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The History of Crystallography in Switzerland

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Abstract: A short review of the development of crystallography in Switzerland and of the Swiss Society for Crystallography is presented.

Keywords: Crystallography · History · SSCr (Swiss Society for Crystallography) · Switzerland

The Beginning: Crystallography in Zürich

Crystallography started in Zürich with the thesis 'Krystallogia seu Dissertatio de Crystallis', which J.H. Hottinger submitted in 1698 to the Collegium Carolinum, the predecessor of Zürich University. Systematic crystallographic research began in Switzerland in 1856, one year after the foundation of the polytechnical college, which later became the ETH Zürich. Crystallography research and teaching served not only the needs of ETH but also of Zürich University, which led to joint appointments of professors from the beginning to present times. The first professor, A. Kenngott, described the crystals of the alpine minerals with the classical methods of morphological crystallography. Under his successor, U. Grubenmann, the main activities at the 'Institut für Mineralogie und Petrographie' were in the field of petrography. After the move of the institute from the ETH main building to the 'Naturwissenschaften-Gebäude' on Sonneggstrasse in 1920 a very fruitful period for crystallography started in Zürich with P. Niggli (Fig. 1). His famous monograph 'Geometrische Kristallographie des Diskontinuums' was a fundamental contribution to struc-

tural crystallography and remained an important reference book until 1935, when the 'Internationale Tabellen' appeared, the later 'International Tables for X-Ray Crystallography', again with P. Niggli and E. Brandenberger from Zürich as co-authors [1].

Paul Niggli

26. Juni 1888 - 13. Januar 1953



Niggli

Furthermore, crystal chemistry and the application of group representation theory to problems of crystal physics were important fields of P. Niggli's crystallographic research. In order to appreciate the exceptional scientific significance of P. Niggli's work, it should be noted that his research and teaching activities were in fact divided rather equally between three main fields, not only crystallography, but petrography and mineralogy as well.

In 1959, under the leadership of F. Laves, the successor of P. Niggli, the institute was reorganized as the Institut für Kristallographie und Petrographie. The main research activities were crystallography of feldspars and metals, in particular their real structures in contrast to the idealized perfect crystal structure description. The 'Laves school' was very successful: 20 members of the institute became professors of crystallography, mainly in Germany. A second chair was created in 1961 and A. Niggli was appointed professor for crystal structure research. Investigations of zeolites and other microporous materials started with W.M. Meier in 1966 based on crystal structure analysis using powder diffraction. In his research division, one of the first computer-controlled powder diffractometers was built in 1973.

Crystal structure analysis as an important tool for chemical research attracted so much interest in the middle of the century that in 1957 the chemical laboratories of the ETH decided to create their own chemical crystallography group under the leadership of J. Dunitz. The first computer-controlled single crystal diffractometers in Switzerland were acquired by this group; the research interests covered many fields of organic chemical crystallography.

The cross-fertilization of crystallography and neighboring sciences in Zürich is illustrated also by the fact that Max von Laue was professor of theoretical physics at the University from 1912–1914. His predecessor was Pierre Debye. In 1920, he and Paul Scherrer became professors at ETH; they are best known to crystallographers for their develop-

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ment of the Debye-Scherrer camera for the investigation of powders.

Crystallography in Switzerland

Zürich remained the unique center of crystallography in Switzerland until 1949 when the Department of Crystallography and Structural Studies (Abteilung für Kristallographie und Strukturlehre) was founded at the University of Bern. The work of W. Nowacki covered the fields of packing studies and crystal structure determinations of sulfosalt minerals. In order to explore and investigate these minerals from the Binn valley in the neighboring canton of Wallis, a working group 'Lengenbach' was founded in 1958.

Crystallographic activities have been increasing since 1970 in the western part of Switzerland. In 1970 the first crystallographic laboratory in the French-speaking part of Switzerland was founded by E. Parthé. The main research field was inorganic structural chemistry. Only a few years later in 1973, the Institute of Crystallography at the University of Lausanne was founded with D. Schwarzenbach. Some examples of his wide research activities are electron density studies, disordered structures and fullerenes. The newly created Ecole Polytechnique Fédérale (EPFL) in Lausanne decided not to create its own crystallography department and to borrow from the University Institute any required crystallographic teaching and services.

In the same year another important area of Swiss crystallography was initiated. A Department of Structure Biology at the Biozentrum in Basel was founded with J.N. Jansonius as research group leader. The first protein structure solved in Switzerland, mitochondrial aspartate aminotransferase, was published in 1980. For many years Basel remained the main center of protein crystallography in Switzerland. The industrial companies founded their own research groups and it is therefore not surprising that the recently founded chairs in this field have strong connections to these industrial research groups. Crystal growth is also traditionally related with Swiss industry and to some extent with several solid-state physics laboratories. Some more details are mentioned in the section dealing with the Swiss Crystallographic Society.

