

mass of rocks. Sorby's paper was no less than epochal in its effect, it appealed both to field geologists and to mineralogists, for it revealed the community of interest in the results which could be obtained by accurate microscopic examination of rocks.

Sorby's method was applied by Websky, who examined thin sections of minerals by polarised light, and attained brilliant results. A happy circumstance brought Sorby's influence directly to bear upon Ferdinand Zirkel. In the year 1862, while at Bonn, Sorby personally initiated Zirkel into his methods of investigation, and inspired him with enthusiasm for the new field of research.

Specimens of crystalline rocks from all parts of the world were secured by Zirkel, who submitted them to microscopic examination by transmitted and polarised light, and arrived at ever sharper definitions of the various inclusions, and the appearances displayed in polarised light. By his comprehensive researches Zirkel established Sorby's methods upon a broader empirical basis, and he at the same time introduced the new methods in his teaching of petrography at Bonn University.

There were still some incredulous voices: Vogelsang in 1864 doubted the existence of glassy inclusions in the component ingredients of porphyry, and other rocks of non-glassy structure; Laspeyres in the same year also disputed the glassy inclusions in porphyritic rocks of Halle, and even doubted the distinction between glass and water vesicles.

The publication of Zirkel's *Lehrbuch der Petrographie* (Bonn, 1866) may be said to mark the culmination of the older methods, and the academical initiation of the new. In his text-book Zirkel embraced all that was known about the mineralogical and chemical composition, the structure, systematic arrangement, the mode of occurrence and origin of the various rocks; he also described the crystallographical results which had already accrued from microscopic investigation, and indicated the far-reaching advantages opened up by the new direction of research. Zirkel's work removed all doubt regarding the value of the microscopic results for systematic petrography.

Vogelsang, in his *Philosophie der Geologie und Mikroskopische Gesteins-Studien* (Bonn, 1867), accepted the new teaching in full, and added much to the knowledge of the