Structure of the Eta Phase of the Iron-Silicon System

THE crystal structures of the different phases of the iron-silicon system have been worked out by Phragmen[1] with the exception of one, which he described as Fe_3Si_2 (25·0 per cent Si). This phase usually appears together with α (solid solution of silicon in ferrite) or ε (FeSi). The composition seems to correspond to 23–25 per cent Si, but it is difficult to obtain it in a pure form. Furthermore, Greiner and Jette[2] showed that the η phase was stable only between 825 and 1030° C.

Osawa and Murata[3] described this phase as Fe_5Si_3 (23·1 per cent Si) and succeeded in indexing the lines on the basis of a hexagonal unit cell with:

$$a = 6{\cdot}727_5 \text{ kX.}, \quad c = 9{\cdot}411_2 \text{ kX.}, \quad \frac{c}{a} = 1{\cdot}398_9.$$

Experimental work carried on here supports their conclusions except that we find the c axis to be only half this length[4].

It was then realized that the powder photographs of Mn_5Si_3 and Fe_5Si_3 show a great similarity. Comparative measurements of spacing, as well as observation of intensities, confirmed this analogy.

The structure of Mn_5Si_3 has been elucidated by Amark, Borén and Westgren[5]; the space group is D^3_{6h} (C 6/mcm), and not that previously suggested[4]. The unit cell contains $Mn_{10}Si_6$. The accompanying table gives the particulars of the Mn_5Si_3 and Fe_5Si_3 structures:

	Lattice parameters			Structural parameters[6]		
	a (kX)	c (kX)	$\frac{c}{a}$	4 Mn (or Fe) in (d)	6 Mn (or Fe) in (g) u = 0·23	6 Si in (g) v = 0·60
Mn_5Si_3	6·898 ± 0·005	4·802 ± 0·005	0·696	$\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{4}$	u u O	v v O
Fe_5Si_3	6·7416 ± 0·0006	4·7079 ± 0·0006	0·69834			

The reason why this similarity has not been noticed before is probably that different authors found some difficulties in deriving the right formula for the phase. Borén[7] studied by X-rays the alloys of silicon with chromium, manganese, cobalt and nickel. He observed the hexagonal phase in the Mn-Si system, but did not remark its similarity with the eta phase of the iron-silicon system. He attributed to the manganese-silicon phase the formula Mn_3Si, while the eta phase of the iron-silicon system was described as Fe_3Si_2. Actually, it now appears certain that they should be described as Mn_5Si_3 and Fe_5Si_3 respectively.

The analogy between the two systems is now evident, as the following comparison shows:

Mn_3Si is a body-centred phase ($a = 2{\cdot}851$ kX)[5].

Fe_3Si, or the region of the continuous solid solution of silicon in iron corresponding to this particular composition, is also body-centred (a = 2·8220 kX. ± 0·0003).

Mn_5Si_3 and Fe_5Si_3 are isomorphous, as described above.

MnSi (cubic, a = 4·548 kX. ± 0·002)[8] has the same structure as FeSi (a = 4·4790 kX., the lattice parameter varying with the composition).

The structure of the eta phase was the only unknown one in the iron-silicon system, which is now completely worked out from the crystallographic point of view.

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Cambridge. Aug. 21.

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Variation of Serum Composition with the Age of Horses as shown by Electrophoresis

THE results briefly reported below became apparent during the course of systematic examination of samples of sera from a wide variety of sources. A simple modification[1] of the Tiselius electrophoresis apparatus[2] was used in conjunction with the Lamm scale method[3] of recording the migration of the serum components. On the graphs obtained the approximate area of that portion of the curve representing a particular component was measured and the figures expressed as percentages of the total protein. The protein concentrations are given in the table below.

It is apparent that serum of the newly born foal with a relatively low total protein content is characterized by a high albumin and α globulin, only traces of β globulin and a complete absence of γ globulin. At the age of five days the albumin has decreased to a concentration slightly higher than that of the adult animal; this is accompanied by a slight but scarcely significant increase in α globulins, a tremendous increase in β globulins and the appear-

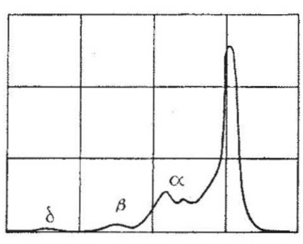

Fig. 1. FOAL BEFORE INGESTION OF COLOSTRUM.

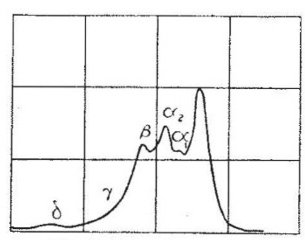

Fig. 2. FOAL 5 DAYS OLD.

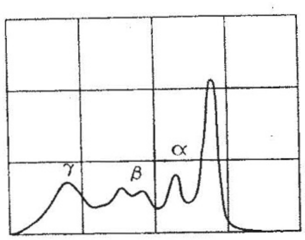

FIG. 3. FOAL 8 MONTHS OLD.

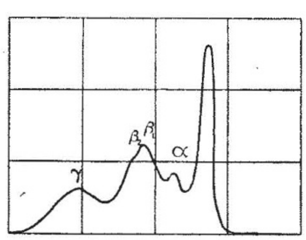

Fig. 4. HORSE 2½ YEARS OLD.

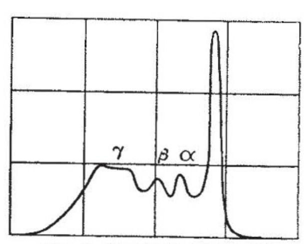

Fig. 5. HORSE 10 YEARS OLD.