indicated by the variety of factors which affect the biological response to carotene ; such as, for example, the effect of vitamin E in increasing growth-promoting activity in rats[29]. The effect of the tocopherol is, however, apparently due to its function as an anti-oxidant in the gastro-intestinal tract, rather than as a vitamin regulating some phase of metabolism in the tissues.

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90/2

WAR-TIME PROGRESS IN X-RAY ANALYSIS

The third annual conference of the X-ray Analysis Group of the Institute of Physics was held during July 9–11 at the Royal Institution. It provided the first opportunity since the War for crystallographers of all nationalities to re-establish contacts and to exchange information and ideas. The chairman, Sir Lawrence Bragg, was able to welcome among about 250 members of the conference no less than seventy-five foreign visitors representing fifteen different countries. In his opening address, Sir Lawrence emphasized the inadequacy of a three-day conference for a full interchange of crystallographic news and views, and he felt that the visits to laboratories arranged for the foreign visitors during the following week, as well as the intervals between official sittings of the conference, should provide additional opportunities for personal discussions. In this spirit, too, the official dinner which took place at Frascati's on the night of July 10 was an outstanding success.

At the general meeting of the X-ray Analysis Group, Sir Lawrence Bragg reported on the previous year's activities of the Group and on the forthcoming discussions about the possible inauguration of an international crystallographic journal. The conversion factor of 1·00202 from kX. units of X-ray wave-length to A. (Ångströms) was agreed on in conformity with a similar decision by the American Society for X-ray and Electron Diffraction. Dr. W. H. Taylor reported on steps undertaken to make crystallographic X-ray tubes more readily available in Great Britain and outlined plans for encouraging and standardizing the manufacture of crystallographic instruments. Dr. A. J. C. Wilson reported on the success of the first supplement to the X-ray Powder Index and appealed for further contributions for future supplements.

During the course of the first official session, Prof. P. P. Ewald extended a welcome to the meeting on behalf of the International Union of Pure and Applied Physics. He took the opportunity to outline the purpose of the Union in promoting the interests of physicists the world over, and emphasized its special task in co-operating with its sister unions to provide the United Nations Organisation, through its scientific section, the United Nations Educational, Scientific and Cultural Organisation, with the best available advice on all scientific matters.

The summaries of the reviews and lectures given at the conference are here arranged according to the countries (in alphabetical order) in which the original work had been carried out. Owing to the diverse subjects discussed, it will be impossible to include references ; these can be obtained from Dr. W. H. Taylor (at the Crystallographic Laboratory, Free School Lane, Cambridge), who has asked contributors to supply him with one copy of all published work mentioned at the conference.

Belgium

Prof. G. A. Homès described the work on X-ray diffraction carried out in Belgium during the War. The Engineering College at Liège opened a "Centre for the Internal Physics of Metals" ; lectures held there had a marked influence on the application and development of X-ray methods for industrial purposes.

New methods and apparatus—including several new camera designs—were employed for use in metallurgical studies. Investigations were carried out on the orientation of grain boundaries, the effect of elastic stresses in steel, lattice distortions in welded materials, and on the sintering of metallic powders.

Work on non-metals included the systematic studies of P. Theys on Belgian clays and baked ceramics, and the investigations of G. A. Homès and S. Lefevre on the polymerization of phenolic plastics.

Prof. H. Brasseur, of Liège, himself elaborated some aspects of his work, which included : (*a*) The crystal structure study of a complex cyanide, crystals of which twinned so readily as to be flexible. (*b*) The study of the mineral substance of bones with particular reference to tricalcium phosphate hydrate, the structure and X-ray pattern of which closely resemble apatite. (*c*) The measurement of bond angles in some organic compounds containing two benzene rings joined by one or more intermediate atoms.

Czechoslovakia

Prof. V. Petržílka gave a brief summary of work done in Czechoslovakia, which was concerned chiefly with the study of metals ; but interest also lay in the determination of orientation of quartz crystals, and in foundry problems such as radiography (often employing radium or radon) of welds and castings.

