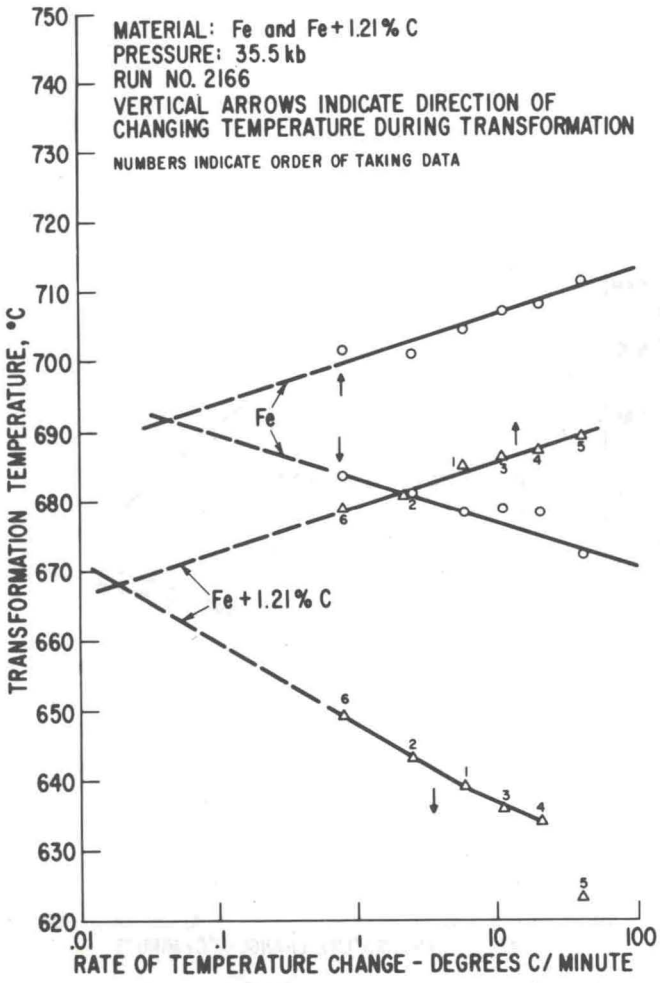

Fig. 11(c) Kinetic data on Fe-C eutectoid reaction

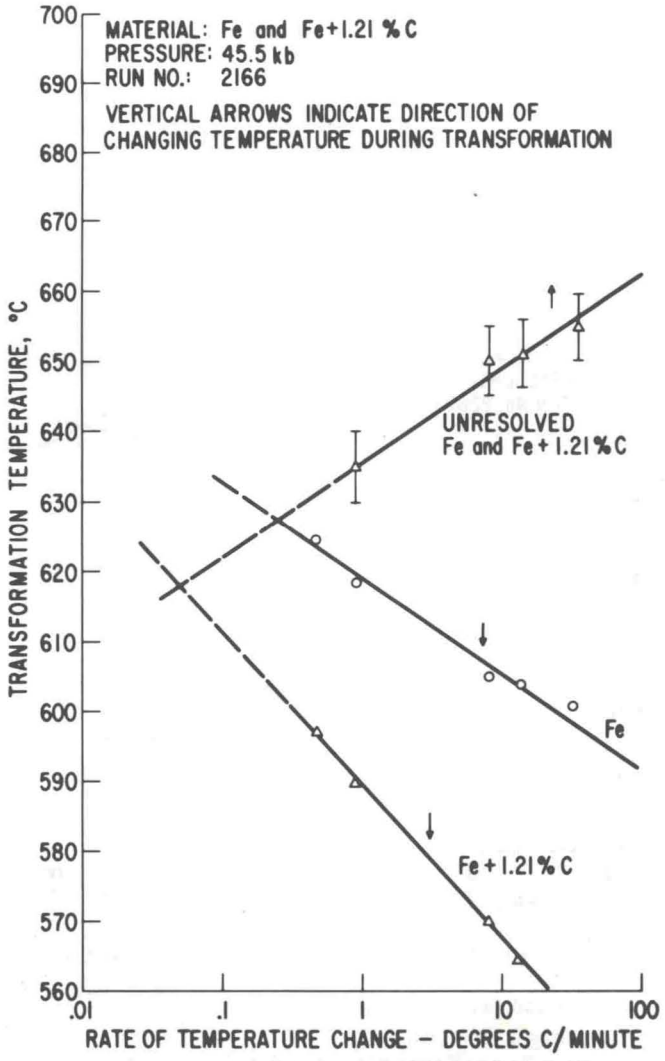

Fig. 11(d) Kinetic data on Fe-C eutectoid reaction

curves. However, the average temperature curve was essentially smooth. It was natural to presume that this effect was evidence of a kinetic phenomenon, that is, in the forward transformation one must exceed an equilibrium temperature further in order to observe the transformation, and conversely, in the reverse transformation one must lower the temperature further, beyond the equilibrium value in order to observe the transformation. In each case, these equilibrium temperatures are presumed to be those where the transformation would take place without diffusion and segregation. A possible explanation for these breaks in the transformation curves would be that beyond some pressure and temperature, the transformations become more sluggish. Some attempts were made to translate the breaks in the forward and reverse transformation curves to a change in phase in the gamma-field. Certain data indicating changes in phase within the gamma-field were tenuous and essentially unconfirmed or not reproducible.

SUMMARY AND CONCLUSIONS

1 A duplex DTCA technique was used to record and compare α-γ transformation temperatures in iron alloys of aluminum, chromium, manganese, cobalt and nickel with those in pure iron, all measurements being made under various pressures up to 70 kb in the belt apparatus. A pressure-temperature curve for this transformation in iron was developed using Ba and Bi room-temperature transformations as primary standards. By relating all iron-alloy data to this iron curve, the data are placed on a self-consistent pressure scale. Future improvements in the iron curve can easily be used to improve the iron alloy data.

2 A pressure-temperature curve for the Fe-C eutectoid reaction was similarly developed. In order to bring these data in agreement with atmospheric data, a special kinetic evaluation of the data was necessary to improve the estimation of

