OBITUARIES

Prof. V. M. Goldschmidt, For.Mem.R.S.

VICTOR MORITZ GOLDSCHMIDT, the eminent geochemist, formerly professor of mineralogy and geology in the University of Oslo, died on March 20.

He was born in Zurich in 1888, the son of H. J. Goldschmidt, who became professor of chemistry at Oslo in 1900. He entered the University of Oslo in 1905, taking as his main subjects chemistry, mineralogy and geology, and there came under the inspiring influence of Prof. W. C. Brögger, whom he was eventually to succeed. He was appointed professor and director of the Oslo Mineralogical Institute in 1914 at the early age of twenty-six. A highly successful teacher, he founded a large research school both at Oslo and at Göttingen, where he moved in succession to Mügge in 1928. Many of his former pupils now hold professorships or high posts in industry, in Europe or America.

Goldschmidt resigned the Göttingen chair in 1935 as a protest against the Hitler regime, and returned to Norway. In 1942 he was sent to a concentration camp by the Germans and sentenced to deportation to Poland, but escaped to Sweden and offered his services to the Allies. He came to Britain in the spring of 1943 and worked under the auspices of the Agricultural Research Council; the first year he spent at the Macaulay Institute for Soil Research, Aberdeen, and later went to Rothamsted Experimental Station, where he remained until his return to Oslo in 1946. For some of the particulars of this notice I am indebted to Dr. W. G. Ogg of Rothamsted and to Dr. R. C. Evans at Cambridge.

Goldschmidt's researches divide themselves broadly into an early group of studies (1911–20) devoted chiefly to petrology and geology; the main group of fundamental geochemical investigations which followed from 1920; and the pioneer crystallochemical studies (1925–27) which developed naturally from them and in turn served to interpret his later work.

His researches in the field of rock metamorphism have been of the first importance. The study he made of the metamorphic aureoles around the igneous massifs of the Oslo district marked a major advance in the correlation of the chemical and mineralogical composition of thermally reconstituted rocks, and contained the first successful essay towards a systematic classification of rock mineral assemblages in the light of the phase rule. Equally important were his investigations on the zonal metamorphism of the crystalline schists of the Palæozoic mountain region of southern Norway, forming as they did a genetic study of rocks re-crystallized under shearing stress and high temperature developed during regional folding and igneous injection.

Goldschmidt's researches in geochemistry were initiated during the First World War when the deficiency of raw materials led him to extended investigations on the mineral resources of Norway. The organisation of this research was entrusted to him by the Norwegian Government in 1917, and he became chairman of the Commission for Raw Materials and director of the Raw Materials Laboratory.

After the War, with a keen research team, he applied himself with great energy to the study of the basic problem of geochemistry—the discovery of the general laws and principles governing the distribution of the chemical elements in Nature. To this end both old and new methods of chemical and physical analysis were brought to bear on the investigation of rocks and minerals. X-ray analysis and quantitative spectrographic methods provided new lines of attack, and he developed later, particularly at Göttingen, an improved technique of carbon arc spectrography.

These studies led directly to his work in crystal chemistry, the most important of his results in this field appearing in the brilliant group of memoirs published in 1925–27: "Geochemische Verteilungsgesetze der Elemente" (iv–viii). His researches on the crystal structure of ionic compounds may indeed be regarded as laying the foundation of the science of crystal chemistry. By the systematic investigation of a wide range of compounds, he was able to formulate the picture of an ionic structure as being determined primarily by the geometrical packing of ions of characteristic sizes, and to tabulate for the first time values of ionic radii for the majority of the elements. These data in their turn provided a basis for the understanding of the problems of morphotropy, and led to an explanation of the morphological relationships which exist within groups of closely related compounds and to a correlation between physical properties and crystal structure.

The principles which Goldschmidt thus established were afterwards codified more formally but without essential modification by Pauling, and have been tacitly invoked in all later work on the X-ray study of ionic structures.

The elaborate series of geochemical investigations Goldschmidt began at Oslo and continued at Göttingen have revolutionized our knowledge of the distribution of the minor constituents of the earth's crust. He demonstrated the partition of a large number of the rarer elements among the successive products of the geological cycle—from the primitive magma to the sediments and the sea—and showed that ionic size and charge are important factors controlling their ultimate sorting and concentration.

Goldschmidt's industrial work was also of great importance. He was a pioneer in the development of forsterite as a commercial refractory, now in wide use; he worked out a process for making alumina from labradorite felspar, and took part in the development of titanium pigments. His interest in agriculture arose during the First World War when Norway was faced with a shortage of potash fertilizers. He suggested the possibility of using biotite as a source of potash, and though the idea was not altogether new, the resulting experiments he developed are probably the most complete set carried out to test the possibilities.

At Göttingen in connexion with his studies of trace elements, he and his colleagues examined samples of soil and tree leaves and showed the marked relative accumulation of certain trace elements in forest litter. What was probably his last publication was an article introducing a trace element symposium in *Soil Science*.

During his stay at the Macaulay Institute and at Rothamsted, Goldschmidt was generous with his advice and took a great interest in the work of trace-element distribution.

He had for some years been engaged on a comprehensive treatise on geochemistry. It is known that the greater part of this was written before he left England, and it is confidently expected that he was able to complete it for eventual publication.

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