Dr. Adéla Kochanovská described a new method for determining anisotropic deformations of polycrystalline cubic metals subjected to internal or external stresses.

Finland

Dr. J. A. Wasastjerna described how he had shown by very accurate experimental determinations of atomic scattering factors in alkali halides that, in the pure substances, the values of the mean squares of the displacements of ions from their theoretical positions are almost completely accounted for by thermal vibrations. In mixed crystals, however, his results showed that there were additional mean displacements of ions due to both long- and short-range disturbances. The experimental values of these two kinds of displacements indicated the existence of a certain degree of local order.

France

In a paper on French work during hostilities, Prof. J. Wyart described some of the advances made in the development of equipment; in particular of curved crystals for obtaining focused, monochromatic radiation, and of apparatus for high precision lattice parameter determination and for the determination of orientation of crystal lamellæ. He discussed in detail the important investigations on diffuse X-ray scattering by J. Laval; he mentioned the study by A. Guinier of the extra spots given by diamond, and the experimental work done on X-ray absorption and emission spectra by Kurylenko and Mlle. Cauchois, and went on to describe work done on reactions in solid phases, such as dissociation of oxides of cadmium, zinc and iron, and adsorption of hydrogen on palladium. He also mentioned structure determinations done on calcium, barium and strontium mixed carbonates, a Mn-As alloy and others.

Prof. J. J. Trillat, continuing the review of French work, described two new methods of electron microradiography, both of which depend upon the photographic effect of secondary photo-electrons rather than of X-rays. The first method, that of electron radiography by reflexion, enables micro-radiographs to be made on finished materials. Very thin films of the Lippmann type are applied to the surface under investigation, which is irradiated by hard X-rays. The photographs so obtained can be used to study the distribution of different metals on the surfaces of alloys and for other topographical investigations. The second method, electronic radiography by transmission, was used in order to obtain radiographs of very thin films, for example, plant tissues, paint films, etc. Here, the material was crossed by photo-electrons emitted from a metallic surface against which the film was pressed. Examples of application of both methods were shown, and further possible developments discussed.

Prof. Trillat also made a brief reference to the electron microscopes both with magnetic and electrostatic focusing which had been constructed in France.

Dr. A. Guinier gave an account of the work carried out in France during the War on the application of X-ray analysis in the fields of chemistry and metallography. He described the studies of M. Mathieu and Mlle. T. Petitpas on nitrocellulose, of Trillat and R. Tertian on the natural and synthetic rubbers, and his own work on measurement of particle size.

The metallographic work carried out may be divided into work on crystalline textures, and on the crystal structure of alloys. Under the former heading an extensive study was made by R. Jacquersson on the effect of torsion on a monocrystalline rod, and P. Lacombe and L. Beaujard studied the surfaces of single metal crystals. Under the second heading, improvements were made in the sensitivity of the detection of crystalline phases, and the use of scattering outside the selective reflexion directions for studying lattice irregularities and periodic defects.

Dr. Mladen Paic explained the principles of 'radio-analysis', namely, analysis by X-ray absorption, and its application to the study of segregation and diffusion of heavy components in aluminium alloys.

Germany and Austria

Dr. R. C. Evans, who had recently returned from an extensive tour of numerous crystallographic laboratories in Germany and Austria, was greatly impressed by the excellence of the equipment and by the generous scale on which it had been available in many diverse academic and industrial centres. It was the more disappointing that remarkably few advances in fundamental research had been achieved. A notable exception was the precision determination of electron density maps in simple structures, as for example that of oxalic acid dihydrate, where the parameter values obtained differ significantly from previously reported results. Dr. Evans painted a vivid picture of present conditions in the laboratories he had visited, where research is proceeding in the face of almost unimaginable difficulties.

