Acta Cryst. (1989). A45, 581-601

The International Union of Crystallography: Its Formation and Early Development

BY HARMKE KAMMINGA

Department of History and Philosophy of Science, King's College London, Chelsea Campus, Manresa Road, London SW3 6LX, England

(*Received* 21 *October* 1988; *accepted* 22 *March* 1989)

Contents

Introduction

In the final section of *Fifty Years of X-ray Diffraction*, Paul Ewald, the volume's editor, discussed the 'consolidation of the new crystallography', emphasizing the international collaboration among crystallographers which had helped greatly in achieving the consolidation of the subject (Ewald, 1962, Part VIII).

Since its admission to the International Council of Scientific Unions, the International Union of Crystallography has been instrumental in encouraging activities involving the crystallographic community worldwide. The formation of the Union itself was, in turn, inspired by pre-existing international links between crystallographers, which had already resulted in a number of important collaborative projects. The Union built on these traditions, especially with respect to its unique feature, that is, its very active publication programme.

The activities of the Union are well documented in the Reports of the Executive Committee and of the General Assemblies which have been published in *Acta Crystallographica* since its inception. Nevertheless, these reports do not record all the work that went on behind the scenes before particular proposals were offered or decisions made. In its office in Chester, the Union holds extensive archives pertaining to the origin and development of the Union. It also holds the personal papers of A. J. C. Wilson, whose involvement in Union activities spans more than 40 years. This article has been written on the basis of this archival material. In addition, use has been made of a number of published sources, notably material written by Paul P. Ewald and the contributions of M. J. Buerger, R. C. Evans, P. P. Ewald, D. McLachlan and D. P. Shoemaker in Section C of *Crystallography in North America*, published by the American Crystallographic Association under the editorship of D. McLachlan and J. P. Glusker in 1983. Last but not least, the article has benefited greatly from discussions with crystallographers who have played an active role in the Union, notably Dr Robert Evans, the Union's first General Secretary and one of its chief 'midwives'. His co-operation, patience and kindness have helped fill gaps, correct misapprehensions on my part and generally brought to life the excitement felt by the founders of the Union. Any remaining errors are, of course, my sole responsibility and the article presents my own interpretation of the documents put at my disposal.

The article does not present a complete history of the Union. For example, it does not begin to do justice to the vigorous activities of many of the Commissions. Nor does it cover the administrative reorganization undergone by the Union over the years. Instead it focuses on the prehistory, formation and early development of the Union, with special emphasis on its chief publication projects which have, after all, been the Union's foremost *raison d'être*.

Early international contacts

Informal international contacts were established almost immediately after the beginnings of X-ray

0108-7673/89/090581-21$03.00

structure analysis, through personal correspondence and visits to foreign laboratories, and although many of these contacts were suspended during World War I, they were not permanently disrupted.

The very first specialized X-ray diffraction meeting with international representation was an informal one and was held at Ewald's mother's house on the Ammersee, Germany, in 1925. Those present, besides Ewald himself, were W. L. Bragg, L. Brillouin, C. G. Darwin, P. J. W. Debye, A. D. Fokker, K. Herzfeld, R. W. James, M. von Laue, H. Mark, H. Ott, I. Waller and R. W. G. Wyckoff (see Bragg, Darwin & James, 1926). The growth of an international network of X-ray crystallographers, however, was stimulated especially through training and collaborative research and in this respect the schools of the Braggs played a central role:

> 'No description of international relations in Crystallography could overrate the influence of the two great British schools and centres of research, at the Royal Institution, and at the University of Manchester, both associated with the name of Bragg. Here students and scholars from all over the world received training and inspiration for crystallographic work; they made contacts among each other which wove them into a friendly international guild' (Ewald, 1944, p. 629).

It was Sir William Bragg who, after a meeting on crystal structure organized by the Faraday Society in London in 1929, convened a meeting of the many crystallographers then present in London which laid the foundations for more formal co-operation between crystallographers at an international level. At this meeting three committees were set up, to investigate, respectively, a co-ordinated abstracting scheme, the preparation of standardized space-group tables, and the standardization of crystallographic nomenclature. The reports of these committees were published in the *Zeitschrift für Kristallographie.* One of the major achievements of the committees was the publication, in 1935, of the *Internationale Tabellen zur Bestimmung von Kristallstrukturen* (*International Tables for the Determination of Crystal Structures*), prepared by C. Hermann (editor) together with 18 collaborators, and with W. H. Bragg and M. von Laue as honorary editors. We shall return to this subject later.

X-ray analysis groups and societies

At this stage, the community of X-ray crystallographers was not organized in autonomous societies, although in Germany the Deutsche Gesellschaft für technische Röntgenkunde organized annual meetings from 1929 onwards which dealt mostly with the analysis and testing of materials by means of X-ray diffraction techniques. In the USA, the American Society for X-ray and Electron Diffraction (ASXRED) was formed in 1941, after a preliminary meeting in 1940.* In the UK, the X-ray Analysis Group (XRAG) of the Institute of Physics was set up in 1943. The formation of specialized groups soon led to discussions about the desirability of founding an international body to represent crystallographers. In *Fifty Years of X-ray Diffraction*, Ewald wrote:

> 'In 1944 the yearly meeting of XRAG was held in Oxford, and Ewald, who then taught in Belfast, was invited to give the evening lecture. In it he gave a historical survey of some of the stages of X-ray crystallography and ended with a strong plea for the formation of an international society or union which would represent the new crystallography. This idea was followed up by the British crystallographers, and particularly by Sir Lawrence Bragg, the Chairman of XRAG. In June 1946, within a year of the termination of fighting, he arranged for an international meeting of crystallographers in London which was attended by some

* The Crystallographic Society of America (CSA) grew out of a local society in the area of Cambridge, Massachusetts, and did not acquire national status until 1946. The CSA and ASXRED merged in 1950 to form The American Crystallographic Association. (See Buerger, 1983, for further details.)

P. P. Ewald (left), President of the Provisional International Crystallographic Committee, and W. L. Bragg, first President of the International Union of Crystallography. (From the collection of R. A. Young.)

120 crystallographers from most of the allied countries.... The result was the decision to form an International Union ...'* (Ewald, 1962, p. 701).

He added that the interim committee set up at the 1946 conference to explore the possibility of setting up the Union was also charged with the preparations for publication, by the new Union, of an international journal of crystallography.

Ewald's lecture to XRAG was delivered on 31 March 1944 and was subsequently published in *Nature* (Ewald, 1944). The union he envisaged would be responsible for publishing an international journal of crystallography as well as abstracts, space-group tables and structure reports. The planning for an international union and that for an international journal of crystallography were certainly closely intertwined and the records suggest that the International Union of Crystallography was set up in the first instance to facilitate the running of a journal by the crystallographic community itself.

Ewald's plea for the formation of an international union did not immediately lead to action. According to crystallographers who were XRAG members at the time, the times were inauspicious for the formation of a truly international body. Communication between scientists from different countries was severely disrupted, many crystallographers were preoccupied with war work and full international cooperation was not only impossible in practice but, to many, emotionally unacceptable: an ideal for the future perhaps, but one that could not be pursued seriously in the Spring of 1944.

In October 1944, however, M. J. Buerger wrote to Henry Lipson, who was then Secretary of XRAG, that the Monograph Committee of ASXRED had been asked to explore the possibility of founding a journal for X-ray and electron diffraction. As a member of the Monograph Committee, Buerger wrote in the hope that XRAG would join ASXRED in this project and asked H. Lipson to discuss it with XRAG representatives. Following this request, and no doubt primed by Ewald's earlier proposal for a journal, XRAG set up a Publications Subcommittee which first met in April 1945.

Preparations for an international journal

By this time, the need for a general crystallographic journal was felt acutely. The *Zeitschrift für Kristallographie* had become the chief international journal for crystallographers subsequent to a decision, made by the editors and the publisher in 1927, to allow the publication of papers in English and French as well as in German. During World War II, however, the journal lost its international character and it closed down in 1944. (It resumed publication in 1955, but it has not regained its dominant status of the pre-war period which had meanwhile been taken over by *Acta Crystallographica.*) Clearly, there was a need for a crystallographic journal published on an international basis.

1. *Proposals and consultations*

The first meeting of the Publications Subcommittee of XRAG in April 1945 was attended by Sir Lawrence Bragg (Chairman), F. A. Bannister, J. D. Bernal, C. W. Bunn, P. P. Ewald, D. C. Hodgkin, W. H. Taylor and H. Lipson. The meeting report shows that there was a strong feeling that, if an American crystallographic journal was in preparation, then there should also be a British one, or preferably a joint publication. The Subcommittee favoured a journal with the same tradition as the *Zeitschrift*, except that it should not be owned privately: the interests of the crystallographic community should override those of a commercial publisher. Ewald felt particularly strongly about this point, in view of difficulties he had experienced as co-editor of the *Zeitschrift* with the journal's publishers, the Akademische Verlagsgesellschaft.

It was also felt that XRAG was too informal a group to take on responsibility for a journal and Ewald renewed his plea for a separate crystallographic society. Bernal, on the other hand, felt that there were too many scientific societies already and suggested that the Institute of Physics, the Physical Society and the Royal Society might be approached for support. In response to the proposal from ASXRED, it was felt that the scope of the journal should be defined, not by the method of investigation, but by the matter studied: the focus should be on solid or other matter of a periodic or imperfectly periodic fine structure. The journal should deal with 'leptology' (in Rinne's terminology) or 'atomic architecture', although neither term was regarded as entirely satisfactory. A circulation of about 1000 would be needed for the journal to be viable and it might start as a quarterly publication. [A brief account of the main points of these discussions was included in the XRAG Meeting Report written for *Nature* by Parker, Stokes & Wilson (1945).]

