critical role for 'antigenic' peptide in some of these cases.

Some of the strongest data to implicate antigenic peptides in allogeneic responses come from a cytotoxic T-cell line, the alloreactivity of which is dependent not only on the presence of an allogeneic MHC molecule but also on the expression of an MHC-linked gene (D. Schendel, University of Munich). The fact that these T cells also respond to genetically identical cells that have been transformed by Epstein–Barr virus is most simply explained by the ability of the same T-cell receptor molecule to see either a peptide from Epstein–Barr virus bound to syngeneic MHC or a peptide from an MHC-linked gene bound to an allogeneic MHC molecule.

Although several experiments suggest the attractive conclusion that MHC–peptide complexes are required for allorecognition, a few suggest that allospecificity is not always peptide dependent. One provocative analysis indicates that as many as 60 per cent of $H-2L^d$specific cytotoxic T lymphocytes express the same T-cell receptor variable region family, but show no evidence of conservation of primary sequence at the V–D–J junction (J. Bluestone, University of Chicago). A favoured interpretation is that an interaction between the V-domain of the T-cell receptor and a domain of the $H-2L^d$ class I molecule is sufficient to confer allospecificity in the case of this particular response.

The difficulty in drawing a precise picture of alloreactivity lies in the wide spectrum of interactions that T-cell receptors are equipped to form. At one extreme is the possibility that some T-cell receptors may interact only with amino-acid side chains (and perhaps even the peptide backbone) of the MHC molecule, whereas, at the other extreme, others might interact only with peptide-derived structures even though the peptide is MHC bound. These simple models are compounded by considerations of conformational changes that might be induced either in the MHC molecule on the binding of the peptide or in the peptide on the binding of the MHC molecule. The favoured model, of course, includes a little of each extreme — most T-cell receptors interact with structures determined by both the MHC molecule and the resident peptide. Thus, allorecognition increasingly becomes a set of special cases of antigen-specific MHC-restricted interactions. □

David H. Margulies is in the Laboratory of Immunology, National Institute of Allergy and Infectious Diseases, Bethesda, Maryland 20892, USA.

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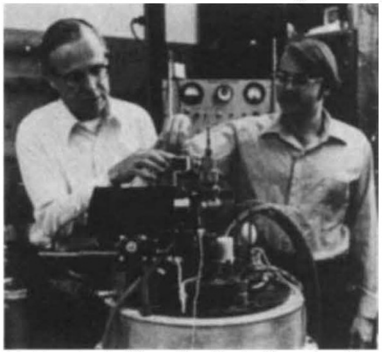
William Martin Fairbank (1917–1989)

THE American physicist, Bill Fairbank, died on 30 September of a massive heart attack while jogging near the Stanford University campus. He was a giant among the experimental physicists of his generation, recognized for his brilliant experiments in low-temperature physics concerning liquid helium and superconductivity, and for his ingenious use of low-temperature techniques to explore many other areas of physics including elementary particles, gravitational waves and general relativity.

During the early part of his career, he and his group performed pioneering studies on the nature of ^{4}He and ^{3}He at low temperatures. They were the first to measure, in 1954, the Fermi–Dirac nature of ^{3}He using NMR techniques at temperatures below 0.25 K. Two years later, they discovered the phase separation of ^{3}He–^{4}He mixtures at temperatures below 0.8 K, also using NMR. By exploring the phase transition of ^{4}He into the superfluid state with microkelvin resolution, they showed that the heat capacity has logarithmic divergences around both sides of the critical temperature, with a discontinuity at the critical temperature. By the late 1960s, Fairbank's group had detected the quantized angular-momentum states of rotating superfluid ^{4}He and nuclear antiferromagnetism in solid ^{3}He. The studies of superfluid ^{4}He were motivated by F. London's theories of the macroscopic quantum nature of the superfluid and led naturally to studies of superconductivity, which London believed was a similar phenomenon.



Fairbank (left) with G. LaRue by the fractional-charge experiment. (From *Near Zero*, Freeman, New York, 1988.)

Fairbank's most important contribution was the discovery, together with his graduate student B.S. Deaver, of the quantization of magnetic flux in a superconducting ring. In one extraordinary experiment, they observed quantization in multiples of *hc/2e*, demonstrating both the macroscopic quantum nature of superconductivity and the pairing of electrons in the superconducting state. Later experiments with rotating superconductors included the first observation of the London moment, a spontaneously appearing magnetic moment that is proportional to spin speed and which also arises from the macroscopic quantum nature of the superconducting state.

Later, Fairbank initiated a series of ambitious experiments which have as a common theme the application of low-temperature techniques and devices to the study of exciting questions in other areas of physics. Three of these continue as lively and important research programmes. The first is the superconducting electron accelerator based on niobium radiofrequency cavities. The unique properties of this facility were needed in the first demonstration of the free electron laser. The second is a NASA programme to perform a fundamental test of Einstein's theory of general relativity in Earth orbit. The experiment is based on an exquisitely precise cryogenic gyroscope whose London moment is monitored. It is scheduled for a test flight in 1993 and a science mission in about 1996. The third is a search for gravitational waves, which are predicted by general relativity and are thought to be emitted during the collapse of stars into neutron stars or black holes. Detectors capable of observing a collapse anywhere within our own Galaxy are in operation, and the construction of detectors capable of sensing collapses within the local Virgo cluster of galaxies are under design.

Perhaps Fairbank's most controversial experiment is the search for free fractional charge in matter (a possible indicator of free quarks), an experiment in which niobium microspheres are levitated in a magnetic field between capacitor plates. The motion of a sphere in an oscillating electric field is used to measure the charge on each sample. After many years of careful work, the group reported "evidence for" (in 1977) and "observation of" (in 1981) free fractional charges in matter with values of +1/3 *e* and −1/3 *e* modulo *e*. In 1986, after studying and understanding a new systematic effect related to an interaction between the magnetic levitation and the capacitor plate vertical alignment, they chose to modify the 1981 conclusion, returning to the earlier wording of "evidence for" but reiterating that the strong statistical evidence for fractional charge in both sets of earlier data remained compelling.

Over the past several years, further modifications of the apparatus have removed this systematic effect and even on the night before his death, Fairbank and his students obtained new data. Analysis of these most recent experiments is continuing. Throughout this difficult work, Fairbank's strengths were always evident. He tackled enthusiastically the most difficult fundamental experiments, remained open to new conclusions and never feared failure.

BLAS CABRERA

Blas Cabrera is in the Department of Physics, Stanford University, Stanford, California 94305, USA.