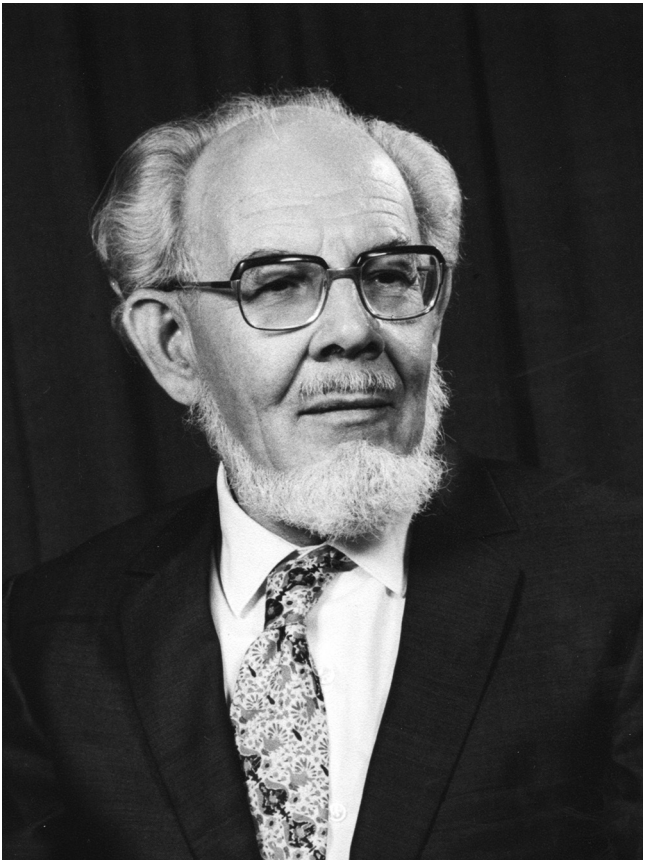

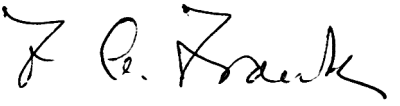

# SIR CHARLES FRANK

*1911–1998*

Elected in 1980

*"For providing fundamental understanding of the behaviour of dislocations in solids."*

BY R.G. CHAMBERS
SUBMITTED BY THE NAE HOME SECRETARY

FREDERICK CHARLES FRANK, scientist, was born on March 6, 1911, in Durban, South Africa, the eldest of three sons of Frederick Frank (1877–1970), farmer, and his wife Medora Celia Emma (1876–1966), daughter of Charles Read of Brundish Hall, Suffolk, and his wife Emma. Frederick Frank's father, Charles Henry Frank of Poslingford, was a Suffolk farmer, like Medora's father, but an impoverished one, and a number of his 17 children emigrated to Canada or South Africa in search of a better life. Frederick himself became a merchant seaman and sailed more than once around the Horn before enlisting in the Third South African Light Horse (Kitchener's Horse) during the Boer War. After the war, he joined two of his older brothers in a business in Durban, and in 1910 he married Medora, who had nursed him in hospital 10 years earlier. In 1911, when their son Frederick Charles was only ten weeks old, the family moved back to England, eventually settling at Abbot's Farm, Denham Abbots, Suffolk, where Charles Frank (he never used the forename Frederick) spent his childhood.

His early schooling, till the age of 9, was at a tiny village school near Denham Abbots, run by a Mrs. Petley. He then went as a boarder first to Thetford Grammar School from 1920 to 1926, and then, after the family had moved from Denham Abbots to Cavendish, to Ipswich School from 1927 to

1929. There he took part in school plays—in the part of Mrs. Hardcastle he is said to have fondled, scolded, and complained in turn with equal skill and energy—and school debates, in one of which he eloquently opposed a motion, proposed by his younger brother John, that scientists should be kept in their place. There, too, he learnt chemistry and gained an open scholarship to Lincoln College, Oxford, and a state scholarship.

At Oxford, he coxed, rowed, punted, and pursued the study of chemistry, gaining a First in 1933. He then became nominally an engineer, earning a D. Phil. in 1937 for work on dielectrics carried out in the Oxford Engineering Laboratory. Part of his later strength as a theoretical physicist lay in the breadth of his background: from 1936 to 1940, he worked successively as a physicist with Debye in Berlin, as a colloid chemist with Rideal in Cambridge, and (in the early days of the war) as a chemist at Porton, before finding his wartime métier with R.V. Jones in Air Ministry Intelligence. He had met Jones at Oxford, and they became lifelong friends. The story of their wartime collaboration is well told in Jones's book *Most Secret War*, which includes several stories of the inspired common sense with which Charles Frank managed to interpret the confused scraps of information coming from occupied Europe, and the extraordinary observational powers that enabled him to detect enemy radar stations from the tiny blurred images on aerial reconnaissance photographs and led to the successful Bruneval raid in 1942. For this work he was appointed OBE in 1946.

