

THE IMPACT OF IMEBORON CONFERENCES ON THE DEVELOPMENT OF BORON CHEMISTRY

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Received April 28, 1997
Accepted May 5, 1997

Dedicated to Jaromir Plesek on the occasion of his 70th birthday, and in recognition of his outstanding contributions to borane and carbaborane cluster chemistry.

The idea of IMEBORON, a regular series of international meetings on boron chemistry was conceived in Czechoslovakia some 30 years ago and has had a profound and entirely beneficial effect on the development of boron chemistry. The nine conferences which have been held so far (in seven different countries) have nurtured a sense of coherence within the widely differing aspects of the subject and have been particularly important in fostering international respect and collaboration. The high quality of the papers presented, and the friendly atmosphere of the meetings was already firmly established at the first IMEBORON at Castle Liblice near Prague in 1971; this has done much to inspire young research workers, and to encourage their active participation.

Key words: Boranes; Carbaboranes; Clusters; IMEBORON; Organoboranes.

The many distinguished contributions to boron hydride chemistry by Czech scientists began in 1959/60 with work by Stan Hermanek and Jaromir Plesek, and by early 1961 their group had expanded to eight members. An early concern was the development of an efficient industrial route for the manufacture of decaborane but this rapidly expanded into a general study of the cluster chemistry of boranes and carbaboranes. Appropriate physical techniques for separation and characterization were also developed at that time and, before long, a steady stream of seminal papers was emerging from the group which ensured their international recognition. By 1967 Hermanek was canvassing the idea of an international family of boron chemists who could meet regularly to discuss their work and this was warmly welcomed by several groups in Russia.

A National Science Foundation visiting professorship to the U.S.A. for 12 months from October 1969 enabled Hermanek to discuss the matter further with nearly all the leading groups in that country and he received enthusiastic encouragement particularly from Bill Lipscomb at Harvard and Fred Hawthorne at UCLA who agreed to act as guarantors from the U.S.A. Several groups in England, France and Germany were also approached and were equally keen on the idea. Accordingly Hermanek, still overseas,

wrote back to Plesek suggesting that such a conference should be organized forthwith and Plesek, being the one in Czechoslovakia, agreed to accept the rôle of local organiser and Chairman of the Conference under the auspices of the Czechoslovak Academy of Sciences. It was, indeed, Jaromir Plesek who devised the name IMEBORON for the conference.

Such were the origins of the idea, but both Hermanek and Plesek have always stressed that the translation of the idea into an actual event within a period of less than 12 months was only achieved through the active support of the Director of the Inorganic Chemistry Institute, Jaroslav Skrivanek and the dedicated hard work of members of their team: Frantisek Mares, Antonin Petrina, Bohumil Stibr, Karel Base and Zbynek Janousek.

IMEBORON I. Castle Liblice near Prague, Czechoslovakia, 21–25 June, 1971

The isolated site of Castle Liblice coupled with the friendly atmosphere of the place were ideally suited for a small informal residential conference where participants could discuss their work relatively undistracted by outside influences, though a few managed to discover some interesting diversions. This ambience was particularly important because many of the participants had not previously met each other and there was time to become acquainted. Moreover, the programme had been planned to cover the whole range of boron chemistry including inorganic borane cluster compounds, carbaboranes, organoboranes, solid-state systems, physicochemical studies and industrial applications, so that each individual piece of work being discussed was relatively unfamiliar to many of the individual participants.

In all about 55 boron chemists attended and 35 papers were presented. The attendance of large contingents from both the U.S.S.R. and the U.S.A. was especially welcome and was a particularly valuable feature at the height of the cold war. Indeed, such was the success of this first international meeting of boron chemists in promoting personal contacts and interactions between groups in different countries and in providing a forum for discussing the most recent advances, that it was decided to continue with a series of such conferences on a regular basis. An international organizing committee was formed and Norman Greenwood offered to host the next meeting in the U.K. IMEBORON had thus been conceived and born, and had proved to be a vigorous and healthy infant.

IMEBORON II. Bodington Hall, The University of Leeds, England, 25–29 March, 1974

The great success of IMEBORON I ensured an enthusiastic response to the announcement of the Leeds Conference and this was further enhanced by official sponsorship of IMEBORON II by the International Union of Pure and Applied Chemistry

(IUPAC). This sponsorship continued for the next six IMEBORONs and was an important factor in ensuring both the scientific and organizational quality of the conferences and in guaranteeing the issuing of visas at a time when international travel and exchange between certain countries was otherwise not always unrestricted for scientists. In the event 115 persons attended from over a dozen countries. The abstracts of 88 papers were circulated and most (though not all) of these were presented at the meeting which was structured into eight consecutive sessions. In addition there were eight plenary lectures which were published shortly afterwards by IUPAC¹. The opening session was chaired by the doyen of British boron chemists, Professor Harry Emeleus², who (with Erich Pohland) had been the first person to isolate and characterize decaborane, B₁₀H₁₄, in Alfred Stock's Karlsruhe laboratory in 1927.

