OBITUARIES.

Samuel Lewis Penfield (1856–1906).

(With a Portrait, Plate VI.)

IN the person of Professor Penfield the Mineralogical Society has lost an eminent Honorary Member, whose death has deprived Yale University of a brilliant and inspiring teacher, and has robbed our science of one of the most ardent of modern investigators. When a man imbued with the genius and the zeal for original research passes away in the fullness of years we can at any rate feel that he has accomplished the work for which he was best fitted and has bequeathed the full results of his abilities to his successors; but when a man, like Penfield, is taken in the prime of life, while his powers are ripe for the achievement of new discoveries, and while past success is being crowned by the promise of even more mature work, the loss is irreparable.

Penfield was born on January 16, 1856, at Catskill in New York, and was the son of a prominent merchant of that town; he was educated at home and at the local school, from which he passed to the academy at Wilbraham, Massachusetts, and thence, at the age of eighteen, to the Sheffield Scientific School at Yale University. He graduated with honours in 1877, having followed the course of chemistry. He had always been attracted towards mathematics and natural science, and shortly after taking his degree found an opening which led him into the paths of mineralogical research.

Professors G. J. Brush and E. S. Dana were just beginning their investigation of the minerals from Branchville, Connecticut, and they enlisted the services of Penfield and his classmate and life-long friend, H. L. Wells, who had become assistants in the laboratory of analytical chemistry, and were ready to undertake the necessary analyses. The two young men had thus at the outset of their career the opportunity of studying many new and interesting minerals. Penfield himself was shortly afterwards transferred as assistant to the mineralogical laboratory. Among the minerals which he analysed during this period were eosphorite, triploidite, dickinsonite, fairfieldite, fillowite, triphylite, childrenite, amblygonite, cymatolite, and spodumene.

In 1880 he proceeded to Germany, and for two semesters worked with Professor Fittig in Strassburg at organic chemistry, publishing a joint

research with him on some organic compounds in 1882. Although Groth was at that time Professor of Mineralogy in Strassburg, and Penfield seems to have attended some of his lectures, his work was entirely on the organic side, and he was evidently contemplating the career of a chemist. His earlier work had, however, given him an interest and an experience in mineralogical chemistry, which were soon to find an application.

At this time the post of Instructor in Mineralogy at the Sheffield Scientific School, under Professor Brush, became vacant, and in 1881 Penfield was offered and accepted the position. During the next two years he published papers on monazite, scovillite, lithiophilite, descloizite, and beryl.

In 1884 he returned to Germany, in order to perfect himself in the methods of physical mineralogy, and studied during the summer semester with Professor Rosenbusch at Heidelberg. In 1888 he became Assistant Professor, and in 1893 full Professor of Mineralogy at the Sheffield Scientific School, and till the end of his life devoted himself with untiring zeal and energy to the twofold duties of his position—teaching and research.

Penfield's scientific publications extend over a period of very nearly thirty years, and amount to more than 110 in number. The earlier papers deal, for the most part, with the chemical composition of various minerals, but he became more and more interested in the study of their crystalline form, and towards the close of his life he devoted himself ardently to crystallographic problems and methods.

Throughout his whole career his researches were conducted with consummate skill and perseverance. Many of them led to results of the highest importance: it is only possible here to call attention to a few of the most prominent as types of his work.

One of the striking discoveries with which his name is associated is that of the isomorphous replacement of fluorine by hydroxyl. His very first published scientific paper was in 1877 on the composition of triphylite, one of the Branchville minerals. In the following year Brush and Dana, in the first of their papers upon these minerals, quoted Penfield's analysis of triploidite and pointed out that it led to the remarkable conclusion that hydroxyl can replace fluorine in a series of minerals so closely related as to be considered isomorphous. Little attention was paid to this statement at the time, except in the way of opposition: many of Penfield's subsequent analyses contributed further evidence of the same replacement, but they excited further opposition on

the part of many chemists: Rammelsberg, for example, always refused to accept Penfield's conclusions, and as late as 1895 in the second supplement of his 'Mineralchemie' criticized the view as quite untenable. But by this time the evidence accumulated by Penfield was too strong to be ignored, and to-day hydroxyl plays a well-recognized part in mineral-formulae as equivalent to fluorine.