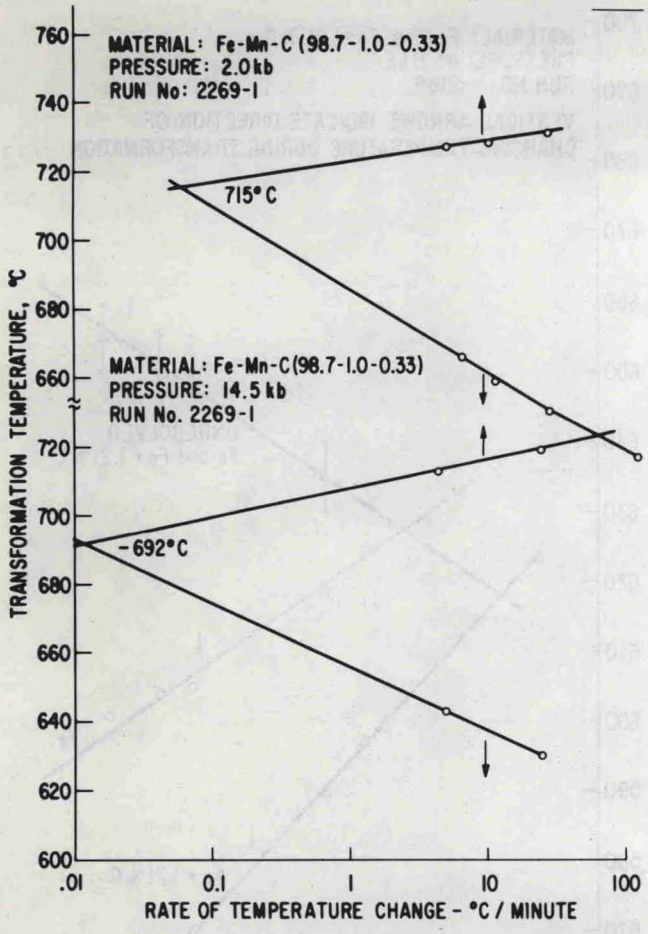

Fig. 12(a) Kinetic data on Fe-Mn-C eutectoid reaction

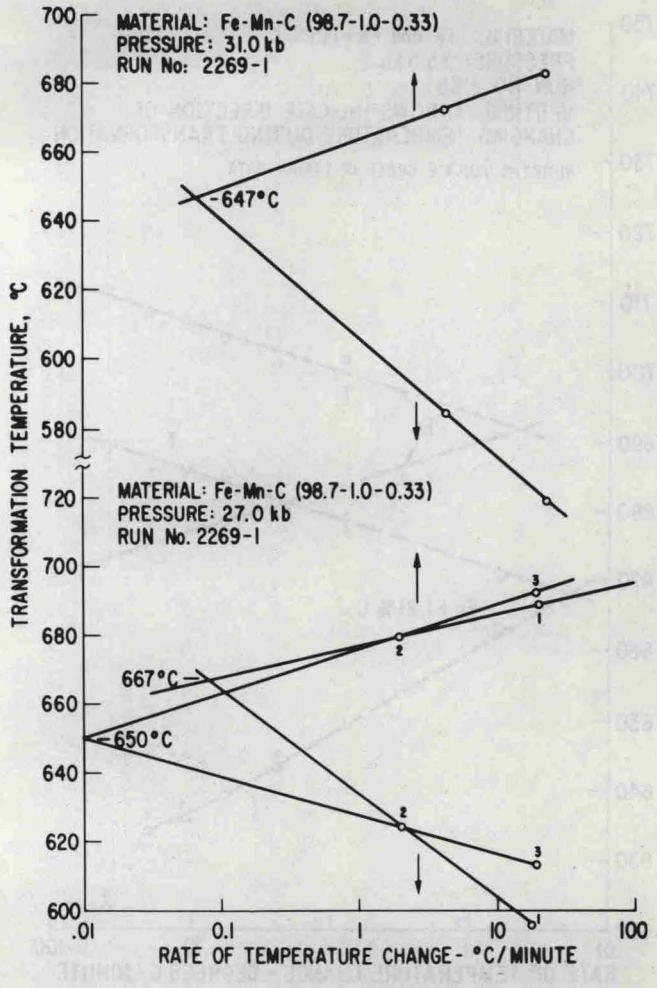

Fig. 12(b) Kinetic data on Fe-Mn-C eutectoid reaction

equilibrium transformation temperature. Similarly, the Fe-Mn-C eutectoid reaction was investigated.

3 The magnitude of hysteresis in the α-γ transformations, i.e., the difference in temperature between the forward and the reverse transformations at any one pressure, is correlated to the difference in temperatures of the alpha and gamma boundaries in the equilibrium phase diagram. Particularly, this argument would hold for Fe-Mn and Fe-Ni, which show large hystereses, and for Fe-Co, which has a very low hysteresis. The Fe-Co system gave a lower hysteresis the closer the composition was to that giving a maximum transformation temperature. All hystereses increased with increasing pressure.

4 The lack of smoothness of certain forward and reverse transformation curves is believed to be due to kinetic factors; no indisputable evidence for the existence of new phases was found within the range of experimental conditions.

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REFERENCES

1 H. Tracy Hall, "Ultra-High-Pressure, High-Temperature Apparatus: The Belt," Review of Scientific Instruments, vol. 31, 1960, p. 125.

2 W.F. Claussen, "Detection of the α-γ Iron Phase Transformation by Differential Thermal Conductivity Analysis," Review of Scientific Instruments, vol. 31, 1960, pp. 878-881.

3 F.P. Bundy, "Effect of Pressure on emf of Thermocouples," Journal of Applied Physics, vol. 32, 1961, p. 483.

4 G.C. Kennedy, private communication. Data to appear in "Solids Under Pressure," edited by Paul, et al.