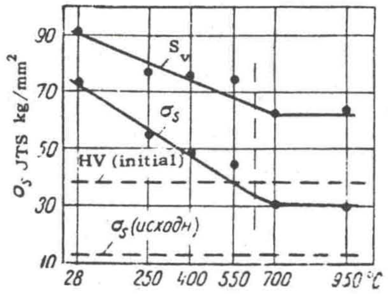

FIG. 3. Mechanical properties of iron vs. temperature during pressure loading at 210 kbar. The vertical line is the approximate transition point from twin (left) to uniaxed structure (right).

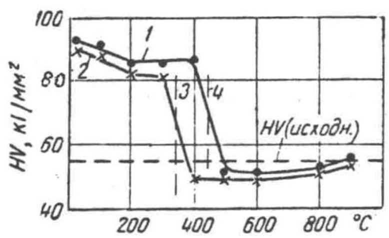

FIG. 4. Hardness of copper specimens vs. temperature during shock loading at 220 kbar:
(1) cooled in water; (2) in air; (3) and (4) distinguish the recrystallized (right) from the unrecrystallized (left) structures on cooling in air and water respectively.

The temperature dependence of the hardness obtained for specimens deformed at ~ 115 kbar (curve 1) can be explained by means of the well known [4] phase diagram which relates the phase transition pressure to temperature of iron under the compression of a shock wave in the range -195 to 885°. While iron under these stress conditions is in the α range at 20°, at 250° there is a partial transition to the x range (hexagonal high-pressure phase in iron): this transition is more complete at 400°. Microstructural analysis showed that the intensity of twinning, and accordingly the hardness, rises with the temperature at this pressure.

According to the diagram transition to the γ range should occur at 550°. In specimens stressed at 700 and 900° transition to the γ range actually did occur and was, according to the data of [4], accompanied by recrystallization. The latter involves a considerable reduction in grain size as compared to the original; twin traces disappear and the hardness is diminished.

Curve 2 of Fig. 2 shows the hardness as a function of temperature in specimens under a pressure of ~ 210 kbar. If we allow for the correction to the phase diagram of iron, which consists in raising the boundary between x and γ regions at pressures above 115 kbar [5], then the state in iron at 20, 250, 400 and 550° should correspond to the x phase, and that at 700° to the γ phase. And indeed, twinning was actually found in all specimens stressed in the range of 20-550°. But there was some reduction in the intensity of twinning as the temperature rose, probably resulting in lower hardness [9]. Particularly vigorous twinning and the greatest rise in hardness were observed in iron strengthened at liquid nitrogen temperature (-196°). These experiments were repeated.

In specimens stressed at 700° a recrystallized equiaxed structure was again observed. At 950° the γ-iron resulting from heating was subjected to load. Slight grain refinement as compared with the original was observed.

In Armco iron specimens shock strengthened at different temperatures and a pressure of 210 kbar we determined the resistance to small (proof stress σ_s) and large (true tensile strength S_v) plastic strains using the procedure suggested in [6, 7]. A cone with an angle of 90° at the apex was forced into the polished surface of the specimen on the shock side at a load of 31.25 kg. Then the diameter of the deformed zone D was measured. The yield point was calculated from the formula