

from 1½ to 2½ miles on each side of Clarion River, except north of the town of Clarion. Owing to the height of the clay in the hills, however, only a small portion of the area is actually underlain by it. The clay is persistent in its occurrence but has a wide range in quality. The best clay is light yellowish brown, fine grained, and moderately hard. Weathered pieces are bluish gray on exposed surfaces and are easily broken.

Formerly the clay was stripped and hauled by wagon to railroads, by which it was shipped to the fire brick manufactories, but for a number of years the practice has been discontinued, and now the old strippings are largely covered.

The following chemical analyses of samples taken from a newly opened drift on the C. B. McQueen farm show the average composition of this clay.

Analyses of air-dried samples of flint clay from C. B. McQueen farm.
(D. B. Bates, analyst, U. S. Geological Survey laboratory.)

	A	B
Ultimate analyses:		
Silica (SiO ₂)	58.96	56.46
Alumina (Al ₂ O ₃)	35.09	37.09
Ferric oxide (Fe ₂ O ₃)	3.82	2.55
Manganese oxide (MnO)	.07	.09
Lime (CaO)	.70	.42
Magnesia (MgO)	.35	.28
Sulphuric anhydride (SO ₃)	.07	.14
Soda (Na ₂ O)	.15	.06
Potash (K ₂ O)	.36	.32
Water at 100° C.	.80	1.46
Ignition loss	9.99	10.64
Rational analyses:		
Free silica	100.18	100.25
Clay substance	25.75	20.50
Feldspathic substance	29.00	54.30
Water at 100° C.	4.30	3.93
Ignition loss	10.75	12.00
	100.00	100.00

Sample A in the above table represents the upper foot, and sample B the lower 2 feet of the section. Sample A has a very siliceous appearance, shows a rough surface, and breaks irregularly rather than with the conchoidal or shell-like fracture characteristic of flint clay. Sample B is like the type of best clay described above, except that instead of being homogeneous it contains a small percentage of bluish inclusions. In some cases it shows streaks which resemble bedding planes. Wherever cracks occur in the clay the surfaces so formed are strongly stained with iron. As is shown by the analyses, the percentage of iron is high for fire clay. This feature makes a good deal of the clay unsuitable for use in the manufacture of refractory articles. The clay at the bank from which the samples for analysis were taken is used at Sligo in the manufacture of fire brick. Clay from the north of the river has not been used south of the Wagner and Bell farms, the reported reason being that the clay in that region contains so much iron that it is worthless. In the area south of the river the best clay is said to have been taken from the Finnefrock farm. Considerable amounts of clay have also been taken from the Miller farm, 2 miles north of Sligo.

Freeport clays.—Both of the Freeport coals are usually underlain with clay, but the area of their occurrence in these quadrangles is small and the clay is not valuable. Flint clay is found below the Lower Freeport coal 1 mile west of Piolett and on the ridge road 2 miles southeast of Sharpsburg Church.

Foxburg-Clarion

It is also locally developed below the Upper Freeport and may be seen near the top of the hill one-fourth mile northwest of Rimersburg station. This flint clay occurs in quantities so small that it is not commercially important in the Foxburg and Clarion quadrangles.

IRON ORE.

Immediately above the Vanport ("Ferriferous") limestone member, and coextensive with it, occurs a bed of iron ore sometimes termed "burrstone ore" because of the chert associated with it. The ore is siderite except near the outcrop, where it is altered to limonite.

Chance reports that the usual thickness of the ore is from 6 to 14 inches, averaging 10 inches, and that exceptionally the bed is 2, 3, 4, or even 6 feet thick. A partial analysis of ore from a point near Sligo is as follows:

Analysis of iron ore near Sligo.

Metallic iron	36.55
Metallic manganese	1.63
Sulphur	.95
Phosphorus	.28

The average content of metallic iron is 33 per cent.

The ore was obtained in considerable quantity by stripping, and more rarely by drifting. The waste from the old workings is in evidence at a great many localities and well marks the ore stratum. The industry died out when the more economically handled and higher grade Lake Superior ores were opened up. With the exhaustion of the latter the deposits in Pennsylvania may again become valuable.

