In the case of perfectly matched horizontal velocities, the apparent vertical drift is cancelled, and the horizontal drift is enhanced. It seems clear, therefore, that this horizontal drift, when included, would move the maxima outward to latitudes of 15°, as in the actual anomaly. Although we have not considered the dynamics of such horizontal circulation, other workers[15] have discussed the principal operative forces.

In view of this, it seems a reasonable conjecture that the complete description of the equatorial $F2$ layer may lie somewhere between these extremes. Account may have to be taken of production[16], loss[17], diffusion[18,19], electrodynamic drift[20], horizontal air motions[12] and temperature variations[21] (see also ref. 22) in assessing quantitatively the grosser features of the $F2$ layer at low latitudes.

Other possibilities include electric currents along the magnetic field lines between conjugate points of the dynamo region[23], and electric field effects associated with the necessity for the electric field to be irrotational[24]. However, the possible importance of these further effects has not yet been investigated.

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PHYSICS

Lorenz Number of Plutonium Metal

RECENT work on the thermal conductivity (k) and electrical conductivity (σ) of pure α-phase plutonium revives the question of the magnitude of the Lorenz number $L(= k/\sigma T)$.

The early work of Sandenaw and Gibney[1] gave L at 20° C between 3·96 and 4·41 × 10^{-8} V^2 deg.$^{-2}$, very much in excess of the theoretically expected value (2·45 × 10^{-8} V^2 deg.$^{-2}$ at a temperature above the Debye temperature, the latter being 192° K for plutonium). It is unlikely that the difference could be wholly accounted for by a lattice contribution to the thermal conductivity. However, their thermal conductivity value (0·020 cal cm^{-1} sec^{-1} °C^{-1}) was not confirmed by the later work of either Lee and Mardon[2] (k between 0·008 and 0·010 cal cm^{-1} sec^{-1} °C^{-1}) or myself[3] (k = 0·0098 cal cm^{-1} sec^{-1} °C^{-1}). These lower values have now been confirmed by a measurement of the room-temperature thermal diffusivity[4] as 0·02 cm sec^{-2} which, using the specific heat data of Kay and Loasby[5] (0·034 cal g^{-1} °C^{-1}) and a density of 19·6 g cm^{-3}, gives a thermal conductivity of 0·013 cal cm^{-1} sec^{-1} °C^{-1}. The problem now arises that using these lower values of 0·01 for k and 142 × 10^{-6} ohm-cm as the room-temperature electrical resistivity[3], L is reduced to about 2·0 V^2 deg.$^{-2}$, nearly 20 per cent lower than the theoretical value and clearly not to be explained by the presence of any additional conduction mechanism.

Linde[6] seems to have been the first to point out the low values of L given by a number of pure metals and suggested that an additional term should be included by splitting the total thermal resistance of a metal into two components, one determined by impurities and lattice defects and hence independent of temperature, the other determined by lattice vibrations. This is an obvious thermal analogy to Matthiessen's rule for electrical resistivity. Linde's theory was extended by Bäcklund[7], who removed Linde's restriction that the resistivity temperature curve had to be linear and suggested the amended form of the Weidemann–Franz law:

$$\frac{k(\rho + \bar{\rho}_0)}{T} = L$$

where ρ is the electrical resistivity and $\bar{\rho}_0$ the intercept obtained by extrapolating back the linear low temperature part of the resistivity-temperature curve to zero temperature. Applying this to the foregoing values of k and the recent resistivity data of Meaden[8], a value of 2·48 × 10^{-8} V^2 deg.$^{-2}$ is obtained for L. This close agreement with the theoretical Lorenz number would appear to be a vindication of the Bäcklund theory. However, recent papers by King *et al.*[9] and Wigley[10] show that Matthiessen's rule fails completely for plutonium at low temperature due to the additional temperature-dependent resistivity caused by self-irradiation. It remains to be shown whether the thermal resistivity is similarly affected by self-irradiation. A theoretical justification for the applicability of an argument similar to Bäcklund's for the various electron scattering mechanisms awaits a fuller understanding of a peculiar behaviour of the electrical resistivity of plutonium[11].

The value of $\bar{\rho}_0$ for uranium from Meaden's results[8] amounts to only 3 per cent of the room temperature resistivity, a variation insignificant compared with the range of values of L consequent on the various available experimental values of k.

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Infra-red Evidence of the Grinding Effect on Hydrargillite Single Crystals

SEVERAL investigations of the infra-red spectrum of hydrargillite powder have been reported[1–4]. However, no study of single crystals as yet seems to have been reported. In the present investigation, thin plates were cut from a single crystal of synthetic hydrargillite (product of Showa Denko Co.) about 3μ thick, some parallel to the (001) plane and some nearly perpendicular to the (001) plane. The absorption spectra were recorded in the region of 4,000 ~ 450 cm^{-1}. The spectra so obtained were