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LEADERSHIP IN INTERNATIONAL RELATIONS*

IN "The Twenty Years' Crisis", Prof. E. H. Carr set out to make a contribution to the science of international relations, but somehow he seemed to lose his way in the maze of power politics. Without any such avowed purpose, he has now given us in "Conditions of Peace"* a constructive analysis in the true scientific tradition, which is a real contribution to the establishment of such a science. It is indeed more than a clear, dispassionate analysis of past ills and present problems, a foreshadowing of future needs ; its calm application of the scientific spirit to world affairs has something of great nobility and vision.

The combined insistence on realism and on learning the mistakes of the past, with the fearless scrutiny of the future, give the book special claims on the interest of scientific workers. Prof. Carr's whole approach is in harmony with the outlook which they are accustomed to bring to bear on their own problems, if not always on those which they face in common with their fellow-citizens. They will recognize instinctively the force of his warning of the danger to the future welfare and prestige of Great Britain of the common inclination to assume that once Nazism is defeated and Germany rendered helpless, the world can with relatively little trouble be re-settled on familiar and comfortable lines. The future, he urges, lies with those who can resolutely turn their back on the old world and face the new world with understanding, courage and imagination.

This call to leadership, which is the dominant note of the whole book, is the complete answer to the vague charges of obscurantism which have found utterance from some of those quarters still looking to the past, as it refutes those who would attempt to maintain the departmentalism or sectionalism of life which has been responsible for so much frustration in the past generation. If democracy is to recover its vitality, to meet the challenge of this present revolution by a redefinition and reinterpretation, science must make its own contribution. The conditions for an orderly and progressive development of human society cannot be worked out without the help both of scientific method and of scientific investigation. Once we begin, as Prof. Carr points out, to put first things first, to determine the conditions for mankind's continuous advance, many of the obstacles to scientific and political co-operation will disappear. When we cease to make peace and security the objects of policy, and policy and plans are formulated to serve clearly ascertained general needs and not private or sectional interests, it will be possible for scientific men to make their contribution to the solution of the economic, social and technical problems involved without detriment to their primary allegiance to science.

That contribution would be the more easily made if scientific workers encountered more often the

* Conditions of Peace. By Prof. Edward Hallett Carr. Pp. xxiv + 279. (London : Macmillan and Co., Ltd. .1942.) 12*s*. 6*d*. net.

scientific temper and outlook which characterize Prof. Carr's admirable book. He brings to his survey exactly the quality for which General Smuts pleaded in 1929 in his Sidgwick Memorial Lecture on "Democracy", and there are few scientific workers who will not readily respond to this challenge to thought. He does not attempt to cover the whole field of the future settlement and eschews anything of a blue-print for a peace treaty. He ignores the Far East, and dismisses the United States, the Colonial problem and Russia somewhat cursorily, but within his limits he probes for fundamental principles and the real causes in a way that should inspire equally constructive and imaginative thinking about the problems which he has left alone.

With its insistence on the factor of leadership, the book is characterized by a breadth and sanity of outlook which sees the whole problem and not merely one section of it, that are badly needed in many circles occupied with reconstruction plans to-day. The relation between domestic policy and foreign policy, the importance of facing reconstruction now and not merely after the War are clearly seen, and a chapter on "Britain at Home" forms as homogeneous a part of the book as those chapters in which he analyses so acutely the theory of self-determination and outlines the new Europe which might be our objective.

In examining the problems of peace from the specific angle of British policy, we must recognize that Great Britain can play no dominant part in the ordering of the world after the War unless the people of Great Britain maintain in time of peace the same sense of common purpose and obligation which has been developed under the impulse of war. Moreover, it is equally inconceivable that we can play a leading part in the reconstruction of the world and leave the structure of society in Britain unchanged and unaffected. What we can achieve in Europe and in the world will grow out of, and is largely dependent on, what we can achieve at home.

In the chapter in which Prof. Carr is urging that we should turn to account in peace the lessons learnt in waging war, and project into post-war reconstruction the organizations or institutions established primarily to serve war purposes, he is once again calling for the forward-looking mind. The opportunities which the imperative need for radical re-planning afford must be seized, and we must recognize that the purpose of our economic system is to produce things wanted for consumption, not things which it is profitable to produce. The bearing of the social minimum not merely on the unemployment problem but also on industrial and agricultural policy and on international reconstruction and relations with the Dominions, the United States and with post-war Europe are outlined tersely but lucidly, and the chapter includes an outline of agricultural policy embodying principles for which scientific workers have long been contending. The emphasis placed on research, like the acute analysis of the weaknesses of party politics in this same chapter, are other points for which scientific workers may well be grateful, and they cannot fail to respond to its challenge to the constructive thought and determined action required to effect the changes essential in our democratic institutions, if democracy is to remain a reality in the twentieth century.

Prof. Carr's insistence on the moral challenge is in striking contrast with the somewhat materialistic note he struck in "The Twenty Years' Crisis". In his glance at democracy he emphasizes the necessity for developing a sense, not only of common benefits to be derived from the State, but also of common obligations, and particularly that of a common responsibility to make democracy work. The democratic ideals of equality and liberty must be reinterpreted in predominantly economic terms, and the new democracy must win the struggle to make political rights effective over economic power. In regard to economic reconstruction, he suggests that the first essential is to draw up an infinitely expansible plan of consumption, with graded priorities, which will assure that our productive forces are occupied to their fullest capacity for its fulfilment, and secondly to substitute welfare for wealth as our governing purpose.

The core of the book lies in the chapter on the moral crisis, in which Prof. Carr outlines the faith and spirit in which the problem of the new Europe and the new order must be approached. The emphasis must lie on positive achievement of good rather than the negative avoidance or suppression of evil. The appeal must be essentially to the individual, to the 'little man', in order to restore his sense of being a constituent member of the community. It must address itself first to the solution of the economic problem, without necessarily expressing itself in economic terms. It must approach the unemployment problem by creating needs vast enough to make a full call on our resources and imperative enough in the moral sphere to command the necessary measures of sacrifice to supply them. The new faith must solve the unemployment problem by providing a moral purpose as potent as was religion in the Middle Ages, or as is war to-day. Its emphasis must be more on obligations than on rights, on services to be rendered to the community rather than on benefits to be drawn from it, and must provide for a similar adjustment in the international field, where a new synthesis of liberty and authority must be achieved.

It is in this spirit that Prof. Carr urges that the immediate post-war activity of the victors should be centred on the economic and social needs of the occupied areas, and that political and constitutional issues should be postponed to a later date. The urgent need is to alter, not the location, but the meaning of frontiers. He argues convincingly as to the impossibility of Great Britain escaping from her responsibilities in Europe, and insists on the imperative necessity of carrying forward unimpaired into the period of peace those forms of co-operation and control which have already been created. We must begin by creating the framework of an international order and then encourage national independence to develop and maintain itself within the limitations of that framework.

Prof. Carr's suggested solution of the German problem is a corollary of this policy of developing new loyalties by giving provisional arrangements an opportunity to demonstrate their value and indispensability. We must help to build up the German economic system into a larger unit under different forms of control, and overcome her belated nationalism by making internationalism worth her while. It is important to defeat Germany by overwhelming force; but it is also important to convince Germans at the earliest possible moment that we have other credentials than force for the reorganization of Europe. The German masses must be given from the outside reasonable convictions that the new order will bring them a higher measure of spiritual, social and physical well-being than the old. Positive incentives to Germans to keep the peace must be provided and opportunities to co-operate in maintaining it.

Without a cogent appeal to the youth of Europe for service to a larger cause there can be little hope of building a new order or solving the many vexed political and economic problems on which Prof. Carr touches with such insight and realism. Some may hold that he is too optimistic and dispassionate in his estimate of Germany, but as to the need for a new spirit, an unprejudiced mind and a sense of values there can be no question, and even those who may think him too cautious can scarcely fail to admit the accuracy of much of his diagnosis and the value of the suggestions he so tentatively advances.

Moreover, there is already evidence of a substantial volume of opinion in harmony with Prof. Carr's views. E. Müller-Sturmheim in his thoughtful article, "Germany as a Spiritual and World Problem" in the *Quarterly Review* of October last, outlined very similar conditions designed to make it impossible for the German people to re-establish their war machine, and at the same time to convince them that their real national and political unity are safeguarded without soldiers or armaments. Any permanent solution must free the German robot from the fear of encirclement inspired by his leaders, and at the same time free him from the unrestricted rule of a total militarism. When, as Müller-Sturmheim points out, the hearts and minds of the German people are thereby opened to the voices of those great Germans whom militarism has hitherto deprived of their influence, the firm integration of Germany into a new world order will be immensely facilitated.

Much the same idea that the new organization of Europe should be directed so as to divorce national structures from military and industrial power, and should be backed by a world control of raw materials and communications, with the dual object of facilitating economic expansion and thwarting policies of autarchy and militarism by automatic sanctions, is to be found in the P E P broadsheet, "The Future of Germany". This broadsheet visualizes the post-war settlement of Europe along the lines of the British Commonwealth, rather than with a written constitution. From this point of view even the disruption of Germany into its original large units existing before 1871, suggested by Dr. P. Einzig in his recent book*, is not necessarily contrary to the modern trend towards larger and more closely integrated units if the original German States are re-integrated, not into a German, but into a European unit.

Dr. Einzig's study of appeasement is scarcely less searching than Prof. Carr's analysis, but his treatment of the German problem is more drastic and far-reaching. Even those who regard his proposals as too provocative cannot disregard his sombre warning against the danger of economic appeasement and the dominance of purely financial interests. Dr. Einzig, it is true, may lay himself open to the charge of making security an object of policy, but it involves constructive measures designed to assist the non-Prussian German States to settle down to peaceful activities and abandon their world conquering ambitions, and to work out a satisfactory existence. Moreover, he frankly recognizes what is often forgotten, as Prof. Carr reminds us, that no durable peace can be made unless those who have the power have also the will, in the last resort, after having tried all methods of persuasion, to take and enforce with vigour and impartiality the decisions which they think right.

Equally it is important that those who have the power should recognize the moral obligation which alone makes its exercise tolerable to others. This vital truth appears to be overlooked by Dr. Einzig in urging a declaration in favour of a hard peace. That may well have its place in the moral offensive which others besides Prof. Carr have stressed, notably Mr. J. F. Dulles in the American periodical *Fortune*. The importance of propaganda has been overlooked in our war effort, and Dr. Einzig is on sure ground in directing attention to the value of an emphatic assurance to the conquered peoples that after British victory they would not be left at Germany's mercy. That assurance need not be based on the motive of hate which Dr. Einzig inclines to suggest in his account of the mistakes of appeasement. It must be based on the quiet, dispassionate analysis which Prof. Carr gives us.

It is encouraging to find how much of this admirable analysis finds a counterpart in Mr. Dulles's stimulating article. Very clearly, thought in the United States is moving on similar lines, and opinion there is indeed more, rather than less, likely to support a hard peace than in Great Britain. The keenness of Mr. Dulles's analysis of the Atlantic Charter and his insistence on realistic thinking and on the need for a change in outlook and for real political education should be carefully noted. If the conditions of peace sketched out by Prof. Carr are to materialize, with all the implications they connote, scientific workers must make their own contribution. They have a part to play in the political education required and in carrying into the political field the spirit and method of science. The readiness to accept change and the forward-looking mind are part of their own tradition; the Anglo-American co-operation in science already being forged as part of our war

* Appeasement Before, During and After the War. By Paul Einzig. Pp. xii+216. (London: Macmillan and Co., Ltd., 1941.) 10*s*. 6*d*. net.

effort may well be extended to lay the foundations of a true science of politics and of international relations, without which the evolution of world order must remain visionary. Even among the great democracies, politics was, and still is, too much at the mercy of prejudices and catch-phrases. War-time parliamentary elections in Great Britain have shown the dissatisfaction of electorates still approached in the old fashioned way. With the spread of adult education, and with the growth of understanding, of themselves and of each other, of the English-speaking peoples and active co-operation with the U.S.S.R. which war-time needs have made imperative, the development of political science on a world-wide basis has become a possibility which cannot fail to leave its mark on the history of civilization.

EDUCATION AND TRAINING OF ENGINEERS

FOR some time past the Government, industry and the teaching institutions have been working in common towards the creation of a body of skilled engineering personnel in Great Britain adequate to meet the enormous productive and operational needs of the war machine. Much of the system which has evolved, and is still evolving, will be unsuited to a long-term peace-time policy, but the contrast with pre-war procedure has emphasized the need for reconsideration of the whole plan of technical education and training. It is at once evident that the problems involved will not be solved by individual effort, however well conceived, of particular sections either of industry or educational authority. Each has a vital part to play, but it is essential that the separate efforts be linked together intimately in a national plan, and it is gratifying to observe that steps are already being taken in this direction.

The result of a preliminary consideration of the problem by the Education, Training and Personnel Sub-Committee set up some months ago by the Post-War Planning Committee of the Institution of Electrical Engineers was presented in the form of a paper read by its chairman, Dr. A. P. M. Fleming, before the Institution on March 19. The paper opens by emphasizing the need for a broader conception of the aims of technical education on the part of both the educational institutions and of industry, and by quoting the Adult Education Committee of the Ministry of Reconstruction of 1919 as follows :

"Technical education has only too often defeated its own object by the narrowness with which it has been conceived and carried out. . . . Technical efficiency is primarily dependent on qualities requiring for their growth opportunities for expression which cannot be adequately provided within the range of purely technical studies."

That this expression of opinion was no less appropriate in 1939 was due in large measure to the fact that industry, taken as a whole, had failed to accept adequate responsibility not only for the effective practical training of its employees but also for their part-time day release for technical instruction. The latter made necessary a general adherence to the system of evening-class instruction, a system which not only restricts unduly the scope of the technical instruction possible but also leaves no time for the fostering of cultural interests, and imposes considerable strain on the physical well-being of the students. It is shown that on the average during the 1936–39 period no more than 10–20 per cent of the boys who entered upon the first year of National Certificate courses in engineering remained to enter the fifth and final year, and that few of those who withdrew transferred to alternative, more practical, courses. Of no less serious import, however, is the fact that the evening courses provided failed—and must inevitably fail—to stimulate the inclination for independent reading and thinking, and tend to stultify rather than encourage the processes of critical analysis. The effect of these restrictions was evident enough during the pre-war period ; it has since been more serious.

The general replacement of evening technical instruction, in whole or in part, by part-time day instruction, with the evening periods then left free, under careful guidance, for independent technical study and for the fostering of cultural interests, must be regarded as an essential item in post-war planning. Then, and only then, will it be possible for the technical colleges of Great Britain to attain their full status as centres of adult education in the broadest sense.

To this end it will be necessary for the colleges to give much increased attention to the education of the craftsman as distinct from the technician. The former, generally speaking, reach their highest level of responsibility at the age of twenty-one or less, and the problem of ensuring a healthy attitude of mind towards their employment and an improved utilization of leisure hours is a very real one. Its solution will demand not only an effective presentation of the vital importance of craftsmanship in the national life, but also the raising of the status of craft instruction in the colleges and the improvement of personal amenities for craft employment. It is suggested that a national apprenticeship scheme be introduced, sponsored by the Ministry of Labour, as the co-ordinating body for industrial concerns, and the Board of Education, acting similarly for the local education authorities. On the one hand, this would require the provision throughout industry of organized courses of practical training, involving possibly the creation of special apprentice workshops and the use of the now well-established Ministry of Labour training centres ; and on the other, extended courses of instruction in manual processes leading to such aspects of workshop administration as fall within the responsibility of foremen, inspectors, rate fixers and the like.

The scope and difficulty of the whole problem of educating and training engineers, and indeed all technical personnel, has increased, and will continue to increase, with the rapid expansion of scientific knowledge and technical development, and with the necessity which these impose of increased specializa-

tion for the technician and of change from craft to highly mechanized conditions of employment for the artisan. Too much stress cannot be laid on the need in all cases for ensuring an adequate foundation of general education to the appropriate level prior to specialization, and a full appreciation of the purpose of the significant specialized activity in relation to the life and welfare of industry and the community.

A special responsibility in this respect falls on the universities. It is suggested that there are two vitally important needs of industry in Great Britain which it should be the function of the universities to satisfy. One is for men capable of interpreting scientific progress in relation to industrial possibilities and of applying scientific methods of analysis to the problems which arise in each progressive stage of technical development. The other is for men who combine with adequate scientific and technical knowledge the personal qualities and power of leadership specially necessary on the productive and administrative sides of industrial organization. At the present time, the engineering schools tend to treat all students as though they are destined for high-grade scientific or technical work. Those who are—and indeed all—will be better for a broader scientific foundation, less specialization and fuller opportunity to take part in the corporate life of the university. Those who are not—and in an average year the proportion is high—should be permitted to replace the more advanced stages of the mathematical and technical work by studies in such subjects as the social sciences and economics.

To this educational preparation must then be added the practical and essentially technological parts of the training, and in neither respect are the present provisions satisfactory. Many large firms still make no provision for the systematic practical training of their graduate recruits, while those who do pay too little attention to the efficiency, or inefficiency, of the process by which the graduate acquires the information and experience to be gained. In keeping with Sir Richard Livingstone's views, it is suggested that all prospective university engineering students should be required to spend one year in industry between leaving school and entering the university. So long as reasonable continuance of scientific and mathematical study is ensured, and that satisfactory provisions are made within industry for the practical instruction of the boys concerned, this arrangement would be advantageous in every way. It would seem to offer the most effective means of self and guided selection, and the opportunity it would afford for mental adjustment is of the greatest importance.

