TABLE I. Summary of shock-wave measurements in $(\beta+\alpha)$ brass for several initial temperatures.

T_i (°C)	U_s (m/sec)	U_p (m/sec)
20	3815	0
20	4720	618
20	4860	750
20	5020	709
20	5290	913
20	5590	1100
20	5670	1170
20	5870	1400
20	5960	1440
20	6010	1380
20	6030	1450
20	6240	1640
20	6300	1640
195	5410	1370
195	5470	1370
200	4520	798
200	4590	864
200	4620	905
200	4630	893
205	4040	633
205	4070	633
205	4330	837
205	4334	867
205	5110	1290
205	5150	1240
205	5730	1680
205	5810	1680
210	5970	1760
215	5210	1320
215	5470	1460
215	5500	1410
305	5590	1650
305	5690	1650
340	4190	863
340	4250	863
365	5150	1400
385	4930	1420
430	4540	1180
430	4560	1190
430	4760	1410
440	5150	1550

constant C_{44} changes by 22%. This occurrence is consistent with an order–disorder transformation.

Presumably this transformation begins below 300°C and continues until ~480°C. A transition also is indicated by the specific-heat vs temperature curves of Cu–Zn alloys in the above composition ranges. These curves[9] show a sharp peak at $T_c \approx 480$°C, indicating a transition of β brass to an ordered structure. Thus the electrical resistance, specific heat, and elastic moduli of near stoichiometric Cu–Zn alloys are appreciably affected by temperature changes. The isentropic compressibility and isothermal compressibility also increase with increasing temperature.

In our experiments heating the brass specimens to ~400°C and then adding heat from the shock compression should facilatate an α (fcc)$\rightarrow\beta$(bcc) structural transformation in the alloy. The thermal and shear effects of the shock compression may produce a decrease in the electron concentration of the α phase by diffusion to a point where additional electrons can be accommodated in the β phase. This change, however should be indicated by a cusp in each of the U_s–U_p curves (Fig. 3) similar to the results that are obtained in the shock-induced, first-order transition of iron and its alloys. Since no inflections are indicated, the observed behavior is principally due to a change in order. The extremely rapid deformation by the shock destroys order in the alloy. The change to disorder is facilitated by heating, but it is not accompanied by a volume change and generates no heat of transformation. It is therefore considered a second-order phase transition[10] analogous to the disappearance of ferromagnetism at the Curie point. It is doubtful, however, that the anomaly in the shock propagation is indicative of a transition in Cu–Zn by melting under shock compression. Calculations indicate, e.g., that a 0.5-mbar shock produces a temperature increase exceeding 650°C in Cu–Zn specimens, initially at 450°C. However, no change of state due to alloy melting is indicated by the volume changes in the shock compression results at 450°C. The absence of a discontinuity in these results supports the view that melting of Cu–Zn in this compression range is a longer process than ~1 μsec, the duration of our shock observations. The structural changes then are indicated primarily by substantial displacements of the U_s–U_p curves with increasing temperature. These displacements perhaps are indicative of the degree of disorder in the alloy at the different temperatures.

[9] H. Mosev, Physik 2, **37**, 737 (1936); F. Seitz, *The Modern Theory of Solids* (McGraw-Hill Book Co., Inc., New York, 1940), p. 37.

[10] W. Boas, *An Introduction to the Physics of Metals and Alloys* (John Wiley & Sons, Inc., New York, 1949), p. 167.