Paul Heinrich von Groth.

PAUL GROTH, Emeritus Professor of Mineralogy and Crystallography in the University of Munich, died of heart disease at an advanced age on 2nd December 1927. With him there departed a master and a teacher who, by his scientific labours, had been able to make advances in the whole field of mineralogy, of physical and chemical crystallography, of the science of deposits, and of petrography, who formed collections illustrative of these branches in his institute, and concerned his teaching with all of them. Groth was born at a time when Eilhard Mitscherlich's discovery of isomorphism and dimorphism was new and excited much interest. Groth's youth coincided with Pasteur's investigation of the asymmetry of naturally occurring organic compounds. As a young investigator Groth was stimulated by the structural theory and benzene formula of Kekulé, the stereo-chemistry of van't Hoff and Le Bel. At the zenith of his powers there came the discovery of Röntgen rays, and in old age he admiringly appreciated the importance of Laue's recognition of the interference of Röntgen rays in crystals. This wealth of experience during a long life fitted him to be a historian of mineralogy and crystallography, and was made available to posterity in his *Entwicklungsgeschichte der mineralogischen Wissenschaften*, 1926.

Groth was born on 23rd June 1843, at Magdeburg, the son of a portrait painter. His youth was spent at Dresden. In 1862 he took up the study of mining at the Mining Academy of Freiberg in Saxony, and became there a pupil of Breithaupt, the mineralogist. In 1865 he migrated to the University of Berlin in order to complete his studies in geology, chemistry, and physics. There he was a pupil of Magnus, the physicist, under whom he obtained the doctor's degree through a thesis on the isomorphism of the permanganates and perchlorates, and in 1868 he became Magnus's assistant. From this time onwards Groth devoted his whole life to crystallographic investigations, particularly with a view to studying the relationship between chemical constitution and crystal structure and the connection between crystal formation and optical activity. In 1870 he published his discovery of morphotropism, the change according to fixed laws in the morphological and physical properties of a crystal when hydrogen is replaced by another atom or group of atoms; later Topsöe found a classical example of this among the double salts of platinum-, gold-, copper-, and mercury chlorides with the substituted alkyl ammonium chlorides. The recognition of morphotropism was the most significant discovery in crystal structure before

the time of Laue and the Braggs. Groth's famous work *Physikalische Krystallographie*, of which the first edition appeared in 1876, was also the first to enunciate the principle that "two morphologically equivalent directions are always also physically equivalent in every respect."

After Groth had become Privatdozent in 1870 at the Mining Academy of Freiberg and later at the University of Berlin, he was called in 1872 as Professor to the new German University at Strasburg, which he left eleven years later for Munich to succeed Franz von Kobell, a poet as well as a mineralogist. At Munich the state mineralogical collection and the mineralogical institute of the Bavarian Academy of Sciences developed under his direction and attained great fame and usefulness. Pupils from all countries were attracted by this vigorous, learned, and indefatigable teacher, in order to complete their studies and carry out scientific investigations. Groth's numerous British pupils showed in special measure their veneration and gratitude.

The foundation of the *Zeitschrift für Krystallographie und Mineralogie*, which Groth edited from 1876-1920, *i.e.* until the 55th volume, and the publication of *Chemische Krystallographie* (1906-1919), a kind of crystallographic "Beilstein," aimed at collecting all available crystallographic data, a necessary preliminary to a knowledge of the nature of matter. The latter work, in five volumes, is a testimony to the author's great capacity for work, and has become indispensable to the related sciences of mineralogy, chemistry, and physics.

To mineralogy Groth did not only contribute many individual investigations, he also produced a valuable systematic aid to the scientific arrangement and use of mineralogical collections in his *Tabellarische Übersicht der einfachen Mineralien nach ihren krystallographisch-chemischen Beziehungen geordnet* (first edition 1874, fourth edition 1898) and in the *Mineralogische Tabellen* (1921), published conjointly with K. Mieleitner.

The main field of Groth's investigations was crystallography. To him crystals were primarily a means of recognising the chemical and physical properties of matter, but he was never wanting in an interest in the distribution of crystals in nature, in questions of chemical and physical geology (œcology). The dependence of natural crystal deposits on the conditions of their formation and on their environment led Groth to the geological consideration of minerals, to the science of deposits, and to the paragenetic consideration of the occurrence of minerals. Thus Groth, as crystallographer, as mineralogist, and as geologist, was a polyhistorian of the mineralogical sciences.

He was elected a Foreign Honorary Fellow of the Society in 1905.

R. W.