plants. Thus it would appear that the original conception of a biological association of different enemies working in unison was well justified. It was quite unforeseen, and could not have been foreseen, that the outstanding success in the repression of prickly-pear achieved up to 1936 would have resulted from the activities of a single species of insect. The agent in question is the Phycitid moth, *Cactoblastis cactorum*, from South America. This fact is all the more remarkable because only one small consignment of material was introduced into Australia. It took the form of about 2,750 eggs obtained in the Argentine in March 1935 and, a year later, two generations of this insect had been reared in captivity, the original number multiplying to 2,540,000. Between 1928 and 1930 about three thousand million eggs, laid by the descendants of insects from the original batch, were distributed in the prickly-pear areas. The

Fig. 2.
THE SAME AREA AS IN FIG. 1 THREE YEARS LATER, OCTOBER 1929, AS A RESULT OF THE ONSLAUGHT OF CACTOBLASTIS.

orange-red larvæ are gregarious internal feeders, which tunnel in companies through the tissues of the plant, thus providing also for the ingress of disease organisms. In this manner the prickly-pear ultimately becomes so completely destroyed that it is reduced to a rotting mass of pulp.

The various other insects that were established have either become suppressed, or their activities nullified, owing to competition with the Cactoblastis. It is only locally, and in relation to a few Opuntia species of minor importance, that the Cactoblastis has shown itself to be ineffective. The most serious of these plants is *Opuntia aurantiaca*, but there is good reason to believe that its control by a species of Dactylopius (cochineal), also from the Argentine, seems assured.

The results of the repression programme have led to 22,000,000 acres of former dense pear country in Queensland being selected for settlement. The previous value of this land was almost nothing, but freed from the pest its capital value would average 10*s*. an acre, without taking into consideration the worth of the new improvements in fencing, water facilities, removal of timber, etc. Hence the State has gained an asset of at least £10,000,000 because of the availability for farming of land hitherto useless. The area once under impenetrable prickly-pears, and now converted to dairy pastures, must exceed 1,000,000 acres on which many hundreds of new settlers live. In New South Wales the greater part of the former prickly-pear country has been brought into production, mainly for sheep grazing, and most of it has been utilized to enlarge adjacent pastoral properties.

The present status of Cactoblastis is satisfactory. Concentrated numbers of larvæ are still attacking, reducing and destroying many of the remaining prickly-pear areas of heavier growth. Native parasitic Hymenoptera are not exercising an undue amount of control and their importance is not growing. After an interesting discussion of the future of the problem, Mr. Dodd concludes that, up to date, there is no indication that prickly-pear will not continue to be held in complete subjugation by its remarkably efficient lepidopterous enemy.

THUNDERSTORM PROBLEMS

By Dr. F. J. W. Whipple

ON July 20 the London Branch of the Institute of Physics visited the Royal Meteorological Society at South Kensington to take part in a discussion on "Thunderstorm Problems". Sir George Simpson, president of the Royal Meteorological Society, was in the chair—a happy arrangement, for Sir George has been working at thunderstorms for nearly forty years; his classical work in India, which included the experiments on which the breaking-drop theory of the production of electricity is based, was published so long ago as 1909 and his most recent papers on the subject describe work of equal importance.

The discussion was opened by Dr. T. E. Allibone, who spoke on "The Physics of Lightning". His survey began with the year 1889, when Vernon Boys told the Physical Society that a lightning flash consisted of many separate strokes traversing the same path. Later, Hoffert recorded eight strokes on a photographic plate by waggling the camera about a vertical axis, and Walter, by using a camera mounted on a turn-table, was able to show that the strokes might be spread over a period of a second. It was Boys again who constructed a camera incorporating two identical lenses rotating about a common axis. The two images of a flash photographed with this camera were distorted differently and, the rate of rotation of the lenses being known, the speed with which the flash had developed could be determined. The Boys camera has been used effectively by Schonland in his studies of storms in the neighbourhood of Johannesburg.

Schonland and his collaborators demonstrated that a lightning flash to earth is a very complicated phenomenon. There is a preliminary 'leader' which starts from the cloud and sends out a number of branches; when one of these reaches the ground it becomes the channel for the main stroke up which the luminosity travels from ground to cloud. Subsequent leaders and main strokes use the same channel. The first leader alone is branched. Its progress is by jerky steps of about 50 metres. Comparison with electrical records has shown that the current in the main stroke is a hundred or more times as strong as that in the leader stroke. The main stroke removes to the ground the charges lowered from the cloud by the leader and retained for a while as ionization in the channel. It may be noted that in detailed studies the timing of a leader is conveniently reckoned in milliseconds, that of the progress of the main stroke in microseconds, while the intervals between the strokes are a few hundredths of a second.

Schonland's work has been supplemented by that of McEachron, who photographed lightning striking the Empire State Building in New York and other lofty structures. The summit of the Empire State Building is 1,250 ft. above ground. McEachron discovered that, when such a high building is struck, there is an inversion of Schonland's initial process and a stepped leader travels upwards from the building. This leader is not followed at once by a main stroke; a dart leader from cloud to building intervenes. The subsequent strokes constituting the flash are of the normal type. At Pittsburgh, where oscillograms were taken showing the character of the lightning striking a tower 500 ft. high, it was found that the first leaders could be either upwards or downwards.

The most powerful currents in a lightning flash occur in the successive main strokes. The currents reach maxima of the order 20,000 amperes and each main stroke lowers a fraction of a coulomb of charge to the ground. This charge comes from the channel ionized by the leader, but many large quantities of electricity are brought down by continuing flow following the main strokes. The total discharge from a flash varies from two or three coulombs up to 100 or more. The most frequent value is about 20 coulombs.

Finally, Dr. Allibone sketched briefly theories which have been suggested in explanation of the jerky movement of leader strokes. He believes that laboratory experiments with camera and oscillograph may throw light on such theories. The potential gradient at which a flash can start has yet to be calculated.

The next subject to be considered, the distribution of electricity in thunderclouds, was introduced by Dr. G. D. Robinson. Until recently there were wide differences of opinion on this subject. The evidence available consisted of observations of potential gradient near the ground and of estimates of the charges brought down by lightning. The evidence was interpreted in various ways. To overcome the difficulties of the subject, it was necessary to develop some form of electrometer which could be carried by a balloon and sent up into the clouds. A suitable instrument, the alti-electrograph, was developed at Kew Observatory. The records obtained with this instrument indicate variations of the sign of the potential gradient by the alternation of the traces of a pair of points on a rotating sheet of prepared paper. Changes in magnitude of the gradient affect the width of the traces and exceptionally strong gradients may cause sparking through the paper.

The discussion, by Sir George Simpson and F. J. Scrase, of the data obtained with the alti-electrographs sent up from Kew in 1935 and 1936, led to the conclusion that in the typical summer thunderstorm of south-east England there is a concentration of positive electricity at the top of the cloud, a concentration of negative electricity lower down and another less widespread concentration of positive electricity near the base of the cloud. Further, it was noticed that the concentration of negative charge is always centred at a level at which the temperature is below the freezing-point. The evidence was clear that two processes were at work, one where the cloud held snow and hail, the other where the precipitation had taken the form of raindrops. The positive charge concentrated near the base of the cloud could be explained by the breaking of the larger raindrops in accordance with the theory propounded by Simpson himself in 1909. It was recognized that the process which was active in the upper part of the cloud was analogous to the electrification of drifting snow. Collisions of ice crystals charge the ice negatively and the air positively. It is the settling of the ice crystals through the air which separates the charges. Incidentally, it may be mentioned that C. T. R. Wilson pointed out in 1923, in the "Dictionary of Applied Physics", that "Simpson's explanation of the electrical effects of drifting snow would seem to imply that snow and hail clouds should be of positive polarity", but this remark seems to have passed unnoticed.

Recently Sir George Simpson and Dr. Robinson have given details of additional soundings at Kew. They have discussed anew the earlier evidence and cleared up various difficulties. The triple structure of the summer thundercloud may be regarded as well established. The structure of thunderclouds in other parts of the world must be very similar, but it is likely that in some regions, notably in South Africa, where Schonland finds a great preponderance of negative charge brought down by lightning, the positive charge at the bottom of a cloud is not so well developed as in England.

In his contribution to the discussion, Mr. J. F. Shipley dealt with the development of thunderstorms and with the character of the air currents in the clouds. He has found evidence for the existence inside a thundercloud of great eddies, like smoke rings with a common vertical axis. That aeronauts who have ventured in balloons into thunderclouds have experienced violent movements, downwards as well as upwards, is notorious. Occasionally a balloon has been carried up and down repeatedly through several hundred feet. This is what would have happened if the balloon had entered a great vortex ring. The same hypothesis accounts for the appearance of some hailstones, which have grown like apples or like miniature fly-wheels. These must have been rotating violently during their growth. It must be admitted, however, that there is nothing in the appearance of

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most thunderclouds to suggest the presence of the vortex rings. Perhaps careful watching of accelerated motion pictures would reveal their existence.

Since the earliest days of wireless telegraphy it has been known that distant lightning affects the apparatus, and the hope has been entertained that it would be practicable to obtain direct observations which would be of use in locating storms with sufficient accuracy to meet the needs of the weather forecaster. Modern methods of recording and analysing atmospherics, the electromagnetic waves which proceed from lightning flashes, were explained to the meeting by Mr. F. E. Lutkin. The wave forms can be photographed with suitable apparatus, the horizontal movement of the light-spot of a cathode ray oscillograph being recorded on paper carried by a rapidly rotating drum. A high peripheral velocity, several metres per second, is needed.

There are a number of types of atmospheric. In the most frequent a series of oscillations with diminishing amplitude merges into a long smooth surge. The principal oscillations gradually lengthen, the first interval between peaks being of the order 150 microseconds and the fifth of the order 300 microseconds. The long surge lasts about a millisecond. The oscillatory movement is associated, it is believed, with the main stroke in a lightning flash, the long surge with the continuous discharge through the ionized channel.

In Australia and South Africa the peaks in the oscillatory movement have been related to the distance of origin by assuming each to be an echo, which has been subjected to a number of reflexions from the ionosphere and from the ground. In this way both the distance of the lightning and the effective height of the ionosphere can be determined.

The Australian and South African teams have both contended that the amplitude of the atmospherics can be used to measure the distance of origin. The approximation can only be very rough. The records at Slough show that the mean value of the field charge at the beginning of an atmospheric varies from 50 volts per metre at 25 km. to 0·1 at 5,000 km., but the individual values are well scattered about the means. A variation in the ratio of ten to one is often found in the amplitudes of atmospherics from a single source.

There are numerous applications of direction finding in the study of atmospherics. For locating storms two stations are required, preferably with telephonic communication; the various areas in which storms are taking place can be identified without difficulty and with reasonable precision.

The number of atmospherics received in Great Britain is greatest during the night in winter; 100 per second is a rate of frequent occurrence. These originate chiefly in tropical America. In summer, similar sources are indicated during the night hours and, during the day, there are large impulses, occurring less frequently, of European origin. Conditions are never favourable for the transmission to England of atmospherics from Africa, for the thunderstorms occur there in our day-time, when long waves cannot be transmitted.

