OBITUARY.

Henry Clifton Sorby (1826-1908).

(With a Portrait,[1] Plate VI.)

In the important work of demonstrating how the internal molecular structure of minerals is revealed by their action upon light passing through them, two British mineralogists—Brewster and Sorby—were among the foremost pioneers. In the more than three hundred papers of Brewster, written between the years 1815 and 1869, there will be found the records of researches upon almost all the common transparent minerals, and on not a few rare ones. But Brewster's work was to some extent limited by the necessity he was under of obtaining for his investigations well-crystallized specimens, from which moderately thick slices could be cut in definite directions. To Sorby remained the merit of showing how the optical method could be applied to the minute, irregular particles of minerals building up rocks, even when exposed in very thin sections and cut at indefinite angles.

Sorby had as a schoolboy imbibed a taste for science, which was fostered by a mathematical tutor under whom he was placed after leaving school. This tutor, the Rev. Walter Mitchell, author of the treatise on Crystallography in Orr's 'Circle of the Sciences' and of some original papers on the same subject, had been a medical student, and was able to instruct Sorby in chemistry and anatomy as well as in various branches of physics, and when only twenty years of age Sorby published his first scientific memoir. In the year 1849 Sorby, having learned the art of making thin sections of hard materials from his friend William Crawford Williamson, conceived the idea of applying the method to the study of the small, mineral particles building up rocks. In 1850, a paper which he wrote on 'The calcareous grit of

[1] The accompanying plate (Plate VI) is reproduced from a portrait, painted by Mrs. M. L. Waller, which was presented to Dr. Sorby by the Sheffield Literary and Philosophical Society in commemoration of his fifty years of connexion with the Society. It first appeared in the 'Naturalist' in 1906, and the block has been lent by the courtesy of the editor and publishers of that journal. The portrait represents Dr. Sorby at the age of 71, and a duplicate of it was deposited in the University of Sheffield. Excellent reproductions of the portrait were sent by Dr. Sorby to his friends, who signed an address to him at the time of the centenary of the Geological Society, only shortly before his death.—L. J. S.

the Yorkshire coast' afforded him the opportunity of showing the value of the method. He effected a complete mineralogical analysis of the rock, identifying the quartz, calcite, and chalcedony by optical methods—both plane and circularly polarized light being employed; he separated the several ingredients by chemical and mechanical means, and he determined the proportions of each in the rock.

About this time, too, Sorby appears to have been greatly struck by the phenomena of polymorphism. The relations of calcite and aragonite in shells and in rocks then, and frequently in after life, were made the subject of experiment and speculation. He also investigated what he regarded as evidence of 'tetramorphism' in carbon; and if mineralogists do not now accept all his conclusions on this subject they cannot but be impressed by the refinement of his methods and the ingenuity of his reasonings.

Pseudomorphism was another question that at this time engaged much of Sorby's attention, and he often returned to the subject in after life. Important memoirs written by him in 1856 showed that great rock-masses like the Magnesian Limestone and the Cleveland ironstone owed their origin to pseudomorphous conversion of the calcite of ordinary limestones into dolomite and chalybite respectively. Experiments consisting of placing calcite crystals into various solutions were commenced at this time, and Sorby was able to watch the operations for more than half a century, some of the specimens being now left by his will to the Sheffield Museum.

While preparing and studying the thin sections of many aqueous, igneous, and metamorphic rocks, the attention of Sorby was naturally drawn to the existence in the crystallized minerals of innumerable cavities containing various liquid and solid substances. On December 16, 1857, he brought before the Geological Society his epoch-making memoir 'On the microscopical structure of crystals'—a memoir which, though neglected, and even ridiculed at the time, laid the foundation of microscopical petrography—and, in doing so, widened enormously the sphere of influence of mineralogy from which it borrowed so much. It was in German scientific literature that we find the first application and development of Sorby's ideas; but French and British workers gradually took up the work—Zirkel, Renard, and David Forbes soon becoming conspicuous among the friends and disciples of Sorby who were prepared to follow and were always ready to defend his method.

