Obituary

John Frank (Jack) Allen (1908–2001)

In late 1937, two young physicists at the Royal Society Mond Laboratory in Cambridge, UK, found that liquid helium could flow through very small capillaries with essentially zero viscosity below a temperature of 2.17 kelvin. While they were preparing a note for publication, they heard of another paper, just submitted by P. L. Kapitza in Moscow, reporting similar results. Both papers appeared side by side on 8 January 1938 in *Nature*. Kapitza and the young physicists Jack Allen and A. D. Misener had discovered the mysterious phenomenon of superfluidity in liquid ^{4}He. It was the start of a golden period in low-temperature physics. Allen, the last survivor of this heroic time, died of a stroke on 22 April 2001, aged 92.

Most of Allen's greatest discoveries were made at the outset of his career (in 1938 he was essentially a postdoc, working without a supervisor, which suited him fine). Between 1937 and 1939 he and his associates at Cambridge produced a stream of papers on superfluidity in liquid ^{4}He, this output coming to an abrupt end with the start of the Second World War. In 1946, with normal life resuming, Allen organized the first international low-temperature meeting at the University of Cambridge, UK. This was the birth of the major triennial event in the low-temperature physics community; the twenty-third meeting will be held in Hiroshima next year.

In 1947, Allen was appointed professor of natural philosophy and head of physics at the University of St Andrews in Scotland, and two years later he became a Fellow of the Royal Society. But although he stayed active in the world of low-temperature physics, revitalizing research at St Andrews and helping to run many conferences and workshops, his own research was never again central. He retired from St Andrews in 1978.

Jack Allen was born in Winnipeg, Canada, in 1908 (the year ^{4}He was first liquefied in Leiden, in the Netherlands). He received his BA from the University of Manitoba, where his father was head of the physics department. In 1929, he went to study at the University of Toronto where James F. McLennan had built up a strong physics department. In 1923 this had been only the second laboratory in the world to liquefy helium, and when Allen arrived he immersed himself in the new world of cryogenics. He received his PhD in 1933, having already written ten papers on superconductivity. Late in 1935 he went

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Co-discoverer of superfluidity

to Cambridge to work with Kapitza, only to find that Kapitza was being detained in Moscow, and was in the process of setting up what was to become the famous Institute of Physical Problems. In Kapitza's absence, Allen effectively took over the low-temperature work, although officially the director was J. D. Cockroft.

In 1935, Don Misener, a graduate student at Toronto, had carried out the first experimental study of the viscosity of liquid ^{4}He. By then it was known that liquid helium underwent some sort of phase transition at 2.17 K, as there were abrupt changes in various thermodynamic properties. Misener's work suggested that the viscosity decreased substantially when the liquid passed through this transition. Misener joined Allen at Cambridge in 1937 to do his PhD, and the two set out to study the phenomenon by examining flow in thin capillaries.

Misener's 1935 experimental work had also attracted the notice of Kapitza in Moscow. Both groups reported their independent discovery of superfluid flow in 1938, with Kapitza being the first to coin the term 'superfluid'. It is puzzling and unfortunate that when Kapitza finally received a well-deserved Nobel prize in physics in 1978, the citation concerning superfluidity made no reference to the work of Allen and Misener.

Allen quickly found other dramatic manifestations of superfluidity, all of which involved the counterflow of the normal and superfluid components or the 'clamping' of the normal component with fine powder. But after 1945 the Moscow group under Kapitza (helped by L. D. Landau, who developed a complete theory of the two-fluid behaviour of superfluid helium in 1941) dominated further research on quantum liquids. The study of superfluid ^{4}He increasingly involved microscopic theories and new experimental probes such as neutron scattering, none of which interested Allen.

Allen was the last of a generation of independent-minded classical physicists who delighted in explaining the visible world. He prized his own ability, and that of glass-blowers and technical people, to build experimental apparatus. Allen was as proud of his invention of the O-ring vacuum seal as anything else he did. It should be no surprise that his greatest work on superfluidity in liquid ^{4}He involved phenomena that could be seen. Indeed, it is most fitting that Allen discovered the famous 'fountain effect' in 1938 with the help of a pocket flashlight.

Over a ten-year period Allen made a movie of the various two-fluid phenomena exhibited by liquid ^{4}He. The photography of these effects was a real challenge, because liquid ^{4}He is essentially transparent. This unique colour movie (the fifth edition was completed in 1982) is one of Allen's great legacies to physics.

Allen had a commanding presence and a dry sense of humour. He strongly identified with the physics of an earlier day, and I imagine that he would have enjoyed talking with classical physicists such as Lord Rayleigh, Michael Faraday and Daniel Bernoulli more than with Werner Heisenberg and Erwin Schrödinger. Superfluidity is a dramatic visible manifestation of quantum mechanics, being the result of Bose–Einstein condensation in which a macroscopic number of ^{4}He atoms occupy the same, single-particle quantum state. It is paradoxical that the phenomenon was first observed by Allen: a great physicist who wasn't much interested in atoms.

Walking the old stone streets of St Andrews, one quickly notices the elegant metal historical plaques on many buildings, commemorating famous people who have been associated with this historic town and its university over the centuries. Almost every plaque connects its subject to physics — not surprising, because Jack Allen was the motivating force behind the sign committee. I very much hope that the town sees fit to so honour Allen himself.

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