At the post-graduate stage the continued practical training, leading, after the appropriate period, to the choice of, and concentration on, a particular branch of engineering work, requires to be supplemented in a much more effective manner than has been the case with systematic technological instruction. The amount of information and accumulated experience which a man must acquire before he can hope—or be expected—to make an original contribution to development is often so great that its acquisition purely by independent effort may be an extremely inefficient process. In recognition of this, a few firms have provided suitable lecture courses and afforded opportunities for discussion as an integral part of their training schemes. The disadvantage of this arrangement is that access is limited, and there is great need for supplementary provisions in the local colleges and universities similar to those instituted in the Manchester area in 1937 under the auspices of the regional advisory committee responsible for co-ordinating technical and other forms of further education. The circular announcing the first series of advanced lecture courses stated: "It is probable that there are many engineers engaged in the highly differentiated engineering industry of the region who would be attracted by courses of lectures dealing with specialized problems related to their daily work. If these lectures were given by specialists in intimate relation with the practical problems of industry, if they attracted engineers who, in their professional capacity, were directly concerned with the subject-matter of the courses, and if the lectures were informal and provocative of discussion, it is believed that they would constitute a useful innovation in engineering education in the region." This scheme offered no attractions in the form of certificates and afforded no artificial examination stimulus to the acquisition of knowledge. Its operation was temporarily discontinued in 1939, but the success and extension of this type of scheme is a matter of considerable educational interest and importance.

The report submitted by the Sub-Committee of the Institute of Electrical Engineers concluded with a discussion of the short-term problems of education and training which will arise in the immediate post-war period. The drafting into industry of men now with the Fighting Services and in Service establishments will present many difficulties; special provisions will have to be made in industry and the educational institutions to cater for the diversity of needs of both industry and the men concerned. Government grants will be required to cover the expenses of the training period. It is emphasized that these should not become the prerogative of ex-officers only, but should be available to all men with the necessary qualifications, experience and promise—a principle which has already been established in the recently instituted scheme of State bursaries. With the view of preparing the ground, the Committee intends to collect data concerning members of the Institution of Electrical Engineers now engaged with the Services and to make an assessment, so far as, and as soon as, is possible, of the probable personnel demands of the various branches of the electrical engineering industry and of the extent to which each firm can absorb, for purely training purposes, personnel outside its own requirements.

At a time of uncertainty like the present, little can perhaps be done in this direction, but it is beyond doubt that, having recognized past deficiencies, the whole of the engineering industry in Great Britain will support wholeheartedly any movement which has as its object the well-being and proficiency of its vast personnel.

CYTOPLASM OF THE PLANT CELL

The Cytoplasm of the Plant Cell

By Prof. Alexandre Guilliermond. Authorised translation from the unpublished French manuscript by Dr. Lenette Rogers Atkinson. (A new Series of Plant Science Books, Vol. 6.) Pp. x+247. (Waltham, Mass.: Chronica Botanica Co.; London: Williams Dawson and Sons, Ltd., 1941.) 4.75 dollars.

PROTOPLASM, the physical basis of life—to use Huxley's oft-quoted aphorism—is the very stuff of life, but its mystery lies not merely in its composition but even more in its organization. The correlation between the structure and behaviour of the nucleus and the demonstrable facts of heredity is one of the outstanding achievements of modern science. Possibly for this reason the study of the cytology of the cytoplasm has suffered in comparison with the cytology of the nucleus. Particular interest is attached, therefore, to this book by Prof. Alexandre Guilliermond, professor of botany in the Sorbonne.

Written by a pioneer investigator, the work is the most complete account in English of the contributions to our knowledge of the cytoplasmic inclusions which have been made by the French school of cytologists of which Prof. Guilliermond has been the leader. Translated from an unpublished manuscript in French, the book is vol. 6 of a new series of plant science text-books published by the Chronica Botanica Company and it contains a foreword by Prof. William Seifriz. who is also a notable contributor to knowledge of plant protoplasm.

The cytology of the cytoplasm and of the nucleus must be approached in different ways. These differences lie not only in the laboratory methods, though Prof. Guilliermond has much to say on this subject. The nuclear cytologist deals with what is usually the largest of the cellular inclusions and yet by his technique he often paints miniatures, although they are often exquisite in detail and definition. Though he may investigate the most minute living inclusions known in plant cells, the cytoplasmic cytologist must allow his attention and vision to roam over the entire range of a varied cytoplasmic 'landscape' and must portray—as in a swiftly executed water-colour—the ever-changing cytoplasmic scene. Understanding and appreciation of Prof. Guilliermond's eminently readable account will grow as the reader recognizes and accepts that the cytological problems of the cytoplasm have, of necessity, been approached by distinctive methods.

To the student of cell physiology the work is of the greatest interest. Much of physiology has been dominated by the desire to explain vital processes in terms of the accepted principles of physics and chemistry deduced from observations *in vitro*, and too often too little attention is paid to the milieu in which they occur *in vivo*. Plastids and vacuoles are two of the inclusions of great interest to the student of metabolism concerning which cytology has hitherto had but little to say. Plastids as living inclusions in the cytoplasm are intimately concerned with carbohydrate metabolism; vacuoles are usually recognized as liquid inclusions in the cytoplasm, characteristically able to accumulate salts and solutes and are regulated in this behaviour by the vital processes of the cells. Full understanding of photosynthesis and of mineral nutrition awaits a complete knowledge of the part which these inclusions play: Prof. Guilliermond's account of their morphology and development is a contribution to this end.

It is inappropriate to anticipate the conclusions which only emerge as one follows Prof. Guilliermond in his skilful path through the maze of mitochondria, chondriosomes, chondrioconcts, plastids and the thread-like, colloidal progenitors of vacuoles. In Prof. Guilliermond's view the chondriome of green plants consists of two types of inclusion which are not always distinguishable on morphological grounds but which, nevertheless, preserve their identity throughout the development of the cells. Of these, one type is characterized by its greater ability to elaborate carbohydrates and develops into plastids, whereas the other type remains minute and its members are regarded provisionally as "inactive chondriosomes". Plastids only have the "chondriosomal form" in their inactive phases and it now appears that their subsequent change in form may be reversible. Prof. Guilliermond takes frequent occasion to remark, with apparent justification, that one must be suspicious of analogies in shape for inclusions as different, as young vacuoles and the thread- or rod-like chondrioconcts may, at certain stages, be similar: in such cases the evidence of chemical composition or of development is marshalled to determine their identity.

A multiplicity of terms may be inevitable in so descriptive a subject but some may feel that this has gone to excess. "Gliode" to denote a colloidal system only to be found in living cells is a case in point. Furthermore, some well-established terms are not used in their precise technical sense. For example, 'crystalloid' is used as though synonymous with 'crystal' and the terminology used to describe colloidal systems seems unnecessarily involved and unfamiliar. The terminology of fats and fatty substances of complex composition has for long been a frequent source of confusion. Many would no doubt prefer 'lipoid' to 'lipide' to denote substances with the solubility and other general properties of fats, while "gluceride", on p. 26, seems an obvious misprint for 'glyceride'. Lecithin-like substances for which the term lipines is often used are somewhat elaborately termed 'phosphoaminolipides', and their identification as the chief components of minute inclusions in the cell is described: this identification, based on microchemical tests alone, may appear too sanguine to the critical biochemist.

For the most part the style is admirably concise and vivid—especially in the morphological descriptions. However, even brevity may be carried to extremes and some of the descriptions of the physicochemical characteristics of cells are for this reason meaningless: this is the case in the following passages: "The ratio cholesterol : fatty acid, or the lipocytic coefficient, is characteristic of a given species. It constitutes a cellular constant. There also exists a mineral constant. Similarly the water content for each type of tissue always fluctuates about the same value, therefore each type of tissue in a species possesses a constant and specific content of water of imbibition. Water is thus a cellular constant." Nevertheless, physiologists should not be deterred by this cursory treatment of these aspects of cell physiology from reading the rest of the book.

A historical point arises in connexion with the vacuole. De Vries is credited with the discovery of plasmolysis. Most authorities credit de Vries with the first use of the term, but the first observation of the process is usually attributed to Nägeli in 1855.

Prof. Guilliermond's book was published in 1941. English readers will be gratified that this new account

of so much French cytological work could be published in the United States despite the collapse of France. The preface states that Dr. J. Dufrenoy, who is well known to many English and American botanists and who was at one time an associate of Prof. Guilliermond, is now in the United States and assisted with the preparation of the book for the press. May we express the hope that a free interchange of ideas between the botanists of England and France may soon return, meanwhile English readers will welcome the latest summary in English of the work of French cytologists on the cytoplasm of plant cells.

F. C. STEWARD.

ANALYSIS OF MODERN STEELS

The Chemical Analysis of Ferrous Alloys and Foundry Materials

Modern Practice and Theory. By E. C. Pigott. Pp. xv+362. (London : Chapman and Hall, Ltd., 1942.) 28*s*. net.

THE increasing use of alloy steels has produced difficulties necessitating modifications in the methods used in the analysis of plain carbon steels described in the older text-books ; and in addition, considerable research has been required in order to simplify the estimation of the various additions, which now include many of the less common elements. The author, in the volume under review, has attempted to remedy the deficiency.

The scheme of the book is conceived on somewhat original lines. Each element is treated separately, and after describing its chemical and physical properties, and its role in steel manufacture, a consideration of the methods of analysis is given. This is followed by complete directions. An admirable feature is a very useful section dealing with the chemistry involved. This section, in particular, makes clear to beginners the fundamental principles underlying the various methods. This is too frequently disregarded in text-books of analysis. Many of the sections give evidence of careful investigation of various methods, more particularly those in which disputes are frequent. The chapter on the estimation of aluminium may be cited as an example ; no reference is made, however, to the method in which most of the metals are removed by electrolysis using a mercury cathode.

The book also contains sections on the analysis of aluminium alloys, copper alloys and refractories. In none of these has the author been so successful. In the section on the analysis of aluminium alloys, it is perhaps incorrectly assumed that all the zinc is extracted by treatment with caustic soda. The silica estimation must also be made in nickel or platinum vessels, and not porcelain, since the attack by strong soda is by no means negligible. The estimation of iron and aluminium in copper alloys by precipitation with ammonia would also lead to high results for the latter element, due to the presence of zinc, if only one precipitation is made.

The method suggested for the analysis of refractories is in many respects open to criticism. The ignition of alumina requires a temperature of at least 1,100° C. and not 900° C. as specified. The single precipitation of magnesium as phosphate in the presence of such an excessive amount of sodium salts must lead to an erroneous result.

There are few adverse criticisms to make on the other portions of the book. The photograph of the carbon apparatus, however, is not marked with the letters used in the description, with the result the details are difficult to follow. In a future edition, the table on p. 345 could be extended with advantage by giving suggested methods for various types of steel.

The author has produced a most useful treatise which should prove of great assistance to all analysts who are already experienced in the methods of analysis of the older steels.

CHEMISTRY IN CLINICAL MEDICINE

Manual of Clinical Chemistry

By Miriam Reiner. Pp. xv+296. (New York : Interscience Publishers, Inc. ; London : H. K. Lewis and Co., Ltd., 1941.) 3 dollars ; 18*s*. net.

METHODS of precision play an important part in modern medicine : they constantly seek, by the plain accuracy of scientific statement, to clarify clinical findings, to reinforce judgment, and to place opinion on a stable basis. Their proved value, proved by the work of an older generation, has broadened and amplified their place and scope, growth rapidly pushing forward with each new and accepted success. The present generation has in the physical, such as X-rays, and the chemical, such as the numerous tests whereby the intimate functions of the body metabolism can be observed, become familiar with new weapons which are now as much clinical necessities as a thermometer or a stethoscope. So far the field of value of such measures remains largely diagnostic and prognostic ; the therapeutic application, without decrying the place of the exact control observations possible in many diseases, still rather lags behind.

Miss Reiner's little volume on the technique of the many chemical methods in everyday use comes from the Mount Sinai Hospital, New York, and certainly fulfils the standard which would be expected from a product of that institution. The book is first of all a manual, that is to say, it is a volume compact in make-up, but bold in print ; systematic in arrangement but complete in adjuvant details ; and of a size convenient to be propped up on a laboratory desk or thrust into a peripatetic pocket. The whole subject is fully, indeed generously, covered, ranging from specifications, indicators and measures to tests for the common poisons, vitamins and hormones. Adequate and proportionate space is given to the various function tests, gastric analyses, urine and cerebro-spinal fluid examinations, etc., the section on blood analysis being—and rightly so—the largest.

The method of statement of the procedure to be followed gives to each step of detail its corresponding line, thus gaining on one hand clarity of presentment and on the other being practical and time-saving. It is pleasing to note an insistence on exactitude of measures and times and on the technical details of the preparation of reagents.

Miss Reiner's book is obviously intended for an American audience and suffers, therefore, in trivial details in presentation to a British. With this slight reservation, the book can be cordially commended as a competent and careful piece of work fulfilling in every sense its aim. The bibliography has been wisely cut down to one or two references pertinent to each item.

JOSEPH GEOGHEGAN.

Practical Mathematics

By Clement V. Durell. Pp. viii+176+xv. (London: G. Bell and Sons, Ltd., 1942.) 3*s*. 3*d*.

THE intensive study of the principles of elementary mathematics has greatly increased with the coming of war and, as a consequence, a new type of book has made its appearance. The necessity of this lies in the fact that, in preparing for the technical branches of the Services, students have little time to study several comprehensive text-books. What they need is a single volume containing the essential arithmetic, algebra, geometry, trigonometry and mechanics, dealt with as tersely as possible and with a practical bias.

Mr. Durell's book meets these requirements and, as would be expected from this author, the treatment is lucid and the subject-matter well presented. The ten chapters amply provide the basic mathematical equipment needed by the students for whose use the book is especially intended. A larger space than usual—some twenty pages—has been devoted to tables but, in view of their value to practical students, it is somewhat surprising to find that tables of anti-logarithms have been omitted.

Elementary Qualitative Analysis

For College Students. By Prof. J. H. Reedy. (International Chemical Series.) Third edition. Pp. x+156. (New York and London: McGraw-Hill Book Co., Inc., 1941.) 10*s*. 6*d*.

THE fact that a third edition of this American manual on elementary qualitative analysis has been issued indicates the undiminished confidence and popularity in which this book is held in the United States. Moreover, it can be confidently recommended to teachers and students in Great Britain as a satisfactory work on qualitative analysis up to intermediate standard.

The book follows the conventional system of analysis for the common metals and acid radicals, but new methods and modifications of older methods have been included in certain cases as time-saving and reliable measures. The use of the centrifuge for facilitating the rapid separation of precipitates is of interest and might be more widely adopted. In addition to instructive details, the manual includes numerous exercises and questions, and is generally written in a style which will stimulate and hold the interest of a student starting on chemical analysis. The price, however, is likely to be too high for most students.

A New Scheme of Elementary Qualitative Analysis

By A. J. Mee. (Dent's Modern Science Series.) Pp. x+52. (London: J. M. Dent and Sons, Ltd., 1942.) 1*s*. 9*d*.

ANY departure from the well-trodden paths of elementary qualitative analysis is a sufficiently novel event to stimulate the interest of all chemists engaged in the teaching or practice of chemical analysis. In this little volume, Dr. Mee describes a new workable scheme for the detection and separation of the common metals, the principal feature lying in the fact that hydrogen sulphide gas is not required in the analytical separations. The poisonous nature and the difficulty of providing adequate supplies of hydrogen sulphide provide an additional recommendation for these new methods, which do not require any reagents not part of the normal stock of a chemical laboratory. For confirmatory tests with certain metals, however, special reagents are advocated, but the detection of acid radicals follows conventional lines.

The scope of this book broadly covers the requirements of students in qualitative analysis to intermediate standard. Teachers of chemistry are advised to obtain a copy of this book which is very moderate in price, and read it carefully; if there is something to criticize, there is also much to interest and stimulate.

Intermediate Quantitative Analysis

By Dr. A. J. E. Welch. Pp. iv+128. (London: University Tutorial Press, Ltd., 1941.) 3*s*. 6*d*.

THE small volume under review provides a course of practical exercises in quantitative chemical analysis up to intermediate and Higher School Certificate standard. Since the book is essentially designed to meet the requirements of examining bodies, the emphasis is largely on volumetric analysis, where the use of equivalents and normalities is strongly advocated. There is also a short but adequate section on gravimetric analysis, and many problems and exercises are to be found throughout the text. The book is very moderate in price and can be recommended as a worthy successor to "Elementary Quantitative Analysis" by Briggs and Bausor, which it now replaces in the University Tutorial Press series of text-books.

World Revolution and the Future of the West

By Dr. W. Friedmann. (Thinker's Library, No. 88.) Pp. x+118. (London: Watts and Co., Ltd., 1942.) 2*s*. net.

DR. FRIEDMANN, from an originally German and juristic standard, forecasts the fashion in which the present horrible chaos came upon us, and how the direct values should be secured. He is rightly concerned primarily and mainly with Western civilization. The globe has been humanized from the West, the Greco-Romans leaving their human structure to survive the revolutions which have led us to the present. Humanity, imperfectly indeed, passed the consolidatory Roman stage crowned by the glory of Greece. Then a further socializing covers the same ground in Christianity. Without the survival of these three—law, reason, beauty—humanity would not have come to the birth: laid as they have been in fresh revolutions to the present.

The legacy ensures the survival of socialization and lends itself from time to time to quiet lapses, as the eighteenth century, or scientific marvels, from the eighteenth century onwards. The British Empire has served and should still serve as the umbrella: one supposes that with the United States, an ultimate guarantee can be secured.

The main theme of Dr. Friedmann is what he calls the totalization of the West. He describes the methods by which, as in England, the desired advance is secured without conflict. The present crisis takes the form of securing to every individual sufficient to his needs spiritual as well as physical. One is bound to say that the standard of the spiritual is deplorably lowered on the way. The agency of a B.B.C. plants standards of taste far below what would be enjoyed if it continues to enforce the same with damnable iteration. There is a plain duty to lead upward.

It is pleasant to see that Dr. Friedmann, though obviously a communist in theory, lays the greatest stress on preserving as much freedom as consistent with the social fabric holding together. But a brave man will hesitate on prophecies in detail. The world conflict has still to be completed. F. S. MARVIN.

