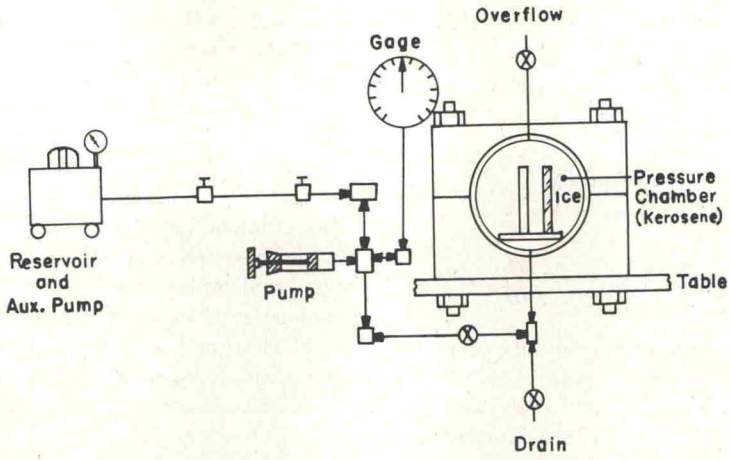

Fig. 1. Schematic drawing of compressibility apparatus. A cathetometer (not shown in diagram) is placed in front of the window-equipped chamber to measure the linear deformation of the compressed ice sample.

support and the ice specimen and frozen on with chilled degassed water from a syringe. As is illustrated in Figure 2*a*, each strip possessed a very sharp black-white border, which facilitated accurate focusing of the cathetometer cross hairs. Once attached, each marker strip was then sliced through obliquely with a sharp razor blade to permit each side of the severed marker strip to move freely during compression. Care was taken to ensure that the severed strips remained perfectly aligned after cutting. The alignment was checked before pressurizing the liquid in the chamber. No visible distortion of the marker strips was observed in any of the tests. As is indicated in Figure 2*a*, two marker strips were attached at the top, mainly as a safeguard against accidental detachment of the primary (topmost) marker but also as an additional check on the cathetometer measurements.

During compression both the specimen and the T support will undergo shortening. As is demonstrated in Figure 2*b*, this shortening will produce maximum offset of the marker strips at the top and negligible offset at the bottom. However, since the observed offset is for ice relative to aluminum, this offset will measure less than the true shortening ΔL of the ice by an amount equal to the shortening of the aluminum support. If we designate the observed offset as ΔL_1

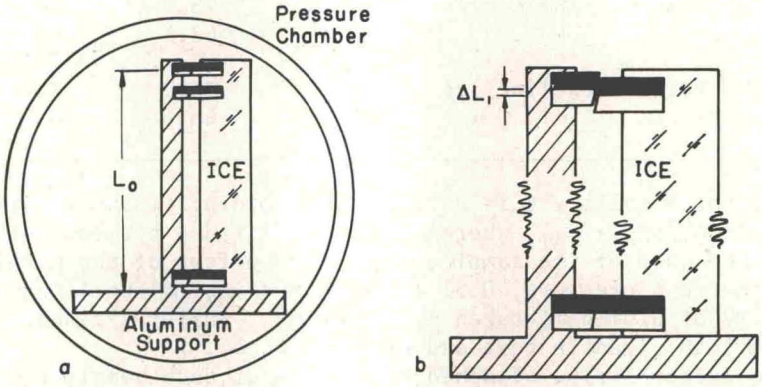

Fig. 2. Diagrams illustrating the technique of determining the linear compressibility of ice samples for (*a*) conditions at zero gage pressure and (*b*) conditions at test pressure. Equations relating strip marker offset ΔL_1 to compressibility of the ice sample are given in text.

and the shortening of the aluminum stem as ΔL_{A1}, then

$$\Delta L_1 = \Delta L - \Delta L_{A1}$$

or

$$\Delta L = \Delta L_1 + \Delta L_{A1}$$

Substituting in (1), we have

$$\theta = -\frac{1}{L_0}\frac{\Delta L_1 + \Delta L_{A1}}{\Delta P} = -\frac{1}{L_0}\frac{\Delta L_1}{\Delta P} + \theta_{A1} \quad (2)$$

where θ_{A1} is the linear compressibility of aluminum. A search of the literature [e.g., *Birch*, 1966; *Bridgman*, 1923] showed some variation in the measured values of θ_{A1}. A compressibility of 0.43 Mb^{-1} was adopted here. This value is less than that deduced for ice on the basis of the volume compressibility data of *Richards and Speyers* [1914] by nearly an order of magnitude.

During tests several individual determinations of the marker offsets were made by using different initial settings of the cathetometer micrometer. Readings could generally be reproduced within the 5-μm readability of the micrometer, which has a stated accuracy of ± 2.5 μm. Calibration tests were made with an aluminum prism in place of an ice specimen. Zero offsets were observed for all positions of marker strips at the test pressure. The fact that all

TABLE 1. Linear Compressibility θ of Ice as a Function of Ice Type and Crystallographic Orientation

Test Sample*	Ice Type and Orientation	L_0, mm	ΔL_1, μm	θ, Mb^{-1}
1*a*	Laboratory single crystal ⊥c†	74.8	69	3.4
b		65.5	63	3.5
2*a*	Laboratory single crystal ⊥c	75.5	75	3.6
b		61.6	64	3.8
3*a*	Laboratory single crystal ⊥c	75.5	66	3.2
b		61.6	63	3.7
4*a*	Laboratory single crystal ||c	78.5	79	3.6
b		71.1	70	3.6
5*a*	Glacier single crystal ⊥c	69.3	72	3.8
b		58.5	63	3.9
6*a*	Glacier single crystal ⊥c	62.4	64	3.6
b		53.6	56	3.8
7*a*	Glacier single crystal ||c	75.2	86	4.1
b		63.1	63	3.6
8*a*	Polycrystalline ice	70.7	71	3.6
b		68.6	68	3.6

Linear compressibility θ is determined according to the relationship $\theta = -(1/L_0)(\Delta L_1/\Delta P) + \theta_{A1}$, where L_0 is the distance between the marker strip and the base of the sample, ΔL_1 is the offset of the marker produced at the test pressure, 0.31 kb (ΔP), and θ_{A1} is the linear compressibility of aluminum, taken as 0.43 Mb^{-1}. Fuller explanation of measurements is given in text and Figure 2(*a*, *b*).

*The two marker strips attached to the top of each sample are designated *a* and *b*.

†Symbols ⊥c and ||c indicate directions perpendicular and parallel to the crystallographic *c* axis, respectively.