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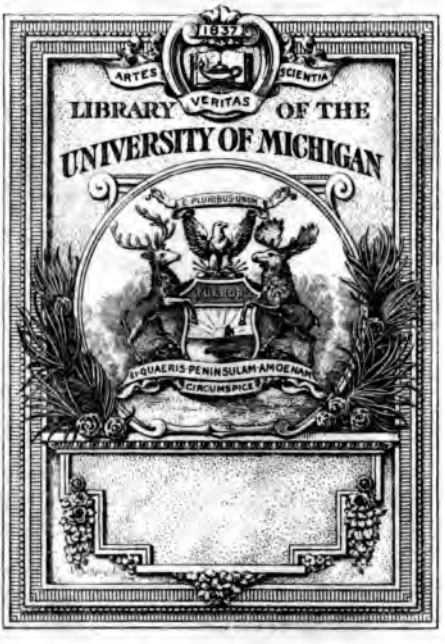
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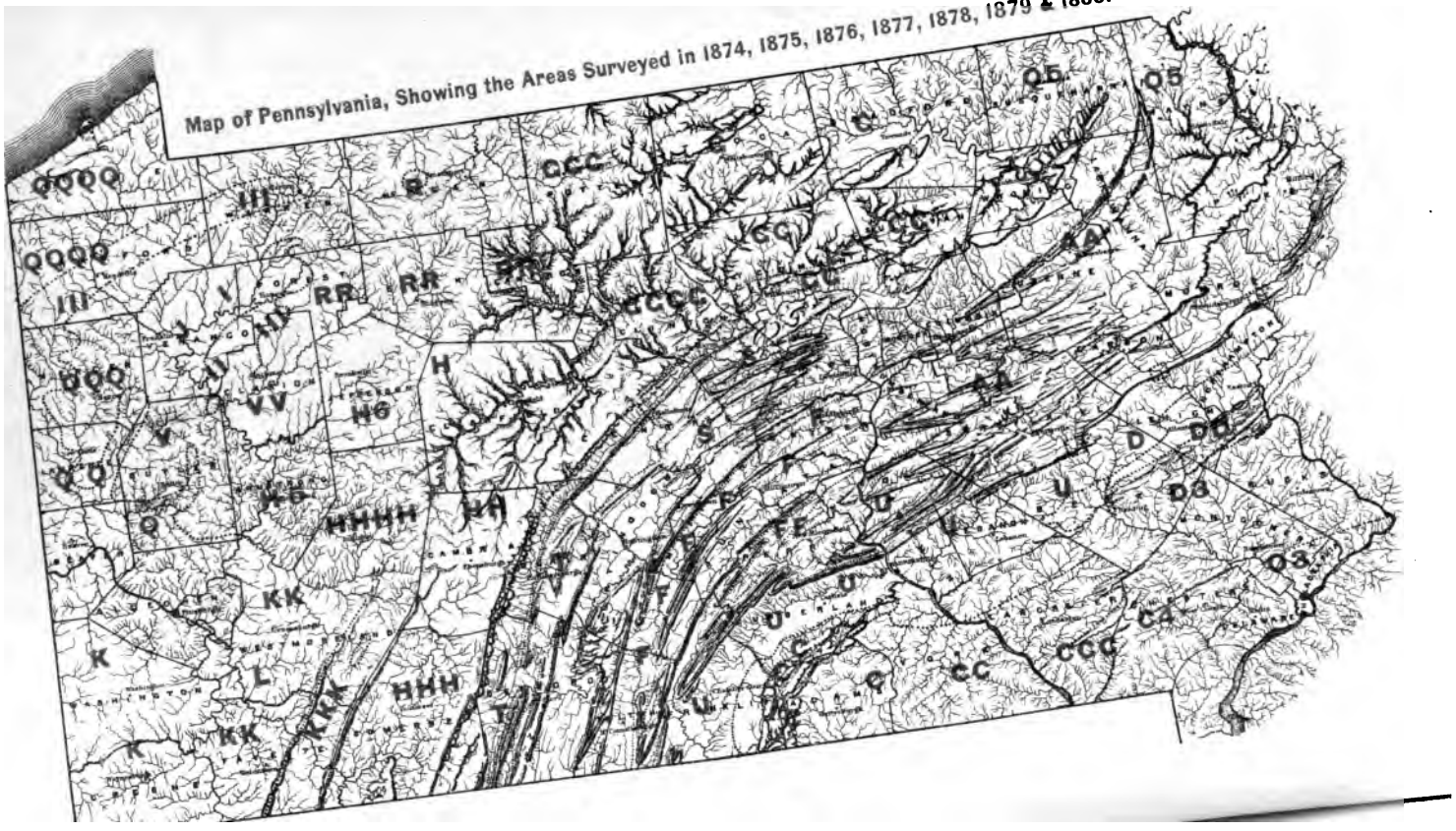
Map of Pennsylvania, Showing the Areas Surveyed in 1874, 1875, 1876, 1877, 1878, 1879 & 1880.

SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA:

1880.



REPORT OF PROGRESS

IN

# JEFFERSON COUNTY,

BY

W. G. PLATT,

WITH A COLORED MAP OF THE COUNTY.

HARRISBURG:
PUBLISHED BY THE BOARD OF COMMISSIONERS
FOR THE SECOND GEOLOGICAL SURVEY.
1881.

Entered, for the Commonwealth of Pennsylvania, in the year 1880, according to acts of Congress,

By WILLIAM A. INGHAM,

*Secretary of the Board of Commissioners of Geological Survey,*

In the office of the Librarian of Congress, at

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# LETTER OF TRANSMISSION.

PHILADELPHIA. *May 12, 1881.*

*To His Excellency Henry M. Hoyt, chairman ex-officio of the Board of Commissioners of the Second Geological Survey of Pennsylvania:*

SIR: I have the honor to submit a Report of Progress of the geological survey in Jefferson county, made during the last field season by Mr. Wm. G. Platt. whose able reports on the adjoining counties of Indiana and Armstrong have been published, and of which this report on Jefferson county is a virtual continuation.

In the first year of the Survey, 1874, a prelimnary examination of Clearfield and Jefferson counties was made by Mr. Franklin Platt, and was published as Report of Progress H; but, for various reasons, it seemed expedient to the Board to order a more thorough and complete survey of the region. This re-survey has now been accomplished, within the limits of Jefferson county; and all the more successfully because of the light which recent surveys have thrown upon it from the surrounding country:—from Indiana and Armstrong on the south; from Clarion on the west; and from Forest, Elk, Cameron and McKean on the north. Errors have been corrected, and a good basis has been laid for private and professional surveys hereafter.

The whole Bituminous Coal Region of western and northern Pennsylvania has now been surveyed and reported upon, occupying the whole or parts of thirty several counties. Twenty-four volumes of these reports have been published (G 1, 2, 3, 4; H 1, 2, 3, 4, 5, 6; K 1, 2, 3; Q 1, 2, 3, 4; R 1; V 1, 2; besides I 1, 2, 3 on the oil regions, with

sections of coal strata; and L 1, on the coke region;) and another is passing through the press (R 2.) The re-survey of Clearfield and the coal area of Centre county will occupy another (H 7.) The completion of the Warren county survey will add (in I 4) some information respecting the Coal Conglomerate. Finally, the special survey of the mines of the Monongahela region, ordered for the year 1881, will be published as L 2.

To this list should be added the already published *Coal Flora* (one volume of text and one of plates) by Mr. Lesquereux; and the *Permian Flora* (text and plates P. 2) by Messrs. White and Fontaine.

The literature of the Bituminous Coal Region of Pennsylvania will therefore be given to the State in thirty volumes and three atlases.

It may not be a vain or senseless boast that the Commonwealth of Pennsylvania has thus placed at the disposal of workers and thinkers in geology a larger furniture of closely corellated observed facts relating to the bituminous Carboniferous Formation than has been published by any government in the old or new world.

It is to be regretted, however, that all these careful surveys of the coal field of western and northern Pennsylvania had to be prosecuted, not in a natural sequence to, but in advance of such a *topographical survey* of the State as should supply accurate maps of the various subdivisions of the field. The *geological colored maps* published with the reports are mere copies of private county maps, slightly corrected here and there as special occasion and special information permitted. While they give a correct idea of the geographical areas occupied by the several coal beds, and groups of beds, all over western Pennsylvania, they are more or less *inaccurate in detail* everywhere and at all points of this great region. Nor can the thousands of local errors thus published be corrected by this or any other future geological survey of a general kind until a triangulation of the State be completed by the Geodetic Survey of the United States, or by a Geodetic Survey ordered and performed by the Commonwealth itself. When this is done, and land-

marks of true latitude and longitude are established in every county and township in the State, then correct county maps can be published, to which the geology of our report maps can be transferred, and from which local errors of outcrop-lining and coloring can be eliminated.

If the Legislature of the Commonwealth which has ordered the resurveying of the boundary lines of the State, should regard the rectification of its interior county and township lines (with the true locations of county court-houses, &c., and the proper delineation of the principal streams) as of equal or greater importance, then it should be kept distinctly in view, that so great a work can be accomplished only at a very considerable cost of time and money; and *that it cannot be accomplished at all until the whole State has been properly triangulated*—the triangulation a part and continuation of that of the U. S. Coast and Lake Surveys.

But this U. S. triangulation has already penetrated the eastern part of the State to such a distance that the angles of certain primary triangles are already located as far north as Schuylkill county, and as far west as York county. It only depends upon the will of the Legislature to have the system of triangles extended to every county in the State.

An appropriation of $10,000 a year, in aid of the operations of the U. S. Coast Survey, would secure established points in every county within the next five or six years; and if it pleased the Legislature to direct the Board of Commissioners of the Geological Survey to organize a geodetic (or accurate geographical) survey, as a sequel to the geological survey of the State, the filling in of the U. S. Coast Survey triangles could be done by the Board in the eastern part of the State while the primary and secondary triangles were being determined by the Coast Survey in the middle and western parts.

The colored geological map of Jefferson county, which accompanies this report, shows the areas of Sub-carboniferous rocks where these are brought to the surface in the deeper valleys, along the anticlinal folds. The axial lines of these folds are represented by lines, named as in the report. With the assistance of this map, the vertical sections inserted in

the text, and the index of names at the end of the book, the reader will experience no difficulty in making out the geology.

Respectfully submitted,

J. P. LESLEY.

## LETTER OF W. G. PLATT.

615 WALNUT STREET,
PHILADELPHIA, *May 10, 1881.*

Prof. J. P. LESLEY, *State Geologist:*

SIR: I have the honor to submit my report of the survey of Jefferson county. During a portion of the field work I was assisted by Mr. J. Cheston Morris, Jr., of Philadelphia, who volunteered his services and was an efficient aid. Much of the detailed geology of Rose and Pine Creek townships, as reported in the following pages, is his work.

I am indebted to the citizens of the district everywhere for courtesies extended to me. I desire specially to mention my obligations to Mr. Jas. Caldwell, County Surveyor, Mr. P. W. Jenks, of Punxsutawney; Hon. R. N. Nicholson and Mr. S. W. Smith of Brookville; Mr. N. B. Lane of Brockwayville; Mr. M. E. Steiner of Knoxville; Messrs. J. A. Wilson and Jno. Blandy of Philadelphia, and others.

Very respectfully, your obedient servant,

W. G. PLATT.

# TABLE OF CONTENTS.

# JEFFERSON COUNTY.

## 1880.

## INTRODUCTION.

Jefferson county, in the fourth tier of counties east of the Ohio line, and in the third tier south of the New York line, has Forest and Elk counties on the north, Clearfield on the east, Indiana on the south, and Armstrong and Clarion on the west*.

Jefferson county was established under an act of Assembly, approved March 26, 1804.

The original boundary lines inclosed an area of more than 1000 square miles, embracing much of what is now Forest and Elk, beyond the Clarion river. At what time its present boundaries were erected is not certain; but much shifting took place, especially along its northern border until within comparatively recent years.

Its *south line* now runs due west 23⅛ miles from the Clearfield-Indiana corner. Its *west* line thence due north 28¼ miles to the Clarion river. Its *north line* runs, first, up the Clarion river to Elk county; then, due south one half mile; then, southeast 13¾ miles to Clearfield county. Its *east line* runs, first, southwest 10 miles; then, due south 15⅛ miles to the starting-place at the Clearfield-Indiana corner.

The *area* thus contained measures 646 square miles, or 413,440 acres.†

* All of these counties, with the exception of the western part of Clearfield, have recently been surveyed and reported upon.

† These are the figures of the Census report of 1880. Egle's History of Pennsylvania gives the total acreage of the county as only 412,800, which is equivalent to 645 square miles.

Originally the county contained only a single township (Pine Creek township *); but at present it is subdivided into twenty-three townships arranged somewhat as follows:

| | | | | |
|---|---|---|---|---|
| Barnett. | | Heath. | | |
| | | Polk. | | |
| | | | | Snyder. |
| Eldred. | | Warsaw. | | |
| | | | | Washington. |
| Union. | | | | |
| | Rose. | Pine Creek. | | Winslow. |
| Clover. | | | | |
| | | Knox. | | |
| Beaver. | | | | |
| | | McCalmont. | | Henderson. |
| | Oliver. | | | |
| Ringgold. | | | | |
| Porter. | Perry. | Young. | Bell. | Gaskill. |

At the time the county was set off in 1804 there were probably not 25 white inhabitants within its boundaries†; and long after its establishment, it remained a hunting-ground for Indians. Settlements were made slowly, until after speculation in lumber began (about 1830), when the tide of immigration set in, and, as the Census figures show, the population nearly quadrupled between 1830 and 1840.‡

The earlier settlements had been chiefly along the Red Bank and Mahoning creeks, especially along the Mahoning, where the surface is smoother and better adapted to cultivation.

*Punxsutawney* on Mahoning creek is the oldest town in the county, having been laid out in 1818 (or 1819).

*Brookville* the present county seat was established in 1829, though no building was erected there until 1830.

After 1850 the growth of population though steady, was less rapid than it had been for the previous twenty years, partly because of the destruction of the forests, and partly because the commercial reverses of that time checked the lumbering business, and stemmed the tide of immigration.

* Apparently not derived from any particular stream, but from the abundant growth of pine forests, and a plentiful supply of water to float them.

† Outside of Post Barnett (settled in 1797) there seems to have been no attempt at colonization.

‡ In 1810. 161; in 1820, 561; in 1830, 2,025; in 1840, 7,253; in 1850, 13,518; in 1860, 18,270; in 1870, 20,566; in 1880, 27,935.

The next decade showed a much smaller increase, because of the Civil War; but after 1870, even in spite of the commercial depression following upon 1873, there was a marked improvement, owing entirely to the construction of the Bennett's Branch railroad, which opened up to market the coal fields at Reynoldsville. If the decade between 1830 and 1840 may be designated the *lumber era* in the history of Jefferson county, so the years between 1870 and 1880 may be regarded as the beginning of the *mining period.* If the present commercial activity be uninterrupted, in the next decade the mining interests of the county will take another long stride; for the development of the Reynoldsville Basin has only begun and is certain of a steady growth and increase.

Apart from mining and lumbering few industries engage the attention of the people. Saw mills and planing mills have been erected upon nearly all the larger streams, but their aggregate production is comparatively small. There are also some small foundries, woolen factories, pottery works, chair factories and shops for the manufacture of other kinds of furniture; but these like the others are greatly subordinate to agriculture, which forms the chief pursuit of the population, and one, moreover, from which a fair profit is derived, considering the amount of capital invested.

The people are mainly of Scotch-Irish descent, with a considerable intermixture of the German element, industrious, prudent and thrifty.

## *Topography.*

The surface of Jefferson county is uniformly broken and hilly; everywhere occupied by the same set of rock strata, lying nearly horizontal, and excavated into valleys and ravines in the same style. Although one valley cannot be said to be the exact counterpart of another, nor the streams be considered of equal size and importance, yet *the type* of the topography is the same wherever we look at it, and any one part of the county, therefore, is, in this respect, a picture of the whole.

Standing upon one of the many elevated points of the region the observer may see beneath him a broad valley, from 300 to 500 feet deep, and as irregular in its trend and course as its slopes are variable in their fall. Here precipitous walls face the stream on both sides; there a sharp descent upon the one side is faced by a long gentle slope upon the other, according as the dips are arranged; at another place the valley widens under the influence of a synclinal, and both its slopes are gradual. Numerous ravines, some short, some long, some deep, others shallow, debouch into the valley from both sides. Uplands undulating, but of a pretty uniform height, stretch away in both directions. No mountain ridges are anywhere visible on the horizen. As far as the eye can see there spreads an elevated table land, broken by vales, valleys and ravines.

The *height above tide* of the upland summits ranges from 1600′ to 1800′. They are lowest at the southern end of the county, and highest at the northern end, in obedience to a topographical law prevailing throughout western Pennsylvania: that the surface elevations gradually increase in the direction of the rising anticlinal axes, *i. e.*, towards the northeast.

To this law there is one notable exception in Jefferson county: the southeast corner borders on the high table land of the Chestnut Ridge anticlinal, whose summits frequently attain an elevation of 2000′; and some few points in Gaskill township rise very nearly to that height; but these points are related more closely to the topography of Indiana and Clearfield counties than to that of Jefferson, which is in fact a mere continuation of that prevailing throughout Clarion, Armstrong and western Indiana counties.

Few accurate hypsometrical data (heights above tide) can be furnished in Jefferson county. Almost the only levelling done has been along the line of the Bennett's Branch Extension railroad, following Sandy Lick and Red Bank creeks; and a line leveled by Mr. John A. Wilson from the mouth of Falls creek to Ridgway. Some few other lines have been run by engineers in recent years; but their data are not now accessible.

## *Bennett's Branch railroad levels.**

| | | |
|---|---|---|
| Falls Creek bridge, | *above tide* | 1405′ |
| Evergreen water station, | | 1398′ |
| Maghee's, (Sandy Valley P. O.,) | | 1387′ |
| Panther run, | | 1386′ |
| Reynoldsville, | | 1377′ |
| Prior run, | | 1366′ |
| Prindible, | | 1360′ |
| McAnnulty's run, | | 1359′ |
| Camp run, | | 1341′ |
| Fuller's, | | 1327′ |
| Wolf run, | | 1319′ |
| Iowa mills, | | 1299′ |
| Bell's mills, | | 1268′ |
| Brookville tunnel, east end, | | 1242′ |
| Brookville station, | | 1235′ |
| Coder's run, | | 1223′ |
| Puckerty Point, | | 1214′ |
| Rattlesnake run, | | 1207′ |
| Baxter's, | | 1206′ |
| Troy, | | 1186′ |
| Heathville, | | 1161′ |
| Patton's, | | 1131′ |

## *Levels from Falls Creek to Ridgway.*

The elevations of Mr. Wilson's survey are referred to ocean level. The line starts east of the Falls Creek bridge, and in elevation exactly one foot above it.

| | |
|---|---|
| Station 0, *near Falls Creek station, B. B. line, sub-grade,* | 1406′ |
| Station 240, Surface of ground, McMinn's Summit, | 1625′ |
| (*McMinn's Summit is the Boon Mountain divide.*) | |
| Station 305, Foot of hill on Toby waters near Law's [Lane's?] mill, | 1483′ |
| Station 420, Surface of ground at Brockwayville, | 1466′ |
| Ordinary low water in Little Toby here, | 1441′ |
| Bench on floor of bridge over Toby creek, | 1451′ |
| (This is the main Ridgway road.) | |
| Station 1001, Mouth of Little Toby creek, | 1321′ |
| (This is ordinary water level.) | |
| Station 1442+87, Junction of surveyed line with Philadelphia and Erie R.R., about 2500′ westward from the P. & E. passenger station at Ridgway. Elevation of top of rail, P. & E. R.R., | 1389′ |
| Bench, top of up-stream end of pier of public road bridge across Clarion river below mouth of Elk creek, in Ridgway, | 1383′ |

* See Report of Progress N.

*Drainage.*

The drainage of Jefferson county is all westward towards the Ohio River, through (1) the *Clarion river* at the north end of the county, (2) *Red Bank Creek* in the center and (3) *Mahoning Creek* on the south. Each of these streams has its own complex system of tributaries, each with its own system of small branches and branchlets; and thus the surface of the whole county is broken into hills.

Although the Clarion and Mahoning are larger streams, yet, as they flow on the borders of the county, they are less important to it than the Red Bank.

*Red Bank Creek* is the principal stream, as a glance at the map will at once show. Its water basin is unsymmetrical on the two sides; a much larger part of its drainage coming in from the north than from the south. Excepting indeed for the Little Sandy branch its basin on the south side would be confined pretty much to the hills which overlook the creek; whereas towards the north its far-reaching arms extend to the Elk County line.

*Red Bank Creek* in the original maps and drafts of Jefferson County bore the name of *Sandy Lick*, which name is still retained for its main branch, coming from Clearfield County, along which the Bennett's Branch railroad is laid. The Creek assumes the name of Red Bank at Brookville, where the

*Sandy Lick* unites with the North Fork, and both branches carry enough water during floods to float rafts and logs.

*Mill Creek*, a branch of the Sandy Lick, is also a rafting stream.

*Little Sandy*, before alluded to as occupying the southwestern part of the county is a rafting stream.

The volume of water, however, in all the streams, large and small, is extremely irregular, varying as it does from stages of high flood when the larger streams are destructive torrents, to stages of almost complete exhaustion during periods of severe drought. This extreme of variability is largely the consequence of the porous and loose condition of the surface rocks, which thus copiously yield water so long as they hold it. In 1879, an exceptional year, after a

succession of prolonged droughts, there was a dearth of water in all parts of the county; the larger streams had barely enough in them to turn a mill; and considerable difficulty was experienced, especially in the upland country, to obtain water for the cattle. As a rule the County is abundantly watered for agricultural purposes and for domestic supply in towns and villages.

*The Red Bank-Mahoning divide* in the southeast corner of the county crosses from Clearfield at a point nearly due east from Reynoldsville. Thence it follows an irregular southwest line, around the heads of Elk run and around the heads of the Little Sandy. *Paradise settlement* stands at the top of it; so does *Shamoka*, *Oliveburg* and *Frostburg*. Porter P. O. at the southwest end of the county marks the top of the divide in that region.

*The Red Bank-Clarion divide* divide on the north enters Jefferson south of Lane's Grove, where one branch of Rattlesnake run takes its rise. After passing Brockwayville the water-shed is forced almost to the edge of the Little Toby valley, as will be seen on examination of the county map. Along with the last named stream it passes into Elk county, where curving about the heads of the North Fork (Red Bank system) it returns again to Jefferson, whence closely skirting the Clarion river, it runs southwest to Sigel. There it turns sharply about and next sweeps around the head of Big Mill creek, extending thence south to within a few miles of the Red Bank valley. It therefore describes a semi-circle in northern Jefferson, stretching from one side of the county to the other.

## *Railroads.*

The Bennett's Branch Extension railroad, or, as it is sometimes called, the Low Grade Division of the Allegheny Valley railroad, extends through Jefferson county. One terminus of the road, the western, is at Red Bank station in the Allegheny valley, from whence communication is opened northward to Buffalo and the lakes, and southward to Pittsburg. Its eastern terminus is at Driftwood, a station on the Philadelphia and Erie Railroad, by means of which latter

another avenue is afforded either northward to the lakes or eastward over the Pennsylvania railroad to the Atlantic seaboard. The total length of the Bennett's Branch Extension is 110 miles; the distance traversed by it in Jefferson county is 33 miles, or nearly one third of its total length.

This unique low-grade route across the highland of Pennsylvania was surveyed and laid out by Mr. Jno. A. Wilson, who also superintended its construction, which was completed in 1874. The *maximum gradient east* towards the summit is 37 feet per mile;* *maximum west*, 16 feet per mile.

A line of railroad has been projected and surveyed from Reynoldsville to Punxsutawney with the object of developing the extensive coal fields lying north of the latter place.

Another line of railroad to connect Reynoldsville and Punxsutawney with the Erie railway in McKean county, has been projected and located along Falls creek and the Little Toby. This line would afford the coal fields at Brockwayville and along Rattlesnake run an outlet northward.

### *Forest trees.*

The southern portion of Jefferson county was mostly covered with *white oak*, *black oak*, *rock oak*, *chestnut*, *sugar*, *beech* and *hickory*.

The rock areas of northern Jefferson have been covered with *pine and hemlock* with scarcely a trace of white oak. There is still a considerable quantity of marketable pine and hemlock left.

Perhaps nine tenths of the pine timber of Jefferson has been cut.

*White oak*, *chestnut*, *sugar*, *beech* and *hickory* are the principal kinds of wood on the cleared lands.

*White oak* is found mostly on the high uplands.

Mr. James Caldwell, who is authority for this general statement, writes that he has observed *pine* and *hemlock* on the cut lands; that *birch* and *cherry* sometimes succeed to *pine* and *hemlock*; and that occasionally *white oak* succeeds

*This grade of 37 feet per mile prevails only over a short distance (about three miles) just before the summit is reached. The grade from Driftwood to the foot of the hill at Bundy's is only 18 feet per mile.

where the original *pine* and *hemlock* first has been mixed with *white oak.*

### *Geological Structure.*

The rocks of Jefferson county are folded in a regular succession of parallel anticlinal ridges and synclinal basins, stretching from southwest to northeast. The folds are not all equidistant from each other. Those west of the Perrysville anticlinal are nearly so.

The anticlinal arches are low, and the synclinal basins are shallow; and while they are not equal in height and depth, when compared with one another, the difference is small, although of considerable importance in its effect upon mining interests. Some idea of how gently the rocks incline from the horizontal may be got from the fact that the whole thickness of strata outcropping at the surface in any basin, does not exceed 500 feet, although the basin is in some cases six miles wide.

The axes of the rolls and troughs being parallel *the line of strike* is necessarily uniform in all parts of the county; about N. 40° E. (S. 40° W.)

The normal dip, therefore, is either to the N. 50° W. or S. 50° E. But the real dip is somewhat different, owing to the plainly marked *rise of the whole region* (with its anticlinals and synclinals) *towards the northeast.* The effect of this general tilt is seen: — 1. in the gradual succession of lower strata at the surface in each basin, from southwest to northeast; and 2. in the swinging of the normal dip round towards the west, viz: from N. 50° W. to N. 60° W., N. 70° W., N. 80° W. and even West; and from S. 50° E. to S. 40° E., S. 30° E., S. 20° E., and even South.

One small *vertical fault* was discovered at Fuller's mills of which a description is given in its proper place in this report.* Similar displacements may occur at other places; but they certainly do not seriously affect the geology.

One of the most marked features of the geological map, viz. the rapid deepening which takes place in the Reynoldsville and Lisbon basin north of Rockdale, is not caused by a

* See Index.

fault, as might first appear; but simply by the almost complete dying out of the Perrysville anticlinal there.*

The anticlinal and synclinal axes of Jefferson county are mostly prolongations of those in adjoining counties, and I therefore give them the same geographical names in this report. But two of them have received new names: 1. *The Falls Creek anticlinal*, practically a continuation of the *Indiana Axis*; and 2. *The Perrysville anticlinal*, a name already suggested in the Indiana county Report H⁴.

[Northwest.]

KELLERSBURG ANTICLINAL.

*Centreville synclinal.*

ANTHONY'S BEND ANTICLINAL.

*Fairmount synclinal.*

BAGDAD (BROOKVILLE) ANTICLINAL.

*Leechburg (Apollo) synclinal.*

WAYNESBURG (ROARING RUN) ANTICLINAL.

*Smicksburg synclinal.*

PERRYSVILLE ANTICLINAL.

*Lisbon (Reynoldsville) synclinal.*

FALLS-CREEK (INDIANA) ANTICLINAL.

*Blairsville synclinal.*

CHESTNUT RIDGE ANTICLINAL.

[Southeast.]

The following short descriptions of the location and course of each of the above rolls and troughs, commencing on the southeast, will prepare the reader for the more detailed descriptions in the body of the Report.

CHESTNUT RIDGE ANTICLINAL.—The axis or center line of this roll passes just outside the limits of the county, through Bell township of Clearfield county. In this northern latitude the axis no longer forms the prominent mountain ridge that it does at the south, where it crosses the Conemaugh and Youghiogheny rivers, but traverses rather an elevated table land, several miles broad, and covered for the most part by the rocks of the Lower Productive Coal Measures. The dips along its west flank, which is the slope leading into Jefferson county are shallow, being rarely (at least within the Jefferson line) more than 2°. This latter fact is plainly expressed by the geological map, which shows how

*This is a common feature to the Bituminous Coal regions, but I can recall no place where the effect of the change is better expressed than at Rockdale.

slowly the rocks accumulate in the Blairsville Basin. The plateau of Chestnut Ridge is, in this latitude, the dividing water-shed between the Susquehanna and the Ohio.

*Blairsville Synclinal.*—This basin occupies the region situated between the Chestnut Ridge anticlinal on the one side and the Falls Creek (Indiana?) anticlinal on the other. This basin throughout Indiana county towards the south, is from five to six miles wide, maintaining these dimensions with great regularity until it approaches the Jefferson county line, where the western side of it, (the Indiana arch) breaking down completely, the Basin extends, with nearly horizontal strata, over a distance of twelve miles, to the Perrysville arch. This is the explanation of the outspread of Lower Barren strata in the Mahoning Valley east of Punxsutawney; just as it explains also the presence of these rocks throughout all of southeast Jefferson. Another anticlinal, which provisionally, I have named the Falls Creek, rises north of Punxsutawney to again diminish the Blairsville Basin to its original dimensions. But this arch, though distinct and easily recognized, is much too feeble to effect the geological change produced by the Indiana arch further south.

The synclinal of the Blairsville Basin crosses the Mahoning creek near Big Run village, whence it extends east of Paradise, and thence across the heads of Stump creek. It follows very nearly, in fact, the line which the Indiana arch would have followed had the latter remained continuous from Indiana county through Jefferson. The Indiana arch, where seen for the last time on Little Mahoning creek several miles south of the Jefferson line, lifts the *Mauch Chunk red shale* formation high above the water line, exposing in so doing several prominent layers of red clay shales. The absence of the arch in southeast Jefferson is a great boon to that region because it gives to the county the only coal basin of any size and value it possesses; but on geological grounds the disappearance of the arch is much to be regretted, inasmuch as we are thereby prevented from constructing there a section of the Conglomerate and Mauch

Chunk formations, and thus directly joining the work of the Sandy Lick valley with the work of the Conemaugh.

FALLS CREEK ANTICLINAL.—This rises as a very gentle arch at the northern border of Bell township. In quick succession it crosses Turnip run, Big run and Laurel run, in each of which valleys it lifts an area of Lower Productive Coal Measures to daylight; it is more than a mile northwest of Paradise, and about the same distance southeast of Reynoldsville; it is accountable for the shallow northwest dips felt in some of the mines at the latter town; it crosses Soldier run above the mouth of Mix run, and the Sandy Lick above Pancoast; it crosses Falls creek near the mouth of Wolf run, and seems to follow thence the latter valley along the Clearfield line; but, scanty exposures in that wilderness region prevent it from being located exactly. This Falls Creek arch may possibly be the southwestward prolongation of the Boon Mountain arch, or it may be an independent fold, situated between the southwest end of Boon mountain, and the northeast end of the Indiana arch. We have already seen that it is not exactly in line with the latter; what becomes of it in Clearfield county can only be decided after a more thorough survey of that region.

South of the Sandy Lick creek, throughout Winslow and McCalmont townships, the Falls Creek arch has dips of only about 1° on either flank. It therefore exercises no effect upon the topography and very little upon the geology. Its strength is suddenly developed north of the Sandy Lick valley, hoisting, as it does, the *Homewood Sandstone* to the level of Falls creek, and forcing the *Freeport group* from the hilltops north of Pancoast. It utterly destroys the economic value of the Reynoldsville basin along the eastern side of Washington township.

*Lisbon synclinal.*—This important basin, continuous through Westmoreland, Armstrong, and Indiana counties, is the Reynoldsville basin of Jefferson. At the Indiana-Jefferson line the Indiana arch expires, and this basin is merged in the next, but after the rise of the Falls Creek anticlinal becomes distinct again. It passes close to Shamoka and almost directly under Reynoldsville; still further north, after

the disappearance of the Perrysville anticlinal at Rockdale it merges with the Smicksburg synclinal.

PERRYSVILLE ANTICLINAL.—The axis crosses from Indiana county into Jefferson at a point about one mile southeast of Perrysville, at which place it is a low flat arch with gentle dips. After crossing Mahoning creek between Perrysville and Whitesville it passes under the uplands of Perry township, gaining strength rapidly as it runs, and gradually replacing *Lower Barren strata* at the hilltops with Lower Productives. The village of Frostburg is situated almost over the arch, whence northeast the axial line extends east of Elk run. Here it has dips of 3° and 4°, which become even sharper as the axis approaches Sandy Lick Creek, the valley of which it crosses at Carriers station, two miles below Reynoldsville. It hoists there the *Homewood Sandstone* high up in the hills. The same force is exerted also after it crosses into Washington township, but after reaching the Beaver dam branch of Falls Creek at Rockdale, the arch subsides and is quickly lost. A slight roll was detected in the rocks in the ravine of Rattlesnake run south of Brockwayville, which may perhaps be the dying end of the Perrysville arch. North of that however there is no trace of the fold.

Attention has already been directed to the important effect which the subsidence of this axis has upon the mining interests of northeast Jefferson. It enables, in fact, the *Freeport group* to come into the hills at Brockwayville, and has thus preserved there an extensive outspread of coal which will ultimately command attention. The Perrysville axis attains its greatest strength in the Sandy Lick region, from which it then subsides in both directions. Southward it has been traced through Indiana and Armstrong counties to where it finally expires on Crooked Creek.*

*Smicksburg synclinal.*—This sub-basin is not always easy to distinguish in the broad shallow basin, between the Perrysville and Waynesburg anticlinals. It passes somewhere about two miles northwest of the village of Perrysville,

* See Report H⁵, pp. XXXIX and XL.

whence its line is nearly straight to Fuller's mills on the Sandy Lick, in which region it is defined, at the hilltops, by a considerable patch of *Mahoning Sandstone*, south of the creek. North of the creek its run is through a wilderness region until it appears at the head of Rattlesnake run, northwest of Rockdale. Thence united with the Lisbon synclinal it extends across the Little Toby creek at Brockwayville.

WAYNESBURG ANTICLINAL.—This Roaring Run anticlinal of Armstrong county is one of the main axes of Jefferson. Its line is unbroken and perfectly straight from where it enters the county to where it leaves it. In the Geology of Pennsylvania by H. D. Rogers, it was designated the Fourth Great Axis, and was so called in my Report of Progress for Indiana county. In that latter report* it was shown to cross the Mahoning Valley at Good's mill below Smicksburg, whence within a few miles it passes into Jefferson county. It crosses Pine Run at the mouth of the Middle Branch, and next crosses Big Run at Sprankle's mill. Between the Mahoning creek and Big Run its strength increases very considerably; for, while on the first named stream the *Ferriferous limestone* does not quite reach the daylight, the same rock on Big Run is lifted 200 feet above the drainage line. This, allowing for the difference in the depth of the valleys, and their relative elevation above sea level, is a clear rise in the axis of at least 300 feet. The *Lower Barren strata* disappear totally from its back in Oliver township, but come back again in Knox township, where there is a marked dimple at the center of the fold. The axis crosses Little Sandy creek at McKinstry's mill, lifting the *Homewood Sandstone* to the same elevated position there that it occupies in the Big Run region. But thence northeast the axis weakens somewhat and then rises again forming the dimple above alluded to. This is the explanation of the small area of *Lower Barren strata* through which the axis passes southwest of Knoxville.

Northeast of that place the axial line is not easily located, because the region traversed by it is mostly wilderness. As

Report HHHH p. 286.

nearly however as it can be located it crosses Sandy Lick creek just below Iowa mills, and next crosses Mill creek about four miles east of Port Barnet. Thence it passes nearly under Warsaw, and finally leaves the county in the northeast corner of Polk township, in which latitude it is a broad arch with gentle dips.

*Leechburg synclinal.* —This basin in Jefferson county includes the villages of Ringgold, Worthville, Bellview, Port Barnet, Richardsville, Warsaw and Schaffner's Corners. The town of Brookville, the county seat, is also situated within it. The basin is of uniform width throughout the whole length of the county, the distance across from anticlinal to anticlinal being almost exactly five miles. How much the trough shallows towards the northeast, in consequence of its rising floor, is prettily shown by the geological map, which tells the reader at a glance that the *Coal Measure* strata north of the Sandy Lick creek are reduced in this basin to a shallow covering at the hilltops. From an extensive outspread of *Lower Barren* measures at the southwest end, we pass without any reduction in the altitude of the summits, first to the upper horizons of the *Lower Productive* measures, then to the lower horizons of that series, and finally out of those rocks nearly altogether. The little basin of *Ferriferous limestone* in Polk township is all of any value that is left of them in that northern region, and the limestone itself, in turn, passes out of the hills before reaching the Elk county line. This is really a reduction in the depth of the basin, compared with its southwest end, of at least 400 feet, which shows a continuous rise of $\frac{1}{4}°$, supposing the surface to be no higher at the north than at the south; in point of fact however, there is a considerable difference of elevation in favor of the north end, so that the reduction in the *depth of the basin* does not fully express the strength of the northeast rise, which after due allowance is made for change of altitude, becomes nearly $\frac{1}{2}°$, or an increase in height, at right angles to the true dip, of 29 feet nearly for each stratum in every mile.

The Leechburg basin in Armstrong County is subdivided by a small subordinate roll into two basins, called there the

Apollo and Leechburg troughs; but that roll disappearing before reaching Jefferson County, the basin there is simple, rather larger on its western side than on its eastern, but otherwise without complications of any kind. The synclinal axis crosses Pine Run near the mouth of Eagle run; it passes nearly under Ringgold; crosses Little Sandy Creek at Worthville, and the Sandy Lick somewhere near Bellport Mills; it passes close to Maysville where its path is distinguished by a single knob of *Freeport* strata; thence it runs under the limestone uplands at Schaffners Corners, and so passes out of Jefferson County into Elk, where its course has been traced by Mr. Ashburner.

BAGDAD (BROOKVILLE) ANTICLINAL.—The axis of this roll enters Jefferson County from Armstrong above the mouth of Little Sandy Creek, whence it follows up the Red Bank Valley for about four miles, and then strikes across the southeast corner of Clover township, to again cross Red Bank Creek between Brookville and Dowlingville. This double passage of the axis across the Creek is the explanation of the wilderness condition of that valley *above* Dowlingville and *below* Heathville; while the intermediate region in the bend, (Troy for instance) is at the synclinal and therefore in higher and smoother (*Coal measure*) rocks. The axis runs a mile northwest of Brookville. It twice crosses the North Fork Valley; once below the mouth of Craft run and again below Richardsville; then it makes the wilderness of western Polk township. and eastern Heath.

This axis is a straight and continuous line through Jefferson county, being, in fact, one of its principal folds. It lifts the rocks 500 feet at least on Red Bank Creek, and considerably more than that at the north end of the county. The arch however is much narrower at the south, with sharper dips on both flanks, than it is at the north.

The Bagdad axis has been described under various names in the different reports. Mr. Chance in Report VV referred to it as the Brookville anticlinal. In my report for Armstrong county I traced it to the Kiskiminetas River which it crosses at Bagdad station, where it was long ago known and described, and from which place also it has derived its

name. Prof. Stevenson called it the Pin-Hook anticlinal in Westmoreland county.

*Fairmount Synclinal.**—The axis of this basin crosses the Red Bank in Jefferson county at Troy, and passes thence through the region in which Big Mill Creek heads in Eldred township. The line there becomes indistinct and difficult to trace because of the shallowness of the basin and the horizontality of the strata. Further north in the wilderness of Heath township it is scarcely distinguishable at all.

This basin, which is of so much importance at Fairmount, contains nothing of special value in Jefferson county. The coal beds are all small and the most of them are too impure for shipment. It shallows as rapidly northeastward as does the Leechburg trough, before described. North of Eldred township it is bare of coal measures.

ANTHONY'S BEND ANTICLINAL.—This fold is persistent and continuous through Jefferson county; but is distinctly and easily recognized only in the neighborhood of Corsica, where it crosses from Clarion county, and where also it has some sharp southeast dips. It has lifted the small areas of *Homewood sandstone* to daylight, which are found along Runaway run and Welch run southeast of Corsica; just as it has lifted the same rock to the uplands at the headwaters of Big Mill creek. As nearly as the axis can there be located it passes about one half mile southeast of Sigel, whence it extends as a broad arch through the wilderness of Heath township to the Clarion river.

*Centreville synclinal.*—The axis of this trough comes into the county from Clarion about one mile northwest of Corsica. It crosses Big Mill creek near the mouth of Jimmy's run; it passes in the vicinity of Kahle P. O., and passes also near Butterfield's in Barnett township, whence it crosses the Clarion river at Clarington, and extends into Forest county. Its basin is the shallowest of all the Jefferson county troughs.

KELLERSBURG ANTICLINAL.—The axis of this roll cuts

*So named from the mining district at Fairmount near New Bethlehem, through which it passes.

only the extreme northwest corner of Jefferson county, so that this report has little to do with it. Its arch is so indistinct in that northern region as barely to be recognizable, but that the uplift is in full force there, even if its arch has greatly broadened, is clearly evident from the elevated position which the rocks occupy over all Barnett township. If the axis were extinct in that region, the northwestern corner of Jefferson, instead of being the rocky waste of *Conglomerate* that it is, would contain a valuable basin of Coal Measures. But this axis like the others of Jefferson county, while retaining their full strength towards the north, have so flattened as to make the stratification of that northern region, nearly horizontal.

### *Stratified rocks.*

The outcropping strata of Jefferson county are as follows:
*Lower Barren Coal Measures*, No. XIV.
*Lower Productive Coal Measures*, No. XIII.
*Pottsville Conglomerate, No. XII.*
*Mauch Chunk red shales, No. XI.*
*Pocono Sandstone, No. X.*

The geological map accompanying this volume is colored to show the areas which they occupy.

### *The Lower Barren Measures.*

In many of the localities colored on the geological map with the *Barren Measure* tint, the *Mahoning Sandstone* at the base of the group alone exists.

The greatest thickness of *Barren Measures* is in the region of Punxsutawney. They overspread the uplands generally along the Indiana county line, except on Chestnut ridge. They have quite an extensive range in Henderson township bordering Clearfield county. North of the Red Bank and Sandy Lick creeks they are scarcely represented at all.

The *Barren Measure* strata are a succession of sandstone layers and slates and shales. The latter predominate where ever there is any considerable accumulation of the group. There are some insignificant *coal beds* interstratified; but no *iron ore* beds to speak of; nor any particularly good deposits

of *fire clay*. Several of the upper *limestone* beds have been spared by erosion to a few favored localities. The hills of the Paradise settlement, for example, are abundantly stored with limestone.

Except around their rocky (*Mahoning Sandstone* outcrop) edges the distinctive feature of the Barren Measure areas is a smoothness of surface due to the disintegration of the shales; so that the parts of the county occupied by these strata are *par excellence* its farming land.

I was able to recognize few of the better known horizons of the Lower Barren group in Jefferson county. One identification of the *Black Limestone* was made at Clayville. The red shale layers familiar to all observers of the Lower Barren group were seen on the hills south from Punxsutawney and also in the Paradise region. The *Mahoning Sandstone* is an unfailing landmark in the geology wherever its horizon is caught.

### *The Lower Productive Coal Measures.*

Their aggregate thickness of about 300 feet is exceedingly uniform everywhere in the county, and the number and order of the beds are the same as in the adjoining counties, viz:

| | |
|---|---|
| *Freeport Upper coal,* | Freeport group. |
| *Freeport Upper limestone,* | |
| *Freeport Lower coal,* | |
| *Freeport Lower limestone,* | |
| *Freeport Sandstone,* | |
| *Kittanning Upper coal,* | Kittanning group. |
| *Johnstown Cement bed,* | |
| *Kittanning Middle coal,* | |
| *Kittanning Lower coal,* | |
| *Buhrstone iron ore,* | Clarion group. |
| *Ferriferous limestone,* | |
| *Clarion coal,* | |
| *Brookville coal,* | |

*The Freeport upper coal bed* though nearly always present wherever the land is high enough to include it, is not a reliable seam for mining purposes in Jefferson county.

Throughout the Perrysville region the seam possesses no value at all. The same along the Little Sandy.

On the eastern side of the county where its thickness is

sufficient, its slaty and pyritous condition condemns it at nearly all points; as for instance at the Beaver mine north of Punxsutawney, and at the Schäfer mine, still further north, on the waters of Big Run.

At Reynoldsville it measures four feet in some places; but, so far as yet explored, it is entitled to no consideration as a means of supply for shipment to market.

At Brockwayville, its northernmost limit in Jefferson county, the bed is of rather better quality, but thinner.

*The Freeport upper limestone* attains its greatest development along a narrow belt extending northward from Perryville to the Little Sandy creek at Worthville. West from that belt there is a rapid diminution of thickness. Eastwardly also it thins away and ultimately disappears from the measures. I could find no trace of it throughout Knox and McCalmont townships; and none in Winslow. To the northeast, it reappears around Brockwayville; and to the southeast, at Clayville, on Mahoning creek.

*The Freeport lower coal bed* not only gives its great value to the Reynoldsville Basin, but is also the main seam of Jefferson county wherever the hills are high enough to include it. Although this coal bed is one of the most uncertain of the Lower Productive series and seldom of workable size in adjoining counties, it is everywhere workable in Jefferson county; but not equally good in all of the county; nor is its thickness uniform.

It is thickest and best in the Reynoldsville Basin, in which is included the Punxsutawney region as well as that directly around Reynoldsville. The development of the bed is however as yet confined to the immediate vicinity of the railroad at Reynoldsville. The superb fields at Punxsutawney are yet untouched awaiting railroad facilities; so are the extensive fields along Soldier run and Mix run; at Brockwayville; and along Rattlesnake run.

*The Freeport Sandstone* is seldom a prominent rock in the region under discussion. Throughout the Perrysville region it is hardly noticeable at all, being slaty; neither is it of importance at Punxsutawney nor along the upper wa-

ters of the Mahoning; nor still further north along the Little Sandy. It acquires local prominence however at Reynoldsville where on the hills facing that town from the west it becomes 30 and 40 feet thick. It is massive also, and therefore conspicuous on the Brookville pike near Baum's hotel.

*The Kittanning group* is of small importance at all points in the county.

*The Kittanning upper coal* nowhere exceeds three feet in thickness and seldom is more than the half of that. Mr. Daly has a mine upon it near the village of Corsica.

*The Johnstown Cement bed* was repeatedly observed in the course of my survey; and in fact at nearly every locality at which good exposures exist of its horizon. In most cases it was represented by a small layer of impure ferriferous limestone; with its characteristic minute univalve fossil impressions.

*The Kittanning middle coal bed* acquires some prominence in Knox and McCalmont townships, because of its thickness there, but not because of its purity. It is at its best in Union township, supplying that region with nearly all the coal required for local use. Elsewhere in the county the bed is small.

*The Kittanning lower coal bed* is a regular and persistent feature of the series throughout Jefferson, but the seam is mainly small and poor. At no place does it yield marketable fuel. Its outcrop being conveniently near that of the Ferriferous limestone, it supplies fuel for the lime-kilns wherever the latter stratum is quarried. On this account the coal bed has received considerable attention from the farmers.

*The Buhrstone iron ore* has its vanishing limit in Jefferson county, and only vestiges of it remain. Along Red Bank it is distinguishable nearly as far east as Brookville, but in such attenuated form as to render it valueless for mining purposes. The same is true of the Little Sandy region. On Mahoning creek its horizon is only above water level at Perrysville, where however no trace of it was de-

tected. In the northern townships it was identified only only near Brockwayville.

(*Ball iron ore* is abundantly scattered through the various slate and shale layers of the Lower Productive series; but not a single persistent ore stratum of any value or importance came under my observation in Jefferson county. No attempt has ever been made to erect a furnace, although the old charcoal stacks of Clarion and Armstrong approached almost to the Jefferson line. Recently some explorations have been undertaken for iron ore among the Conglomerate strata in the region of the Clarion river; and have not altogether failed; but they have not yet discovered sufficiently valuable deposits to justify systematic development.)

*The Ferriferous limestone* has here too lost much of that prominence which distinguishes it throughout Clarion and Armstrong and Butler counties. It is however a key to the geology; and is easily distinguishable up the Red Bank as far as Brookville; but up Sandy Lick valley it seems absent.

Northward from Brookville also it can be traced only a short distance; changing first into cherty limestone, and then into sandstone over all northwest Jefferson.

On the northeast side of the county it reappears first at Shaffner's corners; and again in the next basin to the east, at Brockwayville, on the western flank of the Indiana anticlinal. This is the eastern limit of the Ferriferous limestone; but it can be traced thence southward to Rockdale, where it is again lost in approaching the Sandy Lick valley.

The work then of mapping this stratum in Jefferson county confirms that already previously done in Indiana, and proves that the rock has no equivalent *as a limestone* east of the Indiana anticlinal axis.

*The Clarion coal bed* is the least important of the series; being very often a mere dark streak in the rocks.

*The Brookville coal bed* is nearly always impure, but mostly of workable dimensions. Its greatest development perhaps is in Beaver township, where it is the main source of the local coal supply.

## POTTSVILLE CONGLOMERATE No. XII.

This series, as now arranged, contains about 300 feet of strata, subdivided as follows:—

*Homewood* sandstone.
*Mercer* group of coals and sandstones.
*Connoquenessing* upper sandstone.
*Quarkertown* coal.
*Connoquenessing* lower sandstone.
*Sharon* coal and shales.
*Sharon* conglomerate.

Of the conglomerate series I was able to distinguish only the *Homewood Sandstone*, *the Mercer shales* and the *Connoquessing Upper sandstone.*

These undoubtedly have a persistent range through all northern Jefferson.

*The Homewood Sandstone* especially is a distinguishing feature in that region. Its thickness may in places amount to 75 feet, but that size is exceptional, the average being about 50 feet. The rock is nearly always massive, usually coarse-grained and in some instances pebbly. In a word it shows here the same features that it does throughout northern Indiana county and throughout Clarion and Armstrong.

