Kamerlingh Onnes Conference on Low-Temperature Physics

By ***Charles F. Squire***

FIFTY years ago H. Kamerlingh Onnes liquefied helium at Leiden University and to commemorate this the Netherlands Physical Society, together with Leiden University and certain Dutch industries, held a conference on low-temperature physics (June 23–28, 1958). There were more than 30 nations represented and over 300 participants, of which 100 were from the USA and three from the USSR. It was quite clear that Kamerlingh Onnes had really started something, for there were some 165 papers ranging over the topics which are unique to very low temperatures. The much coveted scientific award, The Kamerlingh Onnes Medal of the "Nederlandse Vereniging voor Koeltechniek", was presented to S. C. Collins of the Massachusetts Institute of Technology. He became the third recipient of this honor, the other two being Peter Kapitza and the late Sir Francis Simon.

Conference delegates were given a most delightful time during the hours when they were not absorbed in science. Many swam in the North Sea at Noordwijk, went on boat trips in the canals which boarder the polders, and visited the great cultural centers of Holland. At the banquet, which was held in the international bird park, The Avifauna, the conferees and their wives were convinced that international good will could nowhere else reach such warmth. The after-dinner remarks by our own Karl K. Darrow were witty, sparkling, and spoken in three languages (Dutch, English, and American slang). No effort or detail was left undone by the efficient and generous organizing committee, three of whom were outstanding: C. J. Gorter (the president), J. van den Handel (the secretary), and G. J. van den Berg (the concert master).

On the scientific side of the meeting, the blending of experimentalists and theoreticians was stimulating. For example, R. Feynman of the California Institute of Technology tried to tell V. P. Peshkov of Moscow how to make a measurement on rotons in superfluid liquid helium, and D. K. C. MacDonald of Ottawa firmly convinced A. H. Wilson of Coventry that the theory of thermoelectricity was inadequate. The experiments on neutron scattering from rotons in superfluid helium reported by J. Yarnell of Los Alamos brought forth enthusiastic applause and a request for a preprint was made by E. Andronikashvili of Tiflis, USSR. Surely the last skeptic about the existence of quantum excitations called rotons in superfluid liquid helium has been silenced by now. According to W. F. Vinen of Cambridge University, the hydrodynamical picture of uniformly rotating superfluid liquid helium requires still another quantized excitation called a vortex. He described a new experiment in which single quanta of circulation around a fine wire have been observed by studying transverse oscillations of the wire; the experiment has provided direct evidence both for the peculiar flow pattern to be expected in the superfluid of uniformly rotating helium and for the quantization of circulation. E. F. Hammel and R. D. Taylor of Los Alamos reported detailed experiments on the He-3 isotope. V. P. Peshkov indicated that the well-known phase separation of liquid He-3 from liquid He-4 at very low temperature could be observed optically.

John Bardeen presented further work on the new theory of superconductivity which he developed together with L. N. Cooper and J. R. Schrieffer. H. Fröhlich of Liverpool seemed fairly convinced of the BCS theory insofar as it goes and now demands more details particularly with respect to the Meissner effect. A. H. Wilson, on the other hand, is an outright skeptic! There were contributions to the experimental treasure chest of superconductivity by P. H. Keesom of Purdue University, H. A. Boorse of Columbia University, and B. B. Goodman of Grenoble University.

There were a group of papers dealing with nuclear magnetic resonance and electron magnetic resonance at very low temperatures. The paper by A. Abragam of Saclay, France, on spin temperature as a basic thermodynamic concept was superb. With eloquent gestures he could take a nuclear spin system in and out of a magnet before one's very eyes so vividly that one was reminded of the sleight-of-hand artist on a vaudeville stage. Abragam indicated that in LiF the spin lattice relaxation time, T_1, is four hours in a field of 5 kilogauss and at 2°K but that the time is only 5 seconds in the crystal's own internal field of 8 gauss at this same temperature. Under these low fields a spin temperature is analytically defined and its identity with thermodynamic temperatures is experimentally established. Studies in "spin calorimetry", of the thermal mixing of two or more spin systems, strengthen the validity of the concept. C. Kittel of Berkeley proposed a method of nuclear magnetic cooling utilizing electron-spin resonance. He foresees temperatures of the order 10^{-7} °K.

