

MAR11-2010-008597

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

From the Meissner Effect to the Isotope Effect: Precursors to the Microscopic Theory of Superconductivity

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After the discovery by Kamerlingh Onnes in 1911 of the low temperature disappearance of resistance in mercury to a state of perfect conductivity, there was a long period of more than two decades before there was a major experimental advance. In 1933, Meissner and Ochsenfeld discovered that a superconductor is not only a perfect conductor but in addition it is a perfect diamagnet. In 1935 F. and H. London presented a phenomenological understanding of the electromagnetic properties of the superconducting state, which included the London penetration depth for applied magnetic fields and later introduced the concept of a “stiffness” of the superconducting wave function. In 1950, Ginzburg and Landau developed a phenomenological theory for the superconducting state using general thermodynamic arguments. In the same year, Maxwell, and Serin et.al discovered the Isotope Effect which indicated that the electron-phonon interaction would play an important role in the theory of superconductivity.