Between 1979 and 1982 three new chairs were created: H.-B. Bürgi at the new Laboratory of Chemical and Mineralogical Crystallography in Bern replacing

the former 'Abteilung für Kristallographie und Strukturlehre', G. Chapuis at the Institute of Crystallography in Lausanne and K. Yvon in Geneva. The main research activities of these new groups are 'structure correlation' studies and analyses of the atomic displacement parameter information in Bern, modulated crystal structures in Lausanne, neutron scattering, materials (energy storage and superconductivity) and powder investigations in Geneva.

Female researchers play a remarkably important role in crystallography and correspondingly there are two very active groups under female leadership in Switzerland: the Laboratory of Chemical Crystallography in Neuchâtel with Helen Stoeckli-Evans and the Chemical Crystallography Laboratory of the University of Basel with Margareta Zehnder. The crystallography division of CIBA in Basel with Greti Rihs should also be mentioned in this context.

The increasing crystallographic activities in several parts of Switzerland were accompanied by a decrease in Zürich. The chair of F. Laves has remained vacant since 1973, the chairs of A. Niggli, J. Dunitz, and W.M. Meier since 1985, 1990, and 1992 respectively. Quite a number of chemical institutes have organized their own independent service crystallography divisions. With R. Nesper, a research group with pronounced crystallographic interests was founded at the Inorganic Chemistry Laboratory of the ETH. The worldwide explosion of biocrystallographic research did not influence the creation of new chairs in Switzerland until 1987 when T. Richmond became Professor for the X-Ray Crystallography of Biological Macromolecules at the ETH in Zürich. Ten more years passed until a similar development took place elsewhere in Switzerland: chairs of biological crystallography were created at the University of Zürich 1997 (M. Grütter), 1998 in Bern (U. Baumann) and 1999 at the Paul Scherrer Institute and the ETH (F. Winkler).

In 1993 W. Steurer accepted the position of joint (ETH and University Zürich) professor of crystallography, and a new 'Laboratorium für Kristallographie' was founded. His main research fields are quasicrystals, their structure analysis and description and the interpretation of both Bragg and diffuse scattering. Further activities of the new Laboratorium are *ab initio* structural studies based on powder diffraction, crystal physics, magnetic structures and a crystal structure determination service. Furthermore a high-pres-

sure crystallography group with M. Kunz started at ETH in 1996. The traditional leadership of the Zürich crystallography in the German speaking area was resumed as shown by a report in the magazine 'Bild der Wissenschaft' [2].

The whole fascinating field of crystallographic research in Switzerland is represented in further contributions in this issue.

Neutron and Synchrotron Beamlines

Laboratory radiation sources are increasingly unable to fulfill the special demands of modern structural research. Neutron scattering laboratory sources are unavailable. The Swiss scientific community was privileged to have a very active neutron scattering group, first at the Swiss Federal Institute for Reactor Research in Würenlingen, where neutrons produced by the nuclear reactors Diorit and Saphir were used from 1960 to 1993. In 1996 the neutron spallation source SINQ became operational at the Paul Scherrer Institute (PSI) in Villigen. Switzerland is also a member of two international institutions at Grenoble, the neutron scattering facility Institut Laue-Langevin (ILL) and the European Synchrotron Radiation Facility (ESRF), which are both frequently used by Swiss crystallographers. In addition, two Swiss-Norwegian beamlines have been operational at ESRF since the end of 1994. The Swiss Light Source at PSI will start operation in summer 2001, so that a synchrotron source will soon be available locally.

The Swiss Society for Crystallography

Fig. 2 shows the logo of the Swiss Society for Crystallography (SSCr). The society was founded on November 9, 1968 at the initiative of W. Nowacki (Bern), who was elected as its first president. The young society also included from the very beginning members interested in crystal growth, who formed a section with activities of their own. Already in May of the following year the SSCr was admitted as a member society of the 'Schweizerische Naturforschende Gesellschaft', the predecessor of the 'Swiss Academy of Sciences' (SAS). From the beginning of 1970 the committee of the SSCr also acted as National Committee for the International Union of Crystallo-

graphy (IUCr). Many members of our society have since served in various commissions of the IUCr. The program of the annual meeting of the SSCr regularly contains scientific contributions by members of the society and one or more invited talks by first-rate speakers. The first such meeting took place in Basel during the annual congress of the SAS, where the Nobel Prize winner Dorothy Hodgkin spoke on the crystal structure of insulin.

J. Dunitz and W.M. Meier represented Switzerland at the 9th International Congress of the IUCr in Kyoto in 1972, at which a European Crystallographic Committee (ECC) was founded. A major task of this committee, in which the SSCr had its delegate, was the organization of annual meetings in Europe between the triennial International Congresses. These European and global meetings have become regular events, which always attract a good number of Swiss crystallographers. At the 17th European Crystallographic Meeting, which was held in Lisbon in 1997, the European Crystallographic Association (ECA) was inaugurated. It replaces the looser association formed by the ECC.