SOCIAL STRATIFICATION IN BRITISH SOCIETY

AT the extended general meeting of the British Psychological Society held at the Municipal Training College, Brighton, during April 9–12, the Section of Social Psychology arranged a symposium, under the chairmanship of Prof. M. Ginsberg, on the theme of "Social Stratification".

Prof. T. H. Pear, professor of psychology in the University of Manchester, read a paper on "Psychological Aspects of English Social Stratification". He began by pointing out that sociologists approach the subject of social stratification by making general statements about classes, comparing and contrasting them, but with very few illustrations from actual instances or research studies. This sort of specific information is regarded as rather a matter for journalists or novelists; but journalists and novelists are often biased by selection and personal preferences. Perhaps the roots of the difficulty lie deeper. Is it part of the general tendency of sociologists to eschew the concrete case—to be nomothetic instead of epigraphic? Anyone who ventures into this area of psychology puts himself in a position to be shot at from both sides simultaneously. The subject of the symposium, therefore, is almost untouched by psychologists and attracts surprisingly little attention from sociologists. There are social forces which make it difficult for a professional thinker to regard his own position in society objectively, and fully to comprehend its meaning in a wider social pattern. Severe taboos are imposed upon detailed consideration of social status (especially of persons living in any but the 'top' and 'bottom' layers of society). This unanalysed acceptance of social status ('knowing one's place') partly explains the sociologist's and psychologist's neglect of social stratification. So English social psychology is, on the whole, an account by middle-class writers of middle-class behaviour.

English social stratification is not what it was in 1939 and it will change considerably when peace comes, according to Prof. Pear. It is, however, necessary to record that as in Disraeli's time there are still two Englands. From many directions we hear that after the War there will be great changes in the English social classes. In one sense this is a platitude. All modern wars cause social change; this is what they are fought for. Social stratification will be less, and the lines of demarcation less clear. At the beginning of this War, some urged that it should be fought for the 'English way of life', describing it in a manner which might be recognized by their friends, if not by the majority of the English. Since then, many have pointed out that no national way of life ever completely survives a great war; relatively few could wish our social structure to be exactly restored—cracks, moss, mildew and all.

Prof. Pear then went on to discuss social differences as shown by language. Each class uses characteristic terms of approval, disapproval, endearment, enthusiasm and boredom, and each disapproves or ridicules the choice of others. Euphemisms, too, are class-labels. Perhaps most of these are used by the middle (especially the lower-middle) class. Of the learnt phrases which especially indicate social strata the emollient group are the most striking. A good diplomat has many in stock, and knows when to produce the right one. They are used to begin, interrupt or end a conversation, to refuse or decline a request, suggestion or invitation; to correct a misstatement, to oppose a proposition without rancour, to adduce incontrovertible if unwelcome evidence, to accost a stranger, encourage a shy person or reprove a backslider. One social group may inaccurately attribute 'bad' speech to another. American journalists, when they 'quote' English working-class speech, are apt to write it without aspirates, yet in many parts of industrial England the 'h' is seldom dropped. With such warnings in mind, it may be said that difference in vowel-pronunciation is an important mark of social class. The Cockney modifies all the English vowels, usually transforming them into diphthongs. The auditory 'aspect' of speech is perhaps more important than the visual accompaniment, facial expression, gesture and posture. The comparative absence of facial expression and gesture from the speech-behaviour of the English 'ruling classes' may be a sign of social stratification.

On reading attempts made between 1918 and 1939 to explain war in terms of human experience and behaviour, Prof. Pear has been driven to conclude that most of them were conceived from an upper-class point of view. Underlying them is the assumption that when war is declared the author will take —or be holding—a commission. Few, especially those who 'explain' the stirring up of war in peace-time as due to aggressiveness, ask themselves how much the poorer people know about the nations for whom, after war has broken out, they are exhorted to feel emotions specified by the propagandists. In the past, privilege may have exercised good influences in many directions, yet during our lifetime its shortcomings have been increasingly obvious. To-day it seems to be falling into disfavour all over the world. Yet the difference ought to be clearly recognized between lessening privilege and decreasing tolerance of individual differences. Prof. Pear urged social psychologists to study social phenomena, both in the upper and the lower classes. For gentle manners are not the result of an accident, and he feels it would be a tragedy if we lost them.

Mr. Tom Harrisson, of Mass Observation, contributed to the symposium a paper on "Class Consciousness and Class Unconsciousness". There is no doubt that there are differences between different groups of the community, but after spending five years in making Mass-Observation studies of ordinary people in all parts of the country, he feels the extent of class difference has been exaggerated. Some sections of the community are richer or poorer, more or less educated, but the conception of clearly divided self-conscious groups is of doubtful validity. The class who are really 'class conscious' are the small upper-class group, who feel deeply aware of the mass of poorer and less educated people 'below' them, and often fear them. Many of the characteristics of 1942 Britain are due to this underlying 'fear of the masses' among our leaders, and their consequent tendency to treat working people as if they are somehow stupid and dangerous, to be kept in good humour but also to be kept in place. Among much the largest section of the community—the manual workers—there is little class consciousness; there are many divisions within the working class, as regards mentality and outlook. There are marked differences and conflicts, for example, within a cotton mill, and even within the team of three working on one cotton operation—the spinner, the side piecer and the little piecer.

This is not to say that there are not big differences between different sections of the community. But these differences are not necessarily *class* differences ; there are often much bigger age or sex or temperament differences on the same subject. In general, the basic distinction is the amount of money owned or earned, and connected with this the degree of education. In observational studies of non-voting, over a series of municipal elections in which there were candidates of 'middle-class' and 'working-class' parties, it was found that 38 per cent of the so-called upper-class did not vote, 42 per cent of middle-class and 48 per cent of working-class. In a recent investigation on political attitudes, it was found that while most middle-class people were, for example, able to name at least one living Liberal politician, the majority of working people could not name one at all. Again, the degree to which people hold an opinion on propaganda films decreases sharply as one descends the economic scale. Many other examples could be given from Mass-Observation's researches, said Mr. Harrisson, to illustrate differences of knowledge and reaction between those who ended their education at the elementary stage and the better-off minorities. Cash differences inevitably produce other differences. But to term these indiscriminately 'class differences' obscures the fact that there are probably few inherent differences within the individual which cannot be eradicated in various ways, often quickly.

Mr. Harrisson thinks that the mental gulf between the upper classes and the working classes has been gradually exaggerated in the minds especially of the upper classes, though this does not make it any less significant psychologically for them. We have seen lately, in the rapid growth of works councils in war industry, how much can be done in a factory simply by bringing together around a table once a month some representative workers and managers. In the past most firms have assumed that the distinction between management and worker is absolute and essential ; in war this distinction is found to be obstructive to maximum effort, and it has now been proved to be (to a considerable extent) avoidable.

Mr. Harrisson considered that the most useful symbol of British social structure is the familiar pyramid, with the King on the top, the mass of £3-a-week people at the base. There is a constant tendency among those at the bottom to try to climb up towards the top. The general tendency is to admire those at the top, seldom to resent them.

Mr. Harrisson described some ways in which working people in "Worktown" canalize our culture urge to go up the social scale. Every week-end Worktowners spend an extra quantity of money in special pleasures, such as drinking beer in the public lounge, where the *same* beer costs 1*d*. more than it does in the 'vault', used on week-days. During the week anybody wearing a bowler hat is either middle-class or a mourner. At the week-end, anybody and everybody may wear a bowler and look thoroughly middle-class. The week-end cycle is a regular process of class elevation, and men who never think of wearing a tie during the week may have a gold tie-pin on Sunday. Secondly, there is the cycle of the year, for which people save up every week, to take one week's holiday at Blackpool or elsewhere, generally at a much higher level of expenditure, environment and social prestige than they have ever enjoyed in their home town. One week a year they are able to live on a higher rung of the ladder.

Thirdly, there is the cycle of life. Many working people put aside money every week in their lives so that they can be buried with rich pomp and ceremony at their deaths. Moreover, the graves in Worktown cemetery are graded into four classes, according to the distances from the path and therefore the number of people who see your tombstone. Class I is very expensive and beside the main path. It is the ambition of many poor people to have in death a class position unattainable in life.

Prof. J. C. Flugel, assistant professor of psychology in University College, London, read a paper in the symposium on "Class Mind and Group Mind". He agreed with much of what Mr. Tom Harrisson had said. But we are forced to use the term 'class' because there is no better one available at present ; in using it we must constantly remember that class is nothing rigid, but something very fluid. Psychologists have not tried to investigate the problem of class-consciousness systematically, though there has been a certain amount of work on racial and other attitudes. One is sometimes inclined to believe that the term 'class', as H. G. Wells remarks, has degenerated into a mere weapon or term of abuse. Class may be fixed by a class hierarchy, but otherwise it is difficult or impossible to define. Class fulfils only partly the criteria of McDougall's "highly organized group", that is a group with a common purpose, continuity, some adequate idea of itself, interaction or rivalry with other groups, a body of common traditions, internal organization of the group, including specialization and differentiation. Marxism aims at bringing about an accentuation of these criteria, especially a common purpose, an adequate idea of the class grouping, and interactional rivalry. It assumes that there are only two classes and there will be an increasing dichotomy. In this Marxism has proved to be wrong, said Prof. Flugel ; not only has 'class' become increasingly continuous, but also class distinctions are cut across by numerous other groups, the boundaries of which are drawn on other lines. Many workers are now small-scale capitalists ; many in the general election of 1931 had the capitalist side of their feelings (fear about savings, etc.) accentuated so much that it swamped the workers' side (Labour sympathies, etc.).

Prof. Flugel felt that class distinctions are becoming more confused, rather than less, and that Marx's brilliant theory has not worked out in practice in Great Britain. Employers have increasingly sought to cultivate new loyalties within classes by profit sharing, bonus systems, welfare schemes, and so on. Then there is the rise of the manager in all his different grades ; the increase of minor bureaucrats and officials ; the small business man running his own business or shop, who may be more of a property owner than the salaried manager, but inferior in wealth to the skilled worker ; such people feel interest in the nature of their business rather than their class.

Prof. Flugel went on to point out some changes in social stratification. A new sense of interest in and guilt about the conditions of the poor has occurred in the upper classes, and increasingly within the past few years. The realization of this responsibility is largely due to the rise of Socialism, but is also in opposition to Socialism. Then, working people have become more conscious of their increased opportunity to rise in the social ladder, though it is still limited. Workers want to belong to the upper class, rather than to destroy it.

Some connexions between social stratification and Freudian theory were finally suggested by Prof. Flugel. The upper class group compare, from the

workers' point of view, with the 'ego-ideal'. This would explain to some extent three contradictory attitudes towards the upper class—the attitude of wanting to rebel against it, the attitude of wanting to attain it, and the attitude of wanting to submit to it. On the other hand, pure class-consciousness in the Marxist sense stresses only companionship in a continuation of the sibling relationship, the 'id'. But we also need the child-adult (parent) relationship, the 'super-ego'. Now all revolutions towards one class lead to dictatorships, and these are thereby socially unstable. A revolutionary movement can scarcely be as morally satisfying as a 'patriotic' movement.

Summing up, Prof. Ginsberg said that he felt the Marxist point of view, which he by no means wholly accepts, had been rather underestimated in discussion and that there are aspects of it which still throw light on present conditions. There is a certain reality in 'class', in so far as 'you feel at home' with somebody of your own class. There is much else that can be said; what is needed now is more thoughtful study.

ANIMAL HUSBANDRY IN INDIA*

By SIR ARTHUR OLVER, C.B., C.M.G.
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IT would be quite impossible to gain a clear idea of the complexity of the problems facing animal husbandry in India without some understanding of the special factors conditioning the subject in India. For example: (1) Religious and traditional prejudices and customs. (2) Effect of the density of the population and the low purchasing power of the cultivators on farming practice. (3) General lack of appreciation of the fundamental principles which underlie proper breeding, feeding and management, and the great need which exists for a properly balanced system of land utilization. (4) Lack in most Provinces and States of any expert animal husbandry organization devoted solely to the interests of livestock. (5) Annual droving of millions of dealers' cattle from north to south of India.

Slaughter. The cow is a semi-sacred animal and must not be slaughtered. In strict Hindu communities, it is not permissible to give a merciful release even to a fatally injured and suffering animal. These inhibitions are productive of the most far-reaching difficulties and make it impracticable to carry on dairying or stock breeding on strictly commercial lines.

Castration. Until comparatively recently, stock owners were unwilling to castrate their cattle at an early age, though the males and females run together on village grazing grounds. This objection is now being overcome, and castration of inferior animals is carried out on a large scale by Provincial veterinary departments. It cannot, however, be too much or too often emphasized that no lasting progress can be expected in livestock improvement until arrangements are made for controlled mating, and for the proper feeding and management of breeding females and young stock.

Grazing areas. Though highly desirable, the improvement of such grazing areas as remain is not a solution of the cattle-feeding problem. The best of these areas tend to be taken up for cultivation, and in any event, cultivators ought to aim at devoting a portion of their holdings to fodder crop production; thereby producing better stock and more milk, and helping to maintain the fertility and physical condition of the soil. Without such a change of system—where necessary—progressive degeneration of cattle seems certain to follow the gradual disappearance of good grazing lands on which the better cattle are at present bred.

Pinjrapoles and Gaushalas. The semi-religious pinjrapoles and gaushalas which are maintained in most cities throughout India have in many cases become anything but the homes of rest and comfort for derelict animals they are intended to be. By arranging for competent management and by breeding from the best of the cows and selling their milk, it has been shown that conditions can be greatly improved and profits made. Further, by taking up land for cultivation outside the city, the extra funds thus obtained can be utilized, to great advantage, to provide fodder crops and grazing for the hopelessly derelict and for the better feeding of the milking herd and young stock. By using selected sires, valuable young bulls were also produced, which should be of considerable value to breeders in the vicinity. These institutions could thus be made valuable demonstration centres all over India, and in addition to their great educational value, would save large numbers of quite good milch cows which are committed to their care.

Density of population. Owing to the smallness of the holdings and the low purchasing power of the individual, it has generally been considered impracticable for the Indian ryot to produce fodder crops for the proper feeding of his cattle, or to produce or purchase the increased supplies of milk which are essential for the health and proper development of the people. The tendency has been to consider that the only practicable policy is to produce more and more crops for sale or direct human consumption. As a result, soil fertility and humus content have been greatly depleted in many areas and enormous damage is being done by denudation, owing to removal of cover and humus from the soil. There seems, however, to be no reason why, by a suitable system of mixed farming, the ryots in suitable areas should not obtain as great money returns as under the present system of devoting their entire holdings to crops and, in addition, better stock and an invaluable supply of milk and dairy products for their families. Experiments undertaken to test this view have in fact shown that by substituting mixed farming, including milk production, for the mere raising of crops for sale, agriculture in many parts of India could be raised to a higher level.

Dung burning and the manurial value of livestock. Throughout the drier parts of India the custom of burning cow dung for fuel is a serious handicap to agriculture. A great deal of manurial value is lost; the soil is deprived of humus; and, as cattle are not usually herded on the land due for cultivation, the manurial value of their urine is also lost.

Moreover, under the present system, village grazing grounds become so trodden and infected with disease that it is impossible to breed or maintain any but the most stunted stock on them.

In the absence of available firewood, the burning of cow dung seems bound to continue, but it is clear that more of the manurial value could be made available for crop production if cattle were better fed and maintained on the holdings, wherever possible.

* Substance of a lecture before the India and Burma Section of the Royal Society of Arts, delivered on March 13.

Breeding practice and European cattle. Except among the expert breeders, who are dying out as the best of the grazing areas are taken up for arable cultivation, there is little tendency to ensure systematic mating to produce definite types, and one of the great dangers of importing European cattle into India is that the male cross-bred progeny are used indiscriminately as sires. It has now been shown that the better Indian breeds can easily be improved to a relatively high standard, by proper breeding, feeding and management. To control such work properly among the 200 million livestock of India, organized animal husbandry is, however, essential; thus it would take the place of these professional breeders. Otherwise sires of mixed or unknown parentage will be more and more used, though it is now well known that their progeny is very inferior.

Buffalo or cow. Much more highly fed as it usually is, the she-buffalo is generally considered to be a much more efficient milk and butter-fat producer than the cow, but a careful analysis of available data has shown that this is probably the case only where an abundance of coarse grazing is available. Indeed, strictly assessed in relation to the relatively high value in nutrition of the solids-not-fat of milk and with due regard to the need for a correctly balanced diet for the people, it is probable that for home production the balance would favour cows of the best Indian milch breeds. Under parallel conditions of feeding and management, such cows produce as much or more milk than buffaloes, and although the percentage of butter-fat is lower, the Zebu cow is highly efficient in converting dry crop residues into food of high biological value, and can even produce butter-fat as cheaply as the buffalo. For commercial dairying the buffalo has obvious advantages, but it is difficult to feel that the custom of maintaining she-buffaloes for milk production as well as cows for the production of working bullocks can be economically sound in rural areas.

Calf-rearing. In the case of buffaloes, the female calves are usually well fed and reared, while most of the males are allowed to succumb. In the case of cows the opposite happens, and in both cases it is the custom to present the stuffed hides to the cows at milking time to induce them to give their milk. In recent years it has been shown, however, that with proper handling when first brought into the milking herd, Indian cows yield their milk perfectly well without this, and that early maturity can readily be induced. It seems, therefore, that on agricultural holdings it would be sounder to use cows and feed them and both the male and female calves properly, instead of maintaining buffaloes as domestic milk producers and cows to provide the essential supply of work cattle. The custom of keeping cows in cities should also be discouraged, since it is insanitary and the cows—usually the best obtainable—are generally slaughtered at the end of the current lactation.