A lively general discussion followed the four formal contributions. The outstanding difficulty in the whole subject is to explain how a lightning stroke begins. The idea that, owing to the existence of a large space charge, potential gradient increases from the ground up to a maximum at the base of a thundercloud, a maximum high enough to initiate a spark, has had to be abandoned. Very strong gradients, sufficient to cause sparking in the alti-electrograph, occur however inside the clouds, and this suggests that a flash to ground originates within the cloud and extends downward in the leader stroke process. The suggestion was made in the discussion that the trigger might be a spark between two drops, highly charged with electricity of opposite signs, brought together in their fall through the cloud.

Much interest was shown in the location of thunderstorms by radio apparatus, and it was stated that a practical application of the method has been found in the safeguarding of transmission lines. It is sometimes possible to cut out of circuit a line which passes through a region where thunderstorms are active, the instructions being sent from a central station with apparatus for determining the bearings of atmospherics.

As to apparatus required for further studies of thunderstorm problems, perhaps the outstanding need is for the development of simple electrographs which will serve to provide measurements of the strength of the field in and around the clouds. More than one type of electrograph is needed, for weak fields have to be measured as well as strong ones. A comparison of records of strong fields will serve for a satisfactory calibration of the alti-electrograph traces. The measurement of the weaker fields is especially desirable above the clouds. At present it is definitely known that the gradient immediately above a cloud is negative, so that an electric current starts upwards. Some of the lines of flow curve round and reach the ground at a modest distance; but it is believed that others go upwards to the ionosphere and carry electricity which is to return to earth in the air–earth current of fine weather. It is to be hoped that, some day, measurements of potential gradient and conductivity will be obtained well above the clouds and show whether there is an upward current strong enough to furnish the appropriate quota of air–earth current.

THE TOTAL SOLAR ECLIPSE OF SEPTEMBER 21, 1941

By D. H. SADLER
SUPERINTENDENT, H.M. NAUTICAL ALMANAC OFFICE

ALTHOUGH the achievements of Dr. B. Lyot in photographing the corona without an eclipse[1] have provided an alternative method for certain spectroscopic work on the inner corona, a total solar eclipse still provides the only opportunity for observation of the outer corona, and for many other important researches such as, for example, the observational determination of the deflexion of light by the mass of the sun. The total time available for observation during totality is only a few hours a century, so that literally every second is of prime importance. That the tracks of totality may pass across the earth's surface in a band 60–100 miles wide without crossing land, or be confined solely to polar regions, together with the ever-present chance of cloud, acts merely as a greater inducement to make the fullest use of every opportunity. It is thus particularly unfortunate that the shadow of war is likely to obscure the shadow of the moon on September 21.

The eclipse of September 21, 1941, may be classed as 'about average' in regard to duration of totality, accessibility of the track of totality, and likely conditions of observation. The track passes overland for half its length, starting at a point midway between the north of the Black Sea and the Caspian Sea, passing a few miles south of Astrakhan, where the eclipse is visible shortly after sunrise, with the sun only a few degrees above the horizon; it then crosses the northern portion of the Caspian Sea and proceeds across Lake Aral into Turkestan. It passes a short distance (about 200 miles) north of the Observatory at Tashkent, but the altitude will not be more than 20° and the duration less than two minutes; even so it is a 'close approach' to an established observatory. As the track passes from Russian to Chinese Turkestan it crosses mountainous country to which access would be extremely difficult. Proceeding in a south-easterly direction the track sweeps across China, emerging at the coast almost midway between Shanghai and Hong-Kong, a few miles only north of Foochow; it passes just north of Formosa. The far interior of China is probably not readily accessible for astronomical expeditions, and in any event conditions of both altitude and duration improve towards the east; the track, however, does pass over Hankow, at which place the eclipse will occur at local noon with the sun at an altitude of 62° and with a duration (the maximum for the eclipse) of 200 seconds. It is between Hankow and the coast that the best conditions for observation will probably be found. Leaving the coast of China, the belt of totality passes out into the Pacific Ocean and the remainder of the track does not strike land, except for two small islands (Rota or Luta Island and Tinian Island) slightly north of the important island of Guam; the southern limit of the eclipse track passes about 20 miles north of Guam itself.

It is not a very common occurrence for an eclipse to be visible from an important city, situated within a few miles of the central line of totality; it is a much rarer event, and one that must be almost unique, for a city to be within 30 miles of the point at which central eclipse occurs at local apparent noon.

Although present conditions have made expeditions from Great Britain quite impossible, it is hoped that the eclipse will not pass unobserved. It is unlikely that the Russian astronomers at Tashkent will allow an eclipse almost 'on their doorstep' to pass without making some attempt to observe it; observing conditions will not be good, however, and the difficulties of transport, combined with the overshadowing war with Germany, will not encourage a full-scale expedition. At the Stockholm meeting of the International Astronomical Union in 1938, both Chinese and Japanese delegates offered to give all facilities and assistance to astronomers intending to observe the eclipse in China; unfortunately there will now be none to take advantage of these offers. It is hoped that both the Chinese and Japanese astronomers will make an effort to secure observations, but so far no reliable information is available about any proposed expeditions.

Similarly, no definite information is to hand about American expeditions, but in view of the international tension, it must be considered unlikely that any expedition will go to China; the islands to the north of Guam (Rota Island lies well within the track) would be a possible eclipse site.

This is the second eclipse that has been partially obscured by war; the enforced absence of the European astronomers from the eclipse of October 1, 1940, was compensated by the good work of the South African astronomers, who operated instruments sent from Great Britain in addition to their own.

[1] Mon. Nat. Roy. Astrol Soc., **99**, 580.

OBITUARIES

Prof. Paul Sabatier, For.Mem.R.S.

THE recent death of Paul Sabatier at Toulouse has removed from our midst one of the founders of modern catalytic chemistry. Sabatier commenced his lifelong research into problems of catalysis in 1897. The year 1900 may be regarded as the dawn of the epoch of catalytic hydrogenation, an investigation which culminated in the award of the Nobel Prize in 1912.

While Sabatier's general method of approach was from the point of view of a preparative organic chemist, nevertheless in the course of his work he showed a deep perception and thorough appreciation of the physical chemical implications. The range of reactions which he studied both by himself and with his co-workers, among whom the Abbé Senderens must be especially singled out, is truly remarkable, and a good account of them is presented in his monumental book "La Catalyse en Chimie Organique", first published in 1913 with a second edition in 1920.

Sabatier was greatly interested in the problem of hydrogenation, and showed *inter alia* that good hydrogenating catalysts were also effective in dehydrogenation ; he succeeded in the difficult case of benzene in both hydrogenating it to cyclohexane and in dehydrogenating the product on the same catalyst. In his very early experiments he observed how sensitive catalysts were to heat treatment and how active catalysts could be prepared by gentle reduction of the oxides or nitrates. The use of alcohol instead of hydrogen as a reducing agent is due to Sabatier. He has put on record many interesting cases of selective hydrogenation which still await adequate explanation, such as the reduction of $\varphi CH_2\ CH_2\ CO\ CH_2\ CH_2\varphi$ to $\omega\ \omega'$ diphenyl pentane or to dicyclohexyl pentane, or amyl acetylene to amyl ethylene or to normal heptane, the former on a 'less active' copper catalyst, the latter on an 'active' nickel catalyst.

One of Sabatier's most illuminating contributions to the science lies in his discovery of directive or selective catalysis. He showed, for example, that formic acid could undergo two modes of decomposition, to carbon dioxide and hydrogen or to carbon monoxide and water ; that alcohols could be converted into aldehydes and hydrogen or to ethylene and water. While metals 'favour' the first mode of catalytic decomposition and dehydrating oxides the second, there exists a whole series of catalysts on which both reactions occur, the relative extent of each reaction being dependent on the mode of preparation of the catalyst and on the temperature. This specific action of the catalyst led Sabatier to write : "La nature chimique du catalyseur exerce une action décisive dont on peut guère trouver l'explication que dans des combinaisons temporaires quoiqu'il puisse être dans certain cas, difficile d'en précisir la vraie nature." The modern hypothesis of the intermediate chemical compound or chemisorbed complex could not be expressed more clearly. That these "combinaisons temporaires" are not identical with isolatable chemical compounds could be gathered from further work of Sabatier, who was one of the first to evaluate the exact temperature coefficient and the apparent energies of activation of catalytic reactions. In many cases these were relatively small and less than those required to decompose the true chemical compounds.

Sabatier was likewise the first to pay detailed attention to what are now termed promoters ; already in 1902 he investigated the effects of incorporating various oxides, for example, of beryllium, aluminium and magnesium in a nickel catalyst to obtain more active and robust systems. Among the many and varied catalytic reactions discovered by this indefatigable worker the following may be mentioned as ones which have been adapted to modern chemical industry or are potentially important : the reactions of alcohols with hydrogen sulphide and ammonia to yield thiols and amines respectively ; esterification in the gaseous phase ; the formation of ketones and ethers from acids and phenols. In hydrogenation reactions we may mention the reduction of the cyanides to amines and of the isocyanides to secondary amines and the stepwise reduction of the nitro group in cyclic nitrobodies.

Doubtless many of us wish that circumstances might have permitted us to solemnize in a more formal manner the departure of Paul Sabatier to a distant shore, but we can at least affirm that he has left his imperishable characteristic imprint on our science and on our industry. ERIC K. RIDEAL.

Dr. E. L. Ince

DR. EDWARD LINDSAY INCE, head of the Department of Technical Mathematics in the University of Edinburgh, died on March 16 at the comparatively early age of forty-nine. Dr. Ince, who was one of the first research students of Prof. E. T. Whittaker when the latter established a school of mathematical research in Edinburgh almost thirty years ago, had a varied life of mathematical activity. From Edinburgh he proceeded to Trinity College, Cambridge, becoming a Smith's Prizeman during the War of 1914–18. In 1918 he was a temporary lecturer at the University of Leeds ; in 1919 he studied at Paris ; from 1920 until 1926 he was a lecturer in mathematics at the University of Liverpool. In 1926 he was appointed to the professorship of mathematics in the then newly founded Egyptian University in Cairo, but in 1931 he returned to Britain for the sake of the health and education of his family. For a brief period he was lecturer in the University of Edinburgh, then at the Imperial College of Science and Technology, and finally, from 1935 until his death, lecturer in technical mathematics at Edinburgh.

Ince's published work falls into three parts : some two score or more papers, mostly on Mathieu functions

and on linear differential equations with periodic coefficients; a tract on descriptive geometry and two text-books on ordinary differential equations; and a volume of tables ("Cycles of Reduced Ideals") computed for the British Association, on the Tables Committee of which he served for many years.

Ince firmly believed that theoretical solutions of problems, however abstractly elegant, were incomplete unless the mathematician either tabulated the solving functions himself or rendered them tabulable. Perusal of his papers will show that in his chosen field of research he achieved both of these objects. He regarded his research, however, as entirely subsidiary to the work of teaching and of examination. To these duties he brought a rigour of self-imposed obligation which in the end was worn as a natural discipline, until ill-health supervened.