An important application of the principle is given in the memoir upon the chemical composition and related physical properties of topaz, which he made in conjunction with J. C. Minor, and which is a model of the best type of scientific research; work which introduces method and order where previously irregularities had prevailed in what was known of a common mineral. The authors showed that the percentage of water, which is only small, and had previously been regarded as the result of incipient decomposition, increases as that of fluorine diminishes, and that different specimens of topaz, if arranged in order of their fluorine-percentage, exhibit a regular progressive change in specific gravity, in refractive indices, in birefringence, and in optic axial angle. This enabled them to refer all topaz to the exceedingly simple formula $(AlF)_2SiO_4$, in which F is replaceable by OH.

Another most remarkable investigation, in which the same replacement is again invoked, was that of the chondrodite group, whose complex crystallographic characters had been deciphered by Scacchi, vom Rath, and others. Penfield and W. T. H. Howe succeeded in proving that the group consists of three species distinct in chemical composition as well as in crystalline form, and differing progressively by a molecule of Mg_2SiO_4; also that the length of the vertical axis is proportional to the number of the magnesium atoms in the formula. This striking morphotropic relationship rendered it possible to predict, for the first time in the history of mineralogy, the composition and form of a hitherto undiscovered mineral, and constituted a very notable scientific advance.

Among the more refined and difficult of his chemical researches may be mentioned those on tourmaline, canfieldite, spangolite, connellite, hamlinite, bixbyite, parisite, and his last published (1906) memoir on stibiotantalite.

In addition to the new minerals analysed for Brush and Dana, as mentioned above, he established, in conjunction with other authors, the following new species: bixbyite, canfieldite, clinohedrite, gerhardtite, glaucochroite, graftonite, hamlinite, hancockite, leucophoenicite, nasonite, nesquehonite, pearceite, roeblingite, and spangolite.

Possessed not only of extraordinary insight and quick apprehension,

but also high inventive skill and dexterity of manipulation, Penfield could not fail to be one of the most gifted and successful of mineral chemists. He possessed the same qualities as a crystallographer, but his chief interest in crystallography was as a practical means of mineralogical research; and he devoted much time to the determination of the geometrical and physical characters, not only of minerals, but also of laboratory compounds. Among the most noteworthy of his crystallographic studies were the determination of clinohedrite, argyrodite, pearceite, sperrylite, and the double halides prepared by Wells.

In much of his work he enlisted the co-operation of his assistants and pupils.

Towards the end of his career, when his mind was much occupied with teaching, he devoted much thought to practical and graphic methods for the representation of crystals, and his protractors and the methods of drawing and projection which he described are now well known. To this period belong his papers upon the stereographic projection and its application to geographical maps and sailing charts, a subject for which he anticipated important developments in the future.

Penfield's clearness of exposition is nowhere better exhibited than in the revised and enlarged edition of G. J. Brush's 'Manual of Determinative Mineralogy, with an Introduction on Blowpipe Analysis,' which was published in 1896, and was followed by several other editions. The introductory chapters which he wrote for this book are models of clear and lucid treatment, and among the very best that can be placed in the hands of elementary students.

For a few years before his death his health was such that he was obliged to husband his strength with great care, and to set very definite limits to the work that he could undertake; nothing was more characteristic of the man than the courage and determination with which he set himself to do the work of which he was still capable. The planning and equipment of his new laboratories in Kirtland Hall was at that time a great pleasure to him.

In a cheery letter written a few months before his death he wrote—'I have to be careful not to take too much exercise or exert myself physically and my hours of work are very much shortened. I ought not to get tired in any way, and I tire easily, so I have to be very careful and constantly on my guard. I go to my laboratory every day and get in about five hours' work. As I look back upon the last three years I can see that something considerable has been accomplished. My

troubles came just as my new laboratory was being started. It has taken a great amount of time and energy, but energy well spent, and the work is done. . . . It is a great delight now to work in my new building where the surroundings are most attractive and everything can be kept clean and neat.' Then after a description of the work on which he was engaged—'I have other things also on hand or in my mind, but I cannot put out work as fast as I formerly did. During hours allowed for study I prefer to work rather than read. I am not complaining; I am so much better than I ever expected to be three years ago.'