Dual- or single-purpose cattle. Judging from the limited success which expert breeders have obtained in Great Britain in their endeavours to produce cattle which are really efficient dual-purpose animals, for the production of milk and meat, it would probably be extremely difficult to produce breeds which would be efficient both for milk production and for the ...st trotting or walking work which is the main pur- ... for which cattle are bred in India. With the ...pread of motor transport the demand for fast ...ullocks for road work is, moreover, rapidly decreasing, and with heavier ploughs it seems probable that slower moving cattle may in future be more acceptable to cultivators. A strong view is, however, held among them, from north to south of India, that capacity for fast work and high milk production do not go together. In any event, in view of the very striking improvement which has in recent years been effected in the milk yield, early maturity and docility of pure Indian dairy cattle, it seems certain that the best of these breeds will be developed to still higher levels. Milk recording and the publication of milk records has been undertaken by the Animal Husbandry Bureau to this end.

Annual droving of dealers' cattle. The droving of immense numbers of dealers' cattle from north to south and east to west of India involves constant danger of spreading contagious disease of all kinds, and protective inoculation of such cattle should so far as possible be enforced.

Animal husbandry departments. Embracing as it does about one third of the domesticated animals of the world, animal husbandry in India is obviously a huge undertaking, the development of which on modern lines requires much more extensive Government provision, independent of the requirements of cash crops, than has so far been made available.

It is not possible in the limited space at my disposal to discuss all the measures which were taken during my eight years as animal husbandry expert to place the various branches of animal husbandry in India on a better footing. From the first it was obvious that in view of the crippling losses from disease, malnutrition and similar causes, far more comprehensive Government expert assistance to stock owners was required. Every help was accordingly given by the Imperial Council of Agricultural Research to the reorganization of the Mukteswar Research Institute as (1) a research station in the hills, with staff and facilities for dealing in appropriate sections with all branches of veterinary research, and (2) a plains station for the production of biological products on the very large scale which is needed, and for research which can be satisfactorily carried out in the plains. The research staff at Mukteswar was organized in appropriate sections, each capable of dealing with a branch of veterinary research, and the substation at Izatnagar was provided with additional sections to deal with animal nutrition, poultry and poultry diseases, and genetics, in addition to the production of biological products. In this way a very comprehensive animal husbandry research and production institute was built up, and to provide the necessary link between research and the field work of Provincial veterinary departments, a veterinary investigation officer was also provided by the Imperial Council of Agricultural Research for each British Province and certain affiliated Indian States. These have been found of great value both to research and in the systematic study of local disease problems, and have now been made a permanent part of Provincial and State disease control organizations. Stockmen, capable of carrying out inoculation and first-aid treatment, after suitable training at veterinary hospitals, were also arranged for. The facilities for disease control and animal husbandry have thus been improved and research plans facilitated both at Mukteswar and at veterinary colleges, and during the past decade our knowledge of disease conditions and of the incidence of disease has been greatly increased.

The standard of veterinary education and technical training was improved at most veterinary colleges, and arrangements have recently been made to institute a B.Sc. university degree course at the Madras Veterinary College, in conjunction with the four-year veterinary graduates course. This is a welcome move in the direction of higher veterinary education, which is much needed in India.

Much attention was given to the improvement of dairying in India; this topic has been dealt with exhaustively by Dr. Norman Wright, who was brought out to give expert advice on the many and difficult problems which have to be faced by this industry under Indian conditions. Attention was also given to the control of disease among equines and to the improvement of local breeds of horses and donkeys; the breeding of horses was in the main provided for by a military organization, in the operations of which the Imperial Council of Agricultural Research had no say.

The nucleus of an Animal Husbandry Bureau was also formed and all the information available in the records of military dairies, dairy farms and similar institutions was extracted and published. By this means the great potentialities of pure-bred Indian cattle in regard to milk production was for the first time made generally known, and in combination with the publication of milk records, has acted as a great stimulus to the improvement of pure Indian milch breeds.

Authoritative definitions of the breed characteristics of several of the best-known breeds of Indian cattle were also taken up by the Bureau and have since been published; and a village survey was carried out, in four areas in different parts of India, with the view of ascertaining precisely the amount of milk and other dairy products produced and consumed by the Indian ryot.

A co-ordinated scheme for the improvement of the sheep of various parts of India was instituted by the Imperial Council of Agricultural Research, and a representative was sent to South Africa to obtain first-hand information with the view of considering the possibility of establishing an Angora goat industry in certain parts of India where similar goats already existed. Some assistance was also given to the improvement of village goats and poultry.

The main problem of animal husbandry in India is the improvement of the working bullock, and one of the most important measures taken to improve livestock was the organization in 1938 of the first All-India Cattle Show at New Delhi, at which representatives of the most important breeds of pure Indian Zebu cattle were exhibited for the first time in history. Such a central show is a logical development of the annual shows which are held in many Provinces and States, and at which local cattle are judged and prizes given, each year. These shows are a part of the measures taken by Provincial Governments to secure systematic improvement of livestock and have proved of the greatest value in suitable areas. If properly followed up, the central show should serve to advertise to the world that, for tropical countries, Indian Zebu cattle have no equals.

As it covers no less than about one third of the domesticated animals of the world, animal husbandry in India obviously requires much more extensive Government provision, apart altogether from the requirements of cash crops.

X-RAY ANALYSIS OF HÆMOGLOBIN

By M. F. PERUTZ

Cavendish Laboratory and Molteno Institute, Cambridge

IT has been shown that very detailed X-ray diffraction photographs can be obtained from crystals of horse methæmoglobin suspended in concentrated solutions of ammonium sulphate. On rapid drying in air, these crystals contract by 42 per cent of their wet volume. The dried crystals give a poor diffraction pattern consisting of few low-order reflexions around the central spot[1].

A method has now been developed whereby it is hoped greatly to extend the information which X-ray photographs from single crystals of proteins have yielded up to the present. It is based upon a suggestion first put forward by Bernal, who observed that after the transition of chymotrypsin crystals from the wet to the air-dried state, the shrinkage is accompanied by alterations of the relative intensities of reflexions. Bernal concluded that if it were possible to obtain complete sets of reflexions in different states of hydration of the crystal, then this may enable us to distinguish between the effects of intra- and inter-molecular scattering and, eventually, to compute a direct Fourier synthesis of the molecular structure of the protein[1].

Single crystals of horse methæmoglobin can be made to contract so slowly that the complete drying process occupies several days. In addition, it was found possible to arrest the contraction over periods of weeks at stages of hydration intermediate between the wet and the air-dried, leaving sufficient time at each stage to record the reflexions from the principal crystal zones. So far the following results have been obtained:

(*a*) *Cell dimensions and optical properties.* Horse methæmoglobin crystals are monoclinic and belong to the space group $C2$, with two molecules in the unit cell. The cell dimensions at various degrees of contraction are given in the accompanying table. It

CELL DIMENSIONS AT DIFFERENT STAGES OF SHRINKAGE

Stage of shrinkage	a	b	c	β	$c \sin \beta$	Volume (A.^{3})	Contraction per cent
1 Wet	109 ± 0·5	63·8	55·1	111·1	51·4	357,000	—
2 Intermediate	,,	,,	51·4	116·2	46·1	321,000	10·3
3 ,,	,,	,,	53·5 ± 0·3	127·5 ±0·5°	42·3	294,000	17·7
4 Air-dried	104 ± 1·5	,,	54·1 ± 1·0	137·5 ±1°	36·5 ± 0·5	242,000	32

Probable errors are given wherever they exceed 0·2 A. or 0·2°.

is seen that b stays constant throughout the contraction, while a does not change until the final stage 4, when it suddenly shrinks from 109 A. to 104 A. The most important variable is the c spacing, which contracts by a total of 29 per cent. The angles between the optical extinction directions and the a axis remain unchanged during the transition from stage 1 to stage 2. At stages 3 and 4 the crystals had become too opaque for optical examination.

(*b*) *Changes of diffraction pattern.* Shrinkage of the crystals has the effect of increasing the intensity of the diffuse background relative to that of the Bragg reflexions; it also causes the latter to fall

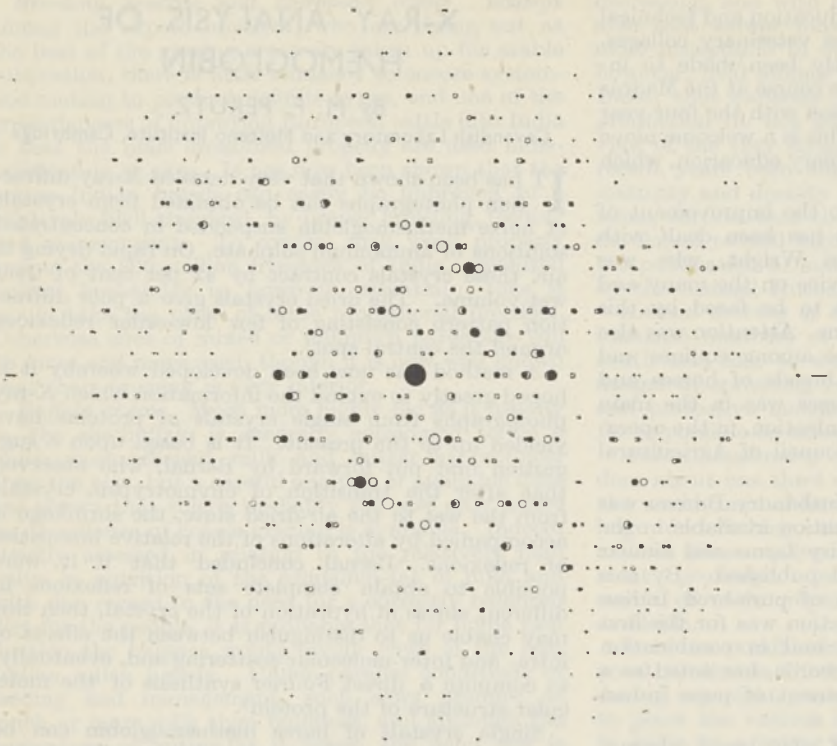

Fig. 1.
DISTRIBUTION OF F'^2 IN THE RECIPROCAL LATTICE PLANE $h0l$.
The large circle in the centre is the origin. The c^* axis is horizontal.

off more rapidly at larger angles θ. While the patterns at the two intermediary stages show almost as much detail as those obtained from wet crystals, all reflexions of spacings smaller than 7 A. vanish in the case of the air-dried crystals.

The greatest changes in the relative intensities are to be expected in the $h0l$ reflexions, since all contraction takes place in the b plane. Fig. 1 consists of the superimposed pictures of the reciprocal lattice planes $h0l$ for the stages 1 and 3 respectively. The blank circles are drawn at the reciprocal lattice points belonging to stage 1, the blacked circles at the appropriate points for stage 3. The areas of the circles are proportional to F'^2_{h0l}. A temperature factor of $e^{-60\sin^2\theta/\lambda^2}$ was applied to the F'^2 values for stage 1, so as to adapt their rate of falling off to that observed at stage 3. It will be noted that there exist definite regions in reciprocal space where F' tends to have high values and others where it tends to vanish, and that these regions tend to occupy identical positions with respect to the origin and the c^* axis, irrespective of the degree of shrinkage.

(*c*) *Patterson-Fourier projections* on the b plane have been prepared for the stages 1, 2, 3 and 4. Those for stages 1 and 3 are illustrated in Fig. 2. If these two maps are superimposed so that the centres and the a axes coincide, then the positions of the majority of peaks also coincide. Moreover, the peaks show striking similarities in shape. If several unit cells are drawn of each of the two projections and the two large maps so obtained are superimposed with their a axes and one row of origins coinciding, then the effect shown in Fig. 3 is seen. The map can be divided into regions which are parallel to the a axis. Proceeding from the line of superposition (A in Fig. 3) there is first a region where both the maxima and the outlines of all major peaks coincide (region AP or AQ). Next comes a region where the correspondence between the outlines gradually vanishes and where the peaks which belong

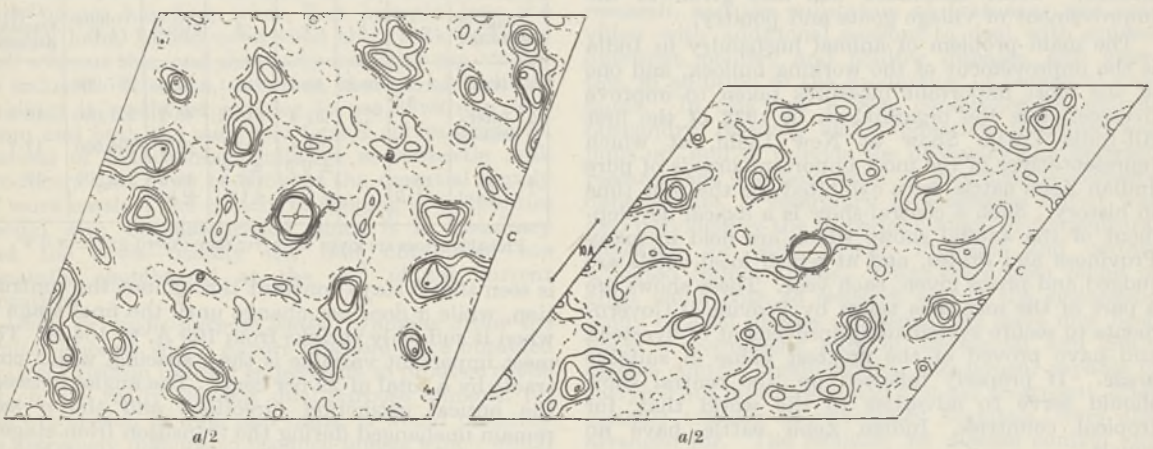

Fig. 2.
(*a*) PATTERSON (x,z) PREPARED FROM F'^2_{h0l}. $e^{-60\sin^2\theta/\lambda^2}$ OF STAGE 1, WET CRYSTAL; (*b*) PATTERSON (x,z) PREPARED FROM F'^2_{h0l} OF STAGE 3, PARTIALLY DRIED CRYSTAL.
In both diagrams the contours are drawn at intervals of 50 and the negative contours are omitted. The dashed line is the zero contour. The higher contours near the origin are omitted and the origins are marked by axial crosses.

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to the contracted crystal tend to be displaced towards the line A (shaded region PR or QS). Finally, beyond this second region, no relation exists between either the outlines or the positions of the peaks (beyond R or S). The first of the three regions extends to a spacing of ~15 A. from the line of superposition, the second from 15 to ~21 A. It should be noted that no reflexions with spacings smaller than 3 A. have been used for the Fourier summations and that in consequence the maps cannot reveal any detail smaller than 1·8 A.[2]

The results lead to the following conclusions concerning the molecular structure of hæmoglobin :

(I) The rigidity of the crystal along the b axis shows that the molecules must be linked together in this direction. Each of the two molecules in the cell lies on an axis of twofold symmetry parallel to b. Hence the diameter of the hæmoglobin molecule in this direction must be equal to the length of the b axis, that is, 64 A.

(II) Optical and X-ray data go to show that throughout the shrinkage the hæmoglobin molecules maintain their orientation relative to the a and b axes, despite the very great changes in the angle β. This orientation can be maintained only if the molecules form coherent sheets extending through the crystal parallel to the c plane, with layers of water and probably ammonium sulphate between the protein sheets. On drying, the layers move together and simultaneously slip over one another, thereby increasing the monoclinic angle (Fig. 4). Additional evidence for the existence of a sheet structure is the tendency of the crystals to break up into fragments parallel to the c plane under various conditions leading to dissolution or denaturation.

(III) Certain conclusions could be drawn concerning the thickness of the protein sheets, that is to say, the distance apart of two neighbouring water layers, if it could be decided which of the peaks in Fig. 3 are definitely of intramolecular origin. It can be shown that if two corresponding peaks at different shrinkage stages coincide and are closely similar in shape, then it is highly probable that they belong to the intramolecular type. On the other hand, if two peaks do not coincide, it does not necessarily follow that they are not of the same type. Thus we can be reasonably certain that the peaks in the region AP (0–15 A.) are all intramolecular, but no decision is possible as regards most of the peaks beyond 15 A. In consequence, it is certain that the distance apart of two neighbouring water layers is greater than 15 A. On the other hand, it cannot be greater than 36·5 A., as this is the c spacing in the air-dried crystals. Furthermore, each molecule lies on an axis of twofold symmetry. These conditions limit the number of possible arrangements to two. Either the hæmoglobin molecule must consist of two sheets of protein of 18 A. thickness each with one layer of water and possibly salt in between, the two sheets being related by a twofold axis, or it consists of a single rigid sheet of 36 A. thickness, the sheet itself possessing twofold symmetry. No decision between these two possibilities can be made at the moment.

Fig. 3.

SUPERPOSITION OF SEVERAL UNIT CELLS OF EACH OF THE DIAGRAMS SHOWN IN FIG. 2.

All contours with the exception of the + 50 contour are omitted. The full contours and crosses correspond to the wet crystal (Fig. 2a), the dashed ones to the partially dried crystal (Fig. 2b). A marks the line of superposition and is parallel to the a axis. The scale is in A.U. The diagram shows only the outlines of the major peaks and not their maxima.

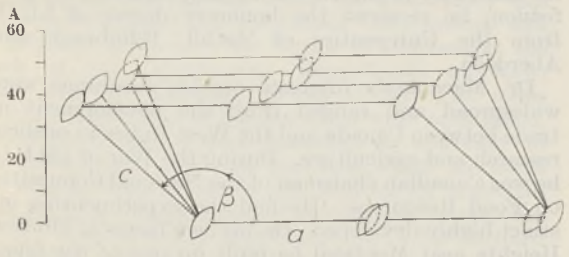


Fig. 4.

CHANGES IN CELL DIMENSIONS DURING SUCCESSIVE STAGES OF CONTRACTION.

The positions of the diad axes are marked : each of these is associated with one hæmoglobin molecule. The protein sheets mentioned in the text lie parallel to the a axis and normal to the plane of the paper.

