V. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

Accurate and reproducible measurements of resistance changes in silver foils due to shock-wave compression were accomplished. These results were made possible by careful preparation of well-characterized specimens and by careful design of the impact experiment. Experimental accuracy was sufficient to resolve an effect of silver purity on the electrical resistance or resistivity as a function of shock pressure. A smaller effect of annealing prior to shock loading also appears to be discernible. In some, but not all cases, the structure of voltage-time profiles obtained during the 1/2 microsecond of shock compression was reproducible. The structure of the voltage-time profiles appears to depend on purity and state of anneal of the foil and on pressure.

Comparison between shock and hydrostatic resistivity was used to deduce the point defect concentrations generated by the shock wave. Defect concentrations were found to be proportional to the three-halves power of strain; concentrations were higher than those found in slow deformation to the same strain. The high vacancy concentrations computed (as high as 2×10^{-3} at 120 kbar) are believed accurate to an order of magnitude. Dislocation models for the generation of point defects by plastic deformation in shock waves are useful in understanding the present work. A speculative model involving stress relaxation effects was able to account for observed defect concentrations and to explain the purity effect.

Saada's model for point defect production in plastic deformation of f.c.c. metals was tested and found inadequate to explain magnitudes of defect concentrations found in the present work. However, a model of the Saada-type is still useful in interpreting present results.

Within the framework of Weertman's discussion of defect production in shock compression, the present results give evidence for the presence of dislocations moving at or near shear-wave speed.

Calculations involved in analyzing data have themselves provided some interesting results. A semi-empirical calculation of silver resistivity versus hydrostatic pressure has been established and used to extrapolate existing experimental data beyond 30 kilobars. Such calculations should prove useful in other high-pressure work. A contradiction was found in Bridgman's experimental results for the dependence of noble metal resistance on pressure and temperature; there is evidence of error in his conclusion that temperature coefficients of resistance are independent of pressure (0 to 12 kbar). Significant heat flow into the silver foils from epoxy bonding layers in 1/2 microsecond was indicated by solution of the boundary value problem for a composite sandwich with different initial temperatures in each material.