The contents of these discussions were communicated to the Americans and also to crystallographers in the USSR, who had independently begun to make plans for a replacement of the *Zeitschrift für Kristallographie.* In July 1945, W. A. Wooster reported to XRAG discussions he had had with Soviet crystallographers during a visit to Moscow. According to Wooster's report, the group headed by A. V. Shubnikov, Director of the Crystallographic Laboratory

* There are two errors in this passage: the meeting in London took place in July 1946 and it was attended by approximately 330 crystallographers. It was primarily an XRAG meeting, but enlarged by inviting 70 crystallographers from overseas.

of the USSR Academy of Sciences' Lomonosov Institute, wanted to see established an international journal of crystallography, in accordance with the Academy of Sciences' general policy of fostering international collaboration in science. They were considering three possibilities: (1) the USSR Academy of Sciences would publish a journal to be issued in triplicate, in Russian, English and French; (2) the format of the *Zeitschrift für Kristallographie* would be revived, so that papers in different languages would be published side by side; or (3) papers would be published to a particular format separately in the UK, USA, USSR and France and then distributed from each country to the others so that the entire collection could be bound in one volume. In all cases, the editorial board would be an international one. To resolve these questions, the Moscow crystallographers proposed that an international congress be held in London in June 1946 and that discussions about an international journal be top of the agenda. The substance of this proposal was also transmitted to ASXRED.

2. *Plans for meetings*

In October 1945, F. A. Bannister wrote on behalf of XRAG to Shubnikov in the USSR and to J. D. H. Donnay in the USA, proposing to hold preliminary discussions about the new journal in January or February 1946 and then to crystallize plans at a conference in London being arranged for July 1946. The proposal for preliminary discussions was rejected by Donnay on the grounds that US crystallographers would not be able to afford to go over to Europe twice in one year. The Publications Subcommittee of XRAG then decided, at its second meeting held in December 1945, that a preliminary meeting should be held with delegates from France, the Netherlands, Belgium and Sweden. Any proposals that were acceptable to all the Western Europeans could then be discussed with the American and Soviet crystallographers during the July conference in London.

At this meeting of the Subcommittee, it was also reported that the Institute of Physics was strongly in favour of an international journal based in London and was prepared to accept financial responsibility for it, either alone or together with other bodies. The preferences expressed by the Subcommittee were, in descending order: (1) an international journal based in London, the responsible authority being a union of bodies such as XRAG and ASXRED; (2) a tripartite journal co-ordinated by an international society; and (3) three separate journals published in the UK, USA and USSR, respectively, which would mean abandoning international collaboration.

The reports of the Publications Subcommittee were further discussed at an XRAG meeting in January 1946. Here Sir Lawrence Bragg also reported on correspondence with J. Wyart, C. Mauguin, P. P. Ewald and J. A. A. Ketelaar, who were all in favour of an international journal of broad scope. The following resolutions were adopted at the meeting: the group favours a single international journal (carried unanimously); and the centre of publication should be either in the UK or the USA (generally agreed). These resolutions were communicated to Donnay in the USA, to Mauguin and Wyart in France, Ketelaar in the Netherlands, H. Brasseur in Belgium, P. Niggli and M. Scherrer in Switzerland, A. Westgren in Sweden, V. M. Goldschmidt in Norway, R. W. James in South Africa and to the USSR Academy of Sciences in Moscow. The idea of a preliminary meeting of Western European crystallographers was abandoned.

The Subcommittee met once more before the July conference, in May 1946. It was decided that discussions about the new journal should take place on 12 and 13 July with delegates from the UK, USA, USSR, France, Czechoslovakia, Switzerland, Norway, Sweden, Germany, Belgium, Denmark, the Netherlands, Finland and India. The first duty of those taking part in the discussions would be to set up an international committee. It was also agreed unanimously that Robert Evans should be approached for the editorship of the new journal. Finally, the question of possible titles for the journal was discussed, but no agreement was reached. In response to a letter written by F. A. Bannister to all XRAG members, only two suggestions had been received: *Journal of Structure Analysis* (from W. T. Astbury) and *Journal of Leptology** (from Ewald). Further discussion of this subject was deferred until the July conference.

The birth of the Union

Thus far, discussions about the formation of an international union had been much in the background, but these came to the fore again at the meetings held after the scientific programme (9–11 July) of the 1946 conference in London. [For a personal account of this conference, see McLachlan (1983).] The conference was attended by some 330 crystallographers and by all accounts was an exhilarating occasion where friends and colleagues from different countries were reunited after the traumatic war years. The address at the conference dinner was given by Max von Laue, who was interned at Madingley, near Cambridge, at the time. The British authorities gave him permission to travel to London for the conference after having been approached on the matter by W. L. Bragg.

Those present at the conference agreed to the formation of a Provisional International Crystallographic Committee which was empowered to explore

* Ewald since discovered that the term 'leptology' has somewhat unfortunate etymological connotations (see Ewald, 1977).

the possibility of publishing an international journal and other publications of interest to the crystallographic community. Its members were H. Brasseur, J. Novák, A. T. Jensen, A. Guinier, J. Wyart, M. von Laue, W. T. Astbury, F. A. Bannister, J. D. Bernal, W. L. Bragg (joint Chairman), C. W. Bunn, R. C. Evans (Acting Secretary), P. P. Ewald, H. R. Lang (Institute of Physics representative), K. Lonsdale, W. H. Taylor, J. M. Bijvoet, J. A. A. Ketelaar, P. Terpstra, K. S. Krishnan, I. Oftedal, I. Waller, L. O. Brockway, M. J. Buerger, J. D. H. Donnay, I. Fankuchen, L. H. Germer, D. Harker (joint Chairman), D. McLachlan, R. W. G. Wyckoff and W. H. Zachariasen. Representatives from the USSR would be appointed after the delayed arrival of the Soviet delegation.

1. *The Provisional International Crystallographic Committee*

This committee met on 12 and 13 July 1946 for the previously planned journal discussions. A thorough survey was carried out as regards the potential number of subscribers in the countries that were represented, the expected number of submitted papers, editorial representation and preferred languages of

Photograph taken outside the Chemistry Department, University of Leeds, where a small symposium was held on 18–19 July 1948. Many of the crystallographers present had travelled up from the XRAG conference in London which led to the foundation of the International Union of Crystallography. (From the collection of D. W. J. Cruickshank.)

First row, left to right: G. W. Brindley (UK), W. F. de Jong (Nor), W. G. Burgers (Ned), Mrs A. M. B. Douglas (UK), G. V. Kurdyumov (USSR), D. Harker (USA), J. A. A. Ketelaar (Ned), J. Bénard (Fra), Mme A. R. Weill (Fra), I. Fankuchen (USA).

Second/third rows, left to right: Miss M. Astbury (UK), E. Grison (Fra), G. A. Jeffrey (UK), D. W. J. Cruickshank (UK), J. C. L. Favejee (Ned), J. S. Woldringh (Ned), Mlle C. Stora (Fra), Mme L. Walter-Levy (Fra), Unidentified, J. Thewlis (UK), R. W. G. Wyckoff (USA), Mme A. Kochanovska (Cze), P. Renaud (Fra), J. F. H. Custers (Ned), H. Brasseur (Bel), E. G. Cox (UK), M. Paic (Fra), G. W. R. Bartindale (UK).

Fourth/fifth rows, left to right: L. G. Sillen (Swe), A. T. Jensen (Den), I. W. Oftedal (Nor), B. Patnaik (UK), L. Morel-Klopstein (Fra), L. L. van Reijen (Ned), J. J. de Lange (Ned), I. MacArthur (UK), Mlle E. Stryk (Ned), I. B. Borovsky (USSR), G. E. Eichclz (UK), D. A. Cumming (UK), S. Konobeyevsky (USSR), Mlle C. H. MacGillavry (Ned), E. P. Wohlfarth (UK), W. Nowacki (Swi), J. Goodyear (UK), V. Petrzilka (Cze), S. C. Nyburg (UK), J. Novak (Cze), R. Tertian (Fra), D. McLachlan (USA), R. J. J. H. Gillot (UK), J. Ewles (UK). Those cited as UK include those working in the UK.

publication. Extensive discussions about the scope of the journal took place on the basis of detailed proposals submitted by Bernal, which were endorsed by the committee with some minor alterations. A ballot was held on the journal's title and *Structural Crystallography* came out as the clear favourite.

Bragg brought up the question of which parent organization should assume responsibility for the journal and mentioned the possibility, among others, of forming an international union to represent crystallographers. This suggestion received strong support from those present at the meeting. It was agreed unanimously to recommend the immediate formation of a separate International Union of Crystallography and Bragg was asked to explore the position in this matter.

The meetings of 12 and 13 July also resulted in the formation of three subcommittees: (1) the Journal Subcommittee, composed of Mauguin, Taylor, Harker, Shubnikov, Ketelaar, Buerger and Ewald, plus two other members as yet to be nominated; (2) the *Strukturbericht* Subcommittee, with Bernal, Ewald (Secretary), Wyart and Wyckoff as members; and (3) the *International Tables* Subcommittee, consisting of Buerger (Secretary), Hermann, Lonsdale, Nowacki, Patterson, Robertson and Wyart. It was the Journal Subcommittee that was given the subordinate responsibility of looking into the possible formation of an international union and it was arranged that this Subcommittee would meet again on 17 July.

The Soviet crystallographers had not arrived in time to take part in the above discussions, but immediately upon their arrival a special informal meeting was convened on 15 July. The Soviet delegates generally approved the recommendations made by the earlier meetings, but they wished to see the journal's title discussed afresh. They strongly favoured *Acta Crystallographica*, proposed by Shubnikov, and asked for the question to be re-opened at the meeting of the Journal Subcommittee on 17 July.

2. *The Journal Subcommittee*

This meeting was held at the Cavendish Laboratory in Cambridge and was attended by Wyart (representing Mauguin), Taylor, Bragg, Harker, Shubnikov, Ketelaar, Buerger, Ewald (Chairman), Evans (co-opted as Secretary) and, by special invitation, F. M. Stratton (representing the International Council of Scientific Unions, ICSU) and M. Srivin (interpreter). In view of the strong Soviet preference, *Acta Crystallographica* was now adopted as the title for the journal. The editorial structure of the journal was also discussed and it was decided that there would be an Advisory Board, an Editor, a Panel of Co-editors and a Technical Editor. Ewald was to be invited to be Editor and R. C. Evans, I. Fankuchen, A. V. Shubnikov and J. Wyart, plus a German crystallographer as yet to be nominated (which did not in fact happen), as Co-editors. For membership of the Advisory Board invitations would be issued to W. L. Bragg, V. M. Goldschmidt, A. Joffé, M. von Laue, C. Mauguin, P. Niggli and R. W. G. Wyckoff. No recommendation for the technical editorship could yet be made. It was agreed to recommend publication of papers in English, French, Russian and German, with abstracts in English for all papers. Ewald was to investigate publication arrangements with publishers and printers.

