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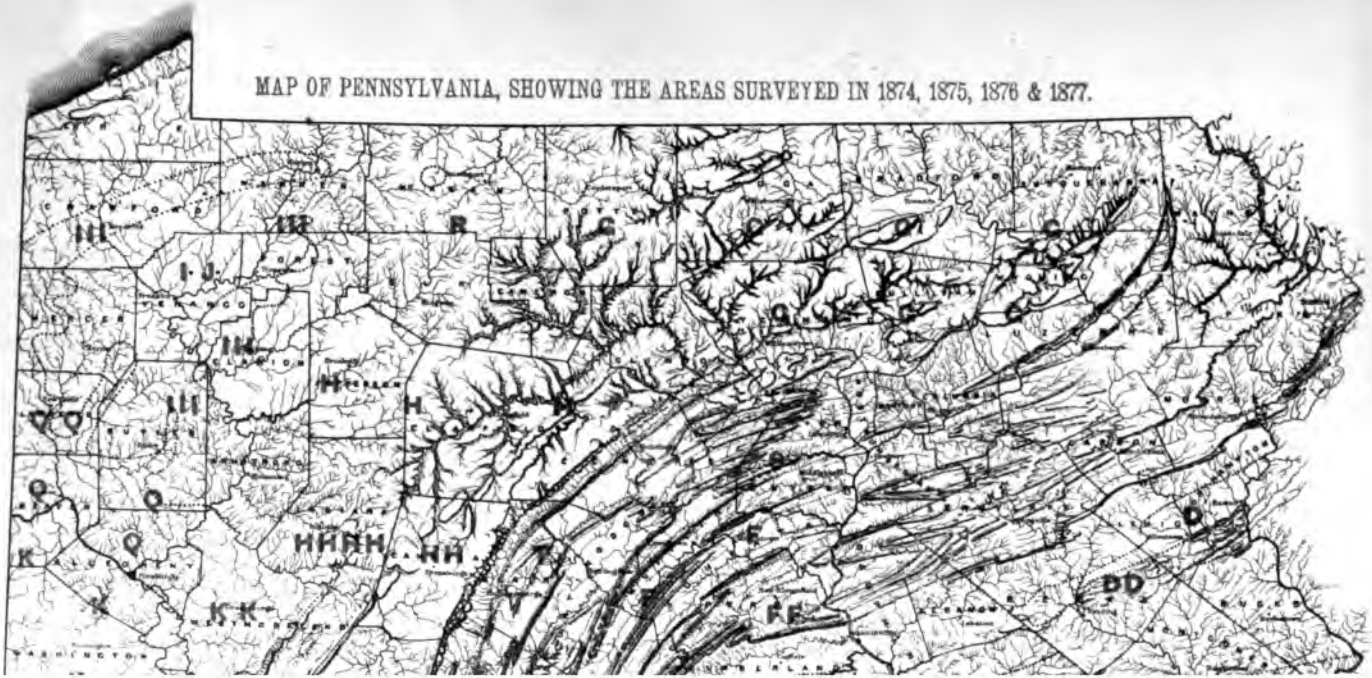
MAP OF PENNSYLVANIA, SHOWING THE AREAS SURVEYED IN 1874, 1875, 1876 & 1877.



GEOLOGICAL SURVEY OF PENNSYLVANIA:
F 1874-75.

REPORT OF PROGRESS

IN THE

JUNIATA DISTRICT

ON THE

FOSSIL IRON ORE BEDS

OF

MIDDLE PENNSYLVANIA,

BY

JOHN H. DEWEES,

WITH A REPORT OF THE

AUGHWICK VALLEY AND EAST BROAD TOP DISTRICT,

BY

C. A. ASHBURNER.

ILLUSTRATED
WITH 7 GEOLOGICAL MAPS AND 19 SECTIONS.

HARRISBURG:
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PREFACE.

The volume now published as Report of Progress F, on the Fossil Iron Ore beds of Middle Pennsylvania, with their inclosing rocks, is the first of a series of reports prepared by Mr. John F. Dewees, Assistant Geologist in charge of the Survey of the Juniata District, to exhibit the results of his systematic examination of all the outcrops of the Upper Silurian and Lower Devonian formations in a belt of country extending from the Susquehanna river on the east, to the Maryland State Line on the south, commenced in 1874 and continued to the present time.

The demand for such a survey was exacted by the growing importance of the Fossil Ore to the iron manufacture of the State, and by the insufficiency of published information on the subject. The Board of Commissioners of the Second Geological Survey of Pennsylvania, feeling the impossibility of accomplishing detailed surveys of the numerous counties, in the middle belt of the State, traversed by these outcrops, while so much of the working force of the survey was necessarily spent upon the almost unstudied Coal fields of the western counties, and on the even more important and more difficult Oil region, ordered that a special and complete survey should be undertaken of the outcrops of the fossil ore; taking in only so much of the geology of the other Palæozoic formations as should be needful to discover and explain the number, places and relationships of the ore beds in question.

To do this however required more than an eye survey of the outcrops, and mines. To distinguish one ore bed from another, and to trace them separately through the belt of country which they characterize, carefully measured cross sections must be made, as well as allignment surveys of the outcrops themselves. In fact an instrumental discussion of the topography could alone suffice to ensure the correctness of the geological conclusions.

Mr. Dewees was therefore provided with a working corps and the necessary instruments, the efficiency of which may be fairly judged by the sections and maps published with this volume. His party consisted at first of Mr. Ch. E. Billen, Mr. Ch. A. Ashburner and Mr. Arthur Hale.

During the first season transit lines were run along the south foot of Jack's mountain from Logan gap to Jack's narrows; and short lines, branching off at many points from the base line, were run to the crest of the mountain; and in the opposite direction to the Juniata river, affording materials for a contour line map of the flank of the mountain, and the valleys in front of it. On this map the ore openings were located. The vertical sections of the measures were then constructed, the curves calculated, and the thicknesses of the formations obtained.

A punctual study was made of all the strata outcropping along the banks of the Kishicoquillis creek from Lewistown northward, past Logan furnace, and through Logan gap into Kishicoquillis valley. Specimens for study and for the State museum were taken from every layer, were numbered and labeled, and by these numbers reference is made to them in the report.

A similar section was made at Mount Union extending along the banks of the Juniata river into Jack's narrows. This also will be found in the report, and a comparison of these two sections will suffice to establish on the securest basis the systematic geology of Middle Pennsylvania from the top of the Hamilton to the bottom of the Oneida formation. Intermediate sections, shorter but made with the same scrupulous care, confirm and illustrate the differentiation of the series, and fix the positions and relations of the ore-bearing rocks.

During the following year, 1875, the instrumental survey was extended westward to Orbisonia, and afterwards across the country northwestward around the end of Jack's mountain, across Sideling hill, to the summit of the Broad top mountain; and still later, over nearly the whole of the Trough Creek coal basin, taking in Rocky ridge, the Red Shale valley, Sideling gap, and across to Blacklog mountain.

The surveys around Orbisonia and on Broad Top were entrusted entirely to Messrs. Billin and Ashburner, aided a part of the time by Mr. Hale; Mr. Billin being chiefly occupied with the topography and Mr. Ashburner with the construction of the sections, but in all respects working in harmony, with mutual assistance, in the study of the geology of the district. The zeal and skill of these gentlemen cannot be sufficiently praised. Their work speaks for itself.

In the meanwhile Mr. Dewees followed the outcrops of the ore eastward into Union county, on both sides of East Shade mountain; on both sides of the ore bearing ridges to the south of it; through Juniata county; on both flanks of West Shade mountain; around the end of Blacklog mountain at Littleton, in Huntingdon, and finally around McConnellsburg cove to the Maryland state line. After a long and severe illness he resumed the study of the ore outcrops on the Lower Juniata and on both sides of Tuscarora mountain. His reports on this more southern ore belt will be published when prepared. They cannot be illustrated with contour line maps and measured structural sections like those published with this volume, because his field party had to be sent to other districts of the state. But his description of the outcrops of fossil ore, of the several exposures, openings and regular mines upon them, and of the series of sandrocks and shales which inclose them will be as minute and thorough as that of this volume.

Our knowledge of the geology of the Juniata River district of Pennsylvania previous to 1874 was due to the admirable survey of it made, under the orders of Prof. H. D. Rogers, by Dr. A. A. Henderson, in the two field seasons of 1839 and 1840. His reports afforded the substance and many of the details of that description of the region to be found in Vol. I of the Geology of Pennsylvania, published in 1858.*

The northern limit of Dr. Henderson's researches was East Shade mountain, Jacks mountain, and Sideling ridge; its southern limit was the Blue, North, or Kittatinny mountain. Between these limits it stretched from the Susquehanna river to Maryland. Throughout his district he mapped the meandering outcrops of the Clinton formation (No. V) which holds the Fossil ore; but of the ore itself he had very little to say, because it was at that early day scarcely anywhere exposed by nature or artificially opened up to examination. He describes, however, the mines of Juniata furnace, (p. 358); of Perry furnace, (p. 360); at Oak Grove, (p. 362); in Slenderdale and other ridges, (p. 374); at Mifflintown, (p. 375); in Tuscarora valley, (p. 378); in the Lewistown valley, (p. 410); and in the Little cove, (p. 414).

Dr. Henderson's report was illustrated with many cross sections, some of which are reproduced in the text, and the rest in the atlas of sections of 1858. Some of them were used in constructing the long sections published on the same sheet with the Geological Map of the State. But these sections were constructed without the use of instruments; and the groups of rocks were generalized into thick formations; so that very few details can be made out, and none of these details are reliable for local use at the present day. In fact, both the topography of his original colored map,† and the geological structure of his numerous and conscientious sections, bear the imprint of an accomplished field geologist, who worked at a disadvantage because without instruments of precision, and who could hope therefore to accomplish little more than a faithful reconnoissance of his field, and to sketch in its main features.

Since then, the erection of large iron works within the district, the enlarged demand for stock from the growing iron manufacture of Eastern Pennsylvania, and increased

*See pages 313 to 433. A synoptic index of these 120 pages is given on pp. 143 to 146 of Report of Progress A, 1876.

†This map my lamented friend presented to me a few years before his death.

facilities of transportation afforded by the extension of the railway system, have combined to stimulate local exploration and exploitation of the fossil ore outcrops; and this in turn, has excited farmers and miners to search for other kinds of iron ore, and given rise to the discovery of valuable outcrops of brown hematite ore belonging to the Hamilton formation, but running parallel to and lying never far away from those of the Clinton fossil ore. New horizons of the latter fossil ore have also been made known; so that now the number of fossil ore beds lying at different stages in the column of the Clinton group is so much greater than was once supposed, that the difficulties of the systematic geologist are greatly increased, as well as the hopes of the land owner and iron worker.

The district under review in this volume embraces parts of four counties: Snyder in the east, Mifflin and Juniata in the middle, and Huntingdon in the west. Long, slightly curved, parallel, and interlocking anticlinal mountains traverse it from east-northeast to west-southwest, bringing up the under rocks, and tilting the beds of iron ore towards the north and south, but allowing their outcrops to fold around their pointed, declining eastern and western ends. These outcrops form, therefore, a series of closed circuits, or very long, narrow ovals. Subordinate anticlinals in the intermediate valleys of upper rocks bring up other outcrops of the fossil ores, in complicated zigzags. Between these again are *synclinal* oval outcrops of the higher Hamilton brown hematite ores.

The whole makes a geographical belt about 80 miles long and 10 miles wide, practically isolated from a similar belt running across the lower Juniata river further south, and from the belt of fossil ore outcrops in Union, Centre, and Blair counties further north and west. It is a natural arrangement, therefore, to confine the description of the Middle Juniata Belt of Fossil Ore within the limits of one report. Its termini towards the Susquehanna are the east ends of Jack's mountain and of Shade mountain; its termini in the other direction are the west ends of Jack's mountain and of Black Log mountain. One outcrop follows the south flank of Jack's mountain from end to end; another encircles East Shade mountain; another Blue Ridge; another Black Log and West Shade mountain. Other smaller ones encircle smaller ridges south of East Shade mountain, or follow the ridges on each side of the Juniata river and along the middle of the Lewistown valley. By the table of contents it will be seen that the description follows always a direction from east to west, beginning near Selinsgrove in Snyder county, and ending at Fort Littleton in Huntingdon county; and takes the successive ranges of outcrops in an order from north to south, beginning with Jack's mountain and ending with West Shade mountain.

As the best geological work east of the Juniata was done in the neighborhood of Lewistown, the elaborate sections there made in 1875 are introduced early in the book, at the beginning of the second chapter, after only the Jack's mountain outcrop east of Logan's gap has been described; and to that chapter the reader is referred for a better understanding of the following short summary of the geological formations dealt with in this report:

A more extended range of the Palæozoic formations, subsequently surveyed by Mr. Billin and Mr. Ashburner, across the Aughwick valley, west of the Juniata, from the centre line of Blacklog valley, through Rockhill gap, past Orbisonia; past Three Springs, at the southwest end of Jack's Mountain; across Sideling Hill, through the railway tunnel, and also through Sideling Hill Creek gap; across Ground Hog valley; and finally across the East Broad Top Mountain coal basin,—to the Rockhill Company's coal mines, is given in Mr. Ashburner's report in this volume.

Mr. Ashburner's report is illustrated by his own admirably executed sections, and by Mr. Billin's beautiful contour line maps, to all which the reader is referred.

Mr. Ashburner describes in his report his method of projecting and calculating the thickness of each formation, and his reasons for assigning its hypothetical limits.

The larger part of the Palæozoic column is here represented, viz: from the top of the Lower Productive Coal measures No. XIII down to the middle of the Trenton (Siluro-Cambrian) limestone No. II; a measured depth of 18,397 feet. Adding to this say 2500 feet for the unrepresented or overlying coal measures,* and 6000† feet for the Siluro-Cambrian dolomites underneath the surface of Blacklog valley, we get about 27,000 feet of conformable Carboniferous, Bernician, Devonian, Silurian and Siluro-Cambrian strata, down to the Potsdam sandstone No. I, in the central region of Pennsylvania.‡

Mr. R. H. Sanders' measurements in Blair County, from the lowest coal bed down to the Potsdam sandstone,§ (made under less favorable circumstances, because on a less continuous line of outcrops,) confirm the correctness of Mr. Ashburner's section. Mr. Sanders' total is 23,348 feet to which must be added say 2,700 for admitted overlying coal measures, making about 26,000′ as against Mr. Ashburner's 27,000′. So remarkable a correspondence between two long sections independently constructed, in two neighboring districts, cannot fail to inspire confidence.‖

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*The coal measures both in the bituminous and in the anthracite fields are about 3000 feet thick, and this is the empirical addition always used in the following paragraphs.

Respecting formations more recent than the coal measures, it need only be said here that with the exception of a suspected capping of the coal measures of Greene county with strata of early Permian age, not a trace of any Mesozoic or Kainozoic rock has ever been noticed in Middle, Northern or Western Pennsylvania. Even the lignite of Brandon Vt., of Ironton in Lehigh Co. and of the Pond bank in Franklin Co. has never been detected in any of the ore banks of the middle counties. The country remained out of water from the end of the coal era to the supposed submergence in the Champlain age. (See Reports Q, QQ, III, &c.)

†The exact figures will be given by Mr. F. Platt in his report on Blair County, from the topographical work of Mr. R. H. Sanders in Canoe Valley, and Sinking Valley, and Mr. C. E. Hall's palæontological and structural section along the Little Juniata river and Pennsylvania railroad. See also Appendix A to this volume.

‡The Potsdam is excluded from all measurements in Pennsylvania except along the northwest flank of the South mountains, because it nowhere appears above the surface, except at one point to be described in Mr. F. Platt's report of Blair County. The same is true *a fortiori* of the Cambrian, Huronian and Laurentian rocks.

§Published in advance of the Blair Co. report in the Proc. Amer. Philos. Society, Philadelphia, March 15, 1878, page 349.

‖To allow scrutiny by those who desire to verify these important facts, I have appended Mr. Sanders' section at the end of Mr. Ashburners's report. (*A.*)

These are the first exact instrumental measurements of the Palæozoic rocks ever made in America where the series is not only continuous but thick. The measurements given in the Final Report of 1858 are in the main either conjectural or averaged, and have therefore no great value for a comparative study of the rate and proportion of deposition in different areas.

These measurements then afford a trustworthy basis of comparison to which all local measured sections already made, or to be made, along other lines across the middle belt of Pennsylvania may be referred; such as Mr. Billin's measurements in Union and Centre Counties, and Mr. Chance's measurements at the Delaware, Lehigh and Schuylkill water gaps; the long section to be measured from the coal of the Third Mountain, down through the Susquehanna Gap to Harrisburg*, and the long section to be measured this summer (1878) from Mercersburg to Bedford.

A measured section has just been received from Mr. H. M. Chance, and inserted as appendix B to this volume, showing a total thickness of 13,636+feet, between Lockhaven and Farrandsville, from 86 feet above XII down to the top of III; or,—by adding 2,914 feet for additional coal measures, 16,550 feet. Mr. Chance gives the following table:

XIII.	Coal measures, (2,914)+86',	3,000'
XII.	Pottsville conglomerate,	129'
XI.	Mauch Chunk red shale,†	100'
X.	Pocono sandstone, (merging into IX,)	1,175'
IX.	Catskill red sandstone, &c.,	2,106'
VIII.	Chemung, Portage, Hamilton, U. Helderberg,	5,764'
VII.	Oriskany, wanting at Lock Haven.*	
VI.	Lower Helderberg, &c., limestones,	895'
V.	Clinton shales, (with fossil ore,)	1,080'
IV.	Medina and Oneida sandstones,	2,301'
	Total to top of Hudson river,	18,636'

The Susquehanna river section is peculiarly favorable for this work, from the top of III (Hudson river slate) to the bottom of XIII (Coal measures,) because the strata are

* Well exposed at Milesburg, (Centre county.)

† Cut away in a short distance northward to nothing by the overlying conglomerate.

nearly vertical and in one direction (south side of the Cove synclinal) the entire distance. A rough measurement was made here very early in the course of the first survey, forty years ago, and the enormous thickness of the Silurian and Devonian rocks excited the astonishment of European geologists, and was received by them with unconcealed incredulity. The formations were estimated to be of the following thickness:

XIII.	*Coal measures*, in the Pottsville basin to the east, .	3,000′
XII.	*Pottsville*, in the Dauphin basin to the east, ...	660′
XI.	*Mauch Chunk*, on the Susquehanna river, less than	3,000′
X.	*Pocono*, in the Second mountain, less than	2,000′
IX.	*Catskill*, on the Susquehanna river, ...	6,000′
VIII.	*Chemung, Portage, Marcellus*, (?) . . . . . 5,000 to	6,000′
VII.	*Oriskany* shales, ... (maximum,)	100′
VI.	*Lower Helderberg*, &c., limestones, . . (wanting.)	
V	*Clinton*, &c., ...	1,000′
IV.	*Medina* SS., *Oneida*, SS., ...	500′
	Total to the top of III. *Hudson river*, ...	22,260′
	As against Mr. Ashburner's, 18,394+2,500—1,300=	19,594′
	As against Mr. Sanders', 23,348+2,700—7,500=	18,548′
	As against Mr. Chance's, 13,636+2,914=	16,550′

The total thickness of Palæozoic rocks declines therefore in a northwest direction through Middle Pennsylvania.

The local variations in thickness of each subdivision of it, each group, each individual formation and stratum, are infinitely numerous, and sometimes very surprising. Examples may be found noted in Mr. Ashburner's report.

The tolerable maintenance of the total is a strong argument against any such non-conformability as would imply oscillations of the sea-level important enough to cause one formation to overlap the upturned and eroded edges of another.

Abundant evidence, however, that extensive areas have been gently and alternately elevated and submerged is afforded by the interesting set of coal beds described by Mr. Ashburner as cut in the railway tunnel through Sideling hill*, and by the much older Hamilton coal beds of Perry county.

That the Mauch Chunk red shales of XI were sometimes out of water (or at the level of the water) is shown by the batrachian foot prints at Mount Carbon on the Schuylkill; by slight hollows in its upper surface filled with coarse gravel (at the bottom of XII,) in the old exposure in Solomon's gap, descending to Wilkesbarre, and elsewhere; and by the rapid thinning away of the whole formation northwestward from Farrandsville in Clinton county.

What is true of the subcarboniferous (Bernician) Mauch Chunk red shales of XI must be true of the very similar (much older, Silurian,) Clinton red and varigated and olive shales of V, holding the Danville and other fossil ore beds, described by Mr. Dewees in this volume. The waters must have been shallow, but very broad, to permit successive thin layers of small fossil shells to be spread over so wide an area, and yet to vary so incessantly in volume and quality. The absence of these ore beds from Dauphin, Schuylkill, and Lehigh counties designate some sort of low lying shore-line in that direction.

The extension of the *true* fossil ores northward to Lake Ontario, and their absence from southern Virginia and Tennessee, with a notable reduction in thickness of the whole Clinton formation in the southern States agrees with and explains that absence.

On the other hand, the much wider expanse of the "rock-ore" (at the top of the Medina No. IV, and lying 1,000 feet beneath the "fossil-ore-beds,") not only eastward to the Schuylkill and Lehigh water gaps, but as far south as Alabama, and as far west as Wisconsin, taken in connection with its absence from the New York outcrops, leads to but one conclusion, namely: That the water area of the Clinton ore age was gradually shifted northward; or at least, that conditions favorable for animal life (probably a

* Coal beds in the Pocono Sandstone No. X analogous to the coal bed in No. X at Duncannon, at the mouth of the Juniata; to the coal beds in No. X in Wyoming county; to the coal beds in No. X, on the New river in Virginia, and elsewhere. Mr. Chance detects one of these little coal beds near the top of X in his section at Farrandsville. (See Appendix B.)

shallowing of the water) supervened only in the north, and not until much of the Clinton had been deposited.

The connection of those curious layers of coarse material, named the Ore-sandstone and the Iron-sandstone, with the fossiliferous ore beds themselves, cannot be elucidated in advance of the publication of Mr. Dewees' description of the metamorphoses which he saw these sandstones undergoing as he passed southward over their successive outcrops in Perry County, and the subject must be left therefore for another report.

This report has already been too long withheld from the press (for good reasons which need not be said), and must now issue; but it should be understood that a much larger mass of observations remain for the next volume, which will include all the fossil ore outcrops in southern Snyder, Juniata, Perry and Fulton counties.

The following succinct description of the formations among the outcrops of which run those of the Marcellus ore bed of VIII, and the Clinton fossil-ore beds of V, will assist the reader. They are described in their natural order from above downwards thus:

Marcellus Shale (VIII.)

Black slates, overlying the Marcellus ore bed, and forming low hills along the centre line of each synclinal; constitute the highest rock in the Lewistown valley. Sometimes these slates contain enough carbon to flame, and even to burn freely; but never become workable coal beds.

Marcellus Ore Bed.

A layer of brown hematite ore underlies the black slate and overlies the limestone next to be described. It is constant, but variable in thickness; sometimes a mere trace; often ten or twelve feet thick. Bunches of it occur even thicker. It is sometimes of even size for long distances and then suddenly thins out. Large and profitable ore banks have been worked in it. In closely folded synclinals of Oriskany sandstone, containing no black shales, no ore need be looked for. Where the ore bed is good at the surface there occurs a change of good ore into poor ore at a depth of from 20 to 50 yards; on high ground, cut by deep cross ravines, the good ore continues to a still greater depth. Below the limit of change the bed consists of an impure earthy carbonate, or dirty clay-iron-stone; which, deeper still, turns into a dark pyritous clay.

In prospecting for this ore it is necessary to remember, first, that the ore immediately underlies the carbonaceous black, and overlies the calcareous green shales. So long as the trial shaft throws out black shales the ore is not yet reached. If a shaft throws out green shales, or limestone, it is sunk outside of the ore belt; or there is no ore left in the trough. A shaft may also go through nothing but a deposit of surface drift thicker than common.

Upper Helderberg Limestone (*VIII.*)

Limestone beds and lime shales underlie the Marcellus ore bed.

In Snyder County it is a mass of greenish limestone. In Tuscarora Valley this green limestone is about 40 feet thick.

At Peru in Juniata County, the top layer is a pure good limestone.

At Lewistown may be seen 40 feet of dark green limestone crumbling under the weather into light green shales.

At McVeytown 40 feet of black limestone is divided into beds of half a foot or a foot in thickness, some of them black clay slate, others hard gray subcrystalline limestone.

From Orbisonia to Fort Littleton, its outcrop decomposes into green shales.

The layers are generally more or less hydraulic, and the burnt lime hardens instead of slacking and is therefore rejected by the farmers. It is said that the hydraulic cement used in the construction of the Schuylkill Canal was made from this limestone, quarried near Perryville, Juniata Co.

Corniferous Shale (*VIII.*)

Under the Upper Helderberg hydraulic lime shales and limestones lie 133 feet (at Lewistown; 110′ at McVeytown; 100′± in Tuscarora Valley; 30′ to 40′ in Snyder County,) of fine grained, calcareous, fossiliferous sandstones, yellowish and shaly at the surface, having lost the lime by leaching, It is called in this report *Corniferous Shale.*

Peru Limestone (*VIII.*)

The bottom layers of the corniferous shale above described take on a special aspect for several miles east and west of Peru, in the Tuscarora Valley, that of a hard, thin bedded limestone, breaking up into long narrow blocks. Outside of this area the usually hard, yellow square fractured character prevails.

Peru Sandstone (*VIII.*)

A three foot layer of fragile rock occurs at Peru, overlying the typical *Oriskany,* but very distinct from it. It shows no fossils, and therefore cannot be named *Caudagalli grit.* Southwest of Peru fragments of it, scattered upon the surface, contain pebbles as large as a chestnut, and in sizes from that down to a grain of sand.

Pockets of iron ore have been found in this rock, at Orbisonia and elsewhere, and mined to some small extent.

A siliceous brown hematite occurs in considerable quantity in shales over the Oriskany in the Tuscarora Valley. The shales are so impregnated as to look like rich ore, but on being broken a core of sand appears surrounded by an iron crust. The surface of the ground is sometimes covered with this deceptive and almost always worthless rock.

Oriskany Sandstone (*VII.*)

This rough-weathering, highly fossiliferous sandrock, 160 feet thick in Long hollow, 140′ at McVeytown, 110′ in the ridges north of Lewistown, and 95′ at Mt. Union, dwindles down eastward to 40′ in Snyder county, and 25′ at Peru in Tuscarora valley at the end of Shade mountain. In Union county on the Susquehanna West branch, it can scarcely be recognized at all.

On Kishicoquillis creek at Lewistown it can be subdivided into a middle soft argillaceous sandstone mass 30′ to 40′ feet thick, between upper and lower masses of laminated shale beds.

The Oriskany outcrops always make crested ridges; and when massive, very rugged ones, studded with picturesque pulpit rocks, like those so much visited opposite Huntingdon. The rock may also be recognized by the fossil casts which pit its weathered surface often in great abundance.

Sometimes it furnishes a good fire brick clay.

Around McVeytown, and in Jack's narrows, its sand is sharp, and so slightly cemented, that the erosion of the surface has caused huge accumulations of the best glass-sand, which are mined, crushed, washed and sold at a profit; and this condition of things prevails more or less along the north dip of the southeast synclinal from near Lewistown to McVeytown; and on the north side of the Oriskany synclinals of Ferguson valley. In Snyder and Juniata counties also the Oriskany outcrops disintegrate, and the coarse sand is spread in sheets along the tops of the ridges, and is farmed along with the surrounding land.

At the McVeytown glass sand mine, the fine grained white sand is more than 100 feet deep, and very little mixed with clay.

The mother rock is compact enough to require blasting; but the masses thrown out by the blast crumble in falling, and are often so completely broken up in the fall as to make it needless to pass them through the crusher, and they are at once washed with the accumulated sand. Some layers are however harder and must be passed through rolls before going to the washers. The quantity of foreign matter washed out is insignificant when compared with the bulk of the sand.

The Oriskany rocks are in some localities hard and massive enough to serve for building stone.

The cleavage planes in the McVeytown deposit do not run regularly, but diagonally, forming wedge-shaped and pot-shaped nests, which are liable to drop out in mining when least expected.

When Mt. Hope furnace tunnel (7 miles from Lewistown) was driven through the southeast dipping Oriskany to reach the Marcellus ore bed, it is said that more than 60 feet of pure white sand was brought to light.

Where iron is present in the rock the sand is rejected by the glass smelters.

The top part of the formation is frequently charged with iron, and its outcrop blocks look like masses of ore, but they are mere iron stained and encrusted chunks of sandstone.

Oriskany Iron Ore. (*VII.*)

In Hill valley, Huntingdon county, where the Oriskany is a soft, argillaceous, red, purple, and white mass, a bed of brown hematite, of fair quality, occurs in it, varying in thickness from five to ten feet. This is the old "Lane ore-bank," which is still worked, the ore being mixed with fossil-ore at Matilda furnace. There are other ore banks on this outcrop in Hill valley.

Oriskany Shales. (*VII.*)

The Oriskany shale takes its name from the Oriskany sandstone, which overlies it. It is calcareous, siliceous, variegated in color, and of varying thickness, but is generally a constant deposit wherever the Oriskany sandstone exists, and with it forms the tops of the ridges. Its layers are hard, and its fracture is sometimes square and sometimes conchoidal.