In 1877 Sorby wrote for this journal an interesting obituary of his friend David Forbes, and it is impossible at the present time to read

this notice without being struck by the contrast between the scientific careers of the two men. Forbes was called upon, while still very young, to seek his fortune by taking charge of mining work in a foreign country; his short and active life, full of travel, adventure, and peril, was exposed to frequent accident and disease; yet, while accumulating wealth, he lost no opportunity of advancing scientific knowledge, and found time to study rocks by Sorby's method and to follow to some extent in his footsteps; born two years after Sorby, Forbes, as the victim of many hardships, predeceased his friend and master by more than thirty years. Sorby, on the other hand, inherited from his father a sufficient fortune, which contenting him through life, he steadily resisted every temptation that might distract him from the great work of scientific research to which he regarded his life as dedicated; he considered the care of his health and the avoidance of pleasures and occupations that would interfere with his studies as duties which he owed to science; and, though his end was probably hastened by an accidental fall, he lived to an advanced age, retaining till within a few hours of his decease his interest in and capacity for scientific investigation. Sorby, in writing upon the advantages to a scientific man of being free from business or professional cares, says, 'I am thankful to say that complete immunity from such routine employment has been my own happy lot.' Never, indeed, did a man make better use of his opportunities!

It was a characteristic of Sorby's mind to prefer seeking for new truths rather than following up the pursuit of lines of investigation already discovered. Hence the wonderful versatility of his genius. But though neglected for a time, the old fields of research were again and again revisited by him. Thus in 1869, returning to the study of the cavities of minerals and the nature of their liquid contents, he was able to show that in many minerals, including gems, carbon dioxide in a liquid state is frequently present in 'the sealed flasks of crystals', as Julien has so aptly styled these cavities. Our own journal shows how, especially between 1877 and 1879, Sorby returned to the consideration of methods of determining the optical constants of minerals in thin sections.

Sorby's work naturally led him to ponder deeply on the conditions under which minerals and rocks must have been formed. His early papers on the origin of cleavage and foliation are admirable illustrations of the results to be obtained by a combination of experiment and observation. His more general conclusions on the subject are elaborated in his Bakerian lecture 'On the correlation of chemical and mechanical

forces'; and various applications of his views on the subject are made in his experimental work on fused rocks and his memoirs on 'cone-in-cone' structure and on 'impressed pebbles'.

In 1863 the application of his method to the study of meteorites led Sorby to investigate the nature of the iron-nickel alloys in them, by examining etched surfaces under the microscope. Not only did this lead to many interesting scientific results, but in the end resulted in discoveries of far-reaching importance to the industries of his native town of Sheffield. In the various artificial products which he studied Sorby showed the presence of pure iron in interlacing cubes and octahedra, of an intensely hard constituent (now known as 'cementite'), and of the pearly material (now called 'pearlite'). He thus laid the foundation of new methods of metallurgical study, which have been so fruitful of results in recent years.

In 1865 Sorby commenced his interesting investigations based on the adaptation of the spectroscope to microscopic work, among which we must notice his studies of the spectra of jargoon and other gems and coloured transparent minerals.

During the earlier years of his life Sorby's work was almost wholly carried on in his Sheffield homes—at first at Woodbourne and afterwards at Broomfield. But after the death of his widowed mother, to whom he was devotedly attached, he began to take a more active part in the scientific work of London. From 1876 to 1879 he was our first president; from 1878 to 1880 he was president of the Geological Society; and from 1875 to 1877 he presided over the Royal Microscopical Society. In 1875 he bought a yacht—the 'Glimpse'—and during the summer months pursued his researches on board this vessel. This change in his habits led to the adoption by him of new lines of research. Those who met him found him enthusiastic as ever in all matters connected with geology and mineralogy—but his talk was chiefly of Gothic architecture, and the mechanical and artistic methods of the ancient builders, while old books, ancient engravings, and water-colour drawing occupied much of his time. He utilized his yacht not only for visiting places of interest, chiefly in East Anglia, but also for collecting marine animals and plants, the structure and distribution of which were pleasant objects of study, while ingenious methods for their preservation and exhibition were constantly being devised by him.