Unversed in Ince's special domain, I will not presume to appraise his papers. That has been fitly done by his master and colleague, Prof. E. T. Whittaker, in the recent posthumous conferment of the Makdougall-Brisbane Prize, awarded to Dr. Ince by the Royal Society of Edinburgh. Perhaps a more personal reminiscence may be permitted. When the "University Series" of small text-books, published by Messrs. Oliver and Boyd, was projected some three years ago, the editors invited Dr. Ince to submit a manuscript on ordinary differential equations. Soon afterwards Dr. Ince was seized by a very debilitating illness, which laid the seeds of the later and mortal one. I at once begged him to relinquish or defer the undertaking; but I was met by a quiet yet firm refusal. The book had been sketched; its outlines were clear; during convalescence chapters would be pencilled; examples would later be added. And indeed in due course the book was completed; nor does it bear any trace of the physical weakness that attended its composition.

The quiet resolution that nerved Ince to this task, as later to the completion of his last paper on Lamé functions, gives the measure of the man. He drew this courage from sources which evoke the respect and reverence of his friends.

A. C. AITKEN.

Prof. N. S. Kurnakov

BY the death of Prof. N. S. Kurnakov on March 19, at the age of eighty, Russia has lost a pioneer physical chemist whose work and influence, great in his own country, extended far beyond its borders. His early training some sixty years ago in the St. Petersburg Mining Institute must have largely influenced the trend of his subsequent work, which was mainly concerned with the applications of the principles of the phase rule to the study of binary systems, more especially alloys and salt mixtures, and with the development of the mineral resources of Russia. Kurnakov was one of the first to devise and use recording pyrometers for the thermal study of alloys and binary mixtures generally, and he was particularly interested in the variations of viscosity and of hardness which accompany changes of composition in such systems. He founded one of the chief schools of inorganic chemistry in the U.S.S.R., and right to the end of his life was director of the Institute of General and Inorganic Chemistry of the Academy of Sciences of the U.S.S.R.

Kurnakov's work, carried through with the assistance of numerous younger collaborators, many of whom are now contributing materially both to the defence and the development of Russia, is an admirable example of the fact that the development of scientific knowledge and the growth of industrial practice are closely related and largely mutually dependent. The work and ideas embodied in his treatise "An Introduction to Physico-Chemical Analysis" enabled him to play a great part in discovering and developing the resources of the salt lakes in the Crimea and on the Caspian, the deposits of potassium and magnesium in the region between the Volga and the Emba Rivers, and the deposits of bauxite at Tikhvin, upon which the Russian production of aluminium largely depends. His concern with the exploitation of Russia's resources in platinum and other noble metals led to researches on their compounds, which in turn yielded important developments in the extraction and purification of these metals.

Though little known personally to his British colleagues, Kurnakov was greatly esteemed and honoured in the U.S.S.R.: he held the Order of the Red Banner of Labour and was very recently awarded a Stalin Prize.

H. V. A. BRISCOE.

WE regret to announce the following deaths:

Prof. E. Abelaus, formerly professor of physiology in the University of Toulouse.

Dr. R. D. Archibald, formerly senior lecturer in electrical engineering in the Royal Naval Engineering College, Keyham, on August 17.

Prof. Otfrid Foerster, formerly professor of neurology in the University of Breslau, honorary fellow of the Royal Society of Medicine, aged sixty-eight.

Dr. W. Gardiner, F.R.S., honorary fellow and formerly fellow and bursar of Clare College, lately University lecturer in botany in the University of Cambridge, on August 31, aged eighty-one.

Prof. Thomas Gibson, formerly professor of pharmacology in Queen's University, Kingston, aged seventy-six.

Mr. S. H. Horgan, a pioneer in the half-tone process for the reproduction of pictures, on August 31, aged eighty-six.

Prof. R. F. Irvine, the well-known Australian economist.

Mr. W. Macnab, C.B.E., the well-known chemical engineer, technical adviser to the Explosives Supply Department of the Ministry of Munitions during the War of 1914–18, on September 3.

Prof. A. K. M. Noyons, professor of physiology in the University of Utrecht, aged sixty-three.

Dr. Vinnie A. Pease, since 1920 micro-analyst in the U.S. Bureau of Chemistry (now the Bureau of Agricultural Chemistry and Engineering), on April 30 aged fifty-nine.

NEWS AND VIEWS

The British Association: Science and World Order

FURTHER details of the meeting of the Division of the Social and International Relations of Science of the British Association to be held during September 26–28 at the Royal Institution (NATURE of August 30, p. 251) have now been issued. The aim of the meeting is to "demonstrate the common purpose of men of science in ensuring a post-war order in which the maximum benefits of science will be secured for all people".

Mr. Winant, the American Ambassador, and M. Maisky, the Soviet Ambassador, will preside at some sessions, and others will be held under the chairmanship of Dr. Wellington Koo (Chinese Ambassador). Dr. Beneš (president of Czechoslovakia), Mr. H. G, Wells, and Sir Richard Gregory (president of the British Association). Czechoslovakia, Poland, Norway, Holland, Belgium, and France will be represented, and exiled men of science from Germany, Austria, and possibly Italy, will also take part. The meeting will seek to define the part which science can play in helping to secure the best use of the possibilities of the twentieth century and to make practical contributions to problems and their possible solution.

Atmospheric Pollution

THE annual report for the year ending March 31, 1940, on the Investigation of Atmospheric Pollution, which would normally be issued by the Department of Scientific and Industrial Research, has been replaced by a summary prepared for the information of the co-operating bodies. From this it appears that the deposit over the whole of Great Britain, as represented by the deposit gauges, has decreased. The highest total deposit measured for the year (395 tons per square mile) was in Manchester, while the lowest measured (57 tons per square mile) was at Loggerheads, Shropshire; both places, however, show smaller deposits than in the previous year. There were only three complete sets of results with automatic filters: Cardiff, Coventry and Stoke-on-Trent. These are not sufficient to provide a basis for comparison with the previous year. The average monthly suspended impurity does, however, show interesting characteristics, notably maxima, in January 1940, which it will be remembered was unusually cold. This increase in suspended impurity was no doubt due to an increase in all forms of domestic heating during the cold period despite the shortage of fuel in some districts. All three places show a sharp increase in suspended impurity in October, followed by a minimum in November, although the average temperature for that month was lower than the average for the past fifty years or so. It may be that the continuation of Summer Time until November 20, 1939, and the restriction on the combustion of fuel imposed by the fuel rationing scheme may be responsible to some extent for these minima in November.

Complete results for the measurement of the concentration of sulphur dioxide by the volumetric method were obtained from the stations at London (Beckton and Crossness), Salford and Sheffield. The averages from these stations are slightly lower than those for the previous year. The measurement of sulphur gases by the lead peroxide method does not show any unusual features. Measurements of suspended impurity by the automatic filter made in Central Park, New York City, show that New York has its purest air in the afternoon between 1 and 3 p.m., while the measurements for British cities have invariably shown that the early morning air is the cleanest. This difference is no doubt due to the greater convectional turbulence of a continental climate in the day-time, resulting in a distribution of the pollution through a greater depth of atmosphere and a corresponding reduction of concentration at ground-level. Further measurements made in Dublin by Dr. Leonard have shown an interesting correspondence between concentration of sulphur dioxide and suspended impurity, the two curves for the average monthly values showing a noticeable degree of parallelism. Automatic filter results at Leinster Lawn, Dublin, indicate a ratio of domestic to industrial pollution of 3·3 to 1 in winter and 2·3 to 1 in summer.

Luminous Plastics

IN a paper by Dr. V. E. Yarsley published in the *Electrician* of August 8, an interesting account is given of recent developments in moulding materials for practical purposes. Perhaps the application to luminous plastics is the one which has attracted the greatest public interest. Having a light switch, door handle or telephone clearly visible is of real practical value for a night emergency in war-time. The layman usually associates luminescence with phosphorus or radium, and the terms luminescence, fluorescence and phosphorescence are often misused. Those substances which convert incident radiations into visible light, and not into heat, as is more usual, are called luminescent. Those materials which emit visible radiations only during the period when the exciting radiation is impinging are said to be fluorescent. The commercial luminescent materials do not belong to the radium family. They are usually metallic sulphides, more particularly those of zinc, calcium, strontium and barium. Mixtures may be used, and in some cases increased luminosity results from the addition of minute quantities of metals.

Luminous plastics may be produced either by adding the luminous pigment directly to the moulding powder or by covering the moulded article with a suitable luminous lacquer. While the latter appears the more natural method, since it requires the relatively expensive luminous pigment only in the lacquer layer, yet there are certain advantages

gained by adding the pigment to the moulding composition. A considerable amount of research has been necessary to develop a luminous pigment sufficiently stable to withstand the stringent conditions of moulding, while at the same time care had to be taken that the pigment in no way affected the chemical stability of the plastic mass. Very considerable progress has recently been made in this direction.

An interesting range of moulded luminous plastics which appeal both to the domestic user and to A.R.P. authorities is manufactured by Roanoid, Ltd., of Glasgow. These are produced in a suitable light-coloured thermo-setting plastic and include moulded letters and numerals in $1\frac{1}{4}$ in. and 2 in. sizes, and also various fittings. Cellulose acetate sheet containing a variety of fluorescent dye-stuffs in standard sheets of 56 in. by 26 in. which can easily be cut or stamped to form displays or printed signs for shop windows, cinemas and theatres are available. The ultra-violet light used for irradiation of the plastic sheet is not harmful to the eyes, since the special 'blacklamps' of 80 and 125 watts used emit radiations which have no physiological action. It is stated that while fluorescent paints lose some of their power after a few weeks exposure, fluorescent plastic sheet showed no diminution during the period under test.

Examination of Jewels in Electric Meters

THE apparatus required to measure electric power is both expensive and requires special attention. The higher the accuracy aimed at the greater is the cost of the meter, and the time and labour that has to be devoted to it rapidly increases with the accuracy demanded. To encourage the use of electricity, the Electricity Commissioners have recently allowed the testing for low-load performance to be done at one tenth instead of one twentieth of full-load capacity. Another economy they have effected is to show that an appreciable extension of the life of jewels and pivots of electric meters can often be obtained by cleaning. An article on meter jewels, their examination, grading and reconditioning, giving the recommendations by the Meter Technical Committee of the Electricity Commissioners for overcoming the present difficulties of obtaining new jewels and pivots, appears in the *Electrical Review* of August 8.

The first method described is to use a microscope with a magnification of 40–70 diameters, the stage being fitted with a simple means of holding the jewels, coaxially with the microscope and automatically positioned with the jewel cup in focus. The chief defects to be looked for are surface cracks, appearing as sharply defined straight or curved lines (parallel if more than one) on the jewel surface, and scratches from the original polishing or acquired during transport. Jewels, after examination, are classified Grade 1 jewels, which can be used immediately; Grade 2, which can be re-surfaced, showing no defects beyond shallow central wear or slight scratches within the working surface area. A pivot end that is unpolished and of bad shape must be ground to shape and polished; it should be hemispherical and never ground to a needle point. Even very slight films of dust or grease may obscure serious defects. Boiling in an aqueous solution of sodium hydroxide followed by quick drying and a rinse in commercial alcohol is said to be beneficial.

