

the effects of correlation and exchange between the valence electrons and the ion core, and also among the valence electrons. This determination was checked with a combined theoretical-experimental one which used available experimental data, primarily from deHaas-van Alphen experiments, to supplement a simpler calculation [8] . The agreement between the two determinations of the behavior of $E(\vec{k})$ away from the zone surface was used to justify the potential used in the more elaborate band structure calculation, even though the calculated shape of the surface at certain zone corners did not agree with the experimental results. Harrison [9] has obtained a different shape for the Fermi surface of aluminum using a similar theoretical-experimental approach; he was able to fit the experimental data with a model having fewer deviations from a free electron Fermi surface than Heine's. Harrison used the band calculations of Heine to modify the surface predicted by the free electron model and used data from deHass-van Alphen experiments to determine the details of the geometry.

Later work by Harrison has investigated the validity of a nearly free electron approach for determining the Fermi surface of the polyvalent metals [10] . The conduction electron wave functions are plane waves orthogonal to the wave functions of the core electrons (O.P.W.'s); the electron energy is proportional to k^2 . Comparison of constant energy surfaces for aluminum calculated with one O.P.W. and with three or four O.P.W.'s shows that the latter show fewer sharp bends than the one O.P.W. surface, but are not greatly modified otherwise [11] .

While the use of plane waves or a nearly free electron picture to describe electrons moving in the periodic potential of the crystal lattice appears physically unrealistic, there seems to be theoretical justification for a one O.P.W. approach in terms of a pseudo-potential which cancels the lattice potential [12, 13] . This justification has not been worked out in detail.

Cohen and Heine have discussed the band structure of the alkali and noble metals in terms of a model which assumes that the wave function of an electron may be represented by one O.P.W. in the interior of the Brillouin

zone and by two O.P.W.'s near a zone face [14]. The energy, $E(\vec{k})$, is then spherically symmetric except near the zone boundaries and the E vs. $\vec{k}$ curve is parabolic except near the zone face. In this picture the geometry of the band structure allows the warping of the Fermi surface to be expressed in terms of a distortion parameter which depends on the band gap at the zone face. This gap can be related to the observed atomic term values for the free atom and the distortion of the Fermi surface can be compared for the entire alkali series. The effective mass at the bottom of the conduction band, m^* , is also obtained from the distortion parameter and compared with the results of a quantum defect method calculation; both methods give the same trend for m^* in going through the series. The relationship Cohen and Heine derive depends upon having energy bands that are parabolic except near the zone faces; the description of the wave functions by 2 O.P.W.'s is one way, but not necessarily the only way, of justifying this energy dependence [15].

On the theoretical level techniques of band structure calculations have advanced to the point where predictions about the shape of the Fermi surface may be made, at least for some metals. The validity of the results depends upon whether the physical assumptions, primarily those about the potential, are correct; the correctness of the assumptions may be judged in part by the agreement with experimental determinations of the Fermi surface.

B. Experimental Techniques for Obtaining the Fermi Surface.

As the work of Heine and of Harrison on aluminum has pointed out, a purely theoretical determination of the Fermi surface is not always feasible and experimental information is badly needed. Chambers [16] and Pippard [17] have presented reviews of the techniques available. We shall summarize these methods and mention some more recent developments.

Measurements of the magnetic susceptibility of metal single crystals at low temperatures sometimes show oscillations which are periodic in H^{-1} , where H is the magnetic field. These oscillations constitute the de Haas-van Alphen effect. Their period gives the extremal area of a cross section through the Fermi surface with its normal along the direction of H . From measurements taken with different orientations of the crystal one can