

MAR06-2005-002323

Abstract for an Invited Paper
for the MAR06 Meeting of
the American Physical Society

Liquid Helium 3 and Solid Helium at Yale and Beyond

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Many of the foundations of low temperature physics in the latter half of the twentieth century were built at Yale University under the leadership of Professor Cecil T. Lane who came to Yale in 1932 and Henry A. Fairbank who obtained his Ph.D. at Yale in 1944 under Lane's guidance. This discussion will mainly treat the contributions of Henry Fairbank and his students during the period between 1954 and 1963, when Henry Fairbank left Yale to become chairman of the Physics Dept. at Duke University. Following World War II small amounts of helium three became available to low temperature experimenters. Henry Fairbank's graduate students were provided with the opportunity to investigate second sound in dilute and later concentrated mixtures of helium three in superfluid helium four. These measurements showed strong effects of the phase separation in helium 3 - helium 4 mixtures previously discovered in the laboratory of William Fairbank (a student of Lane and a brother of Henry Fairbank). As more helium three became available, studies of pure helium three were performed, including measurements of the thermal conductivity, the density and the specific heat. Early evidence for the melting curve minimum was found. The main emphasis in this work was to search for Fermi liquid behavior. Much of the later work in this area was performed by the group of John Wheatley at the University of Illinois. In studies of solid helium four at Yale, a surprising observation was made. Hitherto it had been thought that hcp was the stable phase throughout the low temperature part of the phase diagram. It was found via ultrasound experiments that a small silver of bcc solid existed at the lowest pressures. While this author was a graduate student at Yale, Henry Fairbank pointed out to him the possibility of cooling helium three via adiabatic compression from the liquid into the solid phase. (Pomeranchuk Cooling). A brief discussion is given of the use of this technique in the discovery of superfluid helium 3 by Osheroff, Richardson and the author at Cornell.