The Solar Corona

DR. DONALD H. MENZEL has an article entitled "What is the Solar Corona?" in the *Telescope* of May–June, in which he refers specially to the researches of Bengt Edlén, of Uppsala, who has shown that coronium is chiefly iron. Nickel and calcium have also been identified, the outer electrons in all these elements being torn away. Difficulties arise in explaining how the comparatively low temperature of the sun—about 6,000° C.—can be responsible for tearing away the outer electrons, the removal of which requires a temperature of at least 100,000° C. Then again, Edlén has pointed out that the great breadth of the coronal lines suggests a very rapid movement of the atoms, and a temperature of 2,000,000° C. would be required to explain this. Conclusions of a similar nature have been reached by independent lines of investigation and various explanations have been suggested to account for the source of this high temperature. The most acceptable hypothesis is that the highly heated coronal matter is issuing in great jets from holes and cracks in the solar surface. These crevices, which are probably associated with sunspots, run far down into the hot interior, where the temperature is several million degrees.

Many problems arise as a consequence of this hypothesis. Thus it is suggested that solar prominences are formed as condensations from the corona, and the motion-picture records of active prominences corroborate this view. Thousands of miles above the solar surface prominences are observed to "materialize" and to be moving downwards. They are previously invisible because their earlier high temperatures caused them to emit radiations of an unfamiliar character. The identification of the remaining coronal lines still awaits a solution and a great mystery is the tendency of coronal matter to move in well-defined arches or streamers. A possible explanation may be found in the presence of magnetic and electric fields. It is suggested that the source of electrification of the ionosphere may be found in the X-ray energy associated with the coronal emission.

Forest Administration in Malaya

THE annual report of the Malay Forest Department for the year 1939 (Govt. Press, Kuala Lumpur, Federated Malay States, 1940) is of unusual interest. A history is given of the growth of the Department from the year 1883, when the Director of Gardens, Straits Settlement, initiated a small Department. Five years later, Mr. H. N. Ridley became director and instituted a policy of Government reservation which saved valuable forests from destruction during the rubber boom of thirty years ago. As the result

of a report on the forests by the late Mr. H. C. Hill of the India Forest Service, a Burma forest officer was appointed to the control. At present, the ten States of Malaya have each a Forest Department loosely united by a common and interchangeable staff of senior European officers and an ever-increasing body of Malays trained in the vernacular school of Kepong.

In some respects the Malay States now possess one of the most up-to-date forest departments in the Empire. That this is realized by the Government is evidenced by the recent investigation into the position of forestry and mining. Mining is one of the most important of the industries and yet the interests of the mining community tend to clash with those of agriculture and forestry. Some 10,471 square miles of the States are reserved forest (about 20 per cent of the country), yet 52·8 per cent of forest land still remains unaccounted for. Much of the reserved forest is in mountainous country. The mines are mostly concentrated in the plains. Since timber is heavy and will not bear expensive transport charges, the Forest Department wishes to develop the management of the forests which are reasonably accessible—often in the neighbourhood of existing mining tracts and into which the mining industry may wish to expand. It is recognized that the mining community takes a large amount of the produce of the forests. The problem which is now being faced is to settle, if possible for a period of years, those areas which will probably be required for the extension of mining. In this the Geological Department is affording assistance; thus allowing the Forestry Department to concentrate its works of improvement on workable, because accessible, forests which will not be liable to be expropriated at short notice. The crucial point arising out of the arrangement is the obvious recognition by the Government of Malaya of the importance of the forests to the country and its inhabitants.

Venereal Diseases in War

According to M. Schubert (*Ven. Dis. Inform.*, 22, 327; 1941), a comparison between the incidence of venereal diseases in the Prussian Army during 1903–1913 and the four years of the War of 1914–18 showed that the average incidence was 20·4 per 1,000 during peace-time and 20·5 per 1,000 during the War. Contrary, therefore, to the widely prevalent but false assumption that the incidence of venereal diseases during that War was much higher than in peace, the difference was only very slight. The only increase which did occur was in the number of cases of syphilis. Of those infected during the War 67·5 per cent contracted their infection at home and only 32·5 per cent at the front. After demobilization of the army after the War there was a catastrophic increase in the incidence of venereal disease up to 1921–22, after which date there was a gradual decrease which in 1925–26 became increasingly noticeable and was probably due to better-regulated conditions for treatment. The decrease in the incidence of syphilis was greater than that of gonorrhœa. During the past few years chancroid has been very rarely seen in Germany. During the first nine months of the present War no increase in the incidence of venereal disease has been observed except among the troops who had been in Poland, in whom the number of syphilitic infections was low and chancroid was not found.

Health of Hong Kong

According to Dr. Selwyn Clarke, the director of medical services, Hong Kong, in his annual report for 1939, the colony's chief health problem is the large number of Chinese refugees from the Sino-Japanese War. In July 1939 the number of persons entering the colony exceeded the number leaving it by 327,833. Many of the immigrants were destitute, ill-nourished and diseased, and the overcrowded conditions in which they lived were a most serious menace to public health. The largest number of deaths in 1939 were caused by non-tuberculous diseases of the respiratory system. Tuberculosis came next, the majority of the deaths being due to the pulmonary form. 24 per cent of 1,500 refugees whose blood was examined showed a malarial infection. There were more than 9,000 cases of beriberi, 800 cases of cholera and 3,000 of influenza during the year.

Announcements

A Rockefeller Foundation grant of 25,000 dollars for research in endocrinology for five years under the direction of Dr. J. S. L. Browne, assistant professor of medicine and lecturer in pathological chemistry at McGill University, is among recent gifts to the University.

A Department of Radiology has recently been established in the medical faculty at McGill University under the direction of Dr. C. L. Peirce, radiologist-in-chief at the Royal Victoria Hospital, and Dr. W. L. Ritchie, director of radiology at the Montreal General Hospital.

The National Institute of Health of the United States Public Health Service is organizing a new research unit to be called the "Unit of Gerontology", which will deal with the diseases of the aged. Further information can be obtained from Dr. Edward J. Stieglitz, Investigations in Gerontology, National Institute of Health, United States Public Health Service, Bethesda, Maryland.

On the recommendation of the Agricultural Research Council, the following awards of one agricultural research scholarship and two studentships for research in animal health have been made by the Ministry of Agriculture and Fisheries, and the Department of Agriculture for Scotland: H. E. Davenport, of University College, Nottingham, a research scholarship in helminthology; F. Alexander, of the Royal (Dick) Veterinary College, Edinburgh, a studentship for research in animal health; A. McDiarmid, of the Royal (Dick) Veterinary college, Edinburgh, a studentship for research in animal health.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot 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.*

Hydrological and Biological Studies of Loch Sween

IT is now many years since I directed the attention of zoologists to the excellent facilities for marine biological research afforded by Loch Sween on the coast of Argyle. In the years before 1914 it provided a delightful centre for the activities of Glasgow students of zoology during their Easter vacation. During the early post-war years Government approval was actually obtained for the conversion of one of the hospital barges used on the rivers and canals of France and Flanders into a floating laboratory, to be used as tender to the Millport Marine Station and moored for periods in Loch Sween and other west coast lochs. These plans had, unhappily, to be cancelled when economic pressure brought about the curtailment of expenditure on scientific research during the lean post-war years.

It is accordingly of much interest to myself to read in an article by Dr. F. Gross[1] of his references to Loch Sween, and I think it well to indicate two lines of investigation which to my mind deserve special attention. The first of these is an intensive study of the hydrography of the Loch—more especially of the rise and fall in the level of its waters. During my early seasons there I naturally endeavoured to construct a time table, but found myself reduced to giving up this task in despair. Tidal behaviour in the Sound of Jura outside the Loch; the local distribution of barometric pressure; the direction of the prevalent wind: all these factors played their part, but it appeared to me there must be other unknown factors, and I found myself inclined to suspect something of the nature of a *seiche*. In this connexion I bore in mind the existence of the strongly flowing tidal currents of the Sound of Jura which form a kind of barrier across the mouths of the sea-lochs opening into it and which, in the case of Loch na Cil, widely open to the south-west, is so effective as to make that loch a useful anchorage even in a south-westerly gale.

The second line of investigation is that of the origin of the fine silt accumulating in the Loch and constituting a factor inimical to the oysters which in earlier days were so abundant. During my tenure of the chair of zoology in the University of Glasgow, I kept under observation a large aquarium tank in which grew the Canadian pondweed Elodea with a balanced animal population—pulmonate Gasteropods, fresh-water Oligochaetes, Protozoa, etc. My special interest in this tank lay in its gradual accumulation of a thick deposit of fine mud of organic origin—composed of fæcal and other debris from its animal and plant inhabitants—and the interesting problem suggests itself: Is any appreciable proportion of the fine mud of Loch Sween contributed by its rich planktonic and other fauna? Dr. Hilary Moore's important studies of the mud of the Firth of Clyde might find a profitable extension to the muddy deposits of Loch Sween and other similar highland sea-lochs.

JOHN GRAHAM KERR.

Tayvallich,
Loch Sween,
Argyll. Aug. 31.

[1] NATURE, **148**, 71 (1941).

Plankton as a Source of Food

THERE are several points which should be raised in connexion with the communication from Dr. Nicholas Polunin[1] in which the value of phytoplankton as plant manure is discussed. He suggests that the development of a rich growth of algæ in an open bucket or pan of water increases the value of this water as plant manure. It is, however, obvious that the only increase in total matter in the water is the carbon absorbed by the algæ. This carbon, incorporated in the algal cells, is of very doubtful value as plant manure. Growth of algæ in the water is dependent on the presence of dissolved nutrients, notably nitrogen and phosphorus salts, and the transformation of these into organic compounds does not increase their amount, or their value as plant manure, but rather the reverse, since the complex organic compounds must be decomposed by bacteria before the nutrients become available to the plants manured. For the purpose suggested, that is, the watering of vegetables, which are short-period crops, it would seem more important to add the nutrients in readily available form than to build up a reserve of organic matter in the soil. Furthermore, it is probable that there is a loss of nitrogen from the water during the development of the plankton, owing to the escape of gaseous nitrogen by denitrification or by the reaction between amino-nitrogen and nitrite. It is unlikely that any of the algæ capable of fixing nitrogen, (that is, members of the Cyanophyceæ) would grow in such tanks or buckets. It would therefore appear that the bucket of water constitutes a more valuable plant manure in its original state than it does after the development of a phytoplankton.

Figures which I obtained during experiments on the growth of algæ under conditions similar to those mentioned may be of interest. The vessels used were shallow tubs and glass tanks, open or with glass lids, heavily manured with the essential elements. Under summer conditions, a dense growth of Chlorococcales developed, but its dry weight was small in comparison with the amount of salts added. A tub of 100 litres capacity, to which 28 gm. of nutrient salts were added, produced a total dry weight of Chlorococcalean plankton of the order of 5 gm. in one month. No figures for the changes in total quantity of dissolved salts are available, but the following figures give an idea of the changes in nitrogen content. With ammonium nitrate, the decrease in ammonia and nitrate nitrogen was compensated by the increase in organic nitrogen, but in water manured with ammonium sulphate, a decrease of 15 per cent or more in total nitrogen was observed, while with potassium nitrate the decrease was 10 per cent.

It will be evident from this that the increase in humus content, which is in any event of problematical value as plant manure, is more than offset by the probable loss of nitrogen, and the certain decrease in availability of the nutrient salts.

WINIFRED PENNINGTON.

Freshwater Biological Association,
Wray Castle, Ambleside,
Westmorland. Aug. 14.

[1] NATURE, **148**, 143 (1941).