*The Mercer shales* comprise a group of strata from 30 to 50 feet thick in which there are usually two seams of coal. One of these, the upper, is of importance in Jefferson county, attaining in one place the thickness of 9′ (nine feet). Generally however both seams are small. The Mercer shales contain also a valuable deposit of fire clay at Port Barnet.

*The Connoquenessing upper* sandstone is beautifully shown in many of the exposures along Red Bank creek. It is a prominent feature too in the northwest corner of the county, where it has an extensive outspread above the water level. It is usually about 75 feet thick.

*Mauch Chunk shales* No. XI are supposed to lie below the Sharon conglomerate, and below these again the *Pocono Sandstone formation* No. X.

Below the horizon of the Conglomerate is a nearly total

blank for lack of exposures. Nor could anything be detected of the Mauch Chunck formation unless we regard as belonging to this horizon a stratum of red clay shales on the Little Toby in an exposure about 100 feet below the Homewood sandstone. In that case the Conglomerate series would here be reduced to about one half its supposed dimensions on the Red Bank.

*The Pocono sandstone* No. X is shown on the geological map to be above the water level along the Clarion river; but nothing can be said of its condition there because no differentiated section is possible in that wilderness region. Only the top of the formation is lifted to daylight—probably about 100 feet.

REPORT OF THE PROGRESS

OF THE

SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA,

IN

# JEFFERSON COUNTY.

By W. G. PLATT.

## DETAILED GEOLOGY.

### CHAPTER I.

*Containing detailed description of Porter, Perry, Young, Bell and Gaskill townships.*

§ 1. The detailed geology of Jefferson County is, in this Report, subdivided into townships, which follow each other in regular order from west to east, tier upon tier, beginning at the south and advancing northward. Thus the first township described is Porter township, occupying the southwest corner of the County; the next is Perry lying east of Porter; next Young east of Perry, and so on to the Clearfield line when the order begins at the west again with the next northward tier of townships. Each chapter embraces one of these tiers, so that a cross section of the County from west to east is thus contained in each chapter. Moreover in beginning at the south and west we there adjoin regions already surveyed and described in previous Reports of Progress, namely Indiana County* on the south and Armstrong† and Clarion‡ Counties on the west. The same ar-

*H⁴. †H⁵. ‡V³.

rangement has also the advantage of considering the rocks approximately by groups downwards in the geological scale; the Lower Barren series being at the extreme south, then the Lower Productives at the surface further north, and lastly the Pottsville Conglomerate series at the extreme north. The vertical sections which accompany the Report have been arranged in groups instead of being inserted separately along with the text describing them, as was done in previous reports. The present system has many advantages over the other, especially as the short sections of coal beds often illustrate the larger rock sections in which the coal beds are in many instances scarcely more than indicated. It frequently happens however in this Report that sections are quite remote from their text, but no difficulty will be experienced in determining their exact place, since each section bears not only its appropriate number, but the number also of the paragraph wherein its description is given.

## *Porter township.*

§ 2. This township occupies the south-western corner of Jefferson County. It contains about 11,000 acres, most of which is cleared land, under cultivation. Pine run flows in a deep valley along its northern edge; on the east is Perry township; on the south is West-Mahoning township of Indiana County; and on the west is Red Bank township of Armstrong County.

*The surface* is much diversified with hill and valley. The valleys, narrow and with only small streams flowing through them, are straight, and usually have gentle slopes which admit of easy and profitable cultivation. The uplands are more in the nature of an elevated plain, overspread by a thin covering of *Lower Barren rocks*. The *Lower Productive Coal Measures* are in the valleys, by which distribution of the strata the proportion of upland surface to valley is approximately shown on the geological map by the different colored areas representing the two rock-groups in question.

§ 3. *The drainage* is all into Mahoning Creek which here flows a few miles south of the Jefferson line in Indiana

County. A narrow divide, along the crest of which runs one of the principal wagon roads of the township, crosses from west to east, dividing the township in that direction nearly in half. South of it the waters run direct into the Mahoning; whereas north of it they go first into Pine Run, and afterwards into the Mahoning at Eddyville in Armstrong County.

§ 4. *The geological structure* of the township consists of two synclinal folds, with an intermediate anticlinal arch. One synclinal, the *Lisbon Synclinal* of the Kiskiminitas, barely touches the south-eastern extremity of the township; the other axis, the *Leechburg-Apollo Synclinal*, runs through the Yariger lands, and thence across Pine run above the mouth of Eagle run. Both basins are shallow with gentle dips. *The anticlinal fold* is the *Waynesburg-Roaring Run axis* of the Kiskiminitas region. After crossing Mahoning Creek near the forks in Indiana County, it enters Porter township about one half mile west of the Armstrong-Indiana-Jefferson line. Thence it passes close to Porter P. O. and across Pine Run above the mouth of the Middle Branch. It is an important axis with pronounced dips towards the northwest and southeast, which in some instances incline as much as 4° and 5°. On Pine Run it lifts the *Ferriferous limestone* high above the water level.

§ 5. *The outcropping rocks* of Porter township comprise a column upwards of 400 feet in length, extending from a point in the *Lower Barren Measures* about 100 feet above the *Freeport Upper Coal*, to the *Brookville seam.* The exposures, though both fragmentary and incomplete, have enabled the following partial section to be compiled, Fig. 1:

*Porter township general section.*

| | | | |
|---|---|---|---|
| Shale and concealed strata, | | 50′ | 0″ |
| Mahoning Sandstone, | | 50′ | 0″ |
| Slates, | | | — |
| Coal, *Freeport upper* | 3 4″— | 4′ | 0″ |
| Fire-clay and shales, | | 8′ | 0″ |
| *Limestone, Freeport upper,* | | 6′ | 0″ |
| Shales and sandstone, | | 25 | 0″ |

| | | |
|---|---|---|
| Coal, *Freeport lower*, | 3′ | 0″ |
| *Limestone, Freeport lower*, | | ? |
| Concealed; place for *Freeport S. S.*, | 50′ | 0″ |
| Coal, *Kittanning upper*, | | ? |
| *Johnstown Cement*, | 2′ | 0″+ |
| Shales, | 40′ | 0″ |
| Coal, *Kittanning middle*, | 3′ | 0′? |
| Interval, (estimated,) | 50′ | 0″ |
| Coal, *Kittanning lower*, | 2′ | 11″ |
| Clay, | 2 | 0″ |
| Shales, clay, | 25 | 0″ |
| *Ferriferous limestone*, | 5′ | 0″+ |
| Concealed, | 55′ | 0″ |
| Slates, | 20′ | 0″ |
| Coal, *Brookville*, | 1′ | 0″ |
| Shales and S. S., | 20 | 0″ |
| Water level. | | |
| Total, | 421′ | 11″ |

§ 6. Considering first the exposures in the southern part of the township, *the Freeport Upper Coal* is mined on the J. K. Neal property, in the ravine of Big Hamilton run, about one mile southwest from Porter P. O. A section of the mine shows from 3′ 6″ to 4 feet of coal, without persistent slate partings, but in places pyritous. In general however the coal is good. Black slate is the roof and fire clay the floor. Northward one half mile, on the property of Jas. Stockdill, the same bed *carries a rider*, 3 feet thick separated from the lower bench by a parting of slate 1 foot thick, as follows:

| | | |
|---|---|---|
| Coal, | 3′ 0″ | 8′ 0″ |
| Slate, | 1′ 0″ | |
| Coal, | 4 0″ | |
| Clay, | — | |

*The rider* is a local deposit which speedily thins away in all directions. A thickness of four feet is as much as can be depended upon for the Freeport upper seam in this neighborhood. *The Mahoning Sandstone* is abundant on the surface above the coal at Stockdill's. The dip is S. E.

§ 7. In the lane leading from Mr. Stockdill's house to the Perrysville road *limestone* outcrops 30 feet below the *Freeport upper coal.* It is smooth, non-fossiliferous and brownish in color. Possibly it may represent the *Freeport upper limestone*, as nothing was seen of the latter either at

the Stockdill mine, or at Neal's, but more likely the outcrop belongs to the *Freeport lower* limestone. If the latter then the coal which outcrops near the water level on the same hill side 30 feet lower is the *Kittaning upper seam.* It has not been explored; neither has the limestone above it.

§ 8. The same rocks occupy the next ravine west of Hamilton run, but are undeveloped there. Still further west, on the Travis and McClelland farms, and close to the arch of the Waynesburg anticlinal, are two high detached knobs containing the Freeport group. At Travis' the hill includes the Freeport upper coal with a shallow covering of loose shale; but at McClelland's the *Freeport upper limestone* makes the summit.

The limestone stratum is 6 feet thick, consisting of good stone, compact, brittle, and exhibiting its usual minute univalve shells. It has long been quarried both on the Travis and McClelland farms, having been opened many years ago when old Phœnix furnace near Milton was in blast*. The exposure at McClelland's is the only good one of the Freeport upper limestone in Porter township.

§ 9. In a small ravine north of McClelland's house one of the coal beds of the Kittanning group is mined, but which one is uncertain. Very likely it is the *Kittanning lower bed.* It measures 3 feet thick, overlaid by tough slate and underlaid by clay. Heavy sandstone overlies the roof slates; the rock is abundant on the surface in the fields above the mine. The dip is southeast.

§ 10. North of McClelland's the outcrop line of the *Freeport upper coal* crosses the road a short distance beyond the intersection of the Milton and Smicksburg roads. It makes a distinct bench on the hillside as it curves around the headwaters of Dien's run, to pass thence under the high land to the northwest. It underlies all the region between the headwaters of Dien's run and the county line at D. McGregor's, but no openings exist. A small outcrop near the hilltop at McGregor's is the only indication of it there. Forty feet below it on the same hillside the *Free-*

*See Report H⁵ p. 140.

*port lower seam* was stripped and yielded 4 feet of good coal.

§ 11. Going east from McGregor's along the Perrysville road the high divide along which the road runs is covered with *Lower Barren Measures. The Mahoning Sandstone* is especially prominent about the heads of all the ravines where these cut down to the base of the deposit. It is this rock which shows so conspicuously at Mr. Geo. Travis' (Porter P. O.) and at the Methodist Church still further east. At the latter place the surface is thickly strewn with large bowlders and fragments of rock; so it is also on the opposite side of the same hill descending through Mr. R. Adams' fields to the middle branch of Pine Run.

§ 12. The work of development on *Mr. Adams' property* has exposed the following strata of the Lower Productive group:

*The Freeport upper coal* is mined at the roadside about one half mile northwest of Mr. Adams' dwelling house. It measures 3 feet thick; has frequent binders and knife edges of slate but no persistent partings; was once mined some distance further north and yielded there 4 feet of coal; has firm slate roof at both places; the coal is even and regular; the dip is 4° towards the southeast.

*The Freeport upper limestone* does not appear here, but is reported on the H. Schrock farm, across the Middle Branch, towards the north. It has not been investigated.

*The Freeport lower coal* shows a meagre outcrop east of and 40 feet below the mine. It has sandstone above it.

§ 13. *The Johnstown Cement* outcrops in a small ravine between Mr. Adams' house and his mine. The appearance of the stone indicates sufficiently the large amount of iron and clay contained in its composition. Its color is dark blue; there are no fossils. The stratum is two feet thick, and may be thicker.

*The Kittanning middle coal* is 40 feet lower on the same hillside. Only its outcrop was seen, the thickness of which is 3 feet according to Mr. Adams, who once opened into it near by.

*The Kittanning lower bed* was seen a short distance lower

down the run towards the west, in which direction the rocks rise. The average dip being unknown the interval here between this seam and that next above it can only be guessed, but it is not far from 50 feet. The Kittanning lower seam is not worked; nor is its thickness known on the Adams property. It is underlaid by fire clay, below which are clay shales 25 feet thick, extending to the *Ferriferous Limestone*, which is here above the water level and has been quarried. Five feet of good stone have been exposed. At the fresh fracture the stone displays the same coarse and uneven surface which is so characteristic of it everywhere. Moreover it is crowded with its distinguishing encrinite stems. Its color is grayish. The *Buhrstone ore* is absent.

§ 14. The limestone rises rapidly with the other strata down the run from Adams', and crosses the Waynesburg anticlinal nearly one hundred feet above the water level. Few exposures of it were detected. A partial uncovering of it may be seen on the E. Harman farm, south of the cross roads at Postlethwaite's. Here the dip is northwest, having crossed the anticlinal arch. The distance of the limestone stratum above the water level is reduced from 100 to 70 feet, and finally to nothing at the mouth of Caylor run, where the rock dips under the stream bed, remaining then below until after it has crossed the Leechburg synclinals, when it rises out to daylight again at Snyder's saw mill. At Snyder's it is in the comb of the dam, about 4 feet of it being exposed. No exposures of higher strata are here found towards the southeast, although the hill in that direction rises 350 feet, thus insuring all of the Lower Productive group and 100 feet of the Lower Barrens in addition. The *Mahoning sandstone* is prominent on the surface near the top of the hill. Across the run, towards the west and north in Ringgold township, many exposures occur which are elsewhere described.

§ 15. The strata below the Ferriferous limestone have little outcrop range in Porter township (being confined to the Pine Run Valley), and their geology is nearly a blank for lack of exposures. Of the *Clarion coal* nothing whatever was observed. Of the *Brookville* only one exposure

was detected, namely, on the J. Elkins farm, above the mouth of Middle Branch. The seam is there one foot thick, roofed by compact black slate; it rests upon shales and thin-bedded sandstones.

### *Perry township.*

§ 16. This township borders on Indiana county east of Porter township. In shape it is nearly square with boundary lines running due north and south, and east and west. Its area is about 28 square miles, or 18,000 acres—chiefly good arable land.

*The surface* is mostly elevated. With the exception of Mahoning creek the streams are small and flow through narrow ravines. The Mahoning creek flows a tortuous course through a deep wide valley extending along the southern border of the township. A narrow divide, trending east and west, crosses the northern part of the township and separates the waters of Mahoning creek from those of the Little Sandy. Frostburg is at the summit of this elevated plateau.

§ 17. *The stratigraphy* consists of three folds—one anticlinal axis and two synclinals. The synclinals occupy the southeast and northwest corners of the township; the anticlinal traverses a central area, in a transverse direction from southwest to northeast.

§ 18. *The synclinal* at the southeast is the *Fillmore axis* of the Conemaugh; it touches only the extremity of Perry township. The synclinal at the northwest is the *Lisbon axis*, which enters the township near M. Schrock's, and runs thence northeast in the vicinity of the Shilling school house.

§ 19. The anticlinal axis is the *Perrysville axis*, the course of which southwest through Indiana and Armstrong counties has been described in previous Reports of Progress*. It crosses Mahoning creek directly east of Perrysville, and extends thence nearly under Frostburg. Its strength develops rapidly towards the northeast, the effect of which is

*H⁴ and H⁵.

seen first in the elevation of the Freeport group to the hill-tops, and afterwards in their removal from the surface along the line of the axis. A small and feeble anticlinal, traceable only for a short distance, passes through the fields of the Iler farm west of Perrysville.

§ 20. *The outcropping rocks* extend from the top of the *Mahoning Sandstone* nearly to the base of the *Lower Productive Series.* Partial sections of the Freeport group are frequent in all parts of the township, because of the importance of these strata in a mining sense, but otherwise the rocks contain little of interest and are mostly concealed. Briefly expressed the distinguishing features of the section are (1) the massive condition of the *Mahoning Sandstone;* (2) the small size of the *Freeport upper coal bed;* (3) the the commanding importance of the *Freeport upper limestone;* (4) the superior thickness of the *Freeport lower coal seam* over all of the other coal beds. Upon this bed, in fact, the township depends for its supply of coal, no other seam being mined; (5) the presence of the *Johnstown Cement.* The remaining observed strata include the *Freeport sandstone,* and the *Kittanning upper* and *lower coals.* The *Ferriferous limestone* was seen only once. Possibly its horizon is above water level at Perrysville, but no outcrop of the rock was detected there. In connected form the section as compiled from numerous partial sections is as follows:

*Perrysville section.*

| | | |
|---|---|---|
| Shales, | — | — |
| Sandstone, Mahoning S. S., | 50′ | 0″ |
| Coal bed, *Freeport upper seam,* | small. | |
| Shales, | 10′ | 0″ |
| *Limestone,* | 6′ 0″— 10′ | 0″ |
| Interval, chiefly shales, | 25′ 0″— 50′ | 0″ |
| Coal bed, *Freeport lower seam,* | 3′ 2″— 5′ | 6″ |
| Interval, | 10′ | 0″ |
| Sandstone, Freeport S. S., | 10′ | 0″ |
| Shales, | 12′ | 0″ |
| Coal bed, *Kittanning upper seam,* | 0′ 4″— 3′ | 0″? |
| *Johnstown Cement,* | 3′ | 0″ |
| Shales, | 5′ | 0″ |
| Interval, concealed rocks, | 85′ | 0″± |
| Coal bed, *Kittanning lower seam,* | 1′ | 6″ |

| | | |
|---|---|---|
| Interval, concealed rocks, | 50′ | 0″? |
| *Ferriferous limestone*, | 5′ | 0″? |
| Total thickness, | 310′ | 0″ |

§ 21. The section at Perrysville begins at water level with the horizon of the *Ferriferous limestone*, and continues upwards (going northwest) into the Lower Barrens. The *Kittanning lower coal* makes a feeble outcrop at the roadside a short distance north of the village. On the John Iler farm, near the forks of the roads, still further north, the *Johnstown Cement* is partly exposed. The rock is hard and tough, with irregular fracture; its color is dark bluish grey; it is fossiliferous; its composition is rather that of an impure limestone than of a cement, as is shown by the following analysis of a specimen of it by Mr. McCreath:

| | |
|---|---|
| Carbonate of lime, | 82.393 |
| Carbonate of magnesia, | 1.891 |
| Oxide of iron and alumina, | 4.653 |
| Phosphorus, | .300 |
| Insoluble residue, | 8.020 |

§ 22. Close to this exposure of the Johnstown Cement, and 80 feet above it vertically, the *Freeport lower coal* is mined. The bed is 5 feet thick parted near the top by a small layer of impure cannel slate. Being close to Perrysville the mine is quite extensively operated for local supply. The coal is of fairly good quality. The *Freeport upper limestone* outcrops in a field 25 feet above the mine. The dip at this place is southeast.

§ 23. These exposures and developments are in the ravine of Perrysville run. Crossing the Iler farm westward into the ravine of Foundry run, the *Mahoning Sandstone* is met in massive condition at the top of the hill. The *Freeport upper limestone* is finely exposed in the fields west of Mr. Iler's house. It is 10 feet thick, divided into three layers by small partings of shale. The top layer is an impure cement; the centre bench consists of excellent limestone; the bottom bench though less pure than that above makes good quarry lime. Minute fossil shells were observed in all three benches. The following analysis by Mr. McCreath will show the character of stone in the upper and middle benches:

| | *Top bench.* | *Middle bench.* |
|---|---|---|
| Carbonate of lime, | 48.571 | 90.000 |
| Carbonate of magnesia, | 23.762 | 2.860 |
| Oxide of iron and alumina, | 7.250 | 1.285 |
| Phosphorus, | .032 | .011 |
| Insoluble residue, | 16.660 | 3.480 |

§ 24. A stratum of lean iron ore, reported one foot thick (lumps of ore 6 inches thick were seen) directly underlies the limestone. Above the latter are loose shales in which the Freeport upper coal seam does not appear. Above the shales is the Mahoning Sandstone.

§ 25. Coal is reported to outcrop 25 feet vertically below the limestone quarry. No investigation of it has been made, and the outcrop at the best is but a doubtful one. The *Freeport lower coal* is only 3 feet thick on this hillside, having been opened into by Mr. Iler 45 feet below the limestone quarry. The vertical interval therefore between the limestone and the *Freeport lower coal* is on the west side of the Iler farm nearly double what it is on the east side, close to the Perrysville road; while the thickness of the coal at the two places differs from 5 feet to 3′ 2″. The dip at the limestone quarry is northwest, and consequently the reverse of that on the east side of the farm, which fact shows that the arch of a local anticlinal passes through these fields. The *Kittanning upper seam* is here 35 feet below the Freeport lower. It is only 4 inches thick. The *Freeport Sandstone* is loose bedded and shaly.

§ 26. Ascending Foundry run the *Freeport lower coal* touches water level on the M. Schrock farm near the heads of the run. The thickness of the seam at this place is the same as at the Iler limestone quarry, namely from 3 feet to 3′ 6″. The *Freeport upper limestone*, 8 feet thick, outcrops 45 feet above, thus repeating the quarry section at Iler's. *The Mahoning Sandstone* comes in above the limestone and overspreads all the uplands extending southward to the valley of Mahoning creek, and northward to the edge of the township.

§ 27. The following section was leveled on the farm of Mr. George Blose in the valley of Perrysville run one mile northwest of Perrysville. (See section 4b, p. 16.)

*Geo. Blose section.*

| | | |
|---|---|---|
| *Mahoning Sandstone,* | 30′ | 0″ |
| Interval, | 10′ | 0″ |
| *Freeport upper limestone,* | 5′ | 0″ |
| Interval, | 30′ | 0″ |
| *Coal bed, Freeport lower,* | 4′ | 9″ |
| Interval, | 165′ | 0′ |
| *Coal bed, Kittanning lower,* | 1′ | 6″ |
| Water level of Perrysville run. | | |
| | 246′ | 3″ |

The *Freeport upper coal bed* could not be detected in any of the imperfect exposures at the base of the Mahoning Sandstone. The *Freeport upper limestone* shows in the spring at Mr. Blose's house. The *Freeport lower coal bed* is quite extensively mined to supply the local market with fuel. The bed here presents the following section, which is typical of it in this immediate region:

*Fig. 3, § 27.*

| | | |
|---|---|---|
| Coal, | 1′ 10″ | |
| Cannel slate, | 0′ 10′ | |
| Coal, | 1′ 5″ | 4′ 9″ |
| Slate, | thin. | |
| Coal, | 0′ 8″ | |

The parted condition of the bed seriously injures its value other than for mining in a small way by the farmers. Westward and northward from Perrysville its condition materially improves. The following analysis by Mr. McCreath shows the character of the coal at Blose's:

| | |
|---|---|
| Water at 225°, | .880 |
| Volatile matter, | 32.173 |
| Fixed carbon, | 53.496 |
| Sulphur, | 3.361 |
| Ash, | 10.090 |
| | 100.000 |

| | |
|---|---|
| Color of ash, | grey, pink tinge. |
| Coke per cent., | 66.947 |
| Fuel ratio, | 1:1.66 |

§ 28. In one of the entries of the Blose mine a wedge-shaped mass of sandstone comes into the seam below the cannel slate, dividing the bed into two parts, without however affecting the quality of the coal in either bench. The sandstone parting is confined to a narrowly circumscribed

area. It first appears as a thin knife-edge of rock, which, gradually increasing, becomes 18 inches thick, and is then continuous without change as a compact fine grained sandstone, to the end of the entry. The rock area has a proven length of at least 100 feet, and is about 50 feet across. Horses of clay also disturb the coal considerably. An instance of where the erosive current cutting through the upper bench of coal, has been arrested by the hard sandstone mass, is prettily shown at one place in the mine.

Below the mine the rocks are concealed nearly to water level, at which place the Kittanning lower coal was once opened into 18 inches thick.

§ 29. The valley of Mahoning Creek is crossed between Perrysville and Whitesville by the *Perrysville anticlinal axis*. In ascending the creek therefore, eastward from Perrysville, the strata assume lower levels, and the Freeport group, which occupies the hill tops about Perrysville, creeps down nearly to the water line at Whitesville. East of Whitesville, and extending thence nearly to Punxsutawney, the valley is rugged and rocky from the outcrop of the Mahoning Sandstone in massive condition. The southeast dip from the crown of the arch to Whitesville is a trifle more than 2°, using the Freeport lower coal as a basis of measurement.

§ 30. With this brief statement of the geology, indentifications of the different strata at local exposures, are easily accomplished. The *Freeport upper limestone*, almost without cover, is seen in the roadside close to N. Croasman's house south of Whitesville. The village of Whitesville is situated on a narrow neck of land which projects northward into a bend of the creek. The *Freeport upper limestone* underlies the surface of this narrow plateau, as it does also a similar one, occupying a similar but southward bend of the creek, east of Whitesville. This double bend which the creek here describes, indicates the passage of the *Fillmore synclinal* across the valley.

The *Freeport upper limestone* is quarried in small quanties on the J. Bath farm for agricultural purposes. Being

at the hilltop, and much cracked and broken from exposure the stone is cheaply raised. It makes good lime.

§ 31. The *Freeport lower coal* is 40 feet below the limestone on the Bath farm. Where opened in one of the fields north of the dwelling house it shows 5½ feet of coal, which is considerably above the average thickness of the bed in the region of Whitesville. The section in detail, as follows:

*Fig 4, § 31.*

| | | |
|---|---|---|
| Coal and slate, | 1′ 0″ | |
| Bony coal, | 0′ 4″ | 5′ 6″ |
| Coal, | 4′ 2″ | |
| Clay, | — | |

The same coal bed is also exposed at Croasman's near Whitesville, where instead of being 40 feet below the Freeport upper limestone as at Bath's, the interval between the strata is only 28 feet. The coal bed at Croasman's measures thus:

| | | |
|---|---|---|
| Coal and slate, | 0′ 6″ | |
| Bony coal, | 0′ 2″ | 4′ 2″ |
| Coal, | 3′ 6″ | |

The coal is of fairly good quality at both places.

The *Freeport lower limestone* underlies its coal on the Bath farm, but has not been investigated.

The *Johnstown cement*, 3 feet thick, is exposed in the creek bank on the same property. The *Kittaning upper seam*, which should overlie the cement, does not appear. The *Freeport Sandstone* shows in place above the cement.

§ 32. Ascending the hill slope in a northwest direction from the Whitesville bridge the Freeport group is met at an elevation of 200 feet above the creek. No good exposures of the lower strata were detected. An outcrop of coal, said to represent a seam 3 feet thick, shows on the T. J. Postlethwaite farm, 60 feet below the Freeport lower. Very likely it represents the *Kittanning upper bed.* The *Freeport lower seam* is mined by Mr. Postlethwaite, its section there being nearly identical with that obtained on Mr. Croasman's farm, above given. The *Freeport upper limestone* outcrops in the fields above the mine.

§ 33. In the elevated country about Frostburg, traversed by the Perrysville anticlinal, the Freeport group occupies the hilltops. The *Freeport upper limestone*, though found as far east as the Bell farm, is apparently absent from the measures directly around Frostburg. So it is still further

Fig 1. § 5.


Fig. 2. § 20.

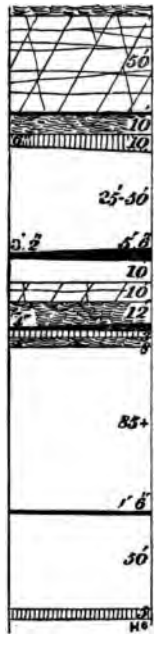
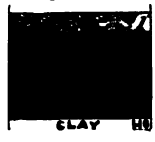



Fig. 3. § 27.

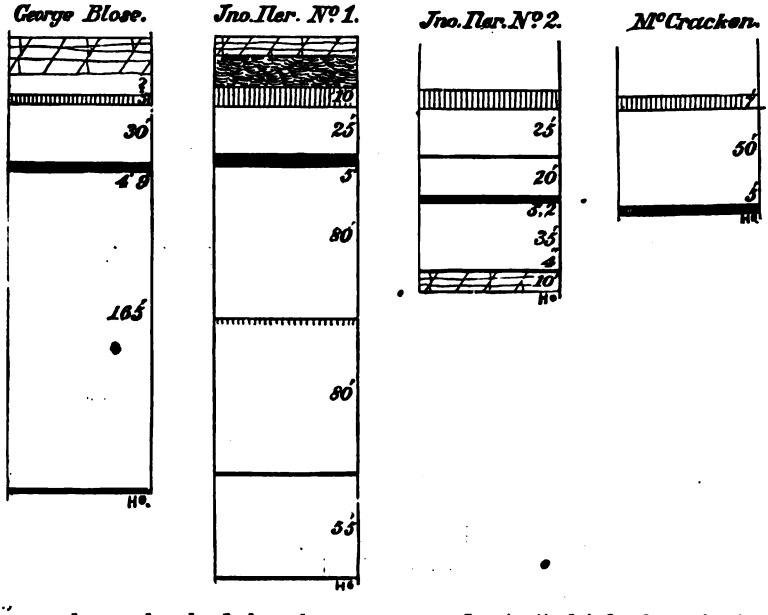

Fig. 4. §31.




east in the region of Punxsutawney. The *Freeport lower coal* has been opened into on nearly every farm that contains it round about Frostburg. It is less valuable at the latter place than at Punxsutawney, partly because of the small detached areas into which its outcrop line is broken,

and partly also because of its reduced size and the inferior condition of its coal.

On the farms of Messrs. P. and R. Whitesel, southeast of Frostburg, a small area of the bed is contained between the forks of a nameless run, flowing southeast. Where Mr. Whitesel opened into the outcrop of the bed, it showed 5 feet of coal. Another area is contained on the farm of G. and S. Means east of Whitesel. The Jordan and Palmer properties are also underlaid by it; while north of Frostburg a narrow ridge holding the same strata extends from the Frostburg church northeast to H. Depp's, at which lat-

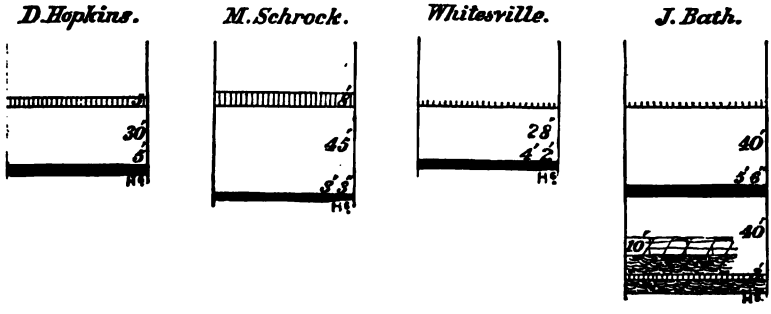



ter place the bed has been exposed 4′ 6″ thick, but is irregular and much disturbed by clay horses. At Frostburg, on the farm of Mr. R. Anthony the same seam shows 5 feet of solid coal, without partings. The outcrop of the bed is in most cases easily distinguishable by the topography.

§ 34. *Potters Clay* underlies the Freeport lower coal at Frostburg. It was once mined there to supply a small pottery in the village; but the clay not proving satisfactory the pits upon it were abandoned, in favor of others beneath the *Freeport upper limestone* at the Perry church.

§ 35. The adjoining farms of H. M. Bell and John Martin, one mile southwest from Frostburg, embrace a small area of the Freeport group. A still smaller area of the same strata is found on the Wm. McGee farm further south. At each of these places the *Freeport lower coal* has been opened about five feet thick, rather slaty and impure; the *Freeport upper limestone* is also exposed 50 feet above the coal. There is no indication anywhere in this vicinity of the *Freeport upper coal bed.*

§ 36. Passing west of this locality, across the heads of Ross run, the horizon of the *Mahoning Sandstone*, crosses




the divide at the Perry church, and extends thence unbroken as far as the northwest corner of the township, where it curves southward around the hill at A. Swab's. Thence it passes into Ringgold township. Outlying patches of the Freeport group are found on the Gourley farm close to the Perry church, and also on the Neel, Lewis and Hopkins farms. The most extensive developments in Perry township of the Freeport upper limestone for quarry use is in the small outliers last named. Situated at the hilltop the rock requires little or no stripping to remove it. The deposit is about 6 feet thick, all excellent stone, as is shown from the following analysis of a specimen selected from the quarry of Mr. D. Hopkins:

| | |
|---|---|
| Carbonate of lime, | 91.875 |
| Carbonate of magnesia, | 2.421 |
| Oxide of iron and alumina, | 1.312 |
| Phosphorus, | .012 |
| Insoluble residue, | 3.130 |

2 H⁶.

§ 37. The *Freeport lower coal bed* is mined quite extensively hereabouts as well for local household supply, as for burning limestone. The same section of the bed is exhibited in all the mines—Hopkins, Lewis, Neel, McCracken and Gourley; being in every case 5 feet thick with slate roof and clay floor. The coal contains little slate and is hard and firm, but pyritous. The following analysis of a specimen of it, obtained from the McCracken mine, shows the average condition of the bed in this vicinity:

| | |
|---|---|
| Water, | 1.110 |
| Volatile matter, | 36.023 |
| Fixed carbon, | 55.804 |
| Sulphur, | 2.593 |
| Ash, | 4.470 |
| | 100.000 |
| Color of ash, | Reddish grey. |
| Coke per cent. | 62.867 |
| Fuel ratio, | 1:1.55 |

Fragments of the Mahoning Sandstone are seen on the surface above the Hopkins mine. The same rock is also distinct on the uplands west and northwest from the Perry church. A good display of it is in the ravine at the Shilling school house, and again on the uplands south of Swab's. At Smith's east of the Shilling school house, the Freeport upper limestone outcrops in a spring.

§ 38. The *Freeport upper limestone* outcrops also in the roadside near Mr. A. Swab's house in the northwest corner of the township. It is of a light gray color, and is compact and fossiliferous. Above the rock there is a faint outcrop of coal, which indicates the *Freeport upper coal bed. The Freeport lower coal* outcrops in a field towards the northeast, where it was once opened into and showed only 2′ 6″ thick. It is 45 feet below the Freeport upper limestone. The reduction in the thickness of the Freeport lower coal as compared with the Frostburg and Perrysville section, is especially noteworthy.

§ 39. Descending 215 feet from the outcrop of the Freeport lower coal at Swab's, southeastward to a small run, the *Ferriferous limestone* is reached. It has been opened

into by Mr. Swab, by whom some of the rock has been removed for quarry lime. The thickness of the deposit is not fully shown. Sandstone is abundant on the hillside just above the horizon of the *Kittanning lower coal bed*, but there are no exposures of the rock in place.

The same strata are again crossed in descending northward from the high point at Swab's towards Sprankle's mill on Big Run (a branch of the Little Sandy.) A description of that region is given in subsequent pages, relating to Oliver township.

*Young township.*

§ 40. This township borders the Indiana County line east of Perry township. It is a rectangular area 6 miles long by about 3 miles wide—18 square miles, 11,520 acres.

*The Mahoning Creek* flows across it from east to west in a deep wide valley in which the town of Punxsutawney is situated. *South from the Creek* the region is an upland plateau, the top of which is about 350 feet above the creek level. It is covered with Lower Barren Measure shales and is but little broken by ravines. The region north from the creek, on the other hand, though no less high, is much diversified with hill and valley—a fortunate arrangement of the topography for the commercial interests of the township, inasmuch as easy access is thus secured, above water level, to the large and valuable coal beds of the Lower Productive series. The small tributary valleys, of which there are four, trend southward, and are roughly parallel to one another. The most important of them is the Elk run valley.

§ 41. The *Perrysville anticlinal axis* barely touches the northwest corner of the township, but is nevertheless distinctly felt over all that region. It is this axis which elevates the Lower Productive Coal Measures above the waters of Elk run, carrying the series indeed to the hill tops about the heads of that stream. The anticlinal has dips amounting to 3° and 4° on its southeast flank; its northwest flank is more gentle.

§ 42. The *Fillmore synclinal* of Indiana county crosses Mahoning creek at Punxsutawney. This basin which in Indiana county is a narrow one, broadens out after entering

Jefferson, owing to the collapse of the Indiana anticlinal, and overspreads in consequence all of the southeast corner of Young township. The same synclinal further north passes under Reynoldsville, so that these two towns are situated within the same basin. If the Indiana anticlinal possessed the same force along Big Mahoning creek that it does along Little Mahoning creek to the south in Indiana county, the region between Punxsutawney and Bells Mills would be a wilderness of Conglomerate instead of having the Mahoning Sandstone at water level with Lower Barren strata on the surrounding hills which is the case there now. Another axis, which truncates the southeast corner of McCalmont township expires before reaching the boundary of Young township. (See map).

§ 43. *The outcropping rocks* constitute a vertical section 550 feet in length, extending from a point 400 feet above the *Freeport upper coal*, to a point 150 feet below it. The lowermost strata of the section come to the surface in the northwest corner of the township; the highest strata are in the region of the synclinal south from Punxsutawney. Rock exposures, excepting of the Freeport group, are both infrequent and fragmentary. The following section arranged from numerous local sections, obtained in different parts of the township represents to a partial extent the succession of the strata from the top downwards, Fig. 5:

*Young township general section.*

| | | |
|---|---|---|
| *Limestone*, | | — |
| Shales, | | 15′ 0″ |
| Coal and shales, | | thin. |
| Concealed rocks, | | 75′ 0″ |
| Coal, slaty, | | 3′ 2″ |
| Interval, concealed rocks, | | 80′ 0″ |
| Red shales, | | 6′ 0″ |
| Interval, | | 10′ 0″ |
| Shales and thin-bedded S. S., | Lower Barren Measures. | 27′ 0″ |
| Red shales, | | 2′ 0″+ |
| Interval, | | 30′ 0″ |
| Sandstone, greenish, | | 10′ 0″+ |
| Shales, | | 10′ 0″ |
| Coal, | | thin. |
| Shales, argillaceous, | | 65′ 0″ |
| *Limestone, black*, | | ? |
| Slate, black, | | 20′ 0″ |
| Mahoning Sandstone, | | 50′ 0″ |

| | | |
|---|---|---|
| Coal, *Freeport upper*, | 4′ 0″— | 6′ 0″ |
| Shales, ferruginous, | | 6′ 0″ |
| Clay and ore balls, | | 5′ 0″ |
| Limestone, *Freeport upper*, | | ? |
| Interval, shales? | 30′ 0″— | 40′ 0″ |
| Slates, | | 5′ 0″ |
| Coal, *Freeport lower*, | 6′ 0″— | 7′ 0″ |
| Clay, | | — |
| Concealed rocks, | | 95′ 0″ |
| Coal, *Kittanning middle*, | | — |
| Total thickness, | | 567′ 2″ |

§ 44. Considering first the Barren Measure strata, and the area overspread by them, the section above given shows them to consist chiefly of argillaceous shales, without any valuable beds of coal or limestone. South from Mahoning Creek they are the country rock. So they are also in the Mahoning Valley, to the exclusion of all other strata, eastward from Clayville for several miles. Punxsutawney is built among them, and has therefore no productive beds of coal *above water level* within its immediate vicinity. The *Freeport upper coal bed* is not less than 50 feet below the creek bed at Punxsutawney, and may be more. But northward from that place the Barren Measure strata rise slowly into the air until only a thin covering of them occupies the hill tops between Elk run and Mill run. The Mahoning Sandstone, their basal rock, is more conspicuous in the creek valley than at almost any other place in the township. Large blocks and bowlders of it, broken from the main formation, lie strewn upon the hill slopes and the creek bottom. In the left bank of the Creek near Clayville there is a partial display of the rock in place, amounting to 50 feet in thickness. Possibly the formation may here be thicker, but of this there is no proof from actual exposures. North from Mahoning Creek the same rock is a key to the identification of the Freeport upper coal. Abundant evidence of it exists in the form of massive bowlders in the ravine of Mill Run; it can also be seen to advantage along the road leading past Mr. Wm. Smith's house, across the divide between Mill Run and Elk run; it is hardly less conspicuous in the ravine of Little Elk run, being well exposed on J. Conrad's farm where it directly roofs the Freeport upper

coal. In the ravine of Big Elk run it is rather more shaly but still distinct. Bowlders of it are seen high upon the hill slope above the Hawk and Kestler mines. Further north in McCalmont township it is of equal prominence, as will be noted in succeeding pages of this report.

§ 45. In the valley of Elk run the Mahoning Sandstone sinks below water level before reaching St. Clair's saw-mill, near the mouth of the run. Smooth argillaceous slates appear on top of it, and make the creek banks at Punxsutawney. There is an exposure of these slates in the roadside between the town and the mouth of Elk run, and another exposure of them in the creek bank further west; still another is seen in the roadside beyond the bridge at the east end of the town. The stratum is a prominent feature of the local geology; but the slates, in themselves, contain nothing of interest to the miner.

§ 46. *A stratum of limestone* outcrops above the slates, in the bed of Elk run at St. Clair's saw-mill, one half mile north of Punxsutawney. The rock has never been investigated, nor is its thickness known. Presumably it is the same rock that outcrops on the hillslope *above* the Clayville dam, but its color there is black, while at the saw-mill it is grayish. There are no fossils.

§ 47. The best exposure of the higher strata, those extending from the Mahoning Sandstone to the topmost rock of the above section, is obtained along the Indiana pike leading southwest from Punxsutawney. The stratification in that direction is nearly horizontal, so that the thickness of the different rock layers can be closely estimated. Only partial exposures are found. The red shale layers constitute the most conspicuous feature. A small outcrop of coal, apparently only a thin streak, shows at a point 100 feet above the creek. It will not repay investigation. Possibly other small coal seams, similar to this one, may occur in the concealed intervals of the section. A seam of some local importance in a neighborhood so barren of coal as is this upland country south from Mahoning creek, outcrops on the farm of Mr. Wm. Long, by whom it is mined. It shows the following section:

| | | |
|---|---|---|
| Sandstone, | | — |
| Coal, bony, | 1′ 2″ | 1′ 8′ |
| Coal, | | 2′ 0″ |
| Clay slate, | | — |

The roof is much cracked and broken, and the coal throughout is rusty and poor. The upper bench consists entirely of bony coal, too impure for use. The lower bench on the other hand yields fairly good coal, but the seam being small is troublesome and expensive to mine, and the coal can only find a market in its immediate neighborhood. The seam is nowhere else operated in this region.

Another outcrop of coal appears in Mr. Long's fields, 85 feet above the last; and 15 feet still higher, at the hilltop, there is an outcrop of argillaceous limestone. This last stratum is among the highest in this neighborhood geographically, as well as topographically, and marks an horizon 403 feet above the Freeport upper coal.

§ 48. *The Lower Productive Coal Measures* may be studied in the valleys west and north of Punxsutawney. The section already given shows that the Freeport group contains the principal strata of the series. In point of fact the *Freeport lower coal* is here as at Reynoldsville and at Perrysville, and throughout all of the southern part of Jefferson county, the main feature of the economic geology. It is not only a thicker bed than the others, but it is more regular, and its coal is of a better character. Upon it chiefly the value of this basin depends. Nearly all of Young township is underlaid by it, but at the present time only that part lying north of Mahoning creek is of value because of its elevation there above water level. The mine sections and descriptions given below, will show the thickness and condition of the bed, and will explain in detail the run of its outcrop line through the hills.

§ 49. In this connection allusion may be made to the variability, throughout the northern part of Young township, in the vertical distance between the Freeport upper and lower coals, ranging as this distance does from 40 to 60 feet. The same variability of interval was observed between these strata, in the Perrysville region.

It is desirable also here to state distinctly that the Free-

port group contains but *two workable beds* of coal round about Punxsutawney, and *not three* as in some cases has been wrongly supposed. The error has arisen from a misapprehension of the geology along Elk run and Little Elk run. The Kennedy mine along the latter stream (presently to be described) has been supposed to *overlie* the Hawk mine, whereas in point of fact the two mines are upon the same seam—the Freeport lower. There is occasionally a small intermediate seam of coal in the Freeport group, but its occurrence is altogether sporadic, and north of Punxsutawney it possesses neither thickness nor persistency.

§ 50. The *Freeport upper coal*, although a bed of considerable thickness, and rivaling in this respect the Freeport lower, yields inferior fuel. Moreover it is most cases, hereabouts, directly roofed by the Mahoning Sandstone, which injures it. It is but little operated, owing to the overshadowing importance of the Freeport lower coal. On Mill run it is not opened at all, though its bench is there distinct, as it creeps slowly up the slopes to finally occupy the hilltops at the J. B. Morris school house. Neither is it exposed in the next small ravine to the west, nor in the Mahoning valley to the south. Its horizon touches the water level in the last named valley at the Clayville bridge, but there is no visible outcrop of the bed there.

§ 51. In the ravine of Little Elk run it is thrice exposed—at J. Conrad's, at Weaver's and at Wm. Smith's. At each of the places it varies greatly within short distances both in thickness and composition. Much of it is slaty; all of it is pyritous; and the sandstone roof being cracked and broken admits the water from above, which causes the coal to have a dirty, iron stained appearance. The following measurement, reproduced from Report H, was made in the Weaver mine:

*Fig. 6, § 51.*

| | | |
|---|---|---|
| Roof, massive sandstone, | | — |
| Rotten clay slate, | | 0′ 1″ |
| Coal, poor and rotten. | 1′ 3″ | 5′ 3″ |
| Coal, | 4′ 0″ | |
| Fire-clay floor, | | — |

The coal here rises to the northwest gently There is

much irregularity in the mine resulting from the waving sandstone roof. No single specimen of the coal would fairly represent its average character because of the frequent changes in this respect, which it undergoes; but a specimen representing the best of the coal yielded on analysis by Mr. McCreath as follows:

| | |
|---|---|
| Water, | 1.000 |
| Volatile matter, | 33.200 |
| Fixed carbon, | 59.428 |
| Sulphur, | 2.042 |
| Ash, | 4.330 |
| | 100.000 |
| Coke per cent., | 65.80 |
| Color of ash, | brown, with reddish tint. |
| Fuel ratio, | 1:1.78 |

§ 52. Mr. Wm. Smith' s mine upon the same bed is on the opposite side of the ravine, and about one half mile to the westward. The difference in elevation between the two points is 65 feet, which fact shows how gently the strata here incline. The coal bed is only partially opened at Smith's, showing about 4 feet of slaty indifferent coal. The hillslope above it is abundantly strewn with blocks of Mahoning Sandstone. Thence northwest the coal continues to rise at an angle of about 2°, until it reaches the Brookville road, at the top of the divide, which it crosses beyond Wingert's. There are no further openings upon the bed towards the west. Eastward in the main valley of Elk run it is known only by its outcrop, which has there never been examined. It shows in the fields of the Hawk farm, 50 feet above the mine working the Freeport lower; at this place it is distinguished by a high bench which runs along the hill slopes in graceful curves. The bed is widely known throughout McCalmont township to the north.

§ 53. *The Freeport upper limestone* is exposed only at a single locality in Young township on the property of Mr. J. A. Gillespie, at the Clayville bridge. Nowhere else was it detected at all, and its existence throughout the northern and eastern part of the township is doubtful. At Clayville the rock is ferruginous and very impure. It occupies the bed of the Creek there. Lean impure iron ore (cold short) overlies it,

the thickness of which could not be ascertained from lack of exposures. The following analysis of a specimen of the ore will show its character.

| | |
|---|---|
| Iron, | 21.100 |
| Sulphur, | .127 |
| Phosphorus, | .493 |
| Insoluble residue, | 30.010 |

§ 54. The mines and developments upon the *Freeport lower coal* in the region northwest of Punxsutawney will be described in order from southeast to northwest, each valley and ravine being considered separately.

In the Mahoning Valley there are no exposures of the bed on either side of the creek in Young township.

In the ravine of a small nameless run, which unites with the Mahoning at Clayville, the bed has been repeatedly opened, showing a full section on both sides of the stream. The coal has ample cover, and nowhere else in the region does it appear to better advantage, or in finer condition. There is an unbroken area of it eastward, embracing thousands of acres, which occupy the divide between this run and Mill run.

§ 55. Mr. W. G. Carmalt has opened into the bed near where it touches the water level of the run, about ¼ mile northwest of Clayville. The bed here is only imperfectly seen. It is reported 4′ 6″ thick. What is seen of it shows good bright clean coal, lying nearly horizontally. A slope was put down on the west bank of the stream, on the property of Mr. Wall, but is now abandoned. Near by on the same property the bed was again opened into above water level. Large blocks of massive sandstone (Mahoning) here show in the stream valley, washed down from above. At the Carmalt mine the hill barely includes the Freeport upper seam.

§ 56. The outcrop line of the Freeport lower coal is rendered distinct by its bench on both sides of the ravine. On the property of Mr. H. A. Hum, two thirds of a mile north of Carmalt, mining operations upon this seam are quite largely carried on to supply local trade. The following measurement and description of the bed at this place are taken from report H:

*Fig. 7, § 56.*

| | | |
|---|---|---|
| Coal in roof, | | — |
| Slate, | | 0′ 4″ |
| Coal, hard, | 1′ 8″ | 6′ 8½″ |
| Coal, softer, | 4 6″ | |
| Slate parting, | 0′ 0½″ | |
| Coal, | 0′ 6″ | |
| Fire-clay floor, hard, | | — |

Where this measurement was taken the true roof was not shown. The top bench of coal, of which only a portion was seen is reported to be 3 feet thick. At no part of the mine has the bed been cut from roof to floor. When examined for the First Geological Survey of Pennsylvania, this bed, as showing here, was called an eight-foot coal bed and it may average for some distance that very great thickness. The coal is good, clean and handsome, and mines out well. The dip, as given in the workings, seems to be gentle to the south 10° west. This is one of the handsomest exhibitions of clean, bright coal to be found in the Reynoldsville Gas Coal Basin.

A specimen of the upper part of the main bench of Hum's coal, forwarded to Mr. McCreath for analysis yielded:

| | |
|---|---|
| Water, | 0.920 |
| Volatile matter, | 35.440 |
| Fixed carbon, | 59.962 |
| Sulphur, | .848 |
| Ash, | 2.830 |
| | 100.000 |
| Coke per cent., | 63.64 |
| Color of ash, | brown, red tinge. |
| Fuel ratio, | 1:1.69 |

The coal is bright, with glossy luster, compact, with small amount of iron pyrites.

