GEORGE STANLEY RUSHBROOKE
BA, CPhD, MA(Cantab), FRS

G Stanley Rushbrooke, Professor of Theoretical Physics, Newcastle University, 1951-80, died on December 14 aged 80. He was born on January 19, 1915.

Throughout this century physicists and chemists have struggled to understand how the physical properties of solids, liquids and gases arise from the forces between their molecules. Stanley Rushbrooke devoted a distinguished career to furthering this area of study and played an important role in the group of scientists who largely solved the question.

As a postgraduate student at St John's College, Cambridge, in the 1930s, George Stanley Rushbrooke came under the supervision of R H Fowler, then the leading British authority on statistical mechanics. It was postulated at that time that liquids could be described as slightly disordered solids and Rushbrooke's first project was to explore this theory further. He continued throughout his life to make important contributions to the statistical mechanics of arrays of molecules and magnetic elements on the sites of a regular lattice array, which is an appropriate model of a solid, but he came to realise that this was not an appropriate one for a liquid.

Rushbrooke held posts in both physics and chemistry departments at Bristol, Dundee, Leeds and Oxford. But it was during his time as Professor of Theoretical Physics at Newcastle University that his most innovative work was done. In his study of 1951 to 1953 Rushbrooke, helped by one of his students H E Scoins, made a decisive break with pre-war tradition by the reintroduction into statistical mechanics of the concept of the direct correlation function - a function that had been devised in 1914 by two Dutch physicists and then ignored for forty years. This function was to prove the key in creating a genuine continuum theory of liquids, free from the artificial constraint of a solid-like lattice. In 1954 Rushbrooke was elected to the fellowship of the Royal Society of Edinburgh and in 1979 to that of the Royal Society of London.

Rushbrooke used the device of the direct correlation function in 1960 to develop an ingenious theory of the structure of liquids known, because of the way the molecular interactions were linked, as the hyper-netted chain method. But others had by then also appreciated the power of this revived function and this theory was postulated simultaneously also in the United States, Japan and The Netherlands. The 1960s saw Rushbrooke at the peak of his powers, producing a steady flurry of papers on the theories of both liquids and lattice models.

Above a certain critical temperature liquids and gases can no longer be distinguished from each other, although this transition to a unified fluid state was then imperfectly understood. But in 1963 Rushbrooke showed rigorously that one set of physical properties of a magnetic system at the equivalent (Curie) point had to be at least as large as another set. It was found later that they are, in fact, equal in size and that this result holds also for liquids and gases.

This apparently obscure mathematical identity, and others that followed, paved the way for a number of papers in which the problem of the critical state was, in essence, finally solved. The Nobel Prize for this achievement went, nearly twenty years later, to Kenneth Wilson at Cornell University, but Rushbrooke's simple result of 1963 was a touchpaper.

Rushbrooke was a regular attender at the biennial Gordon conference on liquids in New England where he would sit quietly smoking his pipe until he had an incisive contribution to make to the discussion.

In 1949 Rushbrooke married Thelma Barbara Cox, who died in 1977. They had no children but he is survived by his twin brother, who is a mathematician.