stress is applied. These surface regions are constrained by the frictional forces which add an inhomogeneous stress field to the applied stress.

We were not able to calculate the resulting stress pattern and have to resort to a rule of thumb known to mechanical engineers in the following argument illustrated in Fig. 9. When compressional stress is applied to the *ab* surfaces which are assumed not to change their dimensions because of frictional forces, then the bar is deformed into the shape of a rectangular barrel. The curvature of the sides of an *ac* cross section is appreciable up to distances of about $3a$ from the upper and lower ends. The curvature of the sides of a *bc* cross section extends to about $3b$ from the lower and upper ends. Only when $c \gg a$, b does one find a center region of homogeneous stress.

In our case the approximate dimensions were $b=3c=9a$ with current along b. Choosing the c or stress direction along [100] we found (i) an appreciable increase in resistivity when the b or current direction was along [011] and (ii) a negligible resistivity change when it was along [010]. This anisotropy indicates that the [100] stress axis is no longer a fourfold symmetry axis under these conditions.

In order to explain this let us consider the extreme case $b \gg c \gg a$. Since $c/a \gg 1$ the largest part of the *ac* cross sections will be unaffected by the presence of the friction forces. With $c/b \ll 1$, however, the strain component u_{yy} is nearly zero. This situation can be approximated by a superposition of a homogeneous stress field along c and another along b. Neither of these stress fields can remove the equivalence of the [111] valleys and hence they cannot contribute to a sizeable

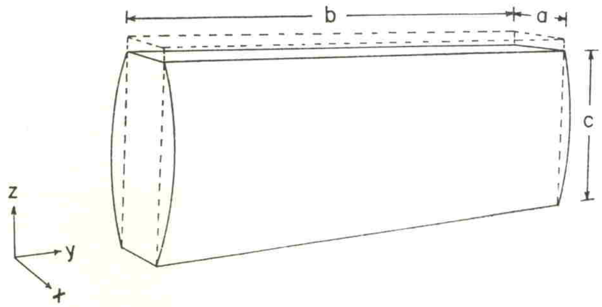

FIG. 9. Deformation of a rectangular bar under compression applied over the *ab* surfaces in the presence of large frictional forces. The small outward bulging of the *ac* surfaces is not shown in the figure.

piezoresistance in case (ii) because the stresses are along [100] and [010], respectively. In case (i) a stress along [011] appears which causes the observed increase in resistivity.

From this we conclude that the friction forces introduce additional stresses in the material. They are on the average larger along the long dimension b than along the short dimension a. We verified this by studying samples with different b/a ratios.

Under [111] compressional stress X we estimate that in our geometry an average perpendicular stress of about $0.15X$ will appear in the current direction. This means that a roughly 15% higher stress than otherwise will be required in order to reach saturation. Although the low-stress piezoresistance measurements are falsified by the stresses originating from friction, once saturation is reached the piezoresistance measurements give the correct answer.