

the water and the surrounding mud could be precipitated. Seams of clay-ironstone vary in thickness from mere paper-like partings up to beds several feet deep. The Cleveland seam in the middle Lias of Yorkshire is about 20 feet thick. In the Carboniferous system of Scotland certain seams known as *Black-band* contain from 10 to 52 per cent of coaly matter, and admit of being calcined with the addition of little or no fuel. They are sometimes crowded with organic remains, especially lamellibranchs (*Anthracosia*, *Anthracomya*, etc.) and fishes (*Rhizodus*, *Megalichthys*, etc.).

A microscopic examination of some black-band ironstones reveals a very perfect oolitic structure, showing that the iron has either replaced an original calcareous oolite or has been precipitated in water having such a gentle movement as to keep the granules quietly rolling along, while their successive concentric layers of carbonate were being deposited. Mr. Sorby has observed in the Cleveland ironstones an abnormal form of oolitic structure, and remarks that one specimen bore evidence that the iron, mostly in the form of small crystals of the carbonate, had been introduced subsequently to the formation of the rock, as it had replaced some of the aragonite of the inclosed shells.¹⁴⁹

The subjoined analyses show the composition of some varieties of clay-ironstones.¹⁵⁰

	Clay iron-ore (Coal measures), Yorkshire	Black-band (Carboniferous), Scotland	Cleveland ore (Lias), Yorkshire
Peroxide of iron.....	1.45	2.72	2.86
Protoxide of iron.....	36.14	40.77	43.02
Protoxide of manganese.....	1.38	—	0.40
Alumina.....	6.74	—	5.87
Lime.....	2.70	0.90	5.14 (zinc)
Magnesia.....	2.17	0.72	5.21
Potash.....	0.65	—	—
Silica.....	17.37	10.10	7.17
Carbonic acid.....	26.57	26.41	25.50
Phosphoric acid.....	0.34	—	1.81
Sulphuric acid.....	trace	—	—
Iron pyrites.....	0.10	—	—
Water.....	1.77	1.0	3.48
Organic matter.....	2.40	17.38	0.15
	99.78	100.00	100.61
Percentage of iron.....	29.12	34.60	35.46

¹⁴⁹ Address to Geol. Soc. February, 1879.

¹⁵⁰ See Percy's "Metallurgy," vol. ii. Bischof, "Chem. und Phys. Geol." zupp. (1871), p. 65.