

are usually equal; in this case Eq. (4) leads to the condition $A=0.47A_1$. We used this relation to compute B and B_1 for values of A_1 between 0.00 and -0.08 ; the result can be expressed as

$$B/A = B_1/A_1 = 3.3 - 60A_1, \text{ for } A_1 < 0. \quad (13)$$

Before attempting to fit the curves of n^* vs pressure it is useful to notice that the terms arising from the sixth order Kubic harmonics dominate the expression for n^* , Eq. (9); if $C=0$ and $|A| \leq 0.03$ the terms in A and B contribute only about 1% to n^* . We can simplify the fitting of the data with no significant error by considering only the contribution of terms in A_1 , B_1 , and C_1 to n^* ; the expression for n^* then becomes:

$$n^* = 1 + 12.3A_1^2 - 24.6A_1(C_1 - B_1) - 0.615(C_1 - B_1)^2. \quad (14)$$

Examination of this expression together with Eq. (13) and Table IV shows that if the scattering time is taken to be isotropic, that is if $C_1=0$, the predicted change in n^* will be an increase as the pressure increases. In order to obtain a decrease in n^* with an increase in A_1 a non-zero value of C_1 must be considered. In Fig. 9 we give some curves of n^* vs A_1 obtained using Eqs. (13) and (14) and various forms of C_1 . $C_1 = -0.3$ and $C_1 = -0.4$ represent the simplest nonzero C_1 's whose magnitudes give values of n^* at $A_1=0$ that are in the same range as the observed values. The other forms of C_1 were chosen because they give a steeper initial slope of the n^* vs A_1 curve.

The experimental data can be semi-quantitatively fitted using non-zero C_1 's of the form shown in Fig. 9; that is the change in n^* produced by changes in A_1 of the magnitude indicated in Table IV is consistent with the size of the observed effect. Furthermore the value of n^* passes through a minimum and then rises rapidly; no additional assumptions need be introduced to account for the observed minimum of n^* in cesium. However a quantitative fit does not seem feasible at this stage; some theoretical guidance as to the form of C_1 is needed. It is perhaps worth noting that while the consideration of nonzero C_1 's was forced upon us by the direction of the change in n^* , it is also needed to account

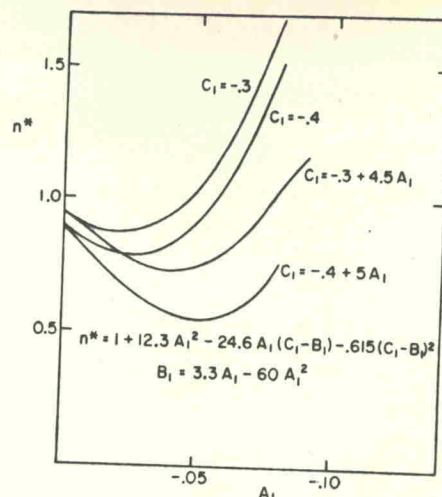


FIG. 9. n^* vs A_1 for various values of C_1 .

for the magnitude of the change in n^* in sodium and lithium, where the predicted change in A_1 is small.

Several difficulties with the fit should be considered. Ham's data, in Table IV, indicate the warping in sodium is zero both at atmospheric pressure and at 15 000 kg/cm², making it impossible to attribute the change in n^* to the pressure dependence of A_1 . However the existence of a low temperature magnetoresistance in sodium implies that there is a small anisotropy of the Fermi surface although this effect might conceivably be connected with the martensitic transition that sodium undergoes above hydrogen temperature or with anisotropic scattering times. If A_1 is nonzero for sodium we expect it to change with pressure and if C_1 is large enough the observed effect could still be accounted for.

The calculated change in A_1 for lithium is small (0.004); in order to account for the observed 5% change in n^* we chose a value for C_1 of $-0.4 + 5A_1$ to obtain a sufficiently steep initial slope on the n^* vs A_1 curve. The value of n^* for lithium at atmospheric pressure obtained from this curve is 0.78, in agreement with the fact that the absolute value of n^* for lithium is substantially less than one (Table II). By contrast the absolute values of n^* are much closer to unity for the other alkalis; this suggests that the value of C_1 for lithium should be different from that for the other alkalis.

In order to account for the observed minimum in n^* for cesium it is necessary to postulate that the atmospheric pressure value for A_1 is approximately -0.02 indicating considerably less warping than Ham's calculations, which give -0.045 . With this assumption about A_1 , the cesium data can be explained by the curve for $C_1 = -0.3 + 4.5A_1$. If one accepts Ham's value of $A_1 = -0.045$ the curve for $C_1 = -0.4 + 5A_1$ will produce a minimum in n^* with further warping, but this curve also implies an unreasonably low value of n^* at atmospheric pressure (0.6). Alternatively, since the work

TABLE IV. Warping parameters of alkali metals at two pressures, computed from data of Ham.

Metal	Pressure kg/cm ²	a atomic units	A	A_1
Li	1	6.64	-0.011	-0.011
	15 000	6.42	-0.015	-0.015
K	1	9.85	-0.001	-0.003
	15 000	9.00	-0.007	-0.026
Rb	1	10.64	-0.006	-0.015
	15 000	9.55	-0.021	-0.047
Cs	1	11.44	-0.021	-0.045
	15 000	10.01	-0.041	-0.088