

FIFTY YEARS OF  
X-RAY DIFFRACTION

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*Spain*

Within a year after Laue's discovery F. Pardillo gave a report on it and on the first work of the Braggs to the Royal Society of Natural History (*Bol.* 1913, 13, 336), and two years later (1915) Blas Cabrera wrote a similar report in the *Anales Soc. Esp. Fis. y Quim.* 13, 7. It took, however, another ten years before the new experimental technique was actually introduced in Spain, first at the Physics Department of the University in Madrid, but soon after, and on a larger scale at the Instituto Nacional de Física y Química which had meanwhile been established with the help of the International Education Board (Rockefeller) in Madrid. Here J. Palacios assembled a group of keen young workers to whom he lectured and for whom he invited guests from abroad. A Weissenberg camera was built in the workshop of the institute from the drawings which Hengstenberg had provided, and he and Wierl, both from H. Mark's laboratory in Ludwigshafen, initiated electron diffraction which was taken up by L. Brú. J. Garrido, O. Foz, L. Rivoir and R. Salvin worked together with Palacios on structure determinations of inorganic and organic crystals and on the perfection of the Fourier methods of analysis. The Civil War brought all this to a near standstill from 1935 onwards. The same is true for the work which F. Pardillo had inaugurated quite independently and without external help in the mineralogy department of the university in Barcelona.

A revival took place after the Second World War, and there were considerable shifts of location of the scientists. L. Brú who had no X-ray instrumentation as long as he was professor of physics at La Laguna in the Canaries, was appointed to the physics chair at the University of Sevilla in 1949, and there, gathering some of his former collaborators around him, he began work on structure problems. In 1956 he came in the same capacity to the University of Madrid and is continuing both X-ray and electron diffraction there with an increasing number of co-workers.

L. Rivoir heads the X-ray department in the converted Instituto Nacional de Física y Química, now Instituto de Física 'Alonso de Santa Cruz'.

The most active among the Spanish crystallographers is J. L. Amoros who after graduating at the university in Barcelona in 1942 worked there in the Instituto Lucas Mallada of the Higher Research Council (CSIC) before becoming the professor of crystallography in Madrid. Together with his numerous co-workers he is investigating structures as well as physical properties of crystals and the methods of their

analysis. Interesting and useful publications have been issued by this group which provide the new generations of students with texts to study.

It should be mentioned that also J. Garrido and J. Orland published in 1946 a book *Los rayos X y la estructura fina de los cristales* which forms a good introduction to the subject and contains some methods developed by the authors.

A Crystallographic Society was formed in 1950 with some 35 members; in 1960 membership had risen to 60. In 1960 an Ibero-American Association for Crystallography was founded with the intent of tying together crystallographic research in Argentina, Chile, Uruguay and Spain.

#### *Switzerland*

The development of diffraction methods in this country was shaped mainly by the prominent men in Zürich: P. Debye, P. Scherrer, and P. Niggli. They came to Zürich in 1920, the former two to the Physics Department, the latter to that of Mineralogy and Petrography of the E.T.H. In neither of these places did much interest evolve in crystal structure determination as such, although Niggli analysed tenorite, and under Scherrer the structures of ferroelectric crystals like Rochelle salt were investigated. In Niggli's institute the emphasis lay on the general laws of crystalline architecture in a rather abstract, geometrical and classifying sense; E. Brandenberger's important analysis of the laws of extinctions, and H. Heesch's extension of the theory of space groups to include anti-symmetry elements should, however, be mentioned.

Crystal structure analysis in the accepted sense was used on a large scale from 1930 onwards by the physico-chemist W. Feitknecht in Bern, initially in conjunction with W. Lotmar. Systematic chemical surveys of series of compounds, such as the basic salts of bivalent metals, double hydroxides, and hydroxy salts were carried through mainly using powder diagrams, and led to extensive series of papers; Lotmar later turned to high-polymer and protein diffraction. In the department of mineralogy of the same university, Bern, W. Nowacki has built up an active and well equipped centre of structure analysis. A great variety of crystals, ranging from minerals to sterines and other organic crystals of high molecular symmetry have been determined here. The principles of crystalline structure, and the statistics of the distribution of structures among the space groups have drawn the particular interest of Nowacki (for the latter see Donnay and Nowacki, *Crystal Data, Memoir 60*, Geological Soc. of America, 1954).