A specimen from the lower part of the main six foot bench yielded on analysis (McCreath):

| | |
|---|---|
| Water, | 1.000 |
| Volatile matter, | 33.260 |
| Fixed carbon, | 63.081 |
| Sulphur, | 1.139 |
| Ash, | 1.520 |
| | 100.000 |
| Coke per cent., | 65.74 |
| Color of ash, | reddish brown. |
| Fuel ratio, | 1:1.90 |

§ 57. The bed preserves both its great size and purity as it runs northward through the farm of Mr. J. B. Morris, by whom it has been exposed. In the face of the hill at the outcrop, the coal has a gentle dip towards the northwest, which is continuous to the end of the workings, where a rise in that direction sets in towards the Perrysville anticlinal. These conditions, prevailing also in the Hum mine, reveal a small local flexure, continuous perhaps only for a short distance, and too feeble at any place to occasion mining complications. The following section represents the Morris mine:

| | | |
|---|---|---|
| Gray sandstone, | | — |
| Hard fire-clay, | | 1′ 0″ |
| Coal, | 6′ 0″— | 7′ 0″ |
| Fire-clay floor, soft, | | — |

§ 58. In the ravine of Mill run the Freeport lower coal rises above the water level near the dwelling house of Mr. E. L. Jones, 1½ miles northwest of Punxsutawney. It is there opened and quite extensively operated. Throughout all the gangways of the mine the seam is even and regular, averaging from 5 to 6 feet of good clean coal. Some small knife edges of slate were observed in places, and also some wedges and irregular masses of iron pyrites, but in no case of sufficient thickness or frequency to damage the bed. The coal at this place is rather more tender than is usually the case in this basin, and breaks up more in mining. The dip is southeast at angles of 3° and 4°. Mr. J. B. Morris has also a mine here upon the coal, in addition to the one above described. Further to the northwest the bed is again mined on the George Kurtz property where it shows 6 feet of excellent coal. Thence the outcrop line runs far up a narrow branch ravine to the farm of Mr. Henry Wingert, by whom the coal is opened, showing the following section:

*Fig. 8, § 58.*

| | | |
|---|---|---|
| Roof, black slate, | | — |
| Bony coal and slate, | | 2′ 0″ |
| Coal, | 3′ 3″ | |
| Slate, | 0′ 0½″ | 5′ 3½″ |
| Coal, | 2′ 0″ | |
| Fire-clay floor, soft, | | — |

The coal shows handsomely, the upper bench, above the small slate parting being hard and mining out in large lumps; the lower bench on the other hand is columnar in structure and much more friable, but good. The mine is almost entirely free from the clay "horses" which were noted in the Pantall and McKee mines. The hill rises 75 feet above the mine.

A specimen of this Wingert coal yielded on analysis (McCreath):

| | |
|---|---|
| Water, | 1.150 |
| Volatile matter, | 32.070 |
| Fixed carbon, | 60.428 |
| Sulphur, | 1.702 |
| Ash, | 4.650 |
| | 100.000 |
| Coke per cent., | 66.78 |
| Color of ash, | fawn. |
| Fuel ratio, | 1:1.88 |

Beyond the Wingert mine the line of outcrop passes through the fields of the Theo. Morris farm, and thence into the region of Frostburg and Perry township.

§ 59. The two ravines of Elk run and Little Elk run open up immense areas of this Freeport lower coal bed. The basin indeed is commonly known throughout the county as the Elk Run basin because of its early development there. Ascending from Punxsutawney, the Freeport lower coal bed first appears above the stream bed beyond the forks, about two miles north of the town. In the ravine of Little Elk run it is mined on the J. S. Kennedy farm where it shows 6 feet of coal, rather more slaty and pyritous than in most of the other mines upon the same seam in this vicinity.

§ 60. Continuing up the ravine of Little Elk run there are no additional exposures of the Freeport lower bed on the north side of the stream in Young township. But on the south side it is opened by Mr. S. McKee close to the Brookville road, and again by Mr. J. R. Pantall further to the northwest. A measurement of the bed at these places, accompanied by an analysis of a specimen from each mine, is herewith reproduced from Report H:

*Fig. 9*, § 60.

| | | |
|---|---|---|
| *Pantall mine*, | | — |
| Roof, black slate, hard, | | 4′ 0″ |
| Coal, | 1′ 8″ | |
| Clay parting, not persistent, | 0′ 2″ | |
| Coal, | 3′ 0″ | 5′ 10½″ |
| Slate parting, | 0′ 0½″ | |
| Coal, | 1′ 0″ | |
| Fire-clay floor, | | — |

§ 61. "The coal rises towards the northwest. The mine is only worked to supply a small local demand and is not driven in far; so far as worked the coal looks very well, but the horses of fire-clay are numerous and troublesome. This mine, like the Wachob and D. Brown mines [McCalmont township] is over on the northwest side of the basin, and the coal has risen high in coming up to the anticlinal axis which lies west of the line. In fact this Pantall coal is already well into the hilltops and the Straighthoof outcrop, about one mile northwest of Pantall's marks about the western edge of the basin, at this point, for the Freeport coals."

A specimen of coal from Pantall's mine yielded on analysis (McCreath):

| | |
|---|---|
| Water, | 1.100 |
| Volatile matter, | 31.170 |
| Fixed carbon, | 63.544 |
| Sulphur, | 1.016 |
| Ash, | 3.170 |
| | 100.000 |
| Coke per cent., | 67.73 |
| Color of ash, | yellowish brown. |
| Fuel ratio, | 1:2.04 |

Following is a section of the *McKee mine:*

*Fig. 10*, § 61.

| | | |
|---|---|---|
| Roof, black slate, | | — |
| Bone coal and slate, | 1′ 0″ | 6′ 1″ |
| Coal, | 5′ 1″ | |
| Fire-clay, soft, in floor, | | — |

A specimen of the coal forwarded for analysis yielded (McCreath):

| | |
|---|---|
| Water, | 1.050 |
| Volatile matter, | 33.150 |
| Fixed carbon, | 58.405 |
| Sulphur, | 1.295 |
| Ash, | 6.100 |
| | 100.000 |
| Coke per cent., | 65.80 |
| Color of ash, | gray. |
| Fuel ratio, | 1:1.76 |

§ 62. One of the best known and most extensively operated mines in this region is that of Mr. P. Hawk in the ravine of Big Elk run, close to the forks. The exhibition of coal throughout all of this mine, is exceedingly handsome. Regularity and evenness of bedding prevail. The roof is firm and dry. The dip is gentle, allowing the coal to be worked along the rise. The hills afford ample cover. In report H the mine is thus described:

*Fig. 11, § 62.*

| | | |
|---|---|---|
| Roof, hard black slate, | | — |
| Coal, with some slaty layers and *bony coal*, | 1′ 0″—2′ 0″ | 7′ 2″ |
| Slate persistent, | 0′ 0½″—0′ 2′ | |
| Coal, | 4′ 6″—5′ 0″ | |

The lower bench of the bed yields a very handsome, hard, clean, bright coal. The upper two-foot bench, with its slate layers and bone coal is mined for local use, but could never be shipped to market. A specimen of the main bench yielded on analysis (McCreath):

| | |
|---|---|
| Water, | .950 |
| Volatile matter, | 33.550 |
| Fixed carbon, | 60.523 |
| Sulphur, | 1.167 |
| Ash, | 3.810 |
| | 100.000 |
| Coke per cent, | 65.50 |
| Color of ash, | reddish brown. |
| Fuel ratio, | 1:1.80 |

§ 63. In Mr. Hawk's orchard a small seam is reported to outcrop from 25 to 30 feet above the mine. It has not been examined sufficiently to determine its thickness. Still higher on the same hill is the bench of the Freeport upper coal, capped by the Mahoning Sandstone.

Ascending the run northward from Hawk's there are no further openings upon the Freeport lower bed in Young township; but its outcrop line is easily detected by the topography. On the west side of the run it keeps above the township road, passing finally up a small branch ravine into the fields of the Sadler farm. On the east side it runs through the Smith farm, and thence into McCalmont township where it has been repeatedly opened.

§ 64. The strata underlying the Freeport group are mostly concealed. The vertical section shows that of these subjacent strata there are about one hundred feet exposed in Young township. There is no indication anywhere of the Kittanning upper coal bed, nor of the Johnstown cement. Nor is there any appearance of the Freeport Sandstone. On the farm of Mr. Theo. Morris, near the headwaters of Mill Run, an outcrop of coal occurs 95 feet below the Freeport lower, which outcrop may mark the *Kittanning middle bed.* The latter bed further north in McCalmont township is 6 feet thick, which is the thickness also claimed for it here by Mr. Morris. The locality is deserving of examination.

### *Bell township.*

§ 65. This township borders on Indiana county east of Young township, which latter both in size and shape it closely resembles. Its surface area is about 18 square miles.

The Mahoning creek, flowing across it from east to west, splits it into two nearly equal parts. The southern area is traversed longitudinally by the valley of Canoe Creek, of which Ugly run is an important tributary; the northern part of the township has only small streams, all of which flow southward into the Mahoning.

*The surface* generally is smooth and susceptible of profitable cultivation. The valleys are broad, with gentle slopes.

§ 66. *The stratification* in all parts of the township presents the utmost uniformity. The rocks are nearly horizontal. It has already been sufficiently shown that the cause of this horizontality is found in the collapse of the

Indiana anticlinal axis, the arch of which, if continuous, would intersect the Mahoning valley somewhere near Bells Mills; but there is no trace of it at that place.

§ 67. *The Lower Barren Measures* cover nearly all of the surface. Only in the southern part of the township, in the valley of Canoe Creek, and in the ravine of Ugly run, do the Lower Productive Coal Measures rise to daylight. The local rock sections are extremely imperfect. There are few or no exposures anywhere either of the Lower Barren strata or of the Lower Productives. Of the Lower Barren group there are about 300 feet represented, chiefly shales; of the Lower Productive series there are about 100 feet above the water level.

The Lower Barren group here contains few strata of economic interest. Beside the Mahoning Sandstone in massive condition, and a seam of limestone near the hilltops north of Mahoning creek, and also a small seam of coal in the same region, there is absolutely nothing to report so far as these measures are concerned. The Mahoning Sandstone is handsomely shown in the roadside west from Bells Mills; and it is also well exposed at the mouth of Canoe creek, at which place the surface presents a rugged appearance. Higher up Canoe creek also the same rock is prominent. The thickness of the formation could not here be accurately measured.

§ 68. *A coal bed* belonging to the Lower Barren series was once opened and mined on the J. Milliron farm at the eastern extremity of the township. The mine has not recently been operated and is now shut, so that the quality of the coal remains undetermined. Near the top of the hill towards the northeast, and 120 feet vertically above the mine a stratum of good limestone outcrops, upon which however no developments have been made. The same limestone ranges over the uplands, stretching towards the northwest and makes its appearance in the region of the Lutheran church, southeast of the Cross Roads at McKee's. It is estimated to overlie the Freeport upper coal bed by a distance of not less than 250 feet, and perhaps more.

§ 69. Throughout the Barren Measure area lying south of

Mahoning creek, and stretching to the saw-mill on Canoe creek, below the mouth of Ugly run, no coal seams of importance have been found, nor do any of minable thickness exist there. Occasional small seams have been exposed, as for example on the P. Harold property, northwest of Finley's Mill, but they are in all cases, as in the one just cited, too small to admit of profitable or successful mining.

§ 70. *The Lower Productive rocks* have been but little exposed. The geological map shows how much of the area along Canoe creek and Ugly run is occupied by them. The horizon of the *Freeport upper coal* touches water level about one mile below Finley's saw-mill. There are no exposures of the bed anywhere in this vicinity. On a small branch of Canoe creek, across the Indiana county line and about ¼ mile southeast from Finley's mill, there is an old opening on a bed of coal 4 feet thick, the position of which in the series could not be satisfactorily determined because of the absence of other exposures, but the bed most probably belongs to the Freeport group.* A similar bed of coal has been opened high up Canoe creek at McQuown's mill. This latter seam is without doubt the Freeport upper.† It should also be in the hills round about Finley's mill, where however no indication of it could be detected.

### *Gaskill township.*

§ 71. This township, which occupies the southeastern corner of Jefferson county, comprises an area of about 18 square miles. A considerable part of the region is uncultivated woodland, from which much of the best timber has already been stripped; other parts of the township, as for example the ravines of Ugly run and Clover run are rugged from the outcrop of the Mahoning Sandstone; the best farming country is found in the neighborhood of Hudson P. O. among the smooth shales of the Lower Barren strata, upon which there has here been founded a thrifty and prosperous settlement of farmers.

§ 72. The *surface* generally throughout the township is

* Compare H⁴, p. 267. † See Report H⁴, p. 266.

high. Chestnut Ridge in the southeast corner has elevations of nearly 2,000 feet above tide water, along its summit and western flank. This ridge is the dividing one between the waters of the Susquehanna and the Ohio. Its summit (and anticlinal axis) is just east of Jefferson county, in Clearfield; hence all the surface drainage of Gaskill township flows westward into Mahoning creek.

To enumerate the different lines of drainage is unnecessary, as the geological map shows that feature with sufficient distinctness. According to barometric measurement the water level of Mahoning creek at Big Run village is 1226 feet above tide: the top of the ridge at Bowser's is 1931 feet above tide. Ugly run has an easy fall; so has Clover run, though less gentle than the other.

§ 73. Located on the west flank of the anticlinal axis of *Chestnut Ridge*, the prevailing dip of the rocks throughout all of Gaskill township is towards the northwest. There are no subordinate local flexures. In a single word the township represents a monoclinal, with dips decreasing in intensity from its southeast corner towards the northwest. In the region of the Bowser school house the angle of inclination is not less than 4°; at Big Run village on the other hand, the rocks are scarcely removed from the horizontal.

§ 74. *The outcropping rocks* comprise a section about 400 feet long, extending from a point about 200 feet above the *Freeport upper coal* to a point about 200 feet below it, or to the horizon of the *Kittanning lower coal.* So large a part of the region remains yet a wilderness, and even where settlements have been made, so little has been done towards developing the strata, that the township is to a great extent devoid of geological data. The greatest accumulation of Barren Measure rocks is in the vicinity of Big Run village, and southward from that place along the Bell township line. Argillaceous shales are the predominant feature of that locality. No limestone strata were anywhere detected among these shales, nor any coal beds of interest. One small coal seam 18 inches thick at the maximum, was once opened just above the level of Mahoning creek opposite Big Run village. The opening was made on the property

of Mr. J. W. Brooks, and after being driven a short distance under the hill, was wisely abandoned by its owner. The geological horizon of the seam is on top of the Mahoning sandstone.

§ 75. The *Mahoning sandstone*, as already stated, makes an abundant display all over Gaskill township. South of the Cross Roads at Winslow's store (Hudson P. O.) there is a magnificent exhibition of it both on the uplands, and in the ravine of Ugly run. It is coarse grained, compact and massive. It extends around the head of Ugly run, and thence across the township road near Bowser's; thence down Stony run and Clover run into the valley of the Mahoning. All along Clover run it is unmistakable at the edge of the uplands. It is finely exposed on the property of Mr. A. Bowers, Jr., and likewise at Keller's further north. It roofs the Freeport upper coal. In a small nameless ravine west of Clover run it shows in high cliffs, and has small coal beds associated with it. (Sutter farm.) Some hilltops of massive sandstone seen along the township road near D. F. Bowser's, in the southeast corner of the township, may also represent the Mahoning, but this is uncertain. If not the Mahoning then the rock is the Freeport sandstone.

§ 76. *The Freeport upper coal bed* has been sufficiently developed to prove it of workable thickness, but that is about all. No exposure has been made of it in the ravine of Ugly run; but on the farm of Mr. J. H. Colkitt, about one mile east of Ugly run, and close to the Indiana county line, the bed is mined at the hilltop. Shooting out as it does towards the east to arch in the air across the Chestnut Ridge axis, the bed at this particular place is confined to a single hill. The coal is in good condition. In fact much of the fuel consumed in this region is taken from the Colkitt mine. The following section shows:

*Fig. 12, § 76.*

| | | |
|---|---|---|
| Slate, | | — |
| Coal, | 3′ 0″ | 3′ 9½″ |
| Slate, | 0′ 1½″ | |
| Coal, | 0′ 8″ | |
| Clay, | | — |

The dip is from 3° to 4° towards the northwest.

§ 77. *The Freeport upper limestone* outcrops in an adjoining field to the west, on the property of Mr. G. A. Walker. The deposit has never received the examination it merits. Valuable fertilizer might readily and cheaply be obtained from it, for use upon fields that are sadly in need of it. The indications are that the stone is of good quality. It underlies the coal from 25 to 30 feet, which distance, though in excess of that which usually separates these strata in the region to the west, corresponds with that which prevails throughout much of the Blairsville basin toward the south in Indiana county.*

§ 78. There are no exposures either of the coal bed or of its limestone, north of Colkitt's around the upper waters of Ugly run, nor along the waters of Stony run; but the track of the coal over all that region is followed without difficulty, so long as the Mahoning Sandstone remains in sight. Passing down Clover run it is opened on the farm of Mr. A. Bowers, Jr., by whom it is mined to supply a small local trade. It shows here almost exactly the same section as at Colkitt's, having the same small division slate, and the same roof and floor. The coal also is the same in quality and appearance. Massive sandstone (Mahoning) is abundant on the slope above the mine. Below the mine the hill falls away 175 feet, towards Clover run. The section though meagre and revealing but little is herewith given:

*Bowers section.*

| | | |
|---|---|---|
| Mahoning sandstone, massive, | | ? |
| Black slate, | | — |
| Coal bed, *Freeport upper*, | 3′ 6″— | 4′ 0″ |
| Clay, | | — |
| Concealed rocks, | | 30′ 0″ |
| Coal bed, *Freeport lower*, | | 3′ 0″? |
| Concealed rocks, | | 145′ 0″ |
| Run level, horizon of *Kittanning middle coal bed*, | | — |
| Total thickness, | | 182′ 0″ |

The thickness of the Freeport lower coal in the above section, is given on the authority of Mr. Bowers.

* $H^4$ Chap. XV.

§ 79. A seam of coal is opened some distance further down Clover run, on the property of Mr. Isaac Keller, the position of which in the geological series was not satisfactorily determined because of the absence of sufficient rock exposures at that locality. Possibly it is the Freeport upper, but if so its thickness here is much reduced, being in the Keller mine only from 2′ 4″–3′ 0″ thick; possibly, and indeed more probably it is the Freeport lower coal. The roof is massive sandstone.

On the east side of Clover run the Freeport upper coal (?) was once opened on the J. McCarty farm, where it showed a section similar to that at Colkitt's and Bower's. The mine at McCarty's is now shut. On the farm of J. J. Keller, ½ mile east of McCarty a bed of coal 3′ 8″ thick was discovered in the well. It is apparently also the Freeport upper.

Southward from this place around the headwaters of Clover run the region is almost wholly a wilderness. The surface rocks are of the Lower Productive series. The only development made upon the strata is that near Remaley's mill, close to the Clearfield county line, at which place a bed of coal, reported four feet thick was once opened into. Its position in the series was not determined.

Ascending thence still further south to the top of the Ridge, in the Bowser settlement, Lower Productive rocks continue at the surface. Limestone is reported on the Peace property adjoining Clearfield county, but the rock is not now exposed. The strata here are those of the Kittanning group.

## CHAPTER II.

*Containing the detailed geology of Ringgold, Oliver, McCalmont and Henderson townships.*

### *Ringgold township.*

§ 80. This township borders on Armstrong county, north of Porter township. An approximate estimate of its surface area, based upon the county map gives nearly 14,000 acres.

Little Sandy creek flows along its northern edge. Pine run flows along its southern edge. Both streams occupy deep and wide valleys. The center of the township is high, but much broken by small lateral ravines, one set of which trend north towards the Little Sandy, and the other, south towards Pine run. Along the bed of the main valleys the elevation above tide-water ranges from about 1250 to 1350 feet; on the uplands the summits occasionally attain an altitude of 1600 feet above the ocean.

§ 81. The township is enclosed within a synclinal basin—*the Leechburg basin* of the Kiskiminitas, the center line of which trending northeast, crosses Pine run above the mouth of Eagle run. Thence it passes under Ringgold, and across Little Sandy creek at Worthville. The northwest side of the basin, extending to the *Bagdad* or *Brookville* anticlinal, stretches beyond the northwest corner of the township; the opposite side, extending to the Waynesburg anticlinal, occupies nearly all of the southeast corner but does not quite overlap as in the other case. *The Waynesburg anticlinal*, coming up through Porter township, crosses Pine run above Postlethwaite's and runs thence through the Smathers settlement. The dips therefore in Ringgold township are on the one hand northwest towards its central area, and on the other southeast. The angle of inclination is always slight. The steepest dips are in the northwest corner of the town-

ship, on the flank of the Brookville anticlinal; they are shallowest in the neighborhood of Ringgold.

§ 82. *The Lower Productive Coal Measures*, and the *Pottsville Conglomerate series*, make the surface rocks. There are also some *Barren Measure strata* in the center of the Basin, but of these scarcely more than the Mahoning sandstone is contained. Natural rock exposures though frequent are so imperfect that complete sections cannot be constructed from them; and in the matter of development little has been done aside from opening into the coal beds for local supply.

The following description treats first of the geology of Pine Run valley and its tributary streams, and next of the valley of the Little Sandy. The left bank of Pine Run, skirting Porter township, having already been described in this report, we have here only to deal with the right bank.

§ 83. A vertical section of the rocks outcropping in Pine Run valley, compiled chiefly from exposures found on the Porter township side is elsewhere given (see Fig. 1, § 5.) In descending the valley from the southeast corner of the township the *Ferriferous limestone* is above water level on the crown of the Waynesburg anticlinal for a distance of nearly two miles, extending from the Mohney farm to the mouth of Caylor run. At the center of the arch the limestone is 100 feet above the run, which distance is sufficient to bring to daylight all of the underlying strata of the Lower Productive group. But along the right bank of the stream there are no exposures either of the limestone or of the subjacent strata at any point between Mohney's and Caylor run. The hills towards the north, stretching through the Smathers settlement, consist of the upper horizons of the Lower Productive strata; but no exposures of them are found there.

§ 84. The same upper horizons of the Lower Productive group overspread the highlands about the heads of Caylor run east of Ringgold. On the Wm. Stahlman farm close to the headwaters of the run two strata of limestone outcrop, one of which is at the hilltop southwest of the house. In its exposed condition it has suffered so much from erosion that the original thickness of the deposit is not known. At

present it shows only about 18 inches thick, of which the lower 6 inches are sandy and impure. Possibly it is the *Freeport upper limestone*, existing here in a single isolated knob; it certainly represents no lower horizon than that.

Descending thence southward into the valley of Pine Run at J. B. Postlethwaite's, the following partial section is obtained:

*Postlethwaite section.*

| | | |
|---|---|---|
| *Limestone, Freeport upper?* | 1′ | 6″ |
| Interval, | 60′ | 0″ |
| Coal, *Freeport lower?* 1′ 0″— | 4′ | 0″ |
| Interval, | 5′ | 0″ |
| *Limestone,* | 3′ | 0″+ |
| Interval, | 15′ | 0″ |
| Coal, *Kittanning upper?* | 2′ | 6″ |
| Interval, | 83′ | 0″ |
| *Limestone,* very siliceous, | 6′ | 0″ |
| Interval, | 80′ | 0″ |
| Coal, *Kittanning lower?* | 2′ | 11″ |
| Interval, | 70′ | 0″ |
| Water level of Pine run at Postlethwaite's, | — | |
| | 332′ | 11″ |

§ 85. The interval between the two highest limestones is wholly concealed at Stahlman's, nor is there any satisfactory exposure of it elsewhere in the neighborhood. The coal and limestone immediately underlying it outcrop in the roadside close to Mr. Stahlman's house. Neither stratum has here been explored; but the coal bed is opened on the P. Schafer property situated about one mile towards the south. As there developed it is a very irregular seam much disturbed by an uneasy and rolling roof of sandstone, which sometimes cuts down nearly to the floor of the bed. When the coal is at its full height in this mine it is four feet thick in one solid bench without partings. The coal also is of fairly good quality.

The bed belongs to the Freeport group, but which one of the two seams of that group it represents, whether the Freeport upper or lower, must in the uncertainty of these exposures, remain for the present undecided. It would however appear to be the Freeport lower bed.

The limestone underlying it is exposed in the roadside close to Stahlman's house. Only an estimate can be formed

of its thickness and quality, the exposure being an imperfect one. But so far as indications go the rock is of good quality and would repay quarrying for fertilizing use.

§ 86. The next lower coal, 15 feet below, has been opened by Mr. Stahlman close to the roadside south of his house. The bed has a firm slate roof, is 2′ 6″ thick, and rests upon an even floor of hard fire clay. So little however has the work of development upon it been advanced, that scarcely more than the outcrop of the bed is exposed. The same seam is nowhere else mined in this neighborhood. It is most likely the representative of the *Kittanning upper seam.*

*The ravine of Caylor run* is nearly destitute of exposures. The hills skirting the right bank rise to a sufficient height to include the Freeport group. On the left bank the country is no less high. On the Reed property about midway between Stahlman's and the mouth of the run there is an outcrop of impure sandy limestone, non-fossiliferous, and much too impure to be of any value, but of interest nevertheless in occurring at this geological horizon.

§ 87. About 80 feet vertically below it is the small coal seam which is opened and worked by Mr. Postlethwaite, close to the cross roads above the mouth of Caylor run. It was adjudged to be the *Kittanning lower seam.* Its small thickness precludes it from ever becoming a bed of much importance; and not only is the remark applicable to the bed in this region, but throughout all of the Pine Run valley, so far as it has yet been uncovered there. The coal at Postlethwaite's is compact and firm, and for domestic use in the country round about serves very well. The following section shows the average thickness of the bed:

*Fig. 13, § 87.*

| | | | |
|---|---|---|---|
| Sandstone roof, | | | — |
| Coal, | 0′ | 10″ | 2′ 11″ |
| Slate, | 0′ | 1″ | |
| Coal, | 2′ | 0″ | |
| Clay, | | | — |

Below this mine the strata are concealed to the water level. The cross roads at Postlethwaite's is at the horizon of the Brookville coal.

§ 88. The next tributary ravine west of Caylor run is occupied by a small nameless stream which heads on the Freas property south of Ringgold. The only exposures in the ravine are those of the Freeport group, close to where the run starts. There, on the H. Freas lands, three quarters of a mile south from Ringgold, the Freeport upper (Freeport lower ?) coal has been exposed 3 feet thick. It is overlaid by heavy massive sandstone, which here makes an abundant display on the slope. Limestone underlies the coal at a distance of 3 feet. Neither stratum has been explored to any extent. The same coal bed was once opened close to the roadside southeast of Mr. Freas' house, showing the same thickness at both places. The hill above it at Freas' rises 100 feet and more, but no strata are exposed. Along the road leading to Pine run there is an imperfect exhibition of the *Freeport Sandstone.*

§ 89. The hills skirting the right bank of Pine run between the mouth of Caylor run and the mouth of Eagle run are about 250 feet in height. It is at this place that the Leechburg synclinal crosses the valley. At the run level the Kittanning group of strata are the surface rocks; the hilltops are crowned by the Mahoning Sandstone.

There are no exposures of any value throughout all that interval. In the ravine of Eagle run the Freeport strata have been developed to a small extent along both branches of the run. On the farm of Mr. Jacob Peters (east branch) the *Freeport upper limestone* was discovered near the hilltop, but has been too little uncovered to estimate its thickness. The stone is of a dark blue color, non-fossiliferous, and fairly good. It merits investigation. Higher up the same branch of the run, and near the Lutheran church, the Freeport upper coal was once opened into, but has since been abandoned. The *Mahoning Sandstone* is conspicuous on the surface both towards the east and west, and especially on the divide separating the two branches of the run. It is a massive coarse grained deposit, the full thickness of which must amount to 50 feet.

§ 90. Both the *Freeport upper and lower coal beds* may be observed in the region of the school house on the west

branch of Eagle run. The *Freeport lower seam* is close to the run level, and the opening that was there once made upon it, is now full of water. The bed is reported to have shown a thickness of 6 feet, of which 4 feet can at present be seen at the mouth of the pit. It is roofed by slate.

The *Freeport upper seam* is at this place nearly 70 feet above the last. An opening has been made upon it by Mr. P. Snyder, in whose mine the bed is uneven, being subject to frequent horsebacks. Where fully developed it shows the following section:

*Fig. 14, § 90.*

| | | | |
|---|---|---|---|
| Slate roof, | | | — |
| Coal, hard and slaty, | 1′ 2″ | 3′ 5″ | |
| Coal, good, | 1′ 8″ | | |
| Coal, hard and slaty, | 0′ 7″ | | |
| Fire-clay in floor, | | | — |

Below the mouth of Eagle run the rocks rise towards the northwest in obedience to the Brookville anticlinal. This rise, which quickly forces the strata to higher levels, brings the *Ferriferous limestone* to daylight at the mouth of Painter run. Mention has already been made of the outcrop of this stratum in the dam at Snyder's mill. Towards the north the hills consist exclusively of Lower Productive strata, thus repeating here at the western edge of the township the geology which prevails in the Smathers settlement, along its eastern line.

§ 91. In ascending Painter run we rise from lower to higher strata. The *Kittanning lower coal* is seen near the base of the slope north of Snyder's mill, at which place it was once opened and showed 3 feet thick. The overlying strata are concealed. Neither the Kittanning middle nor Kittanning upper seam was observed, nor was anything seen of the Freeport lower coal. The *Freeport upper limestone* outcrops near the hilltop opposite Mr. J. Sherry's house. A high bench holding the *Freeport upper coal* crowns the hill. The same limestone shows on the J. Brocius property further north, where also the Freeport upper coal, only 1 foot thick at the outcrop, is exposed 8 feet above it. West of this locality on the road leading to Mt. Tabor the Freeport upper coal is 3′ 8″ thick. It pos-

Fig.5. §43.

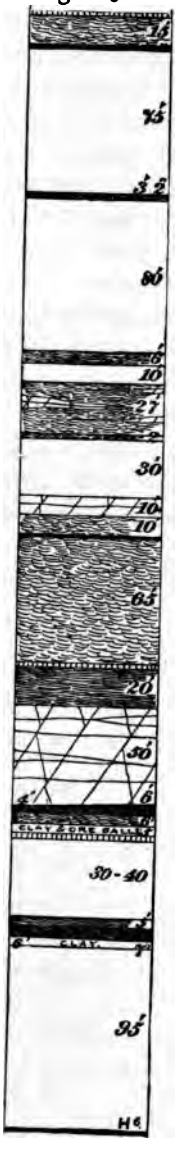



Fig 6 §51.

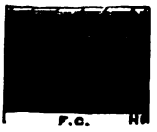



Fig.10. §61.


Fig 7. §56.


Fig.11. §62.

Fig.8. §58.

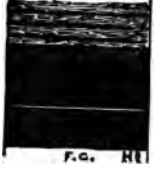



Fig.12. §76.

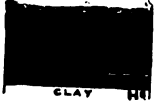



Fig.13. §87.

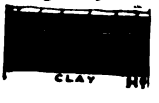
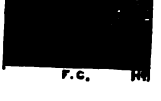



Fig.9. §60.


Fig.14. §90.



sesses the same thickness on the Booser property, south from Mt. Tabor, at which place also its limestone accompanies it.

Around the headwaters of Painter run there are few or no exposures of interest. The Freeport upper coal is contained in the hills skirting the left (or east) bank of the stream, but being indistinct, is difficult to trace there.

§ 92. Where the valley of Little Sandy creek crosses Ringgold township, its slopes are from 300 to 400 feet in height, topped at the east, along the Leechburg synclinal by the Mahoning sandstone, and at the west, near the Brookville anticlinal, by the *Ferriferous limestone.* Conglomerate strata extend eastward up the valley beyond Langville. The Ferriferous limestone is below water level only in the neighborhood of Worthville, at which place, as before stated, the synclinal axis crosses the valley. The following section compiled from exposures on both sides of the creek and in the different lateral ravines, will show the succession of the strata from the highest rock contained in the hilltops at the synclinal south of Worthville to the lowest rock at water level in the northwest corner of the township, Fig. 16.

*Ringgold township general section.*

| | | |
|---|---|---|
| Mahoning Sandstone, | | — |
| *Freeport upper coal,* | | — |
| Shales, | | 5′ 0″ |
| *Limestone, Freeport upper,* | | 15′ 0″ |
| Interval, | | 60′ 0″ |
| Coal, *Freeport lower,* | | 2′ 4″ |
| *Limestone, Freeport lower,* | | 2′ 0″+ |
| Sandstone, | | 10′ 0″ |
| Concealed, | | 40′ 0″ |
| *Limestone, Johnstown Cement,* | | 2′ 0″+ |
| Sandstone, | 10′ 0″ – | 15′ 0″ |
| Concealed, | | 75′ 0″ |
| Shales, | | 30′ 0″ |
| Coal, *Kittanning lower,* | | 3′ 0″ |
| Concealed, | | 50′ 0″ |
| *Limestone, Ferriferous,* | | 5′ 0″ |
| Interval, | | 50′ 0″ |
| *Brookville coal horizon,* | | — |
| Concealed rocks, *Pottsville Conglomerate,* | | 315′ 0″ |
| Water level of Little Sandy, below Milliron run, | | — |
| Total thickness, | | 679′ 4′ |

§ 93. The south slope of the valley at Worthville presents few exposures. The same also is the case with the valley of Big Run, which here unites with the Little Sandy. The hills contain the Lower Productive group of rocks. *The Mahoning Sandstone* is near the summit of the divide about one mile south from Worthville, where, in the vicinity of the Richards school house it has scattered heavy bowlders of sandstone abundantly over the surface. Still further south, on the property of Mr. John Smathers, the Freeport upper coal outcrops in a field near the dwelling house, where also the outcrop of the limestone has been sufficiently exposed to show the impure condition of the rock. The coal seam is 2 feet thick.

The outcrop of this coal crosses the road descending to Worthville near Mr. S. Buzzard's house. Its limestone shows in the spring at Mr. John Richards' house, and again on the opposite side of the hill from this place, near an old stable. Descending thence towards Worthville the rocks are wholly concealed until the horizon of the *Kittanning lower coal* is reached. A partial exposure of the latter was found on the farm of A. Enty on the right bank of Big Run, close to Worthville. The bed at that place is only 2 feet thick, but where opened by Mr. D. Geist on the right bank of the Little Sandy, opposite the village, its thickness is nearly 3 feet, as it is also further east, on the same hill, at Wagner's. The following section is typical:

| | | |
|---|---|---|
| Shales, | | — |
| Coal, | 0′ 7″ | 2′ 8″ |
| Slate, | 0′ 1″ | |
| Coal, | 1 4″—2′ 0″ | |

The shales which overlie the bed, and of which there are here at least 30 feet, are prettily exposed in the creek bank below Geist's mine. They are persistent towards the west down the valley, and comprise a distinctive feature there in the different exposures of that horizon. *The Ferriferous limestone* is above water level at Enty's, at which place it is well exposed, being quarried there for fertilizing use. The stratum is about 4 feet thick in one compact layer, of a light grayish color, brittle, of good quality, and fossilifer-

ous, displaying in this respect its characteristic encrinite stems. The following analysis of a specimen of the rock from Enty's quarry was made by Mr. McCreath :

| | |
|---|---|
| Carbonate of lime, | 96.428 |
| Carbonate of magnesia, | .908 |
| Oxide of iron and alumina, | .990 |
| Phosphorus, | .034 |
| Insoluble residue, | 1.300 |

§ 94. Southward from this place towards Sprankle's Mill the rock rises rapidly on the slopes, but in the opposite direction the northwest dip at Enty's (1°) soon carries it below the water level. It underlies Worthville. So also it is below the bed of Little Sandy creek until the *northwest rise* of the strata brings it to daylight again at S. Pliler's, about one mile below the village. At this latter place it is exposed but imperfectly. *The Kittanning lower coal* is exposed 50 feet above it, which also is the distance separating these strata at Enty's. The coal is three feet thick.

*The Freeport upper limestone* is on the uplands south from Pliler's. It is well exposed on the property of Mr. Geo. Schäfer, by whom it is quarried. It is of good quality, and being here close to the surface can be cheaply raised. The Freeport upper coal is contained in a bench at the hill-top, but has never been developed. The vertical distance between this coal and the Ferriferous limestone, by a direct measurement from Pliler's to Schäfer's is 275 feet. A partial exposure of the *Freeport sandstone* was observed in the roadside near Mr. Schäfer's house.

§ 95. The Freeport group passes thence up the valley of Cherry run. It extends through the fields of the Maurer farm, and through Martz's, passing next up a small branch ravine to C. Schick's, and thence southward towards Ringgold. There are but few exposures of it anywhere in that neighborhood. The Freeport upper (Freeport lower?) limestone outcrops both on the Maurer and Martz farms, but has been developed at neither place. A bed of coal 4 feet thick, apparently the Freeport lower, was once opened by Mr. D. Martz near Milliron's grist-mill. It is not now operated, and there are no further exposures of it either on

the neighboring farms or on the west slope of the valley. Round about Ringgold its horizon is below the surface. The only exposure of coal at Ringgold is the one which has been made upon the Campbell farm near the tannery ¼ mile west of the village. The bed is only 14 inches thick and will not repay further development. It apparently represents one of the Lower Barren seams.

§ 96. On the farm of M. J. Evans one mile below the grist-mill, the Johnstown cement has been exposed 2 feet thick near the level of Cherry run. It has no fossils; nor is the rock of value for fertilizing, being too much intermixed with clay and iron. Greenish clay shales overlie it, above which is the Freeport sandstone. No trace appears of the Kittanning upper coal bed.

§ 97. The *Ferriferous limestone* comes out of the run-bed a short distance further down, but no developments have been made upon it. Its outcrop line follows both banks of the ravine, that to the east joining with the line coming from Pliler's, while towards the west the rock, after passing into the valley of the Little Sandy, follows up the ravine of Milliron run nearly to the head of that stream at Hinderleiter's. It next curves around the west bank of the run, and keeps above the township road which leads west through the village of North Freedom in Armstrong county. In all this distance from Cherry run to the county line there is not a single exposure of the rock. It may be seen however on the hills north of North Freedom, of which locality a description was given in a previous Report of Progress;* and it may also be seen on the right bank of the Little Sandy above Langville in Beaver township of which more will be said in the sequel.

*The Pottsville Conglomerate* strata occupy both sides of the valley of the Little Sandy below the mouth of Cherry run. That region is, in fact, a wilderness, with steep slopes covered with enormous fragments and bowlders of massive coarse-grained sandrock. But so few are the exposures here of the rock *in situ* that it is impossible to measure accurately

*H⁵, p. 181.

its component layers. *The Homewood sandstone* is especially conspicuous. As far as may be judged it is about 50 feet thick.

### *Oliver township.*

§ 98. This township which is estimated to contain about 30 square miles, is situated east of Ringgold and Beaver townships and north of Perry. It is in the southwestern part of Jefferson county.

The region is one of deep valleys. Big Run, heading near Oliveburg flows across the southern part of the township, and receives numerous small tributaries both from the north and south. Little Sandy Creek makes a long circuit through the northern part. It also has numerous important tributaries coming from the north and east, all of which occupy deep wide ravines. Much of the country bordering the Little Sandy, and especially that in the northeast corner of the township is uncultivated timber land. Elsewhere the surface is largely devoted to tillage, but the soil generally is poor.

§ 99. *The Waynesburg (Roaring Run) anticlinal* enters the township at the southwest, and crosses Big Run near Sprankle's mills; thence it runs under the uplands in the center of the township and next crosses Little Sandy creek just above the mouth of Lick run, whence it passes northeast into Knox township. It hoists the strata sufficiently to expose the Pottsville conglomerate in the valleys of Big Run and Little Sandy; it frees nearly all of Oliver township of Lower Barren strata; it has dips on either flank of from 2° to 5°.

*The Leechburg synclinal* which crosses the Little Sandy at Worthville in Ringgold township, touches only the northwest corner of Oliver. Its effect on the geology is seen in the small areas of Lower Barren strata which there occupy a few detached hilltops. Another synclinal—the *Smicksburg synclinal* of Indiana county—makes itself felt in the neighborhood of Oliveburg, in the southeast corner of the township. Both of these are shallow folds.

§ 100. To a large extent the *Lower Productive Coal Meas-*

*ures* make the surface strata of Oliver township. They overspread not only the uplands but they build up the side-slopes of most of the valleys. Their principal coal seam is the *Freeport lower*, which usually here is from 5 to 6 feet thick and in tolerably good condition. In those regions where the hills fail to include it, the supply of fuel is derived from the *Kittanning lower bed*, the thickness of which varies from 2½ to 4 feet. Of the other beds of the series little is known, though most of them have been recognized; but so far as they have been exposed they have proved shallow.

§ 101. The following general section, compiled from numerous local sections, represents the succession of the strata in Big Run valley, so far as these are at present exposed there, Fig. 16.

*Big Run Section.*

| | | |
|---|---|---|
| Slates, | | 20′ 0″ |
| Coal, *Freeport lower*, | | 5′ 0″ |
| Clay, impure, | | 4′ 0″ |
| Concealed rocks, | | 50′ 0″ |
| Sandstone, *Freeport S. S.*, | | 20′ 0″± |
| Concealed rocks, | | 66′ 0″ |
| Coal, *Kittanning middle*, | | 2′ 0″? |
| Shales and SS., | | 40′ 0″ |
| Coal, *Kittanning lower*, | 2′ 0′— | 3′ 0″ |
| Clay, | | 2 0″+ |
| Shales, | | 48′ 0″ |
| Limestone, *Ferriferous*, | 5′ 0″— | 7′ 0″ |
| Concealed rocks, | | 50′ 0″ |
| Slates, black, | | 10′ 0″ |
| Coal, *Brookville*, | | 2′ 10″ |
| Clay, hard, | | 5′ 0″ |
| Sandstone, massive, *Homewood*, | | 40′ 0″± |
| Concealed rocks; shale and S. S., | | 100′ 0″ |
| Water level at Sprankle's mill, | | — |
| Total thickness, | | 474′ 10″ |

§ 102. It will be observed from this section that neither the horizon of the Freeport upper coal, nor that of the Freeport upper limestone is anywhere reached in the region tributary to Big Run in Oliver township. Both strata however are found just across the southern border in Perry township, as for example at Hopkins' and at A. Swab's, already

previously described ; and they are likewise found towards the north, across the Little Sandy divide.

§ 103. The *Freeport lower coal* has a very limited area of outspread. The best exposure of it in the Big Run valley is on the property of Mr. C. M. Law, by whom it has been opened near the hilltop on the south bank of the run about two miles W. S. W. of Oliveburg. It is there 5 feet thick, in good condition, and roofed by black slates which crown the hill with an even and prettily shaped bench. In every respect its condition at Law's is the same as at Hopkins' and Lewis' further south, and also at Oliveburg towards the east, presently to be described in connection with the valley of the Little Sandy. Towards the west from Law's it is shot into the air in approaching the Waynesburg anticlinal, and none of it is preserved along the Perry-Oliver line. North of Big run the hills also fail to include it excepting perhaps the high land which intervenes between Big Run and Little Sandy at the western border of the township. No exposure of the bed, however, has been made there.

§ 104. The concealed interval of rock which appears in the above section below the Freeport lower coal was not satisfactorily disclosed at any of the exposures. *The Freeport Sandstone* was observed only at a single locality, namely at the top of a hill which forms a prominent point on the E. Smith farm south from Sprankle's mill. The rock is loose and shaly. How much of the deposit may occupy the concealed interval above noted is not known, but combining its proved thickness on this hilltop, with the other interval, it shows a very considerable enlargement of the vertical distance which usually intervenes between the Freeport lower and the Kittanning upper coals. Of this latter seam, whose place is usually directly below the Freeport Sandstone, no outcrop could be detected either at Smith's or at any other point in the Big Run Valley. It will not however be said that the coal bed is here entirely absent, for the exposures at its horizon are, in this immediate region, of an unsatisfactory character.

§ 105. *The Johnstown Cement* was here likewise unob-

served. Between it and the next lower coal, the Kittanning middle seam, the interval is a blank. To judge from surface indications the strata occupying that interval are chiefly shales. The Kittanning middle coal bed was once opened 2 feet thick on the William Hanna property, on the south bank of the run, and adjoining Law's above described. No other development has been made upon it in the valley; it is a small and unimportant seam.

§ 106. Shales and thin bedded sandstones succeed below the Kittanning middle coal to the horizon of the Kittanning lower. The latter bed has an unbroken outcrop line on both sides of the run from one end of the valley to the other. Along the south slope it has been but little developed. Its line passes through the fields of the William Hanna farm and next through Lingenfelter's, whence westward it passes up a small ravine to the Lutheran church at the forks of the road below A. Swab's. Returning again to the Big Run valley it passes above Mr. D. Moser's house, and then up another small ravine to the Ringgold township line. Its outcrop was opened into at Moser's, and 2′ 6″ of coal were shown.

On the opposite side of the valley it has been considerably more developed. It is this Kittanning lower seam that runs through the Gaston settlement, and on thence up Keller's run to Lingenfelter's. Being, in that locality, close to the Waynesburg anticlinal it occupies an elevated position on the slopes, but has nevertheless sufficient cover in all places to insure firm dry coal. On the Mrs. Gaston property it measures only 2′ 2″ thick, but at Lingenfelter's it is 2′ 9″ thick, parted by a small division slate, as shown in the following section:

*Fig. 17, § 106.*

| | | |
|---|---|---|
| Slates, | | — |
| Coal, | 1′ 10″ | |
| Slate, | 0′ 1″ | 2′ 9″ |
| Coal, | 0′ 10″ | |

At all places in the valley the coal from this seam is slaty and of indifferent quality; this is especially the case at Lingenfelter's. The dip at the latter place is N. W., but

at Gaston's it is S. W., which latter moreover is the prevailing dip in most of the mines hereabouts, thus indicating the rise which here takes place in the anticlinal axis towards the northeast.

Where the outcrop line of the bed curves round the north hill of the valley opposite Sprankle's mill, it is close to the summit. Thence, sinking towards the northwest, it runs up a small lateral ravine from Enterline's mill; then it curves back through the farm of Mrs. E. Smith, and so passes out of the township.

§ 107. The *Ferriferous limestone* is never less than 50 feet below the Kittanning lower coal in the Big Run valley. But independent of its relations to other strata, it is easily recognized from its characteristic fossils which it here carries in abundant profusion. Moreover, though reduced in thickness it here retains to a great extent those lithological characteristics which distinguish it throughout those western counties where it attains its maximum of development. It is of a light greyish color, mottled with iron; it has a rough uneven surface at the fresh fracture; and on its weathered face it presents that peculiarly rugged appearance by which those familiar with it readily distinguish it. Throughout the Big Run valley it is in excellent condition for use as quarry lime, and splitting easily it can be cheaply raised.

At the upper end of the valley it is not exposed, though it is certainly above water level as far east as Mr. S. S. Smith's. Along the south bank of the run it is first seen on the Wm. Hanna farm where it is quarried in small quantities for fertilizing use. A specimen selected for analysis gave Mr. McCreath the following results:

| | |
|---|---|
| Carbonate of lime, | 93.643 |
| Carbonate of magnesia, | 1.816 |
| Oxide of iron and alumina, | 1.310 |
| Phosphorus, | .030 |
| Insoluble residue, | 2.040 |

Another outcrop of it is seen in the spring at W. J. Swab's house, about one mile south of Sprankle's Mills; it shows also where its line crosses the township road between Swab's and E. Smith's · it is exposed again in

one of the fields of the Smith farm, being there partially opened up.

On the north slope of the run it may be seen no less frequently. It shows on the Wm. Newcome property 1½ miles east of Sprankle's Mills; it is exposed again on the farm of Mrs. Gaston, where a quarry has been opened upon it. It is from 5 to 7 feet thick, all good stone. At Mrs. Gaston's the rock is very dark colored and crowded with fossils. It carries no iron ore; the Buhrstone ore indeed is absent from the measures throughout all of the Big Run region.

West of Sprankle's Mills no development has been made upon the limestone in Oliver township; we find it however a short distance beyond the line at Enty's of which exposure a description has already been given.

§ 108. The *Clarion coal bed*, whose position in the series is about midway between the Ferriferous limestone and the Brookville coal bed, was not observed. The *Brookville coal* was several times noted. It is this seam which is mined on the Wm. Newcome property close to the township road and near the base of the hill. It is there exactly 60 feet below the Ferriferous limestone which outcrops at the point of the hill above. The coal is 2′ 10″ thick, roofed by slate, and resting upon an even floor of hard fire-clay. The dip at this place is 5° towards the N. W.

It is the Brookville coal also which outcrops in the spring at Mr. William Hanna's house, and it is probably the same bed which is mined on the William Swab farm south of Sprankle's mills, where it yields 2′ 6″ of coal. As far as may be judged the bed never much exceeds this thickness in the Big Run region.

§ 109. *Of the Pottsville Conglomerate* 150 feet are above water level at the center of the Waynesburg anticlinal. The exposures of it however are so imperfect that it is impossible to differentiate its component layers. *The Homewood Sandstone* is here the principal stratum of the series because of its massiveness. Its thickness can only be approximated, but it is certainly not less than 40 feet and may be double that much. It is this stratum which has covered the lower

part of slopes so abundantly with bowlders of rock, making a wilderness from where it rises above the run bed at Hanna's to where it sinks out of sight again below Enterline's mill. It is very conspicuous below the Newcome mine, and it is still more prominent below the Methodist Church, northeast of Sprankle's mills. It also makes an abundant display along the road leading south from the mills; it is abundant too at Enterline's.

The Mercer group could not be satisfactorily made out in the imperfect exposures.

§ 110. The valley of the Little Sandy Creek occupies the eastern and northern part of Oliver township. The following section, embodying numerous local sections, shows all the strata outcropping there, from the highest rock contained in the synclinals to the lowest layer that rises to daylight on the crown of the Waynesburg anticlinal. Fig. 18:

*Little Sandy Section.*

| | | |
|---|---|---|
| Sandstone, Mahoning, | 55′ | 0″± |
| Coal bed, *Freeport upper*, | | ? |
| Shales, | 10′ | 0″ |
| *Limestone, Freeport upper*, | 5′ | 0″+ |
| Interval, | 25′ | 0″ |
| Slates, | 5′ | 0″ |
| Coal bed, *Freeport lower*, | 5′ | 0″ |
| Interval, *Freeport Sandstone?* | 50′ | 0′ |
| Slates, | 10′ | 0″ |
| Coal bed, *Kittanning upper*, | 2′ | 0″ |
| Interval, | 100′ | 0″ |
| Coal bed, *Kittanning middle*, | 4′ | 0″? |
| Interval, | 45′ | 0″ |
| Coal bed, *Kittanning lower*, 2′ 0″— | 4′ | 0″ |
| Interval, | 25′ | 0″ |
| Shales, | 15′ | 0″ |
| Iron ore, Buhrstone ore, | 0′ | 7″ |
| *Ferriferous limestone*, | 3′ | 6″ |
| Interval, | 50′ | 0′ |
| Coal, *Clarion*, | 2′ | 6″? |
| Interval, shale? | 35′ | 0″ |
| Coal, *Brookville*, 1′ 0″— | 4′ | 0″ |
| *Homewood Sandstone*, | 50′ | 0″? |
| Concealed rocks, | 150′ | 0″ |
| Water level, mouth of Indian Camp run, | | — |
| Total thickness, | 655′ | 7″ |

§ 111. The following detailed description of the valley

Fig.15. § 92.