(IV) The dried hæmoglobin molecule is seen to be a platelet 36 A. thick ; it is 64 A. long in the direction of b and probably somewhat shorter along a. Elongated ellipsoids of axial ratios 1 : 4 or 1 : 5, such as those proposed by Polson[3] and Neurath[4], are incompatible with the crystal structure.

Full details will be published elsewhere.

I wish to thank Sir Lawrence Bragg for all he contributed to this research in many discussions on the problem and for his constant help and encouragement ; also Prof. D. Keilin, who helped me to over-

come many of the difficulties I encountered while growing the crystals, and gave me much stimulating advice. I am grateful to the Rockefeller Foundation for the grant which makes this research possible.

[1] Bernal, J. D., Fankuchen, I., and Perutz, M. F., NATURE, **141**, 523 (1938).
[2] Bragg, W. L., and West, J., *Phil. Mag.*, **10**, 823 (1930).
[3] Polson, A., *Koll. Z.*, **88**, 51 (1939).
[4] Neurath, H., *J. Amer. Chem. Soc.*, **61**, 1841 (1939).

OBITUARIES

Prof. Jean B. Perrin, For. Mem. R.S.

IT was with great regret that I saw the announcement of the death in New York on April 17 of Prof. Jean Perrin. He had many friends in England who will feel that we have lost a staunch ally, for it will be remembered that during the War of 1914–18 he was of the greatest assistance to every one engaged in scientific work for the Government departments. He was himself scientific adviser to the French Government, and was keenly interested not only in what was being done in Paris but also in the work done in England, especially the development of tanks. He disliked the Germans very much, and during the whole of the period 1914–18 and shortly before this War broke out the spirit that animated him was "Il faut écraser les Boches". It was some consolation to know that he and his son had got out of Occupied France and gone to the United States.

Early in his scientific career, more than forty years ago, Perrin was elected professor of physical chemistry at the Sorbonne, and since then he has made many original investigations in atomic physics, for which he will always be remembered, as they are included in all modern treatises on these subjects.

Perrin's earliest experiments were designed to determine the nature of cathode rays and the conductivity of gases produced by the action of Röntgen rays and radioactive substances. At that time Varley and Crookes maintained that the cathode rays were material particles charged with negative electricity, which were repelled from the cathode and acquired large velocities under the action of the electric force. But the early experiments which were made to detect the charge were inconclusive, and other physicists maintained that the rays were a form of undulatory motion of the ether. The problem of determining the nature of the rays was settled by Perrin, by experiments with apparatus which showed conclusively that the rays were charged negatively.

But the work for which Perrin is best known is his experimental investigation of the Brownian motion. This investigation was designed with the object of determining the energy of agitation of molecules, from which it is possible to deduce the number of molecules in a cubic centimetre of a gas. There were several indirect methods of estimating that number but the results varied within wide limits. Perrin in his method of determining the number relied on a general theory of motion of particles, which implied that the mean energy of agitation of small particles suspended in a liquid was the same as that of a molecule of a gas. He succeeded by very remarkable original methods in determining the energy of agitation of the particles and thus deduced the number of molecules in a cubic centimetre of a gas.

Perrin's work "Les Atomes" is one of the most popular scientific publications. It deals with the discoveries made in molecular physics during the very active period after the discovery of Röntgen rays and radioactive substances. Before the 1936 edition came out, 30,000 copies had been sold. He also wrote a very interesting book in 1935 entitled "Grains de matière et de lumière", where he gave a most vivid account of modern theories of radiation, and discussed several problems which agitate the minds of physicists.

Perrin never seemed to change; he was just as lively and original in his conversation a few years ago as he was when he was first appointed to be professor at the Sorbonne. He took the greatest interest in young people engaged in research, and had a party for them once a week in his laboratory where discussions took place on all sorts of subjects. What was most pleasant about these meetings was the boyish interest Perrin took in experiments, for he always placed more confidence in experimental investigations than in mathematical theories.

When on one occasion another professor, after trying to persuade him to accept a theory he had propounded, said "At least you must admit there is something in it", Perrin replied: "My dear ——, it would be difficult to propound a theory that was entirely false."

He will be greatly missed by all French men of science, and also by his friends in England, for nothing added so much to the pleasure of a visit to Paris as a meeting with Perrin.

J. S. TOWNSEND.

Dr. T. B. Macaulay

THOMAS BASSETT MACAULAY, whose generous benefactions made possible the foundation of the Macaulay Institute for Soil Research at Aberdeen, died in Canada on April 3.

Mr. Macaulay who was born at Hamilton, Ontario, on June 6, 1860, was descended from the same family as Macaulay the historian, the Macaulays of Uig in the Island of Lewis. His grandfather migrated to Aberdeenshire and his father, Robertson Macaulay, was born at Fraserburgh in that county, but went to Canada as a young man and later became president of the Sun Life Assurance Company of Canada.

Dr. T. B. Macaulay entered the service of that Company in 1877, and held the posts of actuary, secretary, director and managing director, finally succeeding his father as president. He played a great part in expanding the Company from a very small concern to one of the most important corporations of its kind in the world. He was a fellow of the Institute of Actuaries of Great Britain and a charter member of the Actuarial Society of America of which he was twice president. A leading figure in his profession, he received the honorary degree of LL.D. from the Universities of McGill, Edinburgh and Aberdeen.

Dr. Macaulay's interests outside insurance were widespread and ranged from the development of trade between Canada and the West Indies to medical research and agriculture. During the War of 1914–18 he was Canadian chairman of the National Committee on Food Resources. He had the experimenting instinct highly developed. On his own farms at Hudson Heights near Montreal he built up one of the finest Friesian herds in North America, and for many years carried out experiments on the development of strains of maize and soya beans with the view of obtaining early varieties of good quality suitable for Canadian conditions. The work was not delegated to others

but was carried out personally by this busy business man in his limited leisure. The success which he achieved in his experimental work showed that had he elected to become a professional scientist he would have been as eminent as he was in his chosen profession.

Dr. Macaulay contributed generously to numerous causes both in Canada and Great Britain. In memory of his forebears he gave many thousands of pounds for educational, hospital, welfare and other purposes in Lewis and in Fraserburgh, but his benefactions were national as well as local. He was interested in genetics and in research on the endocrine glands, and contributed large sums to the Animal Breeding Research Department of the University of Edinburgh. Probably he will be remembered best as the founder of the Soil Research Institute at Aberdeen which bears his name. The buildings and equipment, including a demonstration farm on peatland in Lewis, were provided by Dr. Macaulay on the understanding that the Government would meet the cost of maintenance. He possessed tireless energy and unbounded enthusiasm. One of his ambitions was to bring about an improvement of the poorer classes of land in Scotland and during his visits to the country much of his time was spent in furthering this object. His influence with the crofters in Lewis was very great and he succeeded in bringing about many improvements where others had failed. The results of peat reclamation experiments carried out in Lewis were later applied by the Macaulay Institute in the successful reclamation of peatland in Lanarkshire on behalf of the Commissioner for the Special Areas.

It was my privilege to become one of Dr. Macaulay's friends and to stay with him several times in Canada, where I saw something of his happy home circle and of his scientific pursuits. He was a man of great sincerity and strength of character, kindly and always anxious to help his fellows. He lived simply and gave generously.

It was a source of great satisfaction to him during his last visit to Great Britain four years ago to stay at the Institute which he was instrumental in founding and to see the realization of some of his cherished ambitions.

W. G. OGG.

Mr. F. J. Selby, C.B.E.

MR. FRANCIS JAMES SELBY, C.B.E., one of the small band of workers who formed the staff of the National Physical Laboratory in its early days and helped to develop it from small beginnings to an institution of world-wide renown, died on March 5. He joined the staff in 1903 to take charge of the prediction of tides which the Laboratory was about to carry out for the Indian Government, and to establish a Division for Optics to supplement the work of the Observatory Department at Kew. Selby was also secretary to the Director, an office which, if the range of his activities were considered, would have been better described as secretary of the Laboratory. In this position, which he made one of great importance in the Laboratory organization, he took a large share of administrative responsibility. His sympathy with the policy of Sir Richard Glazebrook particularly fitted him for this work, and those who knew the Laboratory well realized that it was no less fortunate in its secretary than in its first director. Everyone trusted him and valued his judgment and advice.

In 1909 Glazebrook was appointed chairman of the newly formed Advisory Committee for Aeronautics; Selby was chosen and continued as secretary until 1919, when the committee was replaced by the Aeronautical Research Committee. His services were recognized by the award of the C.B.E.

In 1918, shortly before the Government accepted financial responsibility for the Laboratory in place of the Royal Society, the office of Secretary of the Laboratory was formally established, with Selby as the first holder. In the following year Sir Joseph Petavel became director, and Selby continued to give most loyal service. He retired in 1932 on reaching the age of sixty-five.

Selby's special training was in mathematics, first at University College, London, where he greatly appreciated the teaching of Karl Pearson, and afterwards at Trinity College, Cambridge. He graduated as sixth wrangler in 1891 and later became mathematical master first at Bristol Grammar School and then at Repton. At the Laboratory, Selby retained a keen interest both in mathematics and in education. There was probably no important paper on relativity or the quantum theory that he did not read critically. He took an active interest in the further education of junior members of the Laboratory staff.

On his retirement, Selby intended to write a history of the early days of the National Physical Laboratory, a task for which he had unique qualifications. Unfortunately, little more than two years after his retirement, when the work was only partly done, he had a stroke and his memory was affected to an extent which made the completion of the history impossible.

Selby was twice married, and is survived by a daughter.

T. SMITH.

Mr. C. Oldham

CHARLES OLDHAM was born at Lincoln on April 16, 1865, but at the age of six the family went to live at Sale in Cheshire. It was at the preparatory school there that began the life-long friendship with T. A. Coward that was later to bear fruit in the classical account of the "Birds of Cheshire".

Until his retirement in 1927, the claims of his professional duties as assistant manager of the Manchester office and later of the London office of the Commercial Union Insurance Company, permitted him little leisure to pursue his scientific studies. Despite this temporal handicap, he became an acknowledged authority on British malacology and ornithology. He it was who contributed the field notes for the first edition of Witherby's "Handbook of British Birds", and he made notable contributions to the study of British land and freshwater Mollusca and especially in the critical genus of the Pisidia, his specimens of which are now in the national collection. It is at once a tribute to his characteristic thoroughness and physical endurance that, in the course of the study of this group, he examined almost all the very large number of tarns in North Wales.

Oldham was a field naturalist of the best type, outstanding alike in the accuracy of his observations and the breadth of his knowledge, and by no means the least valuable of his services was his influence upon those with whom he came in contact. For ten years Oldham was one of the honorary secretaries of the Hertfordshire Natural History Society and its president in 1920. His annual reports on the birds

of that county were models of discriminating observation. For twenty-three years he was treasurer of the Conchological Society and he served as vice-president of the Linnean Society, the Ray Society, the British Ornithological Union, the Malacological Society, the British Ecological Society, and on the committee of the British Ornithological Club.

Like all men who possess not mere ability but also wisdom, Oldham was essentially modest and his published papers, though numerous and valuable, are but a poor indication of the profundity and wealth of the knowledge that was so freely placed at the disposal of others. To accompany him in the field was to enjoy a liberal education and to share the riches of a well-plenished mind, whilst the privilege of his friendship was both an inspiration and a stimulus. His loss to science is the greater because in these days of "learning more and more about less and less", the number of those who combine the insight of the specialist with a balanced perspective is growing fewer although the need for them increases.

E. J. SALISBURY.

WE regret to announce the following deaths :

Lieut.-Commander L. C. Bernacchi, who was physicist to the Southern Cross Antarctic Expedition, 1901–4, on April 24, aged sixty-five.

Prof. H. L. Bowman, Waynflete professor of mineralogy and crystallography in the University of Oxford, on April 22, aged seventy-seven.

Dr. Arthur Michael, emeritus professor of organic chemistry at Harvard University, on February 8, aged eighty-eight.

Prof. Carl Oppenheimer, editor of *Tabulæ Biologicæ*, *Enzymologia* and author of well-known books on biochemistry, aged sixty-seven, on December 24, at The Hague.

Colonel M. O. Tandy, O.B.E., formerly of the Survey of India, on April 18, aged sixty-eight.

Dr. W. E. Thrift, provost of Trinity College, Dublin, and formerly Erasmus Smith professor of natural and experimental philosophy in the College, on April 23, aged seventy-one.

NEWS and VIEWS

Planning and Rebuilding in Britain

IN his first official statement in the House of Lords as Minister of Works and Buildings, Lord Portal emphasized that the policy initiated by his predecessor, Lord Reith, still holds good. Lord Portal was replying to inquiries by the Bishop of Winchester, who voiced the wide anxiety as to whether the recent changes at the Ministry of Works and Buildings meant a change in the Government's intentions. He emphasized that unless planning took a prominent place in housing reconstruction, there would be chaos through the rivalry of competing authorities and uneconomic use would be made of the land, with the attendant spectacle of distressed areas.

Lord Portal explained that the broad objective of the new Ministry would be the right use of the land of Great Britain for all purposes. The Minister would have the responsibility of seeing that policies in regard to agriculture, transport, etc., were properly co-ordinated. Further legislation will be introduced in the light of reports to be submitted very shortly by Mr. Justice Uthwatt and Mr. Justice Scott. Considerable reduction in the number of planning authorities has already been made by voluntary arrangement. Lord Portal also said he is working in close collaboration with the Paymaster-General in considering the relation of planning to the need for the preservation of areas of natural beauty and especially the coastline. With regard to the building industry, it would be essential that, directly the War ends, the industry should be ready, through organization, to cope with the demands which would be made on it. The personnel of the industry would have to be dealt with on a new basis.

The Central and Supplementary Registers

THE Minister of Labour stated last winter that it was proposed to merge the Central and Supplementary Registers in a new Appointments Department of the Ministry of Labour and National Service. This has now been done. The Central Register covers those with scientific and technical qualifications, while the Supplementary Register includes those with administrative and managerial qualifications and others, not on the Central Register, with scientific and professional qualifications. It is stated that there is now a lack of men in nearly every branch covered by the Central Register. As regards the Supplementary Register, every effort will be made by the new Appointments Department to make the best use of the varied qualifications which are represented. The Register will be revised at intervals of two months, and it is intended to arrange personal interviews with all those whose names are on it. It will be decentralized to some thirty appointments offices outside London, all of which will be linked with the Appointments Department in London at Sardinia Street, Kingsway, W.C.2. The Central Register is being moved to the same address. These Registers, if properly handled, should prove of immense value in assessing the professional resources of the country for both present and future needs.

Association for Planning and Regional Reconstruction

THE Association for Planning and Regional Reconstruction, Ltd., is incorporated as a limited company not for purpose of profit, and its board is responsible for the direction and co-ordination of research into post-war problems. While the policy of the Association is to co-operate with individuals, organizations and local and national authorities, it does not itself undertake direct works of reconstruction. Its object is to serve as a centre for research, for which purpose it employs a small trained research staff, and to advise and to suggest, as well as to correlate experience. It also endeavours to train a nucleus of men and women in the technique of planning in its broadest sense. The work of the School of Planning and Research for National Development is now carried on through the Association.

The Association has issued a series of four-page broadsheets setting out simply and concisely the results of each piece of research. Of the broadsheets

so far issued, one contains general information regarding the work of the Association and others deal with the distribution of fresh food, human wastes, their collection and disposal, and a summary of existing methods of disposal. The first of these outlines a system of fresh-food production and distribution, assuming a network of 'control farms' and 'fresh food centres'. Those on human wastes summarize suggestions as to how such wastes can be used to maintain soil fertility, and give a technical analysis of present systems of disposal. The Association is also engaged on the preparation of a series of maps, designed to present existing statistical and other information on various problems in visual form. It is also studying the problems of a service to promote positive health and the lay-out of a 'health centre', standards governing housing density, prefabrication possibilities in housing construction, and the marketing of goods in relation to planning.

Scientific Data in Glass Technology

IN his presidential address to the Society of Glass Technology, delivered on April 14, Dr. S. English discussed "The Commercial Use of Scientific Data". After a brief review of the rapid development of the science of glass technology during the past twenty-five years, and the importance of the results obtained in their application to manufacturing processes, the problems of illuminating glassware of the diffusing type were considered in detail. Three essential requirements of such glassware are that it should be (1) practicable from the manufacturing point of view, (2) technically correct from the illuminating point of view, (3) artistically correct. The problem of glare was emphasized in relation to the adaptability of the human eye to an enormous range of illumination intensities from 2,000 to 4,000 ft.-candles on a bright summer day to 0·002-ft. candles for A.R.P. lighting. Diffusing glass envelopes reduce the glare and increase the detail comprehended by the eye by removing the intensely bright source from direct vision.

The properties of completely diffusing opal glasses in conjunction with metal filament lamps were then described. In general, the percentage transmission of opal glasses is always higher for directed light than for diffused light (2·5 per cent increase). The proportion absorbed is always less for directed than for diffused light, by approximately 1–5 per cent, and the proportion reflected is usually less for directed than for diffused light. Examples were given of the use of physical data for the predetermination of the performance of a lighting fitting made in flat opal glass plate, illuminated on one side by a single electric filament lamp, with and without a second plate behind the lamp to serve as reflector, and of a complete opal sphere enclosing the lamp. The efficiency of an opal sphere as a lighting unit depends on the glass, which must be a perfect sphere of uniform thickness, with no neck opening, and giving perfect diffusion of transmitted and reflected light; and on the lamp, which must give a uniform light distribution. The view was expressed that the British illuminating glassware industry should endeavour to provide the whole of the post-war requirements of Great Britain in this field.