Great Britain

Dr. K. Lonsdale described the work done in Great Britain during 1939–46 on the modification of scattering power of crystals due to the thermal vibration of the atoms, the changes that take place during the progressive dissociation of an alloy into its final phases, the phenomena that accompany age-hardening at various temperatures, and the causes of line-broadening on powder photographs of cold-worked metals, and of cobalt and $AuCu_3$. She referred to the extra lines on photographs of graphite, known to be due to the presence of a second structure, and to the extra reflexions, as yet unexplained, given most strongly by diamonds, the perfection of which can be demonstrated by the divergent-beam method; and finally, she described the very small changes of structure that accompany the anomalous electrical properties found in certain temperature regions for Rochelle salt, potassium dihydrogen phosphate and arsenate, and barium titanate.

In discussion, Prof. M. Born expressed a doubt if there was such a thing as a perfect single crystal larger than a thousand units in each direction, since the unsymmetrical vibrations will cause the atoms to be quite out of step over larger intervals.

Prof. J. D. Bernal gave an account of crystal structure determinations made in Great Britain during the period 1939–46. Complete structure analyses of relatively simple organic molecules and of molecular complexes yielded valuable accurate information on intermolecular and intramolecular bond character (J. M. Robertson and co-workers, Cox and Jeffries, H. M. Powell and co-workers). With more complex compounds, it is the detailed stereochemical relations that have been determined, as for example in the work on the sugars and on cholesteryl iodide.

These determinations and others have depended upon notable advances in the technique and methods of crystal analysis developed at the same time. The elucidation of the structure of penicillin (Hodgkin and Rogers; Bunn and Turner-Jones) exploited many of these advances, especially the development

by Bunn of Sir Lawrence Bragg's 'fly's eye' method, and the use of the Hollerith technique for the calculation of three-dimensional Fourier series (L. J. Comrie).

Bunn and co-workers investigated the structures of some natural and synthetic polymers. Further work was done by Perutz and by Mrs. Hodgkin and her co-workers on the internal structure of the protein molecule.

Prof. W. T. Astbury, in the third British review, spoke on fibrous proteins of the keratin-myosin group which show reversible intermolecular elasticity. He stated that fibrin, fibrinogen and the muscle protein tropomyosin, discovered by Bailey, belong to the group. X-ray work has included an analysis of the complete fibre pattern of porcupine quill by MacArthur, and a study of living muscle at various stages. The X-ray interpretation of the denaturation of corpuscular proteins as an unfolding of specific configurations is now made use of in the production of fibrous from corpuscular proteins. He mentioned work done by R. D. Preston on the structure of the plant cell wall, by Rudall on the chitin-protein complex of the insect cuticle, and by Hanes on the preparation and structure of synthetic starch.

Dr. W. Hume-Rothery showed an elegant apparatus for the preparation, in an argon atmosphere, of filings suitable for very accurate lattice parameter determinations.

Sir Lawrence Bragg gave an entertaining evening lecture on the bubble model which he has devised as a two-dimensional representation of the arrangement of atoms in a metal. It illustrated clearly their behaviour under stress and on annealing, as well as the effects of an impurity and of a dislocation in the structure. A short film showing the model in operation was seen at the end of the lecture.

Holland

Prof. J. M. Bijvoet gave an account of the X-ray crystallographic work carried out in Holland during the War (Part III, Chemistry in Wartime in the Netherlands, published under the auspices of the Netherlands Chemical Society).

Structures determined by trial and error methods based on two-dimensional Patterson syntheses have included: (*a*) the investigation of allotropic modifications (example, P_2O_5 (P_4O_{10})); (*b*) order-disorder transitions and the structures of high- and low-temperature modifications (examples, sodium nitrite, sodium cyanide); (*c*) further inorganic structures including lithium and ammonium cyanides; and (*d*) the structures of organic compounds including hexabromoethane and adipic acid.

New methods of structure determinations and further refinements of existing methods were developed. They included the use of isomorphous structures, as in the work on Br-, Cl- and CN-camphor, the application of artificial temperature factors in the summation of incomplete Fourier series, and the use of the background blackening in fluorescent Weissenberg diagrams for the determination of absorption factors.

