obituary

Walter Schottky, author of many significant contributions to the fields of electron and solid-state physics, died on March 4, 1976 at the age of 89. Born in Zürich, he studied under Max Planck at the University of Berlin, and subsequently held university appointments in Wurzburg and Rostock. His first research interest lay in the field of electron physics, and what is now universally called the 'Schottky effect' (the increase in the thermionic emission of electrons from a solid resulting from an external electric field) dates from as far back as 1914.

Possibly as a result of the First World War, Schottky next turned his attention to the radio and in 1915 invented the screened-grid vacuum tube. He is also credited with the invention of the superheterodyne receiver. He studied the 'shot noise' which arises from the discrete nature of the charge carriers in a current of electrons, and in 1918 derived the well-known relationship between the magnitude of the noise and the strength of the current. For these three contributions he was awarded the Hughes Medal of the Royal Society in 1936.

After the war, Schottky's interests turned to thermodynamics and statistical mechanics. One result of this was his prediction of the 'Schottky specific heat anomaly'—the specific heat of a system possessing two closely spaced, discrete energy levels shows a maximum at a temperature comparable with the separation between the levels divided by Boltzmann's constant. His analysis successfully explains specific heat behaviour which has been observed on numerous occasions by low-temperature physicists. His postulation of the existence of 'Schottky defects' in crystals (missing atoms without compensating atoms in interstitial positions) also dates from this period.

In 1927, Schottky became closely associated with the firm of Siemens, thereby continuing a well-established German tradition. From that time onwards he turned his attention to semiconductors, and in particular to the properties of metal–semiconductor contacts, and it is for this work that he is probably most widely known today. It had been known since the early work of Braun in 1874 that metal points in contact with certain solids, such as lead sulphide, show rectifying properties, and although these point-contact rectifiers were not understood, they nevertheless played a most important role as detectors in the early days of radio. In 1931 Schottky and his co-workers showed that in copper oxide rectifiers nearly all the potential drop occurred near the metal contact, thereby implying the existence of some sort of potential barrier. By this time quantum mechanics was firmly established, and Wilson and others tried to explain the rectifying action in terms of the quantum-mechanical tunnelling of electrons through the barrier, but it was soon recognised that this mechanism predicted the wrong direction of easy current flow. Schottky, and independently Mott, suggested that the rectifying action resulted from the thermal excitation of electrons over the barrier, and showed that this model predicted the correct direction of rectification. Schottky supposed that the barrier region contained a space charge caused by a uniform density of charged impurities, so that the electric field increased as the metal was approached, whereas Mott assumed that the conditions of fabrication were such that the barrier region was devoid of impurities, so that the electric field was constant. We now know that Schottky's assumption is the more realistic one in practice, and in consequence the term 'Schottky barrier' is used almost universally to describe a metal–semiconductor contact. Schottky also derived an expression for the capacitance of the contact in terms of the density of charged impurities, and showed how measurements of the capacitance could be used to infer the impurity concentration. This technique is used very extensively throughout the semiconductor industry today.

Schottky was a very versatile physicist who combined a wide theoretical knowledge with a deep physical insight and the ability to look at problems from a practical point of view. He was always ready to apply his science to engineering problems, and it is perhaps appropriate that the term 'Schottky diode' is now firmly established in the vocabulary of electronic engineers who probably know little of his contributions to basic physics.

E. H. Rhoderick

The sudden death of **Professor Richard Foster Flint** of Yale University on June 6, 1976, deprived the world of one of the most eminent of its Quaternary geologists of any generation. Born in Chicago, Illinois, on March 1, 1902, the son of Professors Nott William and Edith Burnham (Foster) Flint of the University of Chicago, he obtained his B.S. in 1922 and his doctorate, *summa cum laude*, from that University in 1925. He joined the Yale University faculty as Instructor the same year and taught at Yale for the next 45 years. He retired in 1970 as Henry Barnard Davis Professor of Geology, the occasion being commemorated by a symposium in his honour and a resulting Festschrift (*The Late Cenozoic Ice Ages*) to which some of the world's leading researchers contributed.

Professor Flint's publications number over 150 research papers and a series of monographs including *Glacial Geology and the Pleistocene Epoch* (1947), *Glacial and Pleistocene Geology* (1957), and *Quaternary and Glacial Geology* (1971). The last stands as the most up-to-date, comprehensive, and masterful overview of the subject in any language. He was also the co-author of a number of editions of such famous Yale texts as *Physical Geology* and *Introduction to Physical Geology*. Especially influential was his stimulating teaching that opened the exciting vistas he saw to generations of Yale graduate students and undergraduates—thousands of the latter benefited from his introductory course on the earth sciences. He also enhanced Yale's reputation by serving as associate-editor, co-editor, or member of the editorial board of a number of scientific journals, including *American Journal of Science, Quaternaria, Quaternary Research, Radiocarbon* and *Zeitschrift für Geomorphologie*. In addition he was Chairman of the National Research Council committees that compiled the Glacial Map of North America and the Glacial Map of the United States.

Professor Flint once said that he did not expect great fame as a scientist, since he desired a life whose breadth would necessarily detract from single-minded scholarship. Yet he not only achieved the full life he sought, including a deep satisfaction in art and pottery, but contrary to his expectations, he also gained the world's acclaim as a scientist. He was a Fellow of the American Academy of Arts and Sciences, honorary member of many foreign geological societies and President of the 7th Congress of the International Quaternary Association.

Professor Flint leaves his devoted lifelong partner, Margaret C. H. Flint, a daughter, Anne Ogilvy, three grandchildren, one great grandchild, and a host of admirers, friends, and colleagues the world over.

A. L. Washburn