Jig Borer Microscope

THE recent introduction of the "Watts" jig borer microscope provides a valuable optical accessory for use with high-precision machine tools such as jig borers, and tool-room milling machines. Its purpose is to enable the axis of the machine to be accurately located in relation to a datum mark on the work-piece. In construction, it consists of a high-power microscope the optical path of which is bent so that the user can conveniently inspect the work from one side when the instrument is set up in the spindle of the machine. The microscope is mounted on a taper shank—No. 4 morse taper is used in the standard model but any of the usual tapers can be supplied—and the shank is inserted in the spindle. In this position the objective axis of the microscope coincides with that of the boring spindle, which the operator is thus enabled to bring within an accuracy of 0·00005 in. to the desired position.

The optical system is so arranged that the intersecting points of the graticule lines when viewed through the eye-piece, which is of the screw-focusing type, are superimposed on the point where the projected axis of the spindle falls on the work-piece. The microscope, which has a power of ×45, can therefore be used (*a*) for setting the spindle over a small punch mark, (*b*) for setting the spindle over a line marked on the work-piece, or (*c*) with the aid of a reference square, for setting the spindle in the plane of any desired surface of the work-piece. The graticule or cross-lines seen in the eye-piece of the microscope are centred relative to the taper shank, but in order to compensate for a small degree of spindle run-out, should this be experienced, provision is made for the adjustment of the diaphragm to enable the cross-lines to be re-set. As the spindle is free to rotate, the instrument has the merit of being self-checking by turning it through an angle of 180°, and a rotatable reflector is arranged so that the light from any convenient lamp can be brought to bear on the job. The instrument is thus well designed to simplify what is a fundamentally difficult setting in precision machine work. The makers are Messrs. E. R. Watts and Son, Ltd., 123 Camberwell Road, London, S.E.5, from whom further details can be obtained.

Phenology of 1941

REPEATING its admirable promptness of last year, the Royal Meteorological Society has issued its fifty-first annual phenological report, for the year 1941, under the editorship of Major H. C. Gunther, although it is somewhat abridged from its pre-war size. It is interesting because of the late spring and the amends of a belated summer, with a remarkably green autumn countryside and an unusually late defoliation of trees, although autumn colours were not much in evidence. The migrant birds arrived punctually in the south but late in the north; there were average numbers of the immigrant painted lady and red admiral butterflies and of the silver Y moth, while clouded yellow butterflies were reported from many parts of the country, including the north. Observations on the magpie moth and the meadow brown butterfly in relation to the rise in temperature for the June-July warm spell which followed the cold late spring illustrated how quickly certain insects may respond to the influence of a favourable spell following adverse conditions. Observations on the dog-rose furnished clear-cut evidence of the preponderating importance of the weather of the moment as compared with any latent tendencies due to a previous season, for in 1941 the flowering dates for the south-east were not less than 16 days later than those for 1940, when the south-east dates were

slightly earlier than the dates for the north-west. But in 1941 the north-west dates of this flower were slightly earlier than the south-east dates. Despite the War, reports were sent in from 277 phenological observers in the scheme—only twelve less than the previous year.

Tuberculosis in Ecuador

IN a recent article (*Bol. Of. San. Panamericana*, 21, 128; 1942), Dr. Jorge Higgins, director of the Anti-tuberculous Dispensary of Guayaquil, Ecuador, states that of Ecuador's three geographical regions, the coast, which has an average temperature of 81° F., is the most severely affected by tuberculosis. The port of Guayaquil, which has a population of 200,000, has the highest tuberculosis mortality in the world. The anti-tuberculosis campaign began in 1934, when the first dispensary in Guayaquil was established. A similar dispensary was afterwards opened in Quito, and more are being planned for the rest of Ecuador. During 1939, the Guayaquil dispensary provided 2,609 medical consultations, 2,406 fluoroscopic examinations, 683 pleural insufflations and 1,431 laboratory examinations; 1,169 patients were admitted and 1,831 home visits were made. A large sanatorium has been started in Guayaquil supported by a new organization called the Liga Anti-tuberculosa Ecuadoria. Poverty, which is one of the most important factors in the causation of tuberculosis, is being partially offset by the introduction in several cities of popular restaurants where good food is supplied at popular prices. Milk stations are also furnishing milk free to the infants of poor families. Several hundred dwellings have been destroyed and their place taken by many hygienic houses for workers.

Historical Medicine and Science

SCHUMAN'S, of 30 East 70th Street, New York, have sent us their latest catalogue entitled "Medical Miscellany, List 'D'," containing an annotated list of rare books and first editions of works on historical medicine and science. In a special section on war medicine are listed the "Opera omnia medica et chirurgica" of Botallo (1660), James Handley's "Colloquia Chirurgica" (1705), Thomas Trotter's "Observations on the Scurvy" (1792), George Guthrie's treatise on "Gun-shot wounds" (1815), and William Braisted's "Report on the Japanese and Russian Medical Organization in the Russo-Japanese War" (1906) among many others. Mention may also be made of Pico della Mirandola's "Opera Omnia" (1506), the third Latin translation of Rhazes' works (1510), Thomas Willis's "De anima brutorum" (1672), Astruc's "De morbis venereis" (1740), David Brewster's "Treatise on the Kaleidoscope" (1819), Johannes Mueller's "Handbuch der Physiologie des Menschen" (1835–40), Cockayne's "Leechdoms, Wortconning and Starcraft of Early England" (1864–66), Allbutt's work on "The Use of the Ophthalmoscope" (1817), and Haeser's "Lehrbuch der Geschichte der Medicin" (1875–82).

Admiral Dumont d'Urville (1790-1842)

BY a terrible railway accident at Versailles on May 8, 1842, France lost one of her most eminent scientific explorers, Admiral Jules-Sébastien-César Dumont d'Urville, whose voyages not only added much to geographical knowledge but also enriched immensely the natural history collections of the Paris museums. Born in Normandy on May 23, 1790, d'Urville entered the Navy at the age of eighteen, and two years later in the *Chevrette* visited the Black Sea. In the Isle of Milo his attention was turned to the famous statue of Venus, which was afterwards bought by the French Ambassador to Constantinople and now stands in the Louvre. In 1822 d'Urville was appointed to the *Coquille*, commanded by Duperrey, and in the course of a voyage in Oceania he made a collection of three thousand plants and another of twelve hundred insects. Returning home in 1825, he was appointed to the command of the ship, which was then renamed the *Astrolabe*. Leaving Toulon on April 25, 1826, the ship visited Australia, New Zealand, New Caledonia, New Guinea, the Carolines and other islands in the Pacific. The ship finally reached France again on March 25, 1829. D'Urville's last voyage, made during 1837-40 in the *Astrolabe*, accompanied this time by the *Zélée*, took him to the Antarctic. It was while he was engaged in writing the account of this voyage that he met his death. The train he was in caught fire, and the carriage doors being locked, some fifty-two persons, including d'Urville's wife and son, were burnt to death.

Photography in Science, Medicine and Industry

THE Association of Scientific Workers is organizing an exhibition which, it is hoped, will be held in November at the premises of the Royal Photographic Society. The exhibition is to illustrate the applications of photography to science, medicine and industry with the view of making such information more generally available and better known to the public. The Photographic Committee of the Association, anxious to obtain examples of such work from as wide a variety of sources as possible, appeals to those who may be able to provide exhibits to write to the Honorary Secretary, Photographic Exhibition Committee, Association of Scientific Workers, 73 High Holborn, London, W.C.1, for further details.

Announcements

DR. HELEN BANCROFT (Mrs. Simmons), known for her work, especially at the Imperial Forestry Institute, on the anatomy of recent and fossil plants, floral anatomy and systematic botany, is interned, with her husband, at Vittel. She would be very glad to receive letters from her scientific friends during her isolation from scientific life. Her address is: Mrs. Helen Holme Simmons, Frontstalag 194, No. 111 Grand Hôtel, Vittel (Vosges), France.

THE Association of Scientific Workers has formed a committee to help in solving the special problems with which foreign men of science in Great Britain are confronted in assisting in the war effort. Foreign scientific workers interested in the work of this committee should write to the Secretary, Foreign Scientists Committee, Association of Scientific Workers, Hanover House, 73 High Holborn, W.C.1.

ERRATUM: In the communication from Dr. J. J. Monteverde which appeared in NATURE of April 25, p. 472, the antigenic formula of *Salmonella bonariensis*, through an oversight, lacks the symbol for phase 1 of the flagellar antigen. The complete formula is $VI_1.VIII$; $i \longleftrightarrow e, n. \ldots$ (phase 2 is still under examination).

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Effect of Shredding and Grating on the Vitamin C Content of Raw Vegetables

IT is now known that a rapid loss of vitamin C takes place when the cells of vegetables are mechanically broken. During the analysis of vegetables for vitamin C, for example, it is important that all grinding or other subdivision of tissues should be carried out in the presence of metaphosphoric acid so that vitamin C-oxidase shall be inhibited before it has any opportunity of coming into action.

The loss of vitamin C which occurs in cooking has led to widespread recommendations that shredded or grated raw vegetables be eaten in the form of salads. Since the preparation thus of raw vegetables must lead to the disruption of a proportion of the plant cells, it was thought of interest to carry out the following experiments to investigate the extent of any destruction of vitamin C.

1. *Savoy Cabbage.*

Savoy cabbage from which the coarse outer leaves had been removed was cut into quarters and the four parts treated in one of the following ways:

(*a*) Grated with a household grater as commonly used for cheese or bread crumbs. The leaf was considerably bruised and some discoloration occurred.

(*b*) Shredded with a household shredder as used for suet. Some bruising was observed but not as much as in (*a*).

(*c*) Shredded with a sharp knife. No bruising or discoloration occurred.

Vitamin C determinations were carried out by the usual method of titration with 2.6 dichlorophenol indophenol on the lots of cabbage after 5, 10, 20, 30 minutes and 1, 2 and 3 hours standing in the laboratory. Replicates of the uncut quarter were analysed to determine the original vitamin C value.

STABILITY OF VITAMIN C IN GRATED AND SHREDDED RAW SAVOY CABBAGE.
(*Vitamin C mgm. per 100 gm.*)

Time	*a*	*b*	*c*
0 min.	50	50	50
5 ,,	34	48	48
10 ,,	34	44	48
20 ,,	31	44	50
30 ,,	34	46	48
1 hour	34	44	50
2 ,,	34	46	52
3 ,,	31	44	48

The results shown in the table above are in harmony with theoretical considerations. In *a*, an appreciable proportion of cells was destroyed and rapid loss of 34 per cent of the vitamin C occurred within five minutes. After this period there was no further loss. Less severe treatment *b* caused a similar loss of 10 per cent of the vitamin C. Process *c*, shredding with a knife, produced no significant destruction of vitamin.

2. *Swedes*

The previous experiment on savoy cabbage was repeated with swede. The same methods of shredding and grating were used.

Although similar in principle to the results for cabbage, the figures for swedes showed two differences. When grated, swedes lost a higher proportion of vitamin C than cabbage. The loss after three hours was

STABILITY OF VITAMIN C IN GRATED AND SHREDDED RAW SWEDE.
(*Vitamin C mgm. per 100 gm.*)

Time	*a*	*b*	*c*
0 min.	36	36	36
5 ,,	31	38	—
10 ,,	28	32	32
20 ,,	25	28	34
30 ,,	22	29	31
1 hour	20	27	32
2 ,,	11	29	32
3 ,,	9	22	34

75 per cent compared with 34 per cent. After coarse shredding the losses were 39 per cent compared with 10 per cent. The more striking difference between cabbage and swede, however, was that while loss of vitamin C in the former was almost instantaneous, in the latter slow, continuous destruction occurred. With swede, as with cabbage, however, shredding or dicing with a sharp knife did not damage sufficient cells materially to affect the vitamin C content of the foodstuff.

MAGNUS PYKE.

April 16.

Natural Breeding Sites of *Drosophila obscura*

MOST of the studies on the genetic structure of wild populations of Drosophila have been on animals trapped by means of a yeasted banana-agar or similar fruit traps[1, 2, 3]. The flies may thus have been drawn from a large number of small discrete breeding units, and hence general inferences are difficult. I have found a very marked deficiency in the number of males trapped in *D. subobscura* Collin and to a lesser extent in *D. obscura*, although the sex-ratio in cultures approximates unity, thus demonstrating the inadequacy of collections by means of baited traps.

For many years I had attempted to secure natural populations breeding *in situ* but with no success until the summer of 1939. In that year Mr. Klaus Rothfels, at my suggestion, examined trees for exudates and found large colonies of Drosophila feeding on the yeast growths of elm tree exudates. The two most common species were *D. subobscura* Collin and *D. obscura*. This discovery was remarkable for the additional fact that a high percentage of the *D. obscura* on the site were mutants of several forms, in very marked contrast both to the proportion of mutants of the same species trapped at some distance and to the proportion of mutants in *D. subobscura* on the site. We concluded that the site was a natural breeding site for *D. obscura* but that the other species merely fed there.

Mr. Rothfels and I were to have continued the work in the summer of 1940 but this was impossible due to his sudden departure. In the late summer of 1941 Mr. Forbes W. Robertson took the matter up again. He examined a large number of trees, beech, sycamore and elm with a few oak and ash, and found yeast patches only on six elms. These were all unhealthy trees from among a group of about two hundred elms within a radius of half a mile in a moist river valley. Three of the trees were definitely moribund. The Drosophila species feeding on the yeasts were *D. obscura*, a few *D. subobscura* and occasional *D. funebris*.

The exudate and bark from one tree were removed to the laboratory for examination. Among a varied fauna we found a number of Drosophila eggs and larvæ on the inner side of the bark. These were

grown in the normal Drosophila culture medium, and from 150 larvæ picked off and a large number of other eggs and larvæ, 20 male and 29 female *D. obscura* emerged to the exclusion of all other Drosophila species. Hence we concluded that the patches on elm trees form a natural breeding site for *D. obscura*.

At present the culture conditions for this species present some difficulty, but these can almost certainly be overcome. When this is accomplished we shall be in a position to undertake the examination of the genetic structure of discrete populations in relation to their known ecology.

I am indebted to Dr. O. W. Richards for the information that he had once observed what appeared to be *obscura*-like forms feeding on an exudate.

CECIL GORDON.

Natural History Department,
Marischal College,
Aberdeen.
April 17.

[1] Dobzhansky, Th., *Proc. 7th Int. Cong. Gen.* (1939).
[2] Dubinin, N. P., and co-workers, *Biol. Zh.*, 6 (1936).
[3] Gordon, Spurway and Street, *J. Genet.*, 38 (1939).

Resistance of a Soil Nematode to Changes in Osmotic Pressure

THE results detailed below are considered to be of sufficient interest to merit early publication. An amplified account will be published in the future, when a description will be given of the species of Rhabditis which was employed. The worms were cultured in an agar broth the osmotic pressure of which was equivalent to that of about 30 m*M*. sodium chloride.

On immersing the worms in distilled water, the body swells, but the alimentary canal swells more slowly than the rest of the body. Similarly, in concentrated saline solutions, the body shrinks, the alimentary canal shrinking more slowly than the remainder. These results show that water can pass into and out of the body down a gradient of osmotic concentration, and also that the main aqueous exchanges do not occur through the gut. Further work indicated that these exchanges occur through the general body surface.

During shrinkage in concentrated solutions, vacuoles are occasionally observed between the cuticle and hypodermis. By analogy with conditions in a plasmolysed plant cell, it seems likely that the cuticle is more permeable to the substances in solution than is the hypodermis. Further experiments with cyanide solutions also suggested that the living tissues of the body wall, rather than the cuticle, are primarily responsible for controlling the permeability of the body wall.

After about fifteen minutes in distilled water, the amount of swelling of the body of the worm is reduced. This reduction is not observed with injured animals, nor when *M*/100 potassium cyanide is used instead of distilled water. These results show that there is, in distilled water, an active method of osmotic regulation whereby the size of the body is reduced. The alimentary canal probably plays some part in this regulation, since fluid is ejected from the anus during the later stages of reduction in size.

On prolonged immersion in concentrated saline solutions, the body slowly re-expands. If, towards the end of this process, the worms are transferred to distilled water, the amount of swelling which is produced is less than that obtained with animals which had not re-expanded. This suggests that, in these conditions, osmotically active material is passing out of the body. The avenue of escape could not be decided upon with certainty.

The conclusions reached contradict the general impression that free-living nematodes can withstand osmotic changes because they possess an impermeable cuticle[1], and indicate rather that this resistance is due to an active method of osmotic regulation. The conclusion that the cuticle is relatively unimportant as an insulating covering, agrees with the conclusions reached as a result of past work upon parasitic nematodes[2].

WILLIAM STEPHENSON.

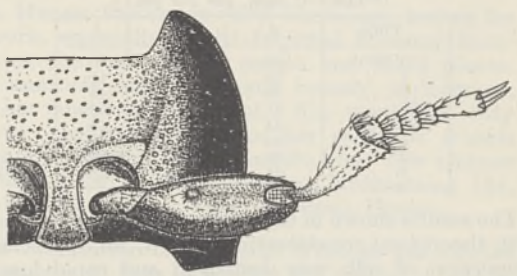
Dept. of Zoology,
King's College,
University of Durham,
Newcastle-on-Tyne, 2.
April 16.

[1] Krogh, A., "Osmotic Regulation in Aquatic Animals", 44 (1939).
[2] Panikkar, N. K., and Sproston, N. G., *Parasitology*, 33, 214 (1941).

Secondary Sexual Characters of Tribolium

THE confused flour beetle, *Tribolium confusum* J. du V., and the rust-red flour beetle, *T. castaneum* Herbst, are the most abundant and destructive beetles infesting flour and other prepared cereal products. *T. confusum* is also one of the insects most commonly bred in the laboratory for experimental purposes. Hitherto it has been maintained[1,2,3] that there are no secondary sexual characters in the adult stage, and in consequence the beetles could only be sexed in the pupal stage, a procedure which is frequently very inconvenient.

