to the overall supply of vitamin E in the dietary. We consider that this aspect of the work requires further investigation, using biological tests, primarily to ascertain whether or not the oxidation products may have an anti-vitamin E activity.

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FORTIETH ANNIVERSARY OF THE DISCOVERY OF X-RAY DIFFRACTION

WHEN Max Laue, then a young *Privatdozent* at the University of Munich, saw, early in 1912, the successful result of the attempt made at his request by Friedrich and Knipping to diffract X-rays by a crystal grating, he could scarcely have imagined the effect that this success would have on so many and so varied branches of science, followed as it was to be by the opening up of X-ray spectroscopy and crystal structure analysis by W. H. and W. L. Bragg. A tribute to this fundamental work of Laue was given by the X-ray Analysis Group of the Institute of Physics, at the instance of the British National Committee for Crystallography, by the arrangement of a special meeting held in London at the Royal Institution during October 24–25*, with an anniversary dinner in London. Many famous figures were able to attend this meeting, and many of them spoke, either during the meeting or at the dinner, including Prof. von Laue himself, Sir Lawrence Bragg, Sir Charles Darwin, Prof. J. D. Bernal, Prof. J. M. Bijvoet, Dr. C. Sykes, Dr. Dorothy Hodgkin and Prof. G. V. Raynor. To complete the picture, a congratulatory message from the American Crystallographic Association, sent by Prof. P. P. Ewald, himself one of those associated with the early work of Laue, was read out by the chairman of the Group, Dr. W. H. Taylor, before the meeting began.

The first session began with an account, given by Sir Lawrence Bragg, of the early days of X-ray diffraction. He told of how Laue's interest in the X-ray problem was aroused by a problem of Ewald's on the double refraction of light, and how Friedrich, somewhat against Sommerfeld's wishes (who thought that he should be getting on with other work), was persuaded, with the help of Knipping, to try the now famous experiment with a copper sulphate crystal. The various stages of the work were described in some detail, and Sir Lawrence mentioned that the early papers had recently been reprinted in *Die Naturwissenschaften* (16, 361; 1952). Sir Lawrence went on to describe the early work of his father and himself and to tell how he first hit upon the now famous idea of the 'reflexion' of a continuous spectrum (rather than one composed of discrete wave-lengths as Laue had supposed) by atomic planes, and the part played by the conception of a crystal lattice, which was then new to him. He outlined some of his early results on crystal structures and traced the development of X-ray spectroscopy by his father, following this by a mention of the early theoretical work of Darwin on the scattering of X-rays by perfect and imperfect crystals, which was so much in advance of experiment that it was overlooked and afterwards worked out in another form by Ewald. He ended by pointing out how many of the later developments had, in fact, been foreshadowed in the first three years.

Sir Lawrence was followed by Prof. von Laue, who spoke about his own experiences in those early days; this was not on the programme, and the pleased surprise of the audience was obvious. Speaking in German, apart from a few introductory remarks in English, he told of the first experiments in Munich and of his own contributions to the work, confessing that, like W. L. Bragg, he too was unfamiliar at the time with the conception of a crystal lattice. He characterized the German contribution as one concerned with 'principles' and the British as one concerned with 'models'. The former approach had been in danger of causing the subject of X-ray diffraction to run into a dead end, from which it had been saved by the latter; and Prof. von Laue pleaded for a collaboration between the two nations in political matters which should be as effective in the cause of peace as it had been in the cause of science. A summary of his remarks was then given in English by Dr. W. F. Berg.

After Sir Lawrence Bragg's historical review, and following Prof. von Laue's remarks, Prof. J. D. Bernal gave a talk in which, after some reminiscences of his own concerning his early days at the Royal Institution with Sir William Bragg, he discussed the future of X-ray crystal analysis in the light of recent developments. He showed how the real crystal, rather than the ideal, is becoming more and more the main object of study and forecast that we should, as a consequence, be led to a greater understanding of such phenomena as epitaxy, adsorption and catalysis, followed ultimately by an explanation of the phenomena of plastic deformation, creep, hardening and fatigue. Turning to methods of structure analysis, he hoped that the time would come when information justifiable on chemical grounds—the known mutual arrangement of constituent atoms in the structure, known ionic or atomic dimension, etc. —could be added to the X-ray data in a rigorous way. Prof. Bernal foresaw that, with the help of electronic and other computing machines, the heaviest part of crystal structure analysis would ultimately be automatic; he even foresaw that the reduction of observations might become so, the output being linked directly to the computer. But, as he said, we are still a long way from being able to drop a crystal down a hopper and receive a table of atomic co-ordinates or an electron density map within a short time.

The second session, on the morning of October 25, was devoted to 'review' papers on various present-day applications of X-rays, Dr. Dorothy Hodgkin dealing with chemical problems, Prof. G. V. Raynor with problems of the metallic state and Sir Lawrence Bragg with the application of X-rays to protein structure.

Dr. Hodgkin dealt mainly with recent developments in the analysis of organic structures and

* See "Forty Years of X-ray Diffraction", by Prof. J. M. Bijvoet, Prof. J. D. Bernal, Prof. A. L. Patterson and Sir Lawrence Bragg (*Nature*, **169**, 949; 1952).

described, among other things, the way in which it is now possible, in certain instances, to determine the positions of hydrogen atoms. She then traced the way in which our knowledge of stereochemistry has been increased by our ability to study the effects of such factors as the repulsive forces between non-bonded atoms in addition to those of the classically directed valencies. Finally, she referred to the analysis of such complex compounds as vitamin B_{12} and the problems set for the theoretical chemist by the molecular configurations recently found in substances such as the boron hydrides.

