

MEMORIAL OF VICTOR GOLDSCHMIDT*

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Professor Victor Goldschmidt died in Salzburg, Austria, on the 8th of May 1933. In his death our Society loses its most distinguished honorary fellow and many of its members lose a dear friend and revered teacher. His work in crystallography was unique and his place in that field can never be filled.



VICTOR GOLDSCHMIDT
1853-1933

Goldschmidt was born in Mainz, Germany, in 1853 and there he had his early schooling. He entered the Mining Academy at Freiberg, Saxony, as a student of Metallurgy and his first work as a teacher was there, assisting Professor Richter in Assaying and Blowpipe Analysis. He never ceased to be interested in the latter subject, which he taught at Heidelberg long after he had transferred his chief attention to another field. It was, however, the influence of the mineralogist Weisbach at Freiberg that first opened to him the field of his major activity—minerals and their crystal

* Read at the fourteenth annual meeting of *The Mineralogical Society of America*, Chicago, Illinois, Dec. 28, 1933.

forms. In a memoir written after the death of his early teacher, in 1902, Goldschmidt has charmingly pictured the atmosphere of the Mining Academy and the mining town where the spirit of Werner, the founder of the school, still brooded over his creation and Weisbach dwelt as high priest before the door of the holy of holies—the room where Werner's own collection of minerals was preserved. At that time every student was a mineral collector as well as a miner and learned to love minerals as only one can who finds and preserves them himself.

Leaving Freiberg in 1878, Goldschmidt studied chemistry at Munich and with Rosenbusch at Heidelberg became familiar with the then new science of petrography. But it was in Vienna, in the years from 1882 to 1887, that he founded his life work in crystallography. Working alone but under the influence of Brezina of the Hofmuseum, he developed the *Index der Krystallformen*, the solid basis upon which rested the complex structure of his life-long labor.

In 1888 he became a docent at the University of Heidelberg presenting as his habilitation thesis the paper *Ueber Projection und graphische Kristallberechnung* already published the year before. Possessed of independent means, Goldschmidt established his own private laboratory where he began to receive students while developing his own plans and studies. In the same year he was married to Leontine von Portheim of Prague, who became in the course of their long and happy life his most active and efficient collaborator. For nearly half a century and to the end of his life Heidelberg remained his dwelling place. In his charming home on the hillside above the city he assembled his unrivalled collection of books on crystallography. And here he and his wife hospitably received the students who from the ends of the earth came to work under his inspiring direction.

Goldschmidt never occupied an ordinary professorship in the University. He always remained an independent teacher, offering talks to the small group which at any one period elected his courses rather than lectures. In the intimate surroundings of his Institute he gave each student the individual help that was needed and was in fact as much companion as instructor. His personal collection of crystals contained abundant material for study which each student carried out with him. And so he joined to himself an ever-widening circle of friends and disciples, who in the course of years carried his methods to the most distant lands.

To few men is it given to envisage so early in a scientific career as clear a picture of what he desired to accomplish as Goldschmidt did. Still fewer succeed in realizing their vision so completely. Goldschmidt's aim was primarily to bring order out of the chaotic mass of crystallographic observations which had accumulated through a century, to reduce them to a common form of expression so that their meaning could be interpreted. First came the *Index der Krystallformen*, a work in which he collected the published data on the crystal forms of all minerals. In the introduction he developed his own system of nomenclature and discussion based on the polar axes, the normals to the pinacoidal body of each crystal. It is interesting to find that the latest tool of crystallographic investigation, the Weissenberg x -ray goniometer, discovers to the investigator the reciprocal lattice which is identical in its nature with Goldschmidt's polarform and polar axes. He also laid particular emphasis on the use of graphical methods and the gnomonic projection.

The three volumes of the *Index* were published in the years from 1887 to 1891. Not discouraged by the vast single-handed labor involved in this organization of the whole literature of mineral crystallography, he passed at once to the next project. His methods proposed that each form on a crystal should be defined by two position angles, comparable to geographical co-ordinates on the sphere, instead of by interfacial angles hitherto universally employed by crystallographers. The adoption of this principle made a complete angle-table for each mineral possible; but the table had to be created from the beginning. In the introduction to his *Krystallographische Winkeltabellen* published in 1897 Goldschmidt gives an outline of his preliminary survey of this undertaking. It showed that something like 33,000 angles and co-ordinates were to be calculated and in all about 70,000 values entered in the tables. This work was completed, with the aid of one calculator, in less than two years.

