

The accuracy will be limited principally by the uncertainty in the gyromagnetic ratio. Work is in progress here which should considerably decrease the uncertainty in the gyromagnetic ratio. The agreement of our result with that of the voltmeter gives added support to the value of e/m for the electron^{6,7} resulting from our value of γ .

If our value of the ratio ν_c/ν_n is combined with the measurement of Gardner and Purcell,⁷ one obtains a value of the ratio of the mass of the proton to the mass of the electron of greatly improved accuracy. This new result is

$$M_p/m_e = 1835.979 \pm 0.056.$$

Several possible applications of this instrument suggest themselves. In the first place, it looks very promising for the measurement of packing fractions. Its simplicity, high sensitivity, and variable resolution should make it useful in many other research and analytical applications. Since this device measures ω , it is suggested that it be called the *omegatron*.

- ¹ Thomas, Driscoll, and Hipple, *Phys. Rev.* **75**, 902 (1949).
² Thomas, Driscoll, and Hipple, *Phys. Rev.* (to be published).
³ K. T. Bainbridge, "Isotopic weights of the fundamental isotopes," Preliminary Report No. 1, National Research Council (June, 1948).
⁴ J. W. M. DuMond and E. R. Cohen, *Rev. Mod. Phys.* **20**, 82 (1948).
⁵ S. J. Bates and G. W. Vinal, *J. Acous. Soc. Am.* **36**, 916 (1914); G. W. Vinal and S. J. Bates, *Bull. Bur. Stand.* **10**, 425 (1914); G. W. Vinal, *Comptes Rendus* **3**, 95 (1932).
⁶ Thomas, Driscoll, and Hipple, *Phys. Rev.* **75**, 992 (1949).
⁷ J. H. Gardner and E. M. Purcell, *Phys. Rev.* **76**, 1262 (1949).
⁸ F. G. Dunnington, *Phys. Rev.* **52**, 475 (1937).

Theory of the Electric Resistivity of Polycrystalline Graphite*

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IT is possible to explain the observed temperature dependence of electric resistivity in commercial polycrystalline graphite by an extension of the theory of single crystal graphite as developed by Wallace.¹ There are two mechanisms required. First, one assumes that the conduction in the polycrystalline sample takes place in the planes of cleavage of the individual crystals. The large anisotropy (of the order of 10^4) prevents any appreciable conduction across the planes. This confinement of the current to the direction of orientation of the crystals, which will not necessarily be in the direction of gross current flow, increases the resistivity of the polycrystalline material over that of a single

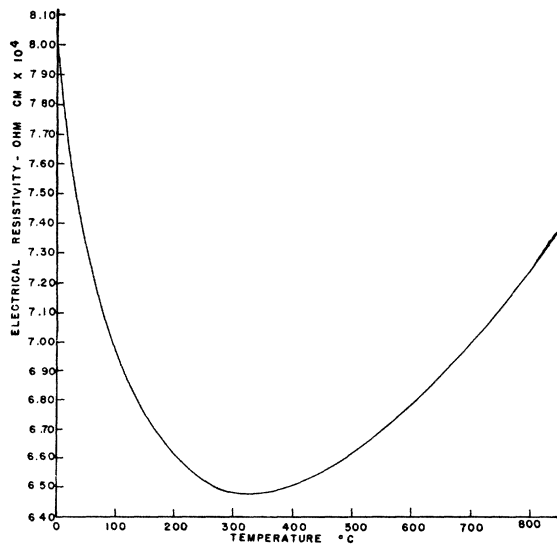


FIG. 1. Typical plot showing the variation of resistivity with temperature for polycrystalline graphite.

crystal in the plane of cleavage by a geometrical factor, s , depending on the ratio of the principal dimensions of the crystals, and their orientation with respect to gross current flow. For completely random orientation and a common ratio of crystal dimensions of 10, this factor is about 7. Second, it is assumed that the electron waves are scattered off the crystallite boundaries. Since these boundaries are regions of disorder, there is almost a certainty of scattering at these regions. Thus the probability of scattering per unit time can be estimated from the size of the crystallites, and the velocity of the waves in the crystal. Using estimates of crystallite size based on the width of x-ray diffraction lines, one computes the scattering probability per second to be 10^{14} . Furthermore, this probability should be temperature independent since the percentage change in crystallite dimension with temperature will be small. Adding this scattering probability to the thermal lattice scattering probability in Wallace's formula and multiplying by the geometrical factor s , one has

$$\rho = \frac{h^2 cs}{16\pi^2 k T} \left(\frac{1}{\tau_T} + \frac{1}{\tau_b} \right),$$

where the τ 's are the inverse scattering probabilities.

By computing τ_T from the original Wallace equation, and measurements on single crystals, a typical plot showing the variation of resistivity with temperature for polycrystalline graphite has been reproduced in Fig. 1.

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¹ P. R. Wallace, *Phys. Rev.* **71**, 622 (1947).

A Note on the Variational Method for the Scattering Problem

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AS we have already pointed out,¹ Hulthén's formulation of the variational principle² has the advantage over other formulations³ in that a more flexible trial wave function can be used. But in his practical applications he adopts a method which leads to a very inconvenient numerical procedure. Moreover, the manner of his application does not utilize the variational principle in its strict form: one of the equations he uses is not logically connected with the principle. In this note we shall indicate how we can improve Hulthén's method by making it more rigorous and at the same time much simpler for practical purposes. We shall illustrate the proposed method by considering S -scattering by a potential field of the Yukawa type.

Considering for the sake of simplicity only S -scattering, we define, following Hulthén

$$\mathcal{Q} = \int_0^\infty \psi(H - k^2) \psi dr, \quad (1)$$

where

$$H = -d^2/dr^2 + V(r). \quad (2)$$

It can then be shown that

$$\delta\mathcal{Q} = 2 \int_0^\infty \delta\psi(H - k^2) \psi dr + k\delta\eta, \quad (3)$$

where η represents the phase shift. After obtaining this equation Hulthén suggested a variational method in which

$$\mathcal{Q} = 0 \quad (4)$$

is used to determine η while

$$\delta\mathcal{Q} = 0 \quad (5)$$

is used for obtaining a set of equations for the variational parameters. In this manner with a trial function of the form

$$\psi(r) = f(r) \cos\eta \sin kr + g(r) \sin\eta \cos kr, \quad (6)$$

Hulthén obtains a system of equations each of which is of the second degree in $\tan\eta$ and solves them by a method of successive approximations.