I have recently found that the males of both species have on the basal fourth of the ventral side of each femur a shallow, oval pit from which arise numerous, erect, golden-yellow hairs. The females have neither the pit nor the associated brush of hairs. In *T. castaneum* (see accompanying illustration) this pit is about 0·04 mm. broad, and the hairs are nearly as long as the breadth of the pit. In living specimens of this species the presence or absence of



Tribolium castanum HERBST, MALE. VENTRAL VIEW OF LEFT FRONT LEG.

the pit and hairs can be detected with certainty with a hand lens of × 15. Specimens to be sexed should be held with the back against the index finger and the thumb nail, which needs to be moderately long, pressed gently just behind the front legs. With a little practice they can be sexed without injury. Alternatively, the insect can be picked up by touching its back with a wet brush, or, as suggested to me by Dr. J. P. Harding, it can be held in a Rousselet live box.

T. confusum has a similar but smaller pit (0·03 mm. broad) and is difficult to sex without the aid of a

binocular dissecting microscope under which the specimen may be held as described above. In the males of *T. confusum* the middle and hind femora also have pits though these are much smaller and more difficult to see than those of the front femora and usually contain only 2–4 hairs.

H. E. HINTON.

Department of Entomology,
British Museum (Natural History),
London, S.W.7.
April 9.

[1] Brindley, *Ann. Ent. Soc. Amer.*, **23**, 751 (1930).
[2] Good, Tech. Bull. U.S. Dept. Agric., No. 498, 3 and 36 (1936).
[3] Park, Gregg, and Lutherman, *Physiol. Zool.*, **14**, 397 (1941).

Mitosis in Amœbæ

THE life-histories of four large, free-living amœbæ have been worked out here; one, namely, *Amoeba lescheri* n.sp. not yet published. But except for *Amœba dubia* (Schaeffer) in which Sr. Bernardine (Dr. L. A. Carter) discovered it in 1913, mitosis had until recently not been demonstrated. In fact we doubted its occurrence.

Pending the publication of a full account of mitosis in these amœbæ and of the whole life-cycle of *A. lescheri* (n.sp.), we should like to state here that we have now also discovered the phenomenon of typical mitosis in the binary fission of (1) *Amœba proteus* γ (= *A. proteus* (Schaeffer); (2) *Amœba discoides*; and (3) *Amœba lescheri*.

MONICA TAYLOR.
CARMELA HAYES.

Notre Dame Training College Laboratory,
Dowanhill, Glasgow, W.2.
April 20.

Flow of Liquids in the Critical Region

IN experiments on the flow of water in a long copper tubing, it was found that the inlet pressure must be maintained free from disturbances to the highest degree possible if flow in the critical region is to be analysed. When extraneous disturbances were eliminated, the flow in the tube falling between Reynolds' numbers 1,000 and 5,000 was found to fall into three distinct classes, all of which were different from both the viscous and the turbulent regimes. Strictly speaking, only the regime existing between 2,200 and 2,500 Reynolds' numbers in the present system showed the ordinarily accepted criteria of critical flow. Nevertheless, as both the regions between 1,000 and 2,200 and between 2,500 and 5,000 fall outside the laws of either viscous or turbulent regimes, they are treated here as 'pre-critical' and 'post-critical' regimes.

In the accompanying graph, the corrected head lost per unit length of pipe is plotted against the average linear velocity of the water in the pipe, for values of Reynolds' numbers ranging between 240 and 2,800 approximately. It is seen that there are four distinct sections of the curve.

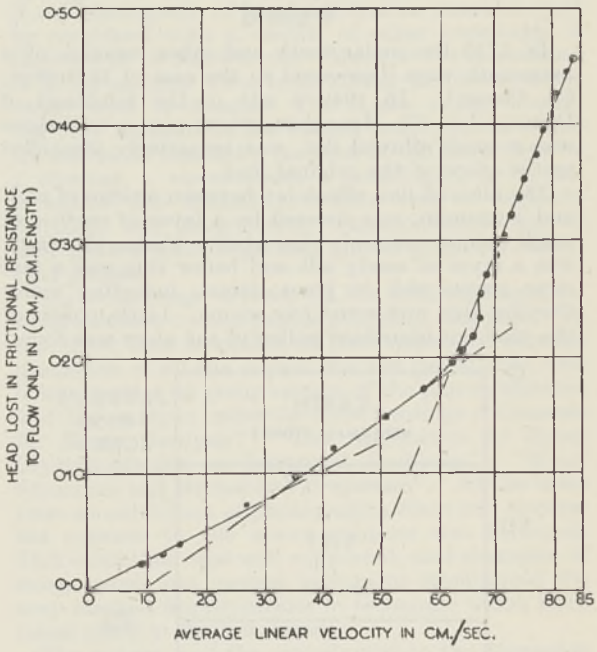
(1) Up to *circa* 1,000 Reynolds' numbers, the ordinary straight line of the viscous regime obtains, characterized by (*a*) passing through the origin, and (*b*) by its slope being governed solely by the viscosity of the fluid in so far as the properties of the fluid are concerned.

(2) Between 1,000 and 2,200 Reynolds' numbers approximately, a second straight line obtains. This straight line differs from the first in that (*a*) it does not pass through the origin; (*b*) it has a higher value for its slope than the first line.

(3) Between Reynolds' numbers of 2,200 and 2,500 approximately, the curve rises almost vertically upwards in the direction of the pressure loss. It is in this and the following region that it becomes essential to eliminate all disturbances from the entry. As mentioned above, strictly speaking this is the critical region.

(4) Between 2,500 Reynolds' numbers and about 5,000, above which the curve shows a definite curvature characteristic of the turbulent regime, there is yet another straight line. The graph goes up to 2,800 only, but other experiments showed that curvature begins above 5,000. This straight line again does not pass through the origin, and it has a steeper gradient than both the viscous and 'pre-critical' lines.

Another important point in connexion with these



lines, which is not evident from the graph, is that in the critical region a change of 25 per cent in the viscosity of the flowing water appeared to have no effect on the position or slope of the lines, especially the 'post-critical' curve. Of course, the viscosity is of paramount, but indirect, importance, in that it influences the type of regime obtaining in the pipe.

Thus, it appears that the classification of flow as viscous, critical and turbulent is an over-simplified system. In unpublished work carried out in this Department and to which reference has already been made[1], it became evident that when flow is at extremely low rates, in a medium of high specific surface, such as might obtain in the flow of fluids through porous strata in oil, gas or water production, then the law of frictional resistance due to flow did not follow the laws of the viscous regime. In other words, a 'sub-viscous' or 'pre-viscous' regime of flow appears to exist. Flow then adopts the viscous regime when the velocity is increased, and as is seen here, passes through an intermediary type of flow before it enters the critical regime. Before entering the fully turbulent type of flow, it passes through

still another distinct type, the post-critical regime. At extremely high Reynolds' numbers the flow becomes further complicated by the production of certain sound waves.

A final point of interest here is the possibility of using the vertical section of the graph in the production of accurately constant rates of flow in instrumental and process controls, as a very great change is required in the overall head loss to produce a small change in the rate of flow.

It is hoped to publish a fuller report than this elsewhere.

ALFRED H. NISSAN.

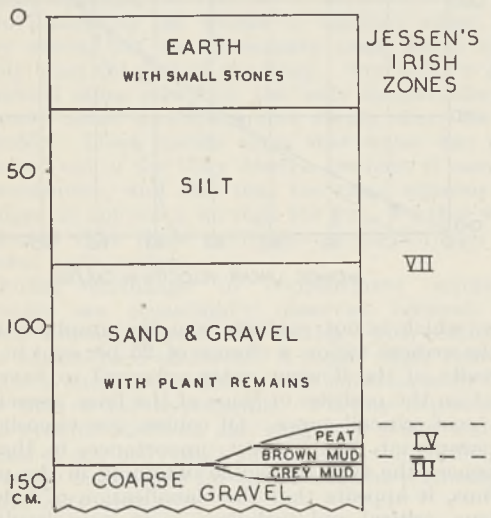
Department of Oil Engineering and Refining,
University, Birmingham, 15.

[1] Nissan, A. H., NATURE, **148**, 503 (1941).

A Late-Glacial Flora in Co. Monaghan, Ireland

IN 1715 the molar teeth and other remains of a mammoth were discovered to the east of Belturbet, Co. Cavan[1]. In 1940 a site in the townland of Drumurcher, Co. Monaghan, where near a mill there was a small alluvial flat, was tentatively identified as the place of the original find.

The alluvial flat, which lay between a ridge of rock and a drumlin, was covered by a layer of earth and small stones, certainly disturbed. Under the earth was a layer of sandy silt and below this was a fine river gravel rich in plant debris, including many Corylus nuts and some tree stems. Little pollen of the pine but abundant pollen of the alder was found



in the silt and the gravel. These deposits should, therefore, have been laid down after the beginning of Jessen's Irish Zone VII[2]. In places the gravel rested on a fine-grained peat rich in Salix leaves and containing also remains of Betula spp., Potamogeton spp., Carex spp., *Scirpus lacustris*, etc. Only pollen of the birch, pine and willow was found in the peat; it should, therefore, belong to Jessen's Irish Zone IV. Downwards the peat passed over into a brown mud; this in turn became grey in colour and rich in sand. The grey mud rested on a coarse river gravel without plant remains; the bottom of the gravel was not reached. In the muds, tree pollen was very scanty. In places the upper gravel lay on the muds or directly on the lower gravel. The stratigraphy, which is illustrated in the diagram, agreed with that outlined in the original description.

The grey mud was rich in plant remains, among which the following plants were noted—Arenaria spp., *Armeria vulgaris*, *Dryas octopetala*, *Oxyria digyna*, *Salix herbacea* and *Thalictrum alpinum*. *Dryas octopetala* excepted, all these plants were previously found in a solifluxion deposit at Ballybetagh, Co. Dublin[3]. With this deposit, associated with a local glaciation in the Wicklow Mountains[4], the grey mud at Drumurcher is presumably contemporaneous. The Drumurcher site is about three hundred feet above sea-level. The presence of the small-leaved arctic form of *Dryas octopetala* in Co. Monaghan supports Jessen's suggestion that these Irish late-glacial deposits may be contemporaneous with the upper Dryas clay of Denmark. Though no traces of mammoth were found in 1940, the resemblance of the flora of the grey mud to that associated with mammoth remains at Borna[5] is worth noting.

Thanks are due to Mr. J. Andrews, the tenant of the site, for his co-operation, and also to Mr. A. Farrington and Mr. A. M. Gwynn for their assistance in the field. The work was made possible by a grant from the Royal Irish Academy, in the *Proceedings* of which a full report will be later published.

G. F. MITCHELL.

Iveagh Geological Laboratory,
Trinity College,
Dublin.
March 31.

[1] Nevile, *Phil. Trans. Roy. Soc.*, 29 (1715).
[2] Mahr, A., *Proc. Prehist. Soc.*, Paper 11 (1937).
[3] Jessen, K., and Farrington, A., *Proc. Roy. Irish Acad.*, B, **44** (1938).
[4] Farrington, A., *Proc. Roy. Irish Acad.*, B, **42** (1934).
[5] Weber, C. A., *Abhandl. Naturwiss. Ver. Bremen*, **23** (1914).

Russian for Scientific Workers

THERE must be many scientific workers who would like to learn Russian if facilities were available, and there are certainly some excellent schools of Russian in Great Britain which would offer facilities. The most useful course would be one which would enable a student to read a Russian scientific paper with the aid of a dictionary and not too great an expenditure of time: on a foundation of this sort, a fuller and more general knowledge of the language could, if circumstances permitted, be developed.

The School of Slavonic and East European Studies of the University of London is making a start with a beginners' class open to any student, and as an act of marked generosity, given without fee to persons employed by the University or its institutions in teaching or administrative posts. Other courses are arranged elsewhere.

The purpose of this letter is to ask whether there are groups of scientific workers who would like to learn Russian, if the necessary arrangements could be made. There seems little doubt that the teaching could be provided in many cases at least, and if one knew the extent of the unsatisfied demand, it would be possible to set about meeting it. I should welcome any suggestions or comments.

E. J. RUSSELL.

Ministry of Information,
Malet Street,
London, W.C.1.

X-RAY ANALYSIS IN INDUSTRY.

X-RAY analysis provides a new tool for solving industrial problems. It is used in many laboratories in Great Britain, and the researchers who have become expert in handling it are constantly developing new methods, and discovering new types of problem to which it can be successfully applied. The Conference arranged by the Institute of Physics, and held at Cambridge on April 10 and 11, had as its object the interchange of ideas and knowledge between the various groups of workers. Two previous attempts to call this Conference have been frustrated, the first by the onset of war and the second by the difficult conditions of the summer of 1940. In order that the object which it had in view might at any rate be partially achieved, the Institute of Physics decided to publish the series of papers which appeared in the *Journal of Scientific Instruments* in May and July 1941 ; these papers formed the basis of discussions for the present Conference. Some anxiety was felt by those responsible for the arrangements, lest preoccupation with war-work would prevent many from attending, but the decision to proceed was made because the X-ray tool is being widely used for problems directly connected with the War. The large attendance at the Conference (some 280 participated) and the generally expressed appreciation of this opportunity for discussion have shown that this anxiety was unnecessary.

X-ray analysis found its earliest application in the study of crystalline structure, the pattern of the atomic arrangement in the perfect crystal. The results of this analysis have had a profound influence on fundamental concepts of the nature of chemical combination. It has been realized that the law of combining proportions is not always the result of the grouping of atoms into molecules ; in many classes of compound it represents the ratio of the numbers of atoms which are welded by the interatomic forces into one continuous pattern. It has been realized that one must be cautious in carrying over into the metallic field concepts based on organic and inorganic compounds, and the physical realities behind such terms as 'intermetallic compound', 'phase', and 'solid solution' have become much clearer. Such work ultimately influences technical applications, because it clarifies ideas.

The Conference concerned itself, however, with more direct applications of the X-ray method, and the subject of crystal analysis was specifically excluded, or rather, its results were taken for granted. An actual crystalline material may be composed of fragments with different types of crystalline structure. The crystallites have characteristics of size, of shape, of orientation, and of perfection, which may profoundly modify the macroscopic properties of the material. The perfect pattern is an ideal only attained by crystals under special conditions. In 'mixed crystals' various atoms may serve as proxies for each other, and an increasing number of crystals are proving to be tolerant to a remarkable extent of minor variations in their pattern without destroying its general plan. X-ray analysis affords valuable information about their characteristics, and is often the only available method of attack ; the study of such problems was the business of the Conference.

The progress of an X-ray analysis is reminiscent of that in a good detective story. It is an indirect method. We cannot extort a full confession from the guilty party. Instead, we are given a series of clues, which point to some possibilities and exclude others, until finally we have an accumulated weight of evidence which makes us confident we have arrived at the right solution. The indirect nature of the evidence is seen most clearly in the analysis of crystalline patterns. Theoretically, the observed X-ray diffraction effects might be produced by an infinity of arrangements of scattering matter (in technical terms the phases of the scattered beams are not observable). A unique solution is only possible because other evidence can be called in support. The right solution must represent atoms of known number and type, with features of arrangement and spacing relative to each other which previous experience with other structures has shown to be characteristic. Instead of logically deducing a solution, intelligent guesses have to be made and tested against the observations. The same is true for X-ray analysis of all types. The clues afforded by the more or less diffuse spots, arcs, or lines on an X-ray photograph of some mysterious material must be combined with a wealth of other knowledge if they are to be followed up. Much of the fascination of X-ray analysis is due to its taking one into so many other fields of science. The X-ray expert should not only understand the optical principles on which his science is founded ; he must at the same time be a chemist, a metallurgist, a petrologist, or a biochemist. The optical principles can be logically deduced, but imagination, common-sense and a wide general knowledge lead him to make his intelligent guesses.

The wide range covered by the industrial applications is shown by the papers published last year. In the short time available at the Conference detailed discussion of all the papers was not practicable, and it was decided to group certain of the papers together and discuss them under the three headings : "Cameras for X-ray Analysis" ; "The Application of X-ray Crystallography to Industrial Problems" ; "X-ray Structure and Mechanical Properties". At the same time an exhibition of photographs, films and apparatus cognate to the above subjects was arranged. This exhibition was well supported, and examples of recent work and modern apparatus emphasized the very marked improvements in technique which have taken place in the last decade.

The papers, and the contributors to the discussion at the Conference itself, all came from laboratories in Great Britain. They did not represent a general review of the application of X-ray analysis to industrial problems, which has been advanced by workers in many countries. The limitation was deliberate. The Conference was planned to be a comparing of notes and pooling of knowledge by the many X-ray workers in Great Britain who desire to collaborate more closely, and it has done much to further this aim.

In each discussion the procedure adopted was that the main aspects of the subject were introduced by speakers who had contributed papers to the symposium, and afterwards a general discussion took place. This present account of the proceedings deals only with the more interesting items arising from the general discussions.

On cameras, two interesting developments may be mentioned, one by Orowan of the Cavendish Laboratory, Cambridge, describing the use of a rotating wire grid which enables much extra useful information to be obtained from rotating crystal photographs, and the other by Frommer of High Duty Alloys,

Slough, concerning the design of very large cameras in which completed metallurgical products can be examined for measurement of internal stress.

The discussion on applications brought out the very great diversity of subjects now being investigated by X-ray methods. Bunn of Imperial Chemical Industries, Ltd. (Northwich), in his remarks emphasized the need for the production of an index of the known structures of chemical compounds, etc., as this would be a great help in the identification of compounds. This question was the subject of further comment by other speakers, and was referred to the organizing committee of the Conference with the view of promoting active steps to provide an index for X-ray workers.

The final discussion was concerned with the correlation of X-ray structure of metals and mechanical properties. Numerous speakers indicated how industry is developing this subject in connexion with such problems as the measurement of internal stresses and preferred orientation in strip and wire, and on the theoretical side Sir Lawrence Bragg showed how the measurements by Wood on the limiting crystallite size of metals can be used to estimate in a simple way their yield strength within very reasonable limits.