Meanwhile Goldschmidt, assisted by his mechanic Stöe, designed and constructed instruments suitable for measuring crystals in the new manner. The two-circle goniometer in its present most-used form is the outcome of years of improvement on the first designs.

To complete the cataloguing of the scattered crystallographic data rendered familiar to him by the preparation of the *Index*, Goldschmidt next undertook to collect and reproduce by photogra-

phy all published figures of crystals of minerals. In the *Atlas der Kristallformen* each figure is accompanied by text references showing not only the locality, author and place of publication, but also where the figure is reproduced in other books. Correlation tables for each species make it possible to identify the symbols and letters of various authors in terms of the finally accepted position. This vast labor, begun in 1903, interrupted by the war and by illness, was finally completed in 1923. The first of the nine volumes was issued in 1912; it is very simply dedicated to his wife, without whose vital assistance it is probable that the work would never have been completed. A volume of text accompanies each volume of plates. The plates number 1564, each carrying about 16 figures so that in all about 25,000 figures are reproduced.

The publication of these various works was never permitted to interrupt the steady stream of papers from Goldschmidt's pen in which he made use of the materials thus laboriously made available or added new studies which illustrated his methods of calculation. Growth and solution forms and vicinal planes, "accessorien" as he called them later, were first brought adequately into the range of goniometric study by the development of his new instruments and were used to illumine the form series of minerals. Many papers were devoted to the discussion of the distribution of forms in zones; these investigations had as a major outcome the formulation of his "Law of Complication" and his theory of "Harmony." In the latter a number law derived from crystals is extended to the discussion of serial arrangements as widely diverse as color scales, musical scales and the spacing of the planets in the heavens. These philosophical developments of crystallographic studies, which included a new analysis of musical harmony and a theory of the development in man of the color sense increasingly occupied his interest during his later years. But Goldschmidt's devotion to crystal morphology remained dominant and at the time of his death he was enthusiastically entering a new field of study, seeking to apply to the points of the interference figure of Laue's x-ray photographs the law of complication derived from the study of crystal faces.

In 1916 Professor Goldschmidt and his wife established and endowed the "Josefine und Eduard von Portheim-Stiftung für Wissenschaft und Kunst" as an adjunct to the University of Heidelberg. One branch of this foundation is the "Victor Goldschmidt Institut für Kristallforschung," an institute which will inherit his

library and collections and insure the continuation of his monumental work through the years to come. It is allied to but independent of the University.

Goldschmidt was not willing to lose touch with his students after they left his laboratory. By correspondence and by personal intercourse, as in 1911 when he visited America, he kept himself informed of what they were doing and showed his living interest in their work. His letters, written in a microscopic and marvelously neat hand, are full of the warmest personal feeling.

In 1928 in celebration of his seventy-fifth birthday a handsome *Festschrift* was presented to Goldschmidt by his students. The introduction by Dr. Milch, Goldschmidt's first student, gives an admirable picture of his life and work. Appended is a complete list of his publications, numbering 177 up to that time. I present here only the eleven later titles of his most recent papers. Two books containing the gist of the crystallographic work left unfinished at his death are about to appear in print: *Kursus der Kristallogometrie*, edited by H. Himmel and K. Müller; and *Betrachtungen zur kristallographischen Systematik* and other studies, edited by M. A. Peacock.

In conclusion I cannot, I think, better illustrate the indomitable spirit of the man of whom I write than to quote in translation his own words written as a conclusion to his Atlas.

The Atlas der Kristallformen is but a tool for the extension of our great science, Crystallography. And when in the evening of life I contemplate this implement, I do not desire to fold my hands upon my breast. After evening follows night and it is a peculiar joy to labor far into the silent night until the oil in the lamp is burnt out and the light extinguished. Then can one go peacefully to rest.

Goldschmidt's "night" lasted ten years and was as full of activity as any equal period in his life. His illness was short and he went to rest at the age of four score years, possessed of all his faculties and secure in the knowledge that his work is lasting and well done.

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