The lattice defects and diffuse Laue spots in crystals of tetragonal tin were investigated. Work was also done on recrystallization phenomena in metallic crystals.

Important mathematical-physical contributions were also made to the theory of order-disorder transitions.

India

Sir K. S. Krishnan gave an account of the theory of electrical resistivity of metals in terms of the scattering of electron waves passing through them. On the basis of the analogy between X-ray and electron scattering, calculations of specific resistances and of the temperature changes in resistance were made by Krishnan in collaboration with A. B. Bhatia for a number of special cases. Close agreement was found between the observed and calculated effects. The large resistance of polyvalent metals in the liquid state was accounted for, and results of some interest obtained for the electrical resistivities of order-disorder alloys of the β-brass type over a wide range of temperatures.

Norway

Prof. O. Hassel described electron diffraction work in Norway on glasses and liquids, using a rotating-sector to modify the background and hence to get more detail in the low-angle range.

Sweden

The diverse researches carried out in Sweden during the War years were described by Prof. I. Waller and Dr. L. G. Sillèn. Besides developing a new type of electrical Fourier summation machine, Prof. Hägg and his co-workers at Uppsala have carried out comprehensive crystal structure studies on inorganic compounds. This and similar work reported from the Institute of Inorganic and General Chemistry of the University of Stockholm is too varied to be described even in summarized form within the space here available. At the latter laboratory some binary alloy phases had also been studied.

Prof. Waller also described the widespread use of focusing cameras in Sweden, his work on the breadth of powder lines and on diffuse, thermal reflexions. X-ray investigations on the kinetics of order-disorder transformations were carried out in the Department of Physics of the Technical University of Stockholm.

United States of America

Dr. R. W. G. Wyckoff presented a survey of the development of electron microscopes, which are now available commercially to suit both routine and research investigations, and of techniques for specimen preparation. High-speed microtomes permit the investigation of thin sections of rubber, polymers and biological tissues. The most striking advances, however, have been made in the methods of replica production, especially using oblique metal shadowing to enhance contrast. Dr. Wyckoff showed a wealth of photographs of macromolecules obtained in this way, in which the shapes and sizes of the molecules are clearly discernible. Using single crystals of virus proteins, it is possible to observe directly the molecular details of crystal formation. This constitutes a new direct method of crystal structure analysis, and Dr. Wyckoff looked forward to a fruitful co-operation between electron microscopists and X-ray crystallographers studying low-angle diffraction phenomena.

Prof. W. H. Zachariasen gave some account of the crystal chemistry of plutonium and neptunium. In the Manhattan Project he had carried out partial or complete crystal structure determinations on a large number of compounds of rare earth elements, thorium; uranium, neptunium and plutonium. The chemical identity of most of these compounds was

deduced from their X-ray diffraction patterns, and a knowledge of the method of preparation. The elements uranium, neptunium and plutonium are closely related crystal-chemically in all known valence states. They are closely related to thorium and particularly cerium in the tetravalent state, and to the elements lanthanum . . . samarium in the trivalent state. A formal valency of two is shown by cerium, thorium, uranium, neptunium and plutonium in some compounds, the structures of which are of the interstitial type.

In the discussion which followed, Mr. H. S. Peiser said that some work on uranium compounds had been done in England, and raised the question of the value to be taken for the atomic radius of uranium.

Dr. D. Harker began with an account of X-ray work on metals done in the United States. He gave a short description of the work of C. S. Barett on X-ray topographs which show the variation of perfection over the surface of a crystal, and went on to mention investigations on the problem of age-hardening of aluminium-silver and gold-copper alloys. He concluded with some remarks about the mechanism of crystal orientation in iron-silicon sheet.

Prof. L. O. Brockway spoke about electron diffraction work. He described some commercial types of apparatus available in the United States, in two of which great space-saving has been achieved by using a high-frequency unit for the generation of high voltage. He gave examples of results achieved, first in the structure of organic liquids and then in the study of monomolecular layers on polished metal surfaces. He emphasized the fact that different patterns may be obtained from X-ray and electron diffraction studies of the same substance, but to get full information both techniques should be used.