Prof. Raynor, after surveying the part played by the electron theory of metals in the development of our ideas of the metallic state, discussed Pauling's suggested valencies and described how, by making absolute measurements of X-ray scattering power, a check might be obtained on these. He added that such an attempt, recently made in Chicago, favoured, if anything, the conventional valencies. Other points dealt with by Prof. Raynor concerned the examination of the diffuse X-ray background, on one hand to determine the local distortions around dissolved atoms in alloys and, on the other, to measure the elastic constants of metals.

In the final talk of the conference, Sir Lawrence Bragg dealt with his recent work at Cambridge on hæmoglobins, carried out in collaboration with Dr. M. F. Perutz. He said that a systematic attempt is being made, based on an extensive series of intensity measurements of the diffraction by a hæmoglobin crystal at various stages of shrinkage, to see just how much could be discovered without making any structural assumptions; and he described a series of ingenious steps by which not only the size and shape of the protein molecule has been established, but from which also the distribution of scattering matter within the molecule is beginning to be understood. When it is realized that the volume of the molecule is 83,000 A.^{3} dry and 116,000 A.^{3} hydrated, the magnitude of this task will be appreciated; but Sir Lawrence gave every hope that, as he put it, we are now in sight of the promised land.

Space does not permit a detailed discussion of these or the previous papers, but a fuller report of the conference will appear in the *British Journal of Applied Physics*.

An account of the conference would be incomplete without a further reference to the dinner held on the evening of October 24, at which Prof. von Laue, replying to the toast of "X-ray Diffraction and the International Union of Crystallography", proposed by Sir Charles Darwin, made what is believed to be his first public speech in English. He began by referring to his early days in Strassburg and ended by hoping, as Röntgen had done before him, that, even if those younger workers present were not as lucky as he had been, they would derive as much enjoyment from their work as he had done from his. In a final gesture, he drank their health in a personal toast which was all the more appreciated for being so entirely and so obviously spontaneous.

In conclusion, a few words must be said about the historical exhibits at the Royal Institution which were shown during both days of the conference. Among other things on view were the original Bragg spectrometer, reproductions of Laue's original photographs, correspondence and note-books of the two Braggs, letters written by Barlow, Moseley and others, and even a (correct) model of rock salt constructed from balls of wool and knitting needles by Prof. Crum-Brown in Edinburgh in 1883. No one who attended the conference could fail to be impressed by the tremendous vitality of X-ray crystallography as well as by its versatility and power in application. He would indeed be a bold man who would guarantee what the next forty years of X-ray diffraction will bring forth.

J. THEWLIS

OBITUARIES

Dr. C. H. Kellaway, F.R.S.

CHARLES HALLILEY KELLAWAY, director-in-chief of the Wellcome Research Institution, London, died on December 13 at the age of sixty-three. He was born in Victoria, and was educated at Melbourne Church of England Grammar School. A brilliant student, always the head of his year, he graduated at Melbourne in 1911, and after holding house appointments at Melbourne Hospital, became resident medical tutor at Trinity College, Melbourne, and then acting professor of anatomy at the University of Adelaide. During the First World War he served as a regimental medical officer with the 13th Australian Infantry Battalion in the Middle East and won the M.C. At the end of the War he worked at the Lister Institute in London under Dr. H. H. (now Sir Henry) Dale for a short period, and then became acting professor of physiology at Adelaide for a short time. In 1920 he was in England again as a Foulerton Scholar of the Royal Society. He worked at the National Institute for Medical Research and at University College Hospital, London. He returned to Australia as director of the Walter and Eliza Hall Institute, Melbourne, in 1923. During the Second World War he was director of pathology for the Australian Medical Services and later scientific liaison officer with D.G.A.M.S. In 1944 he retired with the rank of brigadier and became director-in-chief of research to the Wellcome Foundation, Ltd.

Kellaway's main interest in scientific work was initiated by his collaboration with Dale on the mechanism of anaphylaxis, and through most of his work he returned to the problem of cell damage and the associated release of histamine and similar substances. He was a pharmacologist working in the field of experimental pathology. The Hall Institute was closely connected with the Melbourne Hospital, to which Kellaway was appointed specialist physician, and consequently most of his research there was related with practical medicine. He worked on hydatid antigens and intradermal tests in the diagnosis of hydatid disease, on renal infection and hypertrophy. He studied intensively the pharmacology of the venom of the numerous Australian colubrid snakes, including many not previously studied, and extended his researches to the venom of spiders, the bee and the duck-billed platypus. He produced antivenoms in horses to several of the larger Australian snakes and collected venom from the snakes himself. In the course of this work he was once bitten by a tiger snake. His life was probably saved by the injection of antivenom; but he nearly died from serum reaction. He was one of the world's leading authorities on snake venoms. He continued his work on anaphylaxis and the histamine problem; one of his last personal investigations was conducted with collaborators on the pharmacological action of the toxins of the *Clostridium welchii* group,