The ownership of the journal was still an open question and Stratton's presence at the meeting enabled serious discussion to get started about the possibility of founding an international union which would be responsible, among other things, for the publication of *Acta Crystallographica*. After the meetings of 12 and 13 July, Bragg had sounded out Stratton, a Cambridge astronomer whom he knew well, and had invited him, as Secretary General of ICSU, to explain the procedure of setting up an international union at the meeting on 17 July. Stratton was in favour of the formation of an International Union of Crystallography and undertook to defend the proposal at ICSU meetings. Ewald, who was then Secretary General of the International Union of Pure and Applied Physics (IUPAP), knew that the IUPAP was opposed to the formation of a separate crystallographic union. The crystallographic community felt, however, that its ties with chemistry, mineralogy and other fields were just as strong as those with physics, so that the IUPAP was not in a position to represent adequately the interests of all crystallographers. Stratton was sympathetic to this feeling and, besides, he was in favour of smaller unions, as he felt that they were generally more representative and more effective. At the meeting Stratton pointed out that there was no precedent for an international union publishing a journal, but that there were no rules against it.

In contrast to the substructure that was set up for the arrangements for the journal, no separate subcommittee was formed to see to the foundation of the Union. It was the Journal Subcommittee that took on this additional responsibility and, in consultation with Stratton, drew up the draft statutes and by-laws for the proposed International Union of Crystallography. These draft statutes were presented to, and approved by, the Provisional International Crystallographic Committee; the approved statutes were recorded in an interim report of the Journal Subcommittee in March 1947. In this report, the objects of the Union were formulated as follows: (1) to promote international co-operation in crystallography; (2) to promote international publication of crystallographic research and crystallographic works; (3) to facilitate standardization of methods and units in crystallography; and (4) to form the focus for the relation of crystallography to other sciences. A country would

adhere to the Union through a National Committee recognized by the General Assembly and each adhering country would pay an annual subscription to the Union.

3. *Affiliation to ICSU*

The Draft Statutes and By-Laws were submitted to ICSU and on 7 April 1947 the International Union of Crystallography was formally admitted to ICSU. This was an important event because UNESCO funds for scientific organizations were channelled exclusively through ICSU. Without membership of this body, the IUCr would not have obtained the substantial UNESCO support for its activities that the Union in fact received. The Union's early application and Stratton's support helped to ensure that its affiliation to ICSU proceeded so smoothly.

The admission of the Union to ICSU was recorded in the third report of the Journal Subcommittee, dated 4 June 1947. (The previous interim reports were concerned with the Journal Subcommittee meeting on 17 July 1946 and with the draft statutes and by-laws, respectively.) It was also announced here that the officers of the Union would be elected at its first General Assembly, to be held at some international meeting in 1948 or 1949. In the meantime, the Journal Subcommittee would act as the Union's interim Executive Committee, with Ewald as Chairman and Robert Evans as General Secretary. The Subcommittee reported to the Provisional International Crystallographic Committee which, in fact, never met again after July 1946.

The remainder of this Journal Subcommittee report was concerned with the forthcoming journal. Quotations for the production of the journal had been obtained from several publishers, the most attractive being those of Cambridge University Press* and the American Institute of Physics. The Subcommittee found it hard to decide between these two and proposed that both might be involved: Cambridge University Press might produce the journal while the American Institute of Physics might be asked to assume responsibility for journal distribution and collection of subscriptions in North America. Publication was expected to start in January 1948. (In fact, the first issue of *Acta Crystallographica* appeared in April 1948, the delay being due largely to an insufficient number of suitable manuscripts being available in time.) Finally, it was reported that the launching of the journal would require subsidies and that appeals for financial assistance had been sent to a number of scientific and industrial organizations (see below).

R. C. Evans, first General Secretary of the International Union of Crystallography and first Technical Editor as well as British Co-editor of *Acta Crystallographica*. (From the collection of R. C. Evans.)

The First General Assembly

On 15 July 1947, Elizabeth Armstrong Wood, Secretary of ASXRED, and William Parrish, Secretary of the Crystallographic Society of America (CSA), wrote to Robert Evans inviting the International Union of Crystallography to hold its first international congress in the United States during the summer of 1948. No specific location was proposed at this stage. The invitation was accepted and, in the event, the First General Assembly and Congress of the Union were held at Harvard University from 28 July to 3 August 1948. Here the formal inauguration of the International Union of Crystallography took place, in the presence of some 350 crystallographers from eleven nations, of whom 310 were officially registered as participants. Personal reminiscences of the meeting have since been written by Robert Evans (1983).

The principal business transacted at the sessions of the First General Assembly was reported in *Acta Crystallographica* in December 1948 (Vol. 1, pp. 340–343). The Statutes and By-Laws of the Union that

* The first discussions with Cambridge University Press about a new journal of crystallography took place as early as 7 November 1945. They were conducted by a representative of the Press and by Bragg and W. H. Taylor. The latter wrote a brief resumé which is in the Union's archives.

were adopted by the delegates had been published in an earlier issue of the same volume, on pp. 275–276. These were very similar to the Statutes and By-Laws adopted on 31 March 1947 (see p. 93 of the same volume), except for the deletion of a Finance Committee which had been proposed in 1947 to examine the Union's accounts and the budget estimates prepared by the Executive Committee.

Prior to the Congress, there had of course been discussion and correspondence about the selection of officers of the Union. In a letter to Ewald, written on 19 May 1948, Evans suggested that either Bragg or Ewald himself should be proposed as President. Any successor would most appropriately come from North America. (In the event, the Americans suggested Bijvoet from the Netherlands, who was elected President at the Second General Assembly in Stockholm in 1951. He was succeeded by Wyckoff in 1954.) Incidentally, Evans wrote in the same letter that he was not keen to be General Secretary, because *Acta Crystallographica* kept him fully occupied. Evidently he was persuaded to change his mind. Max von Laue was elected Honorary President of the Union, in recognition of 'his epoch-making experiment from which the modern development of crystallography has proceeded', following a suggestion made by Lindo Patterson on June 1948 in a letter addressed to Ewald and Evans. The first formally elected Executive Committee was composed as follows: Sir Lawrence Bragg (President); A. Westgren and R. W. G. Wyckoff (Vice-Presidents); R. C. Evans (General Secretary); P. P. Ewald (Editor of *Acta Crystallographica*); M. J. Buerger, A. L. Patterson and J. Wyart (ordinary members).

The General Assembly also established six Commissions, to continue the work of the Provisional Commissions and Temporary Commissions that had been set up before the Harvard meeting. They were the Commission on *Acta Crystallographica*, chaired by Ewald; the Commission on *Structure Reports*, chaired by A. J. C. Wilson; the Commission on *International Tables*, chaired by Kathleen Lonsdale; the Commission on Crystallographic Data, chaired by F. W. Matthews; the Commission on Crystallographic Apparatus, chaired by I. Fankuchen; and the Commission on Nomenclature, proposed by J. D. H. Donnay, members of which were to be nominated by the Adhering Bodies. At the time of the First General Assembly, adherence of four countries had been accepted: UK, USA, Canada and Norway (in chronological order).

It was furthermore decided that the Union would organize an International Congress and General Assembly every three years and that the 1951 Congress would be held somewhere on the Continent of Europe. Subsequently Hägg invited the Union to hold its Second General Assembly in Stockholm and this invitation was accepted. Later, at an Executive Committee meeting arranged during the Third General Assembly in Paris in July 1954, it was proposed that the IUCr should organize more specialized symposia between the assemblies. The first of these meetings was held in Madrid in 1956. Since then, specialized inter-Congress meetings have become a regular feature of the Union's activities. It might be mentioned at this point that, at the same Executive Committee in Paris, Evans suggested for the first time that the Union might consider appointing a full-time salaried Secretary, to ensure administrative continuity upon changes of officers. This suggestion was not taken further at the time and it was not until February 1969 that the Union appointed Dr J. N. King as its first Executive Secretary. He is, of course, still in this position.

The main task of the Union so far had been the establishment of *Acta Crystallographica*. Its launching in April 1948, less than two years after the decision to found the journal, was a major achievement, credit for which must go to the Provisional Commission on *Acta Crystallographica*, formerly the Journal Subcommittee of the Provisional International Crystallographic Committee. In particular, the role of Ewald and Evans deserves full recognition, and it ought to be mentioned that they were assisted actively by W. H. Taylor. They were responsible for preparing the specifications that were submitted to publishing firms in six different countries, for comparing the tenders received from these firms, for co-ordinating the activities of the Commission and the Editorial Board, for negotiating with the publishers and for shaping the editorial policy and format of *Acta*. With Ewald as Editor-in-Chief and Evans as Technical Editor and British Co-editor, the journal was off to an auspicious start.

Financial support

Acta Crystallographica could not have been launched without considerable financial support, however, and this matter had been discussed already at the meetings held in London in 1946, when the decision was taken to establish the Union and its programme of publications. It was recognized that financial support was necessary to ensure the success of the various publications of the Union and it was hoped that such support might be raised in roughly equal shares from British sources, American sources and UNESCO. It was agreed at the same time that the subscription price of *Acta Crystallographica* should be kept very low, at about $10, so that it might be readily available to individual research workers. Although this would involve publication at a loss, it was hoped that the deficit could be met from the proceeds of a financial appeal.

First Congress and General Assembly of the International Union of Crystallography, 28 July–3 August 1948. (From the collection of R. C. Evans.)