He died on August 12, 1906.

In January 1897 he had married Miss Grace Chapman of Albany, New York, who survives him.

None who knew Penfield could fail to be impressed by the earnestness, simplicity, and sincerity of his character: in scientific and intellectual matters he was inspired by a boyish enthusiasm and the keenest enjoyment of life and of the work and occupation of an active student and teacher. He endeared himself to colleagues and pupils alike, and made many warm and enduring friendships in Europe and America. Those who were privileged to enjoy his society when he visited Europe in 1894 and 1897, or to see him among his colleagues in their bachelor quarters at the Sheffield Scientific School, or later in the enjoyment of a happy married life in his own peaceful home, carried away the recollection of a sweet and affectionate nature, and feel that by his death they have lost one of the most warm-hearted and sincere of friends.

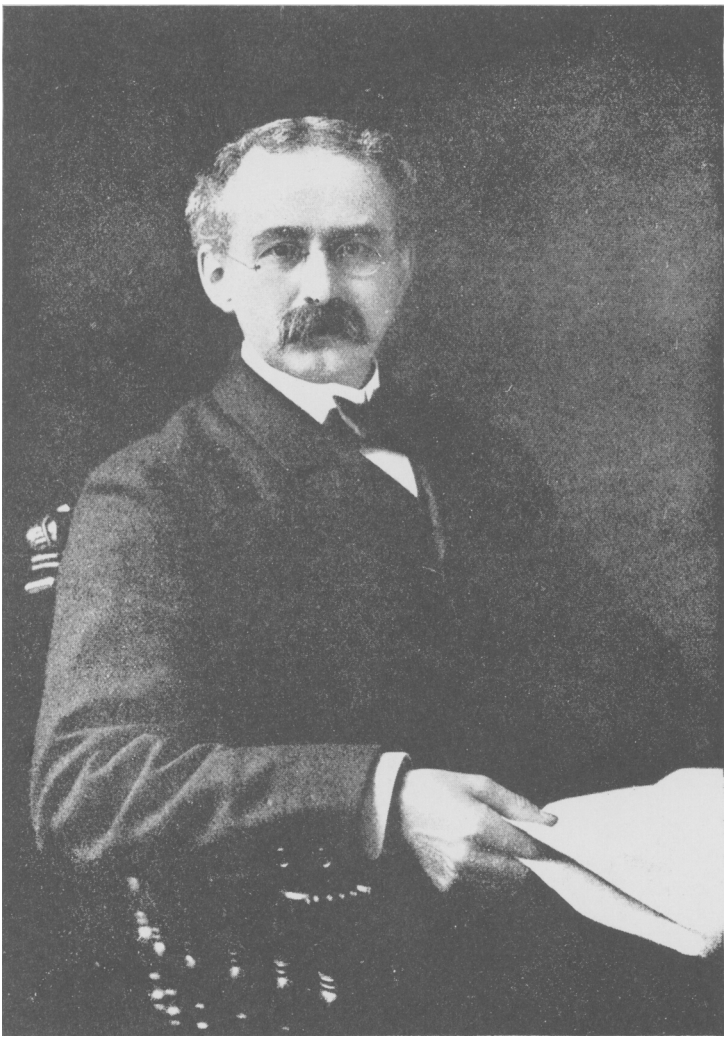
H. A. M.

Robert Philips Greg (1826–1906).

(With a Portrait, Plate VII.)

Born at Manchester on March 23, 1826, Robert Philips Greg passed away at his residence, Coles Park, near Buntingford, Hertfordshire, on August 20, 1906, in the 81st year of his age. His death has removed one who took a prominent part in the formation of the Mineralogical Society and who for the first ten years of its existence held the important office of Treasurer. He was compelled to relinquish this office in November 1885 by the continuance of the severe, and all but fatal illness which befell him in the summer of that year, and, as his health in the following year still remained precarious, he finally severed his connexion with the Society.

Among those who have assisted in the development of the mighty



SAMUEL LEWIS PENFIELD.

(At the age of 46.)

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