On April 10, Sir Lawrence Bragg delivered a lecture entitled "The History and Development of X-ray Analysis." This was a very enjoyable feature. It commenced with a fascinating account of the early work of himself and his father, the late Sir William Bragg, and after tracing the major developments up to the present time, ended with a statement of various problems, such as the structure of proteins, the 'fine' structure of deformed metal, etc., which were in his opinion on the threshold of solution.

As a result of the interest displayed at the Conference and the enthusiasm of the members, a resolution was passed suggesting that the organizing committee should take steps to set up a permanent organization under the ægis of the Institute of Physics to arrange similar conferences from time to time.

CRYSTALLINITY IN CELLULOSE ESTERS

ACCORDING to an article by W. O. Baker (*Bell Lab. Rec.*, 20, No. 6, Feb., 1942) the toughness, strength and flexibility of plastics are influenced by the arrangement as well as the composition of their giant molecules. In an endeavour to discover the fundamental properties of certain compounds such as cellulose acetate and cellulose butyrate, which make these materials resistant to shock, bending, twisting and dimensional change, studies were undertaken on a molecular scale, the high magnification necessary being obtained by photographing X-ray beams after passage through selected samples of the plastics. These photographs give patterns which can be measured to show molecular distances as small as a billionth of an inch, and they also indicate how the molecules are placed with respect to each other.

A minute cylindrical beam is passed through small flat sections about one millimetre thick, much of it expanding into coaxial cones on account of diffraction by the layers of molecules. After an exposure of three or four hours, circular records appear on the photographic film, the degree of crystallinity being indicated by the sharpness and number of circles recorded. In striking analogy to metals, it was found that the cellulose esters could be quenched by rapid cooling from the molten state. The long polymer molecules were then found to be disordered with respect to each other. Neighbours of a given molecule are quite randomly arranged although there is a tendency for sections of the chains to lie side by side. When cooled slowly, however, the molecules have a very ordered arrangement in local regions throughout the plastic. When they have the maximum disorder, the material tends to be most soft and flexible, and when they are most ordered, or crystallized, it is hardest and strongest, but sometimes brittle.

Two other methods of controlling the number of organized and disorganized molecules have long been used as working procedures in the technology of cellulose plastics. The first is to control the shape of the cellulose ester molecules by the amount of the reaction and the nature of the substituting groups so that they can only partially fit together, to give an ordered arrangement. The second, applying chiefly to lacquers such as aeroplane dopes and film formation, is the selection of a particular solvent which evaporates as the cellulose ester film dries. Various liquids were found to cause different amounts of molecular disorder in the resulting films.

The study showed that sections of the plastic's molecules could orient themselves in an ordered position in the solid state and that they undergo considerable torsional motion under the influence of temperature. Thus, it was possible to anneal quenched cellulose esters, and X-ray patterns show how this process causes the chain molecules to take up ordered positions. This ability of molecules to move in plastic solids even at ordinary temperatures appears to be closely related to their plasticity and capacity to bend and return to original form.

DEVELOPMENTS IN ADULT EDUCATION*

By DR. BASIL A. YEAXLEE
University of Oxford

DESPITE all that has been done in the field of educational psychology adult education has still only an empirical basis. There has been practically no research in Great Britain and very little in the United States. Yet without such careful inquiry it is not possible to plan effectively the great extension of the movement that is desirable after the War or to develop the necessary variety of methods. The first stage is to determine the problems to which the attention of psychological investigators should be directed. The educational activities now so widespread among men and women of H.M. Forces should yield valuable data and suggestions.

It must be remembered that nothing like simple extension into this constituency of work on conventional lines was feasible. The opportunity was, and is, immense. But conditions as a rule prevent the systematic, continuous study and the maintenance of academic standards which characterize the courses and classes carried on among civilians in peace-time by university extra-mural departments and organizations such as the Workers' Educational Association. On the other hand, a very small percentage of the

* Substance of an address to the Education Section of the British Psychological Society at its Extended General Meeting, Brighton, April 10, 1942.

population is normally reached by these activities, and a great deal of genuine adult education has been and always must be unorganized. The Central Advisory Council for Adult Education in H.M. Forces, however, which through its twenty-three regional committees makes the civilian resources of the country in lecturers and teachers available to the Services, now reports not only a constantly growing number of single lectures but also a gratifying increase in the demand for short courses*. An extract from one lecturer's diary runs: "The course which never ends: now on Course III, Lecture 8—or something like that: gave a talk on three famous Concertos, the Tchaikovsky, Grieg, and Addinsell's Warsaw Concerto." Another lecturer's report refers to the "widespread evidence of a new sensitiveness to political and economic issues on the part of the average soldier". This lecturer also says: "The mood is sometimes cynical, but more often it is shrewd, positive and percipient, quick to question glib assumptions and assurances, unafraid to seize upon often disconcerting comparisons, but eager to be informed, convinced and reassured on the grave questions that abide the issue of their day."

Adult education among members of the Forces, as among civilians, relies upon the interest of the student. There is no prescribed curriculum, as in schools and universities. Attendance is voluntary, if it is in leisure time, as this work is intended to be. Facilities are open to all. It has been said, however, that of course only some 20 per cent of the troops are in the least likely to avail themselves of these, since that proportion can be safely taken as the maximum number of people who show any interest in adult educational activities, whether cultural or vocational, in civil life. If this proves even approximately true, however, it reflects more upon what is offered than upon those who ignore or reject it. We cannot be content to believe that 80 per cent of men and women are completely devoid of cultural interests because they are unattracted by lectures and discussions on topics which appeal to the 'intelligentsia'. The question for the psychologist is whether adult education has not been too much limited to intellectual interests. He must indeed ask also whether school and college education has been so intellectualist or so utilitarian that average people misunderstand the very word education and do not dream of connecting it with the word adult, or with life as they have to live it.

The rapidly extending practice of arts and crafts by men and women in the Services is one of the factors in the present great experiment that may be of greatest importance in the future development of adult education. It has been said by some that music, drawing and painting and recreative handicrafts have no place in a war-time scheme of adult education because, in their view, these have no relation to the serious business of understanding either the causes and issues of the world conflict which now demands the exercise of all our mental and physical energies or the aims and conditions of social and political reconstruction when victory has been won. The majority, however, would not agree. For in such occupations men and women are neither escapist nor inclined to fiddle while Rome is burning. They are discovering that they have creative imagination and constructive capacity. The importance of this not only educationally and psychologically but also sociologically is all the greater at a time when thousands of men and women are making closer acquaintance than ever before with what mechanization means. It is on this side much more than on the more academic that they are finding new interests, and achieving that greater completeness and balance of personal development which are so greatly needed if human society is not only to recover from the cataclysm of war, but also to approximate more nearly to the good life.

Educational activities among the women's Services are not so extensive as among the men. This is partly due to the fact that hitherto they have not had their own education officers and organization. That deficiency is being remedied. The Director of Army Education now has an A.T.S. officer with the necessary training and experience attached to his staff at the War Office, and soon there will be a similar appointment in each Command. Action has also been taken by the W.R.N.S. and W.A.A.F. Directorates. It is important to note this because the expansion of the Army Educational Corps at once produced a much greater volume of educational demand and experiment among the men, and doubtless the same will happen in the case of the women. But in all probability the women's needs and desires, understood by their own education officers as even the most sympathetic of men cannot be expected to understand them, will not be merely for 'domestic' subjects and 'feminine' activities. They will want many of the same things but will approach them from a different aspect. What the educational psychologist should be finding out is how far it is true that, contrary to popular notions, women are the more practical in their thinking and men the more abstract and theoretical. The two, of course, are complementary. Men and women in the Services share educational activities to an increasing extent. But when women are drawn in much greater numbers into participation in the scheme, many will want programmes of their own. It would be a great pity and a serious loss if now and after the War 'women's interests' in adult education were misconceived, and if attempts to make special provision for them failed correspondingly.

It has been found that women are more inclined than men to seek pure relaxation in their off-duty hours, especially in the evening when the day's work is done. This raises another psychological question—the nature and reciprocal effect of physical and mental fatigue. That men and women work equally hard there is no doubt. But it is probable that a far larger proportion of women than of men are engaged on monotonous duties very similar to some aspect of their peace-time employment. For the greater number of men, joining one of the Services means learning how to do a considerable variety of things which are new to them and several of which usually come into the same day's work. Physically, women often have more endurance than men, though less brawn and muscle. The fatigue they exhibit—or at least the inclination to seek amusement rather than education after a hard day's work—may well be due to monotony rather than to physical exhaustion and may well be more mental than physical. A study of this would be of value in considering what forms of adult education should be promoted when

*The figures for the six months April 1–Sept. 31, 1941, which will be greatly exceeded by those for the ensuing winter half-year, are 18,983 single lectures, 1,530 short courses, and 1,075 classes arranged through the agency of regional committees. These do not include local education authority classes or lectures and classes arranged internally by the Services themselves, using their own personnel. ABCA is of course an independent activity, all talks being given and discussions conducted by regimental officers in parade times.

peace-time conditions of work and leisure are restored. In this connexion again it is worth while to remember what great use the U.S.S.R. has made in adult education of the arts—films, music, the theatre, opera and so forth—as well as of physical training and open-air sports.

There are two tensions to be maintained in adult education. One is between amusement and educational seriousness. Adult education must be recreative and at the same time must not lose real educational content and quality. The other is between emotional states and intellectual effort. There is always a tendency, as war goes on, to take more and more the attitude *delenda est Carthago*, but this results more from a cumulative feeling than from reasoned judgment. World reconstruction will demand discrimination of a kind incompatible with hatred. There has been a considerable degree of spontaneous refusal to accept Vansittartism, but all the time there is a tendency to drift into precisely that state of rationalized hatred and aggressiveness. Similarly the increase of propaganda, of however legitimate and truth-telling a kind, begets a tendency to scepticism and a temper of suspicion. Thus, for example, the unvarnished account by a German refugee of his experiences in an internment camp was received with incredulity by men who assumed that it was rather a blatant attempt to whip up their 'morale'. Years ago, Mr. Walter Lippman warned us of the universal tendency to judge everything by "the picture in the mind". If the problems of democracy and of a planned society after the War are to be solved happily and with reasonable speed, adult education, now and then, must both evoke and sustain the power of imagination and equally train the critical judgment.

FORTHCOMING EVENTS

(*Meeting marked with an asterisk is open to the public*)

Wednesday, May 6

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Prof. J. C. Drummond: "War-Time Nutrition and its Lessons for the Future".

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 6 p.m.—Discussion on "Post-War Planning in Radio Communication" (to be opened by Colonel Sir A. Stanley Angwin and Mr. H. Bishop).

Thursday, May 7

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 6 p.m.—Annual General Meeting. 6.30 p.m.—Adjourned Discussion on "A Critical Review of Education and Training for Engineers", by the Education and Training and Personnel Sub-Committee.

Friday, May 8

ROYAL INSTITUTION OF GREAT BRITAIN (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. James Kendall, F.R.S.: "The Separation of Isotopes and Thermal Diffusion".*

APPOINTMENTS VACANT

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

HORTICULTURAL DISTRICT OFFICER in South-East Norfolk—The Secretary, Norfolk War Agricultural Executive Committee, Sprowston, Norwich (May 8).

UNIVERSITY CHAIR OF OIL ENGINEERING AND REFINING (PETROLEUM TECHNOLOGY)—The Secretary, The University, Edmund Street, Birmingham 3 (May 9).

UNIVERSITY READERSHIP IN ORGANIC CHEMISTRY tenable at London (R.F.H.) School of Medicine for Women—The Academic Registrar, University of London, Richmond, Surrey (May 12).

LECTURER IN MECHANICAL ENGINEERING SUBJECTS—The Clerk to the Governors, South-East Essex Technical College, Longbridge Road, Dagenham (May 16).

REPORTS and other PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Table of Squares of all Numbers less than 300. 9 in. × 6½ in. (London: Scientific Computing Service, Ltd.) 1*s*. [134

China To-day: the Thirtieth Anniversary of the Chinese Republic, 1911–1941. Pp. 55. (Cambridge: Central Union of Chinese Students in Great Britain and Northern Ireland.) [134

Thirty-ninth Annual Report, 1941–1942, of the Imperial Cancer Research Fund. Pp. 32. (London: Royal College of Surgeons.) [134

Report of the Rugby School Natural History Society for the Year 1941. (75th Issue.) Pp. 24. (Rugby: George Over (Rugby), Ltd.) [134

Quarterly Journal of the Royal Meteorological Society. Vol. 68. No. 294: The Phenological Report, 1941. By Major H. C. Gunton. Pp. 89–119. (London: Royal Meteorological Society.) 3*s*. [174

Other Countries

American Philosophical Society. Year book 1940, January 1, 1940–December 31, 1940. Pp. 466. (Philadelphia: American Philosophical Society.) [134

Smithsonian Institution: United States National Museum. Bulletin 100: Contributions to the Biology of the Philippine Archipelago and adjacent Regions—The Fishes of the Groups Elasmobranchii, Holocephali, Isospondyli, and Ostarophysi obtained by the United States Bureau of Fisheries Steamer *Albatross* in 1907 to 1910, chiefly in the Philippine Islands and adjacent Seas. By Henry W. Fowler. Pp. x+879. (Washington, D.C.: Government Printing Office.) 1.25 dollars. [134

Proceedings of the United States National Museum. Vol. 89, No. 3096: The Cuban Operculate Land Mollusks of the Family Annulariidae, exclusive of the Subfamily Chondropominae. By Carlos de la Torre and Paul Bartsch. Pp. 131–386+x+plates 9–57. (Washington, D.C.: Government Printing Office.) [134

U.S. Department of the Interior: Geological Survey. Bulletin 883–B: Spirit Leveling in Texas, Part 2: Panhandle, 1896–1939. Pp. ii+51–149+1 plate. 15 cents. Bulletin 900–F: Subsurface Geology and Oil and Gas Resources of Osage County, Oklahoma. Part 6: Township 28 North, Ranges 10 and 11 East, and Township 29 North, Ranges 9 to 11 East. By H. B. Goodrich, L. E. Kennedy and Otto Leatherock. Pp. iii+209–236+plate 6. 50 cents. Bulletin 906–E: Structural Control of Ore Deposition in the Uncompahgre District, Ouray County, Colorado. By W. S. Burbank. (Contributions to Economic Geology, 1938–39.) Pp. iv+189–265+plates 53–54. 20 cents. Bulletin 922–L: Quicksilver Deposits of the Mayacmas and Sulphur Bank Districts, California. A Preliminary Report by C. P. Ross. (Strategic Minerals Investigations, 1940.) Pp. iii+327–353+plates 47–53. 45 cents. Bulletin 922–N: Chromite Deposits of the Eastern Part of the Stillwater Complex, Stillwater County, Montana. By J. W. Peoples and A. L. Howland. (Strategic Minerals Investigations, 1940.) Pp. iv+371–416+plates 63–65. 40 cents. Bulletin 922–Q: Tungsten Deposits in the Tungsten Hills, Inyo County, California. By Dwight M. Lemmon. (Strategic Minerals Investigations, 1940.) Pp. iii+497–514+plates 72–77. 20 cents. Bulletin 922–S: Tungsten Deposits of the Benton Range, Mono County, California. By Dwight M. Lemmon. (Strategic Minerals Investigations, 1940.) Pp. iii+581–593+plates 88–89. 30 cents. Bulletin 925–A: Geophysical Abstracts 100, January—March 1940. Compiled by W. Ayvazoglou. Pp. ii+50. 10 cents. (Washington, D.C.: Government Printing Office.) [134

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 870: Summary of Records of Surface Waters of Washington, 1919–35. Pp. vi+456+7 plates. 65 cents. Water-Supply Paper 881: Surface Water Supply of the United States, 1939, Part 2: Pacific Slope Basins in California. Pp. xii+446+2 plates. 75 cents. Water-Supply Paper 884: Surface Water Supply of the United States, 1939, Part 14: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. vii+220+1 plate. 30 cents. (Washington, D.C.: Government Printing Office.) [134

Smithsonian Miscellaneous Collections. Vol. 101, No. 8: Bees of the Family Hylaeidae from the Ethiopian Region. By T. D. A. Cockerell. (Publication 3649.) Pp. ii+15. Vol. 101, No. 9: Notes on some American Fresh-Water Amphipod Crustaceans and Descriptions of a New Genus and two New Species. By Clarence R. Shoemaker. (Publication 3675.) Pp. ii+31. (Washington, D.C.: Smithsonian Institution.) [134

Proceedings of the United States National Museum. Vol. 91, No. 3122: A New Fossil Crocodilian from Colombia. By Charles C. Mook. Pp. 55–58+plates 4–9. (Washington, D.C.: Government Printing Office.) [134

U.S. Department of the Interior: Geological Survey. Professional Paper 193–D: Some Structural Features of the Northern Anthracite Coal Basin, Pennsylvania. By N. H. Darton. (Shorter Contributions to General Geology, 1938–39.) Pp. iii+69–82+plates 10–19. 50 cents. Professional Paper 194: The Gold Quartz Veins of Grass Valley, California. By W. D. Johnston, Jr. Pp. vi+102+39 plates. 2.50 dollars. (Washington, D.C.: Government Printing Office.) [144

Government of Iraq. Ministry of Defence: Meteorological Service. Annual Report of the Director, No. 5, Year ending 31st March 1941. Pp. iii+14. (Baghdad: Government Press.) [144

Carnegie Institution of Washington. Year Book No. 40, July 1, 1940—June 30, 1941, with Administrative Reports through December 12, 1941. Pp. xxxii+346. (Washington, D.C.: Carnegie Institution.) 1 dollar. [154

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Agricultural and Chemical Series, Bulletin No. 53: Soil and Plant Material Analyses by Rapid Chemical Methods, 3. By Francis E. Hance. Pp. 265–296. (Honolulu: Hawaiian Sugar Planters' Association.) [154