

XX.—*Crystals of Iron.*

BY AMOS BEARDSLEY, F.L.S., F.G.S., &c.

AT the General Meeting of the Society held at the rooms of the Royal Microscopical Society, King's College, London, on March 14th, 1877, were exhibited some octahedral crystals of iron, which were procured from a hollow cavity in the middle of a bar of pig iron. The way in which they came into my possession was this.

A friend was walking on the Docks at Liverpool some years ago, watching a vessel being unloaded, which had arrived freighted with pig iron from Gartsherrie. These pigs were lifted by cranes, and one accidentally slipped, and dropped on to its end, and was fractured in two pieces, showing a cavity about the size of a duck's egg, and his attention was drawn to some bright lustrous objects which he saw roll out of the cavity. These he at once picked up, and found they were crystals of the metal, octahedral in shape, and about $\frac{3}{8}$ of an inch in size.

All he could find were about 10, and of these 8 came into my possession.

I had shewn them to several persons interested in the manufacture of iron and steel, and thought they might be considered of some importance. However, they have been usually treated as being merely "curious;" at the same time I have never met with any one who has seen such crystals before.

I mentioned the fact to Mr. Collins, and he kindly exhibited them at the above meeting, and suggested that I should let him have one for analysis, which I readily consented to do, and the worth of this paper simply consists in recording such analysis.

Whether the crystallization depended solely on the composition, or partly upon the condition and circumstances in which they were found I cannot determine, but I think it is a fact which ought to be duly recorded, and one which may in some way or other be made practically useful in the manufacture of iron.

Mr. Collins, in his note to me says "I have at last finished the analysis of your crystal, and it is as follows :—

Iron	93·50	p. c.
Carbon	3·11	
Silica	1·35	
Titanic acid 1·5 = Titanium	·76	
Phosphoric acid ·34 = Phosphorus	·15	
Tin	·14	
Manganese	minute trace	
Loss (partly Carbon)	·99	
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	100·00	

"The sp. gr. is only 6·665 in one trial and 6·667 in another ; this is unusually low for *grey cast iron*, which is really what the crystals are.

"The material has considerable malleability.

"Grey cast iron often shows crystalline facets on being broken, but I have never met with complete crystals before. Meteoric iron, however, has been found crystallized in distinct octahedrons, but it usually contains nickel, of which I find none in these crystals."

Along with this analysis Mr. Collins also sent one of *grey cast iron* from Cleator, which is as follows :—

Iron	93·94
Carbon	4·18
Silica	1·92
Phosphorus	·08

Lime and sulphur

a trace

I have also been at some little trouble to my friends in procuring analyses of the various kinds of pig iron from different localities, if possible to ascertain wherein the difference consisted, and to what the crystallization might be owing, as no one individual to whom I have shewn them, nor any author I have consulted appear to have seen such before.

No analysis I have contains *Titanium*, besides these crystals, though I know it is found in the slag of furnace bottoms, and I have specimens obtained thence. Nor do I find *tin* ; on the other hand *manganese* is only in minute trace.

I am indebted to my young friend, Mr. J. Smith, jun., of the Barrow Hæmatite Steel Co., for the following analyses, which may be useful for comparison.

Bessemer iron Nos. 1, 2, and 3, Barrow Hæmatite Steel Co., analysed by E. Richards.

	No. 1.	No. 2.	No. 3.
Carbon, graphite	3·25 ..	2·96 ..	2·81
„ combined	0·33 ..	0·34 ..	0·31
Silicon	3·04 ..	3·02 ..	2·97
Manganese	0·44 ..	0·48 ..	0·37
Sulphur	0·03 ..	0·03 ..	0·05
Phosphorus	0·01 ..	0·02 ..	0·02
Iron	92·90 ..	93·15 ..	93·47
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	100·00	100·00	100·00

The mottled iron Barrow Hæmatite Steel Co., also analysed by Mr. E. Richards is

Carbon, graphite	1·455
„ combined	2·310
Silicon	0·847
Manganese	0·349
Sulphur	0·271
Phosphorus	0·024
Iron	94·744
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	100·00

I also add some others from different parts of the country, which I give in the form of a table.

To these I may add the following:—

	Spiegeleisen, by the Krainische Co., analysed by E. Riley.	Ferro-Manganese by the Krainische Co., analysed by E. Riley.
Carbon, graphite	} 4·753	{ 3·73
„ combined ..		
Silicon	·375 ..	1·98
Manganese	18·215 ..	44·98
Sulphur	trace	—
Phosphorus	·059 ..	·22
Iron	76·361 ..	43·83
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	99·763	99·76

These crystals were formed in a hollow sphere of molten metal, which had gradually cooled down, and this may have influenced their formation.