There were a number of important papers on paramagnetism at very low temperatures and among these we mention the reports of R. Bozorth of the Bell Tele-

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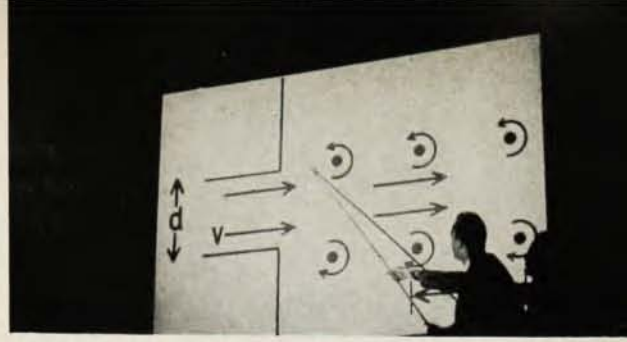
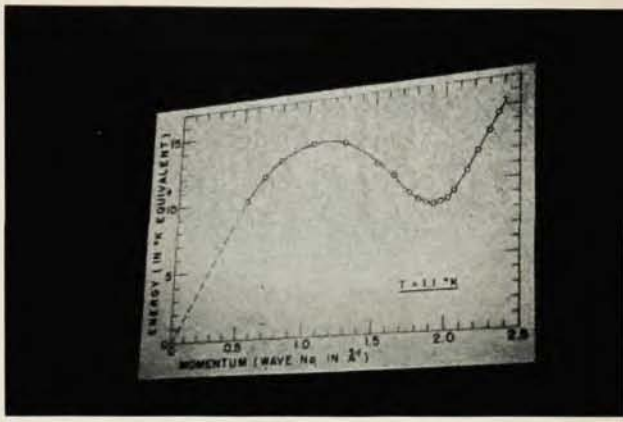
Above (at right center) is S. C. Collins of the Massachusetts Institute of Technology, who received the 3rd Kamerlingh Onnes Medal, presented by the Nederlandse Vereniging voor Koeltechniek (Netherlands Society of Refrigeration Techniques) in recognition of his development of the helium liquefier bearing his name. Others shown (from left to right) are: L. Vahl and W. K. Taconis, president and vice president, respectively, of the Society; Mrs. Collins; J. A. Prins, president of the Netherlands Physical Society; and C. J. Gorter, director of the Kamerlingh Onnes Laboratory. *Photo by A. Van Vliet*



R. P. Feynman (Caltech) lectures on the hydrodynamics of superfluid liquid helium.



Energy vs. momentum of superfluid liquid helium-4, according to J. Yarnell (Los Alamos), from measurements on neutron scattering from rotons.

Boat trip through canals near Leiden. In foreground is "Concert Master" van den Berg.

phone Laboratories, J. H. Van Vleck of Harvard University, and E. Kanda of Tohoku University, Sendai, Japan. Van Vleck reported on the theory of the magnetic susceptibility of nitric oxide in a clathrate compound. The point is that Van Vleck had worked out the quantum theory of the free molecule NO in the gas and had excellent agreement with experiment. Now with the molecule locked in the large cavities of these strange organic compounds, the experiments by Cooke and Meyer of Oxford showed the magnetic susceptibility to be 40% higher than for the free molecule (at low temperatures). So Van Vleck indicates that things can only be understood on the basis of a special crystalline field potential. With his model, the quadrupole moment of the magnetic p_π electron is comparable with that of the whole molecule, and the Kramers doublet verges on detectability. Magnetic cooling in order to orient muclei and thereby gain valuable information has become top priority research at the National Bureau of Standards (Ambler, Hayward, Hoppes, and Hudson), at Oxford University (Kurti, Grace, et al.), and at Leiden (Postma, Miedema, and Steenland). J. W. T. Dabbs of Oak Ridge reported experiments on crystals of $^{238}UO_2Rb(NO_3)_3$ in which alpha particles are preferentially emitted from the region of the nuclear equator, rather than from the poles of the distorted radioactive nuclei.

Finally, there were a number of excellent papers on solid-state physics at very low temperatures. W. R. G. Kemp from the National Standards Laboratory in Australia reported on the use of thermal conductivity measurements to identify the lattice imperfections in Cu-Zn alloys. G. O. Jones of Queen Mary College, London, reported on thermal expansion of solids at low temperatures using an improved x-ray method. New work on solid krypton was reported.

Obviously the parallel-session technique of running a large conference of this sort is necessary. It makes it impossible on the one hand for one to attend all of the interesting contributed papers and it makes it possible on the other hand for a fearful amount of routine work to be reported. The Dutch have no better solution to this problem than we do. The invited papers were for the most part very good indeed and these will appear sometime before the end of 1958 as the *Proceedings of the Kamerlingh Onnes Conference on Low-Temperature Physics*. These should be extremely helpful because there were papers like that of G. Feher of Bell Laboratories on electron nuclear double resonance experiments which are just too complicated to grasp at one sitting. Probably the same can be said for the paper concerning the theory of gaseous equation of state by J. de Boer of Amsterdam, but he has a special talent for making things seem completely clear. On the other hand, the paper by S. Franchetti of Florence would be most valuable to the forthcoming *Proceedings* but will not be included because it is a contributed paper not an invited one.