LOW TEMPERATURES

iments the c/a ratio changed
ange at constant (approxi-
shall see below, the almost
ermines the cross-sectional
results for the initial slope
Table II.

ea as a function of
ield parallel to b_3)

Observer
& Schirber (1966)
l. (1960)
& Schirber (1966)
& Itskevich (1963)

istency between these differ-
t the helium gas technique
We see, however, in Fig. 3
b technique and by the oil–
h other or with the helium
cularly notable because they
(1966a) (see also O'Sullivan
ct can be understood as fol-
n ice from the high tempera-
l, the crystal, because of its
the c than in the a direction.
pensate for this, the pressure
t in the a direction. Thus the
as it would have been under
'Sullivan and Schirber (1966)
s sort, but to a lesser degree,
e measurements of Gaidukov
sene technique. More recent
by Itskevich *et al.* (1965) in-
pressure produced by this
isotropic.

btained by Berlincourt and Steele

Because Zn is so anisotropic in its thermal contraction, this exaggerates the non-hydrostatic effects of methods that rely on setting up the pressure in a solid at high temperatures. Presumably, these methods would not fail so badly with cubic materials, but as we saw earlier they may not be successful even then.

We have now seen something of the methods of measuring Fermi surfaces under pressure. Let us now see what physical understanding we can get from the results. A very important clue to our understanding of several metals that have been investigated (e.g., Zn, Al, Pb, In) is obtained from the nearly-free-electron model of the Fermi surface. We shall therefore consider this before looking at the experimental results in detail.

B. NEARLY-FREE-ELECTRON MODEL FOR Zn

If we have a gas of free electrons (i.e., independent electrons moving in a uniform potential), the energy of an electron of momentum p or wavenumber k is just $p^2/2m$ or $\hbar^2k^2/2m$ where m is the electron mass. If the electrons form a completely degenerate gas, all the energy levels up to a certain energy, E_F, are occupied (each level with two electrons of opposite spin) and those above E_F are empty. The surface in k space that separates the occupied from the unoccupied region is called the Fermi surface and so for free electrons it is just a sphere:

$$\frac{\hbar^2}{2m}(k_x^2 + k_y^2 + k_z^2) = E_F \tag{5}$$

The radius of the sphere thus depends on E_F, i.e., on the number of electrons to be accommodated and on the volume available to them.

If we ignore the lattice potential inside a metal, and interactions between the electrons, then in this simple approximation the Fermi surface of the metal is a sphere in k space whose volume is just sufficient to accommodate all the valence electrons of that metal. If the metal has N atoms in volume V with z valence electrons per atom then:

$$E_F = \left(\frac{3}{\pi}\right)^{\frac{2}{3}} \frac{\pi^2\hbar^2}{2m}\left(\frac{zN}{V}\right)^{\frac{2}{3}} \tag{6}$$

where we have allowed for two electrons of opposite spin per translational energy level. Thus E_F varies inversely as two thirds power