TABLE 1

α-γ TRANSFORMATION TEMPERATURES OF IRON AND IRON ALLOYS AT 20, 40 and 60 kb

Pressure		20 kb			40 kb			60 kb		
Temperature change during transformation	direction up-down average rate °C/min.	↑	↓	av	↑	↓	av	↑	↓	av
		α-γ Transformation Temperatures, °C								
Alloy Fe-X(weight per cent of minor element)										
Fe(pure)	8-12	786	761	773	691	657	674	636	581	609
Fe-Al (0.54)	8-12	836	793	814	721	676	699	669	618	644
Fe-Al (0.75)	8-12	865	807	836	733	683	708	676	618	648
Fe-Cr (1.09)	8-11	770	750	760	687	640	663	631	566	598
Fe-Cr (2.95)	8-12	766	728	747	676	606	641	---	---	---
Fe-Cr (9.49)	30-50	742	642	692	667	429	548	640	391	490
Fe-Mn (1.07)	9-16	765	708	736	676	592	634	---	---	---
Fe-Mn (2.85)	9-12	576	715	645	638	433	536	---	---	---
Fe-Co (10.2)	30-50	810	781	796	726	694	710	683	630	656(a)
Fe-Co (19.9)	8-12	891	876	883	837	816	827	805	778	792
Fe-Co (39.6)	15-25	945	933	939	902	885	893	870	846	858
Fe-Ni (1.07)	8-12	766	724	745	681	629	655	627	545	585
Fe-Ni (3.06)	8-16	736	662	698	655	564	610	---	---	---
Fe-Ni (10.0)	22-31	641	460	550	577	327	452	520	168	344(b)

(a) Extrapolated from 52 kb.
(b) Extrapolated from 53 kb.

a pure iron standard showed a very much smaller change in slope. This apparent discrepancy needs further investigation.

Both of these Fe-Al alloys were utilized as secondary standards in later duplex DTCA runs, where the use of iron would have resulted in the standard transition being too close to that of the second material. Particularly, Fe-Al was used with the 1 percent alloys of Mn, Cr and Ni in iron, and with certain Fe-C runs at the higher pressure.

(b) Iron-Manganese Alloys. The data for two Fe-Mn alloys containing 1.0 and 3.0 percent Mn are shown in Fig.6 and Table 1. The average temperature curves for both alloys appear to be smooth in the region up to 45 kb, except for the scatter from different runs on the 3 percent alloy. However, because of the very large hysteresis in the temperature in these latter data, the average temperature data may not be very accurate; it would seem inadvisable to attribute any significance to apparent changes in slope.

(c) Iron-Chromium Alloys. The data for three Fe-Cr alloys containing 1, 3 and 10 percent Cr are shown in Fig.7 and Table 1. All of the average temperature curves appear smooth, with no significant changes in slope at any point. The 1 percent curve follows closely parallel to the curve for pure iron. The 3 percent curve departs downward at the higher pressures while the 10 percent curve veers upward at these pressures. This behavior may be related to the expansion of the gamma loop at higher pressures; with more data, particularly with a 20 percent alloy, a more complete analysis could be made in this direction.

(d) Iron-Nickel Alloys. The data for three Fe-Ni alloys containing 1, 3 and 10 percent Ni are shown in Fig.8 and in Table 1. All of the average temperature curves appear smooth, with no significant changes in slope at any point. In comparison to the corresponding Fe-Cr alloys, the Fe-Ni alloys transform at lower temperatures and with larger hystereses. Both kinetics and the width of the respective two-phase regions probably make this difference.

(e) Iron-Cobalt Alloys. The data for three Fe-Co alloys containing 10, 20 and 50 percent cobalt are shown in Fig.9 and Table 1. All of these average temperature Fe-Co curves appear smooth with no significant changes in slope. However, the 20 percent data require some additional comment. At 26 kb and at 28 kb, a second transformation was observed at 796 and 788 C, about 70 deg lower than the α-γ transformation. The origin and nature of this additional apparent transformation is unknown, and warrants further investigation.