First row, left to right: C. C. Murdock, A. D. Booth, C. R. Berry, D. Wrinch, T. Richards, J. D. Bernal, N. W. Buerger, I. Fankuchen, B. Warren, H. Mark, C. V. Raman, M. J. Buerger, C. Frondel, A. L. Patterson, P. P. Ewald, R. C. Evans, W. H. Taylor, Mrs R. J. Bailly, R. J. Bailly, G. Hamburger, D. McLachlan Jr, D. C. Hodgkin, S. C. Abrahams, H. M. Powell, K. Lonsdale.

Second row, left to right: E. A. Wood, W. L. Roth, E. W. Hughes, R. L. Griffith, M. L. Huggins, B. W. Low, H. P. Rooksby, R. Brill, W. O. Statton, R. D. Burbank, H. T. Evans, L. W. Strock, G. Switzer, H. S. Kaufman, G. Goldschmidt, H. Lipson, A. N. Winchell, S. B. Levin, R. O. Jackel, E. Grison, A. Frueh, W. Parrish.

Third row, left to right: J. D. McCullough, H. P. Klug, W. H. Zachariasen, M. C. Bloom, R. Pepinsky, L. Pepinsky, D. Fankuchen, R. C. L. Mooney, L. E. Lynd, H. Sigurdson, A. de Brettville Jr, O. R. Trautz, C. B. Slawson, D. J. Fisher, D. McConnell, I. Weil, W. J. McCaughey, A. Van Valkenberg Jr, H. F. McMurdie, H. W. Rinn, A. W. Kenney, S. S. Sidhu, C. E. Black, K. N. Trueblood.

Fourth row, left to right: A. G. Brook, D. Ellis, D. A. Vaughan, O. N. Frey, L. Thomassen, L. H. Germer, A. M. Dowse, W. P. Mason, J. L. Abbott, C. G. Whinfrey, H. W. Dunn, H. W. Keilholtz, W. L. Kehl, M. E. Straumanis, R. A. Van Nordstrand, M. L. Fuller, W. F. Bradley, L. Alexander, E. J. Ritchie, L. Schulz, C. S. Barrett.

Fifth row, left to right: J. G. White, P. Raesz, J. T. Edsall, M. Semchyshen, E. S. Greiner, C. D. West, H. Ekstein, W. L. Bond, M. Collins, H. F. Beeghly, D. Sayre, B. C. Frazer, C. W. Wolfe, R. B. Ferguson, R. J. Arnott, L. G. Berry, D. F. Clifton, J. M. Cowley, H. S. Yoder, N. F. M. Henry, George Vaux.

Sixth row, left to right: S. Beatty, E. Kummer, M. E. Merchant, A. McIntosh, F. W. Matthews, M. A. Peacock, C. S. Hurlbut Jr, C Palache, W. H. Barnes, B. H. Billings, H. N. Campbell, A. H. Ehrhardt, A. E. Smith, H. M. Long Jr, W. J. Roberts, P. F. Eiland Jr, R. V. Gaines, A. F. Wells, F. A. Bannister.

Seventh row, left to right: G. L. Clark, R. W. G. Wyckoff, R. C. Taylor, H. Hughes, Z. W. Wilchinsky, J. W. Fitzwilliam, M. A. Bredig, C. G. Shull, A. C. Eckert, M. L. Jolley, M. L. Kronberg, G. Pish, J. H. Wilson, G. I. Faust, P. A. Bergmann, T. H. von Laue, M. E. Bergmann, B. M. Siegel, F. C. Brenner, S. H. Blank, R. S. Schwartz, R. Ward, A. J. C. Wilson.

1. *UNESCO support*

In February 1947, Ewald, as Chairman of the Journal Subcommittee, wrote to J. Needham at UNESCO, detailing plans for *Acta Crystallographica* and *Structure Reports* and submitting an application for subsidy from UNESCO for their publication. On the basis of projected production costs and income from subscriptions, it was calculated that *Acta* and *Structure Reports* would require support to the value of £5000 and £2750, respectively. Through ICSU, Ewald appealed to UNESCO to subsidize these publications for the next five years by contributing an annual sum of £2500 toward the total subsidy required. The following April, Sir Julian Huxley, the Director General of UNESCO, announced to Ewald the provisional allocation of a grant-in-aid of $8000 (approximately £2000) for 1947, for the purpose of publishing *Acta Crystallographica* and *Structure Reports*. (In 1948, authority was obtained to divert $2000 of this subsidy to meet the travel expenses of Union officers attending the Harvard Congress.)

2. *UK sources*

In April 1947, Sir Lawrence Bragg sent out an appeal to leading British firms and research organizations likely to be interested in the development of crystallography, hoping to obtain a guarantee of £2500 a year for five years. In this appeal, Bragg stated that for the majority of countries interested in crystallography, any contribution they might wish to make towards the total subsidy required would be made most appropriately through UNESCO. Two countries, however, stood in a special position: 'the United States of America as the country in which the journal will undoubtedly circulate most widely, and Great Britain as a leading centre of crystallographic research'. For this reason, these countries and UNESCO were each asked to assume responsibility for one-third of the required subsidy. In the UK, the Imperial Chemical Industries (ICI) and the British Iron and Steel Research Association had already promised annual sums of £500 and £250 for five years, respectively, on the understanding that other British organizations would play their part. Bragg ended his appeal as follows:

> 'Those concerns in whose work modern crystallography, in any of its many aspects, finds some application are therefore invited to give generous support to this venture. In doing this they will be advancing a science which touches their own interests very closely, and helping to ensure that the British contribution towards this international enterprise is worthy of the country in which the first crystal structures were elucidated and which ever since has maintained a leading role in crystallographic research.'

Bragg's approach met with considerable success: a year after the appeal was sent out the Union had received £2850 from British sources, of which £2400 was guaranteed annually for five years.

3. *US subsidies*

The results of appeals in the USA were less impressive. Certainly, the expenses of the Harvard Congress and the travel expenses of some foreign delegates were met by donations from American industrial and research organizations. There was, however, much less generous support for the Union's publication programme from these sources. In 1947, Buerger had approached firms in the USA for a total annual subsidy of £2500. By December 1947, he had received indications of probable support of approximately $2000, well short of the target. On 31 May 1948 Ewald wrote to Patterson (Chairman of the Provisional Executive Committee of the American Section of the International Union of Crystallography) about various points that were likely to arise at the sessions of the General Assembly in Harvard. Under the heading of 'subsidies', he wrote:

> 'The total USA subsidies received for the Union (for Acta and Structure Reports) have so far been £745 in non-recurring contributions, as against £2855 from British sources, £2400 of which have been definitely offered annually for 5 years if called for. This result shows either that X-Ray Crystallography is less recognised by American Industrialists as one of their important tools, or that the idea of the International Union of Crystallography and of its programme has not been sufficiently understood by them. I wonder whether the impending Assembly of the Union in Harvard would not offer a suitable occasion for a second, more general and urgent appeal to U. S. industry.'

In his letter of 21 June 1948, written in reply to several letters from Evans and Ewald, Patterson answered:

> 'With regard to subsidies, I realize that the support from the United States for the Acta has been very small as compared from that of British sources. This is due partly to the fact, which you have stated, that X-ray crystallography is less recognized by American industrialists than it is by British. It is also true, however, that until this year we had no formal organization to compare with your X-ray analysis group. All solicitations for funds were made by individuals on behalf of a not yet existent Union. It seems probable that with our present recognization [*sic*] by the National Research Council we may be able to do a good deal better in the future but it is difficult as yet to be sure. . . . X-ray Crystallography in this country has not had publicizers of the caliber of the Braggs, Bernal, Astbury, Lonsdale, etc. In fact we have had a number who have gotten us into considerable difficulties. We

hope, however, to be able as a result of the activities at the Congress and of ASXRED and CSA to put some of this straight.'

To the embarrassment of the US crystallographic community, the Union initially also encountered difficulties in obtaining the subscriptions due for US adherence to the IUCr. When the US became the second country to be accepted for adherence to the Union in April 1948, the National Research Council of the US National Academy of Sciences was the official adhering body. For the purpose of all dealings with the IUCr, the National Research Council had set up the Provisional Executive Committee of the American Section of the International Union of Crystallography, chaired by A. L. Patterson and composed of representatives from ASXRED, CSA and the Mineralogical Society of America. (This Committee was subsequently renamed the USA National Committee of Crystallography, USANCCr.) While this Committee supported the activities of the IUCr with great energy and enthusiasm, financial control rested with the National Research Council, which in turn depended on congressional approval of its budgets.

In 1950 the Secretary of State decreed that US adherence to the IUCr dated officially from 1 July 1949 and that dues would be paid from that date. The National Research Council then decided that it would pay the subscription for the first half of 1949, so that the US could adhere to the IUCr unofficially from January 1949. Due to the heavy financial commitments of the US Government in the post-war years, approval of the National Research Council's budget by Congress was delayed, as was the payment of dues to the IUCr. On this matter, Robert Evans wrote to Professor R. C. Gibbs of the National Research Council in September 1950:

'I am sorry that you are having so much trouble about arranging for the payment of the USA subscriptions, I very much hope the whole matter will be cleared up well in advance of the 1951 Congress to be held in Stockholm because, by our Statutes, any country which is in arrears for two years is deprived of its voting power. It would be absurd if this situation arose in respect of the USA.'

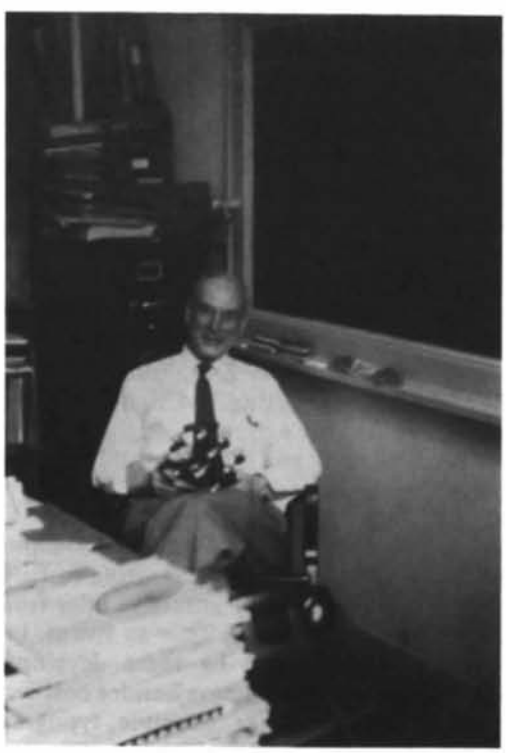
Fortunately this absurdity was avoided, although the US was again in arrears on its subscription for 1951, the dues being paid eventually in February 1952.