Notable features of IMEBORON II were the active and intensive interaction of all the participants in both the formal and informal sessions and periods, and also the wide spread of topics that were available to all. This is perhaps best illustrated by the broad range of the plenary lectures which covered¹: advances in the chemistry of boron hydrides (Riley Schaeffer); intermediate dicarba-*nido*-boranes (Stan Hermanek and Jaromir Plesek); metalloboron cage compounds derived from small carboranes (Russ Grimes); new chemistry of metallocarboranes and metalloboranes (Fred Hawthorne); homolytic reactions of organoboranes (Alwyn Davies); reactions of allylboranes with unsaturated compounds (B. M. Mikhailov); structural principals of refractory borides (V. I. Matkovich); and industrial applications of boron compounds (Ray Thompson). It was, though, the last time that the solid-state chemistry of boron and metal borides was considered in detail since this aspect was already developing its own separate series of conferences and this enabled IMEBORON to concentrate more fully on molecular and covalent boron chemistry.

IMEBORON III. Munich and Ettal, Germany, 5–9 July, 1976

The Gesellschaft Deutscher Chemiker's Commemoration of the 100th Anniversary of the birth of Alfred Stock formed an impressive start to IMEBORON III in the University of Munich. The President of GDCh, Professor Oskar Glemser, presented the Alfred Stock Memorial Medal to Heinz Noth who had also been instrumental in organizing IMEBORON III. By a happy coincidence it was also the 75th birthday year of Egon Wiberg, one of Stock's most distinguished research associates, and he gave a masterly plenary lecture on the life and work of Alfred Stock³. At the same time the University of Munich conferred the degree of Doctor of Science *honoris causa* on Bill Lipscomb who also gave a plenary lecture on the effect of orbital vacancies in boron compounds³.

After lunch the Conference moved to the mountain retreat of Ettal for the rest of the meeting and continued that same evening with Sheldon Shore's plenary lecture describing his systematic studies of the smaller boron hydrides. All nine plenary lectures,

including those of Wiberg and Lipscomb delivered in Munich, were published by IUPAC³.

The impetus and quality of the first two IMEBORONs was maintained: there were some 90 active participants from a dozen different countries, and over 50 papers were presented and discussed. Ettal was also the last IMEBORON at which it was possible to avoid parallel sessions. Thereafter, plenary and session lectures were held in common, but between these the programme was divided into Sessions A and B, reflecting the rapid expansion and specialization of the various aspects of boron chemistry.

IMEBORON IV. Salt Lake City and Snowbird, Utah, U.S.A., 8–13 July, 1979

This meeting was organized by Bob Parry and Goji Kodama. An informal evening reception was followed the next morning by the formal Opening Ceremony at the University of Utah in Salt Lake City, and by the two Conference Plenary Lectures. It is notable that these were by Bill Lipscomb (who was awarded the 1976 Nobel Prize for Chemistry three months after the Ettal meeting) and Herb Brown (who was to be awarded the 1979 Nobel Prize for Chemistry three months after this meeting). After lunch, following the Munich pattern, the conference transferred to the spectacular Rocky Mountains resort of Snowbird before reconvening that same evening for three Session Lectures.

There were over 120 registrants. The scientific programme comprised the two plenary lectures and 12 session lectures, which were published by IUPAC⁴, plus a further 64 section lectures. It was clear that the borane community had indeed become a truly international family as originally conceived by Hermanek and Plesek, and the regular family reunions at IMEBORON were proving to be an ideal way of keeping up with the progress and developments in boron chemistry.

Another delightful feature of Snowbird was the after-dinner speech by Anton Burg who reviewed, in his own inimitable way, his recollections of the pioneering days of boron hydride chemistry in America⁴. However, the most memorable event actually occurred at the very end of the Conference. The last scheduled talk was a session lecture by Bob Williams entitled "Non-classical" Carbocations – Isoelectronic and Isostructural Carbon Copies of Polyboranes; Conservation of Chemical Shift (see pp. 131–150 of ref.⁴). It was planned to follow this by discussion on the important issue of non-classical ions which had been the subject of considerable debate over several years between Herb Brown, George Olah, Saul Winstein and others. In the end, Herb Brown's committed presentation of his own position was so vigorous and prolonged that there was no time for discussion and debate. Indeed, the session over-ran to such an extent that transport arrangements to the airport for several departing attendees, including the Browns themselves, were severely disrupted. It was an enthralling experience. As a postscript it is a pleasure to note that George Olah was awarded the 1994 Nobel Prize for Chemistry for his contributions to carbocation chemistry.

IMEBORON V. University College, Swansea, Wales, 11–15 July, 1983

Andrew Pelter was chairman of the organizing committee for this conference which was held during a burst of superb summer weather at the delightful seaside campus at Swansea. There were 110 active participants from a record 15 different countries throughout the world. The five plenary lectures were published by IUPAC within a month of the meeting⁵ and, in addition, there were 14 invited session lectures and some 54 contributed papers. Professor B. M. Mikhailov of the Zelinskii Institute in Moscow was due to give his plenary lecture on the second morning but, at the last moment, was prevented from attending by a rather severe illness. In a virtuoso performance, Andrew Pelter prepared slides from the structures in Mikhailov's manuscript and gave a brilliant impromptu presentation his work on the fascinating chemistry of the exotic new compound 1-boraadamantane⁵.