At Lewistown, Mt. Union, and also at McVeytown the weathered layers show bright colors; but where exposed on the Kishocoquillis creek they are of dark color. Exposures are almost always yellow; at Lewistown and at McVeytown, traversed by streaks of white and chocolate. Some of the strata of various shades of yellow have thin bands of purple and white, with purple streaks; the whole forming a handsome stone, especially when the colors are heightened by wetting. Each bed is generally in thin layers, traversed by many vertical joints set close together, so that the blocks break off short.

This lower division of the Oriskany varies from less than fifty (50) to more than two hundred (200) feet in thickness.

Small pockets of brown hematite ore are of frequent occurrence in these shales, but nowhere does the ore appear to exist in quantity.

Lewistown Limestone Shale. (*VI.*)

This lime shale underlies the Oriskany Shale, and overlies the Lewistown Limestone, and is the upper division of *Lower Helderberg formation.*

It is composed of a shaly limestone, an argillaceous and in part siliceous shale, with some thin beds of an excellent quality of hard blue limestone of good quality for building or flagging purposes. Portions of it produce blocks from ten inches to a foot in thickness; other portions blocks not more than three inches thick.

Near Lewistown these flags and building stones have been quarried to some extent by Mr. John Stratford. This is its character in the ridges in Mifflin County, but the limestone is generally of an inferior character. Where farmers have burned lime from stone taken from this division it has generally proved unsatisfactory. Wherever the underlying *Lewistown Limestone* is exposed that is used in preference to any other.

The thickness may be stated thus:—At Lewistown, 140 feet; at McVeytown, 130 feet; at Mount Union apparently only 18 (?) feet thick.

Lewistown Limestone. (*VI.*)

This Lower Helderberg limestone underlying the Lime-shale, and overlying the Water lime, is constant throughout the district where the Oriskany Sandstone ridges have preserved it.

It is a bed of sub-crystalline limestone of a bluish color, making an excellent lime, for which it is extensively used. It is burned for lime at Lewistown by Mr. John Stratten; at McVeytown by Gen. John Ross; and by others throughout the region. It is also used in preference to the other limestones of this formation (VI) for fluxing at Emma Furnace, at Logan near Lewistown, and at Matilda Furnace, near Mt. Union, in Mifflin County.

This formation carries at its top, in some places, a bed of chert rock which makes excellent building stone and curbstones.

The Lewistown limestone measures 185 feet at Lewistown; 215 feet at McVeytown; and only 35 feet (?) at Mount Union.

Water Lime. (*VI.*)

The cement layers of this period measure 470′ at Lewistown, from the bottom of the heavy blue-gray sub-crystalline Lewistown limestone down to the Salina group. The thickness of all the limestones of VI from the Oriskany down to the Salina measures 790 feet.

Some of the Water lime beds are of a purer quality of limestone than others. The formation is largely composed of hydraulic beds, some of which should make good cement; but no sufficient series of analyses has yet been made.

At the top of this formation, under the Lewistown limestone, there is a massive bed of dove-colored limestone, more argillaceous than the Lewistown limestone, and having a smooth fracture. This bed is finely laminated, in thin and regular horizontal layers, some of them siliceous.

Near the bottom are a number of massive beds of blue limestone, of excellent quality, separated from each other by inferior limestones and shales, and soft siliceous and calcareous layers.

Some of the more flaggy and earthy beds slack but imperfectly when burned, and are more of the character of a hydraulic cement rock. All the beds contain, as a general rule, magnesia.

Salina or Onondaga Salt Group, (*VI.*)

Underlying the water lime and resting immediately upon the Niagara lime-shales are 350 feet of red, green and yellow argillaceous and calcareous shales, with beds of fragile calcareous sandstone.

The upper portion of the mass is composed principally of green and bluish-gray, argillaceous, calcareous shale; but it includes a stratum of yellow calcareous sandstone; and also some thin and poor limestones. The proportion of these impure limestone layers and lime shales increases towards the top of the group, where it supports the bottom layers of the Water lime group.

The soils produced along the outcrops of this formation are by far the most productive of all the soils of the district.

This is the formation which holds rock salt and gypsum, and yields brine at Syracuse and elsewhere, but it does not seem to be salt-bearing in Pennsylvania; probably because the shallow ponds required for the deposit of salt lay along some northern shore; while here further south the sea was open if not deep.

Niagara Lime-shales, (*V.*)

In the Logan Section 73½ feet of thin bedded variegated red and green calcareous shale, underlying the Salina, are set apart from the great mass of Clinton Variegated Shales, as probably being of Niagara age, perhaps on insufficient grounds.

A 3½ foot bed of solid limestone marks the upper limit of the group; in the middle of the variegated mass lies one 8 foot bed of tough, laminated, gray lime shale; and towards the bottom occur some 2 and 3 inch beds of blue limestone.

The 3½ foot bed of limestone shows no fossils; and is divisible into an upper and a lower dull blue, heavy, compact, square fracturing limestone, weathering blue gray; and between these a middle very hard ferruginous part, showing a rough semicrystalline surface when broken.

Clinton Formation. (*V.*)

The subdivision of the Clinton into the following groups was governed by the instrumental work along the foot of Jack's mountain between Logan gap and Jack's narrows, and these groups are represented upon the sections published with this report, to which reference must be made. Mr. Dewees subsequently modified the nomenclature of the groups to suit his observations in Snyder, Juniata and Perry counties. The measurements here given are from the Logan section:

A.	1. Upper red shale,	432′	1030′
	2. Upper lime shale,	326′	
	3. Lower red shale,	272′	

B.	4. Lower lime shale,	251′		1035′
	5. Upper olive shale,			
	6. Ore sandstone,	38′		
	7. Middle olive shale,	178′		
	8. Iron sandstone,	7′		
	9. Lower olive shale,	561′		
	Total,			2065′

The *outer* slopes of Jacks mountain, Shade mountain, Blue ridge, Blacklog mountain, Tuscarora mountain, the Buffalo and White Deer mountains in Union county, Bald Eagle mountain in Lycoming county, Tussey and Standing Stone mountains in Clinton county, are all outcrops of the Clinton formation.

The red shale group (A) at its top makes the foot of the slope; the Ore sandstone (B) makes a slight terrace half way up the slope; and the Lower Olive shale group (C) crops out within two or three hundred yards of the mountain crest made by the massive beds of the Medina. The Ore sandstone with its terrace is the most important feature of the slope, being an infallible guide to the place of the fossil ore beds.

1. *Upper Red Shale.*—This is so named because of its numerous red beds, although it contains more or less interbedded green and yellow shales. At Logan gap it measures 432′.

In Ferguson valley, *north* of the Lewistown limestone and Oriskany sandstone synclinal ridges, there is an unusually great thickness of red shale layers towards the top of the mass. Here and there an occasional green bed occurs; and at one horizon near the middle of the mass, there are about 40 feet of variegated layers each 2 or 3 feet thick.

In the Lewistown valley, when the Clinton comes up again, *south* of the ridges, very little red shale is visible. Almost the whole mass is green and yellow.

Mifflintown Limestone.—Near the bottom of the Upper Red Shale group lie 6 feet of hard calcareous sandstone layers, each only 2, 3, or 4 inches thick, separated by other very thin layers of calcareous sandstone mottled with red. This peculiar group is recognizable in distant localities, and sometimes become a limestone formation; as, for example, near Mifflintown, on the west bank of the Juniata, where some very hard beds of comparatively pure limestone 3 or 4 feet thick crop out.

2. *Upper Lime Shales, Gray Variegated Shales.*—On Kishicoquilliscreek this group measures 326′.

The rock is compact, heavy; sometimes quite sandy; generally calcareous; color, varying from greenish-gray to green and yellow, with an occasional reddish layer. The weathered surfaces are of a dark greenish tint. The whole group is calcareous and forms the basis of the superior farming land of the valleys of the district.

Lost Creek Limestone.—In the middle of this gray group, and within a thickness of 60 feet, occur several beds of light blue shaly limestone, and near the bottom of the 60 feet a sandy limestone with lime-shales. These calcareous layers are sometimes massive, even 6 or 8 feet thick, and separated by gray shales. They may be studied on the wagon road near G. Means' house in Ferguson valley.

In Lost Creek valley, Juniata county, a few quarries are opened on these beds, for want of available exposures of of Lewistown limestone.

Near Mifflintown, west of the river, in Tuscarora valley, several feet of massive, pure, blue limestone belonging at this horizon several feet thick shows itself in the wagon road.

3. *Lower Red Shale.*—This is the persistent formation which marks with its deep red zigzag belts the surface of Middle Pennsylvania, and gave to the Clinton formation in the old survey the name of the "Red shale of V." It keeps its color throughout, except for an occasional thin layer of reddish green shale. It is finely exposed where the Pennsylvania railroad enters the western end of the Long Narrows of the Juniata opposite Lewistown; and in the river bluffs for several miles at Mifflintown and other places lower down. It is seldom less than 260 feet thick (as on Kishicoquillis creek,) and often thicker. And when the dip is low, its belt of outcrop lies considerably up the mountain slope, producing tillable land.

McCoytown Sandstone.—Near the middle of these shales, occur brown soft sandstone layers, from 6 inches to 2 feet in thickness, breaking with a square fracture. These layers become exceptionally hard and siliceous near McCoytown, in Tuscarora valley, where they exhibit on the surface numerous quartz crystals.

4. *Lower Lime Shales.*—This group varies in thickness from 30 to 160 feet.

The upper portion is shaly, calcareous, growing richer in lime as we descend in the series of its beds. The harder layers vary from one to twelve inches in thickness, and are separated by softer shales. Some of them can be burned to lime for farm purposes.

5. *Upper Olive Shale.*—This group, called by Mr. Dewees the *Upper fossil ore shales*, varies from 30 to 150 feet in thickness. In the Logan section the groups 4 and 5 (*q* and *r* of the plate sections) are taken together, and measure 251′.

The Upper olive shales are described by Mr. Dewees as a mass sometimes of tough blue-gray shale containing lime, sometimes of soft buff colored shale, changing towards the bottom to a white soapy shale, called "soapstone" by the miners, just over the Sand ore-bed.

This change is due to the action of drainage waters on the shale. The action is best seen where the slope of the surface nearly equals the dip of the measures, as in Lost creek ridge, north of Mifflintown and eastward. The color of the shale therefore indicates in a measure to the sinkers the character of the ore bed before they reach it. The ore is likely to be hard under blue gray shale, and soft under the white soapy clays. The change takes place at various distances beneath the surface according to the facilities afforded for the descent and free percolation of the waters. The shales which outcrop at or under water level are always dark or olive green. Sometimes the shales over the ore bed are highly charged with iron and then the ore bed itself is found of extra thickness. At Shade gap a shaft was sunk through 50 feet of buff colored shales.

Fossiliferous limestone layers from an inch to a foot in thickness occur, especially near the bottom of the group.

6. *Fossil Ore Sandstone Group.*—The small section cuts on the pages of this report will show that this group is devisible into—*a*, *the Sand vein ore bed; b*, *the Sand rock; c*, *the Ore sandstone.*

a. The Sand vein ore bed will be described, with the other ores below.

b. The Sand rock, a coarse layer of three or four feet thickness which separates the ore from

c. The ore sandstone is a tough gray siliceous mass, about 25 feet thick, which forms the ridge or terrace on the flank of the mountain, the guide of the miners to the place of the ore.

7. *Middle Olive Shale.*—Siliceous shales varying in different localities from 10 to 50 feet, underlie the Ore sandstone and include in their lower part the *Danville ore beds*, usually three in number, one superior in thickness to the others, and all of them sometimes changing into mere fossiliferous limestones.

The Danville ore rock is a term used by Mr. Dewees to designate the hard layers between the ore beds.

All these ores will be described, in due place hereafter, in this preface, and in the body of the report.

In the Logan section, 178 feet of Middle olive shales underlie the Ore sandstone. Their general color is olive-green, which gradually changes to a prevailing purple, mixed with dark green. The upper part is seldom free from beds of fossiliferous limestone, which are sometimes so numerous and lie so close together as to constitute an almost solid mass of alternate limeshale and limestone strata. Near the bottom, beds of sandstone abound in certain districts.

Beds of fossil ore are sometimes seen to take the place of the above mentioned fossiliferous limestone layers; and these are occasionally good enough to justify mining operations on a very small scale. *The Lauber fossil ore bed*, in Lost Creek ridge, north of Mifflintown, is one of these. On the other hand when these limestone layers contain such notable quantities of iron, the Danville ore beds, which lie close up under the Ore Sandstone, among layers of lime-shales, appear to revert to their normal condition of fossil limestone layers, or are entirely absent.

The whole Middle Olive Shale group may be said to vary in thickness between 100 and 200 feet. Where it is thinnest, the diminution in quantity of deposits seems to have taken place at the expense of the limestone and lime-shale portions; the shales are less calcareous; the fossil limestone layers fewer and thinner, being sometimes reduced to isolated beds only a foot thick. The rest of the formation then consists of argillaceous and somewhat siliceous, olive-green, dove-colored shales, passing downwards into a constant mass of purple shale. The larger beds of limestone show most iron but only near the outcrop. When followed underground the iron disappears.

Scattered blocks of softened fossil-iron ore frequently lie scattered upon the terrace of the outcrop of the group and indicate the presence of small ferruginous limestone layers concealed beneath the surface, which if mined would not necessarily prove valuable.

The Danville ore rock in the Perryville ridge, west from Port Royal, and in Lost Creek ridge north of Mifflintown, where the limestone layers are thickest, is so split up by thin ferriferous and fossiliferous limestone layers as to lose its massive character, although what remains of it is even more siliceous than usual.

One of the limestone beds on the crest of Lost Creek ridge has been opened for ore by Mr. Henry Hirsch, under light cover on a low dip; but it soon loses its iron when the covering gets heavy. Properly speaking, where the bed is well protected from drainage, the limestone has remained undissolved and therefore the *relative* amount of iron in it remains small.

8. *The Iron Sandstone group.*—In the Logan section, this division rock between the Middle and Lower Olive shales is about 7 feet thick, but subdivided into two layers by an intermediate shale 3 or more feet thick, leaving only one foot of sand at the bottom.

In other parts of the country more than 50 feet of numerous alternations of shale and iron sand rock form the group.

As an iron *ore* the very siliceous character of all the layers makes any one more ferriferous layer of the group than the rest of little value.

9. *The Lower Olive shale.*—In the Logan section this group measures 560 feet, and its layers are more siliceous, as a whole, than those of the group of Middle Olive shales. It contains numerous thin beds of sandstone, and a very few beds of fossiliferous limestone. But at the bottom are yellowish-green, iron-stained, argillaceous, laminated slates exhibiting numerous fossil impressions, and crumbling readily under the action of the weather.

The uppermost layers of the group weather to a dark green color.

There are also thin layers of fossiliferous limestone, but they are not numerons, and in fact the Iron Sandstone may be taken as the practical bottom limit of the calcareous strata of the Clinton formation; true limestones, which incessantly present themselves in the column of rocks about it, being scarcely seen below it.

At a depth of 100 to 150 feet below the Iron Sandstone the shales are somewhat siliceous and more varied in color, purple and different shades of green, in alternate beds from 2 to 12 feet thick. Thin beds of steel-gray sandstone are also seen.

Below these are harder olive-green shales, alternating with purple shales. Here occurs the "*Birds-eye*" *fossil ore*, lying from 150 to 200 feet above the top of the Medina No. IV.

Medina White Sandstone, No. IV.

All the mountains of this district, and indeed of middle Pennsylvania west of the Susquehanna river, with the exception of Sideling Hill and its continuations around Broad Top, and one or two others, are made by the outcrop of this formation, with terraces of Oneida on their flanks. The white Medina makes the crest; the red Medina the terrace, and the Oneida the edge of the terrace.

At Logan gap of Jacks mountain the white Medina measures 820 feet; in Rockhill gap of Blacklog mountain 400 feet; the most of it consisting of massive layers of hard gray sandrock, each from 2 to 4 feet thick; some fine-grained, some slightly argillaceous.

At Penn creek gap in Snyder county and in Jacks narrows between Huntingdon and Mt. Union, one division of it is ferruginous. These ferruginous layers are in all from 30 to 50 feet thick. They overlie a shaly layer 6 to 8 feet thick, containing sometimes a good deal of poor brown hematite. Great blocks of this are met with near the crest of the mountain, (as on the south side of Tussey, south of Pennsylvania furnace, on Shade mountain and elsewhere. It is not a true ore, but sandstone, the surface of which weathered into a sandy brown hematite. When the blocks are broken the interior is seen to be an unaltered hard whitish sandstone.

White sand collects along the crests of the mountains, made by the disintegration of the more loosely grained layers of the Medina. Such a sand patch may be seen on the crest of the Blue mountain in Schuylkill county, near Drehersville, and it has furnished materials for glass manufacture.

Medina Red Sandstone, No. IV.

This "Middle of IV," as it was called in the old Survey, 1280 feet thick at Logan gap, and 1500 at Rockhill gap, consists of laminated reddish sandstone layers, too soft and friable for building purposes, interstratified with red sandy shales. Ripple marks abound; sun-cracks show that the deposit took place on an ancient shore; and diagonal bedding shows that strong currents prevailed.

Oneida Red Conglomerate, No. IV.

The top member of what used to be called "the Lower of IV," measures 310 feet in Logan gap and 160 in Rockhill gap. It is a mass of coarse reddish pudding stone, containing large quartz pebbles. On Shade mountain in Snyder county, in some of the strata the pebbles are very numerous, and up to the size of hens-eggs. Others are of coarse sand rock with small pebbles. The layers vary in thickness from one to six feet, so that large stones can be quarried; as at Mr. Jas. H. Mann's quarry near his house in Logan gap, where the top layer rises from water level, with a dip (to the S. E.) of 55° to form the brow of the terrace around Kishicoquillas valley.

Oneida Gray Conglomerate, No. IV.

This is also 310 feet thick at Logan gap and 410 at Rockhill gap, and is made up of very hard, greenish-gray sandstone; of coarse sand grains strongly cemented together, with pebbles not so large as in the Oneida red above. Some of the strata here also are fine-grained, but equally hard, and these contain small scattered pebbles also.

The Hudson river slates and Utica slates, No. III, and the Trenton limestones No. II need not be here described as they appear only *inside* the mountain ovals and have nothing to do with the main object of this report. They are sufficiently described in the Logan gap and Rockhill gap sections.

The iron ore deposits of the district under survey have now their positions in the order of the rocks assigned to them briefly in the foregoing paragraphs. It only remains to indicate somewhat more in detail their distinctive features. In doing this I will follow the same order, and note first the Marcellus ore of VIII; then the Oriskany ore of VII; the Lower Helderberg ore of VI, and finally the Clinton fossil ores of V.

1. The Marcellus brown hematite deposits occur along the outcrop line of black slates where they overlie the Upper Helderberg limestone with a bed of clay between the ore bed and the limestone. This line is persistent, of course, over the whole country; running for many miles in a nearly straight line; sharply returning upon itself; forming numerous zigzags on the map, and always keeping on or near the summits of the rugged ridges made by the Oriskany sandstone, which underlies the limestone.

The ore itself however is not thus persistent, for long distances intervene between the principal deposits, in which intervals scarcely a trace of the ore can be found, or the bed is so reduced in thickness as not to be worth opening.

This seems to be especially the case in Snyder county where the rocks have only a gentle dip (10° to 30°); where the Upper Helderberg limestone (which carries the ore bed) is either thin, or wanting altogether; where the Oriskany is a bed only 20 or 30 feet thick, of course iron-stained sand; and the Corniferous shale also thin.

But in Mifflin, Juniata and Huntingdon counties, where the limestone is from 25 to 45 feet thick, the Corniferous shales at their maximum, and the Oriskany also, the Marcellus ore bed is also well developed, and its dips vary from 40° to 75°.

It has been said above that the brown hematite is only the outcropping part of the bed. Deep mining always find it a bed of impure carbonate, or of dark pyritous clay. The unchanged carbonate is sometimes seen at the outcrop in ravines at water level. But on Sandy ridge, east of Orbisonia, brown hematite has been taken out from the bed below this level. (See pp. F. 122, 123.) Mr. Dewees suggests that in such a case the drainage waters which have altered the bed must have found their way through caverns or rents in the limestone below the present water level.

Generally the ore needs washing to get the smaller particles free from the clay, but in some places a large percentage of lump ore is obtained without washing.

2. Ore of the Corniferous Shale.—This is merely a decomposed shale; a clay impregnated with iron oxide, and holding partially decomposed fragments of shale. The richest specimens show a core of shale, greatly diminishing its apparent value.

It comes in frequently about the middle of the mass of shale. Sometimes the ground is covered with fragments, some of them rich and good. But on opening to mine, there are exposed small layers of ore from one to four inches thick lying between layers of shale, and quite worthless.

A rich but siliceous brown hematite occurs at the bottom of the shales, just over the Oriskany sandstone. In this case the shales are calcareous, hard, and fracturing square; as east of Peru in Juniata county; west of Shade gap in Huntingdon county, on the same range; and southwest of Fort Littleton in Fulton county, where, on the northwest slope, a large quantity of siliceous ore is strewn over the surface, just over the Oriskany sandstone. Here shafts have proved the upper layers of the sandstone to be ferriferous. But the ore is worthless. In the above mentioned cases what ore can be got requires washing from clay.

3. Oriskany Sandstone Ore.—This occurs most frequently on top of the Oriskany sandstone, as if the top layers had been impregnated with iron oxide from the decomposed overlying shales. But cases occur of a local block ore, with square fracture, lying directly upon the top layer of sandstone (which is also impregnated with iron) and under the shales. The sand rock here lies in short rolls, forming small oval basins, filled with the decomposed shale clay, and a deposit of ore varying from 2 inches to 3 feet in depth. (See Minehart's ore bank.)

The ferruginous sandstone blocks often cover the surface and deceive the eye into a belief in the existence of an abundance of good ore; but any attempt at mining only lays bare hard massive sandrock strata in place.

Ore has been found in the middle of the Oriskany sandstones, and of good quality, although siliceous. Local bunches from 2 to 12 feet thick have been mined at Land & Douglass ore banks in Hill valley, Huntingdon county. Here the Oriskany is a set of soft and friable sandrocks, easily cut with a mattock, and interstratified with thin beds, of various colors, overlying the ore.

Ore is found in the seams and cracks which cut through the rock mass. This, a smooth fine-grained argillaceous ore, has been set free by erosion and is often seen scattered down the slopes to the base of the ridges.

4. Oriskany Shale Ore.—This is a 30 per cent. ore seen in place only at one place, the "Chert Bank" southwest of Orbisonia. But scattered fragments indicating its existence are not uncommon in other parts of the district. It comes from a bed of shale, and therefore requires washing from the clay.

5. *Lower Helderberg limestone ore.* This brown hematite is only found in breaks, partings, and pockets of the strata, or, when set free by erosion, as scattered pieces on the slopes of the limestone ridges; as near Fort Littleton. It is interesting as helping to explain the great ore banks of Blair county, near Altoona.

6. *Upper Clinton Shale ore.* Nothing is known of this, except by inference. Bowlders weighing several hundred pounds of compact, siliceous, brown hematite, with a velvety surface, containing 39 per cent. of iron and 28 per cent. of insoluble residue, lie scattered about on a terrace on the west slope of Blacklog mountain, northeast of Orbisonia, and none of them higher up the slope than the outcrop of the Upper Clinton shale belt, from some pocket in which they are therefore supposed to have been set free. A little ore has been found by digging, but not enough to explain the size and number of the scattered blocks.

7. *Sand-vein ore bed.* This is the uppermost of the true fossil ore bed group, and overlies the Sand Rock, so called, or upper member of the Ore Sandstone. It is sometimes a mere fossiliferous limestone, sometimes a lean ore and sometimes a rich ore.

Where the bed is good it is unaltered, calcareous, hard and lean below the drainage level, and rich and soft above it.

Sometimes the upper layers of its floor, the sand-rock, are sufficiently rich in iron to be mined and smelted with it, but the mixture makes the stock more siliceous. These layers, when thus fit to be used as ore, are fine grained, or wanting in those coarse grains of sand which characterize the rock elsewhere. Where, as on Licking creek near Mifflintown, the ore bed is soft, so is the rock under it; where the bed is hard, its rock floor is hard; the difference being chiefly due to less or greater cover, less or greater dip, permitting more or less access to drainage water.

Sometimes the ore bed lies on a bed of loose sand, which gets mixed with it in mining. The ore is also itself then more siliceous.

Sometimes in the middle, sometimes at the bottom of the bed occurs a layer of lean clay ore called Jack, from 2 to 8 inches thick; commonly thickest when the bed is thickest, and *vice versa*. It usually has a sufficient percentage of iron to permit its being shipped to the furnace with the better ore.

The ore-stock from the Sand vein, pure or mixed with Jack, and with the sand layers below, naturally varies very much in quality. It may be said to yield from 20 to 45 per cent. of iron. It may be still enriching itself at certain points by percolation.

In fact, there are so many thin outcropping fossiliferous limestone layers in the shales above the sand vein—layers which never themselves become ore beds,* because they are not water bearing strata—that it seems reasonable to believe that their solutions, passing down through the Sand vein as the great water bearing stratum, enrich it, or perhaps entirely explain its existence as a bed of ore, by the deposit of the hydrated peroxide of iron between its grains of sand.

Sometimes the Sand vein is cut out by a horse, or roll, or settling of its roof towards the floor. On Licking creek, the real ore bed is in places gone, and the ore mined is merely the upper layer of its sand rock floor.

It is a general, but not a universal rule, that the Sand Vein is thickest when covered with the greatest thickness of shales. When the overlying mass of shales is thin, say 20 feet thick, the Sand Vein ore bed is also thin, or does not exist.

The ore bed is softened to different distances down from the surface on the slope of its dip; the distance down being limited by the depth at which the drainage water finds an outlet sideways, or through up-leading fissures at the foot of the mountain. Gangways have repeatedly been driven in soft ore *underneath* the beds of the shallow ravines, through which small brooks descend the mountain side.

* Except where they are broken by faults, which are water bearing planes.

It must not be taken for granted at any given point that, because the ore is at the surface hard, there can be no soft ore underground, for the drainage sometimes undercuts an unchanged part of the bed, finding its way through breaks, slips, or faults diagonally downwards, and changing the bed to soft ore to a considerable depth.

As a general rule, the limit of soft ore (going down,) is more quickly reached on a divide between ravines, than nearer to or in the ravines themselves.

Sometimes the Sand vein is double, or has a rider of ore; a thin stratum of sandstone or shale intervening. This goes to explain the central layer of Jack above mentioned.

The Sand-rock under the Sand vein is in some places 4 feet thick. In other places it has thinned away to nothing; and then there is no ore bed either, or merely a trace of one.

The Sand-rock is sometimes a layer of coarse rounded sand grains, either loose or cemented with iron hydroxide, as described above. Sometimes it is a smooth, very fine grained argillaceous stratum. Sometimes the lower layers are more of a lime shale rock. This carries the water well, and of course the ore bed is then pretty thoroughly softened.

Fragments of Sand rock looking like rich ore sometimes cover the surface along the line of outcrop, and are very deceptive. They are perfectly worthless as ore, but they do good service in guiding the geologist to the Sand Vein ore bed.

Sometimes the only representative of the Sand rock is a 2 or 3 inch layer of loose sand, as described above. When even this last trace of the rock is absent, the shales come down and lie directly on the Ore sandstone.

When fossil impressions are numerous in the Sand rock it is made by dissolution of the shells porous and light, and the plastic clays set free in the process are seen in alternate layers.

Sometimes the shells have been so abundant as to convert the Sand rock into a hard tight limestone, in which case the ore bed which it supports has remained hard and unchanged and full of shells.

A small (2″ to 4″) porous, soft, rich fossil ore bed occurs under the Sand rock and over the the Ore sandstone in the Ferguson valley ore ridge. An analysis by Mr. McCreath showed 59 per cent. of iron.

The Ore sandstone makes the most prominent terrace and often a distinct little ridge along the slope of the mountain; the outcrop of the Sand ore bed being just below or in front of it, and that of the Danville ore beds just above or behind it. This happens when the dip is gentle, or when there is a little synclinal roll. The ridge is always strongly marked where the outcrop sweeps its oval curves around the ends of the mountains.

The ridge is of course bolder where the Ore sandstone is thick and massive, than where it is thin. In the latter case, there may be hardly a ridge at all, but merely a low terrace brow, covered with fragments, broken from a few thick layers, and mixed with débris from the shale and limestone outcrops higher up.

The Ore sandstone proper varies in thickness from 8 or 10 feet in Mohontongo gap, south side of Shade mountain, near Tremont, in Snyder county, to 35 feet on the south side of the Perryville ridge, in Juniata county.

But in addition to and underneath this massive part, there are 10′ to 25′ of argillaceous, laminated, friable sandstone layers, alternating with shales, overlying the Danville ore beds.

The ore sandstone is, at top, in some places ferriferous. In others, the whole of it is a whitish mass, full of fossils and fracturing square. Elsewhere it has fragile layers much broken up. This last character prevails at the eastern end of Jack's mountain, at Centreville, in Union county, and on the eastern side of the Susquehanna river. Here a bed of shale occurs in the middle of the mass, with coarse greenish sandstone beds above and below, from 5′ to 7′ thick, the whole remaining 18′ to 20′ thick. The upper greenish sandstone member is more fragile and broken than the lower one, and has absorbed a notable percentage of iron from the overlying shales. Where the whole mass is much broken the iron has accumulated in the underlying Danville beds, more or less according to dip and other circumstances.