Isolated Nerve-Muscle Junction

A SINGLE muscle fibre with its nerve supply (Fig. 1) has been dissected from the M. adductor longus of the frog (*Hyla aurea*). This preparation survives for as long as twenty-four hours at a temperature of 18–20° C., and electric potential changes have been recorded from some twenty of these isolated nerve-muscle junctions during activity. In most experiments the muscle fibre was kept in saline at a paraffin interface while the nerve was lifted into the paraffin and stimulated there. A 50-μ diameter platinum wire served as leading electrode at the junction and was insulated except where it made contact with the muscle fibre. It was moved to different positions along the muscle fibre by means of a micrometer adjustment. The second leading electrode was in the saline below the fibre and acted thus as a diffuse lead.

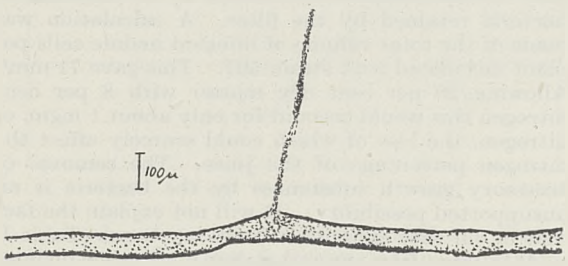


Fig. 1.

PHOTOMICROGRAPH OF A SINGLE MUSCLE FIBRE WITH NERVE SUPPLY.

A single stimulus to the nerve gives a propagated spike along the whole muscle accompanied by a contraction. Fig. 2*a* shows an action potential 0·23 mm. away from the nerve entry. Two components of the rising phase are seen ; the larger and steeper one *s*, the muscle spike, which stays constant along the whole length of the muscle fibre, and an initial smaller component ε, which is only recorded near the motor end-plate (the end-plate-potential (e.p.p.), cf. Eccles, Katz and Kuffler[1]). At 150μ nearer the nerve entry (Fig. 2*b*) the e.p.p. rises much more steeply, reaching about 65 per cent of the action potential before the spike appears. With a further shift of 80μ to the nerve entry (Fig. 2*c*) the e.p.p. is so large that the spike component is barely seen rising above it. Indeed by careful adjustment the e.p.p. becomes so large that no phase of spike rise is observed. Curarization (Fig. 2*d*) diminishes the e.p.p. and the spike is delayed but not altered appreciably in total height. Below a critical e.p.p. height (Fig. 2*e*) no spike is set up and the e.p.p. alone is recorded.

Thus it can be shown that a nerve impulse gives rise at the nerve-muscle junction to a localized negative potential change as large as the muscle spike potential. This potential, in its turn, sets up the muscle spike. It decrements rapidly along the fibre and falls to about 20 per cent at a distance of 0·25–0·35 mm. from the neuro-muscular junction.

Early in the refractory period, a second nerve impulse sets up only an e.p.p. (similar to the e.p.p. in Fig. 2*e*) ; when later, a second muscle impulse is also set up but usually does not reach its full size until 0·5–0·8 mm. from the neuro-muscular junction. At times this impulse dies out after it has reached up to 30–40 per cent of the full spike potential and has propagated as far as 0·3–0·5 mm.

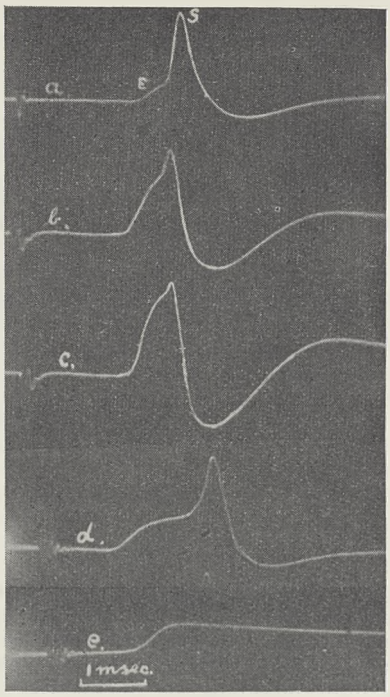


Fig. 2.

ACTION POTENTIALS. (*a*), 200μ AND (*b*) 80μ AWAY FROM THE NERVE-MUSCLE JUNCTION ; (*c*) AT THE NERVE-MUSCLE JUNCTION ; (*d*) SUBPARALYTIC DOSE OF CURARINE ; (*e*) PARALYTIC DOSE OF CURARINE.

When recording in paraffin oil, action potentials up to 55 mv. have been obtained.

S. W. KUFFLER.
Kanematsu Memorial Institute of Pathology,
Sydney Hospital,
Sydney.
May 22.

J. Neurophysiol., 4 (July, 1941).

Effective and Ineffective Association between Root-Nodule Bacteria and the Host Plant

IN a recent paper, Chen, Nicol and Thornton[1] present results from which they conclude that "the production as a result of infection of soluble substances affecting the growth of the bacteria affords an explanation of those differences in nodule growth that determine the effectiveness or ineffectiveness of the different strains of bacteria as regards nitrogen fixation within the host".

A closer examination of the data given in the paper fails to confirm the validity of this conclusion. Controls do not seem to have been adequate, and there is no information as to the nutrients supplied in the plant juices which were added to such a high concentration (18 per cent). These omissions are the more surprising since the authors, in explaining the variable nature of their results, state :

"Composition of the root juice is liable to be affected by the growing conditions of the plant and by details in the method of extraction and filtration that are very difficult to control."

Briefly, three levels of growths were obtained in the

majority of experiments, corresponding with the following conditions and in this decreasing order :

(1) Basal medium + juice of effectively nodulated root ;
(2) Basal medium + juice of uninoculated root ;
(3) Basal medium + juice of ineffectively nodulated root.

However, there is no evidence to show that the nutritive substances of the yeast sucrose medium were such as to support maximum growth, namely, growth which could not be improved by extra nutrients in the medium. In fact, the one experiment which reports results with water instead of plant juices showed that the latter, even from poorly nourished uninoculated plants, caused considerable increase in growth :

	Mean Colony Areas (sq. mm.)	
	Without root juices	With juices from uninoculated plants
Mean growth, all strains	99·7	137·3

The possibility remains, therefore, that the stimulation in (1) over (2) is nothing more than the effect of an abundant nutritive supplement : a result of the effective association and not its cause.

The superior growth made in (2) compared with (3) might, at first glance, argue a case for inhibitory substances produced by the ineffective association. However, in the one comparison reported the growth in the medium containing the "ineffective" juice was no worse than that on unsupplemented medium. On theoretical grounds, it seems not unreasonable to expect the juices from roots carrying an ineffective strain to be relatively impoverished even in comparison with uninoculated controls. The parasitic organisms might well have tied up in their bodies the small amount of nutrients which would have been otherwise available to the cultivated bacteria. Again it is possible to regard the observed effect as a result and not the cause of the nature of the association.

It would seem then that, whilst the results presented in the paper are compatible with the hypothesis postulated by the authors, they do not offer sound evidence in support. At the most they seem to have shown that the root juice of an effectively nodulated plant is a better nutrient than that of an impoverished control which is, in turn, better than that of a plant the nutrients of which have already been largely utilized by parasitic bacteria.

J. M. VINCENT.

School of Agriculture,
University of Sydney,
Australia.

Proc. Roy. Soc., B, 129, 475 (1940).

MR. VINCENT, who courteously sent me a copy of this letter before publication, suggests that the juice from roots bearing effective nodules is more stimulating to the growth of Rhizobium as a result of effective association. This is in agreement with our views. We state in our paper[1] (p. 489) that there is evidence of "an increased stimulating effect from juices of roots bearing effective nodules, possibly connected with the products of nitrogen fixation".

Mr. Vincent makes the further interesting suggestion that the poor growth of Rhizobium on medium containing juice from plants having ineffective nodules is in reality a deficiency effect, due to the removal by the bacteria in the nodule of nutrients present in the juice of uninoculated roots. The basal medium was supplied with mineral salts and carbohydrates in amounts shown by cultural tests to be in excess of the bacterial needs. Thus the stimulating action of juice from uninoculated roots was probably due either to nitrogen or to accessory growth substances. The following data were obtained from a pot experiment in which soy beans were grown in sand under conditions similar to those used to obtain the material for our root juice experiments with this plant.

Soy Beans	Nitrogen %	Nitrogen content per plant (mgm.)	Number of nodules per plant
Without nodules	1·45	16·69	—
With ineffective nodules (Strain 507)	1·73	19·34	45

The presence of ineffective nodules did not reduce the nitrogen percentage of the plants, so that it seems unlikely that the root juice will have been seriously impoverished in this respect. The root juice in our experiments included nodule juice. Some nitrogen may therefore have been locked up in the cells of bacteria retained by the filter. A calculation was made of the total volume of infected nodule cells per plant inoculated with strain 507. This gave 71 mm^3. Allowing 20 per cent dry matter with 8 per cent nitrogen this would account for only about 1 mgm. of nitrogen, the loss of which could scarcely affect the nitrogen percentage of the juice. The removal of accessory growth substances by the bacteria is an unsupported possibility. It will not explain the fact that in our first experiment with soy beans (Table I, p. 481) juice from roots bearing ineffective nodules entirely prevented the growth of one strain of the Rhizobium. The production, in the infected root, of substances affecting bacterial growth explains this and also accounts for the observation that the bacteria in ineffective nodules multiply less and last for a shorter time than those in effective nodules. This poor growth occurs in spite of the fact that the nitrogen fixed per unit mass of bacterial tissue per day is the same for the ineffective strain 507 as for an effective strain[2].

H. G. THORNTON.

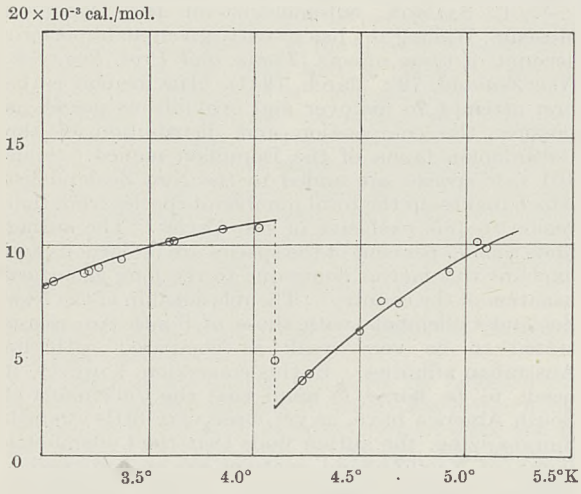
[1] Chen, H. K., Nicol, Hugh and Thornton, H. G., *Proc. Roy. Soc.*, B, 129, 475 (1940).
[2] Chen, H. K., and Thornton, H. G., *Proc. Roy. Soc.*, B, 129, 208 (1940).

Specific Heat of Supra-Conductive Tantalum

THE behaviour of supra-conductive tantalum is far from clear. Early magnetic and electric experiments by Mendelssohn and Moore[1], and a more recent determination of the specific heat by Keesom and Désirant[2], indicated that pure tantalum showed properties very similar to a supra-conductive alloy[3]. Further magnetic experiments by Daunt and Mendelssohn[4] on a very pure sample, however, yielded results consistent with those obtained on other pure supra-conductors.

In order to clear up this discrepancy, it was decided to carry out measurements of the specific heat on very pure samples in the supra-conductive and in the normal state. These experiments were begun in 1939 by Dr. M. Désirant, of the University of Liège, and myself at this Laboratory, but had to be discontinued at the outbreak of war. By then all measurements in the supra-conductive state had been completed. As there is no prospect of resuming this research in the near future, we feel justified in publishing a short account of these results.