Fig.17. §106.

Fig.16. §101.

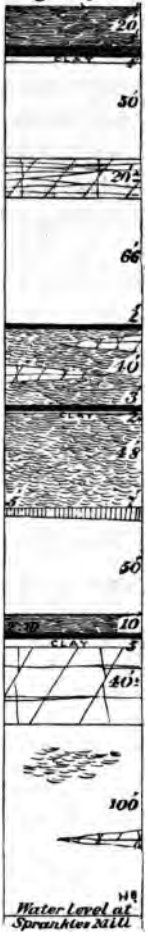
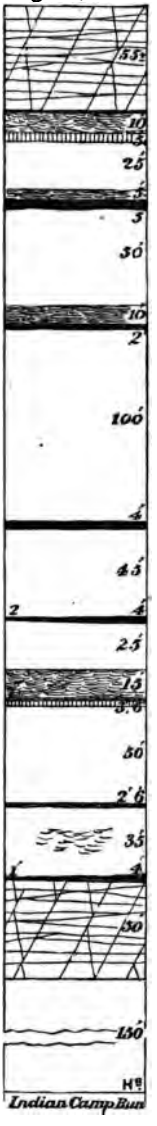



Fig.18. § 110.



treats of the rock exposures in their order from east to west down the creek. At Oliveburg, where the stream starts, the *Freeport lower coal* is contained in a few detached hill summits close to the McCalmont township line. One such prominent knob is found on the farm of Mr. Isaac Jordan, by whom the coal bed has recently been opened, six feet thick and in good condition. Its appearance here is similar in all respects to that which it presents at Frostburg and throughout the Elk run region. The hill above the mine rises to a sufficient height to include the Freeport upper limestone, but no outcrop of that rock could there be detected. Most likely it is absent here from the measures, as it is at Frostburg, and at Punxsutawney. The hilltop at Jordan's is below the Mahoning sandstone.

§ 112. No rock exposures are found northwest of Jordan's for more than a mile down the Little Sandy. That part of the valley indeed, on both sides of the stream is a wilderness. The outcropping strata are those of the Lower Productive Coal Measures. *The Ferriferous limestone* first rises above the water line near the forks, above Hadden's saw-mill, but there is no exposure of it until Burkit's old mill is reached, nearly a mile further down the valley. At the latter place the following section was constructed on the west (or left) bank of the valley. It begins at the hilltop on the J. Burkit farm and descends thence through the fields of that property to the old mill above mentioned.

*Burkit Section.*

| | | |
|---|---|---|
| Hill-top, ***Mahoning Sandstone,*** | | — |
| Concealed measures, | 190′ | 0″ |
| Coal bed, ***Kittanning middle,*** | outcrop. | |
| Concealed measures, | 68′ | 0″ |
| Coal bed, ***Kittanning lower,*** | 4′ | 0″ |
| Concealed measures, | 55′ | 0″ |
| ***Ferriferous limestone,*** | 4′ | 0″± |
| Interval, | 50′ | 0″ |
| Coal bed, *Clarion?* | 2′ | 6″ |
| Concealed measures, | 35′ | 0″ |
| Coal bed, ***Brookville,*** 1′ 0″— | 4′ | 0″ |
| Concealed measures, ***Homewood sandstone,*** | 60′ | 0″ |
| Creek level, | | — |
| | 472′ | 6′ |

§ 113. The developments at this place have been directed to the lower members of the Lower Productive series; the upper horizons are wholly concealed. The Mahoning sandstone is caught only in this one hill which stands out prominently in the topography. Most probably the Freeport lower coal is here a large valuable bed, but the determination of that fact must await development. To all appearances there is an enormous expanse of it on the lands of Messrs. Jenks and Winslow, situated on both sides of Jordan's run east of Burkit's. These lands, embracing several thousands of acres are unimproved forest land, upon which no developments have yet been made to ascertain the thickness and value of their enclosed coal beds and limestone strata.

§ 114. The first coal bed in descending order seen on the Burkit farm is the *Kittanning middle*, of which only its outcrop is exposed. Next below it, in the same field is the *Kittanning lower*, once opened by Mr. Burkit, who claims for it a thickness of four feet. The old bank upon it is now shut. The *Ferriferous limestone* shows in a small gulch close by. The rock is of good quality and would answer well for quarry lime. Fifty feet below the limestone is a small coal seam, which may possibly be the *Brookville*, but which more likely is the representative of the *Clarion*. The lowest coal bed of all, that once opened by Mr. Burkit 85 feet below the limestone is an irregular and uneven deposit. Its outcrop is said to have shown six feet of coal, which under cover quickly diminished to one foot, rising again to 4 feet and then diminishing again. It was followed only a short distance under cover and then abandoned. The opening is now shut.

Below the mine the interval to the creek is occupied by the *Homewood Sandstone*, of which however there are here no exposures.

Descending the creek valley from Burkit's the rocks rise rapidly on the slopes. At the mouth of Indian Camp run the *Ferriferous limestone* is nearly 300 feet above the water level. At or near this place the Waynesburg anticlinal crosses.

§ 115. On the property of Mr. D. Hurl, situated on the left bank of the creek opposite the mouth of Indian Camp run, the following section was leveled:

*Hurl Section.*

| | | |
|---|---|---|
| Mahoning sandstone, | — | |
| Interval, | 230′ | 0″ |
| Coal bed, *Kittanning lower*, | 4′ | 0″ |
| Interval, | 40′ | 0″ |
| *Ferriferous limestone*, | 4′ | 0″± |
| Interval, | 60′ | 0″ |
| Coal bed, *Brookville*, | 3′ | 0″ |
| Interval to creek, concealed rocks, | 220′ | 0″ |
| | 561′ | 0″ |

The *Conglomerate series* at the base of the slopes is abundantly shown by bowlders and fragments of sandstone. Along the township road south from McKinstry's mill some partial exposures are found of the *Homewood Sandstone*. The *Mercer group*, if present at all, is concealed.

The thickness of the Brookville coal bed in this region was ascertained in an opening made upon its outcrop on the Hurl farm. The bed is not now operated.

The *Ferriferous limestone* outcrops in the next higher field, near the School House. It is a smooth compact stone, of a dark blue color and fossiliferous. The exposure of it is too incomplete to judge whether the deposit here carries the Buhrstone iron ore.

The *Kittanning lower coal* was once operated at the roadside close to the school house. Its thickness is given upon the authority of Mr. Hurl. It is underlaid by fire clay.

A high, prominent knob south of the school house catches the Mahoning Sandstone on its summit. The Freeport group is undeveloped.

§ 116. North of the creek, along the waters of Indian Camp run there is a large body of unimproved timber land, controlled by Messrs. Jenks and Winslow of Punxsutawney. These lands may possibly contain the Freeport lower coal, but if so it must be close to the hilltops as the arch of the Waynesburg anticlinal passes through that region.

§ 117. *Lick run* comes into the Little Sandy at McKinstry's mill. The lower part of the ravine through which it

flows, is a wilderness. The surface rocks are mainly those of the *Lower Productive Coal Measures*, with the *Pottsville conglomerate* at their base, extending up the run from McKinstry's for nearly a mile. Still higher up in Knox township the *Freeport lower coal* is mined, of which a description is given elsewhere.

§ 118. Proceeding now down the Little Sandy to Geist's saw-mill, one and a half miles below McKinstry's, we find the top of the Conglomerate there at water level. Just beyond this to the west passes the Leechburg-Worthville synclinal. All of the Lower Productive Coal Measures are contained in the hills north from Geist's, and in some few of the knobs the Mahoning sandstone is caught. It is not necessary here to repeat the section there exposed. To follow the accompanying description the reader has only to refer to the general section given above.

§ 119. Ascending the small run which comes into the creek from the north at Geist's, the *Homewood sandstone* is the country rock for a distance of several hundred yards. The *Brookville coal* is not exposed. Its horizon is here roofed by heavy sandstone. The *Ferriferous limestone* may be seen in the run bank at H. Huffman's, by whom it has been quarried for fertilizing use. The deposit is only 3′ 6″ thick; is of a light grey color and in excellent condition. It carries the *Buhrstone ore*, 7 inches thick, above which are loose fire clay shales.

The run bed rises above the limestone a short distance beyond Huffman's.

The *Kittanning lower coal* outcrops on the hillslope forty feet above the limestone quarry. Its thickness is not known.

The *Kittanning middle coal* is at the level of the run bed at A. Huffman's beyond the forks of the road, about one half mile north of the limestone quarry. Many years ago it was worked at this place, but the bank is now closed. Mr. Huffman states its thickness to be 4 feet.

§ 120. The *Kittanning upper coal* is unknown. So likewise is the Johnstown cement. But the *Freeport lower coal*, being a large and valuable bed is widely known. It is mined by A. Huffman, and again on the adjoining pro-

perty to the north by Mr. A. J. Smathers; again on the opposite side of the run from this place by Mr. J. Johns, and again near Mrs. Kennier's about one mile to the east. At all of these places it presents the same section, and its general condition is the same as at Oliveburg and Frostburg. It is 5 feet thick in one bench, roofed by slate, and underlaid by an even and regular floor of clay. A specimen of the bed, taken from Mr. Huffman's mine, was analyzed by Mr. McCreath with the following results:

| | |
|---|---|
| Water, | 1.540 |
| Volatile matter, | 37.605 |
| Fixed carbon, | 56.762 |
| Sulphur, | 1.103 |
| Ash, | 2.990 |
| | 100.000 |
| Color of ash, | brown. |
| Coke per cent., | 60.855 |
| Fuel ratio, | 1:1.51 |

At Huffman's the rocks are nearly horizontal, but further north there is a sharp rise towards the northwest which is especially noticeable between the Smathers and Johns mine. There is apparently a small local roll in the rocks in that locality.

§ 121. The *Freeport upper limestone* though rather impure, is of importance to the farmers. It is best exposed on the A. Huffman property, where being close to the hilltop it makes an abundant outcrop. It is exactly 35 feet above the Freeport lower coal. A specimen of the rock, analyzed by Mr. McCreath, gave the following results:

| | |
|---|---|
| Carbonate of lime, | 88.928 |
| Carbonate of magnesia, | 1.589 |
| Oxide of iron and alumina, | 1.740 |
| Phosphorus, | .023 |
| Insoluble residue, | 6.770 |

The *Freeport upper coal* is obscure throughout all this neighborhood. It is contained in a small knob northeast of the limestone outcrop at A. Huffman's; it is contained also in a similar knob on the opposite side of the run from this place; again north of Smathers', and again north of Mrs. Kennier's where there is a considerable body of it, and

where also the Mahoning Sandstone makes an abundant display on the surface at the hilltops. But at none of these places could any indication of the coal be detected. The bed undoubtedly is small and of little or no value.

*McCalmont township.*

§ 122. This township is situated east of Oliver and north of Bell and Young townships. It contains about 25 square miles.

The surface generally is high, ranging at its highest part between 1800 and 1900 feet above the ocean level. The township lines, indeed, include a central water-shed, upon which some of the principal streams in the county take their rise. The Little Sandy creek heads here; so do Big run and Elk run flowing southward into the Mahoning; in the extreme northern part of the township the waters flow northward into the Sandy Lick. Being thus near their starting place the streams are all small, but the valleys which they occupy are in many cases several hundred feet in depth, and present in this respect a striking contrast to the size of the streams.

§ 123. The principal fold in the rocks is the *Perrysville anticlinal* which enters the township at the southwest corner and runs thence through the Mt. Tabor settlement, keeping west of Elk run; it passes through the Brown and Uplinger settlement and leaves the township near the point at which the Knox, McCalmont and Winslow lines corner. Its dips are here of irregular strength. Throughout most of its run in the township the axis has a broad back upon which the rocks lie nearly horizontally. This feature is presented in the Brown-Uplinger settlement where for a considerable distance on either side of the arch there is scarcely any dip at all. It is the case also round about Mt. Tabor church. But as we advance southeast from that place the dips soon become very decided, increasing finally to 4° and 5° on Elk run. It is indeed, due to these dips on the southeast flank of the axis, that the central part of the township is overspread by a thick covering of Lower Barren strata. The northwest flank is much more gentle in its slope.

There is a nearly continuous northwest dip from the Brown-Uplinger settlement to Knoxdale, but its effect on the geology in increasing the depth of the basin in that direction is trifling, because its average strength does not exceed 1°, while the decrease in elevation which the country suffers towards the northwest is nearly equal to the decrease in the elevation of the rocks. Hence the Knoxdale basin is shallow.

The central part of the township is traversed by the *Lisbon synclinal*, which further north passes under Reynoldsville.

In the northeast corner of the township a feeble anticlinal is felt along the Big Run waters. It lifts Lower Productive strata to daylight in Big Run valley, and in the ravines of Laurel run and Turnip run. It cannot be traced southward; but northward its equivalent is seen in the small fold (Falls creek axis) which runs east of Reynoldsville and Pancoast. Its dips in McCalmont township are extremely shallow.

§ 124. *The outcropping rocks* comprise the Lower Productive series, and about two hundred feet of the overlying Lower Barren strata. Exposures, excepting of the principal coal beds are few in number and imperfect. The valleys are for the most part unimproved; and so to a considerable extent is the upland region. Vertical sections therefore are fragmentary. The following generalized section embodies the various local exposures observed throughout the township, Fig. 19.

*McCalmont township general section.*

| | | |
|---|---|---|
| Sandstone, | 25′ | 0″ |
| Shales and concealed strata, | 125′ | 0″ |
| Black slates, | | — |
| Sandstone, Mahoning S. S., | 70′ | 0″ |
| Coal bed, *Freeport upper*, | 4′ 0″— 5′ | 0″ |
| Concealed strata, | 48′ 0″— 60′ | 0″ |
| Coal bed, *Freeport lower*, | 5′ | 0″ |
| Concealed strata, | 25′ | 0″ |
| Coal bed, | small. | |
| Sandstone, *Freeport S. S.*, | 20′ | 0″ |
| *Johnstown Cement*, | 3′ | 0′ |
| Concealed strata, | 60′ 0″— 70′ | 0″ |
| Coal bed, *Kittanning middle*, | 5′ 0″— 7′ | 0″ |

| | | |
|---|---|---|
| Concealed strata, | 30′ 0″ | — 40′ 0″ |
| Coal bed, *Kittanning lower*, | | 3′ 0″ |
| Concealed strata, | | 100′ 0″ |
| Water level of Little Sandy creek, | | — |
| Total thickness of rocks, | | 558′ 0″ |

§ 125. Along the Big run waters and throughout the eastern part of the township *Lower Barren* strata occupy the uplands, while in the valleys the Lower Productive group is exposed down to the horizon of the Johnstown cement. From the southern boundary line to the ravine of Turnip run and thence northwestward to the Shamoka corners the country rock is chiefly argillaceous shale, lying above the Mahoning sandstone. That part of the township is smooth glade country, containing some excellent farming land, which is in striking contrast to the rocky and wilderness condition of the valleys. Small coal seams have occasionally been found in the Barren Measure shales, but they are of no value. North's house at Shamoka corners is estimated to overlie the Freeport upper coal by a distance of at least 150 feet.

§ 126. The *Freeport upper coal* rises above Big run, near where that stream crosses the Henderson township line, about one mile below Best's saw mill. Thence, rising rapidly, it extends up Turnip run (a branch of Big run,) up Laurel run and up the valley of Big run nearly to the headwaters of each of those streams. Access is thus given to enormous fields of coal, stretching south and west to Elk run and northward to the valley of the Sandy Lick.

The only exposures that have been made of the Freeport group are on the farms of J. Best and J. M. Schäfer in the ravine of Laurel run. The remainder of the region is a wilderness.

The *Freeport sandstone* makes little or no show at Best's saw mill at the mouth of Laurel run. The *Freeport lower coal* is opened a short distance northeast of the mill, being mined to some extent for local use in the country to the south and west. It shows the following section:

*Fig. 20, § 126.*

| | | | |
|---|---|---|---|
| Roof, clay slate, | | | — |
| Coal, | 4′ 2″ | | |
| Bony coal, | 0′ 2″ | 6′ | 0″ |
| Coal, | 1′ 8″ | | |

Eight inches of additional coal and slate are reported to have been cut through in the present floor of the mine, making the total thickness of the seam at this place 6′ 8″.

The coal in both of the benches that are mined, is to all appearances of excellent quality. Some occasional slate binders appear and some pyrites, but neither to a damaging extent. The coal is tough and hard, and bears handling well. The dip at Best's is S. E.

§ 127. The *Freeport upper coal* was once opened near Mr. Best's house, about one quarter mile northeast of the mine last described. It is roofed by the Mahoning sandstone, which latter, however, at this place is less massive and hence less conspicuous than is usually the case throughout the Laurel run ravine. The coal bed is here reported to be only about 3 feet thick, but this reduction is apparently due to its having been opened at a point where the bed is much crushed. Nothing was seen of the Freeport upper limestone; nor is anything known of the stratum throughout the Big run region. The vertical distance between the Freeport upper and lower coals at Best's is 55 feet.

On the J. M. Schäfer farm next adjoining Best to the west the following section was obtained:

*Schäfer Section.*

| | | | | |
|---|---|---|---|---|
| Sandstone, Mahoning Sandstone, | 50′ 0″ | — 75′ | 0″ | |
| Coal, *Freeport upper*, | 4′ 7″ | — 5′ | 0″ | |
| Concealed rocks, | | 60′ | 0″ | |
| Coal, *Freeport upper*, | | 5′ | 0″ | reported. |
| Concealed rocks, | | 25′ | 0″ | |
| Coal, reported, | | — | | |
| Run level, | | — | | |
| | | 170′ | 0″ | |

§ 128. The *Mahoning Sandstone* is finely shown on the hilltop north of Schäfer's house and buildings. It is a massive rock, coarse grained and of a grey color. Further

north it covers all the uplands extending to Mr. A. Dickey's where it is again finely exposed in a ravine to the west.

The *Freeport upper coal* is opened on the Schäfer property in a field directly north of the tannery. It yields poor coal, dirty from infiltrated clay, the roof, which is of massive sandstone being much cracked. Some of these cracks are an inch and more in width. Moreover the coal is both slaty and pyritous, and does not compare in value to that from the Freeport lower seam. If this exposure of it is typical of the bed throughout this region the seam notwithstanding its thickness, is of little importance.

The *Freeport lower coal* was once opened into by Mr. Schäfer near the run level above the tannery. It showed 5 feet of good coal. The opening is now closed.

Another small coal seam outcrops at the tannery, 25 feet below the Freeport lower, but has not been explored.

§ 129. Transfering the attention now to the Elk run valley we find the same Lower Productive rocks exposed there as those above described, with an additional depth of about 100 feet to the section, extending to the Kittanning lower coal bed. The main branch of the run comes from the Straighthoof property where its headsprings interlock with those of the Little Sandy. Another branch which unites with the main one at the Young township line, comes from near Shamoka corners and flows through the Shull and Elble settlement. The latter stream heads among Lower Barren strata, and in flowing towards the west approaches the region of the anticlinal, and thus works its way into lower strata, the dip being *up the stream;* the main branch on the other hand heads near the center of the Perrysville anticlinal, the line of which it closely follows for a short distance, but flowing then south gradually recedes from it. Hence the lowest rocks exposed in that valley are at the head of it, and what dip there is, is *down the stream.*

§ 130. On the farm of Mr. J. Straighthoof close to the head of the run a valuable bed of coal, with the section herewith given, has been exposed in a field east of the dwelling house:

*Fig. 21, § 130.*

| | | | |
|---|---|---|---|
| Sandstone roof, massive, | | | — |
| Bony coal and slate, | 0′ | 8″ | 7′ 1″ |
| Slate, persistent, | 0′ | 1″ | |
| Cannel slate, | 0′ | 4″ | |
| Coal, | 6′ | 0″ | |
| Slate, | | | — |

The bed presents a handsome appearance, yielding bright clean coal in its lower bench. The roof is compact and dry. The same seam is opened on the adjoining farm to the south by Mr. J. Wachob, where the coal is equally good, though the thickness of the lower main bench is there reduced to 4′ 6″. Otherwise the conditions are the same both in respect of the massive sandstone roof, and in the upper bony coal division and "draw slate." The bed is the equivalent of that opened near Swartz's saw-mill in the Brown-Uplinger settlement, presently to be noticed. It is adjudged to be the *Kittanning middle* seam, though possibly it may be the *Kittanning lower*. There is no exposure of the Ferriferous limestone in that region; there are indeed no exposures of any kind by which the bed at Straighthoof's can be positively identified.

North from Straighthoof's the hill rises to a height of more than 300 feet above the mine, thus including at its top the Mahoning sandstone. The mine is about 150 feet above the water level.

At Smith's saw-mill about two miles south of Straighthoof's a small coal seam, adjudged to be the *Kittanning lower* is at water level. It is 2′ 6″ thick.

§ 131. On the J. Keslar farm, ¼ mile northeast of the mill, the *Freeport lower coal* is mined close to the township road. It is 5 feet thick with a firm slate roof and a regular floor. The exhibition of coal at this place is a very handsome one. There are no slate partings and only a few knife-edge binders; the percentage of sulphur is never large; and the bed lies in a favorable position for mining with abundant cover over it on both sides of the ravine. A specimen of coal selected from this mine for analysis, gave the following results to Mr. McCreath:

| | |
|---|---|
| Water, | 1.160 |
| Volatile matter, | 33.020 |
| Fixed carbon, | 62.228 |
| Sulphur, | 1.062 |
| Ash, | 2.530 |
| | 100.000 |

| | |
|---|---|
| Color of ash, | orange. |
| Coke, per cent., | 65.820 |
| Fuel ratio, | 1:1.88 |

§ 132. *The Freeport upper coal bed* outcrops on the same hill, towards the north, being 48 feet above the lower seam. It was partially opened at one time, and showed nearly 4 feet of coal. The opening is now closed. Above it the Mahoning sandstone covers the surface with large fragments of rock. A leveled section line on the west slope of the hill from Keslar's to Smith's mill connects the exposures in the following order:

*Keslar Section.*

| | | |
|---|---|---|
| Sandstone, Mahoning sandstone, | 50′ | 0″ |
| Slate, | | — |
| Coal bed, *Freeport upper*, | 4′ | 0″ |
| Concealed strata, | 48′ | 0″ |
| Coal bed, *Freeport lower*, | 5′ | 0″ |
| Concealed strata, | 180′ | 0″ |
| Coal bed, *Kittanning lower*, | 2′ | 6″ |
| Elk run at Smith's saw-mill, | | — |
| | 289′ | 6″ |

§ 133. On the farm of Mr. L. Elble about one mile east of Keslar's, some developments have been made upon the Freeport upper and lower coals with favorable results. *The lower seam* is 5 feet thick, in good condition, and yielding coal of the same average quality that it does generally throughout the Elk run region. It was twice opened on the Elble farm, at remote points, and showed the same thickness at both places. *The Freeport upper coal* is 50 feet above the lower. The opening upon the bed being shut, the thickness of the coal could not be ascertained. *The Mahoning sandstone* literally covers the surface above the last opening with fragments of coarse-grained massive rock. Sandstone also crowns the hill at a distance of more than 200 feet above the outcrop of the Freeport upper coal.

On the western slope of this hill and near the base of it Mr. John Shull has opened the Freeport lower coal near the level of the east branch of Elk run, about one mile south of Shamoka corners. The bed at this place ranges between 4′ 6″ and 4′ 9″ thick. Its condition, though good, is rather more slaty than at Keslar's.

The Freeport upper bed is not there exposed. Neither is the Freeport upper limestone; nor the small coal seam one foot thick which outcrops at Elble's about midway between the Freeport upper and lower coal beds.

§ 134. The *Brown-Uplinger settlement* is at the north end of the township round about the heads of Little Sandy creek. The Punxsutawney road passes through it. The surface rocks are those of the Lower Productive series. The following section was obtained along a line extending from the hilltop at Brown's through the Uplinger fields past Swartz's mill, and on thence to the Little Sandy creek.

*Uplinger Section.*

| | | |
|---|---|---|
| Hill top, | | — |
| Concealed strata, | | 80′ 0″ |
| Coal bed, *Freeport lower*, | 4′ 8″ | — 5′ 0″ |
| Concealed strata, | | 30′ 0″ |
| Sandstone, *Freeport Sandstone*, | | 20′ 0″ |
| *Johnstown Cement*, | | — |
| Concealed strata, | | 75′ 0″ |
| Coal bed, Swartz mine, *Kittanning middle*, | | 5′ 0″ |
| Concealed strata, | | 25′ 0″ |
| Coal bed, *Kittanning lower*, | | 3′ 0″ |
| Concealed strata, | | 100′ 0″ |
| Creek, | | — |
| | | 343′ 0″ |

The *Freeport lower coal* is exposed at the roadside close to Mr. Uplinger's house. The mine is on the property of Mr. D. Brown.

The coal is of good quality, but being close to the hilltop the area of it at Brown's is small. This locality is close to the center of the Perrysville anticlinal.

The Freeport upper coal is not here exposed; nor does the hilltop contain the Mahoning sandstone.

A short distance below the mine the *Freeport sandstone* is abundantly shown in Mr. Uplinger's fields. It is equally

prominent further west at the school house. Below it is a stratum of sandy limestone representing the *Johnstown cement*, which has been opened by Mr. Uplinger, but it is too impure for use. The *Kittanning middle coal* is exposed on the Swartz lands, west of Uplinger. The bed shows the following section:

*Fig. 22, § 134.*

| | | | |
|---|---|---|---|
| Shale roof, | | | — |
| Coal, | 2′ | 0″ | |
| Shale, | 0′ | 10″ | 4′ 10″ |
| Coal, | 2′ | 0″ | |
| Clay, | | | — |

The bed has been too little developed to judge definitely of its value. From outcrop appearances the coal is of fairly good quality.

The next lower seam is that once exposed near Mr. Uplinger's house. Beyond the mere outcrop there have been no explorations. Thence to the creek all rocks are concealed.

*Henderson township.*

§ 135. This is a rectangular area of about 22 square miles, situated between Winslow township on the north and Gaskill township on the south. It adjoins Clearfield county.

The *surface* is mainly upland, smooth, fertile, and well watered. The valleys, with the exception of the Mahoning, extending along the southern border, are shallow and have gentle slopes. Nearly all of the region is cleared of its timber.

The *drainage water* flows south into Mahoning creek. Stump creek occupies the eastern part of the township; Big Run the western. The northern part is crossed by a narrow divide which separates the waters of the Mahoning from those of the Sandy Lick.

§ 136. Henderson township lies within a shallow *synclinal basin*, in which the rocks are nearly horizontal. It is, in fact, the northeast extension of the area of horizontality which, as we have already seen, occupies Bell township, and which as before explained is due to the disappearance of the Indiana anticlinal axis. Hence the same Lower Bar-

ren rocks which overspread Bell township and the northwest corner of Gaskill, overspread Henderson. The only outcrop of Lower Productive measures in all the region is at its southeast corner, along the east branch of Mahoning creek.

§ 137. *Of the Lower Barren series* about 250 feet are here represented. It is not possible to present a continuous section of them, showing the order of succession from top to bottom, because the local sections are not only short but the localities at which they occur are widely remote, and there are no means of satisfactorily joining them. It is not however a matter of much consequence, for aside from a few limestone deposits which occupy the elevated stretches of country, the strata enclose nothing of practical interest.

§ 138. *Big Run village* is located among Lower Barren strata. The Mahoning Sandstone, which touches water level at the mouth of Stump creek east of the village is not prominent there. Neither is it on the hills towards the north, though towards the south in Gaskill township it is a massive coarse-grained rock, similar in condition and appearance to that which it presents at Bell's Mills and along Canoe creek in Bell township. Its indistinctness therefore, due to its shaly structure at Big Run, is merely a local variation.

The character of the strata above the sandstone may to a partial extent be seen in ascending the township road leading north from the village, up the Big Run valley. Shales and slates predominate. At Smyre's mill above the mouth of Windfall run, black slates 20 feet thick are exposed in the creek bank. Thence the road leads up the hill over concealed strata to Mr. Jacob Smith's property where two deposits of limestone outcrop, accompanied by a small seam of coal and a still smaller stratum of carbonate iron ore. The section presented at this place is as follows:

*Smith section, No. 1.*

| | | |
|---|---|---|
| 1. *Limestone*, | 4′ | 0″+ |
| 2. Interval, | 50′ | 0″ |
| 3. Iron ore, | 0′ 6″— 0′ | 8″ |
| 4. Slates, | 10′ | 0″ |

| | |
|---|---|
| 5. Coal, | 1′ 3″ |
| 6. Shales, | 10′ 0″ |
| 6. *Limestone*, | — |
| Interval to top of Mahoning sandstone, | 75′ 0″ estimated. |
| Thickness, | 151′ 11″ |

Only the upper of the limestone deposits has been developed, being at the hilltop and bare on the surface in a field west of Mr. Smith's house. Good stone is obtained from it. The iron ore noted is good so far as it has been exposed.

§ 139. From Mr. Smith's a township road leads east towards Stump creek. Along this road on another farm of Mr. Smith, about one and a half miles east of the other, an additional and higher limestone stratum is exposed which *overlies the top rock of the above section about 75 feet.* This locality is near the center of the trough, and the highest limestone there is not only one of the uppermost strata in the geological section of this township, but it is one of the highest of the Lower Barren horizons contained in Jefferson county. A leveled section of the hill at this place resulted as follows:

*Smith Section, No. 2.*

| | |
|---|---|
| 1. *Limestone*, | thickness not exposed. |
| 2. Interval, | 70′ 0″— 80′ 0″ |
| 3. *Limestone*, No. 1 of other section, | thickness not exposed. |
| 4. Interval, | 55′ 0″ |
| 5. Coal, | thin. |
| 6. Interval, | 5′ 0″ |
| 7. *Limestone*, | thickness not exposed. |

The limestones are all of good enough quality for use as fertilizer, though the upper deposit is much better than either of the others. None of them is sufficiently exposed to estimate their thickness accurately, but the indications are that all have a thickness of at least three feet. Samples of each rock were analyzed by Mr. McCreath with the following results:

*Top Stratum.*

| | |
|---|---|
| Carbonate of lime, | 92.500 |
| Carbonate of magnesia, | 2.497 |
| Oxide of iron and alumina, | 1.530 |
| Phosphorus, | .023 |
| Insoluble residue, | 2.390 |

*Middle Stratum.*

| | |
|---|---|
| Carbonate of lime, | 77.143 |
| Carbonate of magnesia, | 4.691 |
| Oxide of iron and alumina, | 3.790 |
| Phosphorus, | .073 |
| Insoluble residue, | 11.780 |

*Lower Stratum.*

| | |
|---|---|
| Carbonate of lime, | 75.357 |
| Carbonate of magnesia, | 9.330 |
| Oxide of iron and alumina, | 4.230 |
| Phosphorus, | .017 |
| Insoluble residue, | 9.780 |

§ 140. Returning again to the road which leads north from Smith's, and proceeding thence a short distance we find limestone exposed on the Jacob Zufall property. It is most likely the *middle limestone* deposit of the Smith section. Six feet of stone have been uncovered at Zufall's, and the bottom of the deposit has not been reached. Massive sandstone here overlies it, outcropping abundantly not only here at Zufall's, but further north in the ravine of McKee's run.

On the Samuel Hoffer farm about one mile north of Zufall's, limestone is found *overlying* the sandstone last mentioned. Possibly it represents a *fourth deposit intermediate* between *the top* and *middle layers* of the Smith section above given. In the absence of all dips the question cannot be decided positively.

The Hoffer limestone is quarried again on the Thos. Peifer farm in the Paradise settlement. It yields good stone at both places.

In the ravine of Stump creek Lower Barren strata are the surface rocks, throughout nearly its entire length. Recently this region obtained some notoriety among landowners through operations there for oil. A well was sunk on the left or east bank of the creek above Kramer's (?) mill, and oil was reported to have been found at a depth of about 1,500 feet below the surface, or about 1,350 feet below the Freeport upper coal bed. It seems indeed that some little oil was discovered but hardly enough to justify the reports that circulated freely for a time respecting the

yield of the well. In the end, after a depth of nearly 1,700 feet had been reached, the tools were drawn, and the well was abandoned.

§ 141. On the hillside directly opposite the well the following strata were observed in the roadside. If my interpretation of the geology of this region be correct, these strata succeed in descending order the lowest limestone deposit of the Smith section:

*Stump Creek section.*

| | | | |
|---|---|---|---|
| ***Red Shale***, | 5′ | 0″ | |
| Shales, olive, | 20′ | 0″ | |
| ***Red Clay Shale***, | 1′ | 0″ | |
| Shales and thin S. S., olive, | 20′ | 0″ | |
| Concealed, (shales?) | 15′ | 0″ | |
| ***Red Shales***, | 2′ | 0″ | |
| Shales, olive, | 20′ | 0″ | |
| Sandstone, olive, thin-bedded, | 20′ | 0″ | |
| ***Red clay shales***, | 1′ | 0″ | |
| Sandstone, | 20′ | 0″ | |
| Interval to creek, | 8 | 0″ | |
| Interval to ***Freeport upper coal***, | 25′ | 0″ | estimated. |
| | 157′ | 0″ | |

These same rocks continue down the valley, on both sides, nearly to the mouth of the creek, a short distance above which the Freeport upper coal rises to daylight. It is nowhere exposed in that locality, but at Anthony's mill, in the valley of Mahoning creek, near the county line, the bed is reported 3 feet thick. It is roofed by the Mahoning sandstone. Other coal beds of the Lower Productive series are reported at the same place but only their outcrops were seen. The valley is a wilderness from Anthony's mill to the mouth of Stump creek.

## Chapter III.

*Containing detailed geology of Beaver, Clover, Rose, Knox and Winslow Townships.*

### *Beaver township.*

§ 142. This township is north of Ringgold and south of Clover. On the west is Clarion county.

Little Sandy creek flows west along its southern boundary line from end to end. Red Bank creek, flowing south, traverses its western side. The two streams unite just beyond the Jefferson border. Both occupy deep, wide and rugged valleys. The central part of the township and the eastern part consist of high land, much diversified by small ravines, but containing summits which range from 400 to 450 feet above the bed of Red Bank creek. These uplands have for the most part been cleared of their timber and brought under the plow; their soil in some cases well repays cultivation, but generally the surface is rugged from the presence of heavy sandstone deposits.

§ 143. The *Brookville anticlinal* pursues a straight course northeast through the western part of the township, following, indeed, closely, for much of the distance, the line of Red Bank creek. Hence the lowest rocks, in a geological sense as well as topographically, exposed in the township are in that valley. The axial line leaves the creek in the bend below Heathville, and next crosses Beaver run about a mile above its mouth; thence it passes through the southeast corner of Clover township.

§ 144. The *Leechburg synclinal* extends northeast from Worthville; it therefore touches only the extreme southeast corner of Beaver township, in which region the *Freeport upper coal bed* is caught in a single hilltop that marks very closely the center of the trough. It is evident then that the prevailing dip of the rocks throughout the town-

ship is southeast, or, in other words, there is a steady accumulation of strata from the line of Red Bank creek towards the southeast end of the township. Only west of the anticlinal and east of the synclinal do the strata incline northwest. How small comparatively is that territory in Beaver township the reader will see at a glance by referring to the map.

*The average dip* is about 2°. It is shallowest of course at Worthville, being there indeed little more than ½°; and steepest along Red Bank creek, close to the center of the anticlinal arch, from which the strata incline, in places, at angles of 5° and more. There are no subordinate flexures in the township so far as could be detected, and no faults.

§ 145. *The outcropping rocks* comprise the *Lower Productive Coal Measures*, and the *Pottsville Conglomerate* series. Of the former, as has already been explained, the entire group is contained in the hills overlooking Worthville, but only in that one locality, as west from thence the uplands are covered chiefly by the *Kittanning* and *Clarion groups*, brought thither by the rapid rise of the strata. The geological map will show sufficiently how the uplands are fringed by the outcrop line of the *Ferriferous limestone;* at what localities that rock is opened and worked will be explained hereafter.

§ 146. All of the Conglomerate strata come to daylight in the valley of Red Bank creek. The sandstone layers comprising the series, are nearly all massive and compact. They make a wilderness along Little Sandy creek from Worthville to its mouth ; and they make a similar wilderness of the Red Bank valley in Beaver township, from the water's edge to the top of the slopes. Beaver run flows in these strata and over them for more than two miles above its mouth. So does Tar run very nearly from its starting place.

Although exposed over so great a stretch of country, the exposures are too incomplete to enable a section to be constructed from them, showing the various component layers of the group. It is clearly evident however that the *Homewood sandstone* at the top of the series is a continuously massive rock, from which most of the huge bowlders and

fragments have emanated that now so abundantly cover the slopes and render them a barren waste. What is the thickness here of this deposit cannot be exactly stated, but so far as may be judged from the imperfect exposures, it may be reckoned as between 50 and 75 feet.

§ 147. The exposures of the *Lower Productive Measures* are, with the exception of some of the principal coal beds and limestone strata, little better than in the other case. So far as the leading features of the section are concerned they are all present, while the intervals separating them are the same here as those which generally apply throughout the county. The *Brookville coal bed* attains workable thickness in Beaver township over all its outcrop area, and is one of the principal sources of fuel supply there. *The Clarion coal bed* is everywhere unimportant. *The Kittanning lower* is universally a workable seam, but small. *The Kittanning middle* and *Kittanning upper* are both obscure. *The Freeport lower seam* is exceptionally small. *The Freeport upper* has not been exposed.

Of the *limestone strata* of this series all are present. The localities at which they outcrop are noted elsewhere in the detailed description. That detailed description first follows the Little Sandy Valley from east to west, and next treats of the Red Bank region.

§ 148. Where the Little Sandy creek crosses from Oliver township into Beaver its side hills are built up of Lower Productive strata, extending from the horizon of the *Freeport lower coal bed* at the summits, to the horizon of the *Ferriferous limestone* at the water's edge. There are no exposures at the township line. The outcrop of the Ferriferous limestone is marked by an extensive swamp, which stretches north from the township road across the bottom lands. Dipping northwest the limestone horizon soon disappears under the creek bed. At Worthville, less than a mile west of the Oliver township line, it is 25 feet below, thus bringing the *Kittanning lower coal* nearly to the creek level. The latter seam is well exposed in some pits north of the village.

§ 149. The road which leads northward, up the hill, from Worthville, contains some of the best exposures found in this

neighborhood. The following section was obtained along it in descending from the hilltops to the water level at the village:

*Worthville Section.*

| | | |
|---|---|---|
| *Freeport upper coal,* | | not seen. |
| *Freeport upper limestone,* | | 15′ 0″+ |
| Shales, clay, variegated, | | 30′ 0″ |
| Sandstone, | | 10′ 0″ |
| *Freeport lower coal,* | 2′ 0″— | 2′ 4″ |
| *Freeport lower limestone,* | | ? |
| Sandstone, | | 15′ 0″ |
| Interval, | | 30′ 0″ |
| *Johnstown cement limestone,* | | 2′ 0″+ |
| Interval, | | 135′ 0″ |
| Shales, | | 30′ 0″ |
| *Kittanning lower coal,* | | 2′ 8″ |
| Interval, | | 30′ 0″ |
| Creek level at Worthville, | | — |
| Total thickness, | | 302′ 0″ |

§ 150. *The Freeport upper coal* escaped detection. Its horizon is contained in a single knob, which stands between Wm. McNutt's house and Alcorn's about a mile north of Worthville. The presumption is that the bed is small and of no importance.

The *Freeport upper limestone* is one of the conspicuous features in the geology of these uplands. It tops all of the highest knobs along the synclinal. Thus it is found at D. Buck's, about a mile north of the village, and at E. Jones', one quarter of a mile still further north. It also outcrops in the road between those two points. It is composed of layers of different color and composition; some of them are grayish and very sandy; others are light blue and of good quality. The aggregate thickness of the deposit is not less than 15 feet and may be more.

The *Freeport lower bed* is opened on the Buck farm, and also by Jones, being at both places a small and irregular seam, roofed by sandstone. The coal however is good. In the Jones mine, which stands in a field east of the road and near the top of the hill, the bed is 2′ 4″ thick, without persistent slate partings and without binders of iron pyrites. The coal is hard and compact.

The *Freeport lower limestone* was seen only at one locality—in the roadside, where this rises over a small hillock north of Mr. Jones' tenant house. Neither the thickness of the deposit, nor its condition for the kiln, could be satisfactorily determined. To all appearances the rock is similar to the Freeport upper stratum.

Of the *Freeport sandstone* only a fragment shows. It may be observed in the roadside at the bend near the top of the hill overlooking Worthville. It shows as a narrow ledge, made of fine grained thin bedded sandstone.

§ 151. The *Johnstown cement* outcrops near by. The rock has only been partially uncovered in the excavations that have there been made in the side of the road. It is an impure limestone, earthy and siliceous. Its color is dark gray.

Beneath this limestone the strata are wholly concealed down to the roof shales of the *Kittanning lower coal bed.* Mention has already been made of the persistency of these shales towards the west, on both sides of the creek, and how conspicuous a feature they are there*. The Kittanning lower coal bed is mined by Mr. D. Geist close to the Worthville bridge, and again by Mr. J. Wagner a short distance further east on the same hillside. A section of these mines has already been given.

From the Worthville bridge westward down the creek, the rocks sink slowly until the outcrop line of the Kittanning lower coal is nearly at water level at Richards' house, about one eighth of a mile below the village. Here the synclinal crosses. The dip speedily changes from northwest to southeast, and sharpening rapidly in that direction, the strata quickly assume higher altitudes as the valley is descended. At the mouth of a small run, near which is Geist's grist-mill, the *Ferriferous limestone* has already risen to daylight. At the mouth of Ferguson run the *Homewood sandstone* is above the stream bed.

§ 152. The surface rocks along *Ferguson run*, as well as along its main branch *Reitz run*, are mainly those of the *Lower Productive Coal Measures.*

At the head of the run close to the Methodist Church,

*See § 93 p 47.

north of Worthville the *Freeport sandstone* crowns the uplands, being massive and fine grained. So it is at the top of a hill on the Wm. Gumbert farm, in the narrow peninsula between Reitz run and Ferguson run. The same farm extends also to the water level of the latter stream, near which, at this place, the *Ferriferous limestone* was at one time quarried with good results, but the quarry is not now operated. It is a grayish rock, abundant in fossils, and makes excellent lime. *The Kittanning lower coal bed*, 50 feet above the limestone, was also opened up by Mr. Gumbert, but the mine like the quarry, has been abandoned.

The outcrop lines of these strata are easily traced southward along either slope of the ravine. At the mouth of Reitz run the Homewood sandstone is added to the section, whence to the Little Sandy it closely skirts the water line.

In the ravine of Reitz run the following section was obtained of the *Clarion group of strata*:

| | | |
|---|---|---|
| Buhrstone iron ore, | 0′ | 2′ |
| *Ferriferous limestone*, | 4′ | 6″ |
| Interval, | 55′ | 0″ |
| Slates, | 10′ | 0″ |
| *Brookville coal bed*, | 4′ | 10″ |
| Clay, | | — |
| *Homewood Sandstone*, | | — |

*The Ferriferous limestone* is well exposed on the D. Reitz farm, having there been opened on both sides of the stream. Its appearance is identical with that at Gumbert's, already mentioned. The Buhrstone ore is an irregular layer, directly overlying the limestone, and ranging from a thin streak to 6 inches thick in places. The average thickness is expressed in the section.

Of the *Clarion coal bed* nothing was seen anywhere in this neighborhood. *The Brookville coal bed* is mined on the M. Hetrick property, next north of Reitz, where the following section of it was measured:

*Fig. 23, § 152.*

| | | |
|---|---|---|
| Coal, | 0′ 6″ | |
| Slate, | 0′ 1½″ | 4′ 10½″ |
| Coal, | 4′ 1′—4′ 3″ | |
| Clay, | | — |

Much of the bed yields slaty coal, especially the lower part. None of it is first class coal, but all of it is suitable for domestic purposes in the country round about, and for burning limestone.

§ 153. Crossing the hill at Hetrick's into the next ravine to the west, we find that the summit is made by the sandstone stratum which overlies the Kittanning lower coal. The rock is abundantly shown by bowlders on the surface.

*The Kittanning lower coal* is not exposed. *The Ferriferous limestone* was once investigated on the farm of Mr. E. Updegrave, by whom it is reported to be 7 feet thick in places, and to carry one foot of Buhrstone ore on top. The old pits upon it are now closed. *The Brookville coal bed* has likewise been opened. In some of the pits it shows a section similar to Hetrick's, but in an opening recently made it develops a thickness of 7 feet, which however is abnormal. Four and a half feet is the average for the Brookville seam in Beaver township.

§ 154. The outcrop line of the *Ferriferous limestone* after crossing the township road at Updegrave's, runs thence south (keeping west of the road) through the Boyer farm and through Brocius', at which latter place it turns sharply westward, to curve then around the hill, and run in a northerly direction towards the Zion church. Where the main line turns at Brocius' there is a small detached area, lying south of it, on the Lang farm. It has been opened at nearly all of the places named, showing as a rule about 5 feet thick, brownish in color, richly fossiliferous, and in good condition for quarry lime. A small draw kiln was erected on the Lang farm, for the purpose of utilizing the rock, but recently it has fallen into disuse.

The *Kittanning lower coal* is 50 above the limestone. It was once opened in the Lang property. It is 3 feet thick.

The *Brookville bed* being the larger seam is here the main source of the coal supply. It has been explored on the Boyer farm and at E. Thomas' near the Zion church, being 4 feet thick at the first named place, and at the latter 5 feet. It is invariably about 70 feet below the Ferriferous limestone.

In descending the hill to the village of Langville the *Homewood Sandstone* is crossed at a point more than 100 feet above the level of the creek. The rock is very massive and heavy; it breaks up into large blocks, of which abundant masses are seen on the slopes in the vicinity of the village. So abundant indeed are these fragments that below Langville the surface is too rough for cultivation, and the region is a waste. All the strata of the Pottsville Conglomerate series rise to daylight between Langville and the mouth of the Little Sandy.

§ 155. The same conglomerate strata occupy both sides of the *Red Bank valley* in Beaver township, so that the same wilderness condition of the surface prevails there that is found along the lower part of the Little Sandy. The *Homewood Sandstone* is the principal stratum of the group and the one from which most of the bowlders have detached themselves, that now so abundantly cover the slopes from the mouth of the Little Sandy northward nearly to Troy in Clover township.

In a railroad cut at Patton's station, close to the Jefferson–Armstrong line, there is a small exposure of red clay shale, without fossils, and only a few feet thick. By a direct measurement it is 220 feet below the top of the Homewood sandstone, and it therefore is most probably a part of the Pottsville Conglomerate series. It may however represent the Mauch Chunk shales; but it is only of local occurrence, not having been detected elsewhere, either in the exposures to the west in Armstrong and Clarion counties, or towards the north in Jefferson county.

The *Homewood sandstone* is at the top of the slopes overlooking Red Bank creek. A good opportunity for observing it is obtained along the road which leads up the ravine of Tar run, in which the rock is very massive, and about 60 feet thick. Its top touches the water level of Tar run at the forks of the road, close to D. Byerly's house.

§ 156. A shallow coal measure covering comes in on top of it and overspreads the uplands. The *Ferriferous limestone* is above water level almost to the heads of the run. For the convenience of those interested in tracing it through the re-

gion, it may be stated that after crossing the road north of the Zion church, it runs through Mr. R. Dingler's fields, bending there to extend up a small ravine nearly to the Pleasantville road at S. Schäfer's, whose house however is above it; next it runs through the Barkhouse property, and next through Oxenrider's, passing above the latter's house, near which it has been opened; beyond this place it bends in graceful curves around the hill into the Tar run ravine, first passing close to Mr. D. Spare's house, and next between Thomas' and Funk's. It crosses the Pleasantville road above the Byerly school house, at which place it is again exposed in good condition and five feet thick. Along the north bank of the run the rock is obscure. Its horizon passes close to Mr. J. F. Hawthorn's house; crosses next the Pleasantville road, at Mr. B. Sowers' house, where explorations to discover the rock have so far been unsuccessful. It is absent too at Gumbert's, next north of Sower's, where the outcrop line bending sharply round upon itself runs in an easterly direction into the Beaver run ravine, up which it extends to the headsprings of that stream. Pleasantville, therefore, while in the coal measures is below the Ferriferous limestone. An outlying patch of the latter rock is found on the farm of Mr. P. R. Reitz, west of Pleasantville.

§ 157. The *Clarion coal bed* is only about one foot thick in this region. It was opened by Mr. Geo. Gumbert, near his house, south of Pleasantville. It is 30 feet below the Ferriferous limestone.

The *Brookville coal bed* is here from 30 to 40 feet below the Clarion. The seam is everywhere 4 feet thick, and in some places considerably more than that. The coal generally is poor. In some of the banks its ashy condition is ruinous to it; moreover the roof is often leaky.

The bed has been opened on the Sowers farm, and also at the roadside west of the Byerly school house.

The *Kittanning lower coal* is also opened near to the latter locality. It is only two feet thick; its roof is massive sandstone.

§ 158. *Beaver run* drains the northern part of the town-

ship. Its ravine which is a deep cut, is occupied by Conglomerate rocks as far east as Baughman's saw-mill, at which place the *Homewood sandstone* disappears beneath the water level. A thin covering of coal measure strata occupies the uplands. No higher horizon than that of the *Kittanning middle coal* is anywhere reached along this run in Beaver township.

The *Kittanning lower coal bed* was once opened on the C. Brocius lands, close to the Rose township line. The bed is reported to have shown 3 feet of coal. It is not now worked.

The *Ferriferous limestone* is exposed on the same property. It is overlaid by a small and irregular layer of iron ore representing the *Buhrstone deposit*, which however is of no value here. The limestone is in good condition.

The *Brookville coal bed* has been explored at the level of the township road below Mr. Brocius' house. It is 4 feet thick, but the bank being now closed, the condition of the coal was not ascertained. The bed is at this place 95 feet below the Ferriferous limestone, instead of 65 feet which is the interval between them south of Beaver run.