IMEBORON VI. Bechyně Castle, Tabor, Czechoslovakia, 22–26 June, 1987

The return of IMEBORON to the country of its origin was arranged under the auspices of the Czechoslovak Academy of Sciences and was most successfully organised by a committee under the chairmanship of Bohumil (Bob) Stibr. Set in the deeply wooded countryside of southern Bohemia, the conference site again proved to be ideal for its purpose and over 100 participants were present from 14 countries. The successful pattern which had evolved during the previous meetings was adopted, the seven plenary and 24 invited session lectures being supplemented by the presentation of a further 36 contributed papers. The plenary lectures were published essentially contemporaneously by IUPAC⁶ and the session lectures were also rapidly published in book form⁷, thereby giving a broad, authoritative overview of the state of the subject as of mid 1987. This included a paper by Albert Soloway and his colleagues reviewing the development of boron compounds for use in neutron capture therapy of malignant brain tumors⁷ (see also below).

IMEBORON VII. Nicolaus Copernicus University, Torun, Poland, 30 July–3 August, 1990

Marek Zeidlewicz and his colleagues organized this highly successful meeting under the auspices of the University and the Polish Academy of Sciences. The seven plenary lectures and 17 session lectures were all published by IUPAC⁸ and illustrate the continuing broad scope of IMEBORON. Some 35 section lectures were presented orally and there were, in addition, 32 poster presentations. The biological and medical aspects of boron chemistry were strongly represented including a striking account of the clinical aspects of neutron capture therapy by Professor Hiroshi Hatanaka of Teikyo University Medical School, Japan⁸. A very useful and lively panel discussion which focused on

other practical and industrial applications of boron compounds was also scheduled. In all there were 110 participants from 12 countries.

IMEBORON VIII. Knoxville, Tennessee, U.S.A., 11–15 July, 1993

The University of Tennessee hosted this meeting which was organized by George Kabalka and his team. Once again IMEBORON lived up to its reputation of attracting hot weather and the air-conditioned accommodation was a welcome feature during the impressive heat wave which was blasting the eastern United States at the time. A record 170 participants from no fewer than 20 different countries attended, and their papers attested to the widely spreading interest in boron chemistry which was itself being so effectively fostered by the IMEBORON series. The pressure of papers meant that only the eight plenary lectures could be presented to the whole conference, whilst the 17 section lectures and the 48 contributed papers were presented to the separate “inorganic” and “organic” sessions. This separation was, however, ameliorated to some extent by the excellent contiguous siting of the various lecture halls and by the extensive mixing and interactions that occurred around the poster displays. Full accounts of virtually all the lectures presented were published in book form shortly after the conference⁹.

Further opportunities for informal discussions arose during the memorable evening riverboat cruise by paddle steamer down the Tennessee River and on the day trip to the Great Smoky Mountains National Park which included “a unique shopping experience in downtown Gatlinburg”.

IMEBORON IX. University of Heidelberg, Germany, 14–18 July, 1996

Walter Siebert undertook the organization of this meeting which proved to be a great success with several innovative features. To celebrate the 25th anniversary of the first IMEBORON the Opening Ceremony was graced by a unique performance of Beethoven's Gassenhauertrio by the IME-Trio (Bill Lipscomb, clarinet; Otmar Zwiebelhofer, cello; and Bernhard Maier, piano). Thereafter, the more familiar sequence of 10 plenary lectures and 24 session lectures was interspersed with the 44 contributed papers and an impressive array of posters. Virtually all the lectures have very recently appeared in book form¹⁰: over 200 participants attended from 14 different countries.

In another innovation, the International Advisory Committee for IMEBORON decided to inaugurate an ongoing series of awards to be presented to distinguished boron chemists at appropriate intervals. These awards will be named after their first recipients who were, in alphabetical order:

H. C. Brown for Organic Synthesis

M. F. Hawthorne for Polyhedral Borane Chemistry

W. N. Lipscomb for Structure and Bonding

H. Noth for Inorganic Synthesis

P. v. R. Schleyer for Computational Chemistry.

It is not intended to award each prize at each IMEBORON but to make an appropriate number of awards which will also take into account the age of the nominees, so as to encourage younger boron chemists and those in mid-career as well as to recognize the life-time achievements of more senior scientists in the field of boron chemistry. In a related exercise, certificates of merit were awarded for the five Posters that were selected as the best from what was a very strong field.

It is clear that IMEBORON is continuing to evolve and is continuing to provide a uniquely effective forum for boron chemists throughout the world to discuss and develop their subject. The input from Czech chemists during the whole of this period has been outstanding and the impetus given to the subject by the Chairman of the first IMEBORON has been incalculable.

It is a pleasure to acknowledge the help I have received from the organisers of former IMEBORON Conferences in assembling material for this paper.

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