Meanwhile, in January 1951, Evans had appealed to Wyckoff, then Chairman of the USANCCr, for further support for the publication programme of the IUCr. As Evans pointed out, only about £900 had been contributed to this programme by US sources until then. The deficit on the publication of *Acta Crystallographica* for 1950 amounted to approximately £1500 and was expected to increase because the journal was expanding in size. Unless further support was forthcoming, the subscription to *Acta* would need to be raised substantially. Moreover, the price at which *Structure Reports* and *International Tables* could be sold might be considerably higher than anticipated. Wyckoff took up this appeal as a matter of urgency and in March 1951 could inform Evans that the USANCCr had authorized the transfer of $5000 to the IUCr to be devoted to the Union's publication programme at the discretion of the Executive Committee, with the exception of $2000 that was earmarked for *International Tables.* Furthermore, in July 1952 Wyckoff's successor as Chairman of the USANCCr, L. O. Brockway, announced that the National Research Council would send the IUCr $17 000 for its publication programme. This generous donation marked the end of the teething problems with respect to the relations between the US and the IUCr on the subject of finance.

The publication programme

1. *Acta Crystallographica*

From the very start, *Acta Crystallographica* has been the flagship of the IUCr as it became established as the foremost crystallographic journal almost immediately. Its very success with crystallographers, however, caused the Union serious difficulties in the early to mid 1950's. The influx of acceptable manuscripts rose so rapidly that in 1951 it was decided to



P. P. Ewald, founding Editor of *Acta Crystallographica.* (From the collection of R. A. Young.)

reduce the backlog of manuscripts, and the publication time, by increasing the number of issues *per annum* from six to eight.

Cambridge University Press, however, could not take on the printing of this extra material and arranged to have the additional issues printed, under their supervision, by a printing firm in Bristol. When this arrangement fell through, Cambridge University Press saw no other possibilities to have *Acta* printed in Britain and suggested that the whole journal should be transferred. Ewald then approached the Danish firm E. Munksgaard, which had sent an attractive offer in 1946. Both Ewald and Evans visited Munksgaard and were satisfied that a transfer of *Acta* to this firm would proceed smoothly. Ewald reported on the negotiations to the Executive Committee in September 1951 and, by mid-October, had received approval for the change of publishers from Bragg, Bernal and Patterson. The move was, however, opposed by Bijvoet, who had been elected President of the Union at the Second General Assembly in Stockholm earlier that year. He would have preferred a Dutch publisher, but the transfer to Munksgaard took place despite his opposition, taking effect in 1952.

The increase in the size of *Acta* was not accompanied by an increase in the subscription price and resulted in a sizeable deficit. The Union's publication programme was now in difficulty and, in the spring of 1953, it was decided to raise the subscription to \$25 (\$14 for individual subscribers). At the same time, Bijvoet appealed to the National Committees to seek further financial support from industrial and scientific organizations in their countries. Several positive responses were received, including generous donations from Dutch sources which had been approached by Bijvoet himself. During 1953, Bijvoet raised a total of Dfl 28 000 in the Netherlands, including a contribution of Dfl 15 000 from the Netherlands Organization for Pure Scientific Research (ZWO). This organization, however, earmarked its donation for *Structure Reports*, which were published for the Union by Oosthoek in Utrecht. The ZWO indicated that *Acta* ought to be self-supporting and that its publication costs seemed to be extremely high. This verdict encouraged Bijvoet, and other crystallographers in the Netherlands, to seek a change of publishers for *Acta*.

On his own initiative, Bijvoet asked Oosthoek to tender for *Acta* and in June 1953 wrote to Patterson that he had received a very attractive offer from this firm. He sent a copy of this letter to Evans, inviting his comments. Disturbed by these developments, Evans replied that other factors besides cost required careful consideration, for example typographical standard, editorial and administrative control, which had to rest with the Union, and contractual arrangements with Munksgaard. He added:

> '... and I must say that after the experience of changing the publisher once, I am not at all keen on the idea of undertaking all these negotiations once more. Nor do I think it would be good for the reputation of the journal if we keep changing our publisher.'

Ewald, having been informed by Evans, expressed similar worries, writing to Evans on 26 June 1953:

> 'All the [USANCCr] committee members considered the change of publisher a rather desperate step, and so do I. Continuity is *very* important in running a journal, and it aggravates a financially tough situation to introduce an element of uncertainty at a critical time.'

Bijvoet had meanwhile obtained another quotation, from the North-Holland Publishing Co. in Amsterdam and, to Evans's and Ewald's dismay, continued to press for a change of publisher. In view of the disagreement, the issue was discussed at the Third General Assembly in Paris in 1954, where it was decided that the possible savings that might be made by a change of publisher should be investigated further.

Matters came to a head at the next Executive Committee meeting, held in London in October 1954. Ewald could not attend. Under pressure from Donald Smits, the newly elected General Secretary, the Committee adopted a resolution approving the transfer to Oosthoek. Evans then informed Smits of his intention to resign as Technical Editor, although he was prepared to remain as British Co-editor. On 9 November 1954 Ewald wrote to Wyckoff, the Union's new President, that he also intended to resign, as Editor-in-Chief, during the course of 1955.

The next month Ewald sent a circular letter to the members of the Advisory Board of *Acta* and the Executive Committee with his comments on the recent events. With respect to the decision to change publishers, he wrote:

> 'I personally also resent this important decision to have been made against my advice, in my absence and by a group of IUCrist. who have - with one exception [G. Hägg] - not been at any of the previous meetings of the Executive Committee or have had personal experience in the running of Acta.'

As regards his and Evans's wish to resign under the circumstances, he concluded:

> 'The simultaneous change with the 1956 Volume of two of its main editors and of the publisher will disrupt the continuity of Acta to an extent as to present a grave threat to its standing and smooth further development. It can only be avoided by a reversal of the London decision and by taking more time for investigating the possibility of further financial improvements including the possibility of a change of publishers at a more opportune moment.'

Wyckoff, as President, did not wish this crisis to deepen and decided that any change of publisher should be delayed. In the light of this decision, Evans was persuaded to withdraw his resignation. Later, in September 1955, Ewald declared his willingness to stay on as Editor-in-Chief, after attempts to find a suitable successor had encountered severe difficulties. He did so on condition that his workload would be reduced by the appointment of two additional co-editors, one in Britain and one in the USA. By the end of the year, Henry Lipson and Eddie Hughes had, on being approached by Ewald, indicated their willingness to serve and their appointment was approved soon after. With this enlarged team, a more peaceful period set in.

In December 1957, Evans informed Ewald in confidence that he wished to resign as Technical Editor at the end of 1958. This decision came as a hard blow to Ewald, but he accepted that, after all his hard work and devotion, Evans deserved the opportunity to spend some time on other activities. Ewald himself felt that the time had come to relinquish the editorship of *Acta* by the end of the decade and informed Smits accordingly in January 1958. It was, of course, no easy matter to find worthy successors to either Evans or Ewald. Ewald thought that it might be advantageous for the Technical Editor to reside in the same country, or even the same place, as the publishers, as had been the case in the early years of *Acta*. He approached Tovborg Jensen, who felt unable to take on the task himself but made alternative suggestions. Ewald then approached R. W. Asmussen and in May 1958 Smits could report that the Executive Committee had approved Asmussen's appointment.

It took considerably longer to find a successor of stature to Ewald. Both Bijvoet and Wyart were invited, but they had too many other commitments to take on such a formidable task. Others were approached - unsuccessfully. In more than ten years as Editor-in-Chief, Ewald had firmly put his stamp on *Acta* and this factor in itself may have been somewhat intimidating. Eventually, Arthur Wilson agreed to accept the appointment, which was approved by the Executive Committee in May 1959. He subsequently edited *Acta* from 1960 to 1977, when he was succeeded by S. C. Abrahams.

Taking his leave at the end of 1959, Ewald sent a circular letter to all those involved in the editing of *Acta*, expressing his thanks for their unselfish devotion and welcoming Wilson as follows:

> 'I am happy to hand over to my successor A. J. C. Wilson a journal which to my belief is fundamentally sound and vigorous, and worthy of the labour he will have to devote to it. I am grateful to Prof. Wilson for having relinquished the Editorship of his own project, the Structure Reports, in favour of the Acta Cryst., and I feel certain that his well-proven devotion to the worldwide interests of crystallographers will not only keep and develop Acta as the international focus we wish it to be, but that the work will provide him with the reward and stimulus of satisfaction.'

2. *Structure Reports*

The second regular publication of the IUCr was the series of *Structure Reports*, which present abstracts of a highly informative type. They draw on a very wide range of primary journals published in many different languages. The reports give detailed and critical descriptions of structure determinations published in the year under review, extracting the structural information in each paper so thoroughly that little would be gained by consulting the paper itself. The reports do not confine themselves to X-ray investigations, but also include parameters of structural interest obtained by techniques such as electron diffraction, neutron diffraction and nuclear magnetic resonance. *Structure Reports* succeeded the *Strukturberichte* prepared on the initiative of Ewald, and as such built on a tradition of systematic collection of structural data that goes back to the early decades of X-ray crystallography.