The experiments were carried out on five rods of very pure tantalum, kindly lent to us by Adam Hilger, Ltd. These rods were of the same batch (Lab. No. 10679) as the one used by Daunt and Mendelssohn. Their specific heat was determined in the temperature region between 3·5° and 5·5° K. The results are given in the accompanying graph.



As can be seen, the specific heat shows a discontinuity at 4·4° K., that is, exactly at the same temperature at which the electrical resistance disappears. This temperature is also the magnetic transition point determined by Daunt and Mendelssohn. The discontinuity amounts to about 9×10^{-3} cal./mol., which is in excellent agreement with the value ($9{\cdot}5 \times 10^{-3}$ cal./mol.) calculated by Daunt and Mendelssohn from magnetic determinations. From the drifts of the galvanometer attached to the resistance thermometer we could form an opinion as to the sharpness of the discontinuity, and conclude that the drop in the specific heat occurs in a very small temperature interval, not exceeding a few hundredths of a degree.

Our results disagree with those of Keesom and Désirant[2], who found a transition region 0·2° wide between 4·0° and 4·2° K. Their results agree, however, with the experiments by Mendelssohn and Moore[1] on slightly impure tantalum. It thus appears that, in sufficiently pure and homogeneous samples of tantalum, the changes of electrical resistance, magnetic induction and specific heat accompanying the establishment of the supra-conductive state occur at one and the same temperature. The outcome of the present research thus fully corroborates the conclusion reached by Daunt and Mendelssohn that pure tantalum shows the same behaviour as other pure supra-conductors and that the anomalous behaviour observed on some specimens is due to secondary causes.

In conclusion, we wish to thank Mr. A. Horseman for his help during the experiments.

K. MENDELSSOHN.

Clarendon Laboratory,
Oxford.
Aug. 15.

[1] Mendelssohn and Moore, *Phil. Mag.*, **21**, 532 (1936).
[2] Keesom and Désirant, *Proc. Roy. Soc. Amsterdam*, **42**, 536 (1939); and private communication.
[3] Mendelssohn, Moore and Pontius, VIIe Cong. Int. du Froid, **1**, 431 (1936).
[4] Daunt and Mendelssohn, *Proc. Roy. Soc.*, A, **160**, 127 (1937).

"The Man of Science as Aristocrat"

IN NATURE of May 3 the Right Hon. J. T. C. Moore-Brabazon states: "The man who by his political efforts can get adequate milk to children deserves more of his fellow men than the inventor of the quantum theory; but in the narrow world of science, who gets the most attention and encouragement?"

This is to me the most encouraging statement I have read respecting a definition of science. Anyone who knows human nature and the great difficulties involved in the practical proposition referred to by Col. Moore-Brabazon will realize that the desired result can only be effected, and then with extreme difficulty, by applying the scientific method patiently to attain the desired end, and the man who does it may thank God for his success.

The quantum theory is a great achievement, but the supply of milk to children, and a host of similar problems, of vital importance to humanity, can only be obtained by intelligence of the first order directed to the special practical end and by the use of the methods of science.

The conception of science and the recognition of its achievements in such directions as that indicated should rank with the achievements in the relatively narrow world usually called pure science. As Prof. Wood Jones in a characteristic sally stated: "It takes more than a white coat and a test tube to make a man of science."

If the younger men of science with the requisite ability were encouraged to strike out in these difficult and unconventional directions, we should get a better world, and perhaps such a world might recognize their achievements; at all events I think so. But the most difficult and the greatest task of which I am aware is that of altering the outlook of men. Once that is done the practical consequences follow automatically.

JAMES W. BARRETT.

103–105 Collins Street,
Melbourne, C.1.
July 19.

"Crop Damage by Air Attack."

SIR JOHN RUSSELL in his article on "Crop Damage by Air Attack"[1] says: "The most serious risk is on the stubbles, if very dry weather should set in after the harvest." For the last nine years I have used a combine harvester, and have made a practice of burning some of the straw on the stubbles after harvest. In only two years have the stubbles been sufficiently dry to burn easily. Usually it has needed several men carrying burning straw about on pitchforks to re-light the straw, which tends to burn for a short time and then go out. I have also used a tractor drawing a chain harrow with a mass of burning straw on it to keep the fire going. A combine leaves a longer stubble than a binder, and with the straw lying on top of this it should burn easily if any stubble will. My experience is that once straw and stubble have been well wetted by rain they very rarely dry out enough for the fire to take easily.

ROGER NORTH.

Fincham Farm,
Rougham,
King's Lynn,
Norfolk.
Aug. 26.

[1] NATURE, **148**, 215 (1941).

RESEARCH ITEMS

Effects of Insecticides on the Mid-gut Wall of a Larva

THE specific action of insecticides on the tissues of various insects is a little-explored field. Knowledge of this kind may prove of value in the selection, improvement and appliction of methods of insect control. A review of the physical and chemical effects of poisons on insect tissues cells and secretions is given by Trappmann (*Z. Pflanzenkrank.*, 48 ; 1938), while the most recent contribution to this subject is by P. A. Woke, of the U.S. Department of Agriculture. In the *Journal of Agricultural Research*, 61. 321–29 (1940), this writer discusses the effects of certain insecticides on the walls of the mid-intestine of the larva of the "southern armyworm" (*Prodenia eridania*). Lethal doses of the poisons were fed to the larvæ in turnip-leaf or sweet potato-leaf "sandwiches". The subjects of the trials were then killed and fixed after different intervals and the tissues examined histologically for comparison with control individuals. It appears that the action of arsenicals was followed by disintegration of the epithelial lining of the mid-intestine and damage to the visceral muscle-fibres. Ingestion of sodium fluoride resulted in disintegration of the substance of the cytoplasm and the nuclei. The epithelial cells of those larvæ that had ingested sodium fluoaluminate were greatly disintegrated and the cross-striations of the muscle-fibres were faint or obliterated. On the other hand, no changes in the epithelium or muscle-fibres followed the ingestion of barium fluosilicate, phenothiazine or rotenone that could be attributed with certainty to the substances named. Rotenone, it may be added, varies remarkably in its toxic action on different species of insects. Silkworm larvæ, for example, died within two hours from the effects of taking in minute quantities of this substance, whereas southern armyworm larvæ readily ingested 5–10 mgm. without showing ill effects. With regard to sodium fluoride, the observation of Hockenyos that this compound can be absorbed in lethal amounts directly through the integument of cockroaches, requires fuller exploration.

Termites and Soil Fertility

WHILE the destructive role of termites in the tropics is widely recognized, another aspect of their activities has so far attracted little attention, namely their effect on the physical and chemical properties of the soil, which they are known to influence to a great extent. Preliminary investigations carried out in Nigeria (*Nigerian Forester*, 1, 8 ; 1940) have shown that the soil of an active termite heap contained an increased amount of fine particles, which tended to improve the water-holding capacity of the soil. The carbon content of a heap was six times, nitrogen content about five times, phosphorus content two and a half times, and potash content more than three times that of the normal soil. Bearing in mind the wide spread of termites in Africa and the enormous extent of their underground activities, the problem deserves a very serious study from the points of view of termite bionomics, soils, natural vegetation, crops and forestry.

Collembolan Fauna of New Zealand

J. T. SALMON, entomologist at the Dominion Museum, Wellington, has recently given an important account of these insects (*Trans. and Proc. Roy. Soc. New Zealand*, 70 ; March, 1941). His memoir is the first attempt to discover and evaluate as nearly as possible the composition and distribution of the Collembolan fauna of the Dominion named. Some 101 new species are added to the New Zealand list which makes up the total number of species from that region to 185, exclusive of sub-species. The author finds that 77 per cent of the species are indigenous and explains this fact as being due to the long geological isolation of the country. The relationship of the New Zealand Collembola with those of South America is stated to be very weak as compared with its Australian affinities. In this connexion, however, it needs to be borne in mind that the Collembola of South America have, as yet, been very little studied. Summarizing, the author finds that the Collembolan fauna of New Zealand contains an ancient cosmopolitan element represented by such genera as Achorutes, Neanura and Onychiurus. An exceptionally strong affinity is betrayed with the Australian and Indo-Malayan forms. There is also a well-marked sub-antarctic element and a few, but important and striking, affinities with the American and African regions. It seems highly probable, according to the author, that the bulk of the species reached New Zealand by land bridges, from time to time connecting that country to northern Australia and the islands north of it, and extending towards Malaya. A comprehensive work of this kind will prove a stimulus to students for studying this group of insects and also for surveying the New Zealand forms still more thoroughly. A useful aid will be found in the diagnoses of the world's families, sub-families and tribes, while the 533 figures and the bibliography will prove an indispensable adjunct. The author mentions Stewart Island, the 'heel' of the South Island and the higher alpine regions over 4,000 ft. as being likely to contain many more species of these insects, adding that they were among the localities which he has, so far, been unable to visit.

Japanese Dinoflagellates

IN his work on the Peridinians of the Diplopsalis group, Tohru Hidémiti Abé describes many varieties of plate structure ("Studies on the Protozoan Fauna of Shimoda Bay. I.—The Diplopsalis Group", *Records of the Oceanographical Works in Japan*, 12, No. 2, March 1941). These may be regarded as some of the more primitive of the thecate forms leading up to the genus Peridinium. Both northern and southern forms are in the collection studied from Asamushi and Shimoda. Those from Asamushi are almost certainly partly southern but mostly northern, and those from Shimoda only southern. There is a very great variety of plate pattern among the members of this group which Schiller in Rabenhorst's "Kryptogamen-Flora" (1937) includes in the genus Glenodinium. A further work on the same subject by Abé ("Notes on the Protozoan Fauna of Mutsu

Bay. *Diplopsalis* and its Allies", *Sci. Rep. Tohoku Imp. Univ.*, Sendai, Japan, 1941), including the strictly systematic portion and literature, is in process of publication.

Wolf-dog Hybrids

WOLVES and dogs may be crossed to give fertile hybrids. N. A. Iljin (*J. Gen.*, 42, 359–413; 1941) has studied the segregation of characters in *X* 101 progeny of a cross (made at the Moscow Zoo) between a zonar grey wild wolf and a black sheep dog. Mendelian segregation is demonstrated for hair colour and hair pattern, eye colour, ear form, size and skull characters. There is evidence of genotypical control of tail shape, nervous disposition, time of rut, and general appearance, but environmental influences play some part. The bark of a dog is purely a modificatory character and may be easily acquired by a wolf. The origin of the domestic dog from *C. lupus* is considered possible.

Differential Response to X-Rays of Diploid and Tetraploid Barley

A TETRAPLOID barley produced by temperature shocks on the diploid Opal *B* variety has rather a low fertility due in part to its autopolyploid state and to the consequent production of offspring with aberrant chromosome numbers. A. Müntzing (*Köngl. Fysiog. Galls.*, Lund F., 11, 1–10; 1941) has X-rayed this barley to endeavour to create differences between the chromosomes and therefore increase the fertility. In the experiments he found that the response of tetraploids to X-rays was much less than diploids. For example, 85 per cent of the expected number of tetraploids produced seeds after a dose of 15,000 r., whereas only 38 per cent of the expected diploids produced seeds. The difference is attributed to the fact that a gene hit at one locus in a tetraploid is protected by three other genes on the homologous chromosomes as compared with one other gene in a diploid.