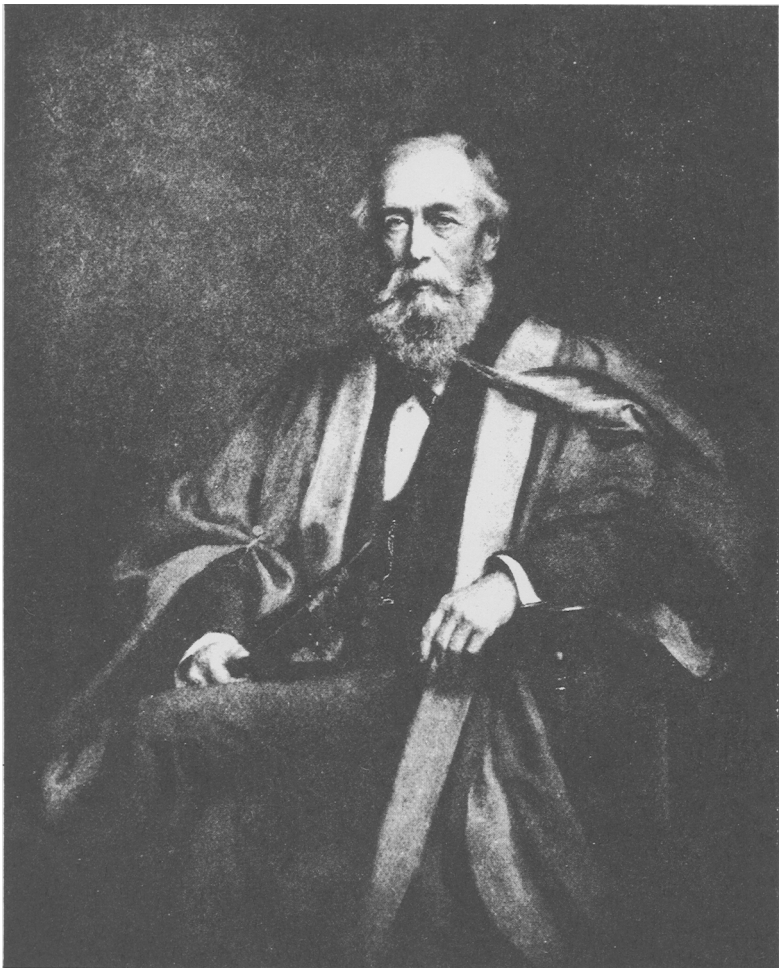
In 1903 his active career was brought to a close by an accident which occasioned partial paralysis, but for nearly five years more—though mostly confined to his bed—he continued his studies and

writing, an important memoir being sent to the Geological Society shortly before his death.

He was devotedly attached to his native town of Sheffield, where so much of his life was spent. Of the Literary and Philosophical Society and other institutions in Sheffield he was a warm and constant supporter, and in the foundation of Firth College and the guiding of its evolution, first into a University College, and finally into the University of Sheffield, he was the leading spirit. All through his life he was 'the Apostle of Scientific Research', and on his death it was found that, after providing for relations and old servants and sailors, the half of his fortune was left, in part to found a chair in the Sheffield University, and in part to the Royal and Geological Societies to promote the researches which had been the object and the delight of his own life.

NOTE. In 'Unencumbered Research; a Personal Experience', published in the volume of 'Essays on the Endowment of Research' in 1876, and in a lecture, 'Fifty Years of Scientific Research,' published by the Sheffield Literary and Philosophical Society in 1897, Sorby has given many interesting particulars of his life and work. In the 'Geological Magazine', for May, 1908, I have shown how the work of microscopic petrography was originated, contrary to prevalent misconceptions on the subject. A list of Sorby's scientific memoirs, more than 250 in number, is published in the 'Naturalist' for 1906.

J. W. J.



H. C. Sorby

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