§ 159. Transferring the attention now to the west side of the Red Bank creek in Beaver township we find the surface rocks the same there as in the region last described: Conglomerate strata make the valleys and ravines, and the Coal Measure rocks, to the horizon of the Kittanning lower coal, make the uplands.

As before explained the rocks west of the Red Bank creek in Beaver township dip towards the northwest. The road leading northwest from Patton's Station up a small nameless ravine affords some partial exposures of the Conglomerate strata. A small stratum of iron ore was observed about 150 feet above the creek.

The *Ferriferons limestone* is reached on the Wm. Smith farm, close to the Clarion county line and near the top of the hill. The rock is here about 5 feet thick. Thence its outcrop line runs north, being next opened on the James Smith farm close to Clover township. It is in good condition for quarry lime at both places. There is an isolated knob of the rock, of considerable size at J. W. Matter's above

Patton's, at whose place also the Brookville coal was once explored, but neither stratum is now exposed there.

*Clover township.*

§ 160. This township adjoins Clarion county north of Beaver township and south of Union. It is a nearly square block, of which the surface area is about 17¼ square miles.

*The surface* generally is hilly. Red Bank creek flows from northeast to southwest through a deep and irregular valley, into which the drainage pours from all parts of the township. North of the creek there is a succession of small tributaries flowing nearly parallel to each other, and which, cutting deep into the measures, repeatedly expose the same strata in the sides of the different ravines. South of the creek the country is less broken, but not less high. In both cases the summits are about 300 feet above the bed of Red Bank creek, which latter here is about 1160 feet above ocean level.

§ 161. The township is situated almost wholly within the *Fairmount Basin.* Only its southeast and northwest corners lie outside of that trough. The Basin is about five miles wide; has moderately steep dips (3°) on both sides, and very gentle dips (1° and less) along its center line, or lowest part. That center line, which is the line of the *Fairmount synclinal* enters the township near Mr. J. C. Anderson's house, about one mile west-southwest of Troy, and thence runs north of the latter village, crossing Welch run about one half mile above its mouth; it crosses Knapp run close to the forks of the road at M. Dickey's, passing thence through the Shields farm, where its path is marked, as it is also near Troy, by a small hill summit of Mahoning sandstone. From Shields it extends across the heads of Dowlingville run above the Covenanter Church, and passes thence into Union township.

*The Bagdad or Brookville anticlinal,* which is the southeast edge of the Fairmount Basin, enters Clover township from Beaver, at a point nearly due north of Pleasantville. It elevates the *Ferriferous limestone* to the hilltops, as is plainly shown by the geological map. The axial arch passes

close to the crossroads, distant about one mile in an air line from the southeast corner of the township.

*The Anthony's Bend anticlinal* on the northwest side of the basin, only barely touches Clover township. It has sharp dips on both its flanks, but especially on its southeast slope, the effect of which is seen in the areas of Conglomerate strata extending down Welch run, and also down the small nameless run which flows close to the Clarion county border. This axis, like the Bagdad, lifts the *Ferriferous limestone* nearly to the hill tops.

§ 162. *The outcropping rocks* comprise the *Lower Productive Coal Measures*, and a part of the Pottsville Conglomerate series. The first named group is preserved entire only at a few localities along the center of the trough, as has before been mentioned. Generally, the uplands north of the creek terminate with the *Kittanning group*, of which we there find a considerable outspread. The *Freeport Sandstone* is in places a distinctive feature; so also is the *sandstone deposit* overlying the *Kittanning lower coal bed.* The latter coal seam and the *Brookville* are the ones chiefly worked for the coal supply; of these the Kittanning lower is small and of little importance at any place; the other though usually large enough to be mined cheaply, is slaty and poor.

Of the *limestone deposits* little is known aside from the Ferriferous, which is everywhere easily accessible, being above water level over all of the township. It is universally in good condition. The *Buhrstone ore* is small. The Johnstown Cement was not detected.

§ 163. *The Conglomerate strata* occupy the lower stretches of the valleys and ravines. The *Homewood Sandstone* is usually a compact rock, but is less conspicuous here than further south in Beaver township. The *Mercer group* is recognizable, but the exposures are too imperfect to permit of its close examination. The lowest rock exposed in the township is the *Connoquenessing Upper Sandstone.* The following section has been compiled from numerous small sections made in all parts of the township, Fig. 24:

Fig.19. §124.

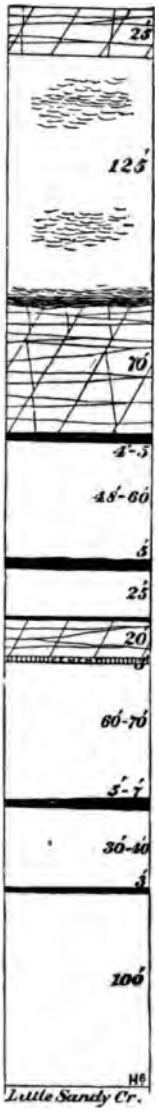


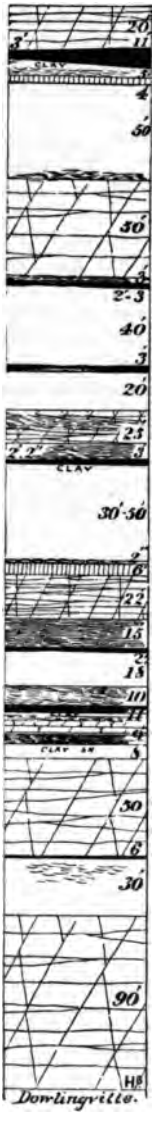

Fig.20. §126.


Fig.21. §130.


Fig.22. §134.


Fig.23. §52.


Fig.24. §163.



*Clover township general section.*

| | | |
|---|---|---|
| Mahoning Sandstone, | | 20′ 0″ |
| *Freeport upper coal,* | 3′ 0″— | 11′ 0″ |
| Shales and clay, | | 5′ 0″ |
| *Limestone, Freeport upper,* | | 4′ 0″ |
| Concealed strata, | | 50′ 0″ |
| Slates, place for *Freeport lower coal,* | | — |
| Sandstone, *Freeport S. S.,* | | 50′ 0″ |
| Slates, | | 3′ 0″ |
| *Kittanning upper coal,* | 2′ 0″— | 3′ 0″ |
| Concealed strata, | | 40′ 0″? |
| *Kittanning middle coal,* | | 3′ 0″? |
| Concealed strata, | | 20′ 0″ |
| Sandstone, massive, interchanging with slates, | | 25′ 0″ |
| *Kittanning lower coal,* | 2′ 2″— | 3′ 0″ |
| Clay, | | ? |
| Concealed strata, | 30′ 0″— | 50′ 0″ |
| Iron ore, Buhrstone ore, | | 0′ 2″ |
| *Ferriferous limestone,* | | 6′ 0″ |
| Sandstones, thin bedded, | | 22′ 0″ |
| Slates, | | 15′ 0″ |
| *Clarion coal,* | | 2′ 0″ |
| Concealed strata, | | 18′ 0″ |
| Slates and shales, | | 10′ 0″ |
| *Brookville coal,* | | 4′ 0″ |
| Clay, | | 2′ 0″ |
| Slates and shaly S. S., | | 5′ 0″ |
| Sandstone, | | 8′ 0″ |
| Slate and bony coal, | | 1′ 0″ |
| Slates, | | 5′ 0″ |
| Clay shales, ferruginous, | | 8′ 0″ |
| Sandstone, *Homewood Sandstone,* | | 50′ 0″ |
| Coal, *Mercer* | | 0′ 6″ |
| Shales and concealed, | | 30′ 0″ |
| Sandstone, *Connoquenessing upper,* | | 90′ 0″ |
| Water level at Dowlingville, | | — |
| Total thickness of rocks, | | 558′ 8″ |

§ 164. *At Troy* the *Homewood Sandstone* is at water level, portions of it being seen in the abutment of the bridge which there spans Red Bank creek. The shales overlying it, and extending thence to the *Brookville coal bed* are shown in a railroad cut a few hundred yards east of the station. From Troy, both up and down the creek the strata rise rapidly towards the Bagdad (Brookville) anticlinal, and quickly assume higher elevations. Their progress upward may be observed by following with the eye the outcrop line of the *Homewood Sandstone*, which though not

always distinct as a cliff, can hardly escape detection on one side of the creek or the other. The circuitous course of the creek from Brookville to Fairmount, winding in and about the Bagdad anticlinal, easily confuses the mind of the observer with regard to the structure, until he perceives that the stream after crossing the anticlinal above Dowlingville flows westward to the synclinal, making first a long bend above Troy to indicate its approach towards that line; then by another long bend back again to the anticlinal at Patton's, and then westward again by a third bend to the synclinal at Fairmount. The creek, therefore, from below Brookville to Anthony's Bend (below New Bethlehem in Clarion county) flows in a single basin—the Fairmount trough.

The right bank of the creek below Troy is steep and precipitous, because the dip is northwest into the hill. The *Homewood sandstone* there makes a bluff closely skirting the water's edge. On the opposite side its outcrop line is at the edge of the hills, nearly one half mile back from the creek. Above Troy it makes a rocky point at the mouth of Welch run. At the same place a small coal bed, not more than 6 inches thick, and belonging to the *Mercer group*, outcrops near the level of the road below the sandstone. The underlying strata of the Mercer group, extending to the creek level, are here concealed.

§ 165. *The Brookville coal bed at Troy* is mined only on the property of Mr. J. Smith, in a hill overlooking Red Bank creek, directly above the mouth of Welch run. Its coal though slaty, is yet sufficiently good for the local trade, much of which it supplies. The following section will show the thickness of the bed at this place:

*Fig. 25, § 165.*

| | | | |
|---|---|---|---|
| Slate, | | | — |
| Coal, | 0′ 11″ | | |
| State, | 0′ 1″—0′ 3″ | 3′ 6″ | |
| Coal, | 2′ 4″+ | | |

The dip is 3° to N. W.

The Brookville bed at Troy being between 70 and 80 feet

below the base of the Ferriferous limestone, its horizon is easily located on any of the farms in that region.

*The Clarion coal bed* was not observed at Troy; but with this it will not be said that the bed is there wholly absent, for the exposures are too incomplete to justify that statement. Undoubtedly however the seam is small, as otherwise it could hardly have escaped detection.

§ 166. The outcrop line of the *Ferriferous limestone* is marked by frequent pits and quarries on both sides of the creek. At the village of Troy it is 140 feet above the water level. Its average thickness is 4 feet; its condition at all points is good. At H. K. Carrier's, on the right bank of the creek, directly opposite Troy it is quite extensively quarried for fertilizing purposes; so it is at S. P. Anderson's about one mile below Troy, being there in prime condition, and supporting the Buhrstone ore, one foot thick. This thickness however of the ore stratum does not hold when traced eastward, for at Carrier's quarry, and indeed at all of the other pits—at McFarlan's near the mouth of Welch run, and at Smith's near by, its thickness does not exceed two inches.

*The Kittanning lower coal bed* at Troy is 50 feet above the Ferriferous limestone. It is mined at Carrier's (H. K.) in the hill above the quarry, at Mrs. McFarlan's, and at S. P. Anderson's. The bed is everywhere small, and the coal of inferior quality. The following section, made in the McFarlan mine, is typical of the thickness of the seam in this vicinity:

*Fig. 26, § 166.*

| | | |
|---|---|---|
| Slate, | | |
| Coal, | 2′ 0″— | 2′ 6″ |
| Clay, | | |

The hills overlooking Troy from the north rise to a sufficient height to contain the Freeport sandstone, which rock in a shaly condition, caps the hill between the village and the mouth of Welch run; southeast of Troy, in the bend, the rocks of the Kittanning group crown the highest summits.

The only good exposure of the *Kittanning middle coal* is

on the S. P. Anderson property, before mentioned. It was there once opened on the hillside south of Mr. Anderson's house. It is exactly 50 feet above the Kittanning lower seam, which latter outcrops at the roadside, on the same hill. The Kittanning middle bed is 2′ 6″ thick.

§ 167. The road leading west from near this place, up a small ravine through the farm of Mr. J. C. Anderson, at the Clarion county line, has some few partial exposures but none of special interest until near the top of the hill, where the Freeport group is caught with a coping of Mahoning sandstone. This is at the center of the basin. The *Freeport upper limestone* outcrops in the road directly in front of Mr. Anderson's house. Its thickness is not fully exhibited, but there is clearly as much as four feet of rock. The *Freeport upper coal* appears a few feet above it, resting upon clay shales. In the woods south of Mr. Anderson's house is an old opening upon the seam, now fallen shut. It is reported to have found the bed in a rolling and irregular condition. At the outcrop eleven feet of coal in one bench, are said to have been exposed, which thickness however under cover of heavy sandstone, quickly diminished to 3 feet; the bed subsequently regained a thickness of 6 feet, and then diminished again. This is the only opening ever made upon the Freeport upper coal in Clover township. At those other localities, presently to be mentioned, at which the bed was caught in the hills, it is undoubtedly of small importance.

§ 168. In the ravines north of the creek so similiar is the geology to that above described, that in treating of that region it is only necessary briefly to indicate the structure, and to point out at what places the strata may be seen.

The small nameless run which follows closely the Clarion county line descends through a deep cut. At its mouth is the synclinal; at its head the anticlinal; the strata therefore rise rapidly up the stream.

*The Ferriferous limestone* is exposed in a spring on the hillside north of the run's mouth. It is about 80 feet above the level of Red Bank creek. There are no exposures either of the Brookville or Clarion coal. *The Kittanning lower*

*coal* is opened close to the roadside on the J. Vandervert property. At Jno. McLaughlin's one half mile further north, the same bed is 70 feet higher, showing thus an incline of about 2° in the strata. *The Homewood sandstone* rises above the run at McLaughlin's, and at D. C. Simpson's beyond the cross roads, a trifle more than a mile north of McLaughlin's, it is above the level of the road. This is a rise of more than 200 feet in that distance.

The sandstone deposit is abundantly exposed throughout all this stretch of its outcrop. At Simpson's it makes a rocky point over which the road passes; it is well shown also further south at Porter's; it is above water level nearly to the J. Lucas farm at the head of the run.

The Ferriferous limestone, which is below the road at McLaughlin's rises above it at J. Love's, near whose house it passes. Thence it runs almost due east to J. Ross' in the ravine of Welch run. The Porter farm and the R. Fitzsimmons property do not contain it; but it comes in again at the extreme hilltop on the D. C. Simpson farm, at which place it has been exposed. Its horizon crosses the Corsica road near Mr. J. Lucas' house, but the rock itself is there absent from the measures. *The Kittanning lower coal* is opened three feet thick at the roadside, north of Mr. Lucas', dipping northwest, which shows that the anticlinal runs through the property. The same dip brings higher strata into the hills between Lucas' and Corsica.

§ 169. Where *Welch run* crosses from Union township into Clover the *Homewood sandstone* is just above water level. It is this rock that shows so abundantly not only at the forks of the run above the school house, but below the latter as far as the G. A. Carrier's farm. An exposure of the rock in place is seen in the road at J. Ross'.

*The Brookville coal bed* is exposed in the woods east of Mr. Ross' house. Its condition here is much the same as at Troy, as will be seen from the following measurement:

| | | | |
|---|---|---|---|
| Slate, | | | |
| Coal, | 0′ 8″ | | |
| Slate, | 0′ 3″ | 3′ | 0″ |
| Coal, | 2′ 1″ | | |
| Clay, | | | |

The *Ferriferous limestone* outcrops on the same hill, 85 feet above; it also outcrops near Mr. Ross' house. Above it at the last place the hill rises in a succession of beautiful benches, the intervals between which suggest the different coal beds of the Lower Productive group, as high as the *Kittanning upper*. The latter indeed has been opened near the top of the hill, two feet thick. The *Freeport sandstone* overlies it.

§ 170. On the G. A. Carrier farm, one half mile south of Ross' the following section was obtained:

*Carrier Section.*

| | | |
|---|---|---|
| Sandstone and sandy shales, *Freeport S. S.*, | 50′ | 0″ |
| Slate, coal outcrop? *Kittanning upper*, | | — |
| Interval, | 40′ | 0″ |
| Coal outcrop? *Kittanning middle*, | | — |
| Interval, | 70′ | 0″ |
| Coal, *Kittanning lower*, | 2′ | 6″ |
| Interval, | 50′ | 0″ |
| *Ferriferous limestone*, | 6′ | 0″ |
| Interval, | 37′ | 0″ |
| Coal, *Clarion*, 2′ 0″— | 2′ | 6″ |
| Interval, | 28′ | 0″ |
| Coal, *Brookville*, | 4′ | 0″ |
| Interval to run level, | 70′ | 0″ |
| | 360′ | 0″ |

The old opening in the Brookville bed, southeast of the dwelling house is now closed. The Clarion seam was once opened near by, and again on the opposite side of the run near the house. The *Ferriferous limestone* is well exposed in a quarry on the west bank of the run. The *Kittanning lower coal* was opened at the foot of the next bench above.

The top rocks in the above section were observed along the slope of the hill west of the house. Crossing that hill, and descending into a small ravine which leads through the J. Guthrie farm, we find there the Ferriferous limestone with a small band of Buhrstone ore on top, exposed in a spring close to the level of the run. The *Kittanning lower coal*, 26 inches thick, is thirty feet above it.

The same coal is also opened near J. Broscius' dwelling house further south. Southeast of this a high hill contains

the *Freeport upper coal.* The hill stands at the center of the basin, and is one of the commanding features in the topography of the region.

§ 171. *Knapp run* joins Red Bank creek below Dowlingville. It has southeast dips along it from the Union township line to the forks of the road at Kelso's, whence to its mouth the strata dip northwest.

The following section, obtained on the W. E. Kelso farm at the center of the basin will show what strata are there caught in the hills:

*Kelso Section.*

| | | |
|---|---|---|
| Summit of high knob east of Kelso's house, | | — |
| Concealed strata, | 40′ | 0″ |
| Slates, (and coal bed?) | | — |
| Concealed strata, | 40′ | 0′ |
| Coal bed? *Freeport lower,* | | — |
| Concealed strata, | 45′ | 0″ |
| Sandstone, Freeport, | | — |
| Coal? *Kittanning upper,* | | — |
| Concealed strata, | 100′ | 0″ |
| Coal bed, *Kittanning lower,* | 3′ | 0″ |
| Concealed strata, | 28′ | 0″ |
| *Ferriferous limestone,* | | — |
| Concealed strata, | 30′ | 0″ |
| Coal bed, *Clarion,* | | — |
| Concealed strata, | 20′ | 0″ |
| Slates, | 10′ | 0″ |
| Coal bed, *Brookville,* | 5′ | 0″ |
| Concealed strata, | 30′ | 0″ |
| Run level, | | — |
| Total thickness of rocks, | 351′ | 0″ |

§ 172. Few developments have been made upon the strata along Knapp run. The Freeport group is contained only in the hill upon which the section was leveled, east of Mr. Kelso's house. Of the condition of the Kittanning group only that of the Kittanning lower coal bed is known. It is this seam which is opened in Mr. Kelso's fields, and again further east at S. Shields in the ravine of Dowlingville run; also still further east on the property of J. Morrison near the Rose township line. It never exceeds 3 feet in thickness, but yields fairly good coal at all places. Black slates are its roof, above which is a deposit of heavy sandstone, not

more than 15 feet thick, but nevertheless as conspicuous a feature in the surface geology as that of any other stratum in the region.

The outcrop line of the *Ferriferous limestone* makes a long narrow projection on the flat between Knapp run and Dowlingville run. It is above water level nearly to the head of Knapp run, but no exposure of it was observed in descending the ravine until the Kelso property was reached. The road leading from Knapp run to Dowlingville run crosses it east of Jno. Shields' house. It is opened both on the Corbett farm, and on that of Mr. S. Shields, being six feet thick and supporting the Burhstone ore, which latter is from 2 to 4 inches thick. It extends up Dowlingville run to the A. J. Sowers farm before passing under water level; it runs through the J. Morrison property where it is exposed again near the roadside, and next curves around the head of a small ravine northeast of the U. P. Church, and so passes out of Clover into Rose township.

The *Clarion coal* is small, being in many cases only a few inches thick.

The *Brookville coal bed*, though repeatedly opened at different places in this neighborhood, is now nowhere worked. Those who have made the investigations all agree in the statement that the coal is so slaty and pyritous that the attempts to mine it were abandoned in favor of the Kittanning lower bed, which though smaller than the other, yields vastly better coal. The Brookville seam is reported to be 4 and 5 feet thick in all the mines that were opened upon it, namely at Shields', at Kelso's, and at R. Magill's. It should be here stated, however, that the outcrop of the seam in the Greenville road at M. Dickey's showed only 2 feet thick.

The *Homewood sandstone* rises above the bed of Knapp run at Dickey's being there partially exposed. The road leading through the Dowlingville ravine to Dowlingville crosses the deposit below S. Shields' house. The surface is abundantly strewn with fragments of rock. The *Mercer group* is recognizable below it in some dark shales, but no good measurements are possible. The village of Dowlingville is at the horizon of the *Connoquenessing upper sand-*

*stone*, portions of which are shown in the railroad cuts opposite.

§ 173. The region south of Dowlingville in Clover township is occupied by the same strata as those above described. The dip is northwest.

In ascending *Rattlesnake run* the top of the *Homewood sandstone* is crossed near the house of Mr. M. Knapp, jr., 150 feet above Dowlingville. The uplands here are only high enough to contain the Kittanning lower coal bed.

The *Ferriferous limestone* covers an irregular area situated between Rattlesnake run on the north, the Rose township line on the east, Red Band creek on the west and Beaver run on the south. The geological map shows the outlines of this area. The rock is well exposed at J. Lehman's, at George Burne's and at W. McAninch's. It is 5 feet thick, grayish in color, and fossiliferous; some portions of the deposit, especially at Lehman's, are very ferruginous.

The *Kittanning lower coal*, which has been opened on the Burne property is 2′ 2″ thick.

### *Rose township.*

§ 174. This is a long narrow area enclosed between Eldred township on the north, Pine Creek and Knox townships on the east, Oliver township on the south, and Beaver, Clover and Union townships on the west.

It is a broken, hilly region traversed by numerous deep and rugged valleys. Red Bank creek flows across it from east to west, dividing it into two nearly equal parts; the North Fork skirts its eastern side north of Red Bank creek, in a ravine as deep and as broad as that of the latter stream; Five-mile run descends along its eastern border south of the creek; Beaver run starts in the highlands at Bellview; and Coder run, coming from the west, diversifies the topography west of Brookville with great variety of hill and valley surface. The drainage of all of Rose township flows into Red Bank creek.

The highest summits, the topographical outline of which in many cases is indicated on the geological map by the isolated areas of Ferriferous limestone, attain an elevation

of about 400 feet above the bed of Red Bank creek, or about 1600 feet above the ocean level.

§ 175. *The Bagdad (or Brookville) anticlinal* crosses the township in a straight line extending from a point on Red Bank creek close to the western border, to a point on the North Fork at the northeast corner of the township. As nearly as its arch can be located, it enters Rose township from Clover about one half mile south from Red Bank creek, which latter stream it crosses about one half mile east of the Clover township line; crosses Coder run above the forks; crosses the Corsica road east of the toll-gate; passes directly west of Brookville; extends through the Matson property, and crosses the North Fork near where Rose township corners with Eldred and Pine creek.

The effect of this important fold upon the geology of Red Bank valley has already been described in connection with Beaver township, where the country is a wilderness for miles in consequence of it. Precisely the same effect is produced between Brookville and Dowlingville, that region being a hopeless wilderness rugged from the outcrop of the Conglomerate strata; the North Fork valley is in the same condition; and so are the lower stretches of the ravine of Coder run from where it enters Rose township to its mouth at Puckerty.

As measured by the Ferriferous limestone the total hoist in the rocks from this fold is about 250 feet. This shows an average dip of 2° along its western flank from the center of the arch to the center of the synclinal.

The eastern flank of the axis extends over the southern part of Rose township, which has rather more gentle dips than has the opposite side of the arch. Moreover there is a subordinate but very weak flexure passing through the region of Bellview, and reversing the dips there over a narrow space. This latter flexure is much too feeble to be traced either towards the northeast or southwest. Very likely it is a local occurrence, confined to a small territory.

§ 176. *The Worthville (Leechburg) synclinal* of Little Sandy creek touches only the southeast corner of the township. It brings the *Freeport lower coal bed* into the hills,

this being the highest stratum of the geological series contained in Rose township.

§ 177. The area which this *Freeport lower coal* overspreads in Rose township embraces only a few acres. Generally speaking the Kittanning group covers the uplands south from the creek; north of it, in the region of the anticlinal these rocks give place to the Clarion group, the Ferriferous limestone being there represented only in occasional high knobs.

§ 178. The valleys, as before stated, contain the *Conglomerate strata*, of which along Red Bank there are 200 feet exposed extending to the base of the *Connoquenessing Upper Sandstone.* The entire section, as nearly as it can be generalized to represent the average, is as follows: Fig. 27.

*Rose township general section.*

| | | |
|---|---|---|
| Shales, | | 30′ 0″ |
| Coal bed, *Freeport lower*, | | 5′ 0″ |
| Clay, | | — |
| Sandstone, *Freeport S. S.*, | | 40′ 0″± |
| Coal bed, *Kittanning upper*, | | small. |
| *Johnstown Cement*, | | 3′ 0″ |
| Sandstone, | | 10′ 0″ |
| Concealed strata, | | 35′ 0″ |
| Coal bed, *Kittanning middle*, | | 3′ 0″? |
| Concealed strata, | | 30′ 0″ |
| Shales, | | 20′ 0″ |
| Coal bed, *Kittanning lower*, | 2′ 0″— | 3′ 0″ |
| Concealed strata, | 35′ 0″— | 45′ 0″ |
| Iron ore, *Buhrstone ore*, | | 0′ 2″ |
| *Ferriferous limestone*, | | 5′ 0″ |
| Shales, sandy, and thin S. S., | | 6′ 0″ |
| Shales, ferruginous, | 20′ 0″— | 35′ 0″ |
| Coal bed, *Clarion*, | 0′ 8″— | 2′ 6″ |
| Clay, | | 4′ 0″ |
| Sandstone and shales, | | 30′ 0″ |
| Coal bed, *Brookville*, | 1′ 6″— | 5′ 0″ |
| Shales, | | 6′ 0″ |
| Coal, | | 0′ 6′ |
| Fire-clay, | 6′ 0″— | 11′ 0″ |
| Sandstone, *Homewood S. S.*, | | 75′ 0″ |
| Shales and thin S. S., | | 30′ 0″ |
| Coal, *Mercer Group*, | | 0′ 2″ |
| Fire-clay, | | ? |
| Sandstone, *Connoquenessing upper S. S.*, | | 70′ 0″ |
| Creek level, | | — |
| Total thickness of rocks, | | 504′ 4″ |

§ 179. The detailed geology will be described in the order of the developments from south to north. Beginning with the Bellview region we find that the village is situated at the horizon of the *Kittanning lower coal*, of which seam, however, there are no exposures in that immediate vicinity. The road leading east from that place, through the McGary settlement, leads to the center of the basin, and higher rocks are successively crossed until, on the E. McGary farm at the Knox township line, the *Freeport lower coal* is reached. The bed, where opened close to the hilltop, shows 5 feet of good coal, without partings and without much pyrite. The roof is shale, and being much cracked, percolating waters are admitted through the fissures, thus staining the coal in places but doing it no material damage. The large size of the bed, and the comparative purity of its coal gives it great advantage in a mining sense over the other seams, which are almost wholly neglected in consequence.

The *Freeport Sandstone* shows abundantly in the road and in the fields west of the mine. It is a coarse grained, massive rock, which in weathering breaks up into large fragments.

North from McGary's the country falls away towards Five-mile run, in the direction of which there are few good rock exposures. A coal bed once opened near Mr. C. Boner's house is reported to have measured 4½ feet thick. It may represent the *Kittanning lower seam*, but its place in the series was not satisfactorily determined. The *Ferriferous limestone* is opened at A. McSparren's, being however only partially exposed. An isolated hill containing the same rock is situated on the H. Campbell farm, between McSparren's and the run. Neither the Clarion nor Brookville coal was anywhere seen in this neighborhood. The Homewood Sandstone is partly above the water level.

§ 180. Southwest from McGary's towards the head of Beaver run, the hills are sufficiently high to include the Kittanning group. A prominent summit east of C. Millen's rises perhaps to the horizon of the *Freeport lower coal*, but if so, the Freeport Sandstone has here wholly changed

from its massive condition at McGary's. The *Kittanning middle coal* is opened in Millen's fields, 80 feet above the Ferriferous limestone. It is 4 feet thick in places, but so slaty throughout that the coal is worthless. The *Ferriferous limestone* is partly exposed on the same property, close to an old church east of Mr. Millen's house. The deposit here is sandy, and yields little good stone.

From Millen's the outcrop line of the limestone bears northwest, extending up the little ravines tributary to Beaver run nearly to their headsprings.

Another exposure of the rock was detected on the Jno. Johns property, northwest of Bellview, and another on the farm of Mr. Geo. Ohl still further north. At each of these places it is in good condition.

The *Kittanning lower coal* was once opened at Johns', 45 feet above the Ferriferous limestone. The bed is small.

The *Johnstown cement* makes the top of a high knob, northwest of Mr. Johns' house. The rock has never been fully investigated, but its thickness is clearly as much as 3 feet. It is a compact stone, of a light brown color and without fossils.

§ 181. The *Brookville road* north of Bellview traverses the lowers horizon of the *Lower Productive Coal Measures* until where it descends into the Red Bank valley. The following exposures and outcrops along that road will easily enable the observer to locate himself in the geology at almost any point between Bellview and Brookville.

The *Ferriferous limestone* which is about 50 feet below the road at Bellview, crosses the highway at B. W. Reitz's one half mile north of the village. The road then crosses a narrow ravine in which it descends nearly to the top of the Homewood sandstone. Both the Clarion and Brookville coals are exposed, the first near Mr. Reitz's house, and the other in the road, almost directly opposite Smathers' mill. Ascending the opposite slope of the ravine the road crosses the Ferriferous limestone at H. Allshouse's, being there partially exposed; thence northward for nearly two miles the outcrop line of that rock is east of the road though close to it.

The low hills which skirt the western side of the road contain only the Kittanning group of rocks. At the watering trough south of Mr. M. Hinderleiter's house the *Kittanning lower coal bed* outcrops in a spring. The same bed is mined in a field towards the east. Beyond Mr. Hinderleiter's house the road crosses the horizon of the Ferriferous limestone, but the rock is unexposed. Thence the outcrop line of this stratum runs northwest, and the Brookville road from Hinderleiter's to the Newsome pottery is in the Clarion group of rocks.

§ 182. Following the limestone, it runs through the George McAninch property to R. F. Witherew's at the edge of the Red Bank valley, where turning back it extends up a small ravine to I. Spykear's. An exposure of it at J. R. Witherew's shows it in an impure condition, being both aluminous and siliceous. A separate area of it is contained at M. V. Schafer's and J. N. Hall's further west, where it yields good stone.

At J. R. Witherew's a hill rises to a sufficient height to include the *Kittanning middle coal*, of which there is an outcrop near the summit. The *reported thickness* of the seam is 3 feet, but the pit being closed, no opportunity was afforded to verify the statement. The *Kittanning lower bed* was likewise once opened on the same hill, 50 feet below the other, and 35 feet above the Ferriferous limestone. A measurement of it at this place, as also in the mine on the Carr property further south, gave the following section:

*Fig. 28, § 182.*

| | | |
|---|---|---|
| Slate roof, | | — |
| Bony coal, | | 0′ 1″ |
| Coal, | 2′ 0″— | 3′ 0″ |
| Clay, | | — |

The dip is gentle to southeast.

The *Homewood sandstone* is at the level of the run southwest of Witherew's mine, but makes only a feeble show there. The Brookville coal is unexplored.

§ 183. The best exposure of the latter seam and also of the Clarion, is at the pottery of Messrs. Newsome, Porter

& Co., at the top of the hill above the railroad tunnel. Owing to the presence of heavy sandstone above these coals, and the thin bedded condition of the sandstone deposit below them, it was at first suspected that these seams with their attendant fire-clay, belonged to the Mercer group of strata, thus making the sandstone at the hill top, the Homewood. But subsequent leveling along section lines leading southward to well-recognized horizons not only failed to confirm this suspicion, but showed conclusively that the beds are at the base of the Lower Productive Coal Measures.

The *Brookville* seam is opened at the pottery, for which it supplies the necessary fuel. The coal is both pyritous and slaty, and while suitable for use in the pottery, and for domestic consumption in the country round about, is much too impure for shipment to market, even if the small size of the bed did not otherwise condemn it. Its average thickness is about 3 feet. The roof is massive sandstone and the floor consists of shales, below which is another small coal seam 6 inches thick. The succession here including the fire-clay is as follows:

*Newsome Pottery section.*

| | |
|---|---|
| Sandstone, | — |
| Coal, | 3′ 0″ |
| Shales, | 5′ 10″ |
| Coal, | 0′ 6′ |
| Clay, light colored, | 3′ 0″ |
| Clay, dark colored, | 3′ 0″+ |

§ 184. The clay deposit has long been wrought to make pottery ware for domestic uses in the vicinity. The articles produced are strong and serviceable; many of them indeed, as for example the flower urns in some of the garden fronts at Brookville, display a considerable amount of potter's skill in manipulation besides artistic taste.

The clay deposit is reported to be quite extensive in depth, measuring it is said 15 feet and more. Only 6 feet of clay however are mined for use in the pottery. Its composition is not uniform, some parts of it being more siliceous than others; all of the deposit is, in fact, of a very siliceous character. The following analyses of the clay by Mr. S. A.

Ford were made from specimens forwarded to the laboratory of the survey in 1874 by Mr. Franklin Platt:

| | 1. | 2. | 3. |
|---|---|---|---|
| Silica, | 58.125 | 60.675 | 78.075 |
| Alumina, | 26.500 | 25.915 | 14.440 |
| Protoxide of iron, | 3.234 | 2.210 | 1.590 |
| Bisulphide of iron, | .008 | | |
| Lime, | .078 | .089 | .056 |
| Magnesia, | .555 | .465 | .480 |
| Alkalies, | 2.180 | 1.925 | 1.670 |
| Sulphuric acid, | .058 | trace. | trace. |
| Water and organic matter, | 9.725 | 9.090 | 4.163 |
| | 100.463 | 100.369 | 100.474 |

§ 185. The *Clarion coal bed* is here 25 feet above the Brookville. At the cemetery a short distance south of the pottery, it shows at the top of a slope which there descends under the hill to the horizon of the Brookville coal. The Clarion seam is only 8 inches thick at the outcrop, but increases to 30 inches thick under cover.

The top of the *Homewood sandstone* crosses the road just north of the pottery. As before stated it is here less compact and massive than is usually the case throughout all parts of Jefferson county. On the opposite side of the creek, above Brookville it is rather more conspicuous but still thin bedded. Brookville itself, that is to say its main street, is just below the base of the Homewood sandstone. The rock shows plainly on the steep side slopes back of the town, and especially good exposures of it were observed in the rear of the court-house. From its outcrop face issue numerous brooks and rivulets, from which indeed the town, so abundantly supplied with the best and purest of water, has been appropriately named.

§ 186. The *Mercer group of* strata is recognizable at Brookville, but only indistinctly. The exposures are not good. The small coal seam however, observed at the roadside above the tunnel undoubtedly belongs to this group. So does the fire clay underlying it, which has never been exposed at this place, but which at Fullers Station further east and also at Garrison's has been mined to a large extent. Descriptions of these localities are given elsewhere. The *Connoquenes-*

*sing upper sandstone* is in this vicinity a conspicuous rock. It makes the narrow peninsula pierced by the tunnel east of the Brookville station; it is exposed also in the left bank of the creek above the mouth of the North Fork, but the best exhibition of it is in the cut at Garrison's.

§ 187. The geology of the northern part of Rose township will in general be sufficiently understood from what has already been said of it. In treating of it in detail it will be sufficient to identify some of the principal exposures, from which the local observer, guided by the generalized section, can then readily determine the stratification of the hills by a simple measurement of their height.

Proceeding west from Brookville by the Corsica road the *Homewood Sandstone* is first crossed at the outskirts of the town. The *Brookville coal seam* outcrops at Mr. Braden's house, where it makes a distinct bench, which curves gracefully round the point of the hill towards the southeast. An opening once made upon it here, close to the roadside, revealed only about 18 inches of coal. *The Clarion seam*, 1 foot thick, is exposed at the water trough. The *Ferriferous limestone* is crossed just beyond that place, and the road then rises nearly to the horizon of the *Kittanning lower seam*, which latter coal, indeed, has been opened by Mr. J. Clements in a field to the north, where it is barely more than 2 feet thick. The Ferriferous limestone is at this place contained in a long narrow hill, extending from Mr. K. L. Blood's to R. L. Matson's, being partially exposed at the latter place, as also in the road west of Mr. Clements'.

Continuing west from the latter place along the Corsica road we cross a small ravine—a branch of Coder run—in which the strata below the limestone are well exposed, and next ascend to G. Vasbinder's, on whose property there is a small detached hill containing the Ferriferous limestone, 3 feet thick. The toll-gate is at the horizon of the Clarion coal, which makes an outcrop. On either side of the road just beyond, are small areas of Ferriferous limestone, one on the J. Haugh farm, and the other on that of E. Snyder. Where the road crosses Coder run the Homewood Sand-

stone, in massive condition, shows abundantly at the surface.

Turning now southward, down Coder run the Brookville coal is reported 5 feet thick on the E. Snyder property, where it was once opened in the woods west of the house. It is roofed by sandstone, while below it are indications of the same clay deposit that is mined at the Brookville Pottery.

The sandstone deposit which forms so conspicuous a feature near the water level in the region of Himes' saw-mill is the Homewood. From that point a road leads west into higher strata. The *Ferriferous limestone* may be seen near Mr. Kennedy's house, south of which a high hill contains the *Freeport sandstone* at its summit. An outcrop of coal beneath the sandstone reveals the *Kittanning upper seam.*

Of the Kittanning group there is here a considerable outspread extending southward to the edge of the Red Bank valley. This area indeed is a part of that which has already been described as occupying the eastern border of Clover township, north of Dowlingville.

The *Ferriferous limestone* is quarried both on the McLaughlin and J. S. Magiffin properties below the mouth of Coder run, at each of which places it is 4½ feet thick, while the Buhrstone iron ore, which rests directly on top of it, is 4 inches thick. To show the condition of the ore, an analysis was made of a specimen from the Magiffin quarry with the following results:

| | |
|---|---|
| Protoxide of iron, | 37.607 |
| Sesquioxide of iron, | 3.214 |
| Bisulphide of iron, | .052 |
| Protoxide of manganese, | 1.776 |
| Protoxide of cobalt, | trace. |
| Alumina, | 1.634 |
| Lime, | 6.600 |
| Magnesia, | 2.594 |
| Sulphuric acid, | trace. |
| Phosphoric acid, | .572 |
| Carbonic acid, | 30.791 |
| Water, | 1.350 |
| Insoluble residue, | 13.810 |
| | 100.000 |

| | |
|---|---|
| Metallic iron, | 31.524 |
| Metallic manganese, | 1.376 |
| Sulphur, | .028 |
| Phosphorus, | .250 |

§ 188. The township road leading north from Brookville, known as the Sigel road, is altogether in *Clarion strata* after leaving Brookville. The property of Mr. M. Matson, east of the road contains a small area of *Ferriferous limestone.* Another and larger area of the same deposit is west of the road, terminating at Mr. R. L. Matson's as already described; still another is found on the S. Martin property, northwest of Matson, and a fourth is at the extreme northern border of the township on the Mrs. Haskell farm. The *Brookville coal* is 50 feet lower in the series. It is small and of no importance. An outcrop of it was observed at the water trough close to Mr. R. L. Matson's house.

The most important feature in the geology of this region is the Homewood sandstone, which is here very massive. Its identification as the Homewood did not at first seem satisfactory, and for a time it was adjudged to overlie the Brookville coal, thus making it correspond with the sandstone deposit which occupies the hilltop at the pottery. But this construction, when continued further north, into Eldred township and onward thence to the Clarion river, was found to be untenable, and the rock was then assigned to the position of the Homewood (or Tionesta) sandstone. This makes the coal bed underneath it (described further on) the Tionesta coal, or as it is now called, the Mercer coal, the equivalent of the coal at Port Barnet, and also of that at Fuller's mills. The sandstone rock appears in great force along the Sigel road north of the Steele school house, and also in the fields west of this, being specially prominent on the J. Vasbinder farm.

*The Mercer coal bed* here almost directly underlies the Homewood S. S. The bed was once opened at the roadside beyond the school house, but the bank is now no longer operated. A good exposure of the seam may however be had on the Vasbinder farm where it measures nearly 4 feet thick.

## *Knox township.*

§ 189. The greater part of Knox township is situated between Sandy Lick creek on the north and east, and Five Mile run on the west. The southern border rests against McCalmont and Oliver townships.

*The topography* of Knox township consists of a network of valleys and ravines, some of them deep and others shallow, some with steep precipitous walls, and others with gentle slopes, separated by narrow ridges of land, the summits of which are of very uniform height. The average elevation of these summits is about 1,750 feet above tide level (barometrical measurement); some few points in the township, as for example a prominent knob on the Mathews farm, and another on the Schaffner farm, are even higher than this; Knoxville stands at an elevation of about 1,700 feet above the ocean; the Bennett's Branch railroad, skirting Sandy Lick creek is 1,341 feet above the ocean at the mouth of Camp run, and 1,268 feet above the same datum at Bell's mills, above the mouth of Five Mile run.

These figures sufficiently express the range of elevation from the bed of the deepest valleys to the summit of the uplands. The drainage system is simple and sharply defined. The waters in the southern part of the township flow southward through the ravines of Indian Camp and Elk runs into Little Sandy creek. The western side of the township and much also of the northern part, is drained by Five Mile run. The water basin of Sandy Lick creek, on the northern and eastern side, is there confined very nearly to the hills which overlook the stream.

§ 190. *The Waynesburg anticlinal axis* (see map) crosses the central part of the township transversely from southwest to northeast. The exact location of this axis is here difficult to determine. This is due partly to the scarcity of exposures in the probable line of its path, but still more to the decrease of strength which the axis suffers in Knox township. It is here certainly not the sharply defined fold that it is at McKinstry's mill on the Little Sandy, nor does it compare in strength with its condition in the region of the Little Toby. Its arch flattens in Knox township, is much

broader there than at either of the other localities above named, and has more gentle dips. The geological effect of this weakening is to bring the Freeport group into the hills, nearly along the line of its path, and though these strata are confined to isolated summits, yet there is a considerable amount of them contained in the township.

As nearly as the axis can be located, it enters the township at the southwest between Lick run and Indian Camp run; it passes close to but west of Knoxville; passes near the cross roads about one mile north of that village, and crosses Sandy Lick creek below Iowa Mills.

§ 191. The *Perrysville anticlinal* is at the southeast corner of the township, east of Camp run. The intermediate basin, occupying the eastern part of the township, is an extremely shallow one, with gentle dips on both sides. How shallow is the trough may be judged from the fact that the difference in the levels of the strata between the top of its sides and the center, does not amount to more than 200 feet. Nor is the basin west of the Waynesburg arch, extending from that fold to Brookville (and therefore occupying the western part of Knox township), any deeper. The region, in fact, is one of nearly horizontal strata.

§ 192. It follows from this statement of the structure that the utmost uniformity prevails in the surface geology. The *Lower Productive Coal Measures* overspread the uplands, and the *Pottsville Conglomerate strata* outcrop in the valleys. A section so compiled as to embrace all the strata in in the township, in their regular succession from top to bottom, extends from the top of the *Mahoning Sandstone* to the base of the *Mercer group*. The section herewith given is not fully complete in all its interval rocks, but the main features are present, and the others will in time display themselves to local geologists when the region is more thoroughly developed. Fig. 29.

*Knox township general section.*

| | | |
|---|---|---|
| Limestone, | ? | |
| Shales, | 60′ | 0″ |
| *Mahoning Sandstone*, | 30′ | 0″ |
| Slates, | — | |

| | | |
|---|---|---|
| Coal bed, *Freeport upper*, | | 5′ 0″ |
| Concealed strata, | | 40′ 0′ |
| Shales and clay slates, | | 10′ 0″ |
| Coal bed, *Freeport lower*, | 4′ 0″— | 5′ 0″ |
| Clay, | | 1′ 0″ |
| Limestone, *Freeport lower*, | | 3′ 0″+ |
| Sandstone, *Freeport Sandstone*, | | 45′ 0″ |
| Coal bed, *Kittanning upper*, | | ? |
| Limestone, *Johnstown Cement*, | | 2′ 0″+ |
| Concealed strata, | 45′ 0″— | 70′ 0″ |
| Slate, | | — |
| Coal bed, *Kittanning middle*, | 2′ 0′ — | 4′ 8″ |
| Concealed strata, | | 20′ 0″ |
| Kidney ore, | | — |
| Slates, | | 15′ 0″ |
| Coal bed, *Kittanning lower*, | 1′ 0″— | 3′ 0″ |
| Shales and thin-bedded S. S., | | 50′ 0″ |
| *Ferriferous limestone*, | 0″— | 4′ 0″ |
| Shales, sometimes S. S., | | 50′ 0″ |
| Sandstone, massive, *Homewood S. S.*, | | 50′ 0″ |
| Slates, | | — |
| Coal bed, *Mercer coal*, | 3′ 6″— | 9′ 0″ |
| Clay, | | — |
| Concealed strata, | | 50′ 0″ |
| Water level at Fuller's mills, | | — |
| Total thickness of rocks, | | 526′ 8″ |

§ 193. Before entering upon a detailed discussion of the mining developments of the township, it is desirable to point out certain features of the above section which are of general interest in bearing upon the geology of other parts of the county. More especially is this the case with the Homewood Sandstone, which stratum in the Sandy Lick valley is a great deposit not only much thicker than in the region to the south and along Five Mile run, but of much greater prominence because of its greater massiveness and the coarser material of which it is composed. Its condition indeed resembles that which it assumes over all northern Jefferson, much of which has been converted by it into a sandy and desolate waste. Just so its outcrop in the Sandy Lick valley has made a wilderness of that region along its whole length in Knox township.

Its great thickness explains also the absence of the Clarion strata and the Ferriferous limestone in the Sandy Lick valley; precisely as their absence in northwest Jeffer-

son is due to the same cause. We find the limestone and its underlying strata regularly developed along Five Mile run and its branches, but not a trace of the limestone rock was anywhere seen in the Sandy Lick valley east of Brookville, although the hills there contain its horizon in an unbroken line, as shown on the geological map. Their accustomed places are occupied by the Homewood Sandstone, which fills the interval between the Kittanning lower and Mercer coals. Not all of the deposit is massive, its upper part being loose-bedded and shaly.

*The Mercer coal* almost directly underlies the Homewood Sandstone. Its existence in Knox township is known only along Sandy Lick creek, this being the seam that was once mined by the Buffalo Coal Company at Fuller's Mills. A description of these mining operations is given on another page in connection with Pine Creek township.

Above the Ferriferous limestone the section shows no abnormal features. We find the principal strata occupying their usual places, with the exception only of the Freeport upper limestone which escaped detection.

§ 194. The following detailed description of the geology begins at the south and considers first the western side of the township. Between Indian Camp run and Lick run a belt of high land, overspread by Barren Measure strata extends northward to the Knoxville road. In the ravines just named the *Lower Productive Measures* are uncovered to the horizon of the Ferriferous limestone, which latter stratum ascends Indian Camp run above water level to Reitz and Sparr's mill, but is not exposed. The same stratum ascends Lick run to the Knox township line.

There are few good exposures of any strata, excepting of the *Freeport lower coal* and the Mahoning sandstone, in the belt between these two runs. The *Kittanning lower coal* was nowhere seen in this region. The *Kittanning middle* (*?*) outcrops in a spring on the A. Kocher property near the head of Indian Camp run. The *Kittanning upper* outcrops on the same farm, 55 feet higher in the hill. The *Freeport lower limestone* is here also reported, 30 feet

Fig.25 §165.


Fig.26. §166.

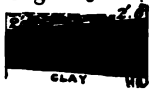



Fig.27. §178.

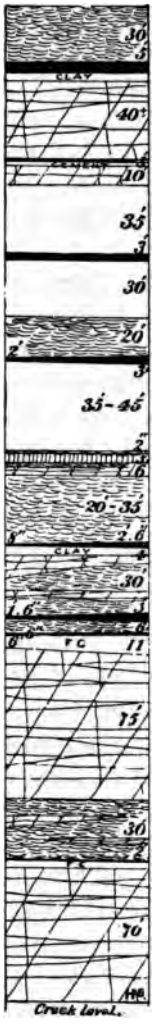



Fig.28.-§182.


Fig.29. §192.

above the Kittanning upper seam. The strata are unexplored.

§ 195. The *Freeport lower coal bed* is the principal seam of that region, and indeed of Knox township, being by far the most reliable, and yielding the best coal. Unfortunately, however, what there is of it, is so much broken up into detached areas that the bed is of value only for local supply. Some of the areas are quite extensive, as for example this one between Indian Camp run and Lick run, which alone contains coal enough to supply Knox township, for years to come, with fuel that is easy of access and cheap to mine.

A good exposure of the seam is on the farm of Mr. W. Borland, in the ravine of Lick run, three miles southwest of Knoxville. The roof is a deposit of clay shale, which being cracked in places causes the coal to have a dirty appearance from infiltrated clay. The coal averages from 4½ to 5 feet thick, lies nearly horizontally in the hill, and mines out easily. Near the present head of the main entry of the mine a bench of hard cannel slate, 2 feet thick, occupies the top of the seam. It first makes its appearance as thin projecting finger points, which subsequently unite into a solid bench. The slate grows thicker as the entry advances northeast, and the indications are that it is a part of a cut-out, traversing a line of S. 60° E. How extensive is this rock-fault can only be determined by exploration.

The hill over the mine rises sufficiently to include the Freeport upper coal, of which however there is no exposure. The Mahoning sandstone makes here only a feeble surface show.