Where the Ore sandstone is close grained, massive, and unbroken, the underlying ore beds have the hard fossil ore character, even near the outcrop. When the dip is gentle, and the ore sandstone is removed by erosion, and the Danville beds are merely covered by shale, they are altered to soft ore.

The Ore sandstone is only 8′ thick in Klopperdale valley, south of Shade mountain, and seems to have let the iron drainage through; for the Sand Vein ore on top of it is there lean, and traversed by vertical cleavage planes, while the Danville ore beds are altered to soft ore.

8. *Danville Ore Beds*. These beds underlie the Ore sandstone, and are separated from it by a roof of shale and laminated argillaceous sandstones, from 15 to 20 feet thick.

The ore beds are included within a mass of rock called by Mr. Dewees the Ore-rock, varying in thickness from 6 feet at Berlin, in Union county, where the beds are very small, to 15 feet at Mount Union, where they are larger.

Three or four ore beds range through this mass of Ore rock which may be described as, normally, a fossiliferous, argillaceous limestone, changing in some parts of the district to a friable, porous, siliceous mass, full of cavities from which the fossil shells have been dissolved away; and in this state of things the included ore beds are more or less altered and softened, but in the normal condition of the rock, the ore beds yield hard ore. This fact goes against the supposition that the iron has been deposited in the ore beds by percolation from above, and lends probability to the supposition that the only effect produced, normally, by the drainage waters, is to soften an ore bed and increase its percentage of iron not actually but relatively.

The Ore-rock taken as a mass, is but slightly ferruginous when it contains good beds of hard ore. But when its ore beds have been altered and softened, the intervening rock seems to have absorbed more or less iron, and sometimes enough to make such layers valuable for furnace use. This process involved also the deposit of a good deal of white siliceous clay, containing insignificant quantities of argillaceous brown hematite or liver ore, as in Klopperdale valley, Snyder county.

The Ore-rock seems to be absent in the Perryville ridge, east of Perryville, and here the ore beds are merely represented by thin layers of fossiliferous limestone. Here, also, numerous fossiliferous limestone layers from 1 to 10 inches thick are found alternating with lime shales in the underlying shale mass, and one of these (the Lauber bed) is a sufficiently good ore to work.

The Danville ore beds are usually from 4 to 8 inches thick each, sometimes near enough together to allow of two or three beds being wrought in one gangway, as in the soft ore mines east of New Berlin, on the Jack's Mountain side.

When the Danville ore beds are separated one from another more widely one of them sometimes reaches the maximum thickness of 3 feet, while the others are small, as in Union county.

The conditions under which the Danville ore beds are altered and yield soft ore, have been described above.

The group of fossil ore beds described above, outcrop on a series of low terraces upon the flank of the mountain, as exhibited in Plate —, showing:

1. A bottom flat of red shale,	150′ to 250′	thick.
2. The Upper limeshales,	40′ to 160′	"
3. The Lower lime shales,	20′ to 150′	"
4. The Sand-vein ore bed,	0′ to 2′	"
5. The Sand-rock,	2′ to 8′	"
6. The Ore sandstone, about,	25′	"
7. The Danville † Ore-rock, with 3 or 4 Danville ore beds,	6′ to 15′	"
8. The Upper olive shales, about,	150′	"
9. The Block ore bed or Iron sandstone,	1′ to 12′	"
10. The Lower olive shales, about,	500′	"
11. The White Medina sandstone formation,	500′ to 800′	"

A low dip of course broadens these terraces, and a high dip contracts them, bringing the Lewistown limestone as a ridge close to the foot of the slope of the mountain on which are the terraces.

A low dip thus widens the belt of good farming land, behind which runs the belt of the ore outcrops, on the steeper slope above.

A high dip lifts the whole slope to a greater relative height above sea level, and above the bed of the stream running at the foot of the mountain.

The ore in these terrace beds is the only ore in the mountain flank yet discovered of any great value, although there is a popular belief in large quantities of brown hematite ore hidden somewhere in the olive shales, higher up the mountain above the fossil ore outcrops. A little of such ore has here and there been found, but the survey has been able to make out no persistent beds of it.

At Bell's furnace, on Licking creek, some brown hematite overlying a white siliceous clay, marks the decomposed outcrop of a bed of ferruginous sandstone; and a similar decomposed outcrop of ferruginous sandstone has yielded a little hematite in the Lower purple shales near Orbisonia.

These shales are so much like the purple shales elsewhere seen associated with the Block-ore or Iron-sandstone, that the hematite is probably a representative of that rock. The sandstone contains but little iron, and the brown hematite is probably a concentration from the white clays which are produced by the mouldering down of the sandstone along its outcrop.

Some of the brown hematite masses found on the mountain may have come from very local fossiliferous limestone beds, which are known to suffer such alteration.

The upper terrace, behind the Ore-sandstone, from Richville to the summit at Jacob Starr's, on the south side of Shade mountain, east of Shade Gap and elsewhere, carries brown hematite from the alteration of the Danville beds.

A great deal of fossil ore lies scattered over this terrace east of Cook's gap, in Shade mountain, Juniata county.

Brown hematite ore marks the outcrops of the fossil ore beds, and of the fossiliferous limestones which represent them where they are absent.

In Klopperdale valley, on the south side of Shade mountain, in the ridges between Selinsgrove and Tremont, in Snyder county, the outcrops of the Sand-ore and Danville ore beds are brown hematite to some depth beneath the surface, on a low dip on table lands.

The layers of altered ore alternate with layers of white siliceous plastic clay.

Sometimes the alteration of the fossil ore bed extends to a great depth if the covering rocks are thin, and where the Ore sandstone (over the Danville beds) is thin and broken.

The Sand vein ore bed (over the Ore sandstone) is sometimes softened and changed to an unusual depth, even on high dips. The depth is determined by the permanent drainage level below ground. The ore below this level is always unchanged and hard.

The Danville beds frequently yield an altered Kidney ore, breaking with a conchoidal fracture, and of reddish color.

The Sand vein ore bed when altered, has a rough exterior, is cellular, frequently more siliceous, and has an angular fracture. It contains also a lean iron clay called "liver ore."

The altered fossil ore exhibits itself at Shipton's run, in Snyder county, at the ends of the ridges, in a cross ravine, proving conclusively that the alteration preceded the erosion of the present surface.

Surface indications of the quality of the fossil ores beneath the surface are few and inferential.

Where the dip is low or moderate, and the Sand vein ore bed crops out low down on the long flat of shales which extend from the Ore sandstone ridge, or terrace, down to the stream at the foot of the mountain, it may be expected that the shales are softened and buff colored; and that the ore bed is altered, softened, and enriched; and as far down the dip as this covering of soft buff shales extends.

If the bed be then mined downwards to levels below the drainage level, it will turn to hard limestone ore under a roof of hard, unaltered shales.

If on the other hand the ore bed rides high up the foot slope of the mountain and outcrops continuously, or in an unbroken line, near or on the ridge or terrace of Ore sandstone, it will probably yield mostly hard ore.

If numerous ravines descend the mountain slope so as to make the Ore outcrop rise and fall, and furnish numerous side outlets to its inside water drainage, then most of the bed (above low water level) will probably yield soft ore. The greater or less number of springs issuing from the outcrop in the ravines is therefore a fair indication of the altered or unaltered state of the bed.

The same rule holds good for the Danville ore beds *under* the Ore sandstone, as for the Sand vein *over* it. But it must be remembered that in this case something is due to the broken and porous, or unbroken and impervious local condition of the Ore sandstone. Where it lets the water through and down easily, the ore beds below it will of course be soft. Or when it is thin and has a flat of shales behind it on the flank of the mountain, then the surface waters will collect against it *behind* and descend to soften the ore beds. The favorable indication here is, that the Ore sandstone outcrop runs at a level (above tide) as high or higher than the outcrops of the ore beds behind it. A *decided terrace*, with a bold front of Ore sandstone, is favorable for soft ore in the Danville beds.*

It has been said above, that when the Ore sandstone outcrop is porous, the ores beneath will be soft; when it is massive and tight, they will be hard.

Cost of Mining Fossil Ore. Mr. Dewees made the following report of this in 1877:

"The cost of mining ore varies with the different condi-

* "The reason for the existence of hard fossil ore under the low dips of the Upper Clinton Fossil Ore Shales, as on the south side of Lost Creek Ridge, lies in the fact that the shales serve as a roof; the water draining off rapidly, and not penetrating through the tough blue-gray shale, which in the locality above named weathers olive green or buff.

"On Perryville Ridge there are points opened on north dips of thirty degrees, (30°,) where the 'Sand Vein' Ore Bed crops out on the crest, and proves to be soft fossil ore. A cross-cut driven in from the base of the ridge cuts hard ferriferous limestone at a depth of thirty-five feet.

"The Danville beds produce soft fossil ore on flat measures, where the Ore Sandstone is eroded, leaving only the siliceous shales covering the beds, but in this case the lower Danville Beds are likely to be hard fossil.

"An ore bed on high or perpendicular dips is generally soft fossil, (altered fossil at the outcrops,) even when the overlying strata afford a thick covering. But there must be some conformation which permits the infiltration of the surface water, such as frequent water seams and breaks in the shales, or a barrier to the water, such as the Ore Sandstone offers." [J. H. D.]

tions of the ore bed, its thickness, the dips, the quality of the ore, (hard and soft,) and the condition of the hanging wall or roof rock.

"Soft or medium soft fossil ore, in beds from sixteen to twenty-four inches thick, on dips steep enough to run the ore to the gangway without hindrance, thus avoiding the labor and expense of scraping and shoveling, can be mined at the small cost of forty cents and upwards per wagon containing from fourteen hundred to sixteen hundred pounds of ore. The soft ore will cut more readily than the medium soft, but with it the top wall is generally softer and therefore more expensive to hold in place, thus increasing the cost of mining the soft ore to about the same as that of medium soft ore.

"When the dips flatten so much that scraping and shoveling become necessary, the cost of mining soft and medium fossil ore increases proportionally, until the dip becomes so low that it will admit of the running of wagons into the chambers. When the dips are as low as this, the bed can be mined more cheaply than where the dip is from twelve to fifteen degrees, which is too steep a slope for wagons to be run into the chambers, and not steep enough for the ore to slide down by its own weight. Still mining with wagons is more expensive than that upon the steep dips.

"At a dip of thirty degrees, soft and medium fossil ore is mined at present at a cost of about fifty cents per wagon load.

"When the beds are smaller, the cost of mining is increased. In a bed twelve inches thick, the cost is sixty cents per wagon load. These prices are considered low when the iron trade is more active than at present.

"The cost of driving the gangways must sometimes be added to the above figures, but generally this cost is paid by the ore obtained. An additional sum of five cents per wagon must also be added for propping.

"Hard fossil ore beds require drilling and blasting, but do not require so much handling as the soft ore to get the ore to the gangways in the flatter dips, as it will run on medium dips, and is less likely to clog in its course. There is, however, some expense in breaking the ore into pieces small enough for the miner to handle.

"At present, in a bed of hard ore from eighteen to twenty-four inches in thickness, the price paid for an eighteen hundred pound wagon of ore is from $1 00 to $1 25; or where the ore is very hard, on a dip of from twenty to twenty-five degrees, the price is $1 75.

"In flat dips or on a level, the labor required for handling the ore makes it very expensive mining.

"The cost of mining hard fossil ore at present is so great, as to prevent the mining of it for shipment by rail, the price being from $2 00 to $3 00 per ton, according to quality.

"The only hard fossil ore mined is used in furnaces near by, within convenient hauling distance. The expense of hauling is about a dollar per ton where the distance is between four and six miles, and from sixty cents to a dollar per ton where the distance is from two to four miles. These prices are of course modified by the character and condition of the roads.

"Royalty for the ore, where it is mined, ranges from twenty-five to fifty cents per ton, in some instances running as high as fifty cents.

"Most of the mines are idle at present, both on account of the little demand for ore, and also because the facilities for shipping from Middle Creek Valley, Snyder Co., have been cut off by the suspension of the Sunbury and Lewistown railroad, which took place January 1, 1875. At points convenient to the canal, the mines are idle on account of the light demand for ore."

9. *Bird eye fossil ore.* This bed must be described out of its order, as it occurs, locally, only about 100 or 150 feet above the basal contact of the Clinton formation, with the underlying Medina formation. It is therefore one of the layers of the Lower Clinton olive shales.

At Paxtonville, where it has been worked, it is about 10 inches thick, on a gentle dip, with a steady floor and rolling roof. The rolls occur every few (2 to 5) yards in the mine, so that the thickness of the bed varies from 6 to 14 inches.

The shales are yellow when exposed to the weather, and greenish yellow under cover. They are purplish green and olive green in the ridges of Juniata and Snyder counties, both north and south of the East Shade mountain, and in Baxter's gap, south of Lewistown. The shales above are harder and more siliceous, with fewer fossiliferous limestone layers, than the shales beneath. The purple shales under the ore bed in Shade mountain are from 10 to 25 feet thick. Under them lie alternate green and yellowish, and green and purple shales.

Mr. Dewees' description of the ore is as follows:

"When the bed is hard fossil or medium, it mines in trapezoidal blocks from fifteen to eighteen inches long, and of the thickness of the bed; the vertical seams mining diagonally with the strike of the measures, twenty-five or thirty degrees, where examined. These vertical seams aid very materially in carrying the surface water into the fossiliferous limestone bed and producing the fossil ore.

"The ore is of a very superior quality, (see analysis). In low dip measures, it is always softer where the shale covering is thinner, and when it passes under cover it changes back to its normal condition of fossiliferous limestone.

"The 'Bird Eye' bed has been mined south of Middleburg, on the south side of Shade mountain, on lands of Peter Welker, along the public road leading to Tremont, and several hundred tons of ore have been shipped therefrom. It has been worked under forty feet of covering, and produced a medium quality of ore on a low dip of five degrees over one hundred yards from the outcrop. Where this ore has been used it has been very highly spoken of.

"The ore was first mined for shipment in Snyder county, near Paxtonville, in the year 1855 or 1856 (?) and was used in the old Beaver Furnace (charcoal). The bed was opened further east during the year 1872 in the neighborhood of Middleburg, Smith Grove, Freeburg, and elsewhere, and the ore shipped by rail to various points.

"It has been opened within five miles of Selinsgrove, on the opposite dip of the eroded anticlinal, and can be opened on this range eastward, to the point where the declining anticlinal closes the outcropping and forms the arch in shales covering the bed of ore; and it may be found in the ravines cut in the anticlinal eastward from the last point of opening.

"The bed has been opened on the property of Emanuel Duck, three miles southeast of Middleburg, and from twelve to sixteen hundred tons of ore have been shipped therefrom. About the same quantity of ore has been sent away from the property of Thomas Portius, near the same place, and also from the property of Andrew Bickel, about a mile eastward.

"Both the north and the south dips have been opened north of Freeburg, five miles west of Selinsgrove. Five or six hundred tons of ore were shipped from the north dip. There are several other openings which have sent away but a few tons.

"The flat measures and the small size of the bed make it very difficult working, and it could not have been profitably mined but for the fact that a larger price is paid for this than for other fossil ore."

10. Block ore. There is a group of block ore beds in the lower part of the Clinton formation, which deserve description.

The Iron sandstone is one of these, and makes the division between the Upper and Lower olive shale masses.

The Boyer block ore layer occurs 250 to 300 feet beneath the Iron sandstone, and 100 to 150 feet above the Bird-eye fossil bed. It is 6 feet thick, and part of it affords good ore where opened in Mahontongo gap, on the south side of East Shade mountain, northeast of Tremont, in Snyder county.

The shot block ore bed lies below the Bird-eye fossil, and about 150 feet above the Medina sandstone; is 6 to 8 inches thick, and contains shot-like argillaceous pebbles.

All three beds are best exposed near the eastern end of Shade mountain, in the ridges west of Selinsgrove, on dips of only 4° to 10°, spreading over a base three miles wide and affording numerous lines of outcrop. They are wrought at Beaverstown and in its vicinity.

The Iron sandstone is exposed on the ridge north of

Shade mountain, from Adamsburg to Paxtonville, with extremely variable size and quality of ore.

The Boyer block ore is only opened in Mahontongo gap.

The Shot block ore has been wrought to the extent of some hundreds of tons on Lost Creek ridge. It is exposed in the Paxtonville quarries, with a bed of compact siliceous clay, breaking with a shaly fracture and smooth surface, and easily cut with a knife.

The report of the Aughwick Valley, or southern end of the district described in this volume, by Mr. C. A. Ashburner, with topographical and geological maps by Mr. C. E. Billin, and geological sections by Mr. Ashburner, is an important contribution to the geology of the Central belt of the State.

It not only extends the description of the Marcellus, Oriskany and Clinton outcrops half way across Huntingdon county, but describes in detail the Medina, Oneida and Hudson river formations on the one side, and the Portage, Chemung, Catskill, Pocono, Mauch-Chunk, and Pottsville formations, with as much of the overlying Coal-measures, as remain in the East Broadtop trough.

It describes the side-throw faults, which traverse the Silurians at Rock-hill gap, and the Devonians near Three-Springs. The colored maps of Orbisonia and its vicinity, and of the East Broadtop railway line, bring out to view these faults finely. Mr. Ashburner's isometric projection of the Three-springs fault deserves careful study. Essays were made to color it; but no system of coloration availed to make it more intelligible; but rather obscured its interpretation.

Although the Section goes up to the coal measures, the beautiful contour line map of Rocky Ridge and East Broadtop coal field, made by Messrs. Billin and Ashburner to illustrate this upper end of the Section, is not quite ready for publication, and will better suit a future volume on the whole Broad top coal region, much of which has been carefully mapped and sectioned.

Colored geological maps of Mifflin and Huntingdon counties are in preparation and will probably be published before the close of 1878.

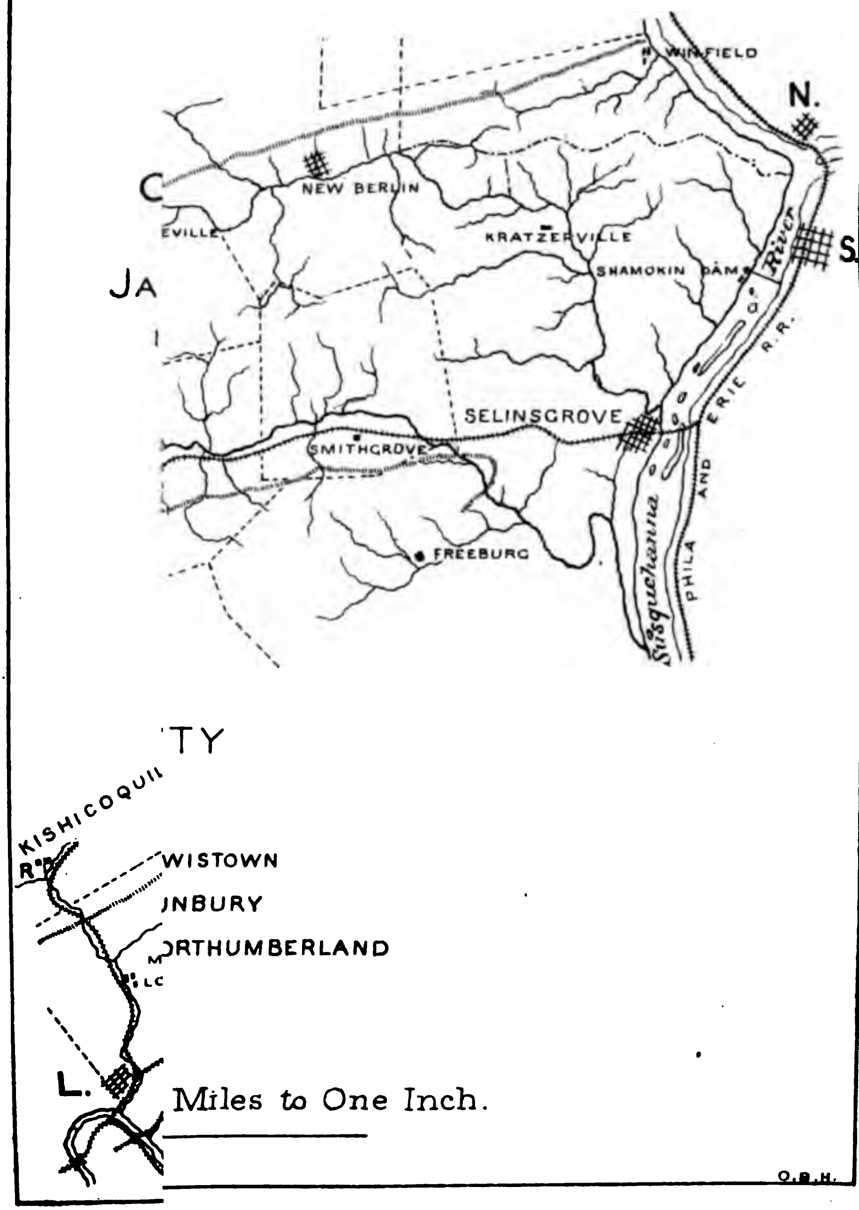
Messrs. Ashburner and Billin desire to express gratitude for much kindness and many favors received from residents in the district surveyed, and from the officers of the East Broadtop RR. Company, and the Rockhill Iron and Coal Company.

Whatever illustrations may be wanting in this volume will appear in a succeeding volume (FF) on the Fossil ores of Juniata and Perry counties.

Circumstances prevent the publication of an index to this volume. The index to FF will therefore be made to include both volumes.

J. P. LESLEY.

PHILADELPHIA, *July 8, 1878.*



Miles to One Inch.

O.B.H.

Chapter I.

Jack's Mountain.

Jack's mountain anticlinal rises from the east. At the Susquehanna River the Ore Sandstone covers the entire crest. The middle of the anticlinal has sunk, causing two anticlinals, or rolls of the Ore Sandstone.

The southern roll is the larger of the two. A large quantity of both hard and soft fossil ore has been mined from the north and south dips of this anticlinal by the Union Furnace Company.

The anticlinal rises rapidly to the westward, causing a cove of the Ore Sandstone and Danville Ore Beds, extending for about a mile, from which a considerable quantity of ore has been mined.

West from the end of the cove the anticlinal continues rising and lifts first the Lower Clinton Shales and then the Medina Sandstone to the surface, in a single anticlinal, 4 miles from the River.

It continues to rise for a distance of 8 miles, to New Berlin, where it attains its maximum height, and forms an anticlinal ridge—500 or 600 feet high—of the upper layers of the Medina white sandstone.

The anticlinal maintains this condition for a short distance westward, and then begins to descend rapidly. At a point E. of Penn's Creek Narrows, and 2 miles W. of New

Berlin, at the Mifflinburg public road, the Medina Sandstone has entirely disappeared, and the flexure is spanned, at water level, by the Lower Clinton Shales.

From this point the axis again rises westward, and before reaching Penn's Cr. Narrows the Medina Sandstone reaches a height of about 200 feet above Penn's Cr. On the west side of the creek the height is greatly increased.

Half a mile east of Centreville, Penn's Cr. cuts through the rising anticlinal of the Medina Sandstone.

On the west side of the gap the mountain is from 500 to 600 feet high. On the east side the anticlinal is much lower. The south dip is eroded. The north dip of the Medina Sandstone is exposed in the gap, sinks about 20° eastward, and is soon lost to view under the Lower Clinton Shales.

The Block Ore is exposed 2 feet thick on a dip of 42° S. on the west side of Penn's Cr. The fossil ore bed is not exposed in the gap.

West of Penn's Cr. Narrows the rise of the anticlinal is gradual. It continues for 10 miles, to Troxelville, and then passes out of the mountain into the Kishicoquillas Valley.

From a point three miles W. from Troxelville, Jack's mountain is a monoclinal, bounding the Kishicoquillas Valley on the south. It increases in height, soon reaching 2,000 feet above tide, which increases to 2,300 feet opposite Atkinson's Mill, 6 miles W. from McVeytown.

From this point the mountain continues to be very high, until after passing Jack's Narrows N. of Mt. Union. After that there is a descent westward, towards the terminus of the mountain at Three Springs. At a distance of 80 miles from the Susquehanna River, the Medina Sandstone sinks under the Lower Clinton Shales; and here Three Springs creek, which is a branch of the Great Aughwick, cuts through the shales and passes over the anticlinal of the Medina Sandstone.

The shales continue westward, enclosed by the surrounding Oriskany Sandstone and Lewistown Limestone Ridges.

Jack's mountain joins Stone mountain just before reaching the Juniata River, and the two united make the broad triple-crested, double-anticlinal mountain from the Juniata River onward to its southwest end.

A transverse fault exists at the end of the mountain, which was discovered by the survey of Messrs. Ashburner and Billin, and will be described in their report included in this volume.

Fig. 1. (page 2 F.) Section of upper layers of Medina Sandstone, in Penn Creek Narrows of Jacks Mountain.

Fig. 1.

Sandstone, ferruginous, fragile.
Sandstone, block-ore.
Sandstone, grayish red.

Shale { argillaceous, siliceous; thin beds of sandstone containing iron; some sandy hematite.

Sandstone { hard, gray, flaggy, with beds of sandy slate.

Sandstone, red, ferruginous, in layers of 1½ to 3 feet thick; some layers rich in iron.

CHAPTER II.

Fossil Ore of Jack's Mountain.

A low monoclinal ridge, formed by the S. dip of the Ore-sandstone, ranges west from the Susquehanna River, at Winfield, Union county, to a point near Centreville, Snyder county. West of this the ridge merges into the terrace of Jack's mountain.

North of the Jack's mountain anticlinal a similar ridge is formed, running W. from the Susquehanna River.

Mining has been prosecuted in the Danville Ore-beds of both these ridges. In the southern ridge, except at its eastern extremity, the ore beds are comparatively thin. In the northern ridge, however, the beds are heavier, one of them, at a point N. of New Berlin, being nearly 3 feet thick.

A large quantity of ore has been mined by the Union Furnace Company in the ore ranges lying north of the Jack's mountain anticlinal, and near the Susquehanna River. The description of these will appear in a future report.

Along the ridge formed by the Ore-sandstone, dipping S. from the Jack's mountain anticlinal, between the Susquehanna River and Centreville, the "Sand Vein" ore bed does not exist. The "Sand Rock" over the Ore-sandstone is also absent, its only representative being a bed of sand 3 or 4 inches thick.

Nowhere, throughout the whole length of the ridge, do large boulders of the Ore-sandstone occur upon the surface. This rock is not compact and massive, as is generally the case, but is soft and porous, lying in two divisions, separated by a silicious slate, and breaking into small fragments, which are scattered over the surface of the hill. Its nature has much to do with the depth at which soft fossil-ore may be found.

The "Danville Ore-bed Rock" is partly decomposed, assuming the character of white silicious clay in the gangways.

The shales over the Ore-sandstone are olive green. They have been eroded near the top of the ridge, thereby lessening the amount of covering over the ore, and producing a soft ore near the outcrop.

Union Furnace Company.

This company has an iron furnace which is located on the W. bank of the Susquehanna River, 4 miles below Lewisburg, Union county.

It was built in 1853 and 1854 by Beaver, Geddis, Marsh & Co., and operated by them until 1862. Since then it has been worked by Peter Beaver, J. S. Marsh, and Levi Rook, under the firm name of Beaver, Marsh & Co.

The stack is built of stone and brick.

Height of stack, ...	50 feet.
Size at bosh, ...	15 "
Number of tuyeres, ...	4
2 hot ovens.	
Inclined plane hoist.	
1 horizontal engine—stroke, ...	7 feet.
Diameter of steam cylinder, ...	24 in.
Diameter of blowing cylinder, ...	6 feet.
Blast pressure, ...	4 lbs.
Steam "	70 "

Average yield of furnace 100 tons of iron per week.

The above facts were communicated by Dr. Levi Rook.

Union Furnace Co.'s mines, lying S. of Jack's mountain anticlinal. One of the first mines opened by this company was in the E. end of Longstown Ridge, a little above water level of the Susquehanna River. The lowest of the Danville Ore Beds was worked, the thickness varying from 20 inches to over 3 feet. This thickness has been proved, by means of cross-cuts on higher levels, to continue for about 1 mile west. The dip is 35° S., giving a long breast of over 80 yards above water level. Near the outcrop the Ore sandstone has been eroded, and soft fossil ore produced; this, however, changes to hard fossil ore at water level.

A specimen of the hard fossil ore now being mined, yielded upon analysis:

Iron,	33.800
Sulphur,	.004
Phosphorus,	.358
Carbonate of lime,	39.142
Carbonate of magnesia,	2.497
Insoluble residue,	3.851

The ore is exceedingly hard and tough, and carries small lenticular masses of slate; color, reddish brown and reddish gray. (A. S. McCreath.)*

A mile W. of Union Furnace, on property adjoining that of McKelvy and Barton on the W., and that of John Phillips on the E., a slope 45 yards long was sunk on the lowest of the three Danville Ore-Beds. At this point the Upper shales and Ore-sandstone have been eroded, and the ore is soft to an increased depth.†

The work was done in 1864 by Wm. Hart, for the Union Furnace Co. The slope is now closed.

