ure. From these graphs a
ere chosen for each 20°K
he temperatures selected
complete set of measure-
btained for the two [110]
ew seals were placed on
and the measurements
obtained in various runs
%. A third crystal was
e results also agreed with
In addition, longitudinal
as a function of tempera-
ted along [100] and are
ion.

ULTS

are related to the acoustic
[110] direction by the

$_{12}+2C_{44})/2 = \rho v_2^2$ (1)

$_{12})/2 = \rho v_4^2$

, v_2 is the longitudinal
hear velocity with particle
ection, and v_4 is the slow
ticle motion in the [$\bar{1}10$]
c bulk modulus, B_s, and
C_{12} can be obtained by
measured quantities in the

$v_4^2/3 = (C_{11}+2C_{12})/3$ (2)

s shown in Table 1 have
uations (1) and (2).
iabatic bulk modulus B_s,
al bulk modulus B_T. The
n B_s using the approximate

$$1-\frac{TV\beta^2B_s}{C_p}\Big)$$

volume, β is the volume
and C_p is the molar heat
f V and β were obtained

Table 1. Values of the adiabatic elastic constants, the elastic anisotropy, and the density of sodium. Elastic constants in units of 10^{10} *dynes-cm*$^{-2}$ *and the density in g-cm*$^{-3}$

Temp. (°K)	Sample	C	C'	C_n	C_{11}	C_{12}	A	ρ
78	1	5·78	0·680	13·26	8·15	6·79	8·50	1·010
78	2	5·77	0·695	13·34	8·26	6·87	8·30	1·010
115	1	5·53	0·665	12·85	7·98	6·65	8·31	1·006
115	2	5·53	0·673	12·94	8·08	6·74	8·21	1·006
155	1	5·27	0·650	12·41	7·78	6·48	8·11	0·999
155	2	5·27	0·652	12·50	7·88	6·58	8·09	0·999
195	1	5·00	0·634	11·97	7·61	6·34	7·89	0·991
195	2	4·99	0·630	12·07	7·71	6·45	7·92	0·991
300	Daniels	4·19	0·585	11·01	7·41	6·24	7·16	0·970

Table 2. Values of the adiabatic and isothermal bulk moduli of sodium in units of 10^{10} *dynes-cm*$^{-2}$

Temp. (°K)	B_s(a)	B_T(b)	B_T(c)
78	7·30	7·29	7·09
115	7·14	7·10	6·99
155	6·97	6·74	6·92
195	6·82	6·50	6·72
300 (Daniels)	6·61	6·16	6·33

(a) $B_s = C_n - C - C'3$.
(b) Computed from B_s.
(c) Swenson.

from SWENSON[10] and the values of C_p were obtained from MARTIN.[11] Swenson's values of B_T are also listed and the agreement is well within experimental error of either measurement.

The values of the adiabatic elastic constant C_{11} obtained from direct measurement of the longitudinal wave velocity on a crystal oriented along [100] are shown in Table 3. The values of C_{11} obtained in this manner agree well with indirect determination of this quantity.

Table 4 includes the experimental values of the shear constants C_{44}, C' and the elastic anisotropy at 78°K along with FUCHS'[3] theoretical values at 0°K. The theoretical values take into account only the electrostatic contribution to the elastic constants. Also included in the tables are the experimental values of these quantities at 80°K determined by QUIMBY and SIEGEL[1] and the experimental values of BENDER[2] at 90°K. Daniels' values at 300°K are also listed.

The values of the elastic constants obtained in this work have a calculated precision of 2–3% when one includes errors in length measurements, transit time, and density. The internal consistency appears to be better than this, as can be seen in Figs. 1 and 2.

Table 3. Values of the adiabatic elastic constant C_{11} *obtained from velocity measurements in* [100] *direction*

Temp. (°K)	C_{11}
78	8·46
115	8·29
155	8·11
195	7·93
300 (Daniels)	7·38

The elastic constants C_{44}, C' and the elastic anisotropy plotted as a function of temperature are shown in Fig. 1. Daniels' values of these quantities at 300°K and the data of Quimby and Siegel at 80°K and 200°K are also shown. Since sodium undergoes a low temperature martensitic transformation from a b.c.c. structure to an h.c.p. structure,[12] no low temperature data were obtained. The values of the elastic constants at 0°K can be obtained by extrapolating the present data and breaking the curve at about 20°K so that the slope is zero at 0°K.