Obituary

u u

Sir Charles Frank, who died on 5 April, joined the University of Bristol in 1946 at the invitation of Nevill Mott. Thirty years later he formally retired as head of department and H. O. Wills Professor of Physics — which, by happy coincidence, was the chair that Mott himself had occupied at the time of Frank's initial appointment as a research fellow. In his retirement address to the department, Frank defined physics as "not just concerning the Nature of Things, but concerning the Interconnectedness of all the Natures of Things". It was this approach to physics that marked all of his work and made him one of the foremost scientists of the past 50 years.

Frank was born in Durban, South Africa, but of British parents. He was educated at schools in East Anglia, before taking degrees at Lincoln College, Oxford. He then moved to Berlin for the years 1936–38 to work with Peter Debye, the prominent physical chemist, at the Kaiser Wilhelm Physics Institute there.

In 1940, his lifelong friend and mentor, R. V. Jones, persuaded the relevant authorities to release Frank from his work at the Chemical Warfare Establishment at Porton Down, Wiltshire, so that he could join the newly formed scientific intelligence group at the Air Ministry. Jones did so, first and foremost, because Frank was an outstanding scientist, but also because Frank's time in Berlin had given him an excellent knowledge of German and — just as significant — an understanding of the German way of doing things.

What Jones had not appreciated fully was Frank's amazing visual acuity. In January 1941, he spotted that the width of a shadow of an unusual structure near Cherbourg, in occupied France, had changed slightly in two successive reconnaissance photographs. The change was incredibly small, approximately 0.1 mm, which was essentially the resolution limit of the photograph. This acute observation led to the first identification of a German radar station. This was just the first of many major insights described in Jones's book, *Most Secret War*, published in 1978; the common thread in all of them was Frank's ability to connect apparently unconnected observations.

Frank's wide range of interests, combined with his outstanding ability, directly influenced the course of much of modern solid-state physics. His name has been associated with such diverse fields as the study of crystal growth, liquid crystals, metallurgy, polymer physics, quasicrystals, snowflakes, diamonds and geophysics. At the highest level, all of these areas involve the ability to see and describe, with the aid of rigorous mathematics, geometrical relationships in three-dimensional space. As Sir Michael Berry said in his funeral address, to see Frank's hand-waving (figuratively and literally) explanations of crystal symmetry in multidimensional space, especially when he was at the wheel of his car, was an unforgettable experience.

In spite of his reputation in solid-state physics, early in his career at Bristol Frank produced what is now regarded as a classic paper on nuclear physics. The paper, "Hypothetical Alternative Energy Sources for the 'Second Meson' Events" (*Nature* 160, 525–527; 1947), represented, for the first time, the idea that nuclear fusion could be catalysed by muons. As students of citation indices know, half of all published scientific papers are never cited and of the rest 80% are cited only once. A few, a very few, are cited 20 or more years after publication; today, probably 90% of papers published on muon-catalysed fusion cite that 1947 paper. Mott's Bristol was in an exciting phase of development, and although Frank was not a member of Cecil Powell's group, which was busily discovering pi and mu mesons, he spotted the wider significance of these new particles and laid the foundations for the later work of Andrei Sakharov in the Soviet Union and Luis Alvarez in the United States.

Frank's scientific style was to publish one seminal paper on a topic and then move on to new investigations. In "Curvature of Island Arcs" (*Nature* 220, 363; 1968), for example, he produced a simple geometrical explanation of the shape of island arcs. The analogy — the depression in a ping-pong ball when it is pressed in one place — was so beautiful and elegant that it just had to be right. Perhaps the most famous of his papers, "The Growth of Crystals and the Equilibrium Structure of their Surfaces" (with W. K. Burton and N. Cabrera, *Phil. Trans. R. Soc. Lond. A* 243, 299–358; 1951), laid the foundation for all that we know about crystal growth and the significance of the so-called screw dislocation as the rate-determining parameter. The impact of this contribution continues to be felt in metallurgy, materials science and the semiconductor industry. When Frank announced his findings at a conference, a member of the audience came forward and produced photographs which illustrated exactly the growth mechanism this work predicted.

Sir Charles Frank received many honours, awards and honorary degrees. His knighthood in 1977 marked his contributions to science at the national and international level. He was elected to the Royal Society in 1954 (at the comparatively young age of 43), and served as vice-president in 1967–69; he received the society's Royal Medal in 1979 and, in 1994, its highest award, the Copley Medal. The Institute of Physics recognized his work by the award of the Guthrie Medal and Prize in 1982.

In 1940 he married Maia Maita Asché, who survives him. She gave him support and encouragement throughout his long and distinguished career — Charles and Maita were a devoted couple and together did much to promote the happy atmosphere in the physics laboratory at Bristol.

Charles Frank always had a kind word for both his senior and junior colleagues, and he bore his physical discomforts with fortitude and determination (I never once heard him complain about the pain which was his constant companion in his later years). He combined intensity with humanity, even-temperedness with rigour, and presence without pomposity. We all miss him greatly.

John E. Enderby

John E. Enderby, H. H. Wills Physics Laboratory, University of Bristol, Tyndall Avenue, Bristol BS8 1TL, UK, was H. O. Wills Professor of Physics at Bristol from 1981 to 1996.
e-mail: jee@siva.bristol.ac