The Ore-bed dips 45° S., and varies from 4 to 10 inches in thickness. A gangway was driven from the foot of the slope for 250 yards W., and another 100 yards E. The length of the breasts was from 50 to 55 yards. This increase over the length of the slope (45 yards) was due to the rising of the ground on each side of the notch in which the slope was located.

Hard ore being encountered in both gangways, they were abandoned and counter-gangways driven about 20 yards above the foot of the slope. The ore in the western of these became of poor quality, and it was abandoned. The eastern counter-gangway continued in soft ore to the adjoining old workings.

About 2,000 (?) tons of ore were shipped from here.

On *McKelvy's* property, about ½ a mile W. from the slope, in a shallow notch in the ridge, the Union Furnace Co. opened the ore by a drift. It was, however, abandoned

* All analyses in this report, which are not credited to other sources, have been made at the Laboratory of the Survey, in Harrisburg, by Mr. A. S. McCreath, and his assistants, D. McCreath and S. A. Ford.

† This shows the effect of proximity to notches or ravines in changing the character of the ore in the bed from a hard to soft fossil.

on account of the inferior quality of the ore, which was a light rotten material.

A shaft sunk on the same ore bed a few hundred yards further west proved the bed to be from 4 to 6 inches thick.

West of McKelvy's, for 1½ miles, the opportunity for reaching the ore beds by means of cross-cuts is not good on account of the thickness of the superincumbent shales. A short cross-cut, driven by D. Davis in 1853, near the outcrop of the ore-beds proved soft fossil-ore, but this will probably become hard ore at a slight depth, as the Clinton Fossil-ore Shales, wherever exposed, are blue, hard and calcareous.

In *Chapel Hollow*, 4 miles W. from the Susquehanna River, on the property of Isaac Eyers, a gangway has been driven east in the upper Danville Ore Bed. The other ore-beds at this place are thin.

The opening was made by the Union Furnace Company in 1853, and worked at intervals until 1868, when the bed was but 4 inches thick.

"About 8,000 tons of ore, of good quality, were shipped from this mine to Union Furnace."

The ore-bed dips 45° S., and varies in thickness from 4 to 18 inches. Changes in thickness occur about every 100 yards.

The main gangway was driven E. about 800 yards, giving about 80 yards of breast. The upper 35 or 40 yards was worked out by means of counter-gangways, opened by cross-cuts from the south slope of the ridge. The counter-gangways extended about 600 yards E., the ore-bed remaining about the same as in the lower level.

Two hundred yards E. from the entrance to the main gangway a slope was sunk to the vein, 30 yards below the level of the mouth of the mine. Gangways were driven 100 yards each way, E. and W., from the foot of the slope. The ore-bed was 16 to 18 inches thick, diminishing to 8 inches at the W. end of the gangways, and to 4 inches at the E. end. The bed contains soft fossil-ore in both directions.

This would seem at variance with the theory that only hard fossiliferous limestone exists below the natural drainage point of the ore-bed. But Mr. Wm. Hart, who had much to do with the mining at this place, represents that soft fossil-ore exists 30 yards below the level of the ravine. It is evident that in such a case, there must be a fault or break in the measures at a lower level, opening an avenue for drainage to a point in the valley below the level of the ravine. For drainage is essential for the formation of fossil-ore from fossiliferous limestone.

On the W. side of *Chapel Hollow*, opposite the opening on Isaac Eyer's property, the same Ore-bed has been opened by two gangways. These openings were made by the Union Furnace Company in 1853, and abandoned in 1863 or 1864, as all the soft fossil-ore in the lower level had been worked out. The expense of mining the hard fossil-ore was too great to allow a profit after hauling it in wagons 4 miles to the furnace.

There are 75 or 80 yards of "breast" above the level of the lower gangway, which is driven in, from water level of the ravine, for 60 yards, through hard fossil-ore.

The ore, which is of an excellent quality, averages 10 inches in thickness. The bed dips 45° S.

About 35 yards above the main gangway a second one was driven for a distance of 1,200 yards, to where it enters the tract of land belonging to Harriet Jenkins. This gangway afforded about 40 yards of breast in soft fossil-ore.

The property of *Harriet Jenkins* is about 1 mile long. At its western extremity is a ravine, in the side of the ridge, from which a gangway has been driven to the east.

This opening was made in 1853, by the Union Furnace Company, and worked at intervals until 1867, when it was abandoned. About 5,000 tons of ore were shipped to the furnace.

There is a gangway and a counter gangway, with 80 or 100 yards of breast upon the ore-beds. The lower level is hard fossil-ore. The upper level was soft fossil-ore, which, however, changed to a hard ore, and the drift was on that account abandoned.

East of this opening there are three cross-cuts driven near the outcrop of the bed, not affording breast enough for gangways.

The Upper Clinton Shales are olive green and blue gray.

"The ore-beds here lie so close together that in working the upper seam the two lower ones can be taken out of the gangway, making in all ten or twelve inches of ore."

David Oldt's Mine is on the west side of the ravine, opposite the gangway on Harriet Jenkins' property. It was made in 1864 by the Union Furnace Co., and for 4 years soft fossil-ore was mined. Three thousand tons of ore were hauled to the furnace, a distance of 5 miles.

The gangway is driven about 200 yards W.

The two lower beds lie close together, in the gangway, and are worked together. The upper bed, over the gangway, is about 4 inches thick. The middle and lower beds are each from 6 to 10 inches thick, making the average thickness of ore worked out of both beds about 15 inches. The intervening rock is thin, and must be handled to get the ore from both beds.

At *Chas. Oldt's Mines*, about 350 yards west of David Oldt's, a cross-cut is driven 100 yards through the Upper Clinton Fossil-ore Shale and the Ore Sandstone to the Danville ore beds, which are the same in number as at David Oldt's, but somewhat smaller.

The opening was made by the Union Furnace Co., (?) but has been abandoned on account of the ore being hard-fossil.

Along the ridge, for half a mile east of this point, the soft "crop-ore" has been worked out.

The *Price Tunnel and Ore Bank* are on the land of Charles Oldt, nearly 6 miles west from the Susquehanna River, and 500 yards east of "Maize's Ore Bank."

Work in the ore-bank was commenced in 1861 by the Union Furnace Co. In 1873, the same Company drove the "Price Tunnel" at a hollow in the side of the ridge, and at a lower level than the old workings.

In consequence of the notch in the ridge at the "Tunnel," the ore is soft to a greater depth than at the ore-bank.

The "Price Tunnel" is about 75 yards long. It has been driven through the Upper Clinton Fossil-ore Shale and the

Ore-Sandstone. At this level, about 200 yards of gangway was driven in hard fossil-ore, giving breasts of soft ore for 40 yards to the outcrop.

The combined thickness of the two lower Danville ore-beds is from 8 to 12 inches. The ore is of a superior quality.

Within a distance of half a mile between 30,000 and 40,000 tons of ore have been mined from this ridge and hauled 6 miles to Union Furnace.

The *Maize Ore Bank*, in a ravine, adjoining the property of Charles Oldt, and 1¾ miles E. of New Berlin, was opened in 1855 by Benjamin Thomas, lessee, who sold it to the Union Furnace Company. It was worked at intervals for ten years, during which time about 5,000 tons of ore were sent to the furnace.

Two gangways were opened, one at water level, and one higher up on the side of the ridge. The lower gangway was driven about 40 yards, when hard fossil-ore was encountered, and it was abandoned. The upper gangway contained soft-ore.

The two lower Danville Beds were worked, giving a combined thickness of 10 inches.

The *Charles Moyer Ore Bank*, situated 1 mile N. E. of New Berlin, is a cross-cut which was driven many years ago, near the outcrop of the ore bed.

It was worked for 5 years, and then abandoned, the beds containing too small a quantity of ore. It was reopened in 1863 by William Hart, and ore was mined until 1869, and hauled to Union Furnace.

There are 12 yards of breast. The ore-bed dips 45° S., is 6 inches thick, and the ore is of good quality.

On the east side of the ravine, on the same property, a gangway was driven at water-level, by the Union Furnace Co., in 1855, and worked until 1865.

The ore-beds contained 12 inches of good, soft fossil-ore. The gangway was driven 175 yards to hard fossil-ore. It was then raised 10 yards and driven 50 yards further, when it cut hard fossil-ore again and was abandoned.

The breast worked averaged about 25 yards at the point where the gangway was abandoned. It increased eastward to 75 or 80 yards.

About 4,000 tons of ore were shipped from here to the Furnace.

Michael Kleckner. The same Danville Beds are opened at Michael Kleckner's, ¾ of a mile E. of New Berlin. The property was leased by the Union Furnace Company, who opened the beds in 1868, and have worked them at intervals up to the present time (1875.)

Gangways were driven about 200 yards. The ore is a rich, soft fossil. About 2,000 tons have been hauled to Union Furnace in wagons, which form the only means of transportation throughout the whole range.

North of New Berlin, on the same property, Andrew Colton opened the ore-beds in 1853 for the Union Furnace Company. The opening was worked for about 5 years and then abandoned. About 3,500 tons of ore were shipped to Union Furnace. Three hundred yards of gangway were driven. The ore was a rich, soft fossil. The ore-bed was rolling, varying from 3 to 6 inches in thickness.

One mile west from New Berlin, in a small ravine, the Danville ore-beds were opened by Christopher Seabold in 1855, (?) and worked for 5 years by the Union Furnace Co., Lessees.

The ore-bed dips 45° S., and contains from 4 to 6 inches of soft fossil-ore.

From 3,000 to 4,000 tons of ore were shipped from this opening.

Openings were made on both sides of the ravine. On the east side the slope from the ravine is gradual. The opening is made at water-level, and the ore is soft to the end of the gangway. The west side of the ravine the slope is more abrupt, and the ore at water-level is hard, so the opening was made at a higher level.

New Berlin to Centreville.

Between New Berlin, Union co., and Centreville, Snyder co., no openings on the ore-beds have been made, though the ridge has the same characteristics as at points to the east. Between the ravines the Upper Clinton Shales extend up as high as the outcrop of the Ore-sandstone, thus preventing the formation of soft ore to any depth.

About 2 miles E. of Centreville, at the public road leading to Mifflinburg, the Ore-sandstone shows no "rib" upon the surface, but is broken in fragments and disintegrated.

At this road the base of the ridge between the two outcrops of Ore-sandstone is about 1 mile wide. The measures dip 28° N. and 42° S. The Lower Clinton Shales are the lowest rocks exposed, and form the crest of the anticlinal.

Westward the ridge is broken by Penn's Creek, at Penn Creek Narrows.

Centreville, Snyder Co.

At this place the ore-beds crop out high upon the ridge, on a level with the terrace of Jack's mountain, affording but a small range of breasts, unless long tunnels be driven through the Upper Clinton Shales. The Ore Sandstone continues of the same character as further eastward.

West of this, the ore ridge merges into the terrace of Jack's mountain. About 1½ miles W. the outcrops of the Ore Sandstone and ore-beds, with a dip of 40° S., run through the lower ground, and continue for 3½ miles, to form low terraces at the base of the mountain. Occasional washes in the terrace admit of a few yards of breast above the level of the ravines. The ore-beds give no evidence of being larger than E. of Centreville, and will probably turn into hard fossil-ore at a slight depth below the surface.

Three and a half miles W. of Centreville the terrace increases in height, continuing so to Moyer's Gap, a distance of 2½ miles. Between these points, it is cut by some small water washes and ravines, which give opportunity for higher breasts in working the ore-beds than to the eastward. Except in the ravines, the ore beds will generally prove to be hard fossil-ore.

Moyer's Gap is at the east end of the wide and fertile valley, known as "Musser's Valley." The dip of the measures is comparatively gentle (25°) forcing the limestone ridge away from the mountain.

Between Moyer's Gap and Erb's Gap the terrace of the mountain is low and flat, and is not broken by ravines. A considerable quantity of altered (?) fossil-ore, and fragments of the ferruginous sand rock, which overlies the ore sandstone, are scattered upon the surface.

The ore sandstone, which is more massive than at New Berlin, is generally covered by the Upper Clinton Shales. The Danville ore-beds, on a low dip of 25°, and under such heavy covering, will prove to be hard fossil.

From *Erb's Gap*, the anticlinal of Jack's mountain passes on west, and enters the Kishicoquillas Valley through the middle one of its coves at its eastern end.

Troxelville.

A mile N. W. of Troxelville, there is an anticlinal spur of Jack's mountain, forming a synclinal cove between it and the main Jack's mountain anticlinal, which passes north of New Berlin.

This mountain spur rises westward very rapidly. In the course of 3 miles the anticlinal arch of Medina sandstone is broken, and the mountain separates into two monoclinals. The N. dip continuing to the Southern synclinal knob in the eastern end of the Kishicoquillas Valley, while the S. dip forms the long monoclinal mountain extending west to the Juniata River, at Mount Union.

From Erb's Gap west to the point of the anticlinal spur of Jack's mountain, the surface is irregular, and much broken by ravines. The Ore Sandstone follows the base of the mountain in a broken condition, and is in many places covered by debris.

Westward from Troxelville the terrace of the mountain becomes more regular. The Ore Sandstone dips 25° S., is massive, and from 15 to 18 feet thick, forming a ridge at the foot of the terrace. It is frequently cut by ravines and washes, making the ore easy of access.

The "Sand Vein" Ore Bed generally shows a good outcrop of ore throughout the whole range of Jack's mountain.

The ore is more silicious than that found in this bed on the N. side of East Shade mountain, being in some places very undesirable for smelting purposes.

One mile W. from Troxelville, on the property of Henry Hartman, a shaft on the Sand Vein opened a bed from 16 to 18 inches thick. The shaft is sunk in a ravine of the ore ridge, north of Hartman's house, where the measures dip 25° S.

The breast is low, but the bed can be reached at a lower level in a ravine a short distance east of here.

The Sand Vein ore at the outcrop contains considerable silicious matter, but the Danville Beds are of fair quality.

Fragments of the "Sand-rock," which is very ferruginous, and contains large rounded sand, are scattered upon the surface.

The Upper Clinton Fossil-ore Shale crops out on flat ground along the foot of the ridge. It is yellow, and of the usual thickness.

Two miles W. from Troxelville, on the property of John Moyer, the Danville ore-beds were opened by Swengle and Dunning, on the E. and W. sides of a ravine.

On the E. side, the upper one of the Danville Beds has been opened by a gangway 20 yards long. When opened the ore was soft; at the end of the gangway it changed to a hard ore. The bed is from 16 to 18 inches thick. A long breast can be obtained, admitting of openings at a higher level. Eastward the outcrop is good, showing soft fossil. The opening was made in 1874. A small quantity of ore has been hauled to the railroad, at Adamsburg, a distance of 5 miles.

On the W. side of the ravine, 30 yards of gangway have been driven.

The ore-bed opened is the lowest of the Danville Beds (?) of which there are generally three, that number being shown in the eastern end of Jack's mountain, and also at Logan Gap. The bed contains 8 inches of soft ore in the upper part, directly under the Ore Bed Rock; and 4 inches of "Jack," which is a portion of the Danville Beds Rock with the lime dissolved out, leaving a lean silicious ore.

A *section* of the Danville ore bed opened on Moyer's property shows: 1. Twenty inches of yellow calcareous silicious rock, from which the lime has been dissolved, leaving it rotten and shaly, containing casts of fossils; 2. Twelve inches of ore, which is soft fossil when not covered by the Ore Sandstone.

The Ore Sandstone is massive, and about 30 feet thick.

For several miles west of Troxelville the terrace contains frequent ravines, with intervening short ridges, offering good opportunities for opening the ore-beds.

The "Sand Vein" ore bed, which, however, contains some silicious matter, has a good outcrop at the base of the ridge, with a dip of 25° S., and the outcrop, which shows soft fossil-ore, runs low, not affording much breast above water-level.

This Ore Bed will generally have more soft ore at the outcrops, and afford longer breasts, in the flat measures between *Troxelville* and *Bennerville*, than west of the latter place.

The outcrop of the Danville Bed is generally about 150 feet high, affording long breasts. This outcrop is in some cases 30 or 40 yards above the outcrop of the Ore Sandstone.

The soft ore on this dip compares favorably with that of the same beds on the south side of this valley, in the ore ridge of East Shade Mountain.

West of this all the way to Logan Gap, along this range, the beds appear to contain the same character of ore.

The dip of the measures increases, causing the space between the mountain and the "Lewistown Limestone Ridge" to become narrower, and making ravines though the Ore-Sandstone less frequent.

Between John Moyer's, (2 miles west of Troxelville and Logan Gap,) there are no openings on the ore beds. As above noted, however, the range promises to yield a large quantity of good ore in the future, though the great expense of getting it to the railroad, will, for some time, exclude it from the market.

The ore is generally hard, which increases the expense of mining it. There is, however, a large quantity of soft ore following the outcrops of the Danville Ore Beds, on the flat measures, where the Ore Sandstone is eroded, and on the outcrops of the steep measures, between Belltown and Logan Gap.

Ulsh's Gap.

This gap is 7 miles west of Troxelville, and a ½ mile east of Bennerville. Twelve hundred feet N. of the old saw-mill in the gap, the ore sandstone crops out from the terrace, forming a small ridge.

A considerable quantity of fossil ore is strewn upon the surface, showing clearly the existence of the ore beds.

The "Sand-rock" has a dip of 38° S., and appears less sandy than to the eastward.

The Upper Clinton Fossil-ore Shale, of a yellow color, outcrops at the base of the low ridge formed by the Ore sandstone.

The Medina sandstone is here about 500 feet thick. The top strata of this rock are much less ferruginous than they appear at Penn Creek Narrows.

The Block Ore (Iron Sandstone) is strewn upon the surface in greater quantity than has been observed east of this. Some of the specimens contain a fair per centage of iron.

North of Bennerville the measures dip 40° south.

East of Belltown the dip steepens to 55°, making the valley between the "Lewistown Limestone Ridge" and the mountain very narrow.

The Limestone Ridge forms a wall at the base of the mountain, broken by an occasional ravine. These serve a good purpose in opening an avenue for the transportation of ore from the mountain. The ravines generally extend back to the terrace, affording better facilities for reaching the fossil-ore beds, and softening the ore to a greater depth than it could otherwise be. The high dips insure soft fossil-ore at the outcrops, and to variable depths below the surface, dependent upon the local natural drainage.

West from Belltown to Logan Gap, a distance of about 8 miles, through the property of the Logan Iron and Steel

Company, the mountain terrace runs with extreme evenness and regularity. The dip continues steep, being 56° at Logan Gap.

The outcroppings of the ore-beds warrant the belief that they exist in good condition, and on these high dips it is fair to suppose that the beds will contain soft fossil-ore to various depths below the surface.

The "Sand-Rock" occurring under the "Sand Vein" ore bed is less silicious than further east, which makes it probable that the ore is less sandy. This Sand-Rock, as explained elsewhere, changes from a silicious to a calcareous rock, and in some cases where soft ore exists it assumes the character of a plastic clay.

The Danville Ore beds probably exist throughout this distance, as they have been shown at Logan Gap and eastward, both by actual workings and by outcroppings.

Logan Gap (*East side.*)

The Upper Clinton Fossil-ore Shale is olive green at the water-level. Higher up on the side of the gap, and on top of the terrace, shafting has shown it to be a buff, unctuous shale.

The Ore-sandstone is about 20 feet thick and quite massive.

The Danville Ore beds are 3 in number, lying in a distance of about 15 feet. The upper bed is 15 feet below the Ore-sandstone. At water-level in the gap these beds are hard fossiliferous limestone. The largest is from 12 to 15 inches thick. Shafting higher up on the side of the gap, in the direction of the strike, shows the beds more highly impregnated with iron.

An analysis of the ore from the Danville Beds yielded:

"Iron,	26.100
Sulphur,	.051
Phosphorus,	.544
Carbonate of lime,	47.018
Carbonate of magnesia,	2.240
Insoluble residue,	9.610

The ore is hard, compact, coarse grained, reddish brown and reddish grey." (A. S. McC.)

Still higher on the slope, or near the level of the terrace, they become soft fossil-ore.

The Danville Ore Beds Rock at the outcrop is decomposed, assuming the character of clay, which is evidence of the soft nature of the ore.

During the year 1860, Wm. Mann, Jr., and James Mann opened the "Sand Vein" Ore Bed at water-level of the creek, and obtained a good quality of hard ore. The bed is said to be 18 inches thick. The "Sand Rock" is 3 feet thick, the upper portion being quite silicious. Where the "Sand Vein" contains soft ore, much of the Sand Rock assumes the character of white clay, the more silicious portion being very ferruginous.

The fact is here shown that the ore in the "Sand Vein" Bed extends lower or nearer the water-line than in the Danville Beds. This may be attributed to the fact that the Sand Rock is a better absorbent of water than the Danville Ore Beds Rock.

In 1875, Messrs. Longacre and Woods opened the "Sand Vein" Ore Bed, on land of the Messrs. Mann, 40 feet higher than the former opening. A gangway was driven for about 140 yards, obtaining soft ore throughout. The bed dips 56° south, and is from 16 to 18 inches thick.

"About twelve inches are of a good, rich ore, and the balance of an inferior quality."

There are two ore beds here above the Ore Sandstone, separated by a thin bed of sand-rock, as at Black Log Gap, Orbisonia, Huntingdon Co.

An analysis of ore from this opening yielded :

"Iron,	46.900
Sulphur,	.005
Phosphorus,	.310
Insoluble residue,	22.880

The ore is compact and rather earthy, and sparkles with scales of specular iron ore. Color, pink and reddish brown." (A. S. McC.)

The gangway is 6 feet high above the rail, with double, squared and notched timbers ; 4½ feet width at collars, and 6 feet at sills. From the present level of gangway several hundred feet of breast can be worked.

Emma Furnace is located 3 miles N. E. of Lewistown, on Kishicoquillas creek, 1 mile from the base of Jack's mountain. It belongs to the Logan Iron and Steel Company. Mr. R. H. Lee is General Manager, and Mr. John C. Rousseau, Sup't, (1875.)

The furnace was built in 1862, and has been making cold-blast charcoal iron most of the time since its erection. The stack is of stone, 34 feet high, 32 feet square at the base; the opening at the top is 2 feet. Width of bosh, 9 feet. There are two tuyeres. The hearth is 30 inches at the top, 24 inches at the base, and 5½ feet high.

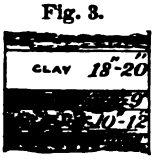
The pressure of blast used is 1½ lbs. per sq. in. There is a hot blast oven with nine arches each, 8 feet high, and 6 inches in diameter. There are two blowing cylinders, 38x60 inches; an air receiver, 48 inches in diameter, and 45 feet long; and a horizontal engine with a 14 inch cylinder, and 5 feet stroke, making 32 revolutions per minute, and carrying 50 pounds of steam.

The ore used at the present time, (1875,) is one half brown hematite from the Moore Bank, (Marcellus Ore Bed,) Mifflin county, and one half Brush Ridge fossil-ore, from Stone Valley, Huntingdon co.

The average consumption in the production of a ton of iron is 5,204 pounds of ore, and 207 bushels of charcoal, ("hearth measure,") or 200 bushels bank measure. The furnace will average 43 tons of cold-blast iron per week, or 55 tons of hot-blast.

Jacob Gross. 1 mile S. W. of Adamsburg. (*For description see page 38 F.*)

Fig. 3.



Silicious shale.
Argillaceous hematite.
Light blue clay.
Sand-ore (sand on exposure.)
Light colored slate.
Powdered red ore (altered fossil ore, containing particles of specular ore.)
Shale, sandy, gray and yellow (thin bed.)

CHAPTER III.

East Shade Mountain.

"The anticlinal axis of this mountain crosses the Susquehanna River about a mile N. W. of Selinsgrove, and traverses Chestnut Ridge until it enters the mountain, through the center of which it runs to the termination of the mountain S. E. of Lewistown. Beyond this point the axis is prolonged many miles S. W. in higher formations, forming the hills bordering the Juniata river on the south.

The general course of the mountain, from its origin, 8 miles west of Selinsgrove to its termination, 1 mile S. E. of Lewistown, is S. 60° W. It rises nearly opposite Middleburg, and continues straight for a few miles, when it curves southward until opposite Beavertown. There it bends N. again to run more westward, to the notch or gap 3½ miles from Adamsburg, beyond which point, for nearly 10 miles, it ranges S. 70° W.; then, in consequence of the introduction of several new axes in the valley adjoining, it again changes its course to S. 60° W., but re-curves a second time to the westward before it terminates, influenced no doubt by the axis of the Blue Ridge of the Juniata. The N. W. flank exhibits the above changes of direction more conspicuously than the S. E. flank does.

The mountain is about 32 miles in length.

Its crest ascends gradually from its N. E. point, and extends for several miles with a broad, rounded and unbroken summit. About 10 miles from its N. E. end the Oneida conglomerate rises to the surface, and the crest becomes triple, the three ridges extending to within 6 miles of Lewistown. The middle ridge is divided from the two exterior crests of Medina White Sandstone by an elevated valley of the softer Medina Red Sandstone."*

This mountain flexure subsides very rapidly toward the S. W., carrying the Medina White Sandstone under the

*Geology of Pennsylvania, 1858.

surface just before reaching the Juniata River, S. of Lewistown. As the flexure sinks, the south-east dip decreases from 40° to 30°, and the north-west dip changes from 55° to 35°.

Where the anticlinal is cut by the Juniata river, south of Lewistown, the section of the Upper and Lower Clinton Shales and the Ore Sandstone, dipping 40° N. W., given below is exposed. (See Plate.)

The Lower Clinton Shales, toward the anticlinal, gradually flatten to 8° or 10°. South of the anticlinal these measures have the same flat dip.

The anticlinal of East Shade mountain continues to subside towards the S. W., and about 2 miles S. W. of Lewisistown carries down the Upper Clinton Red and Variegated Shales.

There are a number of gaps in the N. W slope of East Shade mountain, which are here mentioned in their order, proceeding westward, viz: *Adamsburg Gap*, 3½ miles W. of Adamsburg; *Mitchell's Gap*, 3 miles from Painter's Station; *Oswell's Gap*, 10½ miles East from Lewistown; *Mowry's Gap*, 2 miles East from Painter's Station, S. and L. R. R. These gaps do not cut through the entire mountain, but only through the N. W. dip of the Medina.

Fig. 2. (page F. 24.) Section of Block-Ore beds 1½ miles S. E. from Paxtonville, Snyder County, Pa.

Fig. 2.

Sandstone, laminated, red;	3'
"Pin-stone." Red block sandstone;	15''
Ferruginous sandstone, laminated, concholdal	12''
Clay, white, siliceous, very compact;	6''
Ferruginous Sandstone;	12''
Clay, white, siliceous, very compact	6''
Block-ore; dark red, massive, siliceous;	18''
Clay, white, siliceous;	6''
Lower Clinton purple shales.	

CHAPTER IV.

Iron Ores of East Shade Mountain, North Side.

From a point W. of Selinsgrove, where the East Shade mountain anticlinal crosses Middle creek, there are two parallel ranges of hills which follow along the northern base of the mountain all the way to Adamsburg Gap. The outer ridge is formed by the ore sandstone, and is quite distinct from a second ridge, formed by Lower Clinton Shales, capped by the "Block Ore," which lies nearer the foot of Shade mountain.

The dip of the measures in these ridges increases from 5° N. at Middle creek to 30° N. at Beavertown. At Adamsburg Gap the dip has decreased to about 16° N., which again increases as we proceed westward. Between the two ridges, west of Paxtonville, is a roll in the measures which produces three dips on the ore sandstone, and forces the ridge formed by it a mile N. from the foot of the mountain.

This roll gradually rises in proceeding westward. Near Beavertown it has lifted the ore sandstone so high that erosion has carried off all but the principal north dip.

The "*Sand Vein*" *Ore Bed* from Middle Creek W. to a point S. of Middleburg, has not been worked. The outcrop shows along the ridge, but the bed is thin, and the length of breasts will be small.

At Smithgrove, the bed is 10 to 12 inches thick, and dips 30° N.

From Middleburg W. to Paxtonville, the ore sandstone, which dips N. 45°, forms a prominent ridge. The "Sand Vein" ore is an altered fossil. Several openings were made upon it, but have all been abandoned on account of its small size.

At Shipton Run the Ore Sandstone ridge is of slight elevation. The "Sand Vein" ore-bed is small, and crops out on low ground, affording very little breast.

South of Beavertown this ore bed contains 26 inches of soft fossil-ore. It remains a soft ore, and maintains a thickness of from 20 to 26 inches for several miles west of this.

Between Shipton's Run and Adamsburg, by driving longer tunnels than have heretofore been used, a breast of 100 to 150 feet can be worked.

The "*Sand Rock.*" is exposed at the ore openings in the ridge south of Adamsburg, and is 3 feet thick; it is removed in driving the gangways on the ore-bed. The upper layer, several inches in thickness, is sandy, ferruginous and fragile, while the lower portion is a more argillaceous rock, alternating with thin beds of white clay. The mass is easily removed from the top of the ore sandstone. A thin seam of sand lies between the sand-rock and the ore-bed.

South-west of Adamsburg, in the ravine, where the ore bed is opened low enough to yield a hard fossil-ore, the sand-rock is calcareous and argillaceous, containing many fossil impressions. It is under the ore-bed, with the hard fossil-ore adhering to it.

In some places this argillaceous calcareous rock contains enough iron to warrant its being worked with the ore. It is, however, much inferior to the ore bed, being very silicious and lean.

