

to be appreciably less than 20.1 kcal, and experiments to examine this discrepancy are described and discussed in this report.

EXPERIMENTAL

The rate of carbide precipitation from α -iron was calculated from internal friction measurements on carburized iron wires. The materials and methods have been described.⁽²⁾ Wires of vacuum-melted iron were cleaned of residual nitrogen and carbon by treatment with wet hydrogen, recrystallized from the γ -region to give a large grain size, carburized at about 700°C, and water-quenched to room temperature. The wires were then aged at a certain temperature T_1 until from 30% to 50% of the carbon had precipitated; then they were aged at a higher or lower temperature T_2 for the remainder of the precipitation. At intervals throughout the process the concentration of carbon still in solution was measured from the internal friction peak. The fraction of total precipitation W is then given by

$$W = (Q_0^{-1} - Q_1^{-1}) / (Q_0^{-1} - Q_1^{-1})$$

where Q^{-1} is the height of the internal friction peak and the subscripts 0 , 1 , and 2 refer to the start, the time t_1 , and the end of the precipitation process, respectively. A value of 1.1×10^{-3} was used for Q_1^{-1} in all the runs.

RESULTS

The experimental results are summarized in Table I. All wires except number six were quenched from 700°C, so their initial carbon concentrations^(2,3)

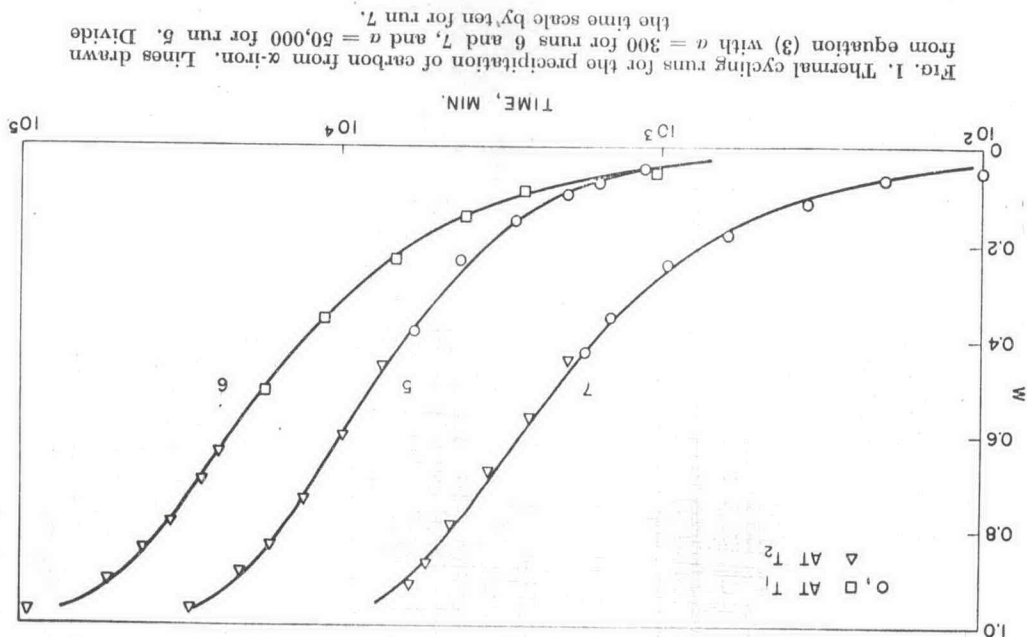


Fig. 1. Thermal cycling runs for the precipitation of carbon from α -iron. Lines drawn from equation (3) with $a = 300$ for runs 6 and 7, and $a = 50,000$ for run 5. Divide the time scale by ten for run 7.

In these runs the wires were cycled between the same temperatures, as shown in Table I; T_1 was 62°C for runs 5 and 6 but 120°C for run 7. Thus for runs 5 and 6 the time at $T_2 = 120^\circ\text{C}$ was multiplied by the sign of Q calculated from equation (2) must be changed.

equation:

$$Q = R \ln p / [(1/T_1) - (1/T_2)] \quad (2)$$

were about 0.025 wt. %. Sample 6 was carburized at 700°C and then quenched from 610°C, so its carbon concentration was about 0.012 wt. %. Wire number one only was quenched directly into an ice bath. To insure uniform deformation the grain size of sample four was kept small by not recrystallizing it from the γ -region. The activation energy Q was calculated from the ratio p between the precipitation rates at T_1 and T_2 (in degrees K) with the following

Run no.	T_1	T_2	p	Q	Remarks
1	37	37	41	16.8	
2	37	120	360	17.1	
3	120	37	330	16.9	
4	120	37	300	16.6	1% strain
5	62	120	50	17.6	4% strain
6	62	120	50	17.6	
7	120	62	50	17.6	
8	80	120	11.5	16.8	Lower conc.
9	120	170	11	16.6	

TABLE I