Dr. D. MacLachlan described the principle of construction of a machine for the mechanical computation of two-dimensional Fourier series. It depends upon the spreading of layers of sand in sinusoidal waves over a scale plan of the unit cell, so that the height of the sand layer at any one point is proportional to its relative electron density.

AUDREY M. B. DOUGLAS (PARKER)
H. S. PEISER
BARBARA W. ROGERS (LOW)

OBITUARIES

Prof. John Laird, F.B.A.

PROF. JOHN LAIRD, regius professor of moral philosophy in the University of Aberdeen since 1924, died on August 8 at the age of fifty-nine. He had been in bad health for some time, but a paper read for him at a conference in July showed no falling off in clarity and incisive wit.

Laird was born on Deeside, not far from the birthplace of Reid, also a son of the manse. He studied philosophy at Edinburgh under Pringle-Pattison and Seth, and then went on to Cambridge, where he was a scholar of Trinity College. The idealism of his Scottish teachers was less congenial to him than the critical, analytic temper of Moore and Russell at Cambridge, though it may have helped him to avoid the extreme, where that temper turns into a one-sided and rigid metaphysics expressed in negations.

Laird's own philosophical temper is well seen in his book reviews, of which he wrote very many. He approaches each author prepared to examine his position on its merits and in its own terms, and as nearly as possible without prejudice, except a prejudice against anything sloppy, pretentious or obscure. The two volumes of his Gifford Lectures delivered in Glasgow ("Theism and Cosmology", 1940; "Mind and Deity", 1941) display that temper on the large scale. Laird set himself to examine the philosophical arguments that have been used to support theism. Carefully, systematically, relentlessly he winnows the chaff from the wheat; at the end, almost disappointed that his work is ended, and there is actually some wheat left. It seems unlikely that anybody will need to do this work again for a long time, and until that time nobody can consider himself a competent student of the subject without reading Laird. The only defect one can point to is a tendency to avoid any aspect of his subject which is not capable of clear statement in abstract terms. This kind of limitation is present, but is scarcely a defect, in his last book ("The Device of Government", 1944), an admirable elementary discussion of political theory. The work which is perhaps the most comprehensive and distinctive of any that Laird wrote is "The Idea of Value" (1929); a specially useful contribution to thought, constructive as well as critical, because so much recent philosophy is centred on the notion of value, and no previous writer has dealt with the subject as a whole.

There are few aspects of philosophy which Laird left untouched, though his main interest was in ethics; and he wrote a great deal. In these days when a reputation for profound scholarship can be earned by writing nothing or by making it unreadable, so prolific and easy a writer is suspected of being superficial. Such a judgment of Laird is entirely unwarranted. Moreover, it is hard to find any signs of carelessness or haste in his writing, and he repeated himself less than most. Four or five of his books have it in them to become classics, and it may well be that future generations will read them when contemporary works now more popular are quite forgotten.

A. D. RITCHIE

Prof. B. H. Bentley

THE death was announced on June 24 at the age of seventy-three of Prof. Bertram H. Bentley, emeritus professor of botany in the University of Sheffield. A scholar of Keble College, Oxford, Prof. Bentley secured a first class in natural sciences in 1896. Going to Sheffield as assistant lecturer in biology in Firth College, he helped to mould the fortunes of the young university and served it until his retirement in 1939. As the number of botany students under his care increased, he was appointed lecturer in botany in 1905 and eventually became head of a newly formed Department of Botany; but it was not until 1931 that the University appointed him to a full professorship.

Although of an inquiring mind and demanding a critical approach from his students, Prof. Bentley will be remembered for his teaching rather than his original work. Much influenced by A. H. Church, for whom he had the greatest respect, and by the distinguished contributions of Bower and others to the study of phylogenetic problems, his teaching was based always on a morphological approach, and he took pains to see that his students were well grounded