The *Ore Sandstone* ridge in the neighborhood of Beavertown, is cut every quarter or half mile by ravines, which, in some cases, extend back to the "Block Ore ridge." Where the Ore SS. caps the ridge, the Danville Ore Beds under it are hard fossil.

From Shipton's run W. to Adamsburg Gap, the Ore-sandstone is a massive rock, apparently 20 feet thick, on dip of 30° N. The "Sand Vein" Bed is a medium soft fossil, and the Danville Beds on their outcroppings are a soft fossil ore.

In the synclinal of the ridges S. of Adamsburg, the Ore Sandstone is generally eroded, leaving Division D* as the covering, which, being divided by vertical seams, permits the filtration of surface water to the ore-beds below. The dip of the bed changes from 70° N. to a very flat one, forming a bend in the measures near the crest of the ridge,

* See Vertical Section.

which is a flat surface. The Danville Ore Beds are soft fossil, very rich in iron.

The *Danville Ore Beds* from the end of the ridge near Middle Creek, where these beds sink under the shales, to a point S. of Middleburg, the Danville Ore Beds are generally a ferruginous fossiliferous limestone.

They increase in size and improve in quality between Paxtonville and Beavertown.

S. W. of Beavertown they lie in a synclinal, where they have been mined and have yielded a large amount of ore.

The Danville Ore Beds Rock is sometimes missing, when the silicious shale underlying the Ore Sandstone thickens. The beds of ore which are contained in this shale, at the usual distance below the Ore Sandstone, are small and irregular in size, being thin beds of ferriferous fossiliferous limestone. Where this is the case, as in the Perryville Ridge, west of Perryville, (Port Royal,) in Tuscarora Valley, the upper strata of the Lower Clinton Shales, lying between the Block Ore and the Ore Sandstone, are very calcareous, and alternate with many beds of fossiliferous limestone, some of them attaining a thickness of 10 or 12 inches, and some of them being ferruginous.

The *Block Ore Ridge* holds the anticlinal flexure of East Shade mountain just east of Middle Creek. West to Adamsburg Gap the north dip forms a prominent ridge, which is broken by occasional ravines S. E. of Middleburg.

Along Middle Creek, where the bed crops out on both N. E. and S. W. dips, it is probable, that if opened, it would yield an ore containing from 20 to 25 per cent. of iron.

At Smithgrove it is exposed in the gap, occurring 150 feet below the ore sandstone. Its thin seams are separated by shale. A portion of it is quite rich in iron, but not sufficiently so to warrant its being worked. Higher on the ridge the strata become thicker.

S. E. of Paxtonville it crops out high upon the ridge, 13 feet thick. The lower portion is about 8 feet thick. Large quantities of ore have been quarried here, by means of open cuts following the line of the crest of the ridge. The ore, (cold-blast, charcoal,) was hauled to Beaver Furnace, as early as 1847. From no other part of the ridge has the "Block Ore" been used in such large quantities.

Between the "Block Ore Ridge" and Ore Sandstone Ridge is a small synclinal. At Paxtonville, (Beaver Furnace,) the N. dip is 45°, and the synclinal is occupied by Lower Clinton Shales, but proceeding westward the dips flatten, allowing the ore measures to remain in the synclinal.

At *Bobb's Run*, the "Block Ore" is exposed at the level of the run, in two strata, separated by 15 inches of argillaceous shale. The lower stratum is about 3 feet thick, and the upper about 8 inches. It is not rich in iron at this low level, though opened higher on the ridge it might prove more valuable.

S. W. of Beavertown it is again exposed, cropping out on the north slope of the ridge, 4 or 5 feet thick. A portion of it might be selected rich enough in iron to be valuable.

From this point S. W. to Adamsburg none of this ore is rich enough for use.

At *Adamsburg Gap* the "Block Ore" dips 8° to 10° N. This dip increases westward.

Along the course of this ridge the soil is generally covered with fragments, which vary greatly in quality.

At *Juniata Narrows*, S. of Lewistown, the "Block Ore" is represented by a few thin seams of argillaceous sandstone in the Lower Clinton Slates.

"The *Bird Eye*" *Fossil Ore* has not been opened to the west of Paxtonville, in Snyder county, although its existence in the ridge is a matter of very little doubt. Access to it is made easy by gaps in the ridge, which are of frequent occurrence E. of Adamsburg.

It exists W. of Adamsburg, though not of as good quality as eastward. It has been found on the N. dip of the Blue Ridge, at Juniata Narrows. It is not likely to exist on the S. side of Shade mountain in the Narrows until near Macedonia Gap, in Shade mountain, for the reason that the Juniata River in its course has carried off the Lower Clinton Shales, the water washing against the Medina Sandstone.

In the ridge E. of the point where the Medina Sandstone of the Shade mountain anticlinal sinks under the Lower Clinton Shales, a stratum of sandstone, containing fully as large a percentage of iron as the regular "Block Ore," is found on the S. side of the anticlinal between the "Bird Eye" fossil-ore and the Iron Sandstone. It is from 5 to 6 feet thick.

This sandstone is shown in a ravine along the public road leading to Freemont, Snyder county.

Its character does not differ materially from that of the regular "Block Ore," except in the top stratum, which resembles a division ("c") of the Paxtonville bed.

A thin layer, from 6 to 8 inches thick, containing small pebbles resembling shot, is also found in the shales, from 20 to 40 feet below the "Bird Eye" fossil-ore. This ore is rich enough in iron to warrant its use, if not loaded with too many impurities. (See future analysis.)

It is found on the road leading south from Smithgrove. It may exist at other points, in larger dimensions.

Description of Openings between Smithgrove and Adamsburg Gap.

Two miles from Smithgrove, 3 miles S. E. from Middleburg, and 5 miles W. of Selinsgrove, on the property of Emanuel Duck, Messrs. Cruikshank & Bro., in 1872, opened and mined the "Bird Eye" Fossil-ore. Ore was shipped to the Bloomsburg Iron Co., at Danville, and to Pottsville.

The ore bed dips 3° to 5° S., and is 8 to 12 inches thick, being mined in large blocks when medium hard fossil.

Under the bed is a green shale, and over it a purple shale a few inches thick, covered by a very hard, blue, fine-grained calcareous sandstone, about 2 inches thick. It is full of parallel seams similar to those in the ore bed, and dividing it, when removed from its bed, into pieces of the size and shape of bricks. After this stone is removed, it is easy to cut out the shale and reach the ore bed.

Parallel gangways, 20 to 40 yards long, have been driven on the dip of the bed, along the line of the outcrop, and the ore mined from 5 to 8 yards on each side of these gangways. In other places the outcrop has been stripped.

An analysis of the "Bird Eye" Fossil-ore from this property yielded:

"Iron,	45.125
Sulphur,	.015
Phosphorus,	.407
Carbonate of lime,	10.928
Carbonate of magnesia,	2.497
Insoluble residue,	12.855

The ore is compact, coarse-grained, and brittle; fracture, irregular; color, reddish brown." (A. S. McCreath.)

On the N. side of the anticlinal, opposite the above described openings, on the property of George Pontius, the Bloomsburg Iron Company have openings on the same bed, made by Cruikshank & Bro. in 1873. Here the dip is 3° to 5° N. The outcrops on the N. and S. dips are about 1,000 feet apart.

Gangways were driven, and in many places the outcrop stripped, after the method adopted in the S. dip. The N. outcrop has been worked for 1,200 to 1,500 feet in length. The flat dip and small size of the bed (8-10 inches) made mining very difficult, but the fact that the ore commanded a higher price than other fossil-ore, warranted the work. The ore was soft, and of good quality, probably due to the fact that the covering shales were but 8 or 10 feet thick.

It is estimated that 4,000 tons of ore have been shipped from these mines. The ore is of a very superior quality, both on account of its richness in iron, and because of the ease with which it is reduced in the furnace. It is shipped by railroad from Weiser's Station and Smithgrove.

Analysis of "Bird Eye" fossil-ore, from Andrew Bickle's property, 2 miles N. of Freeburg, and 2½ miles S. E. of Smithgrove:

Iron,	50.500
Sulphur,	.024
Phosphorus,	.257
Insoluble residue,	15.220

Fossil-ore, compact, coarse, reddish-brown. (A. S. McCreath).

About 1,000 feet north of these openings, on the same ore-bed, the Bloomsburg Iron Co. has made an opening at water level, on the E. side of the ravine W. of Smithgrove. The ore-bed dips N. 8° to 12°, and is 10 to 12 inches thick.

In this same ravine, the Danville ore-beds are exposed, dipping 34° N., and bearing 10 to 12 inches of hard fossiliferous limestone.

One half mile S. of Smithgrove, on the property of Charles Fryman, in the E. side of a ravine, a drift was driven 20 yards on the "Sand Vein" ore-bed.

"The opening was made in 1875. The bed proving soft fossil ore 10 inches thick."

The Ore Sandstone is exposed as a solid massive rock, about 20 feet thick, dipping 34° N.

One of the Danville beds was opened, and proved hard fossil ore, 12 inches thick, portions of it very "lean."

On the property of Levi Stuck, in a ravine about 1 mile S. E. of Middleburg, the Clinton Limestone is opened, and the stone burned for agricultural purposes. The Ore Sandstone is exposed dipping 25° N. The "Sand Vein" Ore Bed does not crop out high enough to afford sufficient breast to open upon.

The Danville Ore Beds were opened by a short gangway, but proved very small.

The ridge is here formed by a flat anticlinal, leaving a wide synclinal, with low dipping measures between it and the Shade mountain anticlinal.

One mile E. of Paxtonville, gangways were driven by the Bloomsburg Iron Co. E. & W. from a ravine in the ridge. In both, the ore-bed proved to be altered fossil ore, with the accompanying clay and "liver-ore."

All openings E. of Paxtonville, show conclusively that the "Sand Vein" and "Danville" Ore Beds are not of much value in that portion of the range.

One and a half miles S. E. of Paxtonville, on property of the Bloomsburg Iron Co., the bed of "Bird Eye" Fossil Ore has been opened by short slopes driven down from the outcrop, "the ore becoming harder in the descent."

The bed dips N. 45°(?), and is from 8″ to 12″ inches thick. The ore is rich in iron.

Several hundred tons were mined here and hauled to Beaver Furnace by Middlesworth, Kerns & Co., about 1855.

One hundred yards N. of the last described openings, large quantities of the "Block Ore" have been mined by means of open cuts.

These begin in a ravine, through the Block Ore Ridge, and extend for a thousand feet or more to the west. The last opening was made in 1872, by the Bloomsburg Iron Co. The other openings date back to the early history of the Beaver Furnace.

Many thousand tons of ore have been shipped from these openings and used in the furnaces, but with what result is not known.

Paxtonville occupies the site of what was formerly known as Beaver Furnace. The following sketch of the furnace may prove of interest :

Beaver Furnace, Franklin township, Snyder co., "was built in the year 1847, by Middlesworth, Kerns & Co., who operated it until 1860 or 1862 (?). From 1862 until 1864 or 1865, the furnace was operated by Walter Francis & Co. A small portion of the time since, it has been operated by Dr. Rook." In 1873, the property belonging to the furnace was purchased by the Bloomsburg Iron Company. It embraces five hundred acres of mountain and ridge land.

The dimensions of the furnace are 8½ feet across the bosh ; height of stack, 35 feet ; size of base of stack, 33 feet square ; 1 foot of sand filling between the outside and inwall ; size of over-shot water wheel, 33 feet ; face of water wheel, 4 feet.

The walls of the stack, which is built of stone, are cracked from the base to the top on two sides, and the water wheel is torn away.

On the property of Henry Benfer, on the E. side of a ravine, the Bloomsburg Iron Company have driven a gangway 40 or 50 yards, on the "Sand Vein" Ore Bed, and found it to contain the altered fossil, and a clay impregnated with oxide of iron, alternating with seams of plastic white clay. The work is now abandoned, there not being enough of the altered fossil ore to warrant the expense of mining.

The Upper Clinton Fossil Ore Shale over the ore-bed is white and soapy, tending almost to a plastic clay. The Ore Sand Stone is a massive rock, with a dip of 45° N.

The ridge at this point has become quite contracted in width, by reason of the increase in the dip of the measures.

About ¾ of a mile W. of Paxtonville, on the property of *Benjamin Watmore*, a tunnel has been driven, cutting the Sand Vein ore bed where it is only 9 inches thick, and of an inferior quality of soft fossil ore.

West of this point the dips decrease, and the ore-beds, which to the east are almost worthless, become more valuable.

One and a quarter miles W. of Paxtonville the Danville Ore Beds were opened on two levels by Middlesworth, Kerns & Co.

Several hundred tons of ore were sent to Beaver Furnace.

On the property of Geo. Grove, 1¼ miles W. of Paxtonville, the Upper Danville Ore Bed was opened by Middlesworth, Kerns & Co., about 1855.

Gangways were driven both E. and W. from a ravine, the ore being soft fossil, which grew harder after proceeding a few hundred feet in the gangway.

The measures dip 20° to 25° N. The ore-bed is 10″ thick.

The openings were operated for about a year, during which time several hundred tons of ore were sent to Beaver Furnace.

Between the ridge in which are the above described openings and the Block Ore Ridge, at the base of Shade mountain, there exists a synclinal, which at this point doubtless contains the Danville Ore Beds.

West of this, the dips decrease, forcing the main Ore Ridge further N., and allowing the Ore Sandstone and accompanying ore-beds to occupy the synclinal.

Bobb's Run. From about 1¼ miles E. to within ¾ of a mile of the run, there are a number of old openings and short cross-cuts scattered along the hillside, ranging one above the other.

Over 100 yards of "breast" were thus worked out, on the low dip at the crest of the ridge, by means of short lifts or steps.

These old workings do not appear to have been made with any well-devised system, and this fact warrants the belief that there is some ore, perhaps a considerable quantity, remaining in the ridge.

The "Sand Vein" Ore Bed crops out at the foot of the ridge, affording no breast above water level.

The Danville Beds cover the N. side of the ridge, affording "breast" of over 100 yards, and generally producing soft fossil ore. At the base of the ridge, the measures have a dip of 20° or 25° N., which decreases toward the outcrop.

The old workings are located upon the Upper Danville Ore Bed, which is 14 to 16 inches thick.

"The ore was considered very superior for making iron, and for working in a charcoal furnace." It was hauled to Beaver Furnace.

The openings were all made by Middlesworth, Kerns & Co., or their successors, Walter Francis & Co.

Three miles from Paxtonville, a slope has lately been sunk by Thomas Russel, for the Bloomsburg Iron Company, from the outcrop of the ore bed on the N. dip to the bottom of the synclinal, a distance of 18 yards.

Short diggings from the bottom show the same characteristics and condition of the ore-bed which exist south of Beavertown, the S. dip being eroded, and only a portion of the bed existing near the bottom of the synclinal. The bed consists of 10 inches of good soft fossil ore, with 2 inches of slate at about the middle.

Thomas Russell is now (July, 1875,) working this bed, obtaining about 100 tons of ore per month, which is stocked at the railroad station at Paxtonville, 3 miles distant.

The ore is raised by means of a small vertical hoisting drum, operated by two men. The wagons used hold from 300 to 400 pounds of ore. This ore is put upon the bank at a cost of $1.25 per ton, the hauling to the railroad costing $0 50 per ton.

There are several openings on this synclinal S. of the old Beaver Furnace openings. The ore is of the same quality, and contains the dividing slate which is said to exist in the old openings.

The first opening ever made in Snyder county is on the Upper Danville Ore bed, ½ mile E. of Bobb's Run.

Dip, 15° to 20° N. Length of breast, 80 to 150 yards.

The ore is a soft fossil, rich in iron. Thousands of tons were sent to Beaver Furnace.

At *Bobb's Run* openings were made in the years of 1857 to 1860, "producing good soft fossil ore."

The "Sand Vein" Ore bed occurs at the foot of the ridge, dipping 42° N. This dip flattens to 10° at the crest of the ridge, which spreads out the Danville Ore beds, affording considerable breast.

Two beds are opened by means of gangways. "The beds measure 12 inches each, and contain good soft fossil ore."

The ore is very soft, and, in mining, it readily mixes with the dividing rock, which is also soft. The flat dips and the necessary separation of material must have made this work unprofitable.

Several hundred tons were sent to Beaver Furnace.

Between Bobb's Run and Shipton Run the Ore ridge is of slight elevation. The Ore sandstone has been eroded from the crest and side of the ridge, leaving nothing but the lower portion, which contains the Danville Ore beds.

The synclinal back of the ridge does not contain the Danville Beds, the Lower Clinton Shales being exposed, stretching across toward Shade mountain.

A tunnel has lately been driven from the level of the low ground, about 90 feet in length, cutting the "Sand Vein" Ore Bed a few yards below the outcrop. The ore-bed here is small, and probably unfit for use. The tunnel is driven through the Ore sandstone to the Danville Beds, proving one of them to be 10 inches thick, with a small amount of breast. No ore has been shipped from this place.

In the ravine of Shipton Run, 1½ miles S. E. of Beavertown, on the land of Abner Eigler, is an ore bank. The opening was made in 1873.

A tunnel was driven about 20 yards through the Upper Clinton Fossil Ore Shale, cutting the "Sand Vein" Ore bed. A gangway was driven from 20 to 25 yards west.

The bed is worthless, there being about 14 inches of "Jack," with seams of sandy, soft ore on the top and bottom of the bed. There are about 25 yards of breast on this bed. The dip is 47° N.

The Sand Rock is porous, argillaceous and silicious, 2½ or 3 feet thick.

In this same ravine the Danville Ore Beds were opened many years ago, but after a few hundred tons of ore had been shipped the opening was abandoned, and work has not since been resumed. A tunnel cut the ore-bed a few yards below the outcrop, where it proved soft fossil 10 inches thick. The dip is 47° N.

On the lands of Reuben Eigler, ½ mile W. of the last described opening, Messrs. Swengle and Denning drove a tunnel 60 or 70 feet long through the Upper Clinton Fossil Ore Shales to the Sand Vein Ore Bed.

A gangway was started E. in the spring of 1874, and worked for about six months. About 500 tons of ore was shipped from here.

The ore is of good quality, and contains no "Jack." It is a medium soft fossil, of somewhat oolitic appearance, and mines in square blocks. The ore bed is 14 inches thick, with 2 inches of sand between it and the Sand Rock. The dip is 38° N. Length of breast from 40 to 50 feet.

Shafting has been done at this point upon the Danville Ore Beds, but without finding a workable seam.

Beavertown Ravine. The synclinal between the Ore Sandstone Ridge and the Block Ore Ridge has risen sufficiently to lift the Danville Ore Beds so high that S. of

Beavertown they have been eroded. West of this they are no longer found lying in this synclinal.

At the base of the Ore Sandstone Ridge the measures dip about 40° N. This dip flattens very much, and near the crest of the ridge is not more than 5° N. The Danville Beds curve gently over the top of the ridge, covering the surface for 200 feet toward Shade Mountain. This flat, containing the ore beds lying on the high ground between the Beavertown Ravine and the next ravine to the west, extends but a few hundred feet.

The ore on the flat has been worked out. The Upper Danville Ore Bed being the largest, (12 inches thick,) has produced the most ore, and has been most thoroughly mined. The second bed has been only partially worked, being very small. The third and lowest of the Danville Beds has been shafted upon, and its existence proved, but being very small it has never been opened for mining.

A slope was made in 1865, by Walter, Francis & Co., who were then operating the Beaver Furnace, at Paxtonville, 6 miles E. of Beavertown. Six hundred tons of ore were mined and shipped, and the mines abandoned the same year.

Rook, Marsh & Co., in 1870, made an opening upon this flat, and continued working it until 1874, shipping several thousand tons of ore to the Union Furnace. They drove a gangway from the E. on the S. dip, at a level 30 or 35 feet below the top of the old slope, and mined the bed upward toward the old workings.

It is said that in this gangway a slope has been driven down on the bed for several yards, for the purpose of testing the bottom of the synclinal. It was shown that the S. dip of the ore-bed extends but a short distance, when it is broken off, and the space is filled up with foreign material.

The ore is a soft fossil, excellent, and free from "Jack."

Southwest of Beavertown, on the E. side of a ravine, on the land of Alfred Specht, the "Sand Vein" has been opened.

A gangway has been driven 60 yards E., on the bottom Sand Rock, which is about 2½ feet thick. The ore-bed is about 20 inches thick, with several inches of "Jack," which is not rich in iron. The ore is a medium soft fossil. Dip, 35° N. Length of breast, 20 to 25 yards.

The gangway was driven in 1873. About 500 tons of ore were sent to the Union Furnace Co., and some to the Bloomsburg Iron Co.

The Danville ore beds are opened by a gangway S. of the last described opening. The gangway embraced two beds, 2 feet apart, neither of which are large enough to warrant their being worked.

Earnst Ore Bank, on the "Sand Vein" Ore bed, located on the W. side of the same ravine as above described. The opening was made by John Earnst, for the Bloomsburg Iron Co., in the year 1872.

A gangway was driven W. 150 to 170 yards. As the ore became hard, and in order to save expense in mining, the plan adopted was to raise the gangway and follow the soft fossil ore, maintaining a "breast" of 30 to 40 yards.

About 4,000 tons of ore were sent to the Bloomsburg Iron Co.

Analysis of the best ore contained in the vein:

Iron,	52.600
Sulphur,	.023
Phosphorus,	.521
Insoluble residue,	11.560

(A. S. McCreath.)

Analysis of the "Jack," from same opening:

Iron,	49.900
Sulphur,	.006
Phosphorus,	.196
Insoluble Residue,	15.100

"Fossil-ore, block, compact, shows spangles of quartz and specular iron; color, iron rust." (D. McCreath.)

At *Siders' Ore Bank*, south of the last named opening, in the same ravine, the Danville Ore Beds, under the Ore Sandstone, have been opened by a short tunnel driven through the Lower Clinton Shales. The Ore Sandstone is massive, and about 20 feet thick.

The tunnel is about 25 feet long, driven from below the beds, thus cutting the bottom beds first. It cuts, in its course, several very thin fossil beds, and one silicious fossiliferous bed, several inches thick.

This last named bed, is about 20 feet below the Danville Beds, occupying about the same position (?) as the Lauber bed, north of Mifflintown, Juniata county. The tunnel also cuts the lower two Danville Beds, containing soft ore.

A gangway, over 100 feet long, has been driven on these two beds, including them both. They vary from 4 to 10 inches in thickness, the lower one being the smaller, and unfit for use.

This tunnel was driven by John Siders, about the year 1860, and "a small quantity of ore was sent to Beaver Furnace, Snyder county."

Work was resumed in 1874, and a small quantity of ore shipped, but the opening was soon abandoned, as the quality of the ore would not warrant its being worked.

These beds are the lower Danville beds, and this being the case, if the tunnel were driven a short distance further, it would cut the upper Danville Ore Bed, which might prove of better quality. It is often the case, that where one of these beds are good, the others are inferior.

On the E. side of a ravine, 1¼ S. W. from Beavertown, Dr. J. D. Conrad has opened the "Sand Vein" Ore-bed.

The bed is a short fossil, changing at the top of the gangway to a medium soft ore, and becoming still softer toward the outcrop. It is 24 inches thick, containing good ore, and some "Jack," which is quite rich in iron. The ore becomes very red on exposure to the weather, more so than any other observed on this range.

Dip, 40° N. Length of breasts, 25 to 30 yards.

The Sand Rock in the breasts changes in quality with the ore bed. As the ore becomes softer, the rock changes, and forms near the outcrop a rotten argillaceous, silicious rock, containing many fossil impressions.

This opening was made in 1873. One hundred yards of gangway were driven. From 1,000 to 1,200 tons of ore have been shipped to Logan Iron Co., Mifflin county; Milford Furnace, Union county, and Bloomsburg Iron Co., Columbia county.

The Bloomsburg Iron Company, in July, 1873, drove a drift on the "Sand Vein" Ore bed, in a ravine a few hundred feet W. of the last described opening.

The first opening was made in the ravine, at water level, but the ore changed to a hard fossil, after getting fairly under cover, and the opening was abandoned then on account of the extra expense of mining.

Another opening was afterwards made 20 feet higher, where medium soft fossil ore continued to exist through the course of the gangway, which was driven westward.

The ore bed is 26 inches thick, containing 6 inches of Jack in the middle of it. The ore is a medium soft fossil, and the Jack is rich enough in iron to use with the ore.

Dip, 40° N. Length of breast, about 25 yards.

About 3,000 tons of ore have been shipped to Bloomsburg.

Analysis of specimens of ore from the above opening:

Iron,	43.100
Sulphur,	.010
Phosphorus,	.243
Insoluble residue,	21.800

"Hard, compact, block fossil-ore; color, reddish brown." (A. S. McC.)

Three hundred yards W. of the last named opening, Dr. J. D. Conrad has opened, and is now, (June, 1875,) mining the "Sand Vein" Ore Bed on the property of J. F. Middesworth.

The bed is opened by a tunnel 60 feet long, through the Upper Shales. Ore was first taken out in 1873. Work has been continued ever since, the ore being sent away by the Sunbury and Lewistown RR., until it stopped in January, 1875, since which time, the ore has been stocked.

The ore is a medium soft fossil, mining in square blocks. The bed is 26 inches thick, with 6 inches of "Jack" in the middle of it. This "Jack" contains from 16 to 20 per cent. of metallic iron, and is mined with the ore, being acceptable to the "iron masters."

Dip, 32° N. Length of breasts, 25 yards.

Between the ore-bed and the Sand Rock, there is a bed of sand 1 or 2 inches thick. Much of this sand is mixed the ore in mining. The Sand Rock is silicious and friable, and about 3′ thick. It is taken out in driving the gangways.

About 5,000 tons of ore have been shipped to the Bloomsburg Iron Co.

Analyses of bottom bench of vein:

Sesquioxide of Iron,	77.714
Sesquioxide of manganese,	.325
Alumina,	5.654
Lime,	.740
Magnesia,	.410
Sulphuric acid,	.065
Phosphoric acid,	.771
Water,	5.822
Insoluble residue,	8.315
	99.816
Metallic Iron,	54.400
Metallic manganese,	.226
Sulphur,	.026
Phosphorus,	.337

Fossil ore, block; color, reddish brown, and iron rust. (A. S. McC).

From 400 yards W. of this opening to the openings S. of Adamsburg, the ridge is considerably broken down by erosion.

The "Sand Vein" Ore Bed is again opened on the property of Jacob Gross, by the Bloomsburg Iron Company, 1¾ miles S. W. of Beavertown. Three hundred yards east of this opening is another, which was made in 1874. One thousand tons of ore were shipped to the Bloomsburg Iron Company. The ore was all mined out and the place abandoned, the property line having been reached at the east end of the workings, and the ridge being broken down to the west.

The dip is 32° N. The bed is 26 inches thick, with about 6 inches of "Jack" in the middle of it. The "Jack," however, contains from 16 to 20 per cent. of iron, being rich enough to mix with the ore of the bed. There is an overlap in the outcrop of the vein here, which forms a thickness of from five to seven feet of fossil ore.

One mile S. W. of Adamsburg, on the land of Jacob Gross, the Bloomsburg Iron Company has worked a bed of fossil ore in an open cut in the synclinals of the ore ridge. The ore is a soft fossil, with "liver ore" and specular ore.

Analysis:

Iron,	42.750
Sulphur,	.021
Phosphorus,	.113
Insoluble Residue,	27.430

(D. McCreath.)

If the bed is one of the Danville Ore Beds, it is certainly one of the lowest. It is probable, however, that it is one or more of the beds of ferriferous, fossiliferous limestone, such as frequently occur in the Lower Clinton Shales, lying between the ore beds, and changed by its surroundings into a fossil ore.

Robert and Michael Dreese. One half mile south of Adamsburg, the "Sand Vein" Ore Bed has been opened along its outcrop, and ore has been mined therefrom for about 150 yards. The work was done by Swengle and Dunning, in the winter of 1874–5.

A slope was driven through the Fossil Ore Shale at right angles to the dip of the ore bed, cutting it a few yards below the outcrop. A gangway was then driven, the ore "robbed," and the roof allowed to fall.

The vein is about 22 inches thick, and the ore a soft fossil. The dip is 35° N.

The Fossil Ore Shale cut in sinking the slope is yellow, tinged with green. Near and on the ore bed, at the outcrop, it is a soapy white shale.

In this soapy white shale there are 3 seams of shale, highly impregnated with oxide of iron, forming an argillaceous hematite ore of smooth surface and shaly fracture. This ore is frequently found adjoining the upper layers of the "Sand Vein" Bed. When mixed with the other ore it greatly diminishes the yield of the furnace. While it should always be worked with the fossil-ore, it should not, strictly speaking, be considered as a part of the ore-bed and measured with it.

The Danville Beds, about 20 feet below the Ore Sandstone, have been opened south of the Dreese property.

The opening is an old one made several years ago, and abandoned on account of the small size of the ore-beds.

But little prospecting has thus far been done for the Danville Ore Beds in this part of the range, and that which has been done has not proven the existence of any bed nearly so good as the "Sand Vein."

One mile S. W. of Adamsburg, on property of Reuben Dreese, Swengle and Dunning opened the "Sand Vein" Ore Bed by means of a tunnel, in 1873.

The average thickness of the vein is about 20 inches. The dip is 30° N. The average height of breast is 40 feet. The Ore Sandstone is about 22 feet thick.