§ 196. The outcrop line of the Freeport lower coal continues above water level around the head of Lick run, passing the McGary mine already described, and extending thence across the Knoxville road into the ravine of Five Mile run. Thence eastward it closely skirts the Knoxville road which it crosses again at Stewart's, about one mile west of Knoxville. It is opened on the Jno. Schäfer farm northeast of McGary's, and is mined also on the J. Cummings property near the forks of the road west of Knox-

ville; also on the A. Eshbaugh farm close by, and also at Mr. R. Stewart's near the saw-mill, where however it is much crushed and otherwise injured by a local deposit of sandstone which rests directly above it. Both in the Eshbaugh and Cummings mine its condition is much the same as at Borland's. The roof is shale, in which there are some small cracks that admit the water from above, but which do not seriously injure the coal. The bed itself is regular and uniform, having an average thickness of 4′ 2″. The coal though pyritous is good at all points. The following analysis by Mr. McCreath of a specimen from the Eshbaugh mine, is a fair expression of its average condition:

| | |
|---|---|
| Water at 225°, | 1.390 |
| Volatile matter, | 38.275 |
| Fixed carbon, | 54.720 |
| Sulphur, | 1.525 |
| Ash, | 4.090 |
| | 100.000 |
| Color of ash, | cream. |
| Coke per cent., | 60.335 |
| Fuel ratio, | 1:1.43 |

According to Mr. Eshbaugh the bed here rests upon impure limestone and clay, but no exposure of the former rock is now visible. It was seen however at Mathew's, as will presently be explained.

§ 197. The *Freeport upper coal* is not exposed at Eshbaugh's, nor could any outcrop of it be detected either there or at Cummings', or in fact at any point in the ridge between Indian Camp and Lick runs. This obscurity of the bed, though agreeing with the usual condition of things in the southern tier of townships in Jefferson county, is at variance with the section obtained at J. Mathew's, only one mile north of the Cummings and Eshbaugh mines. There the Freeport upper coal attains a thickness of 5 feet, having once been opened in the hill close to Mathews' house. The following section, obtained on this hill, is of interest not only in showing the *Freeport upper coal bed*, but in exhibiting also the *Freeport lower limestone* and the *Johnstown cement*, which strata in conjunction with the coal beds, secure an absolute identification of the rocks at this point:

*Mathews' section.*

| | | |
|---|---|---|
| Mahoning Sandstone, | — | |
| Slates, | — | |
| *Freeport upper coal bed,* | 5′ | 0″ |
| Concealed strata, | 50′ | 0″ |
| *Freeport lower coal bed,* | 4′ | 0″? |
| *Limestone,* | 3′ | 0″+ |
| Concealed strata: Shales (?) in place of Freeport S. S., | 45′ | 0′ |
| *Kittanning upper coal bed,* | not seen. | |
| *Limestone, Johnstown Cement,* | 2′ | 0″+ |
| Concealed strata, | 45′ | 0″ |
| *Kittanning middle coal bed,* | 2′ | 0″ |
| Total thickness of rocks, | 156′ | 0″ |

§ 198. *The Mahoning Sandstone* is not so prominent at Mathews as in a high point towards the northwest, where it is coarse grained and massive, and its outcrop quite unmistakable. The observer has only to follow the Brookville road from Mathews to the cross-roads south from the blacksmith shop to obtain a good idea of the condition of the deposit. It is no less conspicuous at the Cummings mine, south of Five Mile run, but thence southward towards J. Shilling's and the Lutheran church, all of which region it underlies, it loses that distinctness by becoming more argillaceous and shaly. Hence, little is seen of it in the ravines leading thence towards Indian Camp and Lick runs. The Lutheran church above referred to is far above the top of the deposit, and the limestone reported as having been discovered in digging the foundation of that building is hardly less than 100 feet above the horizon of the Freeport upper coal. This limestone at the church is among the highest strata contained in Knox township.

§ 199. *The Freeport upper limestone* fails in this region, which is a rather surprising circumstance, considering the abundance of the deposit only a few miles towards the southwest in Oliver township (see Huffman mine, § 121). The opening once made upon the *Freeport upper coal* at Mathews is now closed. The same bed outcrops near the hilltop on the farm of Mr. H. Rhodes, nearly a mile towards the northwest, but has not there been explored. The *Freeport lower coal* has been opened in the woods north of the Brookville road at Mathews and showed 4 feet thick; the same bed is

only 2′ 5″ thick at Rhodes, and 70 feet below the Freeport upper, instead of 50 feet, which is the interval at Mathews. Its underlying limestone has been sufficiently exposed by Mr. Mathews to indicate at least three feet of stone, of rather impure quality, but yet amply good enough for quarry lime. The same may be said of the *Johnstown Cement*, which, besides its outcrop at Mathews, shows in the road near the old school house above mentioned. It is perhaps the same Johnstown cement bed that outcrops on the flank of the hill at J. Allshouse's, near Hopkins' saw-mill. At each of these localities it could be profitably quarried for lime, especially as the farming land in all this region is sadly in need of fertilizer. With these limestone deposits above water level, and in plain view, it is surprising, to say the least, that no steps are taken towards their development by farmers whose land yields them, after the hardest labor, only a bare subsistence.

*The Johnstown cement* becomes a lean iron ore on Mr. M. E. Steiner's property, near Stewart's saw-mill. Mr. Steiner there made an opening upon it, and showed nearly three feet of rock, overlaid by a small streak of coal, which latter is the only representative here of the Kittanning upper seam.

§ 200. Northward from the old school house the Brookville road traverses the strata of the Kittanning group until where the hill pitches sharply towards Five Mile run, beyond Mr. I. Jones' house. A prominent knob north of the blacksmith shop may contain the *Freeport upper coal.* There are no exposures of any importance. The *Ferriferous limestone* was not observed at the point where the road crosses its outcrop in descending to the run, nor was it elsewhere seen along the east side of that ravine. But on the west side in Rose township abundant exposures of it exist. It is reported also to have been found near Hopkins' saw-mill, close to the point at which Five Mile run rises above it. A little search, properly directed would no doubt readily discover it in the ravine west of H. Rhodes' farm.

The *Homewood Sandstone* is above water level for a distance of 3 miles above the mouth of Five Mile run. It

makes an abundant show where its line crosses the Brookville road in Knox township.

§ 201. Transferring the attention now to the uplands on the eastern side of the township, and traversing the road southward along the divide between Five Mile run and Sandy Lick creek, we cross the *horizon* of the *Ferriferous limestone* near Mr. D. Mathews' house at the northern end of the township. There is no indication here of the limestone rock, nor is it probably present at all in the measures. The road quickly rises into the Kittanning strata, in which it then remains nearly to the opposite end of the township. So far as detailed geology is concerned, the region scarcely yields any notes at all. For several miles there are no openings either upon coal or limestone strata. The country rock is chiefly shale.

§ 202. *The village of Knoxville* is built upon high land, within the strata of the Freeport group. The *Freeport Sandstone* shows abundantly in the road west of the village, and the *Freeport lower limestone* is caught in a knoll on the Steiner property south of the village. Deep ravines open thence towards the south and east and west. The outcrops of the Kittanning group on the Kocher property at the head of Indian Camp run have already been mentioned. *The Kittanning middle coal bed* likewise outcrops in the ravine east of the village where some explorations upon it by Mr. Steiner revealed, it is said, 4 feet of coal, in which however there was a damaging parting of slate at the center of the seam. This structure of the bed corresponds with its condition on the P. Hawk farm presently to be described.

§ 203. The road leading southeast from Knoxville crosses some black slates just east of the village, which seem to belong on top of the Freeport Sandstone, below the Freeport lower limestone. Continuing thence about half a mile some exposures are found on the "Windfall lands" of Mr. M. E. Steiner. The following section was there leveled:

| | |
|---|---|
| Hilltop, above Freeport upper coal, | no exposures. |
| Concealed strata, | 75′ 0″ |
| *Freeport lower coal bed*, | outcrop. |
| Freeport Sandstone and concealed strata, | 50′ 0″ |

| | | |
|---|---|---|
| *Kittanning upper coal bed,* | | small. |
| *Limestone,* impure, *Johnstown Cement,* | | 2′ 0″+ |
| Concealed strata, | | 75′ 0″ |
| *Kittanning middle coal bed,* | 3′ 0″— | 4′ 0″? |
| Concealed strata, | | 35′ 0″ |
| Black slates, | | 10′ 0″ |
| *Kittanning lower coal bed,* | | 1′ 0″ |
| Concealed strata, | | 35′ 0″ |
| Run level, | | — |
| Height of hill, | | 287′ 0″ |

Developments were made upon the *Johnstown Cement* by Mr. Steiner, but the deposit having proved impure and worthless, was abandoned. The Kittanning middle coal bed was opened into by Mr. Diter on the adjoining property with the results above given.

§ 204. The same coal bed has likewise been opened on the P. Hawk farm about one mile south from the Windfall lands*. It has been mined at this place in a small way for several years past, proving itself an even and regular seam, but yielding rather indifferent coal. It is the same bed that is mined on the Schwartz property, in the Brown-Uplinger settlement in McCalmont township. At Hawk's it shows the following section:

*Fig. 30, § 204.*

| | | |
|---|---|---|
| Shale roof, | | — |
| Coal, | 2′ 0″ | |
| Soft clay, | 0′ 0½″— 0′ 2″ | 4′ 10″ |
| Coal, | 2′ 8″ | |
| Clay, | | — |

The *Kittanning lower coal*, 3 feet thick outcrops on the same property, 30 feet below the other.

§ 205. *Limestone* is found occupying the extreme hilltop on the Schaffner farm, close to where the Punxsutawney road crosses from Knox township into McCalmont. The rock is close in texture, of a bluish color and non-fossiliferous. It would make good lime and could be cheaply quarried, but no use is at present made of it. Most likely it is the Freeport lower stratum, but possibly it is the Freeport upper, and if so it is the only exposure of the latter rock in Knox

*This locality is not to be confounded with the Paul Hawk farm on Elk run, in Young township.

township. Being at the hilltop, and removed from all other exposures and outcrops, it is impossible to identify the stratum with certainty.

§ 206. Concerning the valley of Sandy Lick creek little is to be said, so far as this relates to Knox township. The road leading to Fullers Station from the Gould school house, southeast of Knoxville, passes a high knob just before it descends into the valley. This knob is on the J. Rhoads farm, and contains the *Freeport upper coal bed* and the *Mahoning Sandstone*. The latter rock makes so abundant a show upon the surface, that it is unmistakable. The *Freeport upper coal* almost directly underlies it, being 5 feet thick according to Mr. Steiner, whose measurement of it was obtained when the bed was mined on the Rhoads property some years ago. Below it for nearly 400 feet the section is an almost total blank. The road descending the sharp hill towards the creek has some few exposures of shale, but nothing of importance or interest.

The massive condition of the *Homewood Sandstone* in this valley has already been mentioned. Traced down the creek it is the dominant feature of the geology. Handsome exhibitions of it can be had at numerous points, but especially good ones were seen in the neighborhood of Iowa Mills.

The *Mercer coal* was once opened at the mouth of Camp run, at which place mining operations upon it for shipment to market were conducted for some time, but the mine is now abandoned, and is full of water. At the pit's mouth the section is as follows:

*Fig. 31, § 206.*

| | | |
|---|---|---|
| Slate, | | — |
| Coal, | 3′ 10″ | |
| Slate, | 0′ 7″ | 5′ 0″ |
| Coal, | 0′ 7″ | |
| Slate, | | — |

Judging from outcrop appearances the bed is slaty throughout and yields inferior coal. Moreover, it is an irregular deposit, subject to sharp pinches and rolls, which make mining expensive. Presumably, for these reasons,

mining operations upon it were abandoned, as otherwise if the bed were normally developed and yielded good coal, it could certainly compete with Reynoldsville and Fairmount, having equal railroad advantages with both of those places.

The *Mercer coal bed* was also opened recently for trial purposes on Anderson's run, close to Fuller's station. Upwards of three feet of coal were exposed. The principal opening upon the bed in this region is that of the Jefferson Coal Company on the opposite bank of the creek, in Pine Creek township, of which a full description is given elsewhere in this volume.

### *Winslow township.*

§ 207. This township, situated on the east side of Jefferson county, makes a nearly square block upon the map. The distance across it, north and south, is 6½ miles; east and west it is about 7½ miles.

Much of the surface is uncultivated, owing in some cases to the steep slopes of the valleys and in others to the rocky condition of the land from the outcrop of sandstone deposits. Decidedly the best farming land in the township is on the uplands south from Reynoldsville, around the heads of Trout run, where the Barren Measure shales and slates make a smooth soil mingled with much lime. Agriculture is there quite profitably conducted, and supports a thriving population. The valley of the Sandy Lick, on the other hand, is so rugged and forbidding that few attempts have been made to cultivate its slopes from one end of the township to the other.

§ 208. *The topography* is much diversified with alternating hill and valley, whose general system of arrangement will readily be understood upon an examination of the map. Sandy Lick creek is the main artery of the drainage system, to which all of the other streams, excepting Stump creek, are tributary. It follows an irregular course through the township, entering at the northeast corner and flowing first westward, then southwest by a sharp turn upon itself at Sandy Valley P. O., and then west again from Reynoldsville by another turn equally sharp. Both bends are closely con-

nected with the Perrysville anticlinal, whose structure has indeed in large part created them. The creek bed falls from about 1,350 feet above tide level at Evergreen to about 1,300 feet at Prindible's, which, as the creek flows, is a fall of less than 5 feet to the mile. Some high points on the uplands attain an elevation of more than 1,800 feet above tide level, but the average range of the upland region is between 1,600 and 1,700 feet.

§ 209. *The geological structure* consists of two *anticlinal arches* with an intermediate *synclinal trough*, in which the town of Reynoldsville is situated. One of these anticlinals is the *Perrysville*; the other is the *Falls Creek*. In point of strength the two are out of all proportion to each other, the Perrysville being quite an important fold, whereas the other is only a faint roll which in some cases is barely distinguishable.

*The Perrysville axis* enters Winslow township at the southwest, close to the head of Windfall run, whence it passes through the Norris and Lowry settlement, and crosses the Sandy Lick below the mouth of Prior run. Thence its axis extends in a nearly direct line to the village of Rockdale in Washington township where it suddenly dies away, and all hold is lost of it. South of the Sandy Lick creek it hoists the rocks about 400 feet, but north of that stream it hoists them much higher until its strength finally fades out. One remarkable feature indeed of the axis in Winslow township is its sudden rise between the Norris lands on the Reynoldsville road south of the creek, and the Brookville road on the north slope of the valley, not more than three miles distant in an air line. At the first named place the Lower Productive coal measures are the surface rocks of the uplands, including even the Mahoning sandstone in some particularly high points, while on the Brookville road and around the heads of Prior run, the top of the Homewood Sandstone is lifted nearly to the hilltops. This is a clear rise of at least 300 feet in the axial line, the effect of which upon the surface geology is at first bewildering to the observer.

§ 210. *The Falls creek axis* has already been described

as extremely indistinct in Winslow township. But though feeble, and lifting the rocks only a few feet, yet its reverse dips can be detected in the exposures south of Prescottville. Its axial line passes, in fact, near the cross roads at Sharp McCreight's, and crosses Mix run below McCreight's mine; crosses Soldier run close to the mouth of Mix run, and extends thence towards Pancoast on the Sandy Lick. At the latter place it is too feeble to be made out in the exposures, but further north it rises into considerable prominence along the waters of Falls creek. Towards the southwest it makes itself felt on the waters of Big Run, where it lifts Lower Productive rocks above the water level.

§ 211. The *synclinal axis* of the Reynoldsville basin passes almost directly under that town, sinking slowly towards the southwest, but rising rapidly from Reynoldsville towards the northeast. It is due to that rise that the Freeport coals, which are the main source of economic value to this basin, leave the hills northeast of Pancoast, and are absent over nearly all Eastern Washington. It is only after the Perrysville anticlinal has subsided north of Rockdale, that these measures come again into the hills round about Brockwayville. But south and southwest from Reynoldsville they underlie all of the upland country, measuring many square miles in extent. It has already been shown that the Elk Run Basin is but a continuation southwestward of the Reynoldsville trough.

In no part of Jefferson county are mining operations so vigorously conducted as in the neighborhood of Reynoldsville. Indeed it is only from that part that coal is at present shipped to market; but this restriction is due entirely to the superior railroad facilities which that section possesses over the region lying southward. It is not intended in this connection to discuss the economic value of the Reynoldsville basin, considered from Punxsutawney to Brockwayville. That subject is reserved for a separate chapter. Here it is desired merely to point out the developed condition of the Reynoldsville hills, and the advantages which that region therefore offers for a study of the Freeport group. The lower part of the section having little in it of economic value or

interest, is considerably neglected, which is a fact to be regretted because it leaves certain geological questions still in doubt, and particularly that relating to the condition here of the Ferriferous limestone stratum.

§ 212. The *outcropping rocks* of Winslow township extend from a point in the series, 200 feet above the *Freeport upper coal* to the base of the *Mercer group*. This comprises a column 568 feet long, much of which can be only imperfectly seen, but most of the main features, as for example the coal beds have been sufficiently exposed to accurately estimate their value. Before proceeding to an analysis of these features, the section may be presented in full, as compiled from numerous local sections, made partly by myself in different parts of the township, and partly by my brother, Franklin Platt, who examined the region in 1874, and published the results of his examination in Report H, Fig. 32:

*Winslow township general section.*

| | | | |
|---|---|---|---|
| Concealed strata, shales? | | 95′ | 0″ |
| Coal outcrop, | | | — |
| Concealed strata, shales? | | 20′ | 0″ |
| Coal outcrop, | | | — |
| Concealed strata, thin sandstone? | | 45′ | 0″ |
| Sandstone, *Mahoning Sandstone*, | | 40′ | 0″ |
| Coal bed, *Freeport upper coal*, | 0′— | 4′ | 0″ |
| Shales, | | 43′ | 0″ |
| Coal bed, *Freeport lower coal*, | 6′ 0″— | 10′ | 0″ |
| Clay shales, | 5′ 0″— | 10′ | 0″ |
| *Limestone, Freeport lower*, | 0′— | 2′ | 0″ |
| Concealed strata, *Freeport Sandstone?* | 25′ 0″— | 35′ | 0″ |
| Coal bed, *Kittanning upper*, | | 2′ | 0″ |
| Concealed strata, | | 70′ | 0″ |
| Coal bed, *Kittanning middle*, | 2′ 6″— | 2′ | 6″ |
| Concealed strata, | | 25′ | 0″ |
| Coal bed, nameless, | | 2′ | 0″ |
| Concealed strata, | | 35′ | 0″ |
| Coal bed, *Kittanning lower*, | 2′ 6″— | 4′ | 0″ |
| Concealed strata, | | 50′ | 0″? |
| Sandstone, | | 10′ | 0″ |
| Slates, | | 5′ | 0″ |
| Coal bed, *Brookville*, | | 1′ | 0″ |
| Clay and shales, | | 5′ | 0″ |
| Sandstone, *Homewood Sandstone*, | | 40′ | 0″ |
| Slates, dark colored, | | 8′ | 0″ |
| Coal, | | 1′ | 0″ |
| Fire-clay, | | 4′ | 0″ |

| | | |
|---|---|---|
| Sandstone and shales, | 7′ | 0″ |
| Slates, black, | 10′ | 0″ |
| Coal bed, | 2′ | 6″ |
| Slates and ore balls, | 8′ | 0″ |
| Coal, | 0′ | 6″ |
| Fire-clay, impure, | 3 | 0″ |
| Sandstone, *Connoquenessing upper*, | — | |
| Total thickness, | 599′ | 6″ |

§ 213. *The Barren Measures* are confined to the southern and eastern sides of the township, their greatest accumulation being in the region between Soldier run and Mix run. So far as exposed they consist chiefly of slates and shales above the Mahoning Sandstone and contain nothing of practical interest. The coal-outcrops near the top of the shales are mere streaks which nowhere become workable beds. Nor are limestone strata known to occur. The best exposures of the Barren Measure shales are found along the Luthersburg pike in the neighborhood of Prospect knob.

The *Mahoning Sandstone* is almost universally a massive and conspicuous rock in Winslow township, variable, however, in point of thickness. No better exposures of it exist in its massive condition than along the southern edge of the township, about the heads of Big run. There it is the country rock, outcropping in great bowlders, as for example along the road at Jas. Dickey's, and also in the ravine east of that point, at Secrist's. It is no less conspicuous in the ravine of Trout run, and also along Mix run. Its thickness is greatly magnified at the latter place, where its top part is rather thin-bedded as is shown by the loose fragments covering the surface in the neighborhood of S. McCreight's. This also is its aspect at Reynoldsville, and along Soldier run; but on the uplands between the latter stream and the Sandy Lick it is compact both at the top and base.

§ 214. *The Freeport upper coal*, of all the strata in the section, is the most uncertain and variable. Round about Reynoldsville it is wholly absent from the measures, not a trace of it having been seen in the air shaft of Powers' and Brown's mine, which pierces the strata from the Freeport lower coal nearly to the top of the Mahoning Sandstone. Nor does the bed exist under the plateau between Trout run

and Mix run, as otherwise it would have revealed itself in the recent exploratory drillings of Messrs. Powers and Brown near the cross roads at McCreight's. But it is found in the ravine of Soldier run, and was once opened on Mr. Jno. A. Wilson's property, a short distance south of the saw-mill. At the time the region was surveyed (May, 1880,) the opening had fallen shut, and only the outcrop could be seen, but Mr. Blandy, who measured the bed when the opening was made upon it, states that it is 4 feet thick. What is its condition otherwise is not definitely known, but there is little probability of its yielding good coal if we may judge from openings upon the seam in other parts of the township. In a word the bed is universally bad—much disturbed by a massive sandstone roof, and as slaty and impure as it is irregular in thickness. In all estimates of the Reynoldsville basin for marketable coal, the Freeport upper seam may be left out of consideration.

There are no openings upon the bed north of Soldier run, nor was any outcrop of it detected at Pancoast. It is clearly a small seam along the Sandy Lick valley from the county line westward to Reynoldsville. But extending the observations southward to the region of Trout run we find it tolerably persistent at a thickness of about 4 feet. Thus it is opened on the J. Secrist property about three miles southwest of Reynoldsville, and also on the S. Phillipi farm, in another ravine of Trout run, towards the east. The Secrist mine is characteristic of the bed, troubled and irregular. Of so indifferent a quality is the coal that the mine is no longer worked. The bed is 3′ 8″ thick, roofed by sandstone, and resting upon fire-clay. The Phillipi mine yields rather better coal, and the bed also is a trifle thicker than at Secrist's.

§ 215. Some coal openings on Sugar Camp run, a branch of Stump creek, in the southeast corner of the township, are possibly upon the Freeport upper bed, but this is not certain. Possibly it is the Freeport lower coal that is there opened, in which case, however, the latter seam has considerably deteriorated in point of purity, in the interval between Soldier run and Sugar Camp run. The wilderness

condition of the region, and the absence of other exposed strata to assist the identification, leave the question in doubt.

The principal opening is upon the property of Mr. Jacob Smith, where five feet of coal have been exposed, rather slaty and impure. The opening was driven for a distance of 50 feet under the hill, without any material improvement in the condition of things. There is a very decided dip towards the south, which soon buries these strata under Stump creek, leaving the Barren Measures to make the hills along the lower waters of that stream, in Henderson township, as already explained.

Mention may here be made of a *limestone stratum* which outcrops on the H. Phillipi tract, near the junction of Sugar Camp run with Stump creek. Most likely the limestone closely underlies the coal bed above described. It is an impure earthy rock, containing some minute fossil shells. It is several feet thick.

§ 216. *The Freeport lower coal* is so prëeminently fine a bed throughout the Reynoldsville region that it gives great value to all the land it underlies. The work of development upon it, though quite vigorously conducted in recent years, has in reality only begun as the expanse of coal is enormous, while the coal itself, either for gas or steam, is of so good a quality that the demand for it in the northern markets, which is its natural outlet, is steadily growing. Already the value of the field for future owners is well understood, and the land within easy distance of the railroad is controlled by mining companies. The ravine of Soldier run, yet untouched, presents an immense area of the bed, lying nearly horizontally in the rocks and raised above the drainage line. From experimental openings and from farmers' mines it is evident that no part of the region yields choicer coal. Gangways could be driven northward towards the Sandy Lick, or southward towards Mix run, which would command millions of tons of coal,—and coal that can be mined out at an expense of little more than fifty cents per ton. The same may be said for the region between Mix run and Trout run, and for that also between Trout run and Big run. The market for this coal can ex-

tend only as the supply in the more northerly and more advantageously situated fields with regard to their market, becomes reduced; but when the condition of the latter justifies the more extensive development of the Reynoldsville region, I know of no locality in the coal regions of Pennsylvania more inviting to capital.

§ 217. The *right bank* of Sandy Lick creek from Reynoldsville nearly to Pancoast is destitute of this coal bed. So is the left bank opposite Pancoast, but on that side for a less distance as the bed there shortly resumes its place in the measures, being worked by the Reynoldsville coal company at the Diamond mine. The hills along the right bank of the creek are abundantly high to include its horizon in an unbroken stretch from the county line to Reynoldsville, and if the bed were present it could not escape detection in the exposures west of that town, along the Brookville pike. Not only however is the Freeport lower coal absent there, but the Freeport upper is missing too. There is a great abundance of massive sandstone on those hills, occupying as well the horizon of the Mahoning as that of the entire Freeport group. Underneath it is a plentiful outcrop of dark slates, below which, at a short distance, is more sandstone, which latter I consider to be the Freeport sandstone.

This irregularity in the strata over the region indicated, is a matter of considerable practical importance, because it rules out the right bank of Sandy Lick creek between Reynoldsville and Pancoast, from mining operations. Careful study was therefore made of the troubled region in order to determine the geological cause of the irregularity, whether it was due to a down-throw fault of 100 feet, or whether the measures were here irregularly deposited, or whether, in fine, the absence of the coal bed and its usually attendant strata was not due to extensive Palæozoic erosion at the beginning of the Lower Barren era.

§ 218. The investigations established the last of these propositions as the correct one. To suppose a fault responsible for the trouble would require a *double down-throw* along two parallel planes about one mile distant from each other, or in other words a strip of country of that breadth, and

four miles long in a nearly east and west line, would have been required to drop about one hundred feet. The necessity for a double throw is evident from the fact that the strata are in their regular position at Pancoast on the north, and also at Soldier run on the south.

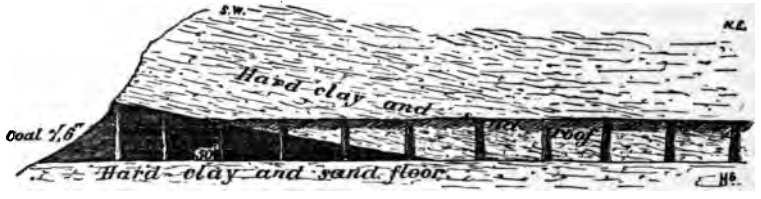
There are, it is true, certain features connected with the Reynoldsville trouble, that at first suggest such a fault having taken place here, as for example the experimental opening made upon the Freeport lower coal by Messrs. Powers and Brown on the left bank of the creek a short distance west of Pancoast. In that opening the coal was found at its regular height at the outcrop, which also proved continuous under the hill for a distance of some 20 feet when it is suddenly cut off by an abrupt wall of sandstone. The coal moreover is hard, and has a somewhat twisted appearance, as if from pressure; but I could observe no slickensides, or polished surfaces along the face of the sandstone wall to indicate that a displacement had taken place.

Conclusive evidence however against the fault is found in the fact that a drop of 100 feet (which is all that can have happened) is not sufficient to bury the Freeport lower coal below water level in the Sandy Lick Valley, at the point where the fault would have crossed that creek below Sandy Valley P. O. Water level at Reynoldsville is 200 feet below the Freeport lower coal, and if a fault of only 100 feet had occurred, there would not then be the slightest difficulty in detecting the seam on the hillslope west of the town. Moreover as further evidence against the fault it may be mentioned that the strata on those western hills dip regularly towards the southeast, away from the Perrysville anticlinal.

§ 219. Abnormal sedimentation over the now troubled area during the time the Freeport group was elsewhere being deposited may possibly have happened at Reynoldsville, in which case the Freeport coal beds were never formed at all on the hills facing that town from the west; but it is more likely that they were normally developed and afterwards cut out by erosion along several channels, just prior to the deposition of the Mahoning sandstone. Such at all events has clearly been the case below Pancoast where an opening

(known as the Sharp mine) was made into the north hill almost directly opposite the experimental opening of Powers and Brown above alluded to. One side of a Palæozoic valley was thus discovered, whose dimensions have not been determined. At the outcrop the bed here presents its full height of seven feet, just as it is at Pancoast. But almost immediately upon advancing under the hill the thickness diminishes, and there is then a gradual decrease inward, the roof sloping and the floor remaining horizontal, until at a distance of about 50 feet, the two come together and the coal is cut out on both sides of the gangway. The entry has been continued for an additional fifty feet into the rock, without however finding the coal, or even a trace of it. The roof rock at the mouth is massive sandstone, which of itself is evidence of irregularity here because the roof-rock of the coal at Pancoast, and generally throughout the country to the south, is hard black slate. Further in the mine the sandstone becomes a medley of clay and sand, irregularly and unevenly bedded. Every feature of the exposure shows clearly the process by which the coal has been removed, namely by the washing out of the bed by an ancient stream, and the subsequent filling up of the valley. The annexed sketch represents one side of the entry of the mine:

Fig 33. §219.




§ 220. The troubled area follows here a course of N. 70° W. (S. 70° E.), but how far this direction is maintained it is impossible to say, since the ancient channel undoubtedly meandered over an irregular line, bending and curving as the streams upon the surface now do. Wherever these extensive wash-outs in the Coal Measures have been at all investigated they have usually revealed a net work of streams coming into the main one from all directions. In this man-

ner only can be explained the absence of the bed along a narrow line running nearly north and south at Prescottville. Moreover, it is evident from the facts above recorded that the stream which cut the coal out at Sharp's was not the same as that which removed it at Powers and Brown's, for we have seen that the bed was found *at the outcrop* on both faces of the hill. These streams are here undoubtedly near their junction, but towards the east their paths widely diverged, as is shown by the presence of the bed at Pancoast, while absent on the hills opposite.

§ 221. The mining developments upon the *Freeport lower bed* at Reynoldsville enable it to be examined there in great fulness of detail. Five collieries now work it for shipment to market, namely, two at Pancoast and three at Reynoldsville. Other openings have also been made upon it by interested property holders, either to prove the thickness of the seam and to test its purity, or, as in some few instances, to mine it in a small way for the local market. These openings will be described in order, from northeast to southwest, beginning at Pancoast.

The principal developments at the latter place are those of the Reynoldsville Coal Company, whose mine is situated on the right bank of the creek, directly north of the railroad station at Pancoast. It is 150 feet above the creek, in which interval the only exposures of the intermediate strata are those of the *Kitanning upper coal* and the *Freeport lower limestone*, which have been uncovered in a field adjoining the mine. Neither stratum is of importance. The most noticeable feature of the exposure is the unusually great distance between the Freeport lower coal and its limestone, as compared with the conditions prevailing at Reynoldsville. The section is as follows:

| | | |
|---|---|---|
| *Freeport lower coal*, | — | |
| Shales, | 15′ | 0″ |
| *Limestone*, impure, | 2′ | 0″ |
| Shales, | 14′ | 0″ |
| Fire-clay, good, | 4′ | 0″ |
| Shales and sandstone, | 4′ | 0″ |
| Coal bed, *Kittanning upper*, | 2′ | 0″ |
| Thickness, | 41′ | 0″ |

§ 222. Between the mine and the railroad is a well-arranged system of tram roads and chutes to convey the coal to the cars. The plant, in fact, is very complete, and the mine is in good condition. I have no statements of the cost of mining, but should not estimate it higher than 60 cents, or, at the outside, 70 cents, per ton, allowing in this a royalty of 25 cents per ton. The coal is of excellent character, very free from ash, and but little troubled with iron pyrites. The thickness of the seam is unvarying so far as the entries and gangways of the mine have yet advanced. What that thickness is, is expressed by the following section:

*Fig. 34, § 222.*

| | | | |
|---|---|---|---|
| 1. Shales and clay, | | | |
| 2. Coal, not mined, | 2′ 0″ | | |
| 3. Coal, | 0′ 8″ | | |
| 4. Slate and bony coal, | 0′ 4″ | 8′ | 3″ |
| 5. Coal, good, | 4′ 2″ | | |
| 6. Slate, | 0′ 1″ | | |
| 7. Coal, | 1′ 0″ | | |
| 8. Fire-clay, | | | — |

An analysis by Mr. McCreath of an average sample of the main bench of coal, No. 5, gave the following constituents:

| | |
|---|---|
| Water, | 1.570 |
| Volatile matter, | 33.430 |
| Fixed carbon, | 61.285 |
| Sulphur, | 1.055 |
| Ash, | 2.660 |
| | 100.000 |
| Color of ash, | brown. |
| Coke per cent., | 65.00 |
| Fuel ratio, | 1:1.83 |

The Washington colliery is situated about one quarter of a mile east of the Pancoast mine. The bed is exactly the same at both places.

§ 223. Advancing now across the "troubled area," southwest to Reynoldsville we find quite extensive developments at the Diamond mine, situated about one mile north of Reynoldsville. The mine is near the top of a narrow hill, through which the main entry has been driven from the Sandy Lick valley to the ravine of Pitch Pine run. The field of coal commanded by this mine is comparatively

small, embracing as it does only two detached outliers, which are prominent features in the Reynoldsville topography. The bed is in superb condition, rather more pyritous perhaps than in some other instances, but not to a sufficient extent to injure it. An incline plane lowers the coal, 135 feet, from the mine to the cars. The interval is destitute of exposures, save of one small coal bed at the level of the railroad, representing the *Kittanning lower seam*, of which more will be said presently. A complete section of the Freeport lower bed in the Diamond mine is shown in Fig. 35:

*Fig. 35, § 223.*

| | | | |
|---|---|---|---|
| 1. Clay shales, | | | |
| 2. Coal, | 2′ | 1″ | |
| 3. Fire-clay, | 0′ | 7″ | |
| 4. Coal, | 1′ | 11″ | |
| 5. Fire-clay, | 3′ | 4″ | 14′ 9″ |
| 6. Bony coal, | 0′ | 6″ | |
| 7. Coal, | 6′ | 1″ | |
| 8. Black slate, | 0′ | 3″ | |

Mr. McCreath made a complete set of analyses of this bed, embracing its principal benches. Only the main bench (No. 7) furnishes marketable coal, and then only the lower five feet of it, leaving a margin of more than one foot of worthless bony coal. The different analyses of the bed are grouped in the following table, including one also of coke made from the slack of the mine. Of this coke it must be said that it was made without care to avoid the slate, and it therefore is not equal to what the hard coal from the best of the bed would yield when properly coked in a Beehive oven. Analysis No. 1 of the table represents stratum No. 2 of the above section; No. 2 of the table is No. 4 of the section; No. 3 is the upper part of No. 6, showing the bony worthless coal of that bench; Nos. 4 and 5 are the lower part of No. 6—the marketable part; analysis No. 6 is the coke.

| | 1. | 2. | 3. | 4. | 5. | 6. |
|---|---|---|---|---|---|---|
| Water, . . . . | 1.100 | 1.190 | 0.980 | 1.120 | .950 | .500 |
| Volatile matter, | 29.990 | 32.810 | 30.300 | 33.860 | 35.130 | 1.150 |
| Fixed carbon, . | 46.639 | 55.316 | 50.521 | 60.692 | 59.304 | 88.478 |
| Sulphur, . . . . | 3.101 | 2.284 | 2.429 | 1.278 | 1.436 | 1.022 |
| Ash, . . . . . | 19.170 | 8.400 | 15.770 | 3.050 | 3.180 | 8.850 |
| | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 |
| Color of ash, | reddish gray. | pinkish gray. | reddish gray. | reddish gray. | dirty gray. | cream. |
| Coke per cent., . | 68.91 | 66.00 | 68.72 | 65.02 | 63.92 | |
| Fuel ratio, . . . | 1:1.55 | 1:1.68 | 1:1.66 | 1:1.79 | 1:1.68 | |

§ 224. The Ohio Mining Company's colliery is situated at the eastern outskirts of Reynoldsville, adjoining the ravine of Pitch Pine run. It commands a great expanse of excellent coal, and is advantageously located for shipment. No special description of the mine is required, other than to point out the broken condition of the bed above the main bench, as compared with its more compact form at the Diamond mine. The section is as follows:

*Fig. 36, § 224.*

| | | | |
|---|---|---|---|
| 1. Clay shales, . . . . . | | | — |
| 2. Coal, . . . . . | 0′ | 1½″ | 10′ 9½″ |
| 3. Fire-clay, . . . . . | 0′ | 8 ″ | |
| 4. Coal, . . . . . | 0′ | 4 ″ | |
| 5. Fire-clay, . . . . . | 0′ | 11 ″ | |
| 6. Coal, . . . . . | 1′ | 3 ″ | |
| 7. Slate, . . . . . | 0′ | 2 ″ | |
| 8. Coal, . . . . . | 1′ | 0½″ | |
| 9. Bony coal, . . . . . | 0′ | 2½″ | |
| 10. Coal, . . . . . | 1′ | 0 ″ | |
| 11. Bony coal, . . . . . | 0′ | 1 ″ | |
| 12. Coal, main bench, . . . . . | 5′ | 0 ″ | |
| 13. Fire-clay, . . . . . | | | — |

Only No. 12 of the section is mined, being uniformly good throughout all the colliery. The lower part of the bench yields decidedly better coal than the upper part, but all of it is marketable. Mr. McCreath analyzed three specimens of the bed, besides one of coke, made in an open air pit from the slack of the mine. The analyses are given in the following table, No. 1 being the upper part of the bench, No. 2

Fig.30. §204.


Fig.31. §206.


Fig.32. §212.

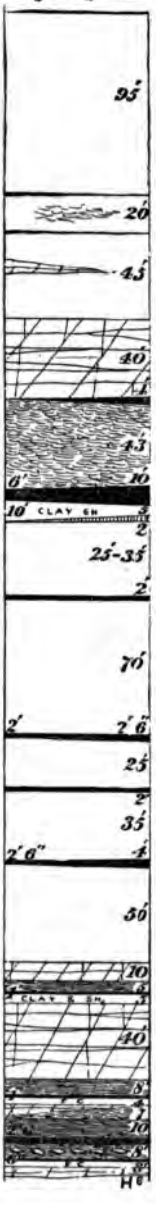
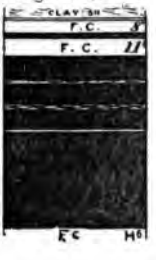



Fig.34. §222.


Fig.35. §223.


Fig.36. §224.



the middle part, and No. 3 the lower part. Analysis No. 4 is the coke:

| | 1. | 2. | 3. | 4. |
|---|---|---|---|---|
| Water, | 0.960 | 1.100 | 1.100 | .780 |
| Volatile matter, | 32.680 | 30.800 | 32.900 | 1.420 |
| Fixed carbon, | 59.097 | 62.524 | 62.174 | 88.950 |
| Sulphur, | 1.063 | .776 | .726 | .900 |
| Ash, | 6.200 | 4.800 | 3.100 | 7.950 |
| | 100.000 | 100.000 | 100.000 | 100.000 |
| Color of ash, | reddish gray. | cream. | cream. | reddish gray. |
| Coke per cent., | 66.36 | 68.10 | 66.00 | |
| Fuel ratio, | 1:1.8 | 1:2.03 | 1:1 89 | |

Mr. McCreath tested the coal from this mine for phosphorus, besides making an analysis of the ash. The following results were obtained:

*Phosphoric acid.*

| | Per cent. in coal. | Per cent. in ash. |
|---|---|---|
| Upper part of main bench, | .071 | 1.145 |
| Middle part of main bench, | .008 | .166 |

*Composition of ash.*

| | |
|---|---|
| Silica, | 1.220 |
| Oxide of iron, | .420 |
| Alumina, | 1.215 |
| Lime, | .120 |
| Magnesia, | .090 |
| Phosphoric acid, | .008 |

§ 225. The colliery of Messrs Powers and Brown is situated on a small branch of Soldier run, about one half mile southeast of Reynoldsville. Like the mine above described, it also commands a large body of coal, admirably situated for cheap mining. The strata are just enough removed from the horizontal to carry off the drainage water. No serious troubles affect the bed, nor is there any noticeable variation either in the thickness of the coal or in its character. The section is as follows:

*Fig. 37, § 225.*

| | | | |
|---|---|---|---|
| Slate, | | | — |
| Coal, | 1′ | 5″ | 10′ 1″ |
| Slate, | 0′ | 1½″ | |
| Coal, | 1′ | 3″ | |
| Slate, | 0′ | 1″ | |
| Coal, | 0′ | 10″ | |
| Slate, | 0′ | 0½″ | |
| Coal, | 5′ | 0″ | |
| Bony coal, | 0′ | 6″ | |
| Coal, | 0′ | 10″ | |
| Clay, | | | — |

No analyses were made of the bed as here mined, because those already given for the other collieries will apply as well to this one of Powers and Brown as to those which they respectively represent. It is a very evident fact from those analyses that whatever size the bed may attain in certain places, only the one persistent and unchanging main bench of five feet can be depended upon for marketable coal. And the best part of this bench is always its lowest part. From that horizon however, comes superb coal scarcely inferior for gas purposes to the best of the Westmoreland and Youghiogheny coals. Its coking qualities though not the best are certainly fair, and much of the slack at the mines might be thus profitably utilized if mixed with some lump coal. With that end in view indeed Messrs. Powers and Brown have already commenced the erection of a bank of Beehive ovens close to their colliery.

§ 226. In order to show the size of the bed and its condition in other parts of the Reynoldsville region I have selected a few openings, made by farmers and other property holders, as typical of their respective localities. Soldier run is represented by the Seley mine; Mix run by the Sprague mine; and Trout run by the Strouse mine.

*The Seley mine* is on the left bank of Soldier run near Wilson's saw-mill. Another opening upon the bed was once made near by on Mr. Jno. A. Wilson's property, and still another exists on J. F. Henry's farm a short distance north of the saw-mill. The different measurements show trifling variations of thickness, but the general result is the same. It is as follows:

*Fig. 38, § 226.*

| | | |
|---|---|---|
| 1. Clay shales and slates, | | — |
| 2. Coal and slate, | 4′ 5″ | 11′ 9 |
| 3. Black slate, | 0′ 3″ | |
| 4. Coal, | 6′ 0″ | |
| 5. Slate, | 0′ 1″ | |
| 6. Coal, | 1′ 0″ | |

Only the main bench, No. 4, is mined. No. 2 is worth less.

The following analyses by Mr. McCreath, show the condition (1) of the upper part of the main bench; (2) of the lower part of that bench, and (3) of the lowest bench, No. 6 of the section:

| | 1. | 2. | 3. |
|---|---|---|---|
| Water, | .850 | 1.040 | .960 |
| Volatile matter, | 31.200 | 31.610 | 32.320 |
| Fixed carbon, | 59.882 | 62.464 | 58.640 |
| Sulphur, | 1.368 | .736 | 1.230 |
| Ash, | 6.700 | 4.150 | 6.850 |
| | 100.000 | 100.000 | 100.000 |
| Color of ash, | dirty gray. | reddish gray. | pinkish gray. |
| Coke per cent., | 67.95 | 67.35 | 66.72 |
| Fuel ratio, | 1:1.91 | 1:1.97 | 1:1.81 |

§ 227. The *Sprague mine* is on a small branch of Mix run south of Prospect knob. Another opening, and one from which a considerable amount of coal is taken during the winter months is found at Mr. McCreight's on Mix run proper, and about a mile southwest of Sprague's. Both mines exhibit the bed in almost exactly the same condition. The section is as follows:

*Fig. 39, § 227.*

| | | |
|---|---|---|
| 1. Slate and sulphurous coal, | 1′ 0″+ | 7 7″ |
| 2. Coal, good, | 5′ 5″ | |
| 3. Slate, | 0′ 2″ | |
| 4. Coal, | 0′ 6″–1′ 0″ | |

A specimen of the main bench, No. 2 was analyzed by Mr. McCreath with the following favorable results:

| | |
|---|---|
| Water, | 1.430 |
| Volatile matter, | 31.940 |
| Fixed carbon, | 62.109 |
| Sulphur, | .531 |
| Ash, | 3.990 |
| | 100.000 |
| Color of ash, | cream. |
| Coke per cent., | 66.63 |
| Fuel ratio, | 1:1.94 |

§ 228. The *Strouse* mine is situated at the head of a small branch of Trout run, nearly due south of Reynoldsville. The bed is somewhat irregular at this place from troubles with "horsebacks." When at its full height it shows the following section:

*Fig. 40, § 228.*

| | | |
|---|---|---|
| 1. Slate and bony coal, | | |
| 2. Coal, good, | 4′ 0″ | 5′ 8″ |
| 3. Parting, small, | — | |
| 4. Coal, good, | 1′ 8″ | |
| 5. Clay, | — | |

Mr. McCreath's analysis of a specimen from the main bench, No. 2, gave these results:

| | |
|---|---|
| Water, | 1.300 |
| Volatile matter, | 30 220 |
| Fixed carbon, | 63.617 |
| Sulphur, | .763 |
| Ash, | 4.100 |
| | 100.000 |
| Color of ash, | lavender. |
| Coke per cent., | 68.48 |
| Fuel ratio, | 1:2.10 |

§ 229. The outcrop line of the Freeport lower coal, following here closely that of the Freeport upper, keeps east of Trout run and south of Windfall run. The rapid rise of the strata northwestward towards the Perrysville anticlinal causes the Freeport group to escape the hills between Windfall and Trout runs. It is missing also with one small exception from the high land between Windfall run and the Sandy Lick. The exception is the Norris lands, where a prominent hill directly south of Prendible station includes not only the Freeport strata, but much also of the

Mahoning Sandstone. Being confined to a single hill, there is not enough of the Freeport lower coal to make the land valuable, other than for mining in a small way for local supply. The bed, so far as it has been exposed, is in fine condition, resembling both in its thickness and in the purity of its coal, its condition at Reynoldsville. The Freeport upper coal bed is unknown. The Mahoning Sandstone on the other hand is abundantly shown in the rocky condition of the surface at the hilltop.

§ 230. The coal beds of the *Kittanning* and *Clarion groups*, five in number, may, so far as the Reynoldsville basin is concerned, be dismissed in a very few words. Few openings indeed have anywhere been made upon them. In a region where one bed is of superior thickness and quality, there, of course, the others are inevitably neglected. But at Reynoldsville a double reason for this neglect exists, since the lower seams are not only impure, but there is hardly one of workable dimensions in all the strata below the Freeport group.

It is therefore only necessary to point out the localities at which the different strata are uncovered. With regard to the *Freeport lower limestone* mention has already been made of its exposure at Pancoast. Another exposure of it is in a small ravine on the property of Mr. A. Reynolds, adjoining Powers and Brown, where it shows two feet of excellent stone, greyish in color, streaked with threads of calcite, and non-fossiliferous. The same stratum was worked some years ago, further west near Donthil's sawmill, to obtain lime for the masonry work at the time the Bennett's Branch railroad was building. Mr. Wilson, engineer of that road, informed me that all the lime required for his purpose in the vicinity of Reynoldsville was obtained at small expense from this quarry. Under such circumstances and considering the scarcity of lime in this neighborhood and how much it is required upon every field now being cultivated there, it is surprising that the farmers have allowed the quarry to fall shut and the draw kiln to go to decay. I know of no other limestone stratum than this Freeport lower in all the measures of Winslow township.

And even that stratum is very irregular and uncertain. But in those places where its existence is proved, and in good condition, the farmers should certainly avail themselves of it for a fertilizer.

§ 231. *The Freeport sandstone* is extremely variable. Mention has been made of its occurrence at the watering trough on the Brookville pike, just west of the Reynoldsville brewery. It is also present at Pancoast, but is there only a few feet thick. South of Reynoldsville it is shaly and indistinct.

*The Kittanning upper coal* is regular and persistent at a distance varying from 30 to 40 feet below the Freeport lower.

Fig. 37. §225.


Fig 38. §226.


Fig 39 §227


Fig. 40. §228.


It outcrops at the stable below Powers and Brown's mine, and is exposed also in an experimental shaft at Pancoast, being 2 feet thick at both places. Some good fire clay is found in the shaft a few feet above the coal, but has not been investigated. The *Kittanning upper coal* shows its outcrop on Fuller's Hill east of Reynoldsville, being there the same small seam that it is at the localities above named.

Between the *Kittanning upper* and *middle coals* the interval, amounting to 70 feet usually, is almost wholly concealed. So far as we may judge from surface appearances, the strata in this interval are mainly shales.

*The Kittanning middle coal* makes frequent outcrops on

the hills close to Reynoldsville. Thus we see it in the pike below the school house, where an opening upon it shows 2½ feet of coal, which is apparently its maximum thickness in this region. Another opening upon it at Pancoast exhibited only two feet of coal. Still another opening on Seley's Hill, in the ravine of Soldier run, revealed only 17 inches, though there is a prospect that the bed may there be thicker.

*A small nameless seam* occurs with apparent regularity in these measures at a distance of from 20 to 30 feet below the Kittanning middle coal. It was partly exposed at one time on the left bank of the Sandy Lick creek at Reynoldsville, and another outcrop of it is seen on Fuller's Hill; it shows also in the bed of Soldier run at Seley's. It was at first supposed to be the equivalent of the Kittanning lower coal bed, but this identification was proved to be incorrect, as the coal in question was found to occupy a nearly central position in the interval between the Kittanning lower and middle seams. F. Platt, in Report H, states that it is two feet thick.

