3.2. Zinc

The zinc orbits studied were the following:

(i) the first zone hole pocket at H (α orbit). The existence of this pocket is not in doubt but there does not seem to have been reported an unambiguous observation of this orbit before;

(ii) the junction at H of the diagonal arms of the second zone hole surface (β orbit);

(iii) the waist of the needles, the third zone electron surface at K (N orbit);

(iv) the unidentified orbit labelled C by Fletcher *et al* (C orbit). For reasons discussed in §3.4 we believe that this is a magnetic breakdown orbit round the diagonal arms in the second zone.

Our results are listed in table 1, which also includes other experimental results.

The α and β oscillations were observed as beats with α having the greater amplitude. The β result in table 1 was calculated from measurements of phase change of the beat

Table 1. Results in zinc

	$10^2 \times \frac{\partial \ln A}{\partial \sigma}$ (kbar^{-1})		$\frac{\partial \ln A}{\partial \ln A_s}$			$\frac{\partial \ln A}{\partial (c/a)}$	
Orbit	Present	Magneto-striction	Expt	Theory	Present	Pressure	Temp
α	$-3{\cdot}34 \pm 0{\cdot}09$		-41 ± 1	-16			
β	$-3{\cdot}5 \pm 0{\cdot}3$		-44 ± 3	-16			
N	85 ± 10	78 ± 5 (GK) 60 ± 2 (RS)	1060 ± 120	410	-150 ± 18	-166 ± 8	-190 ± 30
C	$-2{\cdot}5 \pm 0{\cdot}2$		-31 ± 2	$-9{\cdot}3$ (A) $+19$ (B)			

The magnetostriction results are by Griessen and Kundig (1972), and by Reitz and Sparlin (1972). The pressure result is the average of measurements made by Balain *et al* (1960) and O'Sullivan and Schirber (1966); these results are consistent with each other. The temperature result is by Berlincourt and Steele (1954). The two theoretical results for the C orbit are respectively for the second zone hole monster arms (A) and for the third zone electron butterflies (B).

pattern, combined with the phase change of the α oscillations. Combination of errors from these two independent measurements leads to the larger error on the β result. The low temperature elastic constants used to calculate entries in the table were measured by Alers and Neighbours (1958).

3.3. Cadmium

The cadmium orbits studied are listed below using the orbit labels of Tsui and Stark (1966):

(i) the first zone pocket at H (α orbit);

(ii) the junctions at H of the diagonal arms of the second zone hole surface (β orbit);

(iii) the large orbit in the ΓKM plane round the second zone hole surface ($\gamma^{1/3}$ orbit).

It is interesting to note that we observe the $\gamma^{1/3}$ orbit to be very much stronger than $\gamma^{2/3}$ or γ, as also do Fletcher *et al* in their ultrasonic attenuation experiments. This is in marked disagreement with Tsui and Stark who found $\gamma^{2/3}$ to be strongest. However, there seems

Table 2. Results in cadmium

Orbit	$-10^2 \times \frac{\partial \ln A}{\partial \sigma}$ (kbar^{-1})	$\frac{\partial \ln A}{\partial \ln A_s}$		$\frac{\partial \ln A}{\partial (c/a)}$	
		Expt	Theory	Present	Pressure
α	$-2{\cdot}58 \pm 0{\cdot}07$	$-28{\cdot}2 \pm 0{\cdot}8$	-17	$4{\cdot}2 \pm 0{\cdot}1$	$4{\cdot}0 \pm 0{\cdot}4$
β	$-2{\cdot}62 \pm 0{\cdot}12$	$-28{\cdot}6 \pm 0{\cdot}13$	-17	$4{\cdot}2 \pm 0{\cdot}2$	$3{\cdot}6 \pm 0{\cdot}4$
$\gamma^{1/3}$	$+0{\cdot}67 \pm 0{\cdot}03$	$+7{\cdot}3 \pm 0{\cdot}3$	$-2{\cdot}0$	$-1{\cdot}08 \pm 0{\cdot}05$	$-0{\cdot}4 \pm 0{\cdot}2$

The pressure results are by Schirber and O'Sullivan (1968).

to be no reason to doubt their assignment of the orbit. Our results are listed in table 2 where they are compared with other experimental work. The β orbit was measured in the same way as the β orbit in zinc and for the same reason the error is relatively large. The low temperature elastic constants used in calculating entries in the table were measured by Garland and Silverman (1960, 1962).

3.4. Discussion

We see that where comparison is possible there is generally good agreement between our results and those of others. However it should be noted that only the magnetostriction results on the needles in zinc are directly comparable with our results, whereas the pressure and temperature results have had to be compared in terms of the derived quantity $\partial \ln A/\partial(c/a)$. We would not necessarily expect a given change of c/a to produce identical effects when the change in c/a is produced in different ways as it is here. However, we believe that the observed agreement is due to the large anisotropy of the elastic constants in zinc and cadmium which means that quite similar volume changes correspond to a given c/a ratio change whether this is produced by pressure, uniaxial stress or temperature.

As regards the magnetostriction results on the needles in zinc, there is much better agreement with the results of Griessen and Kundig than with those of Reitz and Sparlin. However, there is some reason for believing the results of Griessen and Kundig to be more reliable. Reitz and Sparlin themselves note that they can make a direct comparison of their results with the pressure results of O'Sullivan and Schirber but find unsatisfactory agreement. But, if they had used the value of Griessen and Kundig given in our table, they would have obtained excellent agreement.

A natural way to interpret our results would be to adopt a pseudopotential approach and to calculate the changes of Fermi surface in terms of the changes produced in the shape and size of the Brillouin zone and the changes produced in the pseudopotential coefficients. However, this is quite a complicated programme of work and requires a considerable computational effort. Therefore we have listed the results of a much simpler calculation, in which we have made the nearly free electron approximation. In this approximation we assume that the topology of the Fermi surface is governed by the Brillouin zone but that the band gaps are zero. The calculation is thus reduced to simple geometry.

Though we would not expect any striking agreement between our simple theory and experiment, we note that there is general agreement both in sign and general trend with the exception of the $\gamma^{1/3}$ orbit of cadmium. However, since the topology of the Fermi surface in the region of this orbit differs from the nearly free electron prediction, the discrepancy with regard to this orbit is not at all surprising.