The ore-bed in the ridge frequently carries a thin seam of loose sand between it and the Sand Rock from ½ to 2 inches in thickness. This mixes with the ore in mining.

The ore bed could be opened at a lower level here, there being a ravine cutting through the shales above the Ore Sandstone, which would have the tendency to carry the soft fossil to a greater depth.

The ore is principally a soft fossil, becoming a medium soft fossil near the gangway, and mining in square blocks. The ore bed here contains less "Jack" than is usual along the range.

The Upper Clinton Fossil-ore Shale is yellow until nearing the ore bed, when it becomes white and soapy, and at the ore bed is merely a plastic clay.

The Sand Rock between the ore-bed and the ore sandstone is from 3 to 4 feet thick. It is taken out in driving the gangway.

A specimen was selected here for analysis, as being a fair sample of the ore to be found along this range to a point near Beavertown, two miles eastward.

"Iron,	48.800
Sulphur,	.028
Phosphorus,	.326
Insoluble residue,	15.230

Block fossil-ore, argillaceous, rather friable, reddish brown. The specimen analyzed shows numerous small spangles of quartz." (A. S. McC.)

One and a half miles S. W. of Adamsburg, Swengle and Dunning opened the "Sand Vein" Bed by means of a crosscut, which is short, and therefore the amount of breast is short. The shales are light colored, and the ore is a soft fossil.

During the year 1873, about 500 tons of ore were shipped from this opening, being hauled to Adamsburg, and shipped thence by rail to Union Furnace, Union county.

The same parties have also made another opening 15 or 20 feet lower, in order to increase the length of breasting. This can easily be done, without materially increasing the length of the tunnel, by starting on the flat land at the foot of the ridge.

The bed is said to be 22 inches thick. There are a few inches of "Jack" in the middle of it. This "Jack" is an argillaceous ore of inferior quality, containing from $\frac{1}{4}$ to $\frac{1}{3}$ as much metallic iron as the rest of the bed. It is not refused by the iron-masters, but is accepted with the rest of the ore as it comes from the mines.

Shaumbach's Tunnel one hundred yards W. of the last named opening, John Shaumbach is at present (June, 1875) having a tunnel driven. It is in the Upper Clinton Fossil Ore Shales, at an elevation that will cut the "Sand Vein" Ore Bed 45 or 50 feet below the outcrop. The ore bed is said to be over 20 inches thich at the outcrop. The dip is about 30° N.

In cutting through the flat at the foot of the ridge, the shale exposed is light colored, becoming darker where the slope of the ridge increases. The shale nearest the ore-bed is a dark gray, tough, calcareous shale. These hard shales are of frequent occurrence when the ore-bed crops out high on the slope of the ridge, and where the surface drainage is good, for the water does not then penetrate deep enough to alter the shale. The alteration in the shale is produced at the same time, and from the same cause as the change in the fossil ore-bed.

Two miles S. W. of Adamsburg, the ridge is broken by a ravine, affording an opportunity for opening the beds.

The advantage is greater in the case of the Danville Ore Beds, the outcrops of which are on the top of the ridge of Ore Sandstone, which is over 100 feet high.

The outcrop of the "Sand Vein" Bed is at a much lower level, being at the north base of the ridge.

The Danville Ore Beds have been shafted upon, are 3 in number, lying close together, within a thickness of 12 feet of rock. These ore-beds are thin at the outcrop, the largest being not more than 8 or 10 inches thick.

About 2 miles S. W. of Adamsburg, on Tilman Ronig's property, there is an opening on the Sand Vein Ore Bed.

The property was opened and ore mined by John Gilbert, in the spring of 1873. One thousand tons of ore were hauled by wagon to Adamsburg, and sent to Bloomsburg, Columbia county, by rail.

The ore is a soft fossil. The bed is 22 inches thick, including a few inches of "Jack." The dip is 30° N.

The opening was made by a tunnel about 60 feet in length, driven through the shales, and cutting the bed 50 or 60 feet below the outcrop.

West from Adamsburg Gap the Ore Sandstone and "Block Ore" pass into the high terrace of Shade mountain, and no longer form separate ridges.

Prospecting on the "Sand Vein" Ore-bed has not resulted in finding a workable bed at any point west of this Gap. The Danville Ore-beds, between Adamsburg Gap and McClure Station, give good surface indications.

Between McClure Station and Mitchell's Gap, the Ore Sandstone forms a low ridge on the terrace, which is cut by a few shallow ravines. These afford poor opportunities for opening the ore-beds. Although the altered fossil ore lies scattered upon the surface in considerable quantities, no prospecting has been done.

As far west as Painter's Station, the Upper Clinton Limeshale crops out high upon the terrace of the mountain, and passes through various points where the land is under cultivation. If this shale were burned, and the lime put upon the land, it would save hauling lime, made from the Lewistown Limestone, from the valley below.

Mitchell's Gap, 11 miles E. of Lewistown. The measures have a high dip, which brings the Ore sandstone close to the mountain. The terrace is cut by a gap which affords an opportunity for opening the ore-bed by drifts, with 50 to 75 feet of breast obtainable.

The Ore sandstone is from 20 to 25 feet thick—the upper portion is massive—and forms a low ridge along the terrace.

The "Sand Vein" Ore-bed has been opened upon both sides of the Gap, and proved to be a bed of altered fossil, alternating with seams of clay. The altered fossil ore seems to be in quantities sufficient to indicate that the vein in its normal condition is of fair proportions.

Oswell's Gap is west of Wagner Station, Mifflin county. A stream of water flows through the gap in the terrace, and empties into the main stream of the valley.

The Upper Clinton Fossil-ore Shale is bright yellow, and about 125 feet thick. Below it the Ore Sandstone is well exposed. It is a massive sand-rock, about 20 feet thick, lying in layers of from 10 to 12 inches.

The Gap affords a good level for drifting upon the ore-beds, with sufficient breasting to make profitable workings either east or west.

A shaft was sunk on the "Sand Vein" Ore Bed in 1873, and soft fossil ore taken from it. The bed is from 10 to 12 inches thick, and dips 60° N.

An analysis of this ore yielded:

Iron,	42.700
Sulphur,	Trace
Phosphorus,	.138
Insoluble residue,	28.680

"Fossil-ore, compact, showing spangles of quartz and specular ore; color, light brown." (D. McC.)

The Danville Ore Beds have not been opened, but a considerable quantity of soft fossil ore on the surface warrants a belief in their existence.

There is blossom of hematite under the Ore Sandstone, but in no quantities large enough to indicate the existence of a workable deposit.

The Sand-Rock lying between the "Sand Vein" Bed and the Ore Sandstone is a coarse, sandy, ferruginous rock, from 2 to 3 feet thick. It is found scattered upon the surface, often giving a false impression in regard to the nature of the ore deposits.

Mowry's Gap, 10 miles E. of Lewistown. Both the "Sand Vein" Ore Bed and the Danville Ore Beds show outcrops of good soft fossil ore. The Ore Sandstone retains a thickness of 25 feet. The upper portion, which at the Juniata Narrows contains more argillaceous matter, here assumes the character of a silicious sandstone.

On the property of Henry Gibbony, on the east side of Mowry's Gap, the measures dip 50° to 60° N. The best method for opening the beds at this point would be by cross-cuts, which would afford 50 to 75 feet of breast.

A surface specimen from "the underlying vein"* on this property yielded upon analysis :

Iron,	32.700
Sulphur,	.031
Phosphorus,	.415
Insoluble residue,	32.560

"Limonite, brittle, argillaceous; color, reddish brown." (D. McCreath.)

In the Lower Clinton Shale, 150 feet below the Ore Sandstone, occurs a "blossom" of hematite. Whether a bed of ore could be found at these points sufficiently valuable to warrant working, can only be ascertained by shafting, and this would be attended with very great uncertainty.

Nine miles from Lewistown, and about 1 mile S. E. from Painter's Station, a tunnel has been driven about 80 feet through the Upper Clinton Fossil-ore Shale, cutting the "Sand Vein" Ore Bed, which is about 12 inches thick, composed of fossiliferous limestone and hard fossil ore.

The opening was made in 1872, by Dr. J. D. Conrad, of Beavertown, Snyder county, but abandoned on account of the great expense of mining, the ore being very hard, and not rich enough in iron to make it pay.

The shales through which the tunnel passes, at the foot of the ridge, are alternating olive-green and yellow, except near the ore-bed, where they are dark gray and calcareous. The dip is 60° N. W.

* Sand Vein (?) C. E. B.

The tunnel is well timbered and secured, and large enough to admit a mule.

From *Mowry's Gap* west to *Maitland Station* the measures dip about 50° N. W., which brings the ore sandstone close to the mountain, forming a high, abrupt and unbroken terrace. Owing to the absence of ravines, cross-cuts will be necessary to open the ore-beds. But 60 or 75 feet of breast can be obtained unless very long tunnels are driven, and this latter would not be remunerative. The ore will generally prove a hard fossil in both the "Sand Vein" and Danville beds.

Maitland Station, 4 miles east of Lewistown, is the most western point, along this range, where prospecting has been done. William How shafted upon the "Sand Vein" Ore Bed, which proved a good, soft fossil ore from 16 to 18 inches in thickness.

The measures dip 40° N. W.

The Danville Ore Beds were also opened. "They are 16 inches thick, and of good quality." These openings are made in a ravine, affording opportunity for profitable working west of this. As far as Jack's Creek, 1 mile E. of the Juniata River, the Ore Sandstone continues, forming a high terrace, which is frequently cut by small ravines. There are no openings upon the ore-beds in this distance, but there is no doubt of the existence of the ore, which will generally prove hard fossil, except in the ravines. Soft ore will also exist near the outcrop of the Danville Ore Beds, being favored by the high dips and numerous ravines.

Jack's Creek flows south from Jack's mountain ; makes its way through the Lewistown Limestone ridges by means of gaps and subterranean passages ; cuts through the Ore Sandstone and terrace of Shade mountain, 1 mile E. of the Juniata River, to the Medina sandstone, which turns its course westward ; then flowing west, between Shade mountain and low irregular hills of Lower Clinton Shales, it empties into the Juniata River 2 miles below Lewistown.

From Juniata Narrows W. to Granville Gap, the Ore Sandstone forms the flank of a ridge, over the surface of which boulders of the rock are scattered.

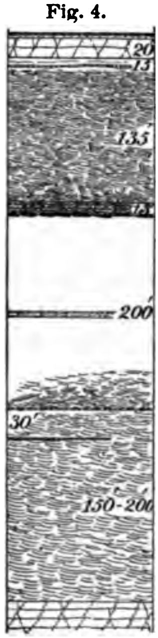
Granville Run, which rises in a gap in the Blue Ridge, cuts through the Ore Sandstone 200 feet from the Juniata River, leaving a small knob between the two streams.

There are no surface indications of ore.

At *Granville Gap*, 1 mile S. E. of the Juniata Narrows, the ore sandstone is exposed on a N. W. dip of 30°. The S. E. dip is 75°. The crest of the anticlinal is flattened and almost arched over by the ore sandstone. None of the ore-beds have been opened, for their exposures indicate that they are very small.

Fig. 4. (page 27 F.) Section of Clinton ore group, south of Smithgrove. Dip 4° to 8°, northward.

Fig. 4.



Sand-vein ore bed; 10″ to 12″; under it a thin layer of sand; then
Sand rock; . . . . 3′
Ore-sandstone; massive; . . . . 20′
Danville ore-bed group, fossilliferous; . . . . 15′

Lower Clinton Shales; . . . . 135′

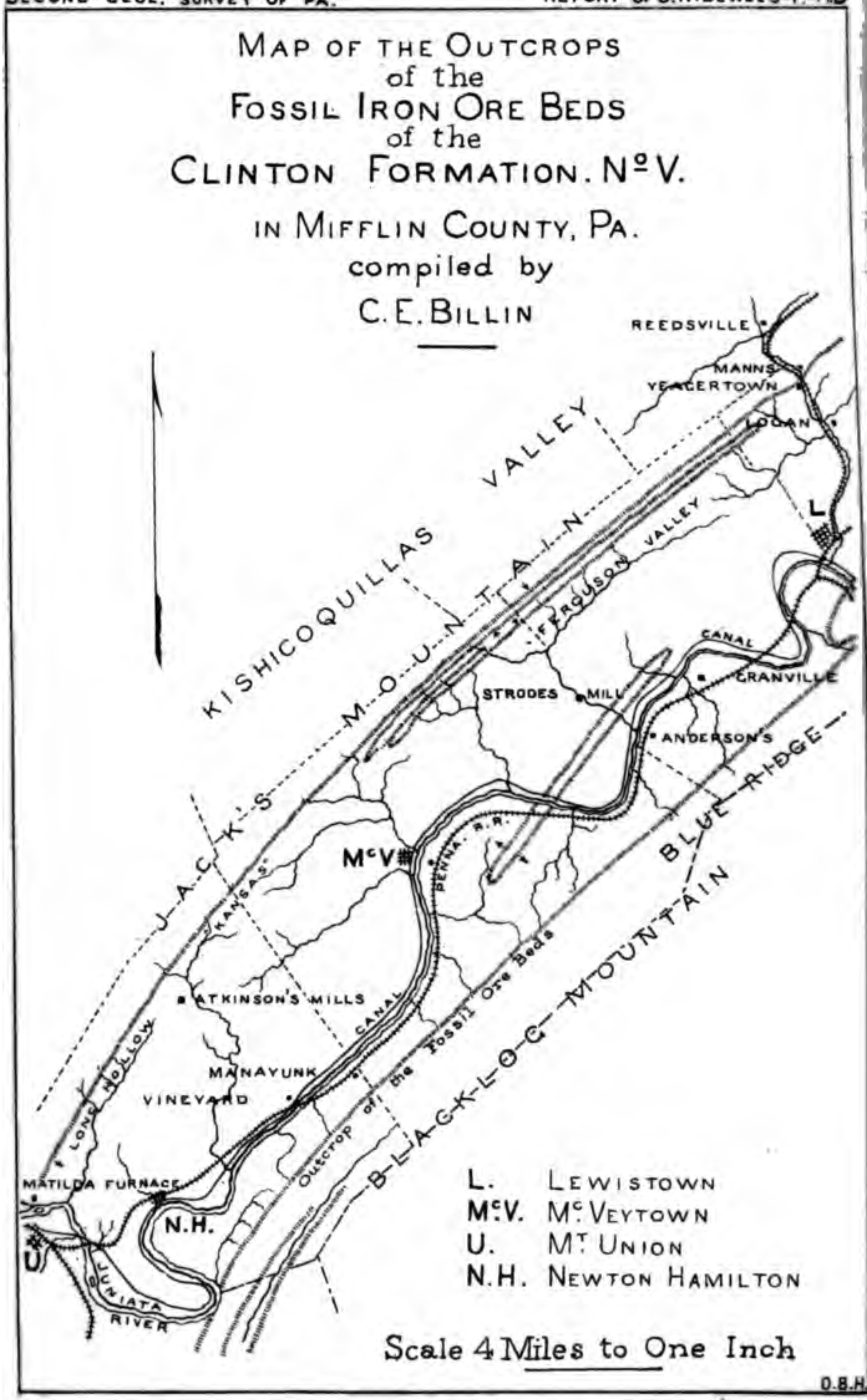
Block-ore; (See detailed section) . . . . 13′

Sandstone, very ferruginous, like block ore; . . 6′+

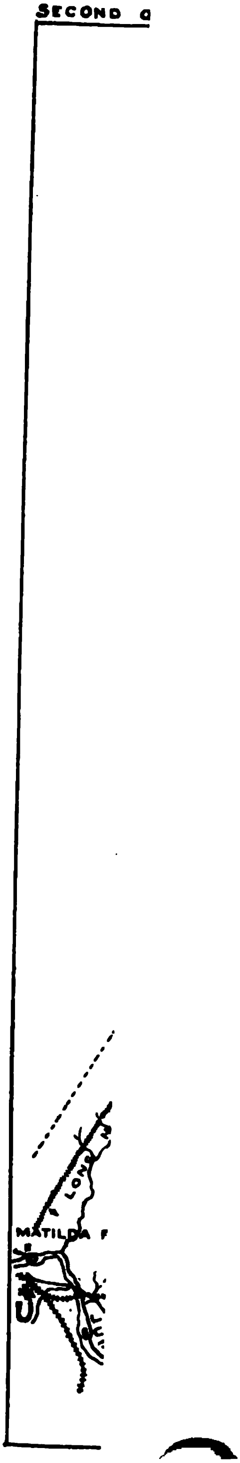
Shale, light green and yellow.
Bird-eye fossil ore, rich; 8″ to 12″ thick.
Yellow shale; . . . . 30′
Shot-block-ore; a sand rock containing small argillaceous pebbles like shot; fracture rough.

Shales; 150′ to 200′.

Medina Sandstone, No. IV.


MAP OF THE OUTCROPS
of the
FOSSIL IRON ORE BEDS
of the
CLINTON FORMATION. No V.
IN MIFFLIN COUNTY, PA.
compiled by
C. E. BILLIN
REEDSVILLE
MANNS
YEAGERTOWN
LOGAN
L
KISHICOQUILLAS VALLEY
JACK'S MOUNTAIN
FERGUSON VALLEY
CANAL
GRANVILLE
STRODES MILL
ANDERSON'S
BLUE RIDGE
McV
PENNA. R.R.
KANSAS
BLACKLOG MOUNTAIN
Outcrop of the Fossil Ore Beds
ATKINSON'S MILLS
CANAL
MANAYUNK
VINEYARD
LONG HOLLOW
MATILDA FURNACE
N.H.
U
JUNIATA RIVER
L. LEWISTOWN
McV. McVEYTOWN
U. Mt. UNION
N.H. NEWTON HAMILTON
Scale 4 Miles to One Inch
D.B.H.

SECOND G



CHAPTER V.

Logan and Lewistown Sections.

(*Plates VII and VIII.*)

These sections show the relation of the rocks between the Juniata River, at Lewistown, and the Kishicoquillas valley, at Reedsville. They include rocks of the lower portion of the Hamilton Period,* and all of the Silurian Age, to the upper portion of the Trenton Period.†

These same rocks, together with all the formations of Devonian Age, and a portion of the Carboniferous Age, have been measured in a section from Orbisonia to Broad Top, by Charles E. Billin and Charles A. Ashburner. The results will be published in another report.

In the valleys lying between Jack's and Shade mountains, there are no rocks higher, in geological order, than the Genesee and Hamilton Shales. These form prominent ridges in the central portion of the valleys.

Logan Section.

The line of section is taken at right angles to the strike of the measures, which is S. 54° W.

The section shows the position of the rocks, and gives the thicknesses of the divisions, which occur between Logan and Reedsville.

At Logan, the Water-lime shale dips 40° S. This dip flattens as we approach the Ferguson Valley Ore-ridge anticlinal, which occurs between Logan and Yeagertown. This anticlinal bears the Ore Sandstone on its crest about 400 feet below the level of the Kishicoquillas creek. The rising of the anticlinal, toward the S. W., brings the Ore Sandstone to the surface, about 2 miles from Yeagertown.

The fossil ore beds crop out on the S. E. flank of Jack's mountain, dipping 58° to the S. E.

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*The Lower Devonian, No. VIII.

†Top of the Limestones of No. II.

The Lower Clinton Shales, No. V, are quite silicious, and contain thin beds of fossiliferous limestone.

The upper layers of the Medina White Sandstone form the crest of Jack's mountain. The bold terrace on the N. W. flank of the mountain is made by the outcrop of the Oneida grey sandstone, No. IV.

At Reedsville, the Trenton limestone dips 42° S. E.

Lewistown Section.

The line of this section is located 2½ miles S. W. of the Logan Section, and parallel to it.

It shows the position of the rocks between Lewistown and the crest of Jack's mountain. It includes the measures from the Marcellus black slate* to the Medina white sandstone, For. No. IV, showing their divisions, and giving their thickness.

Between Lewistown and Ferguson valley, are three synclinal flexures, containing Oriskany Sandstone, No. VII. The several outcrops of this sandstone form parallel ranges of irregular hills.

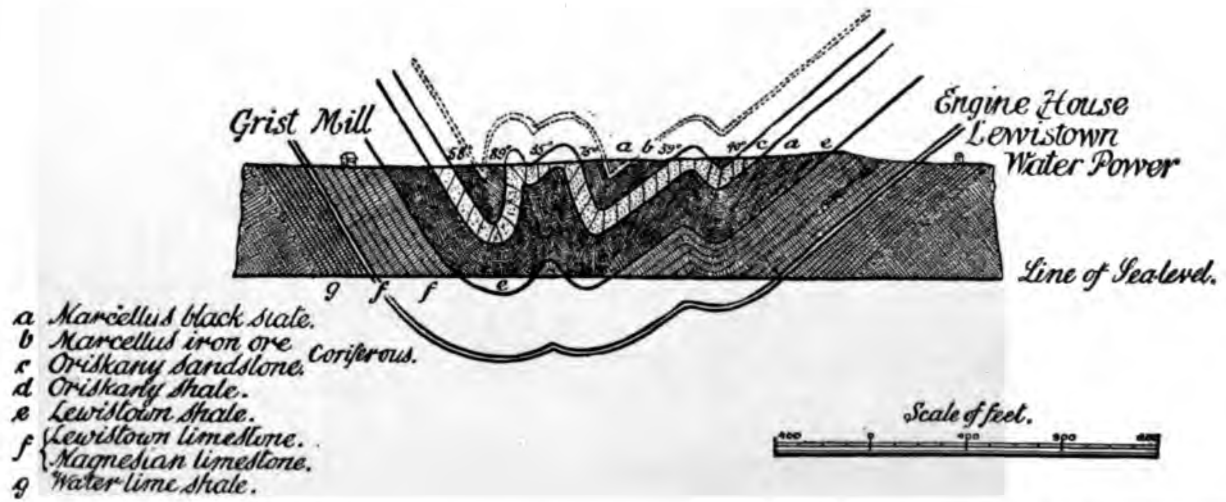
Just N. W. of Lewistown, are some slight flexures which spread out the Oriskany Sandstone over a considerable area. These flexures are shown in more detail in the Kishicoquillas Section, which is located E. of this. To the west, owing to the rising of the flexures, the sandstone has been carried away by erosion.

The principal synclinal flexure S. of "Prospect Rock" contains the Marcellus Ore bed. Both dips steepen, and the flexure sinks slowly to the S. W. It is the same with the McCoy's Ore Bank synclinal of the McVeytown Section. On the N. E. dip of the Oriskany Sandstone of this synclinal the Juniata Sand Company's and Dull and Bradley's Sand Mines are located.

Dry Valley is formed by a synclinal flexure, which, between Logan and McVeytown, is generally known as the "Squaw Hollow Synclinal." It corresponds to the Ross Ore bank synclinal of the McVeytown Section.

* Part of the Hamilton Group, No. VIII.

Second Geological Survey of Pennsylvania. 1874. Juniata district.
J. H. Dewees, Asst. Geol. Kishicoquillas section, Constructed by C. A. Ashburner.




st.G

On the line of the Lewistown Section this synclinal is large, and contains the Marcellus Ore bed. To the west the dips steepen, and the flexure maintains a very constant elevation.

The first synclinal flexure S. of Ferguson Valley is comparatively small, and does not contain the Marcellus Ore bed on the line of section. To the west, however, the N. W. dip steepens, and the whole flexure subsides. This synclinal corresponds to the Dull and Bradley Ore Bank synclinal of the McVeytown Section, and is the one in which the McGirk Ore bank is located.

The Ore-ridge anticlinal brings the fossil ore measures to the surface, where they form two lines of outcrop. This anticlinal has risen nearly 800 feet in the 2½ miles, between the Logan and Lewistown Section lines.

The synclinal between the Ore-ridge anticlinal and Jack's mountain has flattened very much, and has risen at about the same rate as the anticlinal.

The combined thickness of the rocks in the Lewistown and Logan Sections, exclusive of the Marcellus and Trenton Group, is 8,084 feet.

The thickness of the subdivisions is as follows:

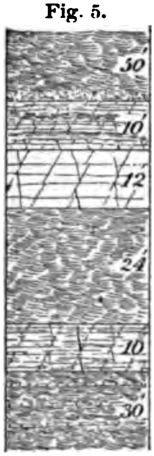
VIII.	Upper Helderberg Limestone,	40 feet
	Schoharie Grit (Corniferous Shale,)	93 "
VII.	Oriskany Sandstone,	110 "
	Oriskany Shale,	205 "
VI.	Lewistown Lime Shale,	140 "
	Lewistown Limestone,	185 "
	Water Limestone and Shale,	470 "
	Salina Shales,	350 "
V.	Niagara Limestone, (?)	3½ to 4 "
	Niagara Shales, (?)	70 "
	Upper Clinton Variegated Shales,	432 "
	Variegated Gray Shales,	326 "
	Clinton Lower Red Shale,	260 "
	Upper Clinton Fossil Ore Shale, Clinton Lower Lime Shale, Clinton Upper Olive Shale,	251 "
	Ore Sandstone, (including Fossil Ore Beds,)	38 "
	Clinton Middle Olive Shale,	178 "
	Block Ore (Iron Sandstone,)	7 "
	Lower Clinton Shales,	571 "
IV.	Medina White Sandstone,	820 "
	Medina Red Sandstone,	1,280 "

III.	Oneida Red Conglomerate,	309	"
	Oneida Gray Conglomerate,	313	"
III.	Hudson River Slates,	937	"
	Utica Shales,	695	"
II.	Upper Trenton (Matinal) Limestone,	675	"
	Total,	8,759	"
	Deduct Trenton Limestone,	675	"
		8,084	"

Fig. 5. (see page 45 F.) Section at Juniata Narrows, south of Lewistown; end of Shade Mountain.

Variegated shales,	508′
Upper Clinton red-shale,	260′
Upper Clinton lime-shale, containing beds of Limestone, 2″ to 12″ thick;	160′

Fig. 5.



Upper Clinton fossil ore shales;	50′
(Traces of sand-vein ore bed.)	
Ore-Sandstone, argillaceous, alternating with small beds of siliceous shale;	10′
Ore-sandstone, massive, cleavage planes 6″ to 12″ apart;	12′
Siliceous shale;	24′
Danville ore-bed rock; traces of the ore;	10′
Lower Clinton shales, containing many thin beds of fossil limestone 1″ to 6″ thick;	30′

Granville Gap, Shade Mountain, Mifflin County. (See page 46.)

Fig. 6.

Ore-Sandstone, argillaceous.

Ore-Sandstone, siliceous, massive; cleavage planes from 6 to 12 inches apart.

Siliceous Shale, Argillaceous sandstone, } alternating.

Danville Ore group; very argillaceous.

Lower Clinton Shale.

Vertical Section.

Upper and Lower Silurian Beds.

Measured between Logan and Reedsville, in Mifflin County.