Genetics of Galeopsis

A. MÜNTZING (*Heriditas*, 27, 193–201; 1941), continuing his experiments with Galeopsis has produced autotetraploid *G. pubescens* and *G. speciosus*, and diploid and tetraploid hybrids between these species. It is found that hybridization between the diploid species and between the tetraploid forms are fertile, while no crosses between diploid and tetraploid forms were successful. The author was able to cross tetraploid *G. pubescens* and tetraploid *G. speciosa* with *G. Tetrahit*, which is believed to be a natural polyploid derivative of *S. pubescens* × *S. speciosa*. The possibility of repeating the synthesis of *G. Tetrahit* is thus possible. Tetraploid derivatives of different diploid individuals of *S. pubescens* show differences in pollen fertility in the first tetraploid generation.

The Pacific Earthquake of November 10, 1938

THIS earthquake has been the subject of careful study by S. M. Mukherjee and M. R. Rangaswami (*Bull. Seis. Soc. Amer.*, 31, No. 2, 121; April, 1941). The instrumental data used were the published readings of seismograms by the observers at the various seismograph stations together with the authors' interpretation of the original seismograms obtained at Bombay, Agra, Calcutta and Kodaikanal. Using the times of *P*, the epicentre was located at 55·3° N., 158·5° W., which is some eighty miles south of the Alaskan Peninsula in the Pacific Ocean. The earthquake occurred at 20h. 18m. 40s. G.M.T. The authors state that the analysis of the *P* and *S* residuals reveals three successive shocks, the second and third occurring 7 and 12 seconds after the first. Examination of the Indian seismograms points to a fourth shock, about 20 sec. after the first. The multiple character of the shock is brought out more conspicuously when the observed times are compared with Jeffreys' surface-focus tables and corrected for ellipticity, than when compared with normal tables. The epicentres of the first three shocks are found to be the same. Mukherjee and Rangaswami considered the identification of the second movement of *P* with *sP* and *pP* and that of *S* with *sS*, but this view was found to be untenable on account of the depth of focus and the character of the non-instrumental observations. The hypothesis of 'surface focus' (that is, less than 10 km. depth of focus) appeared to fit in best with the observations used. The magnitude of the shock was found to be equal to that of the catastrophic Bihar-Nepal earthquake of January 15, 1934.

Earthquakes and Crustal Structure (Southern Pacific Region, U.S.A.)

THIS was the subject of a paper by C. F. Richter of the California Institute of Technology, Pasadena, to the Sixth Pacific Science Congress ("Earthquake Epicentres and Structure of the Pacific Region of North America—Southern Part" by C. F. Richter, Proc. Sixth Pacific Science Congress; 1939). The data used were the epicentres of earthquakes during 1930–1933 determined by J. S. Hughes and Miss E. F. Bellamy at Oxford, together with epicentres since 1933 determined by the United States Coast and Geodetic Survey, and by the Jesuit Seismological Association at Saint Louis, U.S.A. For historical work recourse was also had to the catalogues of Townley and Allen, and also of Wood, Allen and Heck for the years 1769–1933. Epicentres determined at Pasadena were also used. From all these data a map was constructed showing by separate marking the epicentres of large normal earthquakes, minor earthquakes and the few of intermediate depth in the area. The most noteworthy feature of the map was the appearance of a nearly continuous belt of epicentres following the Pacific Coast from near Vancouver Island to Panama. The important structural loop through the West Indies was much less active than the Pacific Coast, so that these seismological data do not assist in the solution of the geological problems of the exact location and character of the loop. Since 1769 three major earthquakes have occurred in California: (1) January 9, 1857, centring near Tejon Pass, with large displacements along the San Andreas fault; (2) March 26, 1872, in the major Sierra fault zone at the edge of Owens Valley; and (3) the San Francisco earthquake of April 18, 1906, with displacements along the San Andreas fault. Allen suggested a division of the fault zone into segments where the rocks are strong and fracture only under great stress, occasioning major earthquakes, and segments where they are weaker, yielding more readily and occasioning less-violent shocks. This appears to be borne out by Richter's work, which shows that as regards numbers of shocks the San Andreas fault was surprisingly inactive, especially near the regions of the great earthquakes mentioned above and near to the earthquake stations at Pasadena, Mount Wilson and Riverside.

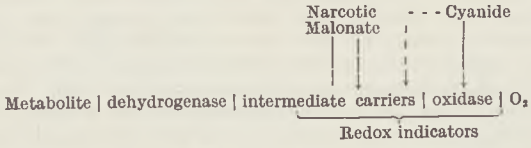
ACCELERATION OF THE RESPIRATION OF SURVIVING TISSUE

By Dr. G. D. Greville

Runwell Hospital, Wickford, Essex

THE respiration of tumour tissue in a glucose medium is increased on addition of a suitable indicator (hereinafter called 'dye') or dinitro-*o*-cresol (DNOC), decreased by a narcotic such as phenylurethane. I observed in 1936* that when narcotic and dye are added simultaneously, the respiration is only slightly less than with dye alone. On the other hand, the narcotic almost abolishes the acceleration in respiration due to DNOC. The accompanying graphs depict an experiment with the mouse tumour *MC* 2146 in phosphate-glucose. Similar results were obtained with other concentrations of narcotic, DNOC and dye.

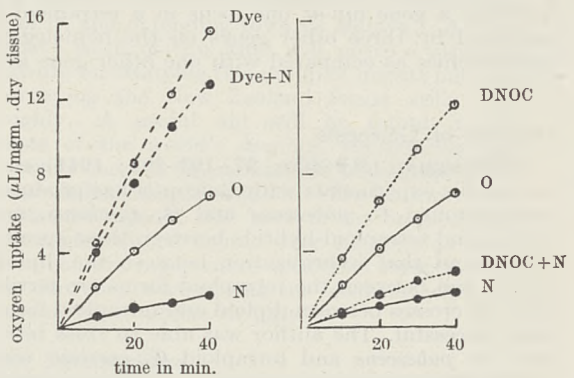
For some years it has been accepted that: (1) dyes 'by-pass' the oxidase-cytochrome system, acting as hydrogen-transfer catalysts, being reduced by activated metabolite through coenzyme and diaphorase, with subsequent autoxidation of the leuco-dye, and (2) narcotics inhibit the metabolite-activating dehydrogenases. These principles fail to explain[1] why concentrations of narcotic which strongly inhibit normal respiration (accompanying graphs) should at most but slightly reduce the oxygen-uptake in presence of dye. As (2) was apparently so well founded, there seemed difficulty in accepting (1) as the mode of action of dyes in surviving tissues. This difficulty has recently been removed by the observation of Michaelis and Quastel[2] that a narcotic at low concentrations, instead of inhibiting those dehydrogenases which activate glucose and its breakdown products, affects the respiratory chain at some link nearer the oxidase. Dyes 'by-pass' this link, and (1) can now be freely accepted as the mechanism whereby they increase tissue respiration. In the accompanying scheme arrows denote inhibition, and 'intermediate carriers' may include any or all of the following: coenzyme, C_4-acid catalysts, diaphorase, flavoproteins, succin-oxidase factor, cytochromes.



Gerard[3] suggests that in brain "the oxidase-cytochrome system does not limit the rate of oxidation, which depends on the dehydrases or their immediately related carriers". Since dyes accelerate brain tissue respiration[4], the latter is presumably either limited by the carriers nearer to oxidase, or else the 'master reaction' principle is inapplicable here, and the rate is limited by no particular link. In rat brain cortex slices, narcotic inhibition is apparently not overcome by dyes; but neither is cyanide inhibition. Indeed in cyanide-poisoned minced brain, hydrogen-transfer by cresyl blue is actually inhibited by glucose[5].

* While working in the Courtauld Institute, Middlesex Hospital, with the support of the Sir Halley Stewart Trust Fund and the International Cancer Research Foundation.

As seen above, DNOC will not restore the narcotic-inhibited respiration of tumour tissue. Several workers have noted that narcotics decrease the response of normal tissues to DNOC, and in the whole animal (cat), dial can prevent the increase in metabolic rate caused by dinitrophenol[6]. The difference in behaviour of dye and DNOC towards tumour tissue inhibited by narcotic is paralleled by their difference in behaviour when the inhibition is by cyanide[7], carbon monoxide[7] or malonate[8]. The graphs show that the link in the chain affected by narcotics cannot be stimulated or 'by-passed' by DNOC. Nitrophenols have only been shown to stimulate oxygen-uptake in intact respiratory systems. Their mode of action is still unknown. After kidney cortex slices have been subjected to anærobiosis, dyes have a reduced and DNOC an augmented effect on the respiration[1]. A speculative interpretation is that asphyxia damages the dehydrogenase end of the chain, and that this is the end stimulated by DNOC (cf.[9]). On the other hand, according to v. Euler[10] the concentrations of cytochrome oxidase and the cytochromes in tumours are strikingly low; since DNOC provokes a large respiration in tumour tissue it would have to provide hydrogen-transfer to oxygen by a cyanide-sensitive mechanism independent of oxidase-cytochrome. For this, however, there is no evidence.



O, NO ADDITION; N, NARCOTIC (PHENYLURETHANE) 0·003 M; DYE, BRILLIANT CRESYL BLUE 2×10^{-4} *M*; DNOC, DINITRO-*o*-CRESOL 10^{-5} *M*; DYE + N, DNOC + N, AGENTS ADDED SIMULTANEOUSLY IN ABOVE CONCENTRATIONS.

Difficult questions concerning C_4-acid catalysis and the path of carbohydrate oxidation in tumours, as well as the mode of action of substituted phenols, are raised by the effect of dyes and DNOC on tumour respiration inhibited by malonate. The typical experiment summarized below shows how, with glucose as metabolite, DNOC evokes a large malonate-sensitive respiration, the dye a large oxygen-uptake which is insensitive to malonate. The failure of DNOC to restore malonate-inhibited respiration is due solely to incompetence, for I have found that DNOC

in acceleratory concentrations does not inhibit the action of dye, when both are added together with malonate.

OXYGEN-UPTAKE (μL./MGM. DRY TISSUE/HR.) OF J.R.S. IN PHOSPHATE-GLUCOSE AT 38°

	No accelerator	DNOC 3×10^{-5} M.	Pyocyanine $10^{-3}M$.
No malonate	11·4	23·1	26·5
Malonate 0.01 *M*.	8·9	9·2	23·8

The succinate–fumarate transformation must be involved in the respiration provoked in tumour tissue by DNOC, but not in the dye-catalysed respiration. Hence the route of carbohydrate oxidation in presence of dye, whether straight path or Krebs[11] cycle, cannot include the succinate–fumarate step. From its magnitude it is unlikely that the respiration in presence of malonate and dye represents a partial oxidation, and it is probable that the oxidations stimulated by dye and DNOC do not differ qualitatively. It would follow that the succinate–fumarate change involved in the DNOC-catalysed respiration is not in the path of carbohydrate breakdown, but is concerned with a catalysis of the Szent-Györgyi[12] type. Tumour tissue will not reduce oxaloacetate with any speed, either alone (Breusch[12]), or in the presence of glucose or glucose with DNOC[1]. Therefore, as Szent-Györgyi[12] has suggested, the catalysis is likely to be by the succinate–fumarate, and not by the malate–oxaloacetate, oscillation. Inhibition of the DNOC-catalysed respiration of *MC* 2146 is overcome by high concentrations (0·06M.) of *l*-malate.