In the Foxburg quadrangle "ore balls" are found in considerable amounts at various places in the Allegheny formation. Some of these have been mined from below each of the Freeport coals, but the principal sources were in the lower part of the formation, between the Homewood sandstone member and the Lower Kittanning coal. In this interval brown ferruginous shale predominates, and much ore has been taken out by stripping. In the northwestern part of the quadrangle an almost continuous bed of iron ore is found about 10 feet below the Brookville coal. This stratum has been worked extensively, and the old pits east, west, and north of Eminton follow nearly the course of a level line around the hills. A little ore has been mined in the Mercer shale member of the Pottsville formation.

Iron ore was mined in western Pennsylvania principally between 1830 and 1860. It was smelted in charcoal furnaces, ruins of which form a picturesque feature of the area. The extensive forests of those days were used in making the charcoal, by piling up 20 to 40 cords of wood, covering it with soil, and burning it. About 20 pounds of charcoal were obtained from each 100 pounds of wood, and about 200 bushels of charcoal were required for each ton of iron.

LIMESTONE.

VANPORT LIMESTONE MEMBER.

Except in certain areas already described (see fig. 6) the Vanport limestone member is persistent throughout both quadrangles. The limestone ranges in thickness from 6 or 8 feet in the eastern part of the area to 10 or 20 in the central and western. In many localities the upper portion of the bed is cherty.

¹Chance, H. M., The geology of Clarion County, Second Geol. Survey Pennsylvania, Rept. VV, pp. 54, 190.

²Chance, H. M., *ibid.*, p. 196.

Where the limestone is removed from drifts this cherty layer which is usually about 1 foot thick and separated by a parting from the strata below, makes an excellent roof.

Formerly the limestone was used in the old iron furnaces as a flux. Very little of it has been used for building, but just now thousands of tons are being used in the construction of the macadamized road from Foxburg to Alum Rock. An analysis of a sample of the limestone by McCreath follows:

Analysis of limestone from Vanport member.

Calcium carbonate	90.23
Magnesian carbonate	.41
Oxide of iron and alumina	1.31
Phosphorus	.06
Insoluble residue	2.10

The lime is of great value as a fertilizer and is, fortunately, of general distribution. Many farmers have individual quarries. The limestone is not burned in or near the quarries but is hauled out and burned in the field in which it is to be used. Some of it has been hauled 8 or 10 miles.

FREEPORT LIMESTONE MEMBER.

Limestone occurs below each of the Freeport coals, but the deposits are limited to small broken lenses. In some cases boulders below the Upper Freeport coal have been dug and burned for fertilizer. The only quarries now open on this limestone are one on Myers Hill, 2 miles south by east from Sligo, and one about 3 miles southeast of West Freedom. However, much limestone is obtained from the weathered outcrops without opening quarries.

SANDSTONE.

Sandstone suitable for a great variety of purposes is abundant in the Foxburg and Clarion quadrangles. The Burgoon, Connoquenessing, Homewood, Freeport, and Mahoning are the most persistent members, but there are local developments of sandstone at many other horizons. The Connoquenessing and Homewood sandstones are quarried by the Black Fox Silica Brick Company near Upper Hillville, and by the Foxburg Sand and Stone Company north of Foxburg, and have been opened at several other places. The rock is commonly white and composed of almost pure silica. The grains of sand are angular or slightly rounded and generally loosely cemented. At the Black Fox quarry the rock is treated as gneiss. It is ground and made into silica brick for use in iron and glass furnaces. The output of the quarry near Foxburg is shipped as sand and used for molding and other furnace work, for grinding plate glass, and for locomotive use. The quarries are near the top of the river bluff and the rock is let down by inclines to the railway.

The Kittanning sandstone has been used to some extent for building stone. The rock is medium coarse grained, and much of it when freshly cut has a pleasing pinkish color. It weathers, however, a dull gray. There is a quarry about 2 miles south of Strattonville at which this sandstone is cut into curbing.

An abundant supply of desirable sandstone for making concrete, for road foundations, bridge abutments, etc., is found throughout the area. A new macadamized road is being built from Foxburg to Alum Rock, and the road bed is first covered with a thick layer of Burgoon sandstone, taken from nearby residual boulders. There seems to be very little rock in these quadrangles which is suitable for dimension stone.

May, 1910.

³Second Geol. Survey Pennsylvania, Rept. VV, p. 54.