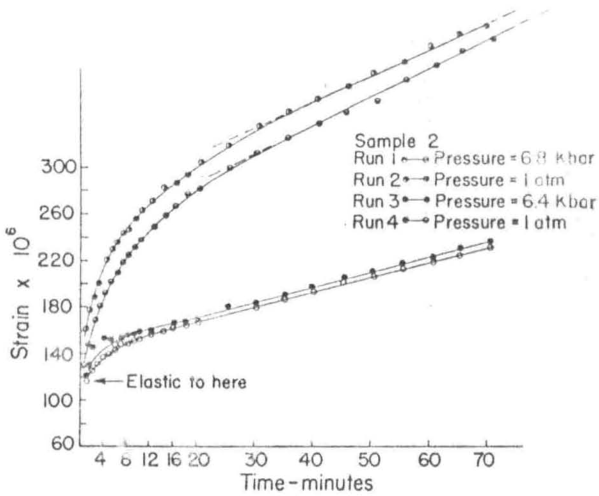

FIG. 2. Pressure dependence of creep in tin at 27°C. All curves were taken on the same sample with the sample unloaded at room temperature and pressure for approximately 1 h between runs. Strain measurements taken with resistance-type strain gauges.

creep at different pressures was measured on the same sample by first dropping the pressure, removing the load from the sample, putting the sample back to the new pressure, and reloading the sample by fusing the wire after the transients had disappeared.

The pressure vessel has been described.[7] The pressure medium was usually kerosene with a few studies made in Dow Corning 200 fluid. No difference in creep was observed in the two fluids.

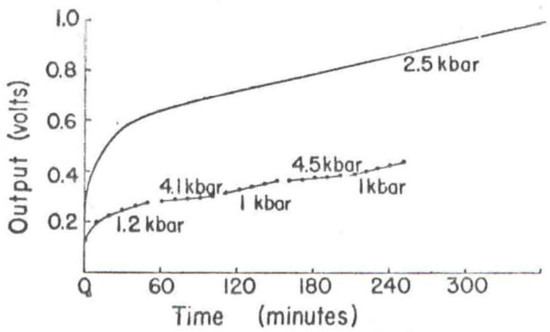

FIG. 3. Typical creep run and creep series on tin. Measurements made with a differential transformer. Data taken at 27°C.

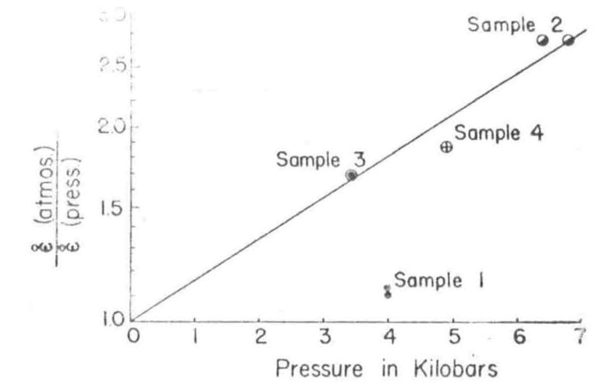

FIG. 4. Pressure dependence of the creep rate in tin. Measurements made with resistance-type strain gauges.

EXPERIMENTAL RESULTS

Figure 2 shows typical creep data taken with resistance strain gauges. Dashed lines indicate assumed steady-state creep values. Figure 3 shows a typical creep curve where the pressure was held constant and a creep series where at periodic intervals the pressure was changed as shown. Figure 4 shows a log plot of the ratio of strain rate at atmospheric pressure to the rate at high pressure as a function of pressure. The line shown represents an activation volume of approximately 9×10^{-24} cm^3 calculated from

$$\Delta V^{\ddagger}=[KT/(p_2-p_1)]\ln(\dot{\epsilon}_1/\dot{\epsilon}_2), \qquad (1)$$

where $\Delta V^{\ddagger}$ is the activation volume, K is Boltzman constant, T the temperature, and $\dot{\epsilon}_i$ the deformation rate at pressure p_i. With the differential transformer, four to ten series of runs were made at each of the temperatures 0°, 27°, and 57°C. While the more impure tin deformed more slowing under a given load and environment than the 99.999% tin, the effect of pressure was the same. All the data on tin could be fit by $\Delta V^{\ddagger}=(8.5\pm2)\times10^{-24}$ cm^3. Within experimental error $\Delta V^{\ddagger}$ showed no temperature dependence. The observed value is approximately $\frac{1}{3}$ of the atomic volume of the tetragonal tin (atomic volume about 27×10^{-24} cm^3) compared to $\frac{2}{3}$ of the atomic volume for the face-centered cubic lead as reported previously.