No. of Specimen.	*Name of Formation.*	Thickness.	Total.	
	Water Line Shale.	Feet.	Feet.	
319 320	Limestone, dark blue, slightly argillaceous, alternating with a dove-colored lime shale,	19.5 to	19.5	
321	Limestone, dove-colored, argillaceous, somewhat hydraulic, alternating with shales of same color, ...	45.5	65.0	
322 323	Lime Shale, dove-colored, argillaceous, containing about the center a seam of hard, bluish black limestone, 3 feet thick, . . .	26. to	91.0	
—	Limestone, not exposed, ...	54.6	145.6	
324	Limestone, dark-grayish blue, argillaceous, square fractured, and laminated in structure, ...	7.2 to	152.8	
—	Limestone shale, not exposed, ...	13.6 to	166.4	166.4
	Salina Variegated Shale.			
325	Lime shale, dark gray, argillaceous, ...	13.6 to	180.0	
326	Sand shale, yellowish brown, calcareous, fragile, ...	6.5 to	186.5	
327	Same as (325), ...	21.5 to	208.0	
328	Lime shales, dark gray, alternating argillaceous and sandy, ...	6.5 to	214.5	
329	Lime shale, dark gray, friable, with an uneven fracture, ...	6.5 to	221.0	
330	Lime shale, dark gray, argillaceous, square-fractured, alternating with a hard, yellow, calcareous sand shale, ...	4.6 to	225.6	
331	Lime shale, green, argillaceous, ...	8.4 to	234.0	
332	Sandstone, yellow, argillaceous, hard, in thin layers, ...	5.8 to	239.8	
333	Lime shale, dark gray, argillaceous, hard, with occasional seams of sand shale, . . .	20.2 to	260.0	
334	Shale, dove-colored, argillaceous, alternating with a yellow sand shale, ...	7.8 to	267.8	
335	Limestone, dark gray, argillaceous, heavy, with an even fracture, ...	4.6 to	272.4	
336	Shales, green, various beds, apparently free from calcareous matter, ...	52.6 to	325.0	
337	Shale, green, not exposed, ...	125 to	450.0	
—	Shale, red, ...	5 to	455.0	
338	Lime shale, yellow, sandy, compact, ...	2.5 to	457.0	
339	Shales, red and green, in alternating beds (from three to six feet thick), ...	5.7	514.5	348.1
—	Limestone, dark blue, argillaceous, massive, with an even fracture, ...	2	516.5	

	Niagara Limestone (?).			
340	Limestone fossiliferous, containing a large percentage of iron, ...	1.5 to	518.0	
341	Limestone, light-blue, heavy, even fractured, ...	2. to	520.	3.5
	Niagara Shale (?).			
——	Shales, soft, red, yellow, and green, the green predominating, ...	70 to	590.0	70.
	Clinton Upper Red Shale.			
250, 172	Shale, red, ...	191.7 to	781.7	
249, 248	Shale, red and green alternating, ...	35.4	817.1	
247	Shale, red, ...	35.	852.1	
246	Shale, green, ...	4.	856.1	
245	Shale, red, with occasional seams of green, .	70.8	926.9	
244	Shale, red, ...	47.2	974.1	
	Shale, green, ...	5.9	980.0	
243	Shale, red, with thin seams of green, ...	4.4	984.4	
241, 242	Shale, hard red, alternating with Shale green, ...	38.	1022.4	432.4
	Clinton Upper Lime Shale.			
174	Shale, alternating yellow, red, and green, .	62.6	1085.0	
175	Sand shale, yellow, heavy, ...	3.6 to	1088.6	
176	Sand shale, olive, (yellow tint,)	3.5	1092.1	
177	Sand shale, lead colored, ...	8.8	1100.9	
178	Limestone, blue, sandy, ...	1.	1101.9	
179	Shale, olive, heavy, somewhat sandy, . . .	11.4	1113.3	
180	Sand shale, lead-gray, heavy, ...	18.5	1131.8	
181	Limestone, ...	1.7	1133.5	
182	Sand shale, light green, ...	9.8	1143.3	
183, 184	Shale, lead-colored, slightly tinted with yellow, heavy, and somewhat sandy, alternating with shale, variegated red and green, .	17.6	1160.9	
185	Shale, variegated red and green, sandy, . .	10.7	1171.6	
186	" " " "			
187	Limestone, fossiliferous, ...	2.7	1174.3	
188, 189	Shale, olive, ...	9.8	1184.1	
190, 191	Shale, olive gray, sandy, ...	115.7	1299.8	
192	Sand shale, pinkish gray, ...	4.5	1304.3	
193	Sand shale, yellowish green, soft, ...	43.6	1347.9	325.5
	Clinton Lower Red Shale.			
194, 195	Sandstone, yellow, in thin seams, alternating with lime shale, ...	12.5 to	1360.4	
196	Sand shale, olive, ...	4.5	1364.9	
197	Shale, red, ...	6.2 to	1371.1	
198	Shale, light green, soft, ...	4.5	1375.6	
199	Shale, red, ...	8.	1383.6	
200	Shale, yellowish green, ...	4.5	1388.1	
201	Shale, red, ...	8.9	1397.0	
202, 203	Shale, light green, soft, alternating with a fragile limestone, ...	12.5	1409.5	

204	Similar to specimens (202) and (203,) but somewhat softer, ...	18.7	1428.2	
205, 206, 207	Shale, olive and yellow, alternating with a lime shale, ...	81.9	1510.1	
208, 209	Shale, red and green, alternating, ...	15.9	1526.0	
210	Shale, green, tinted with red, ...	2.7	1528.7	
211	Shale, red, ...	66.3 to	1595.0	
212, 213	Shale, red, harder than specimen (211,) . .	24.9 to	1619.9	
	Clinton Lower Lime Shale, and Clinton Upper Olive Shale.			
90	Shale, dark, heavy, ...	21. to	1640.9	
89, 88, 87, 86, 85, 84, 83	Sand shale, dark, calcareous, alternating with lime and shales, dark olive, argillaceous, ...	70. to	1710.9	
82	Shale, olive, ...	5.2 to	1716.1	
81	Sandstone, blue, calcareous, ...	1.7 to	1717.8	
80	Shale, olive, ...	4.3 to	1722.1	
79	Shales, green and olive, ...	37.	1759.1	
78, 77, 76	Shale, olive, containing gray sandstone in thin seams, and a calcareous sandstone in a six-inch seam, .	.9	1760.0	
75	Sand shales, olive, soft, ...	60.6	1820.6	
70	Limestone, blue, fossiliferous, ...	.2	1820.8	
45, 73	Sand shales, olive and yellow gray, ...	25.8	1846.6	
44, 74	Sand shales, gray and olive, ...	3.4	1850.0	
43	Limestone, ...	.3	1850.3	
41	Limestone, two seams, 2 and 3 inches, . . .	.6 to	1850.9	
42	Shale, olive, soft, ...	1. to	1851.9	
40	Limestone, blue, fossiliferous, ...	.2 to	1852.1	
71	Shales, olive, ...	18.9 to	1871.	251.1
	Fossil Ore Beds, Ore Sandstone, &c.			
33, 34, 36	Soft fossil iron ore, ...	1.3	1872.3	
	Shale, olive, ...	4.	1876.3	
—	Soft fossil iron ore, ...	1.3	1877.6	
46, 47, 48, 49, 50	Sandstone, tough, gray, calcareous, with thin partings of shale, ...	31.	1908.6	37.6
	Clinton Middle Olive Shale.			
51	Shale, green, ...	8.2	1916.8	
55	Sandstone, grayish blue, hard, ...	13.1	1929.9	
51½	Shale, green, ...	9.	1938.9	
53	Shale, olive, argillaceous, ...	1.6	1940.5	
54	Limestone, grayish blue, fossiliferous, containing from 5 to 7 per cent. of iron, located in the center of specimen, (53,) . .	.6	1941.5	

57	Sandstone, blue, hard, in thin seams, alternating with gray shale, ...	9.8	1950.9	
58	Limestone, blue, fossiliferous, ...	1.6	1952.5	
59	Shales, dark purple, soft, ...	12.3 to	1964.8	
60	Shales, olive, soft, ...	3.3	1968.1	
61	Shale, green, ...	1.6	1969.7	
62	Shale, purple, soft, ...	.8	1970.5	
63 64	Sand shale, dark purple, soft, ferriferous, alternating with thin seams of sandstone, .	18.	1988.5	
65 66	Shales, dark green and olive, ...	53.3	2041.8	
69	Limestone, fossiliferous, ...	.2	2042.	
67	Shale, dark gray, hard, alternating with thin seams of sandstone, ...	24.6	2066.6	
96 97	Shale, dark olive, heavy, ...	19.7	2086.3	177.7
	Iron Sandstone.			
98 99	Sandstone, hard, ferruginous, ...	6.6	2092.9	6.6
	Clinton Lower Olive Shale.			
100 101 102 103 104	Shale, olive, heavy, containing alternating seams of hard, gray, arenaceous sandstone, and a soft sandstone, ...	25.4	2118.3	
105	Shale, olive, ...			
106	Sandstone, gray, hard, ferruginous, ...	.2	2118.5	
107 108 109	Shale, dark green and purple, alternating with soft sand shale, ...	90.2	2208.7	
110 111	Shale, dark green and purple, ...	53.3	2262.	
(—)	Shales, dark green and olive, sandy, ...	335	2597.	
112 113 115	Shales, dark green, very soft, alternating with soft ferruginous shales, ...	67	2664.	
	Medina White Sandstone.			
114 448	Sandstone, light gray, rather fine grained, very hard and massive, surfaces of lower strata dotted with ferruginous specks, . .	820	3484	820
	Medina Red Sandstone and Shale.			
449 to 458 inclusive.	Sandstone, red, fragile, argillaceous and marly, of a thinly laminated structure, .	1280	4764	1280
	Oneida Red Conglomerate.			
459 to 463 inclusive.	Sandstone, red, massive containing large pebbles, ...	309	5073	309

	Oneida Gray Sandstone.			
464 to 467 inclusive.	Sandstone, greenish gray, very hard, fine grained, portions of strata containing oxide of iron, ...	313	5386	313
	Hudson River Slates.			
468 469	Sandstone, gray, very hard, flaggy, alternating with a sandstone, bluish black and hard, and shale, ...	425.	4811.	
470	Shale, yellowish gray, compact, conchoidal fracture, ...	190.	6001.	
471	Sandstone, bluish gray, very hard, fine grained, with conchoidal fracture, ...	140.	6141.	
472 473 474 475	Shales, dark, ferruginous	182.	6323.	937.
	Utica Upper Gray Slate.			
(—)	Shales, dark, ferruginous, containing bituminous matter, ...	210.	6533.	210.
	Utica Middle Black Slate.			
476 477	Slates, black, cleavage perfect, exposed along line of Mifflin and Centre Co. R. R. at Reedsville, ...	302.	6835.	302.
	Utica Lower Gray Slates.			
(—)	Slates, unexposed, ...	855.	7690.	855.
	Trenton Limestone.			
(—)	Limestone, dark blue, ...	120.	7810.	
686 687	Limestone, dark gray, crystalline, with conchoidal fracture, ...	28.5	7838.5	
688	Limestone, dark gray, sandy, containing calcite, ...	22.8	7861.3	
689	Limestone, bluish gray, containing a considerable quantity of calcite, alternating with specimen, (686,)	11.4	7872.7	
—	Limestone, not exposed, ...	62.1	7934.8	
689½	———, ...	2.9	7937.7	
690 691	Lime shale, dark, argillaceous, alternating with a fine grained, bluish gray limestone,	.8	7938.5	
686 687	———, ...	59.8	7998.3	
693	Limestone, gray, very hard, sandy, crystalline, containing fossil specimen No. (692,)	11.4	8009.7	319.7

(319, 320,) Survey Stations 853 to 853+30. (321,) 853+30 to 853+100. (322, 323,) 853+100 to 853+140. (—,) 853+140 to 853+224. (324,) 853+224 to 853+235. (—,) 853+235 to 853+256. (325,) 853+256 to 853+277. (326,) 853+277 to 853+287. (327,) 853+287 to 853+320. (328,) 853+320 to 853+330.

Specimens (329,) at Survey Stations 853+330 to 853+340. (330,) 853+340 to 853+347. (331,) 853+347 to 853+360. (332,) 853+360 to 853+369. (333,) 853+369 to 853+400. (334) 853+400 to 853+412. (335,) 853+412 to 853+419. (336,) 853+419 to 854. (337,) 854 to 854+200. (—,) 854+200 to 854+208. (338,) 854+208 to 854+212. (339,) 854+212 to 854+304. (—,)854+304 to 854+306.

Specimens (340,) at Survey Station 854+306 to 854+307½. (341,) 854+307½ to 854+309½. (——,) 854+309½ to 854+422. (172,) 813 to 814+192. (250,) 4+670 to 4+345. (249,) 4+345 to 4+284. (248,) 814+192 to 815+40. (247,) 4+284 to 4+224. (246,) 4+224 to 4+220. (245,) 4+220 to 4+100. (244,) 4+100 to 4+10. (243,) 4+10 to 4+2½. (241, 242,) 4+2½ to 840+300. (174,) 816+85 to 816+106.

Specimens (175,) at Survey Station 816+106 to 816+110. (176,) 816+160 to 816+114. (177,) 816+114 to 816+124. (178,) 816+124 to 816+125. (179,) 816+125 to 816+138. (180,) 816+138 to 816+159. (181,) 816+159 to 816+161. (182,) 816+161 to 816+172. (183,)——(184,) 816+172 to 817. (185, 186,) 817 to 817+12. (187,) 817+12 to 817+15. (188, 189,) 817+15 to 817+26. (190, 191,) 817+26 to 817+156. (192,) 817+156 to 817+161. (193,) 817+161 to 817+110.

Specimens (194, 195,) at Survey Station, 817+210 to 818. (196,) 818 to 818+5. (197,) 818+5 to 818+12. (198,) 818+12 to 818+17. (199,) 818+17 to 818+26. (200,) 818+26 to 818+31. (201,) 818+31 to 818+41. (202,) (203,) 818+41 to 818+55. (204,) 818+55 to 818+76. (205, 206, 207,) 818+76 to 819. (208, 209,) 819 to 819+30. (210,) 819+30 to 819+35.

Specimens—(211,) at station 819+35 to 819+160. (212, 213,) 819+160 to 820. (90,) 830+25 to 830. (89,88,87,86,84,83,) 830 to 829. (82,) 829 to 828+64. (81,) 828+64 to 828+62. (80,) 828+62 to 828+57. (79,) 828+57 to 828+14. (78,77, 76,) 828+14 to 828+13. (75,) 828+13 to 822+65. (70,) station 822+65. (45,) (73,) 822+65 to 822+35. (44,74,) 822+35 to 822+31. (43,) 822+31.

Specimens (41,) at 822+31. (40,) 822+28. (71,) 822+28 to 822+6. (33, 34, 36,) Sta., 822+6. (—,) 822. (46, 47, 48, 49, 50,) 822 to 822+38. (51,) 822+38 to 822+48. (55,) 822+48 to 822+64. (51½,) 822+64 to 822+75. (53,) 822+75 to 822+77. (57,) 822+77 to 822+89. (58,) 822+89 to 822+91.

Specimens (59,) at Stations 822+91 to 822+106. (60,) 822+106 to 822+110. (61,) 822+110 to 822+112. (62,) 822+112 to 822+113. (63, 64,) 822+113 to 822+135. (65, 66,) 822+135 to 822+200. (69,) 822+200. (67,) 822+200 to 822+230. (96, 97,) 822+230 to 822+254. (98, 99,) 822+254 to 822+261½. (100, 101, 102, 103,) 822+261½ to 822+292. (104, 105,) 822+292 to 822+312. (106,) 822+312. (107, 108, 109,) 822+312 to 822+422.

Specimens (110, 111,) at Survey Stations, 822+422 to 823. (—,) 823 to 826. (112, 113, 115,) 826 to 1583. (114, 448,) 1583 to 1501. (449—458,) 1501 to 1520. (459—463,) 1520 to 1521+75. (464—467,) 1521+75 to 1522+145.

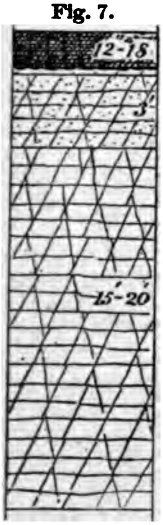
(468, 469,) Station, 1522+145 to 1524. (470,) 1524 to 1525. (471,) 1525 to 1525+250. (472, 473, 474, 475,) 1525+250 to 1526+200. (——,) 1526+200 to 1529. (476, 477,) 1529 to 1531. (——,) 1531 to 1580.)——,) 1580 to 1582 (686, 687,) 1582 to 1582+50.

FOOT NOTE.—(688,) Survey Station, 1582+50 to 1582+90. (689,) 1582+90 to 1581+110. (——,) 1582+110 to 1582+219. (689½,) 1582+219 to 1582+224. (690, 691,) 1582+224 to 1582+225. (686, 687,) 1582+225 to 1582+330. (693,) 1582+330 to 1582+350.

NOTE—Specimens from (196) to (213) inclusive, are from the north dip of the mountain synclinal, and occupy the same position in the section as specimens of red shale (91) to (94) inclusive, taken from the south dip of the synclinal, from stations 830+25 to 832.

McKee's Ore bank. (*See page 66 F.*)

Fig. 7.



Sand-vein ore bed.

Mottled purple and white rock, several inches thick.
Sand-rock; fragile; coarse; ferruginous.

Ore-sandstone, massive.

J. Shehan's Ore bank, W. of McKee's bank.
(See page 69.)

Fig. 8.

Sand-Vein ore bed, impure and shaly at bottom.

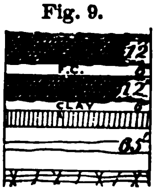
Sand-rock.

Spongy ore, containing small fossils.

Ore-Sandstone.

Moore's Ore Bank. N. W. of Lewistown. On S. dip. *(See page 75 F.)*

Fig. 9.



Shale.
Ore.
Fire clay.
Ore.
} Marcellus ore.

White clay, carbonaceous.

Upper Helderberg Limestone: (at the outcrop a rotten, olive green shale.)

Oriskany Sandstone. (No. VII.)

Chapter VI.

Ferguson Valley. Fossil Ore Ranges.

Ferguson Valley lies between Jack's mountain on the N. and the Oriskany ridges on the S., and extends W. from Yeagertown, for about 13 miles, to the E. end of Kansas Valley.

Owing to the steepening of the dips, and the consequent approach of the ridges to the mountain, the valley, which is 1¾ miles wide at Yeagertown, becomes gradually narrower to the westward.

The Clinton, Saliferous, and Water Lime Shales underlie the valley, and give to it a great variety of soils.

Jack's Mountain Ore range. On the south-west side of Logan Gap the outcrop of the fossil ore-beds attains a greater height than on the east side. No openings have been made on the mountain dip of the ore-beds between Logan Gap and Long Hollow, though there is abundant evidence of the existence of ore in the "Sand Vein" bed throughout its entire course. The outcrop shows in many places, both as fossil ore and as altered fossil or hematite. The bed is seen to be of fair size at Logan Gap, and increases to the S. W., being 22 inches thick at Mt. Union.

A considerable quantity of brown hematite ore is scattered upon the terrace of this mountain. It is in great part altered fossil ore, derived from the numerous small beds of ferruginous limestone contained in the Lower Clinton shales. While it is assuming that this is the origin of much of the "blossom" of ore on the terraces, it is possible that some pockets of brown hematite ore may exist in the shales.

The block ore scattered on the surface of the terrace, 7 miles from Logan Gap, is of no economic value, though richer in iron than that at Logan Gap and Jack's Narrows.

The bed of block ore at Logan Gap is in two thin layers divided by shale. At Jack's Narrows Gap, on the east side of the Juniata River it is 3 feet thick.

The terrace of Jack's mountain is broken by frequent ravines, affording opportunity for opening the ore-beds and increasing the probability of their containing soft ore.

From Logan Gap to Peter Rush's, where the ore ridge sinks away, the terrace is high and regular. From Peter Rush's to a point N. of McVeytown, the outcrop of the ore sandstone is broken down, the terrace is low and broken by numerous small, shallow ravines.

Anticlinal Ore Ridge of Ferguson Valley. The flexure which forms this ridge rises S. W. from Yeagertown, bringing up the Ore sandstone and accompanying ore-beds in about 2 miles, where they form a small ridge.

The anticlinal continues rising to the S. W. and the ridge, which is broken by several ravines, assumes large proportions.

The synclinal between Yeagertown and Jack's mountain rises with the ore ridge anticlinal. North of McKee's the highest rocks remaining in it are the Clinton Lower red shale.

Near McKee's ore-banks, 7 miles S. W. from Yeagertown, the ore ridge is wide, and nearly as high as the terrace of Jack's mountain.

About this point the two flexures, the ore ridge anticlinal and the synclinal between it and the mountain, attain their greatest elevation. They maintain this for a short distance, and then begin to sink rapidly toward the S. W.

In sinking, the ore ridge anticlinal resolves itself into two flexures. This change is first noticed about ¾ of a mile E. of McKee's ore-banks.

The McKee section shows the two anticlinals separated by a pronounced synclinal flexure.

At John Kinzer's, 2 miles S. W. of McKee's, the anticlinals are very much contorted.

Two miles further S. W., at Peter Rush's, which is 3 miles N. E. of the line of the McVeytown Section, the S. E. anticlinal flexure carries the ore sandstone under the surface. A short distance further W. the north-western flexure carries the ore measures under.

Between Peter Rush's and the line of the McVeytown Section, one of the flexures of the ore ridge flattens out. In the McVeytown section there is a single, simple anticlinal on the crest of which the Ore sandstone must lie at a depth of more than 1,700 feet below the surface.

The whole length of the ore ridge from Keever's ore-bank to Peter Rush's is about 8 miles. In this distance a number of ravines cut through the ridge and afford good opportunities for opening the ore-beds at water level. The dips are generally moderate, from 30° to 40°. The ore of the Sand Vein Bed is a medium soft fossil, of very fair quality throughout the ridge.

The Danville ore-beds are nowhere exposed, except at the Graham ore-bank. The fact that the ore sandstone covers the north flank of the ore ridge to the outcrop of the ore-beds shows that the Danville beds contain hard fossil ore, and are in great part limestone beds. Soft fossil ore may be expected to exist at the outcrops of these beds in certain localities along the range where the dips are high, and in the ravines.

At the Graham ore-bank these beds are hard fossil ore, 16 inches thick. They exist on the mountain dip at Logan Gap and at Jack's Narrows, near Mt. Union. At both these points they are of sufficient size to warrant their being worked if they were rich enough in iron.

Ferguson Valley Mines.

Keever's Ore-bank is situated in a ravine cut through the ore ridge, near Robert Mean's house, about 2 miles S. W. of Yeagertown.

The anticlinal ridge formed by the Ore sandstone makes its first appearance here, and rises as we proceed S. W.

A gangway was driven on the N. E. dip of the Sand Vein ore-bed, but on account of the small amount of breast obtained the work was abandoned. The ore-bed, including the impure shaly ore at the bottom, is 16 inches thick. It is hard fossil ore except at the outcrop. It is not rich in iron, some of the specimens taken from the bed being fossiliferous limestone.

This opening was made in 1870, and about 200 tons of ore were sent to the furnace at Lewistown.

For a mile west of this the ore ridge remains small, having been broken down by erosion. For a considerable distance W. mining has been done on the N. E. dip, by means of "stripping."

The dips on the ore-bed are 35° N. E., and 20° S. W.

The section exhibited on page F. 63 shows the position of the beds at Keever's ore-bank.

The Graham Ore-bank, (shown in section on page F. 64, is situated in a ravine cut through the ore ridge 3½ miles S. W. of Yeagertown.

Three fossil ore-beds are exposed in this ravine. Two of them, lying a few feet apart, occur above the Ore sandstone, and constitute the Sand Vein ore-bed. They have both been opened on the S. E. dip, where the upper ore is 20 inches thick, and the lower one has been opened on the N. W. dip. The line of the north outcrop of the upper bed passes under the farm house in the ravine, and lies close to the underlying bed. Twelve hundred feet W. this upper bed was shafted upon on the top of the ridge, and a portion of the outcrop was stripped for ore, which "some years ago was hauled to Hope Furnace." The bed is thicker than at its outcrop near the ravine.

This opening was made in 1857, and worked at intervals until 1872.

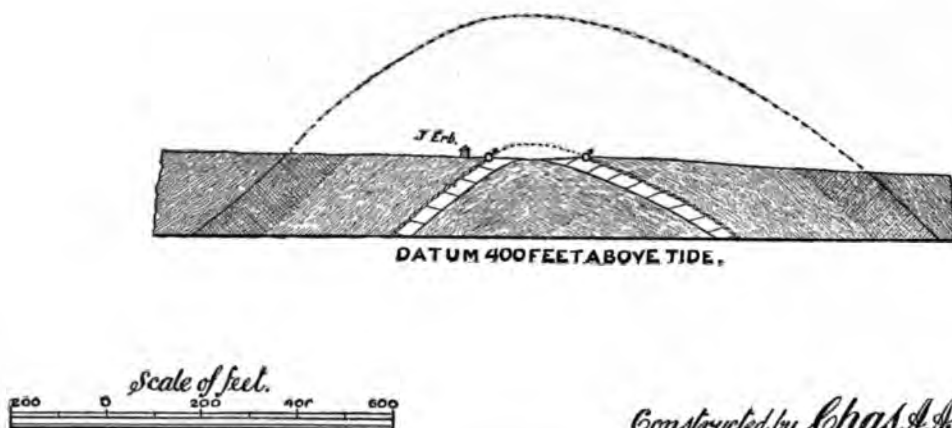
The N. dip was opened in 1870, and a considerable quantity of ore mined therefrom. From 4,000 to 5,000 tons of ore have been shipped from all the openings, the greater quantity coming from the S. dip.

The bed opened is the Sand Vein. It is from 14 to 18 inches thick, with about 4 inches of "Jack" at the bottom.

The ore is a soft fossil on the S. dip, and also on the N. dip, at the water level of the ravine, but becomes harder under cover. The ore from the openings was used at Emma Furnace, Logan, 4 miles distant, being hauled there in wagons. Two and a half tons of this ore are said to have been used for a ton of iron.

Second Geological Survey of Pennsylvania. 1874. J. H. Dewees, Asst. Geol.

Keever's Fossil ore bank

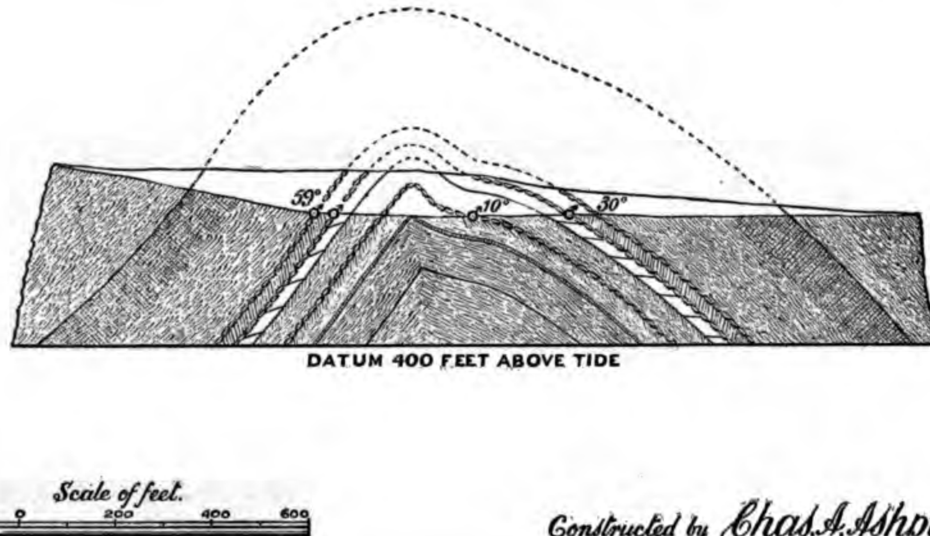


Constructed by Chas. A. Ashburner.

F. 63

Second Geological Survey of Pennsylvania. 1874. Jno. H. Dewees.

Graham's Fossil ore bank.



Constructed by Chas. A. Ashburner.

The ore measures have a regular N. W. dip of 58°, but the S. E. dip changes suddenly from 10° to 30°.

The third and lowest bed contains a fair quality of ore. It is one of the Danville ore-beds. It lies under the ore sandstone, and is exposed on the crest of the anticlinal. On the N. dip, in a ravine 60 feet to the right of the base of the hill, it was shafted upon, and found to be a bed 16 inches thick, containing hard fossil ore at the outcrop. This bed corresponds to the Danville ore-bed exposed at Logan Gap as a hard fossiliferous limestone.

Joseph Snyder's Ore-bank, in a ravine 4½ miles S. W. from Yeagertown. The opening is made on the Sand Vein ore-bed, at water level, where it dips 65° S. E. It was made in 1845, and a small quantity of ore was sent to Lewistown. No work has been done since that time. "The ore-bed was 18 inches thick, and the ore was pronounced good."

The outcrop of the bed indicates a good seam of medium soft ore. It continues S. W. along the flank of the ridge, where from 25 to 40 yards of breast can be obtained.

The Upper Clinton fossil ore shales are yellow, and correspond in thickness to those at Logan Gap. The north dip of the ridge contains shales of the same character.

The anticlinal of the ore ridge has risen high enough to expose nearly 300 feet of Lower Clinton shales under the ore sandstone.

The ravine, in which this opening is located, heads in the terrace of the mountain, and cuts diagonally S. E. across the measures. It affords opportunity for opening the ore-beds on three dips, the mountain dip, (S.) and the N. and S. dips of the ore ridge anticlinal.

The outcroppings on the N. dip of the ore ridge show the existence of the Sand Vein ore-bed. The Danville ore-beds are not exposed.

John Couples' Ore-bank is about 6 miles S. W. from Yeagertown, in a ravine through the ore ridge. The opening was made by John Couples. It is not worked at present.

It is on the S. E. dip of the Sand Vein ore-bed. The Danville ore-beds have not been proven.

The Ore sandstone dips 30° N., being much flatter than east of here. It crops out upon the ridge at an elevation nearly equal to that of the terrace of Jack's mountain.

The indications are that a large quantity of fossil ore could be economically mined from the synclinal between the ore ridge and the mountain.

The anticlinal of the ore ridge has continued rising, and at this ravine has almost brought the Medina Sandstone up to daylight. West of here the flexure subsides, and soon puts the ore-beds and succeeding rocks under the surface.

The ore ridge has a wide top, being increased in width by the addition of a roll producing a second anticlinal in the ridge. This anticlinal, here first exposed, increases toward the south-west.

The McKee Ore-bank is in a ravine through the Ferguson Valley Ore Ridge, 7 miles S. W. from Yeagertown.

At this ravine, the two anticlinals of the ore ridge are separated by a pronounced synclinal flexure. In proceeding S. W. all of these flexures sink very rapidly. The effect of this will be readily understood by a comparison of the McKee and McVeytown Sections. (See Plates.)

The McKee Section shows the fossil Ore-beds, Ore sandstone, &c., lying above water level in the ore ridge synclinal. (See Plate.)

