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 aegis 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. x 6½ in. (London: Scientific Computing Service, Ltd.) 1s. [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.) 3s. [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, Holoccephali, Isospondylii, and Ostorophysi 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. Cockrell. (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]