When textbooks on the subject began to appear, all available structural information obtained by X-ray analysis was included; it was still practicable to do so, the results were of great interest and they demonstrated to outsiders the power of the new method. For example, Ewald's *Krystalle und Roentgenstrahlen*, published in 1923, summed up the state of the art at that time and included a 20-page list of all structures then known. [Similarly, Wyckoff's *The Structure of Crystals* (1924) included all structures which had then been determined, to the author's knowledge, and a complete bibliography of crystal-structure data.] Thinking that it would be a good idea to keep the list of structures up to date for a second edition of his book (which was in fact never written), Ewald started a card index to enter all newly solved structures he came across.

About this time, there was a very rapid increase in the number of published structure determinations, because of the expansion of the community using X-ray analysis as well as advances in theory, methods and instrumentation, and Ewald found that he needed assistance with his index of structures. Carl Hermann was appointed to this task in 1925, working with Ewald in Stuttgart. He was supported initially by a special fund associated with the Notgemeinschaft. After a few years Hermann's salary began to be paid by the publishers of the *Zeitschrift für Kristallographie* and, from 1928, the structure index, co-edited by Ewald and Hermann, was published regularly as a supplement to the *Zeitschrift* under the title of

Strukturbericht. Ewald left Germany in 1937 and Hermann was imprisoned by the Nazi regime throughout much of World War II. In consequence, publication of *Strukturbericht* ceased in 1941, the last volume to appear being Volume VII which contained structure determinations up to 1939.

Ewald felt strongly that the IUCr should take over responsibility for the publication of structural reports along the lines of *Strukturbericht* and a Commission on *Structure Reports* was set up formally for this purpose in 1948. Its Chairman was Arthur Wilson and under his general editorship ten volumes of *Structure Reports*, covering the years 1940–1954, were published. He was assisted by three section editors: initially C. S. Barrett (Metals), J. M. Bijvoet (Inorganic Compounds) and J. M. Robertson (Organic Compounds). In addition, each of the editors was helped by a great many crystallographers who scanned particular journals and translated or abstracted relevant material.

The task of catching up on structural data which had been published since 1940 was a formidable one and the Executive Committee appreciated that the great amount of work to be done could not be achieved quickly on goodwill alone. It was therefore decided to pay the editors honoraria, at least during the early stages of the project when the workload would be highest. Priority was given to the volume that was to cover structures published during 1947–1948 and it was anticipated that the material for this volume would be complete by the end of 1949. Preparation for the volumes covering 1949 and 1945–1946 was to be done in parallel, with target dates of completion of December 1950 and June 1951, respectively.

In fact, the targets proved over-optimistic and correspondence exchanged between Wilson and Evans during the summer of 1950 reveals the Executive Committee's concern about the delay in completion of the 1947–1948 volume and escalating costs of the project. The Executive Committee had counted on some return on sales during 1950; instead, the editorial honoraria exceeded the amount budgeted for and it was feared that the delay in publication would push up the price of the volumes and reduce sales.

Through the hard work of the editors, the volume covering 1947–1948 came out at the end of June 1951, published for the IUCr by Oosthoek in Utrecht. This was followed by the volumes for 1949, 1945–1946, 1950, 1942–1944 and 1940–1941. With the appearance of the last-mentioned volume in January 1957, the gap of the war years had been closed. Although not immediately self-supporting, *Structure Reports* sold well and established themselves as an important source of information for the practising crystallographer. The collective effort involved made *Structure Reports* a fitting project for the Union.

3. *International Tables*

Another major endeavour in which the IUCr has responded to the crystallographer's need for systematic information has been concerned with the tabulation of space groups. In taking on the responsibility for publishing *International Tables for X-ray Crystallography*, the Union provided an invaluable practical aid to crystallographers. In doing so, the Union again built on a pre-existing tradition.

The application of space-group theory, which was developed in the 1890s, to X-ray analysis of crystal structure was first treated by Paul Niggli in his *Geometrische Kristallographie des Diskontinuums* (1919). In this book are described the possible ways of repeating an object in space by symmetry operations such that the environment of each object is equivalent. Niggli aimed to turn abstract space-group theory into a practical tool for crystal structure analysis and he included tables of co-ordinates and missing reflections. Niggli's work was followed in 1922 by *The Analytical Expression of the Results of the Theory of Space Groups* by Ralph Wyckoff, who here presented the first complete tabulation of symmetry-related positions. Another version was presented by W. T. Astbury and K. Yardley (later Lonsdale, upon her marriage) in their 'Tabulated Data for the Examination of the 230 Space Groups by Homogeneous X-rays', published in the *Transactions of the Royal Society* in 1924.

A serious difficulty associated with these early presentations of space-group theory as applied to crystal-structure analysis was the lack of standard conventions as regards notation, nomenclature and pictorial representation. This was one of the problems discussed at the meeting of X-ray crystallographers organized by Sir William Bragg in London in 1929. As was mentioned earlier, a committee was set up here to address the question of standardization of crystallographic nomenclature and, through the work of this committee, the space-group designation worked out by Hermann and Mauguin came to be adopted as standard.

Initiatives taken at this meeting in 1929 also led to the preparation of standard crystallographic tables. Ewald and Bernal were instrumental in setting up this project, plans for which were consolidated at a meeting held in Zürich in the summer of 1930. Among those present were Astbury, Bernal, Ewald, Hermann, Kathleen Lonsdale, Mauguin, Niggli and Wyckoff. The eventual outcome of this meeting was the publication, in 1935, of the two volumes of the *Internationale Tabellen zur Bestimmung von Kristallstrukturen*, under the editorship of C. Hermann. Both Ewald (1962, p. 700) and Bernal (1963; in his biography of Astbury) have recounted that Niggli regarded the planned *Tables* as essentially a revised version of his earlier book and felt that his work was being appropriated

illegitimately. Clearly, much of the work that went into the *Internationale Tabellen* drew on contributions other than Niggli's, for example on the mathematical work of Astbury and Yardley. Bernal credits Astbury with having persuaded Niggli to adopt a more reasonable stand. The *Internationale Tabellen* represent the first major publication in the history of X-ray crystallography which involved active collaboration on an international scale. Their authority and value for the crystallographic community also greatly encouraged standardization, especially as regards the acceptance of the Hermann–Mauguin notation. This is not to say, of course, that disagreements about nomenclature and notation have ceased; editors of later editions of the *Tables* have found all too acutely that such debate continues forever.

When the formation of the IUCr was being planned, the original edition of the *Internationale Tabellen* was out of print and it was decided that the preparation of a revised and enlarged edition of the *Tables* would be an eminently suitable project for the Union. A Subcommittee was established at the London meeting in 1946 to draw up detailed proposals for this project, composed of Buerger, Hermann, Lonsdale, Nowacki, Patterson, Robertson and Wyart; they were later joined by Zhdanov.

In a report written in 1947, Lonsdale, Patterson and Buerger suggested that the *Tables* should appear in three volumes; one presenting space-group theory; one presenting mathematical tables; and a third one with physical and crystallographic tables. They also proposed that there should be an editorial committee under the general direction of Kathleen Lonsdale and that N. M. F. Henry, A. L. Patterson and G. Hägg should be invited to act as editors for Volumes I, II and III, respectively. Buerger would act as editor at large.

Kathleen Lonsdale, General Editor of the first edition of the *International Tables for X-ray Crystallography*. (From the collection of S. C. Abrahams.)

The general substance of these proposals was accepted when the IUCr was formed officially and decided to go ahead with the *International Tables*. There were, however, some changes in the editorial structure. Hägg declined the invitation to edit Volume III and in 1948 Caroline MacGillavry was appointed in his place. In 1952 she was joined, at her suggestion, by G. D. Rieck. In 1949 Patterson resigned as editor of Volume II because of pressure of work and Lonsdale and J. S. Kasper took over editorial responsibility for this volume. Lonsdale also joined Henry on Volume I.

It transpires from a report written by Ewald for the Executive Committee in 1949 that Niggli was upset about being left out of the preparation of the new edition of the *Tables*. Niggli still felt that he had received insufficient credit for his pioneering work with respect to the tabulation of space groups for X-ray crystallography. Ewald visited Niggli in Zürich in May 1949 in an attempt to placate him. His report states:

> 'I defended the idea of handing over the second edition to a group of people who have really used them for practical purposes not only for theoretical speculation.'

While this approach was perhaps not entirely tactful, Ewald reported that the visit ended with Niggli being much less formal and more friendly. Whether Niggli was completely reconciled, however, Ewald did not say.

Tenders for the publication of the *Tables* were obtained from four publishers, in the UK, Denmark and Sweden, and that of the Kynoch Press in Birmingham was accepted. The original *Internationale Tabellen* had been published by Bornträger and the IUCr went to some trouble to contact representatives of this publisher to negotiate the use of a number of diagrams from the original edition. To the pleasant surprise of the Union, permission to reproduce this material was obtained quite freely.

The first volume of the *International Tables for X-ray Crystallography*, entitled *Symmetry Groups*, was published in October 1952. The other volumes, *Mathematical Tables* and *Physical and Chemical Tables* followed in 1959 and 1962, respectively. The contents of these volumes require no comment in a crystallographic journal, but special mention might be made of the superb historical introduction written by Max von Laue for the first volume. In addition, a very useful innovation was introduced: each volume contained a dictionary of terms in five languages (English, French, German, Russian and Spanish).

Lonsdale (1959) later commented on the many headaches these dictionaries had caused the editors. Indeed, the whole project was one of enormous proportions and required immense patience on the part of the editors, especially amidst ceaseless debates about nomenclature. Commenting on discussions about the print run of Volume I, Lonsdale wrote to Evans in January 1952:

> 'If we do sell all copies within the next ten years I would agree with Ewald that 4000 is too many, but as I have no intention whatever of revising this edition after 10 years, and I very much doubt whether you will get anyone else to do it, I think we had better cater for 20 years instead, and in that case 4000 is not too large.'*

No doubt the editors of the most recent edition of the *Tables* would echo this sentiment. On the other hand, the central place that the *Tables* occupy in the daily work of the crystallographer must have given the harrassed editors and their collaborators a sense of considerable satisfaction.