§ 232. *The Kittanning lower coal seam* is in the creek bed at Reynoldsville, having there once been opened by Mr. P. W. Jenks, of the Central Land and Mining Company, in order to test its thickness and quality. The vague tradition which for years prevailed that the "creek coal" was a large and valuable seam, was forever exploded by this trial pit of Mr. Jenks, for the bed proved to be not only much broken by parting slates, but perfectly worthless for fuel. The following measurement was obtained in the trial pit:

| | | | |
|---|---|---|---|
| Roof, slate, dove colored, | | 4′ 0″ | |
| Slate, black, | | 0′ 4″ | |
| Coal, | 0′ 6″ | 0′ 7″ | |
| Slate, | | 0′ 7″ | 3′ 3″ |
| Coal, | | 1′ 7″ | |
| Slate, | | 0′–0′ 2″ | |
| Fire-clay floor, | | 4′ 0″+ | |

Mr. McCreath analyzed a specimen of the coal with the following results:

| | |
|---|---|
| Water, | .800 |
| Volatile matter, | 32.020 |
| Fixed carbon, | 51.887 |

| | |
|---|---|
| Sulphur, | 3.593 |
| Ash, | 11.700 |
| | 100.000 |
| Color of ash, | reddish gray. |
| Coke per cent., | 67.18 |
| Fuel ratio, | 1:1.62 |

Another outcrop of the same bed is seen in a railroad cutting north of Reynoldsville, near where the siding of the Diamond Company intersects.

§ 233. The geology of the *Clarion group* is so obscured by imperfect exposures that little information can be furnished respecting it. These strata rise above the creek bed between the Reynoldsville bridge and the engine-house, about one half mile towards the west-southwest, but there is not a single exposure of any of them until we see the *Brookville coal* in the railroad cut just beyond the engine-house. Careful search was made for the *Ferriferous limestone*, not only in that immediate locality, but also throughout nearly all that part of Winslow township, where its horizon is above water level, without, however, discovering a trace of the stratum. Imperfect exposures on side hills are confessedly misleading in many cases, and it cannot therefore be stated positively that the limestone is wholly absent from the measures at this place, although from present indications it seems highly probable that such is the case.

*The Clarion Coal* is also wholly concealed. The Brookville seam measures only one foot thick, and is very irregular at that.

§ 234. The *Homewood Sandstone* is above water level only in the western part of the township. Its coarse-grained massive condition causes it to be conspicuous wherever it runs. A good exhibition of it is afforded along the road leading from Donthil's mill to Carriers station, where enormous bowlders of it are abundant on the surface. A still better exhibition of it is in the cliffs along the east bank of Prior run, which ravine it converts into a wilderness, as it does also the valley of Sandy Lick creek westward from Carrier's Mills. It is not above 40 feet thick on Prior run.

*The Mercer group* is represented by the slates and small

coal seams which appear in the railroad cutting at Carriers station. The utmost variability exists in these shales and slates, and rapid changes occur within short distances. There are three coal beds in the group, of which the lower, 2′ 6″ thick in places, preserves a tolerable regularity. The upper and lower are fugitive seams which cannot be traced at all.

*The Connoquenessing upper sandstone* rises above the water level at the mouth of Prior run, but quickly disappears again under the creek bed on the west side of Perrysville anticlinal.

## CHAPTER IV.

*Containing detailed geology of Union, Pine Creek and Washington townships.*

### *Union township.*

§ 235. This adjoins the Clarion county line north of Clover township and south of Eldred. Mill creek flows northwestward through a deep and rugged valley which extends along the entire northern edge of the township. Little Mill creek (also flowing west) has cut another deep ravine a few miles further south. South of the last a short distance, and running due east and west across the center of the township is a narrow but distinct water-shed, which divides the waters of the Clarion river from those of the Red Bank. The Brookville pike follows the summit of this divide, and thus plainly marks its course upon the map. South of the divide are several small runs of which the most important are Coder run and Welch run.

*The average altitude* above sea level along the divide is about 1,550 feet, which expresses very closely the elevation of the uplands generally throughout the township. Corsica stands at this level; so does Roseville; so too does the Methodist church on the divide between the two Mill creeks. Here and there are prominent knobs, which rise for one hundred feet or so above the general average, and form conspicuous summits or "round tops." Evans round top, the most prominent feature in the topography of Union township, is an instance of one of these summits.

§ 236. The *Anthony's Bend anticlinal* crosses from southwest to northeast, diagonally through the center of the township. Its course is across Welch run at the Clover township boundary, and across the head of Coder run just east of the Evans round top; next across the heads of Little Mill creek, and next across Mill creek proper about two miles above the Olean road. It is here a very distinct fold, as it is in Clo-

ver township, with sharp dips on either flank. It lifts the Conglomerate strata above the level of Mill creek where it crosses that stream, and it makes the Kittanning group the principal surface rocks of the township.

The *Fairmount synclinal* touches only the southeast corner of the township, crossing Coder run below the junction of its two head forks, and passing thence east of Roseville.

The *Centreville synclinal* is only a short distance west of the Anthony's Bend anticlinal. It runs nearly under Corsica and crosses Little Mill creek above the Olean road. The trough which it represents is a very shallow one.

§ 237. The *outcropping rocks* comprise a section extending from the Freeport lower limestone to the base certainly of the Homewood sandstone and probably to the base of the Mercer group. It is unnecessary to present the section in detail, because it is only a repetition of that already given in Fig. 24 for Clover township. The reader has only to turn to that section, on page 89 of this volume, to ascertain the aggregate thickness of the strata, and the vertical distances separating the principal coal beds, &c. For the rest the geology of Union township will be sufficiently elucidated, for all practical purposes, when the principal openings and developments now existing there have been identified and described.

§ 238. The *village of Corsica* stands at the top of the Red-Bank-Clarion divide, among the strata of the *Kittanning group*. The *Kittanning upper coal bed* is opened on the farm of Mr. Lawrence Daly about one half mile south of, and twenty feet above the village. Mr. J. Williams has also opened the same coal on the opposite side of the road. Its thickness ranges from 2½ to 3 feet. The coal is fairly good. The dip is N. W.

An analysis by Mr. McCreath of a specimen of coal from the Williams mine resulted as follows:

| | |
|---|---|
| Water, | 2.080 |
| Volatile matter, | 34.065 |
| Fixed carbon, | 51.498 |
| Sulphur, | .827 |
| Ash, | 11.530 |
| | 100.000 |

| | |
|---|---|
| Color of ash, | grey, red-tinge. |
| Coke per cent., | 63.855 |
| Fuel ratio, | 1:1.51 |

§ 239. Continuing southward along the Troy road we approach the Anthony's Bend anticlinal and consequently pass into lower rocks. At Mr. J. G. Simpson's, close to the Clover township boundary, we find the strata uncovered in a small ravine as far down as the horizon of the *Kittanning lower coal*. The coal beds have here been sufficiently exposed to ascertain their thickness. The *Kittanning upper*, opened in a field north of Mr. Simpson's house is 3 feet thick, as at Corsica; the *Kittanning middle* is "barely 3 feet thick," according to the statement of Mr. Simpson, whose mine upon it is now closed; the *Kittanning lower*, opened in the woods south of the house and close to the level of the run, is exactly 3 feet thick, but increases to 4 feet thick and even 5 feet, further west on the property of Mr. D. D. Simpson, in the main valley of Welch run. The same bed is also opened on the Lucas farm, across the Clover township line, and is there only 3 feet thick, which is about the average for it in Union township. The *Ferriferous limestone* is not above the water level at Simpson's, but is at the hilltop further south at Lucas' on the crest of the anticlinal. It is high up in the hills also at Moore's across the Clarion county line where it is about 4 feet thick and in good condition.

§ 240. *The sandstone stratum* roofing the *Kittanning lower coal* bed is the most prominent feature of the surface geology along the upper waters of Welch run. Mention has already been made of the same sandstone deposit along the lower waters of that stream in Clover township. It shows very abundantly at D. D. Simpson's, where it makes a cliff 20 feet high. The same rock is prominent north of Corsica. The following section, which contains the Freeport sandstone in addition to the Kittanning group was obtained at Simpson's:

*Simpson section.*

| | |
|---|---|
| Hilltop, Sandstone, *Freeport Sandstone*, | — |
| Interval, Sandstone? | 60′ 0″ |
| Coal bed, *Kittanning upper*, | 3′ 0″ |
| Interval, | 85′ 0″ |

| | |
|---|---|
| Coal bed, *Kittanning middle*, | 3′ 0″? |
| Interval, Sandstone massive, | 25′ 0″ |
| Coal bed, *Kittanning lower*, | 3′ 0″ |
| | 179′ 0″ |

§ 241. Directly north of Corsica an outcrop of coal shows in the Olean road which may be the Kittanning upper, but this is uncertain. The *Kittanning middle bed* is opened at T. Orr's and also at Hindman's tenant house, on the same road about one mile northeast of Corsica. It measures 2′ 10″ thick, and consists of rather clean coal without partings. The roof is slate.

*The same Kittanning middle bed* was once opened close to Mr. J. W. Hindman's dwelling house, where it yielded, according to report, 3 feet of good coal. This is the average thickness of that seam in nearly every part of Union township, and moreover it is the best of all the coal seams yet opened there. The *Kittanning lower* is 57 feet below it at Hindman's, being close to the water level. Its reported thickness is 4 feet. The *Kittanning upper*, which has likewise been opened on this property north of the house is 2′ 10″ thick. The Freeport Sandstone crowns the hill.

§ 242. Passing now still further north along the Olean road, we cross the horizon of the *Ferriferous limestone* before reaching the waters of Little Mill creek, but there is no evidence of the rock there in any of the exposures. On the geological map I have drawn the line of the Ferriferous limestone up the valley of Little Mill creek to its head, and up the valley also of Big Mill creek to *its* head, but only for the purpose of giving clearer expression to the geological horizons. Once for all with regard to Union township I may say that while the *horizon* of the Ferriferous limestone has an extended run through it, I saw no trace of the rock in any part of it. It is without doubt absent from the measures in that region just as it is absent from Eldred township, further north, where its horizon often comes into the hills, without however exhibiting any indication of the limestone.

The *Homewood Sandstone* is abundantly shown on the surface close to the water level of Little Mill creek at Dar-

rah's saw-mill. Rising westward it makes a wilderness of that region adjacent to Long run near the Clarion line. So it does along the valley of Big Mill creek, very nearly from one side of the township to the other.

The uplands between these two creeks have a shallow covering of Coal Measure rocks. The coal bed opened near Darrah's saw-mill is apparently the Brookville, which has no value, being less than 3 feet thick, and consisting for about one half of slaty bony coal, too impure for use. The dip is quite sharp towards the southeast.

The *same Brookville (?) seam* has been opened on Mr. Joseph Aaron's land, a short distance south of Howe's saw-mill on Big Mill creek. Here as at Darrah's it carries a bench of cannel slate, but the thickness of the lower bituminous bench at Howe's is 3 feet, mostly indifferent coal. Heavy sandstone *underlies* the coal, indicating the Homewood. Heavy sandstone, no less thick *overlies* it and covers the uplands west of the Methodist church.

§ 243. The Brookville road east from Corsica is among the strata of the Kittanning group until beyond Roseville. The *Kittanning upper coal* was once opened at P. C. Love's, just east of Corsica, but is now shut. At the summit of the Evans round top, one mile southeast of the village the *Freeport lower limestone* is bare on the surface. Its exact thickness is unknown, but obviously there are several feet of it. It might profitably be quarried for fertilizing purposes. To determine its composition Mr. McCreath made a partial analysis of it with the following results:

| | |
|---|---|
| Carbonate of lime, | 92.857 |
| Carbonate of magnesia, | 1.680 |
| Oxide of iron and alumina, | 2.320 |
| Phosphorus, | .019 |
| Insoluble residue, | 2.070 |

§ 244. The *Freeport sandstone* makes an abundant outcrop on the surface extending from the limestone outcrop to the Kittanning upper coal, which latter was once opened on this farm. The same seam shows also near the hilltop at J. Haugh's, more than a mile east of Evans', where also, as at the latter place, the Freeport sandstone is a prominent feature.

The *Kittanning middle coal* is 65 feet below the Kittanning upper, being the bed that is at present mined by Mr. Haugh near his house. It is 2′ 6″ thick, roofed by slate and resting upon fire clay. The coal itself is rather slaty. The Kittanning lower bed is reported to occur near the run level, (Coder run) 60 feet below the Haugh mine.

§ 245. The *Kittanning middle coal* is also the bed mined at W. B. Cowan's, north of Roseville, and three miles east of Corsica. This is the principal mine of northwest Jefferson, supplying a large section of country with good coal. The thickness of the bed is exceedingly uniform being 3 feet in all the rooms and entries of the mine. The roof is slate, hard and compact, and 20 feet thick. The floor is fire clay.

The mine is worked by a short slope, thus necessitating the use of horse power in hoisting the coal. The main dip in the mine is towards the S. 40° W., directly along the strike of the measures, and the incline in that direction amounts here certainly to 2°. Neither towards the northwest nor southeast is there any dip at all. The incline in in the measures along their strike is obviously not continued northeastward in the same force that we see it in Cowan's mine, as in that case the coal measures would be quickly removed from the region. But that the rise in that direction, even if softened, is continuous is no less obvious from the rapid reduction which takes place in the depth of the trough in that direction.

A specimen of coal from the Cowan mine was analyzed by Mr. McCreath with the following results:

| | |
|---|---|
| Water, | 1.940 |
| Volatile matter, | 34.440 |
| Fixed carbon, | 54.000 |
| Sulphur, | .890 |
| Ash, | 8.730 |
| | 100.000 |
| Color of ash, | grey, red tinge. |
| Coke per cent., | 63.620 |
| Fuel ratio, | 1: 1.56 |

A coal bed has been opened on the J. B. Kennedy farm which may be the same Kittanning middle coal, though

more probable identification of it makes it the Kittanning lower.

Thence eastward the strata rise in that direction towards the Bagdad (or Brookville) anticlinal. The Rose township line bordering Union, is scarcely ever above the horizon of the Ferriferous limestone.

### *Pine Creek township.*

§ 246. This is the central township of Jefferson county. Originally, and for many years after the county was established, the boundaries of this township were co-extensive with those of the county itself, the other townships now existing, having since then, from time to time, been carved out of it. Why the name of "Pine Creek" was applied to the township is not apparent, unless perhaps the name was suggested by the wealth of pine forests and the abundance of water within its boundaries. Possibly also Mill creek, at the mouth of which the earliest settlement in the county was made, (1797,) may in those times have been known by the name of Pine Creek, and if so the name could advantageously have been retained for it, as Mill creek at present, in all descriptions of the county, is apt to be confounded with *Big Mill creek*, flowing between Union and Eldred townships.

No township of Jefferson county is more broken by deep ravines and valleys than this of Pine creek. Its surface indeed is a continuous succession of rugged hills forbidding alike to the farmer and miner, because in the one case tillage is next to impossible and because in the other the rocks with few exceptions contain little of value.

Within the boundaries of this township three of the principal streams of the county unite to form Red Bank creek. These are the Sandy Lick which flows along the southern edge of the township; Mill creek, flowing southwest across the township, in a ravine no less deep than the other though less wide; North Fork flowing south along the western side. Water level at Port Barnet (where Mill creek and the Sandy Lick come together, and make a curious succession of bends in the channel way) is about 1,225 feet above mean tide

Atlantic ocean; the highest summits on the upland, as for example one especially prominent point on the Reynoldsville pike east of Baum's hotel is not less than 1,750 feet above tide.

§ 247. The *Waynesburg* (*Roaring run*) *anticlinal* crosses the township at its center, while the *Bagdad* (*Brookville*) *anticlinal*, five miles distant, just touches the northwest corner. We have therefore one basin complete, on the western side of the township, the *Leechburg basin*, and a large part of another basin, *the Lisbon basin* on the eastern side. The axial lines are difficult to locate exactly in a region so sparsely supplied, as is this one, with good exposures; but it is evident from the elevation of the strata that the Waynesburg axis, which is the main anticlinal of the region crosses the Sandy Lick a short distance below Iowa mills, and Mill creek very nearly at the point where the stream, leaving the Warsaw line, enters wholly into Pine creek township. It crosses the Reynoldsville pike between Emerick and Port Barnet.

The *Bagdad* (*Brookville*) *anticlinal* crosses the North Fork above the mouth of Sugar Camp run, and has little to do therefore with Pine Creek township. But its effect upon the geology is destructive to the mining interests of that western region, reducing as it does, the coal measure covering on the uplands to the Clarion group of strata.

The basins are extremely shallow, which means of course that the dips are proportionately gentle. The *Lisbon basin* is the deeper of the two, containing as it does the Freeport lower coal, whereas in the other basin the hills never rise above the Kittanning group. The lowest rock exposed in the valleys is the *Connoquenessing upper sandstone.*

§ 248. Some good exposures of the Clarion group, including also the *Ferriferous limestone*, were found along the Richardsville road, skirting the North Fork north of Brookville. These exposures show the condition of the strata in the northwest corner of the township. Beginning at the J. S. Barr farm we see the outcrop of the *Clarion coal* in the road, the *Brookville coal* 15 feet below it, and the *Ferriferous limestone* 30 feet above it. The *Kittanning lower coal*

is 45 feet still higher, or exactly 90 feet above the Brookville seam. These conditions are repeated on the J. Hoffman farm, one half mile further north, where the Brookville coal, opened in the woods east of the house, shows the following section:

| | | |
|---|---|---|
| Slate, | | — |
| Cannel slate, | 0′ 7″ | 2′ 2″ |
| Coal, | 0′ 11″ | |
| Bony coal, | 0′ 1″ | |
| Coal, | 0′ 7″ | |
| Clay, | | — |

This is a small seam, of no value except for local supply, but it is as good apparently as any contained in the rocks hereabouts. The Clarion coal is not opened, but its outcrop is small and unpromising. The Kittanning lower is scarcely any better, if we are to judge from its outcrop in the road at the W. C. Miller's house, one half mile north of Hoffman's.

§ 249. The *Ferriferous limestone* is exposed on the Hoffman farm, in a field west of the road. It exhibits its characteristic fossils, but is otherwise almost unrecognizable because of its impure condition. Its thickness is apparently about 5 feet, but only little of it is fit for the kiln, being highly siliceous. The same rock and in the same condition is reported to have been once exposed on the Miller farm, while 20 feet below it at the latter place is a calcareous ferruginous schist, filled with fossil impressions, many of which are common to the Ferriferous limestone. At no other place in Pine Creek township than the localities above noted has the Ferriferous limestone yet been discovered, though active search has frequently been made for it on the hills where its horizon is caught. Its sandy impure condition at Hoffman's is without doubt an indication of the gradual passage of the rock into sandstone, which is then continuously its form eastward not only over Pine Creek township, but throughout all the region bordering the upper waters of the Sandy Lick.

No indication of the Buhrstone iron ore is found at Hoffman's, nor at Barr's, nor at Miller's, and it is therefore certainly absent. Another stratum of iron ore makes an abundant outcrop in one of J. Knapp's fields, 25 feet above the

Kittanning lower coal. It has not been investigated, nor would it repay such attention, as the hill which contains it is only a small knob.

§ 250. Descending from Miller's to Sugar Camp run we cross the Homewood sandstone 55 feet thick, below which is the Mercer coal, in the bed of the run. The section then, as here obtained from the different exposures along the Richardsville road is as follows, Fig. 41:

*Miller section.*

| | |
|---|---|
| Hilltop, | — |
| Shales, | 20′ 0″ |
| Iron ore outcrop, | — |
| Shales and slates, | 25′ 0″ |
| Coal bed, *Kittanning lower*, | outcrop. |
| Concealed strata, | 40′ 0″ |
| *Ferriferous limestone*, | 5′ 0″ |
| Shales and sandstone thin, bedded, | 30′ 0″ |
| Coal bed, *Clarion*, | outcrop. |
| Shales, | 15′ 0″ |
| Coal bed, *Brookville*, | 2′ 2″ |
| Clay, | 3′ 0″+ |
| Sandstone, *Homewood Sandstone*, | 55′ 0″ |
| Coal, *Mercer*, | outcrop. |
| Sugar Camp run, | — |
| Thickness, | 195′ 2″ |

§ 251. The same section is applicable to the ravine of Sugar Camp run, with the exception only of the Ferriferous limestone. The Brookville coal is opened at W. Carberry's, about one mile northeast of Hoffmans' showing from 3′ 2″ to 3′ 6″ inches thick with hard slate roof and fire-clay floor. The bed is much parted by knife edges of slate and clay, and is otherwise impure from iron pyrites.

Ascending thence south-eastward to the Ridgway road at J. Jones', we rise to the middle of the Kittanning group and perhaps to the top of it. An exposure in the roadside at this place shows a small coal bed one foot thick, underlaid by shales and thin sandstones for 10 feet, below which is a lean sandy iron ore 6 inches thick, which may possibly be the equivalent of the Johnstown Cement, thus making the coal bed the Kittanning upper. But this identification is less satisfactory than another construction which makes

the coal bed the *Kittanning middle.* The outcrop of the *Kittanning lower* is seen in the roadside a short distance further south. In one of Mr. Clark's fields the *Brookville coal* was once opened, but is no longer worked. This is in one of the branch ravines of Little Mill run.

Southward from Clark's the Ridgway road remains in the Kittanning strata until it reaches the McConnell farm, where the horizon of the Ferriferous limestone crosses from the valley of the North Fork into that of Mill Creek. There is no indication of the presence of the rock. The *Homewood sandstone* is the most distinctive feature of the geology. It is this rock that is quarried for building purposes, at the side of the Ridgway road directly above Port Barnet.

The coal bed mined by Mr. Hastings south of the Ridgway road between Brookville and Port Barnet is apparently the *Brookville seam* overlying the Homewood sandstone. It is of little value, being barely thick enough to mine profitably. It yields inferior coal. The following section was measured:

*Fig. 42, § 251.*

| | | |
|---|---|---|
| Sandstone, | | — |
| Slate, | 0′ 6″ | 3′ 6″ |
| Coal, | 2′ 10″–3′ 0″ | |
| Clay, | | — |

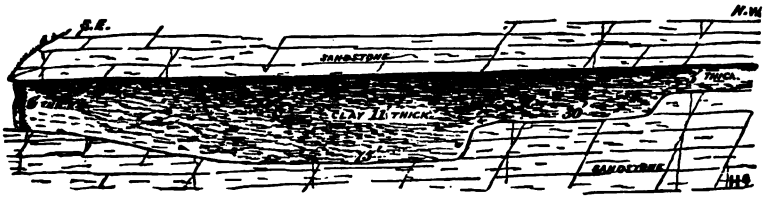
§ 252. The *Connoquenessing upper sandstone* makes the base of the hills at Port Barnet. There is a magnificent exposure of the rock in the long cut at Garrison's, and another scarcely less good in the long narrow peninsula stretching northward from the railroad, in the bend of the creek. Additional exposures of it occur below Brown and Erskine's clay pits at Bellport mills; and the same stratum may also be traced up the Sandy Lick to Iowa mills, beyond which, however, it disappears under the creek bed. As exposed at Garrison's it is 70 feet thick and may be thicker where fully exposed. It is a fine grained mass, greyish-white in color, and micaceous. Nearly all of it is irregularly bedded, so that in weathering on the hillsides it breaks up into small fragments, very unlike the great bowlders which distinguish the Homewood Sandstone at

this locality. The great masses therefore of rock which desolate the valley of Sandy Lick, and the valleys also debouching into it in the neighborhood of Brookville and Port Barnet, have come from the Homewood almost entirely, and not from the Connoquenessing.

§ 253. *Two deposits of fire clay* occur here in connection with the Connoquenessing upper sandstone. Both are very irregular in their outspread. One of them, the lower, is interleaved in the sandstone. It may be seen in the cut at Garrison's, 20 feet below the top of the sandstone deposit. Its maximum thickness is about 5 feet, but it is much too impure to mine for shipment. The other stratum almost directly *overlies* the rock. It is mined for shipment near D. Baughman's house, a short distance southeast of the cut, where its thickness varies from a mere streak of clay to 10 feet.

The most extensive development of it, however, is at Bellport Mills, two miles southeast of Port Barnet. The mining operations there have prettily shown the irregular nature of the deposit, which seems to lie in pot-like cavities in the sandstone, some deeper, some shallower as the case may be. The fluctuations in thickness in the Brown & Erskine pits range all the way from nothing to 11 feet and more. The clay is invariably cut out by sandstone, the face of which is sometimes a nearly vertical wall, and at other times is arranged in short step-like gradations, which resemble miniature terraces on a hillside. The roof is sandstone and the floor is sandstone too. The roof is a regular and even plane, sloping very gently towards the southeast; the floor, as seen in Brown & Erskine's mine, sinks rapidly at first towards the northwest, causing a similarly rapid increase in the thickness of the clay in that direction; remains then nearly level for a short distance, until the entry comes up against the sandstone wall. Many pits have been opened upon the deposit, for a distance of a few hundred feet along the face of the hill with the same result in each case. The following longitudinal section of Brown & Erskine's mine will render clearer the conditions above described:

Fig. 43. §253.




§ 254. The clay deposit is not all of the same quality, nor of the same character. The top part of it is usually sandy and worthless. Some of the clay also is hard and compact, while other of it is quite soft. The following layers were distinguished near the mouth of Brown and Erskine's mine:

| | | |
|---|---|---|
| Sandy clay, | 3′ 0″ | |
| Soft clay, | 1′ 6″ | 9′ 0″ |
| Hard clay, | 3′ 0″ | |
| Soft clay, | 1′ 6″ | |
| Sandstone, white, | | — |

In the deepest part of the pit the deposit is a most valuable one, yielding excellent clay in great abundance and cheap to mine. The exposure at the outcrop along the face of the hill extending over a distance of several hundred feet is very handsome, particularly in showing how regular here is the quality of the hard clay which is the most valuable part of the bed. The same deposit was opened on the Bell lands, east of Brown and Erskine's, but proved there to be too impure for shipment. No attempt to explore it has yet been made at any place east of that point, and there are no natural exposures of the bed.

A specimen of the hard clay from Brown and Erskine's mine was analyzed by Mr. McCreath with the following results:

| | |
|---|---|
| Silica, | 44.220 |
| Alumina, (by difference,) | 38.151 |
| Protoxide of iron, | .510 |
| Titanic acid, | 2.150 |
| Lime, | .020 |
| Magnesia, | .234 |
| Alkalies, | .035 |
| Water, | 14.680 |
| | 100.000 |

§ 255. The clay deposit at Bellport has a small coal seam above it which is never more than 3 inches thick. Another coal seam of much greater importance occurs 80 feet higher in the hill, being almost directly under the Homewood Sandstone, which there makes the summit. It is this coal bed, the *Mercer upper*, which is mined at S. Fuller's, one half mile southeast of Port Barnet. It is 2′ 4″ thick, overlaid by tough black slate, and resting upon clay, which latter was once opened on the hill at Brown and Erskine's and found to yield (according to report) tolerably good clay. The following section represents the Conglomerate strata seen on the hills in the neighborhood of Port Barnet and Bellport, Fig. 44:

*Port Barnet Section.*

| | | |
|---|---|---|
| Sandstone, massive *Homewood Sandstone*, | | 50′ 0″ |
| Slate, | | 5′ 0″+ |
| Coal, *Mercer upper*, | | 2′ 4″ |
| Clay, | | 3 0′+ |
| Concealed strata, | | 55′ 0″ |
| Sandstone, | | 20′ 0″ |
| Coal, irregular, | | 0′ 3″ |
| Fireclay, | 0′ 0″—11′ 0″ | |
| Sandstone, | | 25′ 0″ |
| Clay, impure, | Connoquenessing upper S.S., | 5′ 0″ |
| Sandstone, | | 50′ 0″+ |
| Total thickness, | | 226′ 7″ |

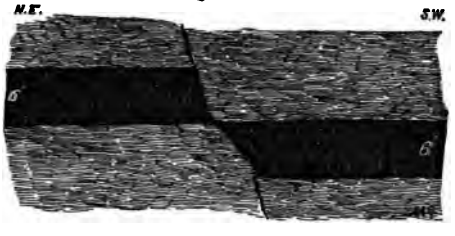
§ 256. *The Mercer upper coal*, so far as yet exposed in Jefferson county, attains it greatest thickness at Fuller's mills in the southeast corner of Pine Creek township. Some data with regard to its condition on the left bank of the Sandy Lick creek at that locality, have already been given in connection with Knox township. It only remains here to describe the openings made by the Jefferson Coal Company, and by Mr. Fuller on the right bank of the creek east of Fuller's station.

Both mines show the bed to be irregularly formed, and very much disturbed. There is a sharp rise from the outcrop northeastward, directly along the strike of the measures, amounting to upwards of 5°. So sharp indeed is the rise that it was found impossible to conduct the gangways for any distance in that direction, although the coal con-

tinued without material change in thickness so far as it was followed. There is a rise also in the strata both towards the southeast and northwest, and the coal therefore may be said to dip from every direction towards the mouth of the pit, only more gently from the northwest and southwest, than from the northeast.

§ 257. The rapid rise northeastward is a local occurrence related to the *faulting* of the bed, of which there is a good exhibition in the Fuller mine, where a downthrow of six feet has occurred, exactly the height of the bed, which thus brings the roof to the level of the floor. The plane of the fault is not exactly vertical though nearly so, and the coal in slipping has been pushed somewhat forward leaving a wedge of slate projecting beyond the faulted line. The following longitudinal section will illustrate:

Fig 45. § 257.




As will be seen from this sketch the line of fault is across the strike, thus lowering the bed in that direction *towards the southwest.* Similar displacements are reported to occur in the Jefferson company's mine, but the flooded condition of that opening at the time of my visit prevented its close examination. The topography of the hill in which these mines have been opened is not markedly affected by the faults, because these latter are invariably small, not measuring in any instance, so far as known, more than five or six feet; but they are nevertheless, small as they are, a serious impediment to cheap mining.

§ 258. The increased thickness of the bed is not due to its faulted condition. The growth is an abnormal one, of local occurrence and subject to some sharp changes. The bed, though possessing a complex structure is divisible into two

main benches, an upper and lower, of which the upper, separated from the lower by a considerable parting of slate, is much more persistent. Moreover it yields the best coal, although in this respect little can be said for the bed, as nearly all of it yields indifferent fuel. Good evidence that such is its condition is found in the fact that the Jefferson mine, though in good order and admirably arranged for shipment, is no longer operated. Herewith are two sections of the bed, one representing the Jefferson mine, Fig. 46, and the other that of Mr. A. Fuller, Fig. 47:

*Fig. 46, § 258.*

| | | | |
|---|---|---|---|
| Slate, | | | |
| Coal, | 1′ 5″ | | |
| Slate, soft, | 0′ 3″ | | |
| Coal, | 2′ 7″ | | 9′ 0½″ |
| Cannel slate, | 0′ 3½″ | | |
| Slate, hard, | 0′ 6″—1′ 6″ | | |
| Coal, | 2′ 3″ | 3′ 0″ | — |

*Fig. 47, § 258.*

| | | | |
|---|---|---|---|
| Slate, | | | — |
| Coal, | 0′ 10″ | | |
| Slate, | 0′ 2″ | | |
| Coal, | 2′ 1″ | | 6′ 0′ |
| Slate, | 1′ 3″ | | |
| Coal, | 1′ 8″ | | |

§ 259. The road leading north from Fuller's to the Reynoldsville pike is destitute of exposures above the Homewood sandstone, overlying the Fuller coal. Where this road, however, intersects with the pike the Freeport lower coal appears in a bench capping the hill. It is upwards of 300 feet above the coal at Fuller's, which is its elevation also on the south side of the creek looking towards Knoxville. We have here therefore two corresponding measurements between the Freeport lower and the Mercer seams.

The *Freeport lower coal* is twice opened on the Reynoldsville pike in the vicinity of P. Baum's hotel:—once on the Jas. Moore property near the Methodist church, and again at Baum's. Its occurrence marks the center of the Lisbon trough in this region. There is a very limited amount of the bed preserved, confined as it is to a few fields adjoining the pike. Its outcrop line is plainly distinguished by the bench

which roofs it. The overlying rocks are so much cracked and broken that the surface water percolates through them, and damages the coal considerably. The measurement of the bed is interesting, when compared with other sections of it made in the Reynoldsville region.

*Fig. 48, § 259.*

| | | | |
|---|---|---|---|
| Sandstone, | | | — |
| Slate, | 0′ | 3″ | 4′ 11″ |
| Coal, | 3′ | 11″ | |
| Slate, | 0′ | 1″ | |
| Coal, | 0′ | 8″ | |

Fig. 41. §250.

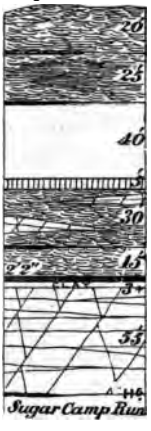



Fig. 44. §225.


Fig. 46. §258.


Fig. 47. §258


Fig. 42. §251.

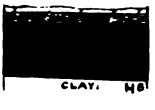
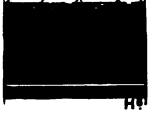



Fig. 48. §259.




§ 260. Between Baum's mine and the water level of Six Mile run at the pike the following section was constructed, which shows the *Johnstown cement bed* in its usual place about 40 feet below the Freeport lower coal bed, Fig. 49 :

11 H⁶.

*Baum section.*

| | |
|---|---|
| Sandstone, | — |
| Coal, *Freeport lower*, as above, | 5′ 0″ |
| Concealed strata, | 40′ 0″ |
| Coal, *Kittanning upper*, | outcrop. |
| Clay, | 2′ 0″ |
| *Johnstown cement*, | 2 0″ |
| Sandstone, | 30′ 0″ |
| Slates, | 22′ 0″ |
| Coal, *Kittanning middle*, | 1′ 0′ |
| Clay, | 1′ 0″ |
| Shales and Sandstone, | 10′ 0″ |
| Water level, | — |
| Thickness of rocks, | 113′ 0″ |

Most of these rocks were observed along the road east of the hotel. At Moore's there is a very marked change in the condition of things at the horizon of the Freeport sandstone, which at Baum's is a concealed interval, but which there undoubtedly consists of shales. At Moore's the sandstone is very massive and abundant, extending down a small ravine leading north from the road. Such sudden changes show how uncertain are these Coal Measure strata, sometimes within a few hundred yards.

§ 261. Westward from Baum's towards Brookville the pike gradually passes into lower strata, which slowly rise into the air in that direction. The horizon of the Ferriferous limestone is crossed, so far as it can be located, about one mile west of Emerick. There are no exposures of any kind in that vicinity to guide the observer. The Freeport Sandstone is contained at the summit of a prominent knob, a short distance southwest of Emerick.

In a northerly direction, towards the waters of Mill creek, the region is a wilderness, concerning which it is possible only to say that the Coal Measure-strata make the uplands, and the Conglomerate the valleys. Apparently the Coal Measure-covering is usually thin, not rising beyond the Clarion strata, excepting perhaps in the northeast corner of the township, where from all indications the accumulation is greater. The Homewood Sandstone is very massive, as may be seen at Schuyler's mill, and on thence along the road leading past Wm. Ohl's, through the wilder-

ness region of Mill creek. A small coal bed once opened at B. Kroh's on the uplands between Mill creek and Little Mill run, may be the Mercer upper, but of this nothing positive can be said.

### *Washington township.*

§ 262. This is situated on the eastern side of the county, adjoining the Clearfield line north of Winslow township. It is one of the largest townships of the county, being more than seven miles long, north and south, in its longest part, and nearly nine miles wide, east and west, in its widest part. The surface area, at a rough calculation is about 50 square miles, or one twelfth nearly of the entire surface area of the county.

Much of the township is unreclaimed wilderness, especially its southwest corner and its western side bordering Mill creek. The Falls creek region on the eastern side is scarcely less wild, as also the ravine of Wolf run, extending along the Clearfield line. The upland country north from Rockdale is the agricultural region, in which there are some few farms that yield a tolerably fair return considering the amount of labor expended, and the method of farming. Most of the land however is lean and rocky, and of so poor a character as only to yield a bare subsistence.

§ 263. This division of the region, as we now find it, into forest and farming land is here, as elsewhere in the county, in direct relation to the *geological structure*, but nowhere more distinctly marked than here. The *forest land* is the Conglomerate region—the region adjacent to the anticlinals. The *farming land* is produced by the Coal Measure strata, which occupy the higher stretches of the valleys and the uplands, and which follow closely the center of the basins between the anticlinals. But in Washington township, by the collapse of the Perrysville arch at Rockdale, there is a much greater outspread of these rocks and consequently more farming land than would otherwise be the case if the axis exerted the same force in the northern part of the township that it does in the southern part, or on Sandy Lick creek west of Reynoldsville. Unless indeed the axis weak-

ened as it does towards the north there would hardly be any farming land in Washington township worth naming. And there certainly would be nothing now left of the area of Freeport coals, which we see stretching from beyond Rockdale northward into the Brockwayville region.

The structure otherwise is very simple. The *Reynoldsville* or *Falls Creek anticlinal* extends along its eastern side, closely skirting the Clearfield line. The axis is not easy to locate in the wilderness region of which that section of the township is composed, but it apparently crosses Falls creek just above the mouth of Wolf run, which latter stream it then follows closely to the headwaters on McMinn's summit.

Between this axis and the *Perrysville* at the southern end of the township is the Reynoldsville Basin, of which we see a prolongation in the knobs holding the Freeport coals at Pancoast. Further north, beyond Rockdale, the synclinal axis of the trough merges with the Lisbon synclinal which then comprises a basin extending completely across the township to the Waynesburg or Roaring run anticlinal.

Although this Waynesburg anticlinal passes outside of the region under discussion, yet its effect is plainly seen in the southeast dips which prevail along all the western side of Washington township. It is responsible also for the wilderness condition of Mill Creek valley.

§ 264. *The Perrysville anticlinal*, of which mention has been made above, enters the township from the southwest at a point about one mile northwest of Sandy Valley P. O. (McGhee's Mills,) whence it runs in a straight line, subsiding rapidly, to Rockdale, where, in spite of its weakened condition, it has lifted the Homewood Sandstone above the water level, covering the surface abundantly with large bowlders of that rock, and suggesting a very appropriate name for the village located at that point. Beyond the village the only trace of the axis is a faint roll on Rattlesnake run below Armstrong's, beyond which it is lost altogether.

§ 265. *The outcropping rocks* of Washington township extend downward from the Mahoning Sandstone (perhaps from the top of it) to the base of the Homewood Sandstone, thus comprising more than 400 feet of rocks. Very likely

the Mercer group, underneath the Homewood Sandstone, is above the water level of Mill creek at the mouth of Norms run, and perhaps also above Falls creek at the mouth of Wolf run; but in both cases the exposures are too imperfect to admit of a positive statement. The various changes which the strata undergo, so far as they can be learned from the present condition of the township, will appear below in the description there given of the mining developments made by the farmers in search of coal and limestone. In general it may be said that all the main features of the Lower Productive group are present.

§ 266. Beginning at the southeast end of the township we find that the *Freeport group* extends northward from Pancoast to the J. Hutchinson farm at the edge of a small nameless ravine about one-half mile north of the Winslow township line. The *Freeport lower coal* there points into the air, and is not found in the hills north of Falls Creek, between Smith's mill and Rockdale, although several high points there, notably one at Gordon's, rise very nearly to its horizon. The bed is opened close to the roadside at Hutchinson's, showing a similar section to that at Pancost. It is herewith appended for comparison:

*Fig. 50, § 266.*

| | | |
|---|---|---|
| Sandstone, roof, firm and compact, . . . . . | — | |
| Coal, . . . . . | 4′ 7″ | 5′ 2″ |
| Slate, . . . . . | 0′ 4″ | |
| Coal, . . . . . | 0′ 3″+ | |

Towards the west the hill rises high enough to include the Mahoning sandstone, which makes however but little show upon the surface. Towards the east the coal bed rises into the air.

Descending thence by the Rockdale road to Osborn's mill on Falls creek, we travel for nearly a mile across the dip of the measures, and in so doing cross all the strata of the Lower Productive group. The Homewood Sandstone is partly above water level at Osborn's mill, being seen in the abundant masses of sandstone which are a prominent feature along the creek, eastward to Wolf's run, and westward up the Beaver Dam branch to Rockdale. There is a superb exhibition

of the deposit near Crawford's mill below Rockdale, where it crops out in a vertical cliff on the left bank of the stream. It can also be seen to advantage along Wolf run, especially in the neighborhood of Smith's mill. A small coal bed opened on the Bell farm some distance further south, belongs apparently to the Mercer group.

§ 267. North of Osborn's mill the Rockdale road quickly rises out of Conglomerate strata into Coal Measure rocks. At E. S. Gordon's, about one mile north of the mill we obtained the following imperfect section:

*Gordon section.*

| | |
|---|---|
| Hilltop, *limestone*, good, *Freeport lower?* | — |
| Interval, concealed strata, | 100′ 0″ |
| *Limestone* reported, not seen, *Johnstown cement?* | — |
| Interval, | 60′ 0″ |
| Coal outcrop, *Kittanning middle?* | — |
| Interval, | 100′ 0″ |
| Sandstone, *Homewood*, | 35′ 0″ |
| Water level, Falls Creek, | — |
| Total, | 295′ 0″ |

The coal outcrop, identified provisionally as the Kittanning middle, is reported by Mr. Gordon to be six feet thick, but this requires verification, as considerable slate and bony coal may have been included in the measurement when the bed was opened here some years ago. The limestone on the hilltop may be Freeport lower; it is certainly no higher stratum than that. The obscure condition of the lower part of the section at this place renders identification difficult. The limestone in question is of good quality, and being almost bare on the surface could be quarried cheaply, and certainly to advantage in a region where the soil, by hard farming, has been nearly drained of its fertile elements.

§ 268. *The village of Rockdale* stands at the edge of the Coal Measures just above the Homewood Sandstone. Within this latter formation and close to the village store is an extensive bog, the soil of which is saturated with natural oil —petroleum,—that has oozed from crevices in the sandstone. Pits and holes dug into the bog attest the presence of oil not only by the odor emitted by the water, but by an occasional bubble rising to the surface and covering the water

with an oily film. The occurrence has no practical significance whatever, because the formation which holds the oil is entirely above the water level a short distance to the east, so that whatever amount of oil it may have originally contained (which doubtless was small) has in time oozed out of crevices just as that at Rockdale is now oozing out. Nevertheless during the oil excitement which recently took possession of eastern Jefferson, this locality was seized upon by "practical oil men" as a favorable spot for drilling, the bog being regarded as an almost sure indication that the "Bradford Sands" 1,500 feet below the water level were oil bearing. It seems useless to point out the extravagance of these notions, because in the fever of "wild catting" the drill alone will satisfy. A test was being made during my visit to that locality in May, 1880, but had not been completed. What depth the hole attained before work was stopped I have not been informed, nor of its results.

§ 269. The hills directly north of Rockdale and east of it contain the Coal Measure strata to the top of the Kittanning group. The coal beds are small and no opening upon them is now worked close to the village. On the N. Cooper farm one mile west of Rockdale, on the main branch of Falls creek, the following important section was obtained showing the Ferriferous limestone and the Johnstown cement, only 120 feet apart. This quarry at Cooper's is the only exposure of the Ferriferous limestone in Washington township, although the horizon of that rock is far above the water line of every important stream. Its identification at Cooper's is rendered certain by its characteristic fossils, with which it is fairly crowded. Its color is very dark, which is an unusual feature, being generally of a greyish hue. The section of the hill is as follows, Fig. 51:

*Cooper section.*

| | |
|---|---|
| Hilltop, | — |
| Shales, | 20′ 0″ |
| Coal bench; *Freeport lower*, | — |
| Shales and concealed rocks, | 40′ 0″ |
| Sandstone, *Freeport Sandstone*, | 30′ 0″ |
| Coal bed, *Kittanning upper*, | outcrop. |
| *Johnstown cement*, | outcrop. |

| | |
|---|---|
| Shales and thin S.S., | 30′ 0″ |
| Coal? *Kittanning middle*, | ? |
| Concealed rocks, | 60′ 0″ |
| Coal? *Kittanning lower*, | — |
| Shales, | 30′ 0″ |
| *Limestone, Ferriferous limestone*, | 5′ 0″ |
| Water level, | — |
| Thickness, | 215′ 0″ |

§ 270. The coal beds are unopened and are probably small. The principal seams of North Washington, as will presently appear from the sections, are those of the Freeport group, which the hill at Cooper's only partially includes. The Brookville coal, under the water level at Cooper's, comes out further south on the J. Crawford land where it is exposed 30 inches thick, roofed by black slate and shales, above which are thin sandstones. The coal itself is slaty and poor. It has also been opened on Kyle's property near by. It is exactly 65 feet below the Ferriferous limestone.

Proceeding now to the northern part of the township where the Freeport coals have been considerably developed, we obtain very satisfactory sections of them at a number of localities. It may be stated in advance that both the Freeport coal beds are underlaid by limestone, and that the Johnstown Cement underlying the Kittanning upper is here also an unfailing accompaniment. Indeed there is no better key to the geology of this region, than that which this "bastard limestone" affords.

We see the *Johnstown Cement* in the well at Wm. Keys near the Baptist church, about one mile northwest of Rockdale. It is ferruginous and very impure. The *Kittanning upper coal* makes an outcrop in the road at the church, where also the overlying *Freeport Sandstone* is partially exposed.

The *Kittanning middle coal bed* outcrops in the fields of Mr. Keys' farm 35 feet below the cement. The same coal bed apparently is opened on Mrs. Teadley's property about three quarters of a mile towards the northwest, and measures between 3 and 4 feet thick, but is very irregular. It is roofed by sandstone.

§ 271. At Jno. Ross' near the Covenanter church, one mile northeast of Mrs. Teadley's, and 2½ miles northwest of Rock-

dale, the following section was obtained, which shows the Freeport group with both its limestones. The Kittanning upper coal is also included, but the cement bed is not exposed, Fig. 52:

*Jno. Ross section.*

| | |
|---|---|
| Shales and sandstone, Mahoning S.S., | 60′ 0″ |
| Coal outcrop, *Freeport upper*, | — |
| *Limestone*, | 3′ 0″+ |
| Slates and shales, greyish, | 50′ 0′ |
| Coal bed, *Freeport lower*, | 4′ 7″ |
| Clay, | 8′ 0″ |
| *Limestone*, | 4′ 0″ |
| Sandstone, *Freeport sandstone*, | 20′ 0″ |
| Coal bed, *Kittanning upper*, | 2′ 0″ |
| Thickness, | 151′ 7″ |

The above section is typical for this neighborhood and will apply also along Rattlesnake run towards the west. The Freeport upper coal is not here worked, but the Freeport lower is mined both on the Ross farm and also at J. Morrison's a short distance further west. It is considerably parted at Ross's as will be seen from the following measurement there made of it:

*Fig. 53, § 271.*

| | | |
|---|---|---|
| Coal, | 1′ 6″ | 4′ 7″ |
| Slate, | small. | |
| Coal, | 0′ 6′ | |
| Slate and bony coal, | 0′ 2″ | |
| Coal, | 1′ 1″ | |
| Slate and bony coal, | 0′ 2″ | |
| Coal, | 1′ 2″ | |

At Morrison's the upper bench measures 1′ 2″, and the lower bench 10 inches, the parting slate being only 3 inches. The bed is also mined at Wm. Patten's a short distance southeast of Ross, where also it is 5 feet thick and in excellent condition, of which latter fact the following analysis by Mr. McCreath of a specimen from Patten's mine, is sufficient proof:

| | |
|---|---|
| Water, | 1.870 |
| Volatile matter, | 32.450 |
| Fixed carbon, | 61.103 |

| | |
|---|---|
| Sulphur, | .547 |
| Ash, | 4.030 |
| | 100.000 |
| Color of ash, | cream. |
| Coke per cent., | 65.68 |
| Fuel ratio, | 1:1.88 |

No better coal than this is obtained from any part of the Reynoldsville Basin.

The Freeport lower limestone is quarried at J. Morrison's, where the following section of it was obtained:

| | | |
|---|---|---|
| Limestone, good, | 1′ 3″ | |
| Clay shales, | 0′ 5″ | |
| Limestone, | 0′ 6″ | 4′ 1″ |
| Limestone, impure, | 0′ 8″ | |
| Limestone, good, | 1′ 3″ | |

Mill creek at Allen's Mills east of Morrison's is 200 feet below the limestone quarry at the latter place, and therefore below the Coal Measures; but the Homewood Sandstone, being here shaly, is indistinct. It becomes more prominent further south, as it does also further north. The Mill Creek valley is wholly unexplored.

§ 272. *Rattlesnake run* is a branch of the Little Toby. It starts at the Covenanter church above alluded to and flows a direct course eastward along the northern edge of Washington township. It flows over nearly horizontal rocks, starting at the top of the Mahoning Sandstone at the church, and cutting down to the horizon of the Kittanning middle coal at Lane's mill, where it turns due north and runs into Snyder township.

Its side slopes therefore contain the valuable Freeport group, which, some day in the future, when this basin finds an outlet towards the north, will command the attention of capitalists. There is a large expanse of superb coal between the church and the mill. The principal seam is the Freeport lower of which there are several exposures, notably at Wm. Keys' and at Ross' about one half mile east of the church, and also at R. Smith's south of Lane's mill. The bed is extremely handsome, being compact and bright and clean. Four and a half feet of coal can be obtained from

one compact bench. It is underlaid by limestone just as it is west of the church.

The following section, obtained on James McMinn's land at Lane's mill, is typical for the Rattlesnake valley so far as the distances between the coal beds are concerned:

Fig.49. §260.

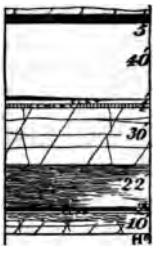



Fig.51. §269.

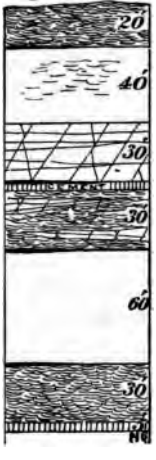



Fig.52. §271


Fig.50. §266

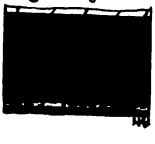
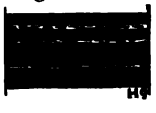


Fig.53. §271.



| | |
|---|---|
| Coal bed; *Freeport upper*, | — |
| *Limestone*, | — |
| Interval, | 30′ 0″ |
| Coal bed; *Freeport lower*, | — |
| *Limestone?* | — |
| Interval, | 40 0″ |
| Coal bed; *Kittanning upper*, | — |
| *Johnstown cement*, | — |

§ 273. By applying this section to the different exposures, identifications are easily accomplished. At T. Armstrong's for example we find the Freeport upper limestone

nearly at the hilltop, and the Freeport lower coal, which is here small, measuring only about 3 feet thick, 20 feet below it. At Wm. McCullough's it is the Freeport upper coal that is mined near the hilltop, and it is the Johnstown Cement that is exposed in the woods, 80 feet below. The coal bed is upwards of 4 feet thick, and in good condition.

