

far our methods are concerned almost entirely with the total content of the various constituents we are determining. We know very little about the compounds of the various constituents occurring in iron and steel, with the metal or with each other. Is the phosphorus present as phosphide or phosphate, or both? How besides as sulphide does the sulphur occur? Do the various carbides which are revealed by the microscope, and which are believed to be so closely dependent on the heat treatment which steel receives, and which are so intimately related to the value of the metal, differ from each other in carbon content, or only in crystalline form? Who will be the first to isolate any of these carbides? Who will first give us a practicable, accurate and sufficiently rapid method for determining oxides in steel? Who will first completely investigate the relation between the chemistry and the chilling properties of cast iron? And who will first give us a study on the form in which nitrogen occurs in this metal, and a sufficiently rapid and accurate method for its determination? Truly the harvest of chemical work before us in connection with iron and steel is bounteous. Will the laborers be forthcoming to gather the harvest?

[CONTRIBUTIONS FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF CINCINNATI.]

XLIX. SOME PECULIAR FORMS OF IRON.

By T. H. NORTON.

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I HAVE recently had occasion to examine two rather odd forms of iron, the peculiarities of which are sufficiently marked to warrant a brief note. The first of these is a sample from a mass of pig iron taken from a deep crevice in the hearth of a blast furnace at *Ætna*, Tenn., after the furnace was blown out. The conditions were such that the iron had been maintained in the molten condition for over a year, and had then cooled and solidified very slowly.

In appearance the sample is of a light, silvery color, and exhibits a most marked crystalline structure, with rectangular cleavage. Despite this crystalline character, it is the reverse of brittle, and shows a high degree of malleability, fragments being easily flattened out with a hammer. The drill makes but slight

impression on it. Portions were tempered and then the attempt was made to pulverize them; a slight crumbling was manifested at first, but after a few strokes of the hammer they became perfectly malleable. The piece could be split easily with a chisel, especially along the lines of cleavage. Small cubical fragments detached by this means and hammered out so as to form very thin plates, were used as material for analysis, as drillings could not be secured. Even in this form, solution was effected very slowly.

Manganese was determined by Volhard's titration method; silicon by Drown's method; sulphur by the cadmium chloride method followed by titration with iodine; phosphorus by Handy's method; and carbon by the Dudley and Pease standard method. The following results were obtained:

	Per cent.
Manganese	0.0362
Silicon	0.0262
Sulphur	0.0106
Phosphorus	0.8285
Carbon	0.1035

It will be seen that the sample would be nearly pure iron, but for the phosphorus present, this being the only serious impurity. It is probable that the peculiarities above noticed are due to this unusual combination, although the very slow cooling may have influenced the crystalline condition.

The second specimen is the result of the prolonged action of the inner part of a non-luminous Bunsen flame on ordinary steel. It has served to support the mantle of an Auer von Welsbach lamp, which has been in steady use for two years, and has been exposed during this period to the combined action of a high temperature and the gases of the inner cone of the flame. As a result it has become so brittle that the upper half crumbles as easily as chalk. The lower portion, less exposed to the flame, is covered with a brittle layer, while the central core is still pure steel. Carbon determinations by the Dudley and Pease method were made of both the original steel and the brittle portion. The latter, although finely divided, required nearly a week for complete solution. The figures obtained were:

	Original steel. Per cent.	Altered portion. Per cent.
Carbon	0.6423	0.0978

About six-sevenths of the carbon had disappeared. Whether this loss alone can account for the peculiar structural change in the steel would seem doubtful.

I am indebted to Mr. B. R. Haile for assistance in the above analyses.

[CONTRIBUTIONS FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF CINCINNATI.]

L. A TUNGSTEN-IRON ALLOY.

BY T. H. NORTON.

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THE nature and composition of tungsten-iron alloys has formed the subject of several papers published during the past few years. As an additional contribution to the literature of the subject, the following brief note of the examination of a commercial alloy may be of interest.

The alloy in question was introduced commercially on account of its extreme hardness. The specimen examined was of a lustrous appearance, except in places where it was coated with a yellowish-green incrustation. A large number of blow-holes were observed. The hardness was about 7, quartz being scratched with some difficulty. The material was quite brittle, being easily shattered with the hammer. The small pieces were powdered with some difficulty in an agate mortar. The specific gravity of the powder was 14.55.

The method of analysis employed was that recommended by Ziegler,¹ which consists essentially in fusion with sodium nitrate in a silver crucible, and subsequent precipitation of the tungsten as mercurous tungstate.

The results obtained were as follows :

	I.	II.
Tungsten.....	93.22	93.43
Iron.....	6.08	6.18
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	99.30	99.61

Mr. D. M. Roth assisted in the analysis of this alloy.

¹ *Ding. poly. J.*, 274, 513.