There is thus reason to suppose that, like narcotics, malonate inhibits hydrogen-transfer in a system in tumour tissue which is 'by-passed' by dyes but not by DNOC. As Szent-Györgyi[12] has found that in several dehydrogenations H passes to the acceptor dye through a C_4-acid system, the 'by-passing' observed in tumour tissue is not without interest.

[1] Greville, G. D., Ph.D. thesis (London, 1939).
[2] Michaelis, H., and Quastel, J. H., *Biochem. J.*, **35**, 518 (1941).
[3] Gerard, R. W., *Arch. Neurol. Psychiat.* (Chicago), **40**, 985 (1938).
[4] Dickens, F., *Biochem. J.*, **30**, 1064 (1936).
[5] Cohen, R. A., and Gerard, R. W., *J. Cell. Comp. Physiol.*, **10**, 223 (1937) (table II, p. 229).
[6] Brewer, G., *J. Pharmacol.*, **58**, 135 (1936).
[7] De Meio, R. H., and Barron, E. S. G., *Proc. Soc. Exp. Biol.*, **32**, 36 (1934).
[8] Greville, G. D., *Biochem. J.*, **30**, 877 (1936).
[9] Krahl, M. E., and Clowes, G. H. A., *J. Biol. Chem.*, **111**, 355 (1935).
[10] v. Euler, H., and collaborators, *Z. Krebsforsch.*, **49**, 46 (1939); *Ark. Kemi. Mineral. Geol.*, **13**, Nos. 6 and 8 (1939).
[11] Krebs, H. A., *Biochem. J.*, **34**, 775 (1940).
[12] v. Szent-Györgyi, A., "Studies on Biological Oxidation and some of its Catalysts" (Barth, Leipzig, 1937).

ACTION OF THE EYES IN READING

BY using apparatus similar in principle to that of an electrocardiogram, M. Luckiesh and F. K. Moss, working at the Lighting Research Laboratory of the General Electric Company, Cleveland, Ohio, have investigated the action of the eyes in reading*. One electrode is placed in the centre of the forehead, and the other on one of the temples. The feeble electric currents produced by the eye muscles are amplified more than a million times, and recorded photographically by an oscillograph. The currents obtained are so weak, and the instrument is so sensitive that electrical disturbances are likely to arise from other biological processes taking place in the patient's body, as well as from electro-magnetic waves induced in his body by electrical apparatus such as lamps.

Reading ordinary type an average adult reader traverses a line of print $3\frac{1}{2}$ in. long in about six stages or fixations. Each shift from one fixation to the next occupies about 0·03 sec., and involves an electrical charge of the order of 0·00001 volts. One fixation comprises about nine letters. Fixations themselves vary in time from about 0·2 to 0·5 seconds. They tend to become longer towards the end of a line. If one fixation proves unsatisfactory, the succeeding one may shift backwards along the line, but it usually occupies a shorter period of time.

The remarkable control exercised by the perceptual faculties over the eye muscles is evidenced by the fact that an ordinary person reads about the same number of letters at each fixation, whether the print is in 4-, 10- or 18-point type. Between fixations visual patterns do not appear to be registered in the brain cortex, so avoiding blurring. The same is true of shifts in fixation from one line to the next, which may occupy 0·12 seconds, involving an electrical charge of 0·00006 volts.

* *School and Society*, **53**, No. 1376 (1941).

The fatigue of continuous reading may be appreciated from the fact that each fixation involves the simultaneous adjustment of six separate muscles to each eye, and that both eyes must work in harmony. Each set of type characters impress a new perceptual task upon the brain, giving rise to conceptual patterns as the letters read convey their message. Records of the electrical charges taking place in the eye muscles at the beginning and end of a long period of continuous reading are not dissimilar, indicating that the muscles retain the ability to respond adequately when perceptual faculties are beginning to show signs of fatigue.

Children often make twice or three times as many fixations as an adult in reading the same amount of print. This manifests itself in the slower rate of reading, as well as in the earlier stage at which fatigue sets in.

An average educated person when reading blinks about six times a minute. Each blink occupies about 0·3 seconds, and the electromyogram indicates that in blinking the eyes shut much more rapidly than they open again. During the process of blinking the eyes are rotated inwards and upwards, and then out again to produce an entirely new fixation. It used to be thought that blinking merely served to keep the cornea moist and wash away foreign particles. Now it is known that blinking also helps to relieve ocular fatigue.

Recent investigations have shown that the frequency of blinking is reduced if conditions for good vision are improved, as, for example, by better illumination, by means of glasses, and by using more legible print. During periods of increased concentration blinking may be postponed until a less critical stage is reached, but only at the cost of an earlier onset of fatigue.

SCIENTIFIC WORKERS AND THE CHEMICAL INDUSTRIES

DELEGATES from all parts of Great Britain (Scotland, Bristol, Birmingham, Billingham, London, Liverpool, Manchester, etc.) met at a chemical industries conference called by the Association of Scientific Workers on August 31 in Manchester to discuss the achievement of maximum technical effort behind war production and the problems of scientific staffs. This conference was the first of a series covering specific industries.

Speeches from the delegates showed the need and value of such conferences. Instances were cited of highly qualified scientific workers being engaged on non-essential work while production in other places was held up for lack of scientific personnel. Specific cases were given of lack of the systematic pooling of scientific information, leading to the holding up of production, and of the fullest use not being made of the resources of existing laboratories and equipment because of peace-time methods of organization.

The keynote of the conference was expressed by the chairman that only a greatly increased production could guarantee the support to the Allied forces which could defeat Fascism. It was generally agreed that the present hindrances to full utilization of all technical resources must be removed and all other questions, including the separate interests of both employers and staff, must be subordinate to this.

The following resolution was agreed upon unanimously :

"This conference of delegates from A.S.W. branches and groups in the chemical industries after discussion finds that the co-ordination and utilization of scientific and technical man-power is not commensurate with the effort needed in the present critical phase of the war. We, the delegates, pledge ourselves to initiate a campaign for maximum production. The organized activities of scientific and technical staff through the A.S.W. nationally and locally are necessary to implement this policy. We, therefore, propose the following programme : To ensure that

(1) The present position where all technical staff are not fully utilized on work essential to the war effort is quickly rectified ; (2) real pooling of technical information and facilities takes place between Government departments and industry ; (3) every incentive is given to increased effort on the part of technical staff by the removal of grievances attendant on non-payment for overtime and irregular salary increments and holidays ; (4) women occupying technical and scientific posts in industry receive the same salaries and opportunities as men doing the same type of work ; (5) adequate training facilities be provided for inexperienced personnel to rectify the effect of transfer and enlistment of technical staff ; (6) the conditions of transference be safeguarded by consultation between representative organizations ; (7) A.R.P. and safety organizations be under democratic control as envisaged by Government legislation.

To carry this programme into effect we propose the following action : (1) the calling of local works and laboratory meetings to apply the programme to local conditions ; (2) initiation of approaches by the A.S.W. to all organizations concerned with production including managements of firms and national and regional production boards ; (3) the closest co-operation with other trade unions ; (4) strengthening of the A.S.W. as representing all technical and scientific staff,"

FORTHCOMING EVENTS

Tuesday, September 16

THE FARMERS' CLUB (at the Royal Empire Society, Craven Street, London, W.C.2), at 3 p.m.—Mr. W. S. Mansfield : "The Maintenance of Land Fertility in War-Time".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned :

TEACHER (MALE) OF CHEMISTRY AND PHYSICS in the Londonderry Municipal Technical College—The Director of Education, Education Office, 5 Guildhall Street, Londonderry (September 20).

ASSISTANT LECTURER IN SCIENCE, MATHEMATICS AND DRAWING in the Halesowen County Technical School—The Secretary, Halesowen Higher Education Committee, 21 Great Cornbow, Halesowen, Worcestershire (September 20).

REGISTRAR at the Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield (September 30).

LECTURER IN NEUROPATHOLOGY AND NEUROPATHOLOGIST to Mental Hospitals of New South Wales—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1.

LIVESTOCK OFFICER—The Secretary, Land Settlement Association, Ltd., 43 Cromwell Road, London, S.W.7.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh. Section B : Biology. Vol. 61, Part 1, No. 9 : Cytological Analysis of Chromosome Behaviour in Three Breeds of Dogs. By I. A. Ahmed. Pp. 107–118. (Edinburgh and London : Oliver and Boyd.) 1*s*. [158

Freshwater Biological Association of the British Empire.) Ninth Annual Report for the year ending 33st Mareh, 1941. Pp. 54. (Ambleside : Freshwater Biological Association of the British Empire. [188

Proceedings of the Royal Society of Edinburgh. Section A (Mathematical and Physical Sciences.) Vol. 61, Part 1, No. 6 : Generating Functions of Certain Continuous Orthogonal Systems By A. Erdélyi. Pp. 61–70. 9*d*. Vol. 61, Part 1, No. 7 : The Clear-Day Barometric Curve at Ben Nevis. By T. R. Tannahill. Pp. 71–76. 6*d*. (Edinburgh and London : Oliver and Boyd.) [268

Other Countries

Indian Central Jute Committee. Technological Research Memoir No. 2 : The Relation between the Physical Fibre Characters and the Spinning Quality of Jute, I. By C. R. Nodder, K. R. Sen and B. K. Chakrabarti. Pp. 20+4 plates. (Calcutta : Indian Central Jute Committee.) 1-rupee ; 2*s*. [148

Records of the Geological Survey of India. Vol. 76, Bulletins of Economic Minerals, No. 3 : Strontium. By M. S. Krishnan. Pp. 16. (Calcutta : Geological Survey of India.) 6 annas ; 7*d*. [148

Proceedings of the United States National Museum. Vol. 90, No. 3111 : The Chicora (Butler County, Pa.) Meteorite. By F. W. Preston, E. P. Henderson and James R. Randolph. Pp. 387–416. (Washington, D.C. : Government Printing Office.) [158

Forest Research in India and Burma, 1939–40. Part 1 : The Forest Research Institute, Dehra Dun. Pp. iii+133. (Delhi : Manager of Publications.) 3 rupees ; 5*s*. [158

Smithsonian Institution : Bureau of American Ethnology. Bulletin 128 : Anthropological Papers, Nos. 13–18. Pp. xii+368+52 plates. (Washington, D.C. : Government Printing Office.) 70 cents. [188

Department of Scientific and Industrial Research, New Zealand. Dominion Observatory Bulletin No. S-60 : Ground Tilt at Wellington, New Zealand. By R. C. Hayes and R. D. Thompson. Pp. 18. (Wellington : Government Printer.) [198

Proceedings of the United States National Museum. Vol. 90, No. 3114 : A New Genus of Sea Stars (Plazaster) from Japan, with a Note on the Genus Parasterina. By Walker K. Fisher. Pp. 447–456+plates 66–70. (Washington, D.C. : Government Printing Office.) [198

Queen Victoria Memorial, Salisbury, Southern Rhodesia. Annual Report for the Year ended 31st March 1941. Pp. 8. (Salisbury : Queen Victoria Memorial.) [268

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