4. *Other publications*

The Union's publication programme is not, of course, confined to the major projects of *Acta Crystallographica*, *Structure Reports*, *International Tables* and, since 1968, the *Journal of Applied Crystallography*. The first book published for the Union was *Fifty Years of X-ray Diffraction*, the commemoration volume published in 1962 on the occasion of the 50th anniversary of von Laue's discovery of the diffraction of X-rays by crystals and of the first crystal structure determinations by W. H. and W. L. Bragg. Other material of historical importance has been published in the two volumes of *Early Papers on Diffraction of X-rays by Crystals*. The Union was also responsible for the publication of Caroline MacGillavry's *Symmetry Aspects of M. C. Escher's Periodic Drawings*, presenting a most imaginative illustration of the principles of symmetry, including colour symmetry. In co-operation with the Crystallographic Data Centre in Cambridge, the Union took on the publication of the series *Molecular Structures and Dimensions*, which became a standard reference work until it ceased publication. In addition there have been numerous incidental publications and bibliographies as well as several editions of the *World Directory of Crystallographers*. The publication programme is certainly a fitting tribute to all those who worked so hard to fulfil Ewald's dream of a publishing Union which would always put the interests of the crystallographic community first.

* The initial print run of Volume I was 4000, but there were revised reprints in 1965, 1969 and 1977. A total of 9501 copies were sold before this volume was replaced in 1983 by Volume A of the new completely revised edition of *International Tables for Crystallography*.

Adhering Bodies

As was mentioned earlier, four countries had been accepted for adherence to the IUCr by the time the First General Assembly took place in July 1948. In February of that year, Evans had written to scientific organizations in 43 countries informing them of the formation of the Union, expressing the hope that their countries would wish to adhere and inviting them to send representatives to the Harvard Congress. He sent a follow-up letter, together with the minutes of the proceedings of the First General Assembly, in September 1948. By the end of the year the number of adhering countries had grown to eight and the international consolidation of the Union continued steadily over the next few years. Briefly, the UK was admitted in 1947, followed by the USA, Canada, Norway, Czechoslovakia, the Netherlands, Australia and France in 1948; Spain, India, Belgium and Switzerland in 1949; and by South Africa, Japan and Denmark in 1950. By 1954, the Union had also been joined by Austria, Brazil, Chile, the Federal Republic of Germany, Italy, Sweden and the USSR and its international status was firmly established.

A simple list, however, does not reveal the misunderstandings, bureaucratic problems and political factors that were occasionally at work in the background. We have already noted, for example, that the US Secretary of State decreed for financial reasons that the USA should adhere to the IUCr officially from July 1949, although this country had been admitted formally to the Union by its Interim Executive Committee already in April 1948. In the case of the UK, there was a brief spell of concern on Ewald's part that an embarrassing breach of procedure might have been committed. As a member of the British National Committee on Physics, he received a Royal Society circular which revealed that this body, in its role of National Academy of Sciences for Great Britain, is the adhering organization for the country to all International Unions and acts as the parent body of all National Committees. Worried that the British crystallographers had bypassed the Royal Society in their involvement with the IUCr, Ewald wrote to Bragg about this 'delicate' matter in May 1947, sending a copy of his letter to Evans. In fact, towards the end of April, Stratton had contacted Evans to suggest that he and Bragg should write to the Royal Society to explain that the IUCr had been accepted by ICSU and to ask them to appoint a National Committee on Crystallography. Hence, Evans could reassure Ewald that a letter was being sent under Bragg's signature, formally inviting the Royal Society to appoint a National Committee, 'at the same time, of course, suggesting that the appropriate committee would be XRAG'. Bragg's letter was sent on 9 May 1947; exactly five months later the

At the Harvard Congress, from left to right: J. D. Bernal, C. V. Raman, C. Palache, P. P. Ewald and A. L. Patterson. (From the collection of C. Frondel; AIP Niels Bohr Library.)

Council of the Royal Society met and agreed to adhere to the IUCr.

1. *Bureaucratic obstacles*

According to the Statutes of the IUCr, the Adhering Body in each country, whether it be a National Academy, a National Research Council, a Scientific Society or a similar institution, should form a National Committee of Crystallography to represent it in the Union. The membership of such a committee needed to be reported to and recognized by the General Assembly for adherence to be ratified. This statutory requirement, on the face of it fairly straightforward, was not always met immediately. In the case of India in particular, the bureaucratic obstacles seem to have been formidable, the delay between admission to the IUCr and the formation of a National Committee of Crystallography being no less than 14 years.

In March 1949 Evans received a letter from the External Department of the Indian High Commission in London which stated that the Government of India had decided to join the IUCr in Group I. Evans replied immediately, asking for the names of members of the National Committee of Crystallography and in particular that of the Committee's Secretary, so that Union reports and circulars might be sent to the appropriate person. Two months later Evans was informed that no National Committee had been formed, but that the functions of such a committee were being fulfilled by the Department of Scientific Research of the Government of India. For the time being this arrangement was accepted by the Executive Committee of the Union, perhaps with some understanding of the organizational difficulties that India faced so soon after gaining independence.

Seven years later, however, the matter was taken up again, by Donald Smits who had succeeded Evans as General Secretary of the Union in 1954. At the request of the Executive Committee, Smits wrote to the Indian Ministry of Natural Resources and Scientific Research in May 1956 to ask for the membership of the National Committee, referring to the Union's Statutes. (In fact, Smits had to send similar requests to Czechoslovakia and the USSR.) In reply, the Senior Scientific Officer informed him that the Ministry acted as the adhering organization to the International Unions. Smits persisted, exchanging many letters with the Ministry and the Departments which succeeded it as the Adhering Body following government reorganizations, and also with Indian crystallographers. It took many years, however, for these efforts to bear fruit: not until 1963 did the Indian Ministry of Scientific and Cultural Affairs form a National Committee for Crystallography, chaired by G. N. Ramachandran.

2. *Political impacts*

No international organization, regardless of its ideals, can avoid altogether problems of a political nature. To be sure, the IUCr has always vigorously supported the aims of international collaboration in science and free circulation of scientists. Already very early in its history it had occasion to speak out on this matter when Jean Wyart, one of the Union's officers, was refused a US visa by the American Consul in Paris and could not, therefore, attend the 1948 Congress at Harvard University. The IUCr took up the matter with the National Research Council and the US Government, but the reason for the refusal was never revealed to the Union. This case caused the US crystallographic community considerable embarrassment which, many years later, led the US National Committee to propose Canada, rather than the USA, as the preferred North American venue for the Fourth General Assembly in 1957 (see Evans, 1983). The Assembly was held in Montreal, with financial and organizational support from both the US and the Canadian National Committees. The Union did not meet again in the USA until 1969, when the Eighth General Assembly was held in Stony Brook, New York.

Ever since this early experience, the IUCr has actively sought assurance that visa applications from *bona fide* scientists would be honoured by any country where meetings organized or supported by the IUCr were to be held. Another unexpected absence at the Harvard Congress was that of the Soviet delegation. Although the records do not show why or where the problems about Soviet participation arose, it does not seem wildly speculative to suggest some connection with the cold war climate of the period.

The political realities of the world have also had their impact with respect to adherence to the IUCr. For example, for many years the People's Republic of China wished to adhere, but only on condition that the Union would never admit Taiwan. The IUCr resisted such demands and when the People's Republic eventually joined in 1978, it was admitted to the IUCr on the stipulation that this act would not prejudice the future admission of any other country.

Much earlier, the Union had to face up to the political sensitivities of the early post-war years, especially with respect to the adherence of Germany. There do not appear to have been any special problems in the case of Japan, which formed a National Committee for Crystallography in 1949 and then applied for affiliation to the IUCr. When Japan was admitted in February 1950, this was the first time since World War II that the country was formally granted membership of an International Union of learned societies. The President of the Science Council of Japan, Professor N. Kameyama, wrote to Evans:

> 'The recent approval of our application for joining in the International Union of Crystallography has brought us rejoicing beyond expression. It was a great delight not only for our crystallographers but also for our scholars in general.'

The Secretary of the National Committee for Crystallography, T. Ito, wrote in similar vein and added that the news of Japan's membership of the IUCr had been reported by the press throughout the country.

3. *The two Germanies*

The adherence of Germany was a much more complex matter. Already in 1947, there was an exchange of letters about this question between Evans, Stratton and Ronald Fraser (Administrative Secretary of ICSU) and there had clearly also been discussions with Ewald. At the time, the consensus was that the issue was too sensitive and that it would be best to maintain contact with the German crystallographic community through individuals only. In 1950 Evans raised the matter again with Fraser, writing that quite a few German crystallographers were planning to attend the Second International Congress at Stockholm in 1951 and asking for advice about inviting Germany to join the IUCr. Fraser replied:

> 'I would urge you most strongly that you take no initiative on the adherence of Germany to your Union until it has been accepted by ICSU.'

When the German Federal Republic was formally admitted to ICSU in October 1952, with the Deutsche Forschungsgemeinschaft as the recognized adhering agency, Evans wrote to the Deutsche Mineralogische Gesellschaft (DMG) to suggest that they seek sponsorship from the official adhering agency for an application for adherence to the IUCr. The formalities were complete by February 1953 and the German Federal Republic became the twentieth Adhering Body of the IUCr.

A very complex situation arose with respect to adherence of the German Democratic Republic. In 1955, Smits received a request from H. O'Daniel, then Secretary of the National Committee for Crystallography in the Federal Republic of Germany (BRD), that this committee be regarded as representative of Germany as a whole and that the official representation of Germany in the IUCr be changed accordingly. After consultation with the Executive Committee, Smits informed O'Daniel that, without official confirmation from the German Democratic Republic (DDR), the IUCr did not feel it was in a position to decide if the DMG was recognized by crystallographers in the DDR as being also their representative.

The next year, the DDR independently applied for adherence to the IUCr, through the Deutsche Akademie der Wissenschaften in Berlin. The Vice-President of the Academy, H. Ertel, informed Smits of the proposed membership of a National Committee so that the application might be brought before the Fourth General Assembly in Montreal in 1957. However, in view of parallel initiatives of the DMG, the German crystallographers were asked at Montreal to find a means whereby they could achieve adequate representation through a single Adhering Body. Meanwhile, action on the application from the DDR was deferred.