The α-γ transformations in all of the Fe-Co alloys proceeded with the lowest hystereses of any of the materials studied. The reason for the low hysteresis may be surmised by inspection of the Fe-Co phase diagram. A maximum temperature for the transformation is recorded at 45 percent Co, and at this point the vertical (along the temperature axis) distance separating the two phases, alpha and gamma, should be nil, with a congruent

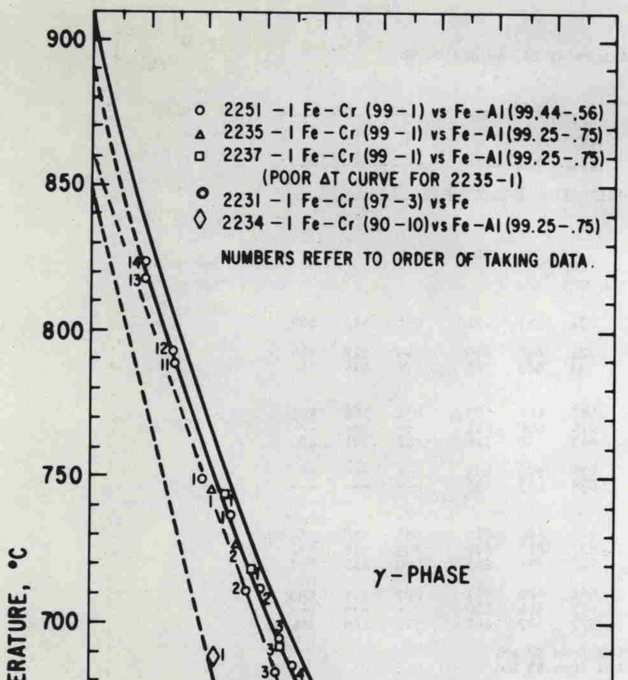

Fig. 7 P-T plots for α - γ transformations in Fe-Cr alloys. Average temperature curves

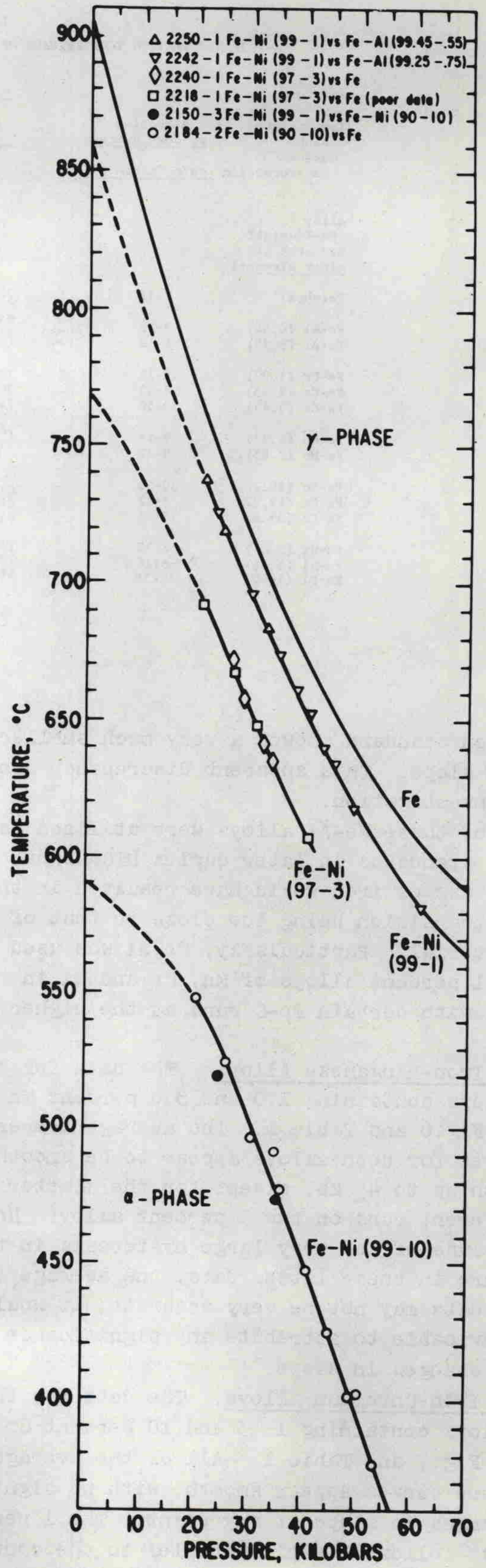

Fig. 8 P-T plots for α - γ transformations in Fe-Ni alloys. Average temperature curves

change in phase. The observation of the lowest hysteresis with the 60-40 alloy agrees with this concept.

The extrapolation of the high-pressure α-γ data usually fits in reasonably well with the atmospheric-pressure data. For the Fe-Co (60-40) alloy, however, where some of the best low-pressure data were obtained, the extrapolation to 972 C was 14 deg lower than that recorded in the literature. A second discrepancy appeared later