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Early Days of Superfluid ^{3}He: An Experimenter's View

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The formulation of the BCS theory led theorists to investigate possible non-S-wave pairing in liquid ^{3}He. Unfortunately as time went on, estimates for the pairing temperature became unattainably low. Nevertheless, the push to lower temperatures by experimentalists continued and was facilitated by the invention of the dilution refrigerator. Nuclear adiabatic demagnetization could then be used to cool liquid ^{3}He to $\sim$1 mK as demonstrated by Goodkind. An alternate approach, suggested by Pomeranchuk, involved adiabatic compression of liquid ^{3}He into the solid phase. Efforts to develop this technique at the Kapitza Institute, La Jolla and Cornell achieved success in demonstrating cooling of mixtures of liquid and solid ^{3}He to $\sim$ 1 mK following dilution refrigerator pre-cooling. Although there was great pessimism regarding the possible observation of pairing in liquid ^{3}He, the unsettled problem of magnetic ordering in solid ^{3}He beckoned. Ultimately two phase transition along the melting curve were observed by Osheroff et al at Cornell. Although first associated with solid ^{3}He, extensive NMR studies showed them to be two new phases of liquid ^{3}He. A brief history of experiments at various laboratories following the discovery is given, along with early interpretations given by Anderson and Morel and Balian and Werthamer. The key role of Leggett's spin dynamics is also discussed.