In the same year he came to the Physics Department in the University of Bristol, where he worked until (and long past) his retirement in 1976, becoming a professor in 1954 and head of department in 1969. With publications spanning 60 years, he was remarkable for the sheer breadth of his contributions to science. His main work was in dislocation theory, but he also made major contributions to our understanding of cold fusion, liquid crystals, alloy structures, polymers, earthquakes, and continental drift.

Soon after Frank's arrival in Bristol, Cecil Powell and his group there discovered the pi-meson, and this led Frank to

look for other possible explanations of what Powell had found, and to his brilliant realization that a mu-meson might catalyze nuclear fusion by enabling two nuclei to approach very close to each other. (A year or so later, Sakharov made the same suggestion independently.) Fifty years later, muon-induced fusion remained an active field of study, and Frank's original paper continued to be widely quoted.

But this was by way of a digression for Frank: his main field of work for many years was the study of dislocations, imperfections in crystal structure that profoundly influence the mechanical strength of metals and other materials, and that are therefore of great technological importance. His contributions were manifold and of fundamental significance: they included the laws governing dislocation branching, the existence and properties of dislocation networks, and the Frank-Read mechanism for the generation of dislocations. The idea for this mechanism came simultaneously and independently in 1950 to Frank and to Thornton Read, working at Bell Laboratories in the United States, and they published it jointly.

A year earlier, Frank had shown that accepted theories failed by an enormous factor to account for the observed growth rates of crystals, but that these could readily be explained if the growth face contained a screw dislocation and that this mechanism would produce "growth spirals" on the growth face. This theory was dramatically confirmed when he presented it at a conference: a member of the audience rose to say that he had recently observed just such spiral features and produced photographs of them illustrating exactly what Frank had predicted.

One can illustrate the diversity of other fields in which Charles Frank made significant contributions by choosing (almost at random) three characteristically short and incisive papers: one on asymmetry in nature (1953), which anticipated population dynamics studies; one on liquid crystals (1958), which stimulated a vast amount of subsequent work on these materials; and one on island arcs (1968), the curved chains of islands that occur particularly in the Pacific. The latter drew a delightful analogy between the earth's crust and a ping-pong

ball: if one pushes one point on a ping-pong ball inward, it will form a saucer-shaped dimple with a sharp rim, and Frank showed that island arcs are probably formed by a similar deformation of the earth's crust.

In his retirement, he continued to publish until well into his eighties. In particular, he undertook the substantial task of editing the Farm Hall transcripts: the secretly made recordings of the conversations of a group of eminent German physicists who were detained at Farm Hall in Cambridgeshire between June and December 1945, including their reactions to the dropping of the first atomic bombs. He had himself visited and talked with them in November 1945; now, almost 50 years later, he was able to correct errors in the transcripts and to elucidate their contents, which make a fascinating story.

In his later years he became increasingly infirm physically, though his clarity of mind and his phenomenal memory remained practically unimpaired, and he bore his infirmities with stoic patience. A few hours before he died, on April 5, 1998 (at Southmead Hospital, Bristol, of internal bleeding), he was busy reading and vigorously discussing with his friends a new book on geophysics.

Charles Frank was one of the outstanding physicists of his generation. In all his work, he showed deep physical insight, an easy mastery of the relevant mathematics, great originality, and an incisive clarity of presentation. For his many scientific achievements, he was elected a fellow of the Royal Society (FRS) in 1954, and was awarded the Copley Medal, the Royal Society's highest honor, in 1994. He served as a vice president of the Society from 1967 to 1969, and was knighted in 1977. His many other academic honors included seven honorary degrees. For more than 60 years, he contributed profoundly to our understanding of nature, not only through his own 200 publications but also through endless conversations with all the colleagues who came to seek his help and advice in understanding their work.

But his interests were not confined to science: they included languages and etymology, the history of science, and the theater, music, and art. He also served for many years as

a governor of two of Bristol's schools, Queen Elizabeth's Hospital and Badminton School.

Of middle height, with an impressive head, he was gruff but even-tempered, warmhearted but unsentimental, and habitually rigorous in his thinking, and he could be counted on to express lively, stimulating, and well-argued views not only on scientific matters but on almost any issue worthy of debate. So too, on nonscientific matters, could his wife. In December 1939, he had met Maita Asché (1918–2009), the lively and delightful daughter of a professor of engineering in St. Petersburg. Her family was Finnish and she was born in Finland, but through the accidents of revolution and civil war she had been brought up in Czechoslovakia. She was staying in Cambridge with Walter Adams, the secretary and later director of LSE, when Charles Frank met her. They married in April 1940. They were a splendidly matched couple and together contributed greatly to the social life of both the university and the city of Bristol.

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