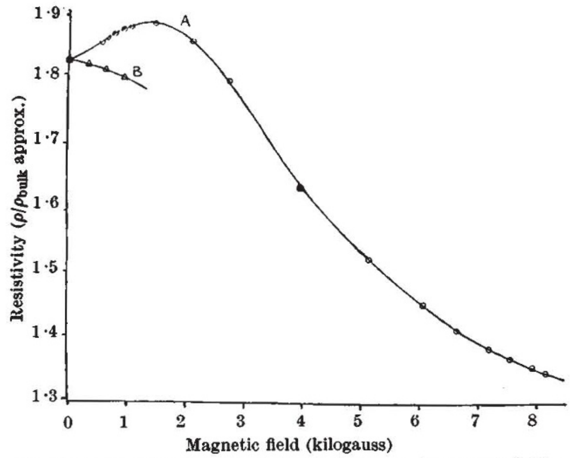

Variation of resistance with magnetic field : *A*, transverse field ; *B*, longitudinal field. (Temp. 4·2° K.)

was therefore considered that an investigation on fine specimens of pure sodium would be worth while, since earlier work on the alkali metals[7] had suggested strongly that the conduction electrons in sodium are almost ideally free. It was also intended in this work to examine the effect in relation to temperature from 20° K. to $\sim$ 4° K., to deduce any variation of the surface reflexion coefficient. Results in this field will be published later; but an interesting effect has been observed when a magnetic field is applied.

The accompanying graph shows the observed variation of electrical resistance in a specimen 30 μ diameter under the application of transverse and longitudinal fields. It is immediately obvious that the effect is essentially of a different character from the customary increase of resistance in a magnetic field (magneto-resistance effect). The remarkable reduction of resistance may be understood if one observes that in a field of $\sim$ 4,000 gauss the conduction electrons in sodium will describe classical orbits of diameter 30 μ. Thus, for example, an electron, having been scattered from one surface of the metal, may have its path so curved by the magnetic field as to avoid subsequent collision with the opposite wall of the specimen and thus have an increased effective path-length. Ultimately, for a sufficiently strong longitudinal field, one would expect that scattering by the walls would become insignificant in comparison with that in the body of the metal. In this case the resistivity should approach a lower limit, namely, that of the metal in bulk. In a transverse field, a similar decrease should occur, although the limiting resistivity will then be greater than that of the bulk material since those electrons travelling more or less parallel to the field will still collide with the walls. With a transverse field, elementary considerations show also that some electrons, dependent on their direction of motion, will suffer an initial diminution of free path which may predominate, although ultimately all free paths should increase. This effect is obvious in the graph, the resistance reaching a maximum around 1,500 gauss for this specimen. On the other hand, one would only expect a progressive increase of free path with a longitudinal field, the electrons pursuing spiral paths around the lines of force. The experimental data confirm this assumption. Measurements on specimens of different sizes under varying fields should provide a knowledge of mean free path and surface scattering coefficient individually: publication of full experimental data and theoretical discussion will follow later.

In conclusion, one may note that this phenomenon is to be distinguished from the diminution of the magneto-resistance effect in very thin films as observed by Patterson[8] and explained by Thomson[4]. In that case, the increased electron-scatter in bulk metal arising from the action of a magnetic field loses its effect as the electron free path becomes curtailed by the physical limits of the specimen.

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Fermi Resonance in Benzene

The existence of a strong doublet rather than a singlet line in the Raman spectrum of carbon monoxide was explained by Fermi[1] on the theory that when in multi-atomic molecules the frequencies of two independent vibrations are commensurable or nearly so, the vibrations perturb each other, resulting in a mutual repulsion of the two levels and a mixing of eigenfunctions, provided the two vibrations belong to the same symmetry species. Such Fermi resonance is found to occur frequently in many polyatomic molecules, and enables one to explain some characteristic features of Raman and infra-red spectra. For example, it is well known that the Raman spectrum of benzene exhibits two strong lines due to frequencies 1606 cm.$^{-1}$ and 1584 cm.$^{-1}$, whereas only one at 1596 cm.$^{-1}$ is to be expected corresponding to the e_g^+ vibration. The occurrence of this doublet was shown by Wilson[2] to be due to Fermi resonance between 1596 cm.$^{-1}$, which is a pure e_g^+ frequency, and a binary combination 606 cm.$^{-1}$ + 992 cm.$^{-1}$ = 1598 cm.$^{-1}$, the total eigenfunction of which has again the e_g^+ symmetry.

In the course of an analysis of the near ultra-violet emission bands of benzene[3], we have discovered an extended series of such Fermi doublets. The main characteristics of the emission spectrum are represented by progressions of totally symmetric vibrations superposed over one of the e_g^+ vibrations in either state, which circumstance is essential to permit the otherwise forbidden transition. The extended series of Fermi doublets arises in the superposition of one to four quanta of 992 frequency on each of the fundamental doublets, each of which again is loaded with one to four quanta of 160, the difference frequency. The observed data are in agreement with theoretical calculations based on first-order perturbation brought about by the cubic anharmonicity factor in the potential energy function of the molecule.

A detailed account has been submitted for publication elsewhere.

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