The Swiss Crystallographic Society started with approximately 120 members, their number rose to 200 in the early nineties and have recently stabilized around 160. The members of the committee of the SSCr serve three-year terms; they can be reelected twice whereas the president cannot serve for two terms in succession. The table lists the main officers of the society since its beginnings. The secretary also served as treasurer until 1993, then F. Winkler became treasurer for six years, followed by J. Priestle. As a tradition, the chairman of the section for crystal growth [Sektion für Kristallwachstum (SKW)] also serves as vice-president of the society. The SKW held its annual meeting 1972 in Freiburg (Germany) together with their German colleagues. Due to the limited number of crystal growers in Switzerland, similar collaborations also took place in many of the following years. The section has seen very active periods, in which several international workshops and summer schools were organized each year and others, where not even an annual report was presented.

A highlight for the society and its section was the organization of the 3rd European Crystallographic Meeting (ECM-3), immediately followed by the 1st European Conference on Crystal Growth, which both took place in Zürich at ETH Hönggerberg in 1976. Joint meetings with cor-

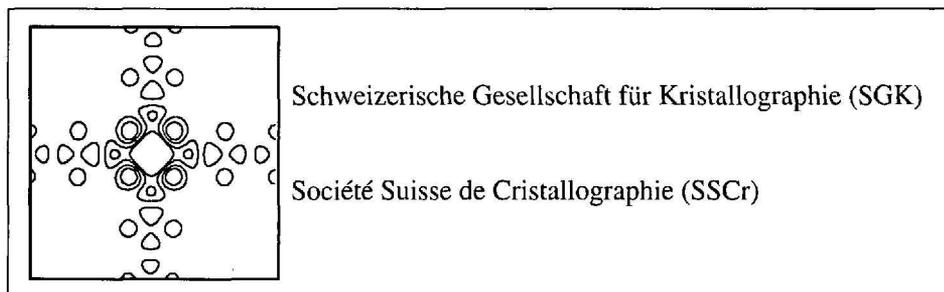


Fig. 2. The logo of the Swiss Society for Crystallography (SSCr) represents the Fourier transform of the cross on the Swiss flag.

Table. The main officers of the Swiss Society for Crystallography

Period	President	Section Chairman	Secretary
1969–1972	W. Nowacki (Uni Bern)	E. Kaldis	P. Engel
1972–1975	E. Ascher (Battelle, Geneva)	E. Kaldis	P. Engel
1975–1978	A. Niggli (Uni/ETH Zürich)	H.J. Scheel	P. Engel
1978–1981	E. Parthé (Uni Geneva)	H. Arend	W. Petter
1981–1984	H.P. Weber (Sandoz, Basel)	H. Schmid	W. Petter
1984–1987	D. Schwarzenbach (Uni Lausanne)	S. Veprek	H. Flack
1987–1990	J. Daly (Hoffmann-LaRoche, Basel)	S. Veprek/E. Kaldis	H. Flack
1990–1993	M. Dobler (ETH Zürich)	E. Kaldis/J. Bilgram	H. Stoeckli-Evans
1993–1996	H. Stöckli-Evans (Uni Neuchâtel)	J. Bilgram	G. Chapuis
1996–1999	G. Chapuis (Uni Lausanne)	J. Bilgram	V. Gramlich
1999–2002	H. Grimmer (PSI, Villigen)	H.J. Scheel	V. Gramlich

responding societies of neighboring countries were organized on several occasions: in 1980, such a meeting was held in Trento (Italy) together with the Italian societies for crystallography and crystal growth. The same year, an international summer school on inorganic crystal chemistry was organized in Geneva. 1983 saw a joint meeting in Tübingen with the German crystallographers and 1987 a meeting in Salzburg with the Austrian mineralogists. Also in 1987, a member of our society, G. Bednorz, was awarded the Nobel Prize in physics together with A. Müller for their discovery of high-temperature superconductivity. Several two-day symposia were organized on the occasion of the retirement of prominent society members: 'Chemistry and Structure' was held in 1990 in honor of J.D. Dunitz, who was nominated an honorary member. The following year 'Zeolites, Metals and Crystallography' was dedicated to W.M. Meier and W. Petter, and also welcomed R. Nesper; in 1993 'Crystal Chemistry' was held in honor of E. Parthé.

In 1979 the secretary of the SSCr, W. Petter, started to write regular com-

prehensive letters to the members, informing them of the activities of the society and its section for crystal growth. Under his successor, H. Flack, these letters developed into A5 size newsletters with typically 20–40 pages, which usually appear three to five times per year and still play an important part in the life of the society. Besides that, the society is also present on the Internet under the address <http://www-sphys.unil.ch/sgk/index.html>. The society recently produced a copiously illustrated brochure describing many fascinating aspects of pure and applied crystallographic research in Switzerland. The brochure is available in German 'Kristallographie in der Schweiz' and French 'Cristallographie en Suisse' and may be ordered free of charge from the secretary of the society:

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- [1] Symmetry-related research by P. Niggli, W. Nowacki, and F. Laves has been described by J.J. Burckhardt, in 'Die Symmetrie der Kristalle', Birkhäuser, Basel, 1988.
- [2] U. Schmoch, A. Hullmann, *Bild der Wissenschaft* 1999, 9, 13.