

Jack Allen

Jack Allen, doyen of low temperature physics, has died in St Andrews at the age of almost 93.

His most important discovery, the superfluidity of liquid helium, was made in Cambridge in 1938. His experiments with Don Misener and Harry Jones – together with those of Peter Kapitza (Moscow), John Daunt and Kurt Mendelssohn (Oxford), and others who all published their results in the same celebrated volume 141 of *Nature* – led to the realisation that the liquid loses all its viscosity when cooled below the so-called lambda transition at $T_\lambda = 2.17\text{K}$. Two apparently incompatible theories of this bizarre phenomenon quickly followed. Fritz London (Poincaré Institute, Paris) suggested that it corresponded to Bose-Einstein condensation, whereas Lev Landau (Moscow) proposed that it was attributable to the thermal energy taking the form of discrete excitations whose dispersion curve (energy-momentum relationship) was of an unusual form. Each theory gave rise to quite definite predictions, so that in principle it should have been easy to decide who was right. But more than 40 years of controversy were to follow before experiments showed that, remarkably, both theories were right: the Landau critical velocity exists, above which superfluidity breaks down in showers of excitations called rotons; and liquid helium below T_λ does possess a Bose-Einstein condensate of atoms with zero-momentum.

Jack Allen was born in Winnipeg, where his father was professor of physics at the then new University of Manitoba. Under paternal pressure – Frank Allen reckoned that the BSc was too narrowly scientific – Jack enrolled for a BA at Manitoba, enabling him to study French, English, History and Geology during his first year, perhaps accounting in part for his breadth of knowledge and the vitality of his writing style later. After graduating, he worked first on the physiology of vision and hearing, and then moved to Toronto to conduct research in superconductivity under J C McClennan.

Following his PhD in 1933, Jack was awarded a US National Research Council Fellowship. This was required to be held in the USA, so he had to defer his hopes of studying with Peter Kapitza in Cambridge and went instead to Cal Tech. He described his time there as “not fruitful scientifically”, but he met a lot of famous or about-to-be-famous scientists including Bill Houston, Theodor von Karmen, Bob Oppenheimer, George Porter and Linus Pauling.

In 1935 he wrote to Ernest Rutherford, to see if he could come and work with Kapitza. This was agreed, and Kapitza wrote a pleasant letter of welcome. But it was not to be. Shortly before Jack’s arrival, Kapitza was detained by Stalin while visiting his mother in Moscow, and was not allowed to return. Although working in Cambridge without a salary, Jack soon found that it was “...a kind of civilized jungle, with people being paid piece rates for all kinds of jobs – demonstrating, supervision, examining, having research students, etc”. He thus survived to discover superfluidity and the famous fountain effect, in which a tiny temperature difference in the superfluid (generated in his case by shining a torch on it) produces enough pressure to squirt a fountain of liquid skywards.

Soon the Second World War intervened. One of Jack’s contributions to the war effort was a new accelerometer to measure artillery shells’ typical accelerations of $150,000g$ within gun barrels. His device was simple but elegant – a one-eighth inch diameter annealed copper ball, whose inertial mass would cause it to flatten slightly against the surfaces of a close-fitting cubical steel box. He and his student Pat Willmore established that shells often suffer tranverse acceleration (so-called side-slap) of $50,000g$ or more,

which was ample to shear the pivots off the gears of a conventional clockwork fuse. It explained the unreliability of ordinary fuses and paved the way for Merle Tuve's radar proximity fuse, used later against kamikaze fighters in the Pacific.

After the war, Jack was appointed to the chair of Natural Philosophy in St Andrews, where he built up a large group of highly talented low temperature physicists. The physics building, opened in 1965, bears his imprint and his loving attention to the kinds of details architects forget about, in innumerable ways. It subsequently became familiar to physicists the world over as a conference venue, and a very good one because it was one of the purposes for which he had consciously designed the layout.

Jack was elected FRS in 1949. He played major roles both in the University, being Dean of the Faculty of Science twice, and nationally as a founder member and chairman of the UK Standing Conference of Professors of Physics and its Scottish equivalent. He was also a member and then chairman of the Very Low Temperature Commission of IUPAP, responsible for the long-running series of biennial and later triennial LT international low temperature conferences.

He was fiercely loyal to his adopted country, being especially proud of Scottish education and science. In his retirement, he organised several plaques commemorating famous scientists whose Scots associations were, he felt, being overlooked – including Neville Maskelyne, for whom Jack erected a plaque at the side of the main road by Schiehallion, the somewhat bulbous mountain with whose help Maskelyne had measured G in 1774.

All his life Jack was fascinated by the physics of meteorological phenomena, and he managed to witness the elusive “green flash” of the setting sun (see *Physics World*, February 1993) on at least seven occasions, his best being on Iona in the mid 1960s –

At dinner in the hotel I said I was going to go up Dun I – the highest point at the north of the island, but only ~ 100 m high – to watch for it. The other three at the table said could they come too and what was it? I explained. We set out and walked purposefully past the Abbey ruins and other people, seeing us walking purposefully, asked the reason. There is little to do on Iona, so anyone walking purposefully must have an interesting reason for doing so. I explained, they joined us, and at the top there were 9 or 10 of us. I gave a lesson on optics. It looked good, because the sun was going to set over Tìree, a long flat island... there was a hanger on the island and I said “Fix your eyes on it until I say ‘Look’...” The solar disk was 1 or 2 solar diameters from the hanger. It sank lower and lower and finally the last bit of disk was there, I said “Look”, and it shone bright green. There was a kind of sigh from the viewers and I said they might not see that again in their lifetimes. We all were back in time before the bar closed. It was terrific.

Although Jack's infectious enthusiasm and energy and impious humour are gone, there is much to remember him by. Not least his marvellous, still unsurpassed, ciné film *Superfluid Helium* with Jonathan Armitage which, with his own gravelly voice on the soundtrack, has introduced the wonders of that extraordinary liquid to successive generations of physics students in many countries.

Jack Frank Allen was born 6 May 1908 and died 22 April 2001

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