At James Patton's, adjoining Armstrong, the Freeport upper coal (which was cut through in the well) measures only 3 feet thick. At Morrison's it is the same. This is its thickness also at Brockwayville.

### *Eldred township.*

§ 274. This comprises an extensive area bordering on Clarion county south of Barnet and Heath townships. It is in the northwestern part of Jefferson county.

Its eastern and western sides consist of rugged forest land in which there is some timber of value. The cleared and cultivated portion of the township lies mainly along the Brookville and Sigel road, which follows a high and narrow divide, running almost due north. This divide is crossed at Sigel, in the northern part of the township, by another belt of high land extending nearly east and west, so that the skeleton of the drainage system has the shape of the letter T. North of the cross-piece (along which runs the Spring Creek road) the waters go direct into the Clarion river; south of it and on the left hand side of the upright arm of the letter, they go into Big Mill creek, while on the right hand side of that arm they flow into the North Fork.

§ 275. *Three anticlinals* and *two synclinals* cross the township from southwest to northeast. The anticlinals are (1) *the Bagdad* (*or Brookville*) *axis* which touches only the southeast corner of the township: (2) the *Anthony's Bend axis* which first crosses Big Mill creek near the mouth of Strainer run (above the Olean road); crosses the same stream again not far from Thompson's saw-mill; passes almost directly under Sigel, whence it runs through Heath township to the Clarion river. The third anticlinal is the *Kellersburg arch* which passes through the wilderness region west of the Kahle settlement, in the northwest corner of the township.

The synclinals are (1) the *Fairmount*, and (2) the *Centreville*. The latter is so indistinct that it is impossible to trace it over the thickly-wooded country through which it passes; but its effect is observable in the flattening of dips between Sigel and Kahle. The Fairmount synclinal crosses the Brookville road at the United Presbyterian church about midway between Sigel and Brookville. It brings the Freeport lower limestone into a high knob on the Wyncoop farm just north of the church, this being moreover, the only locality in the township at which that rock occurs; for the axis in rising rapidly towards the northeast shoots those measures into the air in that direction.

§ 276. *The outcropping rocks*, beginning at the top with this *Freeport lower limestone* embrace the different strata to the base of the *Mercer group*. The most prominent feature of the geology is the *Homewood Sandstone*, which overspreads much of the surface of Eldred township, making rock cities in some localities, and creating a wilderness where ever it runs. The same rock extends northward at the surface, and fairly desolates Heath township. It is massive, coarse-grained and about 50 feet thick.

The *Mercer group* underlying it contains two coal beds 40 feet apart, which traverse the township with tolerable regularity. These are the coals at Sigel, as they are also the coals west of Kahle.

The coal beds above the Homewood Sandstone have been but little developed.

The *Ferriferous limestone* was not seen at all. Whether it is entirely absent from the measures in this township could not be satisfactorily decided for want of good exposures, but such nevertheless seems to be the case. It can be followed from Brookville nearly to the Eldred township line, when hold is lost of it, and not regained, though the country northward for miles is high enough to contain it.

§ 277. The following detailed description of the exposures and mining developments advances northward along the Brookville road. Just south of the township line the *Homewood sandstone* is seen in the road with the upper of the *Mercer coals* underlying, which latter was once opened at the

township road, but which is now closed. Traced northeastward about one mile it is opened at J. Mineweaser's, where it shows the following section:

*Fig. 54, p. 201.*

| | | |
|---|---|---|
| Coal, | 0′ 4″ | |
| Slate, | 0′ 3″ | 3′ 5″ |
| Coal, | 2′ 10′ | |

The coal at the best is both pyritous and slaty, but answers well enough for local domestic use. A specimen analyzed by Mr. McCreath showed as follows:

| | |
|---|---|
| Water, | 1.350 |
| Volatile matter, | 39.615 |
| Fixed carbon, | 48.532 |
| Sulphur, | 1.238 |
| Ash, | 9.265 |
| | 100.000 |
| Color of ash, | grey. |
| Coke per cent., | 59.035 |
| Fuel ratio, | 1:1.22 |

§ 278. The same coal bed is again opened at Andrew Singer's, one half mile towards the north. Ascending the hill thence westward to the property of Mr. F. D. Smith, we find three coal beds in a high knob west of the dwelling house. When connected with the mine at Singer's the section reads as follows:

*Smith section.*

| | |
|---|---|
| Hilltop, coal at surface, | — |
| Sandstone, thin bedded, and shales, | 62′ 0″ |
| Coal bed, | 1′ 3″ |
| Interval, shales, | 32′ 0″ |
| Coal bed, unexplored, | — |
| Interval, | 40′ 0″ |
| Sandstone, *Homewood S.S.*, | 60′ 0″ |
| Coal bed, Singer & Mineweaser, | 3′ 0″ |
| Total, | 198′ 3′ |

§ 279. Between Smith's house and Park's saw-mill the road traverses smooth argillaceous shales, belonging to the Kittanning group. At Mrs. Wyncoop's near the United Presbyterian church a prominent hill rises westward to the horizon of the Freeport lower limestone, which is just caught in the summit. The rock is of fairly good quality,

and would supply cheap fertilizing material. Several of the underlying coal beds outcrop between the limestone and the road, but all are unexplored. The following section was leveled:

*Wyncoop Section.*

| | |
|---|---|
| *Limestone*, | — |
| Interval, | 55′ 0″ |
| Coal, *Kittanning upper*, | ? |
| Interval, | 30′ 0″ |
| Coal, *Kittanning middle?* | — |
| Interval, | 50′ 0″ |
| Coal, *Kittanning lower?* | — |
| Total, | 135′ 0′ |

§ 280. The position occupied in the series by the bed there worked cannot be determined exactly, because of insufficient exposures, but it is apparently the Brookville. E. Robinson's mine is situated one mile northwest of Wyncoop's. The dip is quite sharp towards the southeast, with an independent pitch towards the southwest, along the strike shows how the basin settles in that direction. The coal bed is 3′ 6″ thick, consisting of bright firm coal, well protected from moisture by a compact roof of tough black slate. The coal in some parts is pyritous, but considering all things, it is beyond comparison the best seam that has yet been exposed in Eldred township.

§ 281. Northward from Park's saw-mill the road is just above the Homewood Sandstone, which latter rock becomes more and more conspicuous as it rises gradually to the hill-tops, and overspreads the surface at Sigel. We see it in great abundance in the fields northeast of Mr. Park's house, and also at John Lindsay's. It makes a high bench, which turns directly westward at D. Brocious's, to extend across the Brookville road at the head of Big Mill creek. To follow its course in detail is here unnecessary, because it is unmistakable on the surface at all points. The traveler along the Spring Creek road eastward from Sigel will have it in plain view for miles; so it is also west of Sigel, and especially west of D. Kahle's, near the Clarion county line, where the surface is literally covered with bowlders of massive rock.

§ 282. Some openings have been made on the coals of the

Mercer group, underlying this sandstone, southwest of Sigel. The upper of the seams is 2 feet thick, and the lower sometimes 3 feet thick but variable. Between them is an interval of about 40 feet, composed of shale and thin-bedded sandstones. Openings have also been made on the same beds northeast of Park's saw-mill, on the waters of Shippen run, where their condition is similar to that above mentioned. We find them also at Wm. Rinsel's in the northeast corner of the township, and they have been further identified in Heath township, as is described on another page.

The upper of the coals,—the Mercer upper—has been opened on the L. C. Wynkoop's farm close to the Presbyterian church, one mile southwest of Sigel, and again on the J. Stahlman farm on the opposite side of a narrow ravine. Both banks are now closed. The same seam is exposed close to the roadside further south on the H. G. Katz farm where it shows its usual thickness of two feet. It is the same Mercer upper seam that has been opened by Hutchinson at a higher level towards the west, and by Mr. E. Brocious at a lower level towards the south. It may further be seer on the Geo. Park's farm near the school-house. Its thickness nowhere exceeds two feet.

The lower seam has been less explored. The best exposure of it is on the land of Mr. Jas. Fiscus near the Catholic church, where, though larger than its congener above, is rather inferior to it in quality. It yields here in fact very poor coal. It has been opened on the Walter Bryant lands east of Parks, and at H. McIntire's west of Kahle, being smaller at each of these places than at Fiscus', but composed of rather better coal. The section at the Fiscus mine is as follows:

| | | |
|---|---|---|
| Slate, | | — |
| Coal, | 2′ 4″ | 3′ 8″ |
| Slate, | 0′ 4″ | |
| Coal, | 1′ 0″ | |

Sandstone is seen in the bottom lands below the mine. The rock is apparently in place, and if so it is the equivalent of the Connoquenessing Upper Sandstone.

§ 283. That part of the township lying north and east of Big Mill creek must await some explorations before any

thing positive can be determined of its geology. The coal measure strata above the Homewood Sandstone undoubtedly cap the uplands, but whether they rise to the horizon of the Kittanning group is unknown.

§ 284. Since completing the survey of Elder township, I have been favored by Mr. S. W. Smith of Brookville, with a specimen of iron ore from the property of Mr. Perry Kahle, three miles west of Sigel. Mr. Smith does not locate exactly the *horizon* of the ore, but I conclude from his remarks that it is below the Homewood Sandstone. The ore is a limonite, from the alteration of a bed of siliceous ironstone. Mr. Smith, who conducted the explorations recently made upon it, stated that the bed showed the following measurements.

| | | |
|---|---|---|
| Ore, | 1′ 5″ | |
| Clay Shales, | 1′ 0″ | 3′ 5″ |
| Ore, | 1′ 0″ | |

Thus showing 29 inches of ore in a depth of 3½ feet.

The ore is siliceous, but otherwise of good quality. A specimen of it forwarded by Mr. Smith to the Laboratory in Harrisburg, was analyzed by Mr. McCreath with the following results:

| | |
|---|---|
| Sesquioxide of iron, | 62.500 |
| Sesquioxide of manganese, | .620 |
| Alumina, | 2.172 |
| Lime, | .650 |
| Magnesia, | .396 |
| Sulphuric acid, | .072 |
| Phosphoric acid, | .778 |
| Water, | 10.684 |
| Siliceous matter, | 22.340 |
| | 100.212 |
| Metallic iron, | 43.750 |
| Metallic manganese, | .432 |
| Sulphur, | .029 |
| Phosphorus, | .340 |
| Phosphorus in 100 parts of iron, | .777 |

## *Warsaw township.*

§ 285. This is the largest township of Jefferson county, embracing as it does an area of about sixty square miles, or one tenth nearly of the entire surface area of the county.

It consists mainly of elevated upland, thinly covered with Coal Measure rocks. Much of the surface is too rugged to repay cultivation, and a good part of the township therefore is uncleared land.

*The drainage* goes south through the valleys of Mill creek and the North Fork into the Red Bank. Mill creek forms the eastern boundary of the township south of the Snyder line. Its valley is more than 300 feet deep, usually with rather steep slopes, along which runs the outcrop of the Homewood Sandstone, nearly to the Snyder township line. Mill creek has few tributaries, and none of any size, except Little Mill creek which starts at Maysville.

The North Fork on the other hand has several important affluents, all of which flow through wide ravines. The main stream enters the township at the northeast, and flows westward, keeping close to the Polk township line, until it comes up against the Bagdad (or Brookville) anticlinal which deflects it by a sharp bend, whence its course is southwestward almost directly following the axial line. The valley is from 300 to 400 feet deep, and is a total wilderness from end to end. A great variety of forest scenery is thus presented,—from a broad expanse of unbroken wilderness extending as far as the eye can reach in every direction over hill and valley, to some extremely picturesque views along the water line, where the stream, of crystal clearness, flows, at times, under a nearly perfect arch formed by the overhanging boughs. Moreover the slopes are often thickly clothed with laurel, which furnishes them in early summer with a wealth of flowers.

§ 286. *The Homewood Sandstone* makes a continuous line along the valley, being often high up on the hills. It is nearly everywhere a massive rock, whose thickness cannot be determined exactly, but which is certainly not less than 50 feet and possibly much more. There are no exposures of the Mercer group, nor of the Connoquenessing Sandstone, both of which are certainly above the water level.

Of the *Lower Productive* strata the uplands seldom contain more than the Clarion and Kittanning groups, which however is sufficient to insure a large outspread to the hori-

zon of the Ferriferous limestone. This line I have laid down on the map, making it underlie all the upland country in the eastern part of the township, and a good part of that also is the western. Of actual exposures of the rock however there are very few. The line is intended to indicate the geological horizon involved, and *not the actual existence of the rock.* Indeed I am strongly disposed to believe that the stratum is entirely absent from the measures on both sides of the Pekin run valley, especially as just south of this, in Pine creek township, the stratum where last seen (at J. Huffman's) has a sandy appearance totally unlike itself. The limestone reappears in the eastern part of the township and also in the northern, as will presently be related in the detailed description of those regions.

At one locality northeast of Maysville, situated within the Leechburg Basin, a high knob possibly contains the Freeport group, and has been colored accordingly on the map. It is the only occurrence of these rocks in the township.

§ 287. The township is crossed by the *Waynesburg anticlinal* on its eastern side, and by the *Bagdad* (*Brookville*) *anticlinal* on its western side. Both are here important folds, which become even more important further north. Anticlinals and synclinals are rising rapidly northeastward, causing the Coal Measure strata gradually to disappear into the air in that direction.

The *Leechburg Basin* is a very shallow trough in Warsaw township. We may judge of its condition in this respect by the fact that from the Waynesburg arch at Petersburg, with the Ferriferous limestone on its back, to the centre of the trough, two miles distant, there is only a single knob that contains the Freeport strata. The measures, in fact, *across* the basin, are nearly horizontal; the average dip is certainly not more than 1° if actually that much; while the average rise towards the northeast is certainly ½° if not more.

The course of the anticlinals can be located only approximately as the exposures are much too incomplete to fix them definitely. *The Waynesburg arch* crosses Mill Creek a short distance below H. Potts' farm, where it causes the

Homewood Sandstone to ascend nearly to the hill tops. It crosses the Ridgway road directly west of Petersburg, as above mentioned, and next crosses Beaver run in the southeast corner of Polk township. *The Bagdad anticlinal* traverses the region west of Pekin, and west of Richardsville.

§ 288. The condition of the Coal Measure strata on the eastern side of Warsaw township may be partially seen in some exposures along the Mill Creek Valley, and in the tributary ravines, between Allen's Mills on the south and the Ridgway road on the north. The exposures are too widely separated and too fragmentary to enable a continuous section to be formed of them, but in the matter of interval distances between the strata there is obviously little or no change from the usual section, so that the present purpose will be answered if the different strata which come to daylight are pointed out and identified.

§ 289. Beginning with water level at Allen's Mills, the Homewood Sandstone is there partly exposed. The Brookville and Clarion coals make no outcrop along the road between the mills and the school-house. Neither do they towards the northeast, unless we regard as the Clarion bed a small outcrop of coal and slate directly underneath the Ferriferous limestone at C. E. Temple's.

*The Ferriferous limestone* has been repeatedly exposed in the ravine of Hemlock run, east of Petersburg. It may be seen on the Isaac Temple farm close to the Ridgway road, where it has been quarried to some extent for fertilizer. Only a portion of it has here been removed, but at C. E. Temple's, a little more than a mile distant, towards the east, the deposit measures nearly 5 feet thick—all good stone. It shows its usual lithological aspect, and is thickly crowded with its characteristic fossils. The rock has also been quaried on the J. Raught farm, between the Temple properties.

It here supports a thin layer of the Buhrstone iron ore, which however has no practical significance, being too thin to work. Five feet above the ore is the Ferriferous coal seam, which according to Mr. C. E. Temple measures 3 feet thick where once opened on the Isaac Temple tract.

*The Kittanning lower coal* is 32 feet above the last, and

37 feet above the limestone. It is a small seam, measuring 2½ feet thick at the best. Its outcrop may be seen on the Ridgway road, directly west of Hemlock run. An opening was made upon it at C. E. Temple's.

This coal at Petersburg is roofed by sandstone, which latter corresponds with the stratum seen along the slopes of Mill creek below Smith's. The Kittanning middle Coal bed was not detected.

§ 290. *The Kittanning upper seam* is that which outcrops on the Jno. Shadle farm, east of the dwelling-house. It is reported to be underlaid by "bastard limestone" but this was not seen. The coal is 2 feet thick, with a thin layer of black slate above it, above which is massive coarse-grained sandstone, representing the Freeport. The rock caps the hill at this place, which it covers with bowlders of rock. Toward the northeast it grows more shaly and becomes quite indistinct. This is the highest stratum in eastern Warsaw. Rising northwest it is shot into the air before reaching Petersburg, which latter place is just above the Kittanning lower coal. The sandstone at Petersburg, and west of that place, especially about the head-springs of Mather run is the Kittanning lower sandstone, corresponding with that above mentioned as occurring along Mill creek.

§ 291. Towards the west the Ridgway road, rising above this sandstone, traverses shaly rocks until beyond Maysville. The basin deepens sufficiently to admit the Kitttanning group into the uplands. The high knob, containing possibly the Freeport group, northeast of Maysville, has already been alluded to. It is on the Geo. Wilson farm, and contains three beds of coal. At the top is a sandstone bench 65 feet high. The section is as follows:

*Wilson section.*

| | |
|---|---|
| Sandstone, | 65′ 0″ |
| Coal, | ? |
| Interval, shales and slates? | 45′ 0″ |
| Coal, | 1′ 6″ |
| Interval, | 20′ 0″ |
| Coal, | 3′ 3″ |
| Interval, | 40′ 0″ |
| Coal, | 5′ 0″ ?? |
| Total, | 179′ 9″ |

It is difficult to satisfactorily identify these coals, but the best that can now be done in that direction is to make the lowest seam the Kittanning lower; that next above the Kittanning middle, and the small seam the Kittanning upper. The unexplored bed then becomes the Freeport lower.

§ 292. The Kittanning upper was seen only at one locality in the vicinity of Maysville, namely in the spring at Wilson's house. The next seam below is mined by Wilson, and also by Mr. J. Hick on the property next adjoining towards the north; it has further been opened by W. Fred erick west of Hick, and by Mr. C. B. Irvin at Maysville.

Its thickness ranges from 3 to 3½ feet, with slate both in in roof and floor. The coal is clean, without partings and is hard and good.

Very likely it is the same Kittanning middle bed that is wrought at A. Vasbinder's, on the waters of Seneca run, 2½ miles north of Maysville.

The lowest bed of the Maysville section is reported to be 5 feet thick at several localities, but no opening at present exists upon it. Mr. Irvin claims to have found it that thick on his property close to Maysville; Mr. Wilson claims the same; so does Mr. A. Snyder, one mile northwest of the last. At Petersburg as we have before seen the bed is only 2½ feet thick.

*Limestone* is reported to occur near the cheese factory south of Maysville, but no traces of it are now exposed. It is in place for the Ferriferous limestone. Sandstone occurs a short distance below the factory.

§ 293. The Ridgway road crosses the horizon of the Ferriferous limestone in the vicinity of the school-house, one mile west of Maysville, where also the Homewood Sandstone is at daylight. Towards Buller's Mill on Little Mill creek this sandstone makes a conspicuous display on the surface; but the region west from that stream towards the North Fork is covered with Coal Measure rocks to the horizon of the Kittanning group.

The Richardsville road crosses Pekin run in Conglomerate strata. On the divide between Pekin run and the North Fork the road rises into Clarion strata but not higher than

that. The Brookville coal makes an outcrop at J. D. Snyder's, but is unexplored. The same bed has been opened at M. Humphrey's, one mile west of Richardsville, where it is at least two feet thick.

§ 294. *The village of Richardsville* is built among Conglomerate strata. The top of the Homewood Sandstone is at the school-house at the southern end of the village. It is 180 feet above the water level of the North Fork. The rock is very massive, and is abundantly shown on all the slopes.

Ascending the north side of the valley, the Brookville coal makes an outcrop, as beforementioned just above the sandstone. Thence northeastward there are no exposures until the Ferriferous limestone is met at W. Dixon's, adjoining the Polk township line, 3 miles northeast of Richardsville. The rock has been quite extensively quarried at this place for use as fertilizer. It is certainly 5 feet thick, and may be more. It quarries easily, and makes good lime.

Underneath it is a deposit of bony coal and slate, corresponding to a similar deposit seen at Temple's near Petersburg. The Kittanning lower coal makes an outcrop in the road 30 feet above the limestone, but is unexplored.

### *Snyder township.*

§ 295. This occupies the northeast corner of Jefferson, and has therefore the Elk county line for its northern boundary, and Clearfield county for its eastern. At a rough estimate of its surface contents, the area enclosed is between 35 and 40 square miles.

The northern part of the township is an almost unbroken wilderness on both sides of the Little Toby, being made so by the near approach of the Homewood Sandstone, in very massive condition, to the uplands there. The southern part, covered by Coal Measure strata, is the agricultual part, and is mostly cleared land. The Ridgway road, crossing the township from east to west, very nearly defines the forest region from that under cultivation.

*The drainage* is mainly into the Clarion river through the valley of the Little Toby and its tributaries. At the western side of the township the headsprings of Mill creek inter-

lock with one branch of the North Fork. It is interesting to observe how very small is the interval separating these Red Bank waters from the Little Toby. Those of Mill creek in fact approach, in places, nearly to the abrupt hills which overlook the other stream.

§ 296. *The geological structure* consists of a synclinal trough which extends from the southeast side of the township to its northwest side. The center line of the basin, or itsdeepest part is at Brockwayville. The eastern side has gentle dips; the western side has much sharper ones, which at the northwest, approaching the summit of the Waynesburg (Roaring run) anticlinal amount to at least 5°. This lack of symmetry in the two sides of the Basin is plainly expressed by the geological map, which shows how the Barren Measure strata are confined to the hills at Brockwayville and the region east of it. Towards the west they are quickly shot into the air, leaving the Ferriferous limestone to cap the hills west of Mill creek.

*This Brockwayville basin*, nine miles wide, is made by the union of two troughs into one: the Reynoldsville (or Lisbon) and the Smicksburg. It has already been explained that the junction of the two is effected by the extinction of the Perrysville anticlinal at Rockdale, which further south, as far as the waters of Crooked creek in Armstrong county, is the dividing line between them. There are indications of a faint roll directly east of Brockwayville, which may possibly be the dying end of the Perrysville arch, but it is too feeble and too indistinct to be traced southward under the uplands of Washington township, to where it must unite with the main axis in full force at Rockdale.

The matter is not one of practical importance as the roll in question scarcely affects the dips at all. Of much greater consequence is the rise of the main axes towards the northeast, along their strike, which so rapidly diminishes the depth of the Basin in that direction, as practically to confine the Freeport coals at Brockwayville to the hills south of the Little Toby. This northeast rise (which is independent of the main dips northwest and southeast) is plainly shown in the mines at Brockwayville, where the farmers so far as

practicable, have invariably selected the southwest side of the hills to open their coal seams.

It is unnecessary here to more than refer to the anticlinal axes bounding the Basin—the *Falls creek axis* at the southeast and the *Waynesburg axis* at the northwest—because they barely touch the township, and because also their condition at these particular localities has elsewhere been minutely described. The Waynesburg arch crosses the Little Toby at the northern edge of the township, where its strength is scarcely inferior to that of any axes in Northwest Pennsylvania, giving, as it does, a hoist to the rocks of between 500 and 600 feet. The Falls creek axis is at the Clearfield line.

§ 297. *The outcropping rocks* of Snyder township extend in downward order, from the top of the Mahoning Sandstone to the top of the Pocono Sandstone—in all not less than 700 feet of strata, of which the upper 100 feet belong to the Lower Barren Measures, the next 300 feet to the Lower Productive Coal Measures, and the lower 300 feet to the Conglomerate and sub-conglomerate strata.

*Of the Pottsville Conglomerate group*, and the underlying Mauch Chunk shales, no differentiated section can be made, since the valley of the Little Toby, in which they occur, is a total wilderness from the place at which they rise above the water level to the Elk county line. The most conspicuous feature is the Homewood Sandstone. It is a coarse pebble rock, with smooth, rounded, milk-white quartz fragments of all sizes from a pea to hen's egg. Some of the rock bowlders on the hillsides are immense, and the stratum from which they have broken is certainly not less than 40 feet in height. Its thickness may be even greater, but there are no good exposures of it in place to determine this question.

That its pebbly condition is merely a local occurrence, confined to the region of the Little Toby, is well shown by the exposures at the western side of the township, along the North Fork waters, where the rock is no less thick and no less massive, but to all appearances without a single pebble. The width of the pebble belt on the Little Toby is certainly equal to the width of the present valley, since the rock is

found in similar condition on both the east and west slopes. This distance at Galusha's saw-mill is something more than one-half mile.

§ 298. At several places in the valley, but notably in the region of Galusha's mill, a stratum of *red shale* was observed at a point about 100 feet below the top of the Homewood Sandstone. This shale is at the horizon of the Mercer group, unless indeed the entire *Pottsville Conglomerate* series, as now arranged, is represented by 100 feet of rock, which is improbable considering its condition in the region southwest, and also northeast in Elk county. The red line on the map, expressing the *Mauch Chunk formation*, is placed at a much lower horizon than the shale layer above mentioned, being supposed to occur at a distance of about 300 feet below the top of the Homewood Sandstone. I could not distinguish the Mauch Chunk formation at that horizon either along the Little Toby, or along the Clarion, and whatever may be its thickness at those places, its color is certainly not red. It consists in fact of grey sandstone.

§ 299. *The Coal Measure strata* occupy the uplands of the township, but as before stated, the greatest accumulation of them is south of the Little Toby at Brockwayville. Exposures are frequent, especially of the Freeport group, which contains the only coal beds of value. A tolerably complete section of the Lower Productive series was obtained, of which the upper part, to the horizon of the Johnstown Cement, was observed in the hills at Brockwayville, while the lower part was secured from exposures in the western side of the township. The section reads as follows, Fig. 55, p. 201:

*Brockwayville section.*

| | |
|---|---|
| Concealed strata; shales? | 50′ 0″ |
| Sandstone, Mahoning S. S. variable, often shaly, | 20′ 0″ |
| Shales, sandy, | 30′ 0″ |
| Coal, *Freeport upper*, | 3′ 0″ |
| Clay, impure, | 3′ 0″ |
| *Limestone*, Freeport upper, | 5′ 0″ |
| Concealed strata, | 24′ 0″ |
| Sandstone, thin-bedded, | 5′ 0″ |
| Shales and slates, | 6′ 0″ |
| Coal bed, *Freeport lower*, | 3′ 6″ |
| Clay, impure, | 5′ 0″ |

| | |
|---|---|
| *Limestone*, Freeport lower, | 2′ 6″ |
| Concealed, | 18′ 0″ |
| Sandstone, *Freeport S. S.*, | 15′ 0″+ |
| Slates, | 5′ 0″ |
| Coal bed, *Kittanning upper*, | 2′ 6″ |
| Clay shales, | 12′ 0″ |
| *Johnstown cement*, | 2′ 0″ |
| Concealed strata; shales? | 40′ 0″ |
| Coal bed (in Brockwayville wells) *Kittanning middle*, | 2′ 0″± |
| Concealed strata; sandstone at lower part, | 45′ 0″? |
| Coal bed, *Kittanning lower*, | 2′ 6″ |
| Shales, | 35′ 0″ |
| Iron ore, Buhrstone, sometimes absent, | 0′ 6′ |
| Limestone, *Ferriferous limestone*, | 5′ 0″ |
| Sandstone and shales, | 20 0″ |
| Concealed strata, | 15′ 0″ |
| Coal bed, *Brookville*, | 3′ 0″ |
| Shales, | 10′ 0″± |
| Sandstone, *Homewood sandstone*, massive, | 50′ 0″± |
| Total thickness, | 439′ 6″ |

§ 300. This section is of the utmost importance to the systematic geology of Western Pennsylvania in proving, once for all, the integrity of the Lower Productive series, northwest very nearly to the point where their uppermost horizons disappear finally from the surface. All the coal beds are present, save the Clarion, which was not detected probably because of imperfect exposures at that horizon; all the limestones are present, each under its respective coal bed; even the Freeport sandstone, which so often fails, is not wanting here. For all practical purposes the section is a typical one of the series which it represents.

In regard to the economic value of the basin it may be said in advance of the detailed description, that the Freeport lower coal is the only bed of importance there. The Freeport upper, it is true, is of minable dimensions, but the coal to all appearances is much more impure than the other. Nor is the Freeport lower itself as good in the immediate vicinity of Brockwayville as it is in the valley of Rattlesnake run, of which a description, from the Covenanter church to Lane's mill, has been given on a previous page. But though less good at Brockwayville, yet the bed there yields marketable coal which only awaits an outlet northward to make this basin one of value and importance.

§ 301. The different exposures of the strata in the township will readily identify themselves when the above section is applied. The ravine of Rattlesnake run from Lane's mill to the Little Toby, has the Mahoning Sandstone at the hilltops, and the Lower Productive series at the base, to the horizon of the Johnstown Cement. In a ravine on the J. McMinn property, a short distance below the mill, the *Freeport upper coal*, with its limestone underlying, may be seen at the upper edge of the ravine. *The Freeport lower* makes a distinct outcrop 30 feet below, while 40 feet still lower the *Kittanning upper* is seen. The section was twice repeated at the mouth of the Rattlesnake, that obtained on the east side, distinctly showing the *Johnstown Cement* near the water level. *The Kittanning upper coal* is 12 feet above. The same seam shows in a ravine near Mr. N. B. Lane's barn, where it was once opened and showed 2½ feet of coal. *The Freeport sandstone* is here seen a short distance above it.

Thirty feet above, still higher on the same hill, is the Freeport lower coal which is here opened and mined to supply the local market with fuel. Its section is distinguished by the same features that characterize it in the Rattlesnake valley, namely a small bench of bony coal and cannel slate at the roof, and a small parting black slate a few inches above the floor. The main bench at Lane's (Clark Bank) is 3′ 6″ thick, and consists of bright hard coal.

Its underlying limestone is seen in the road a short distance north of the mine. It makes a plentiful outcrop, but in the absence of all explorations upon it, no statement can be given of its thickness.

*The Freeport upper limestone* is exactly 35 feet above the mine. The rock is somewhat ferruginous, but not enough to affect its use for a fertilizer.

§ 302. Specimens were selected from each of these limestone strata, for analysis by Mr. McCreath at Harrisburg. The result is as follows:—No. 1 being the Freeport upper, No. 2 the Freeport lower and No. 3 the Johnstown Cement.

| | 1 | 2 | 3 |
|---|---|---|---|
| Carbonate of lime, | 89.107 | 87.035 | 51.410 |
| Carbonate of magnesia, | 1.611 | 1.558 | 3.962 |
| Oxide of iron and alumina, | 2.140 | 2.170 | 7.790 |
| Phosphorus, | .024 | .057 | .033 |
| Insoluble residue, | 6.170 | 8.400 | 33.900 |

The ignited "insoluble residue" of the Johnstown Cement contains these constituents:

| | |
|---|---|
| Silica | 27.570 |
| Alumina, | 4.800 |
| Sesquioxide of iron, | trace. |
| Lime, | trace. |
| Magnesia, | 0.245 |

The analysis of the Johnstown Cement was made by Mr. Jno. M. Stinson, assistant to Mr. McCreath at Harrisburg.

§ 303. East of Rattlesnake run and south of the Little Toby there is a considerable area of the Freeport group. The *Freeport upper limestone*, in excellent condition and certainly 5 feet thick, shows in a spring on the J. C. Calhoun farm, 2½ miles southeast of Rockwayville. *The Freeport lower coal* is opened on the Jas. Cochrane property near by. It measures 3½ feet thick.

Descending thence to the Little Toby along the township road, we pass the outcrops of the the Kittanning upper, then of the Kittanning middle, and lastly of the Kittanning lower coal near the creek. The latter seam apparently is the one which was opened by Mr. J. N. Stephens, on the right bank of the stream, close to the bridge.

*The Kittanning middle coal bed* is about 50 feet below the level of the Little Toby at Brockwayville. It is reported to have been found in some of the wells at the village.

§ 304. The Ridgway road west from Brockwayville is below the Mahoning sandstone until near J. Keys' farm, where it crosses a narrow ridge of Barren Measure shales. The Freeport lower coal is opened at Keys, showing the same thickness as at Lane's, but more sulphurous. The following measurement of it may here be reproduced along with an analysis of a specimen of the coal, published in Report H:

*Fig. 56, p. 201.*

| | | | |
|---|---|---|---|
| Cannel slate, | 0′ | 6″ | |
| Coal, | 3′ | 6″ | 4′ 6″ |
| State, | 0′ | 0½″ | |
| Coal, | 0′ | 6″ | |

The analysis is unfavorable to it, but the specimen by no means represents the average of the coal in the basin:

| | |
|---|---|
| Water, | 1.360 |
| Volatile matter, | 38.720 |
| Fixed carbon, | 53.683 |
| Sulphur, | 2.047 |
| Ash, | 4.190 |
| | 100.000 |
| Color of ash, | red. |
| Coke per cent., | 59.92 |
| Fuel ratio, | 1:1.38 |

The same bed is contained in an isolated knob on the H. Smith property which is the western limit of it in this basin. It shows almost exactly the same section as at Keys, but being close the hilltop and having inadequate cover, it yields inferior coal.

*The Kittanning upper coal* was also seen on this property, 35 feet below the Freeport lower. *The Johnstown Cement* is here 30 feet below its coal.

*The Kittanning lower bed* is opened a short distance north of the Episcopal church. It makes an outcrop also on the C. Bovaird property, 40 feet above the *Ferriferous limestone;* it is further seen in the Ridgway road, at the watering trough beyond the Sugar Hill school-house. It is not above two feet thick.

§ 305. *The Ferriferous limestone* is close to the hilltops in this region. A good exposure of it is at Bovaird's, where 4 feet of it are exposed. It is of a bluish-black color and very fossiliferous. Excellent lime is made from it, and at small cost, because the stone can be raised at little expense. Coal being abundant the cost per bushel of lime is not above two cents, but in spite of its cheapness, and the urgent need of it for the land, there is little of it used.

*The Buhrstone ore* is present at Bovaird's, highly fossiliferous, which is not usually the case with it elsewhere, the

fossils being almost invariably confined to the limestone. F. Platt in 1874 had two specimens of the ore analyzed at Harrisburg, the results of which I herewith quote:

| | *No. 1, Top ore.* | *No. 2, Lower bench.* |
|---|---|---|
| Iron, | 36.800 | 37.700 |
| Sulphur, | .034 | .018 |
| Phosphorus, | .296 | .553 |
| Manganese, | 1.744 | 2.212 |
| Insoluble residue, | 22.980 | 20.770 |

Both analyses indicate a good ore.

The Ferriferous limestone is again partly exposed at B. Shaw's near the Warsaw township line. Another and still better exposure of it is on the Jno. Tobin property in the valley of the Little Toby about one mile and a half northwest of Brockwayville.

§ 306. *The Brookville coal* was twice observed in Snyder township. Scarcely any developments have been made upon it, because the bed here hardly repays attention whenever other seams can be obtained. It outcrops in the Little Toby road near J. A. Adams' house. It has been opened on A. Short's land about 2 miles north of the Episcopal Church, where it measures 3 feet thick. It is the only seam caught in the hills round about the headwaters of the North Fork.

## CHAPTER VI.

*Containing detailed geology of Barnett, Heath and Polk townships.*

### *Barnett township.*

§ 307. Situated at the western side of the county, Barnett is one of the northern tier of townships bordering the Clarion river. The entire township is little else than wilderness.

Its northern side is a long slope, 500 feet in height, stretching to the Clarion river. Its southern side, bordering Eldred township, is traversed for nearly its whole length by the ravine of Cathers run, which heads at the eastern side of the township and deepens rapidly westward. A narrow strip, therefore, of high land, trending east and west, occupies the center of the township.

This area of high land, along which runs the main road of the township, is topped by the Homewood Sandstone. Only an occasional hill rises high enough to include Lower Productive strata, and then only the lowermost horizons of that series, certainly not above the Clarion coal. Neither the latter seam, however, nor the Brookville was observed. The coal beds which have been opened at Butterfield's, and at other localities in the township presently to be mentioned, are underneath the Homewood Sandstone, and correspond therefore to the beds opened at Sigel.

§ 308. *The Homewood Sandstone* is universally a massive rock, 40 feet thick certainly, and perhaps thicker. The rocks below it in the Clarion valley 450 feet thick, are an almost total blank, so far as geological data are concerned, because of the absence of exposures in the wilderness region, in which they occur. Assuming, as Mr. Chance has done in the adjacent wilderness townships of Clarion county, that the Pottsville Conglomerate series is 300 feet thick, there is then here left an interval of 100 feet in which the

Mauch Chunk formation would occur, and also some layers (perhaps) of the underlying Pocono Sandstone. What may be approximately the thickness of the Mauch Chunk shales along the Clarion at this point, or even where they begin in the series, or where they end, it is impossible to say. There is a meagre outcrop of dark shales 160 feet above the water level at Clarington.

§ 309. *The Kellersburg anticlinal* runs nearly through the center of the township, from southwest to northeast, crossing the Clarion river a short distance below Clarington. The strength of the uplift as compared with its condition further south is here not in the least diminished, but the arch is much broader and has more gentle slopes. In fact the geology of Barnett township is mainly that of an elevated region, whose rocks are tilted towards the southwest down the strike, and not (to any extent) northwest and and southeast, at right angles to the folds. The folds have widened out so much while rising northeast that the basins here are scarcely distinguishable from the anticlinals. We see this very plainly in passing from Heath township into Barnett, from the Anthony's Bend anticlinal to the Centreville synclinal in which distance of at least four miles there is scarcely any accumulation of strata at all. The fact is no less plain also in Barnett township, where we pass from the Centreville synclinal across the Kellersburg arch almost without noticing it so far as the surface rocks are concerned.

§ 310. The coal beds of the Mercer group have been sufficiently exposed on the Owen Butterfield farm to enable the following section of them to be constructed:

*Butterfield section.*

| | | |
|---|---|---|
| 1. Homewod Sandstone, | — | |
| 2. Coal, outcrop only seen, | small. | |
| 3. Sandstone and shale, | 55′ | 0″ |
| 4. Coal, | 2′ | 1″ |
| 5. Shales ferriferous, with kidney ore, | 10′ | 0″ |
| 6. Sandstone, | 5′ | 0″ |
| 7. Coal, outcrop seen, reported, | 2′ | 0″ |
| 8. Sandstone, | — | |
| Thickness, | 74′ | 1″ |

Only the middle seam, No. 4 of the section is now worked, and hardly repays mining, having nearly as much slate in it as coal, as will be seen from the following measurement:

| | | |
|---|---|---|
| Slate, | — | |
| Coal, | 0′ 6″ | 2′ 1″ |
| Slate, | 0′ 9″ | |
| Coal, | 0′ 10″ | |

It has been opened also at W. Shields further west, but is no longer operated there. It was again twice opened in the southwest corner of the township by Jno. Agnew and J. H. Kuhns, who report it to be 2 feet thick, and to consist throughout of good clean coal. The banks are now shut.

South of Mr. Agnew's house there is a superb exhibition of the Connoquenessing sandstones in the ravine of Cathers run. One cliff of rock directly under the Mercer coals is 30 feet high.

§ 311. Mention should here also be made of a specimen of lean silicious iron ore recently sent to me from the farm of Mr. O. Butterfield by Mr. S. W. Smith of Brookville. Mr. Smith had undertaken some developements in that region for the purpose of determining the nature and thickness of certain ore outcrops which were known to exist there. In a letter accompanying the ore specimen Mr. Smith states that the deposit (which is a brown hematite from the alteration of carbonate ore) was examined on two sides of a hill northeast of Mr. Butterfield's house. Its west face showed 2 feet of ore, and its east face 4 feet. The exact horizon is not given.

The ore, while low both in phosphorus and sulphur, is too silicious to be used in the stack, excepting to mix with better ores. Its thickness (if that should hold at the figures given) would render it easy and cheap to mine. But remote as it is from a market, and without prospect of railroad facilities, its discovery is of little importance at present.

Mr. McCreath analyzed the specimen forwarded to me, with the following result:

| | |
|---|---|
| Sesquioxide of iron, | 34.714 |
| Sesquioxide of manganese, | 3.537 |
| Alumina, | 1.312 |

| | |
|---|---|
| Lime, | .580 |
| Magnesia, | .216 |
| Sulphuric acid, | .082 |
| Phosphric " | .364 |
| Water, | 6.944 |
| Siliceous matter, | 52.850 |
| | 100.599 |
| Metallic iron, | 24.300 |
| Metallic manganese, | 2.464 |
| Sulphur, | .033 |
| Phosphorus, | .159 |
| Phosphorus in 100 parts, | .654 |

*Heath township.*

§ 312. This also like Barnett township borders on the Clarion river at the northern extremity of the county. The region is an almost unbroken wilderness from end to end.

*The Pottsville conglomerate strata* are the surface rocks. Possibly at the southwest corner of the township there may be a small area of Lower Productive strata extending to the horizon of the Clarion coal; but at no other point does this group occur.

The surface is irreclaimably rugged and barren. Occasionally on the uplands, along the Spring Creek road, some spots have been "cleared" by settlers, where the Mercer group overspreads a few fields that are sufficiently level to be ploughed. Otherwise these uplands are a rocky waste, made so by the Homewood Sandstone, which forms a succession of rock cities west Geo. W. Dunkel's. Nor are the sandstone strata below the Mercer shales—the Connoquenessing upper and lower sandstones and the Sharon conglomerate, any less massive than the Homewood, as may be seen by traveling along the road leading to Raught's mill on the Clarion river. In that region there are some gigantic bowlders of rock which on account of their size deserve the celebrity they have acquired as curiosities.

§ 313. The Mercer shales contain here the same coal beds that they do in Barnett township and at Sigel. An opening was once made upon one of the beds at the roadside east of Dunkel's. Its thickness is no longer remembered by the present settlers.

With wood in great abundance there is no inducement to mine these small coal beds which therefore remain neglected. Limestone is reported to have been once found in connection with these coals at Dunkel's, but this could not be verified, and I am strongly disposed to believe that, through mistake, some other rock, a calcareous clay perhaps, was adjudged to be limestone.

*The Anthony's Bend anticlinal* crosses the township at western side. *The Bagdad anticlinal* barely touches the southeast corner. Neither axis has well marked dips, northwest or southeast, but both are rising rapidly towards the northeast.

The synclinals, the *Fairmount* and the *Centreville* are both obscure.

Of the original timber growth the best has been cut off and sold. Of that however which remains there is yet much that is marketable, and its preparation for the mills furnishes the settlers with by far their most lucrative employment, for farming here, as may readily be imagined, yields only the barest subsistance. Hemlock is the principal wood.

### *Polk township.*

§ 314. This is one of the northern tier of townships adjoining the Elk county line. It contains about 35 square miles of territory, of which only a small narrow strip, extending southwest from Schaffner's Corners, is available for tillage. The rest is rugged forest land, containing some good timber, but not the choicest of its original growth.

Nearly the whole township is drained by the North Fork which starts among the Conglomerate highlands at the Elk county line. One branch of it runs to Schaffner's Corners almost directly along the line of the Leechburg synclinal; curving at the Corners slightly eastward around the base of the limestone uplands, which owe their preservation there to this bend of the creek, for had the stream pursued a straight course to Richardville as it seemed first disposed to do, it would have removed the limestone area extending now along the bottom of that trough, just as it has removed it northeast of Schaffner's Corners.

Moreover this limestone area, in its distinct coloring on the geological map, (and indeed, for that matter, in the distinct coloring which, in nature, it gives to the region it occupies,) plainly reveals the structure at a glance. It tells how a synclinal axis rising northeastward, cuts the township transversely along an almost central line. The northeast rise along the strike is apparent from the absence of the Ferriferous limestone beyond the headwaters of the North Fork, where the land is just as high, if not even higher, than it is southwest from Schaffner's Corners. There is no prettier illustration than this in Jefferson county, of the upward tendency of the axes towards the northeast. We see the same thing upon a very much grander scale in the geology of the whole county; but we are able here at Schaffner's Corners to closely observe its effect from farm to farm.

§ 315. The basin is about five miles wide, from anticlinal to anticlinal, and of rather symmetrical shape, though in point of fact its southeast side is a trifle longer and has more shallow dips than its northwest side. This is plain from the location of the limestone area close to the Bagdad axis, which latter fold traverses the wilderness region west of Windfall run, cutting afterwards through the southeast corner of Heath township, and finally through the northwest corner of Polk. It bears the Homewood Sandstone either exposed on its broad back, or thinly concealed by coal measures, just as does the Waynesburg arch extending through the southeast corner of the township between Beaver run and the south branch of the North Fork.

§ 316. At the center of the basin the *Kittanning middle coal* is caught in some few hills southwest from Schaffner's Corners. It is the uppermost geological horizon of the township, whence downwards in the series, the section extends to the base of the Mercer group, and possibly a short distance below that, but hardly more than a few feet, as the valleys are shallow, and the surface of the township mostly upland.

The *Mercer group* is wholly unexplored. An outcrop of coal, occurring at that horizon, was observed in the northern

part of the township, near the head of Muddy run, a branch of the North Fork.

The *Homewood Sandstone* is uniformly massive. Its exact thickness cannot be stated because of the absence of determinative exposures; but of loose bowlders and fragments on the surface there is boundless profusion at all parts of the township. Some of these bowlders are quite large, especially in the region west of Windfall run, and also in the valley of the North Fork; but in no case are they large enough to indicate what I suspect to be the thickness of the deposit here, namely from 40 to 60 feet. It is a coarse grained rock, but not pebbly.

§ 317. *The Lower Productive strata*, so far as they are included in the limestone uplands, present no specially unusual features. Perhaps the most noticeable change in them from their typical condition elsewhere, is the presence of the *Clarion coal bed directly under the Ferriferous limestone; the Brookville coal* being in the position usually occupied by the Clarion, 35 feet below the limstone. Or we may interpret the case differently, and call the upper coal the Scrubgrass, the lower seam the Clarion, and erase the Brookville from the series here altogether. But in view of sections made elsewhere in adjacent townships the latter interpretation is much less likely than the other.

Following is a section of the Lower Productive strata contained in Polk township, between Schaffner's Corners and the Warsaw line, Fig. 57, p. 201:

*Schaffner's Corners Section.*

| | | |
|---|---|---|
| Shales and thin Sandstone, | 20′ | 0″ |
| Coal bed, *Kittanning middle*, | 1′ | 0″ |
| Shales and shaly sandstone, | 55′ | 0″ |
| Coal bed, *Kittanning lower*, | 2′ | 0″ |
| Slates and ferruginous shales, | 35′ | 0″ |
| Limestone, *Ferriferous limestone*, | 7′ | 0″ |
| Slate, | 0′ | 6″ |
| Coal bed, *Clarion seam*, | 1′ | 6″ |
| Sandstone and shales, | 35′ | 0″ |
| Coal bed, *Brookville*, | 2′ | 6″ |
| Sandstone, *Homewood Sandstone*, | — | |
| Total, | 159′ | 6″ |

§ 318. *The Ferriferous limestone* is so readily distinguishable wherever it occurs that it enables the observer, almost without other assistance than the eye, to determine the contents of the hills and to locate the different coal beds. The rock is contained in several isolated areas, of which the largest is that closely following the Richardsville road. The others are found on the Morrison farm, the Mrs. Heit farm, and finally on the Bullers farm overlooking the stream at Hetrick's saw-mill. Northeast of the locality last named, there is none of this rock in the township.

The limestone is so valuable an adjunct to the farmer that it has been opened on nearly every property high enough to catch it. It is unnecessary to enumerate each locality at which it can be seen, because being the only limestone stratum in the region, no mistake is possible in its identification. Probably the most complete exposure of it is at F. Schaffner's, about two miles southwest of the Corners P. O. It is a compact rock, of excellent quality for the kiln, easily quarried and quick to calcine; fossiliferous but not abundantly so; dark gray, and with a rough face at the outcrop similar to that which it almost invariably presents.

A small area of the limestone at the southeast corner of the township, on the back of the Waynesburg anticlinal, should here be mentioned. A good exposure of it found is on the farm of Mr. W. Bond.

§ 319. The *Brookville coal* is the most important seam in the region. All the beds are here small, and this one scarcely larger than the others, but it appears to yield the best coal, so far as the others have yet been tried. An opening has been made upon it on the farm of W. L. Smith at the southern edge of the township. It is there only two feet thick. At W. Wingerd's, north of Schaffner's corners it is 3 feet thick, but slaty. Its outcrop may further be seen close to the water level on the J. Jones farm, east of the Methodist church, and again at Mortimer's towards the southwest.

The *Clarion coal* is unfailing beneath the limestone, but always too small to mine, unless it be taken up with the rock and used for calcining which is done in some cases, and for

which purpose, the coal though slaty, serves very well. The best exposure of it is at H. Heber's, close to the church.

*The Kittanning lower coal* has been opened at S. Davis's, S. Schaffner's, and at W. S. Smith's, in each case proving not only small but slaty and poor. Two feet is its maximum thickness. At Smith's it is only 14 inches thick.

Fig.55. §299.

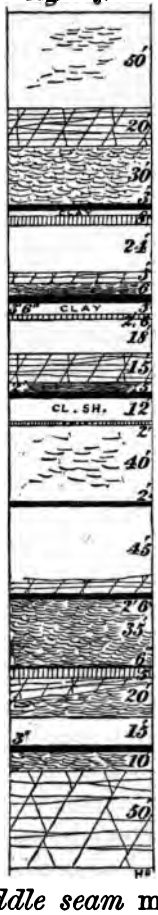



Fig.56. §304.

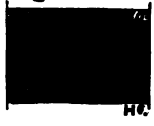
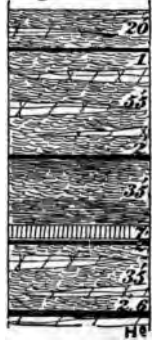


Fig.54. §277.

Fig.57. §317.




*The Kittanning middle seam* makes an outcrop on the hillside at S. Schaffner's which is one of the few localities at which its horizon is caught. It is the smallest bed of the Schaffner's corner section.

*The Buhrstone iron ore* is here totally absent.

# INDEX TO REPORT H⁶.

## I. Nominal Index.

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