Analysed by	Mr. Abel.	100.00	99.768	100.00	100.00	100.00	99.986	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	E. Riley.	100.00	90.584	93.26	92.66	94.03	92.727	98.99	98.28	94.56	91.8655	92.013	95.31	92.013	92.013	92.013
Locality.	3 Foundry Pig, Hemm- ite Iron Co., White- haven.	2.30	4.414	1.01	1.07	.43	0.986	.14	.19	Ni. .05 Co. .63	1.7807	1.338	0.04	1.338	0.10	0.04
	I Grey Pig, Low Saw.	2.795	1.837	0.02	.04	.03	0.197	.04	.04	.11	.0250	.048	trace	.048	0.03	0.43
	No. 1 Grey Pig, Butterly Iron Works, Derbyshire.	3.35	1.27	1.01	.98	.96	1.096	.23	1.45	.50	.6628	1.128	0.43	1.128	0.59	0.43
	Goldendale Iron Works, North Staffordshire.	2.54	2.71	.98	.04	.03	0.197	.04	.04	.11	.0250	.048	trace	.048	0.03	0.43
	Foundry Pig, Netherton, South Staffordshire.	3.07	1.48	.96	.03	.96	1.096	.23	1.45	.50	.6628	1.128	0.43	1.128	0.59	0.43
	Grey Pig, Bowling Iron works, Yorkshire.	2.99	0.97				1.096	.23	1.45	.50	.6628	1.128	0.43	1.128	0.59	0.43
	Grey Pig, Northamptonshire Ore.	0.610	2.980	1.096	.04	.03	0.197	.04	.04	.11	.0250	.048	trace	.048	0.03	0.43
	No. 1 Pig, Forest of Dean Co., Park End Works.	3.26	1.80	1.45	.04	.03	0.197	.04	.04	.11	.0250	.048	trace	.048	0.03	0.43
	No. 1, Weardale Pig.	3.24	1.80	1.45	.04	.03	0.197	.04	.04	.11	.0250	.048	trace	.048	0.03	0.43
	Best Mine Pig, Dowlais, South Wales.	3.10	2.16	1.096	.04	.03	0.197	.04	.04	.11	.0250	.048	trace	.048	0.03	0.43
	E. Riley.	3.10	2.16	1.096	.04	.03	0.197	.04	.04	.11	.0250	.048	trace	.048	0.03	0.43
	No. 4, Iron, Cleveland Pig, Bolckow, Vaughan & Co.	3.9400	1.7260	1.096	.04	.03	0.197	.04	.04	.11	.0250	.048	trace	.048	0.03	0.43
	Pig Iron, Frodingham.	3.420	2.053	1.096	.04	.03	0.197	.04	.04	.11	.0250	.048	trace	.048	0.03	0.43
	British Charcoal Iron. Harrison, Ainslie, & Co.	2.83	0.59				0.59						0.59			
	T. H. Henery.	2.83	0.59				0.59						0.59			
	Swedish Iron, Brand OBA.	3.42	0.61				0.61						0.61			
	E. Richards.	3.42	0.61				0.61						0.61			

Whether they may be considered as only "curious," or whether they may lead to some investigation that may end in benefit to the manufacturer, they at any rate have a right to be recorded as one of the forms in which iron, either alone or combined, may be crystallized.

One of the crystals was submitted to that excellent crystallographer Dr. C. O. Trechmann, of Hartlepool, who remarks upon it as follows :

The crystal of iron which you had the kindness to send me, is certainly an interesting specimen, though I am afraid I shall not be able to give you anything towards its elucidation.

I believe that iron is generally recognised as crystallizing in the cubical system, since Wöhler (*Pogg. Ann.*, 26, 112) described crystals obtained from large castings as skeletonized octahedrons of this system.

Your crystal seems to be a well-defined octahedron, in which the structure or aggregation is obscured by the large quantity of enclosed and attached impurities (plates of graphite).

Some years ago I found similar but smaller crystals (I have now lost them) in a casting, in which the manner of growth was beautifully displayed. They represented octahedrons with one elongated axis, and being quite skeletonized looked like small fir trees with two sets of branches at right angles to each other. The whole crystal seemed composed of bars which crossed and re-crossed at right angles and parallel to the fundamental axes. How the bars were constituted, whether built up of octahedral or cubical sub-individuals I am unable to say.