As a result of this decision, the representatives from the Berlin Academy present in Montreal met with delegates to the General Assembly appointed by the DMG. They agreed in principle to joint adherence to the IUCr, pending further negotiations. In October 1958, G. Rienäcker reported to Smits that, now that amendments had been made to the By-laws of the DMG to ensure adequate representation of the DDR, the Presidium of the Deutsche Akademie der Wissenschaften had given its consent to a joint representation of both states of Germany by the DMG. Joint adherence was approved formally by the IUCr at its Fifth General Assembly in Cambridge in 1960.

The story does not end here, however. The marriage was not a happy one and encountered a severe crisis around the time of the Sixth International Congress and General Assembly held in Rome in 1963. At this time, permission to travel to NATO countries needed to be obtained by East Germans from the Allied Travel Office in Berlin. Relations between East and West were badly strained and the Allied Travel Office would only permit scientists from the DDR to travel to NATO countries on condition that they agreed to represent Germany, not the DDR, which was not then recognized as an independent state by NATO. This condition was unacceptable to the East German crystallographers, or at least to a number of influential ones, and in the end there was no delegation from the DDR at Rome. There were many misunderstandings which contributed to this situation and there appears to have been insufficient communication between the East and West German members of the German National Committee. Certainly there was a feeling among the DDR crystallographers that the DMG had failed to act in their interest.

As a result, the East Germans wished to withdraw from the joint Adhering Body and in March 1964 the DDR members resigned from the National Committee and announced that they could not accept re-election. Rienäcker applied formally for separate representation in the IUCr, but because the Executive Committee felt unable to consider a unilateral request, it took much trouble to set the *de facto* separation on a legal footing. As a matter of fact, the DMG informed Smits that it did not support the request for separation and stated its intention to maintain an acting National Committee for the two Germanies and to send delegates to the Seventh General Assembly in Moscow in 1966.

In November 1965, Kathleen Lonsdale and Donald Smits travelled to Berlin to discuss the situation with crystallographers in both East and West Berlin. (Lonsdale had taken on the duties of acting President of the IUCr during the severe illness of J. D. Bernal, who had been elected President in 1963.) In East

Berlin they met Rienäcker, Neels and a jurist charged with affairs concerned with ICSU. It was pointed out that the Deutsche Akademie der Wissenschaften was already a separate member of ICSU and the official adhering agency of six international scientific Unions. Separate adherence to the IUCr would make it possible to insist that foreign travel must be facilitated in order for DDR crystallographers to be able to fulfil their official duties as members of the Union. In addition, it would make it easier to obtain financial assistance from the DDR Ministry for Financial Affairs for delegates and other crystallographers to attend congresses.

It was also made clear that, if separate membership was not granted by the General Assembly in Moscow, the joint representation would not be reassumed. It would mean that the DDR would no longer be a member of the IUCr, although informal contacts with the Union would be maintained and unofficial delegations would continue to attend IUCr Congresses.

After further negotiations, a compromise was reached at the General Assembly in Moscow whereby the Crystallographic Society in the DDR and the Mineralogical Society (DMG) in the BRD, represented by a joint Regional Committee, were admitted to the IUCr. But this arrangement was short lived. In June 1968, H. Neels announced that the DDR wished to withdraw from the joint Adhering Body and to apply for separate membership of the IUCr through the recently established Deutsche Vereinigung für Kristallographie. He wrote that the DDR crystallographers did not feel that the joint form of membership took into account adequately 'the independent activities in the field of crystallography and the different political and economic development in the two German states'. The Executive Committee accepted the withdrawal of the DDR and, at the Eighth General Assembly in Stony Brook, approved the separate adherence of the DDR to the IUCr. With this acceptance, the political issues which had been at the root of the difficulties receded into the background and scientific activities could now become the primary focus for the relations between the Union and the German Democratic Republic.

A small union in ICSU

Fortunately, such problems about adherence have been rare in the history of the Union and by now the IUCr represents the vast majority of crystallographers worldwide. In some of the adhering countries, the crystallographic community is too small to set up effective scientific societies locally and in these cases representation in an international union concerned specifically with crystallography is all the more valuable. Indeed, this factor was emphasized when the formation of the IUCr was proposed to ICSU and again when moves were afoot within ICSU to bring the administration of smaller unions under the umbrella of some larger grouping.

In the late 1940's and early 1950's ICSU received many applications for membership from smaller scientific unions (in order to qualify for UNESCO funds) and there was a feeling within ICSU that such proliferation should be discouraged. As a result, several proposals were brought before ICSU for a closer association of unions in related fields, for example in some federal structure. Whenever such suggestions were made, it was proposed that the IUCr should be included in the category of the mathematical and physical sciences. The Executive Committee always put up a well argued case against such proposals and defended the autonomy of the Union successfully.

The first time the IUCr came up against the threat of engulfment was only two years after its formal inauguration at the Harvard General Assembly. In July 1950, Bragg received a letter from Stratton to say that the forces of those opposed to small unions in ICSU were gathering together and to suggest that a letter from Bragg about the achievements of the IUCr would be useful. Bragg asked Evans to draw up his version of what the Union had done, to make sure that nothing would be left out. In reply, Evans singled out as the main activities of the Union the publication of *Acta Crystallographica*, *Structure Reports* and *International Tables* and the organization of triennial congresses. He also mentioned the Union's co-operation with ICSU on physics abstracting and with the American Society for Testing and Materials in the preparation of the Powder Diffraction Index. He stressed the economical administration of the IUCr and noted some further points in favour of small unions. First, subjects such as crystallography would have a claim for association with several of the larger unions, for example the International Union of Pure and Applied Physics and the International Union of Pure and Applied Chemistry. Secondly, the organization on an international basis is more important for smaller subjects since in many countries the number of workers is too small to support vigorous local activity. And thirdly, small unions are conducted more efficiently, since less effort and money is required for their organization.

Building on these points, Bragg wrote a masterly letter to ICSU, most of which was included in a report of the meeting of ICSU's Policy Sub-committee held on 10 August 1950 in Paris. Bragg's contribution made a strong case for the autonomy of smaller unions. Although the crystallographic community represented by the IUCr has grown substantially since these early days and the administrative structure of the Union has changed considerably as a result, Bragg's words are still pertinent. It seems fitting, therefore, to conclude this article by quoting Bragg's jus-

tification of the independence of smaller unions, notably the IUCr:

'I would submit that the right criterion to apply is not that of "large" or "small", but that of "necessary" or "unnecessary", or perhaps, to put it in a better way, "efficient" or "inefficient". It is more important to look at the working of these Unions in a realistic way than to frame a tidy administrative scheme. For instance, I have always felt that those who direct the Union of Physics have a very difficult task; it embraces so wide a field that it is hard to get down to anything specific at meetings. I think it is fair to say that its existence has made very little impression on what is happening in physics in the countries adhering to the Union.

May I take just as an example the contrast presented by the Union of Crystallography, of which I am President? Since it was formed three years ago it has launched an international journal which is being extremely successful, it is producing the Structure Reports and the International Tables which will appear shortly, and it is cooperating in abstracting of papers and the preparation of an index of powder photographs. I think it is fair to say that all its money has been usefully applied in the direct interest of science, and that none has been dissipated on inessential activities such as frequent committee meetings and newsletters with long accounts of social functions and other minor events. The administration is economically conducted, as it has no paid secretary. Its efficiency is possible because the Union includes members with many common bonds of interest, with a clear-cut idea of what they want to do as international ventures, and above all people who know each other personally, so that friction and delay in making decisions are almost entirely eliminated. Where such a field exists I think that the creation of a Union is completely justified; money is saved by its being left to manage its own affairs and not being part of a larger body, since every penny is usefully employed.

I have expressed my opinion strongly, but I feel strongly that this is the realistic way to look at the matter. It seems to me that the right criterion to apply is not one of size but one of a clear-cut and definite need for the existence of the Union, the formation of which enables international schemes to be undertaken which would otherwise be impossible. I do not think a Union is necessary merely to organize conferences; there are other means of doing this. It is a necessary nucleus for sponsoring international schemes which are of mutual benefit to scientists in all countries. It would be easy to quote instances of the way in which some of the International Unions are performing exactly this function.

To sum up, my desire is that when the creation of a new Union is proposed, the criterion should not be whether it is large or small. It is worthwhile creating it if the Council is satisfied that useful work can be done by such a Union, which could not otherwise be done; and that it will be run by a body of enthusiastic and lively people more efficiently as a separate unit as regards finance and administration than as part of a larger Union, involving the complexities of administration leading to frustration and delay which are so provoking for energetic people.'

References

BERNAL, J. D. (1963). *Biogr. Mem. Fellows R. Soc.* **9**, 1-35.

BRAGG, W. L., DARWIN, C. G. & JAMES, R. W. (1926). *Philos. Mag.* **1**, 897-922.

BUERGER, M. J. (1983). In *Crystallography in North America*, edited by D. MCLACHLAN JR & J. P. GLUSKER, pp. 153-155. New York: American Crystallographic Association.

EVANS, R. C. (1983). In *Crystallography in North America*, edited by D. MCLACHLAN JR & J. P. GLUSKER, pp. 145-147. New York: American Crystallographic Association.

EWALD, P. P. (1944). *Nature (London)*, **154**, 628-631.

EWALD, P. P. (1962). Editor. *Fifty Years of X-ray Diffraction.* Utrecht: Oosthoek.

EWALD, P. P. (1977). *Acta Cryst.* A**33**, 1-3.

LONSDALE, K. (1959). *ICSU Rev.* **1**, 165-167.

MCLACHLAN, D. JR (1983). In *Crystallography in North America*, edited by D. MCLACHLAN & J. P. GLUSKER, pp. 140-144. New York: American Crystallographic Association.

MCLACHLAN, D. JR & GLUSKER, J. P. (1983). Editors. *Crystallography in North America.* New York: American Crystallographic Association.

PARKER, A. M. B., STOKES, A. R. & WILSON, A. J. C. (1945). *Nature (London)*, **155**, 643-649.