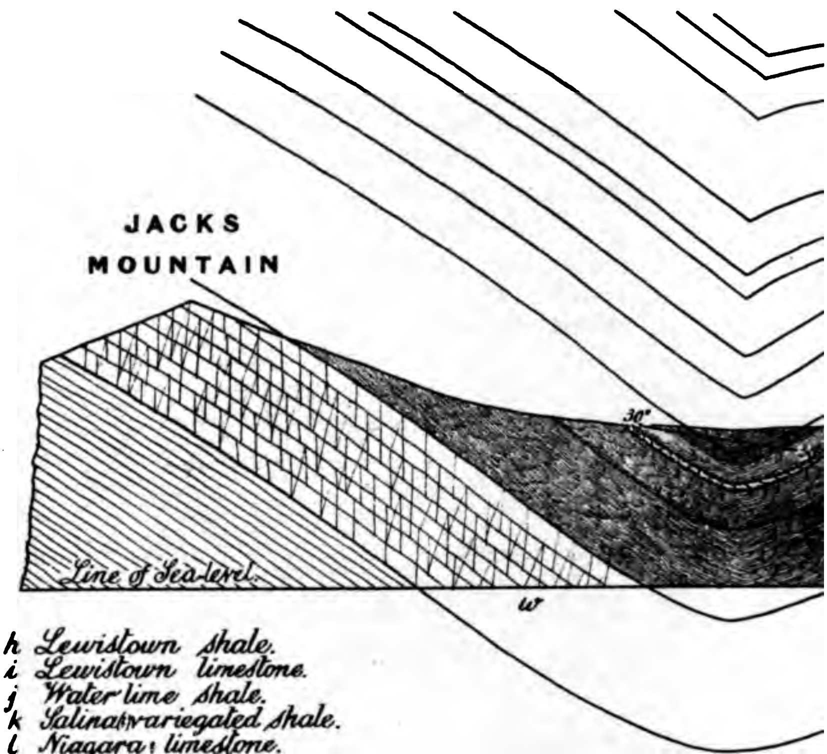
Openings or shaftings have been made on both dips of each anticlinal. They are all on the Sand Vein ore-bed, as no outcrops of the Danville ore-beds, or the Danville ore-beds rock are visible. It is fair, however, to presume that the Danville ore-beds do exist, their presence having been proven at the Graham ore-bank, corresponding with beds in Logan Gap.

The Ore sandstone is from 15 to 20 feet thick and is much broken, except in the ore ridge synclinal, where it is more massive. The broken condition of the Ore sandstone on the south dip of the south anticlinal may cause the ore in the Danville beds to be soft fossil.

The sand rock under the Sand Vein ore-bed, which is opened on the S. dip of the southern anticlinal, is a fragile,

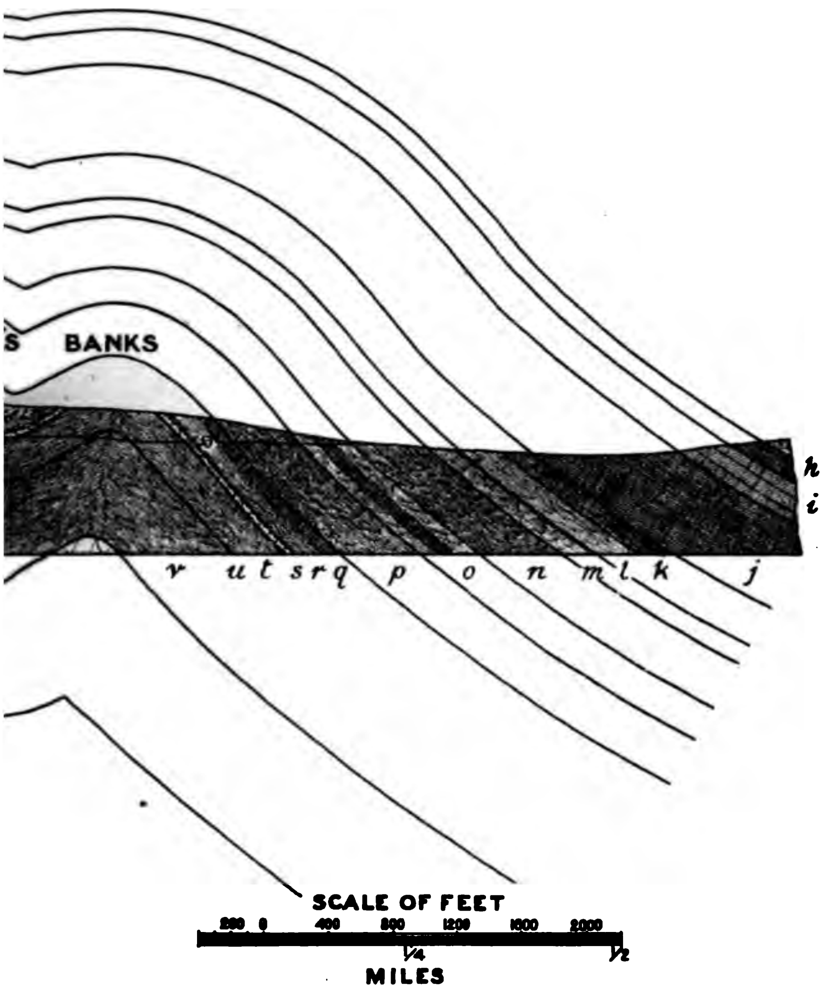
Second Geological Survey of Pennsylvan

M^c Kee section, Const



h Lewistown shale.
i Lewistown limestone.
j Water lime shale.
k Salina variegated shale.
l Niagara limestone.
m Niagara shale.
n Clinton upper red shale.
o Clinton upper lime shale.
p Clinton lower red shale.
q Clinton lower lime shale.
r Clinton upper olive shale.
s Fossil ore beds Ore S.S. &c.
t Clinton middle olive shale.
u Iron Sandstone.
v Clinton lower olive shale.
w Medina white sandstone.

74. Juniata district. J. H. Dewees, Ass't. Geol.
by Chas. A. Ashburner.



coarse-grained, brown rock, containing a considerable quantity of iron. Where opened on the N. dip of this same anticlinal it is hard, with the upper surface very smooth, and above it lie several inches of a mottled purple and white rock. The bed is about 3 feet thick, and is removed in driving the gangways.

The S. dip of the southern anticlinal is 53°. The Sand Vein ore-bed has been opened on this dip. Several hundred yards of gangway were driven on both the east and west sides of the ravine.

The East gangway is now (1874) lying idle, and the roof has fallen in at the mouth of the drift. The west side is being worked "light-handed."

The N. dip of the southern anticlinal is 23°. It is also opened by a gangway, which has been driven about 100 yards. On both dips of this anticlinal the Sand Vein ore-bed is from 12 to 18 inches thick.

The S. dip of the northern anticlinal is 50°. A shaft sunk on the Sand Vein ore-bed proved it a seam of good ore, 8 to 10 inches thick.

The N. dip of this anticlinal is about 45°. A shaft was sunk south of James Shahen's house, and proved the same bed about 12 inches thick.

The S. dip in the mountain terrace is 30°.

Diggings in search of ore have been made in the ravine, in the line of the ridge synclinal, but they are all too low, being under the Ore sandstone and the Danville ore-beds.

Several thousand tons of ore have been shipped from the southern openings, and 200 tons from the north opening.

A specimen of the lower 6 or 8 inches of the Sand Vein ore-bed from the S. dip of the S. anticlinal, yielded:

Iron,	16.000
Sulphur,	.024
Phosphorus,	.230
Insoluble residue,	58.370

"Inferior fossil ore ('Jack'), compact, highly silicious, and of a light brown color." (A. S. McCreath.)

A specimen of the upper 10 or 12 inches of the same bed, yielded upon analysis:

Iron,	36.400
Sulphur,	.017
Phosphorus,	.184
Insoluble residue,	35.200

(A. S. McCreath.)

The proper proportions of the upper and lower benches of the same bed were mixed, and yielded:

Sesquioxide of iron,	42.857
Alumina,	7.816
Oxide of manganese,	.093
Lime,	.448
Magnesia,	.738
Phosphoric acid,	.547
Sulphuric acid,	.122
Water,	5.500
Insoluble residue,	41.500
	99.631

Iron,	30.000
Sulphur,	.048
Phosphorus,	.239

(A. S. McCreath.)

Another analysis of ore, taken from the gangway of the N. dip of the S. anticlinal of McKee ore bank. The ore is a delicate pink fossil, somewhat argillaceons and slaty in structure. Bed 12 to 14 inches thick, the upper 8 or 10 inches being of a much better quality than the lower portion:

Iron,	44.400
Sulphur,	.028
Phosphorus,	.115
Insoluble residue,	28.880

(A. S. McCreath.)

Analysis of fossil ore from the Sand Vein bed on James Shehan's property, from the N. dip of the N. anticlinal. The ore is compact, sandy and of a deep red color. Bed 12 inches thick.

Iron,	34.000
Sulphur,	.018
Phosphorus,	.124
Insoluble residue,	35.480

(A. S. McCreath.)

John Shahen's Ore-bank is in a ravine, a ½ mile W. of the McKee ore-bank. The ridge synclinal has sunk so that the ore-bed may be opened in it, at water level of the ravine.

The N. dip of the S. anticlinal is opened by a slope driven at right angles to the measures through the Upper Clinton fossil ore shales, affording a short breast. The Sand Vein ore-bed is about 16 inches thick. About 75 tons of ore were shipped from this opening. It was made by Robert Crumm in the winter of 1873–4.

The synclinals and anticlinals are the same here as at McKee's ore-bank, and there is every reason to suppose that the ore-bed will prove as thick and of as good quality.

The anticlinals continue to sink westward. They are again cut by a ravine on the property of John Rothrock. Openings have been made on the S. anticlinal, in both the east and the west sides of this ravine.

The N. anticlinal forms a ridge between these openings and Jack's mountain.

McCord and Rothrock Ore-banks are about 8¼ miles S. W. from Yeagertown, in the first ravine west of John Shahen's ore-bank.

The two anticlinals appear, still sinking toward the southwest. The ravine cuts through the S. dip of the N. anticlinal and both dips of the southern anticlinal, but leaves the N. dip of the northern flexure unbroken.

The sinking of the anticlinals toward the west has increased the dip of the measures, excepting the S. dip of the S. anticlinal, which is 37°, being 16° less than at the McKee ore-bank. The N. dip of this anticlinal is 75°. The S. dip of the N. anticlinal is 80°, and the N. dip is from 35° to 40°.

The base of the ridge, containing the two anticlinals, is over 2,000 feet wide. The Lower Clinton shales form the crest of the anticlinals.

The S. dip of the S. anticlinal was opened and worked "fifteen or twenty years ago" by Charles True. Some of the ore was shipped to Hope Furnace, and some sent to Hancock and Foley, Danville. "The ore-bed is 14 inches thick." The Sand-rock contained so much iron as to induce some persons to mix it with the ore; this resulted in the condemnation of the ore as containing too much sand.

Openings have been made on the W. side of the ravine, by John McCord, and ore is now being mined from a N. dip of 80°. In order to gain height of breast, a tunnel about 50 feet long was driven under the Sand Vein ore-bed, in the direction of the rise of the creek. Over 250 yards of gangway have been driven on a 14 inch bed of ore. The gangway is 5 feet high and 4½ feet wide at the base. The railroad gauge is 22 inches, and the cars contain about 1,400 pounds of ore.

The ore is a medium soft fossil, of good quality. Streaks of shale occur in the bed.

The Sand-rock is ferruginous for about 6 inches under the ore-bed, below which it is more argillaceous.

Over the ore bed, along the line of the gangway, is a thin bed of fossiliferous limestone, which changes with the ore in the gangway. Thus, when the ore in the bed is soft, the overlying limestone changes to a thin bed of ore, and when the ore in the lower bed is hard the overlying bed is a fossiliferous limestone.

There is a slip in the ore-bed, within 50 yards of the face of the gangway, causing a break in the overlying rock and shales. After this the ore becomes a hard fossil at the level of the gangway. The gangway was raised, following the soft fossil ore, which rises to the S. W.

The S. dip of the N. anticlinal is opened by means of a tunnel 100 yards in length, driven through the Upper Clinton limestone and the Upper Clinton fossil ore shale. This was done to gain height of breast.

The Sand Vein ore-bed is the one cut. The Danville beds, if they exist at all, are so small that they were not considered of sufficient importance to open. It is probable, however, that if the Danville beds do exist on at this place, they contain soft fossil ore, near their outcrop.

There is a thin bed of sand under the ore-bed, which is sometimes mined with it. The ore is soft and changeable in quality. The dip is very steep, and in some places *reversed.* To the south-west this may change, as the rock is considerably contorted, owing to the rapid sinking of the anticlinal.

The Sand Vein bed has been proven on three different dips to be 14 inches thick. The north dip of the mountain synclinal has not been opened.

The Upper Clinton fossil ore shale is yellow or buff on the high dips. The lower portion of the Clinton limestone is very massive.

Several thousand tons of ore have been shipped from the N. dip of the S. synclinal. A sample specimen of ore from this opening, yielded:

Iron,	42.300
Sulphur,	.010
Phosphorus,	.516
Insoluble residue,	25.930

(A. S. McCreath.)

Analysis of specimen from the S. dip of the N. anticlinal. The ore beds are faulty and poor. Dip in part reversed:

Iron,	27.500
Sulphur,	Trace.
Phosphorus,	.206
Insoluble residue,	43.110

(A. S. McCreath.)

The Ore sandstone is from 20 to 25 feet thick. Under the Sand rock there is a bed from 4 to 6 inches thick of soft, porous, light ore, of superior quality. This ore bed is composed of small fossils. It is found in other places, as at Keever's ore-bank. A sample specimen, analyzed, yielded:

Iron,	59.100
Sulphur,	Trace.
Phosphorus,	.110
Insoluble residue,	7.470

"This ore is exceedingly tough, of a brown color, and an earthy appearance."
(A. S. McCreath.)

The north dip of the south anticlinal is opened on the east side of the ravine, on the property of John Rothrock. It was first opened in 1870, by James Shahen, junior, for Joseph Ruble. The ore-bed is from 14 to 16 inches thick. About 3,000 tons of ore have been shipped from here.

The ore is compact, of a brown color, slaty structure, and contains numerous particles of specular iron.

Analysis of sample specimen.

Iron,	41.700
Sulphur,	.034
Phosphorus,	.212
Insoluble residue,	27.640

(S. A. Ford.)

The S. dip of the N. anticlinal was also opened on the E. side of the ravine, but no ore was shipped therefrom. The size of the ore-bed is not certainly known, the works having fallen in.

John Kinzer Ore-Bank. In a ravine, a ½ mile S. W. of the McCord ore-bank, the Sand Vein ore bed has been opened on the N. dip (65°) of the S. anticlinal, producing soft fossil ore.

A gangway was driven 40 or 50 yards to the E., and ore is being mined at the present time. A small quantity has been hauled to the canal for shipment.

The gangway driven is too small for the future working of the bed. The ore-bed is from 12 to 14 inches thick, and contains a fair quality of soft fossil ore. On the bottom of the bed is a thin seam of gangue or "Jack."

Analysis of a sample specimen yielded:

Iron,	39.800
Sulphur,	.011
Phosphorus,	.231
Insoluble residue,	31.560

"The ore is compact, iron-rust color, with a tendency to break into blocks."
(A. S. McCreath.)

On the S. dip of 35° of the S. anticlinal, between the McCord ore-bank and Kinzer's ore-bank, there are two cross-cuts driven through the Upper Clinton shales to the Sand Vein bed. The ore is a hard fossil. The bed is from 12 to 14 inches thick. Only a small quantity of ore has been mined.

"From one of the cross-cuts the Hope Furnace Company mined ore, which was of a fair quality."

The same bed was opened on the west side of Kinzer's ravine, in 1871, but it is too small and poor for profitable working.

There are no openings on any other of the dips of the two anticlinals, except a shaft east of this ravine, on the N. dip of the N. anticlinal.

The Danville ore-beds have not been opened, though the altered fossil ore scattered on the surface, over the Lower Clinton shales, is evidence of their existence.

The Ore sandstone is from 20 to 22 feet thick. The S. anticlinal is low, and the Ore sandstone forms an arch in the ravine about 75 feet high.

The S. dip of the N. anticlinal is from 80° to 90°, and the N. dip is from 35° to 40°.

Both anticlinals sink rapidly toward the W. In a short distance the Ore sandstone on the southern flexure passes under the Upper Clinton shales.

In a ravine through the N. anticlinal, on the property of Michael Aultz, a gangway has been driven westward for some distance, in the Upper Clinton fossil ore shales. This gangway was abandoned because it did not strike the Sand Vein ore-bed, the opening being too far south.

The depth of natural drainage is very slight, consequently there cannot be a great depth of soft ore.

A considerable amount of breast could be obtained on the N. dip of the mountain synclinal in this same ravine, by driving a cross-cut *from a lower level on the W. side of the ravine* cutting the N. dip of the Sand Vein ore-bed.

From a cross-cut, driven at a higher level through the yellow shales, ore has been obtained. The bed is said to be small. The Danville ore-beds are not proven. Should they prove of sufficient size, there is enough breast on these beds to permit profitabte working.

John Allen Ore-bank. About ¼ of a mile W. from Michael Aultz' house, in a deep ravine.

To reach the N. dip of the mountain synclinal, it is necessary to drive N. under the Ore sandstone, and through the débris of the ravine—an expensive process. A long breast could be obtained from this level, as is the case in all the ravines from Michael Aultz' west to the terminus of the ridge. The Ore sandstone crops out about 40 feet above the ravine, on the S. slope of the ridge.

The dips of the Ore sandstone are high, corresponding to the dips of the anticlinal in Ferguson Valley north of McVeytown Gap. A short distance W. the Ore sandstone disappears beneath the Upper Clinton shales. (See McVeytown Section Plate.)

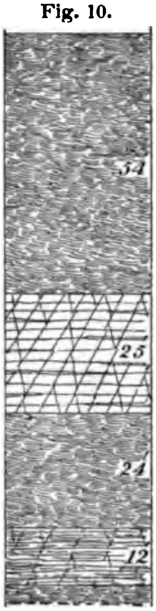
At Peter Rush's house the ore ridge becomes imperceptible, being covered by the Clinton Red shales and the Clinton limestone. The shales pass behind and in front of the house. The measures dip 50° S.

The mountain synclinal continues S. W. from this point, with only the S. dip of the Ore sandstone cropping out on the terrace of Jack's mountain.

Throughout the entire length of the ore ridge, the analyses of the Sand Vein ore-bed, the only one which has been mined, show a large percentage of phosphorus and insoluble residue.

Fig. 10 (see page 78 F.) Section of Clinton rocks.

Fig. 10.



Upper Clinton fossil-ore shale; . . . . 54'

Argillaceous sandstone; 10' } Ore-sandstone. 25
Sandstone . . . . 15' }

Siliceous shale; . . . . 24'

Danville-ore group; . . . . 12'

Lower Clinton shale. The upper 30' contains many thin beds of fossiliferous limestone.
Variegated shale.
Upper Clinton red-shale, (with one fossil ore bed,) 260
Upper Clinton lime-shale; 160

Chapter VII.

Mines in ridges between Ferguson Valley and Lewistown.

Moore Ore-bank. On the S. dip of the Marcellus ore-bed, in the "Squaw Hollow Synclinal," 3 miles N. W. from Lewistown. It was opened by the Logan Iron and Steel Company in 1871 (?), by whom it has since been worked.

The ore is a brown hematite, the carbonate not having been reached at the present depth of the mine (82 feet.)

The following is an analysis of a specimen of this ore:

Iron,	44.700
Sulphur,	.008
Phosphorus,	.165
Insoluble residue,	19.950

"Limonite, compact, with adhering clay. The structure somewhat laminated, part of the ore being beautifully stalactitic." (A. S. McCreath.)

The ore bed has proved very good. It contains from 3 to 6 feet of ore, and at one point is said to be 16 feet thick. At the present end of the East gangway the bed is but 2 feet thick.

The dip at the opening is overturned. The bed starts at the outcrop with a gentle dip S., which gradually increases, becoming perpendicular at 40 feet below the surface. At the bottom of the mine, 82 feet below the surface, the bed stands on an overturned dip of 80° N.

A perpendicular shaft was sunk N. of the outcrop, striking the bed at about 70 feet from the surface. The mine has been worked in two lifts, the upper lift being the first worked out.

Squaw Hollow Synclinal. South dip, 1 mile N. W. from Lewistown. The Marcellus ore-bed has here been opened. It proved to be a bed of workable size, containing a good quality of ore.

Fifty feet below the outcrop of the bed, there was a carbonate ore, imbedded in clay. An analysis of the ore, and also of the surrounding clay is here given.

Carbonate Iron Ore, hard, compact, steel gray in color, and of a conchoidal fracture:

Protoxide of iron,	48.857	Sulphuric acid,	.133
Sesquioxide of iron,	.825	Carbonic acid,	32.650
Bisulphide of iron,	.262	Water,	.368
Alumina,	2.240	Organic matter,	.360
Protoxide of manganese,	1.625	Insoluble residue,	6.410
Lime,	4.536		
Magnesia,	.569		100.149
Phosphoric acid,	1.314		

Iron,	38.700
Sulphur,	.192
Phosphorus,	.574

(A. S. McCreath.)

Analysis of the Clay:

Silica,	76.100
Alumina,	10.040
Protoxide of iron,	3.493
Bisulphide of iron,	.043
Lime,	.683
Magnesia,	1.419
Sulphuric acid,	.151
Alkalies,	2.460
Water,	5.390
Organic matter,	.110
	99.889

(A. S. McCreath.)

Analysis of Limonite, containing cavities filled with ferruginous clay. From near the outcrop of the ore-bed, in the same shaft as above:

Sesquioxide of iron,	62.143
Alumina,	3.795
Oxide of manganese,	.651
Lime,	.722
Magnesia,	.360
Phosphoric acid,	1.362
Sulphuric acid,	.053
Water,	11.390
Insoluble residue,	19.690
	99.166
Iron,	43.500
Sulphur,	.021
Phosphorus,	.595

(A. S. McCreath.)

Analysis of a light brown argillaceous ore from the Corniferous shales, (Schoharie Grit,) in the same synclinal, 1 mile N. W. from Lewistown:

Iron,	25.000
Sulphur,	.257
Phosphorus,	.688
Insoluble residue,	47.230

(A. S. McCreath.)

Minehart Ore-bank. Four miles S. W. from Lewistown, on the S. dip of the main synclinal, S. of "Prospect Rock." (See Lewistown Section plate.)

This ore-bank was opened 15 years ago by John Minehart. It is now owned by the Glamorgan Iron Company. "Several thousand tons of the ore from this bank have been used for making iron."

The Oriskany sandstone lies on a flat dip, is much contorted, and contains bowls or cavities on the upper surface. These bowls are filled with light colored clay derived from the Corniferous shales, and a silicious ore which has been mined and used in small quantities in the furnaces of the Glamorgan Iron Company, at Lewistown.*

The ore-bed is from 6 inches to 3 feet thick. A specimen yielded, upon analysis:

Iron,	26.000
Sulphur,	.046
Phosphorus,	.588
Insoluble residue,	47.232

"Limonite, silicious, with adhering clay; structure, laminated; color, chocolate brown." (S. A. Ford.)

The sandstone under the ore contains various quantities of iron. Some of it is quite rich, but too silicious for use in the furnace.

The same condition of the sandstone exists on the N. dip of the anticlinal opposite the Minehart ore-bank, as has been demonstrated in several shafts sunk. The fact should be noticed, that the above condition of the sandstone differs greatly from that of the N. dip of the same synclinal, where an extensive bed of pure white sand is mined by the Juniata Sand Company.

*For description of Glamorgan Iron Company's Furnaces see p. 142.

Juniata Sand Company's Mine. A. J. Kuhn, Manager. This mine is 4 miles S. W. of Lewistown, on the N. dip of the Oriskany sandstone, in the main synclinal S. of "Prospect Rock." (See Lewistown Section Plate.)

There is a bed of pure white sand from 90 to 100 feet thick. "At one point it is but 40 feet thick, the rest being discolored by oxide of iron and rendered useless for the manufacture of glass."

Gaps in the ridge are of rare occurrence, but where they do occur the sand is discolored by oxide of iron.

A layer of yellow sand 12 to 18 feet thick occupies the top of the formation.

When the mine was first opened, the sand was worked out toward the outcrop of the bed, leaving enough roof to prevent the surface falling in, and to keep water out of the mine. Subsequently the workings were changed to a point 30 feet lower, and the bed opened by means of a tunnel driven north through the Oriskany shales, which dip 46° to the N. W. This tunnel is about 250 feet long

From the tunnel, gangways are driven 400 feet S. W. and 100 feet N. E.

The main gangways are from 15 to 18 feet wide, and 15 feet high, leaving about fifteen feet between them and the old workings. The top is supported by heavy timbers. The gang-way narrows at the top, and, in addition to the heavy cap timbers, it is lagged and packed to prevent the sand from moving.

The roof is very treacherous. It is liable to fall from small pockets on account of the cleavage planes running irregularly.

At McVeytown the necessity for timbering is not so great, because the mode of working is different. The gangway is more arching and not so high. The deposit of sand is also more solid, and less liable to give way than at this mine.

Chambers of various sizes are driven right and left from the main gangways at right angles to it. Pillars of sand rock are left standing between the chambers to support the roof.

The chambers are from 20 to 25 feet long, the length being regulated by the quality of the sand. When the sand contains oxide of iron, even in small quantities, it becomes unfit for use as fine glass sand, and is not mined.

When it becomes necessary it is proposed to drive a tunnel still lower on the slope of the hill, which will cut through the Lewistown lime shales, in addition to the measures cut by the present tunnel. It will be a long time, however, before the great quantity of sand on the present level can be worked out.

The sand-rock requires to be blasted in mining, but in falling it breaks to fine sand, which needs only to be washed to be prepared for market. The mine is supplied with a railroad track and cars for moving the sand to the washing-house.

The following analysis of sand from this mine, shows its general character:

Silica,	98.84
Alumina,	.17
Oxide of iron,	.34
Oxide of manganese,	Traces.
Lime,	'
Magnesia,	"
Loss on ignition,	.23
	99.58

(A. S. McCreath.)

At the washing-house, the sand is thrown into an iron bowl, where it is agitated by arms attached to a revolving horizontal beam. From this bowl it passes into an octagonal screen of wire cloth, 2 feet in diameter. The water, passing through the screen, carries the sand with it into a trough or box a few feet below.

The sand settles to the bottom of the box. The water "*wastes*" over the top of it, and carries away the white clay, which exists in the sand in small quantities. Through this trough or box passes an elevator, made of gum-belting 8 or 10 inches wide, with the boxes or scrapers on the lower side.

This elevator runs on an inclined plane, sloping 18°, at the rate of 9½ feet per minute, and carries the sand high enough to drop it into another trough at the level of the next floor. A small stream of water is passed through the sand in this trough, when it is again elevated by the same process as before, and carried the length of the building to the "drying house." The whole distance from the "tip house" to the "drying house" is about 100 feet.

The elevators are carried over pulleys, and the sand is pushed along on a smooth board surface by the scrapers attached to the lower side of the belting.

The engine used to drive this machinery has a cylinder 9 inches in diameter, with a 22 inch stroke, and a driving wheel 6 feet in diameter, which is run at 15 revolutions per minute.

The drying house is over one hundred feet long, part of it being used for drying, and part for storing sand. The heat for drying is generated by three furnaces, each with a fire surface of 26x36 inches. These three furnaces consume about one ton of bituminous coal per day. The sand is spread upon a floor, under which pass flues connected with the furnaces, and is there thoroughly dried, ready for market.

The top of the drying floor is	3	inches	fire clay.
Under that are laid, ...	3	"	sand.
" " "	6	"	clay.
" " "	1	"	fire-clay.
" " "	10	"	stone, on edge.

This floor becomes heated by the hot air from the furnaces passing under it, and it parts with the heat very gradually, thus making a good drying surface.

About 30 tons of sand per day are prepared for the market. This quantity could readily be increased.

The sand is conveyed to the Granville R. R. Station by means of one of Hodgeson's patent tramways, 1½ miles long.

The following description of the tramway is from a note by E. Gybbon Spillsbury, published in the Engineering and Mining Journal of November 17, 1877:

The mine lies 65 meters above the level of the railroad. The tramway has been constructed across the canal and the

Juniata River, which latter, on the line of the tramway, is a little over 277 meters (850′) wide. This necessitated the erection of a center pier to support the rope on such a span, and owing to the great amount of ice in the winter season, this pier had to be constructed of masonry work to the height of 8.30 meters, (25½′,) surmounted by a trestle, 7.70 meters (23½′) high, making a total height of 16 meters, (49′.) On the whole line there are 53 trestles over which the rope is carried, the general distance between supports being 50 meters, (153′,) the two river spans being 138.50 meters (420′.)

The rope was manufactured by Messrs. Roebling, of Trenton, N. J. It is 18.75 mm. (¾ inch) in diameter, of the best English cast steel. It was made in one length, and weighed a little over 8 tons.

The buckets of which there a hundred, are made of galvanized iron, and carry about 50 kilos (40 ℔s.) of sand. The total weight of a loaded bucket and hanger is 85 kilos (187 ℔s.)

Motive power is supplied by a small 10-horse power engine at the mine, the steam being drawn from the mine boilers. The rope travels at the rate of 3 miles per hour, the capacity at that speed being 60 tons per day. The cost of this tramway, inclusive of stone pier and motive power, has been $5,334 per mile.

Glamorgan Iron Company. This company has two furnaces situated in Lewistown.

No. 1 furnace was built by Etting, Graff & Co., in 1853, and put in blast the autumn of the same year. It occupies the former site of a charcoal furnace, which was built by Duncan & Long about the year 1843.

The present stack is square, and built of stone and brick:

Height of stack, ... 46 feet.
Size at bosh, ... 12 feet.
Number of tuyeres, three.
Upright engine; stroke, ... 5 feet.
Diameter of steam cylinder, 32 inches.
Size of blowing cylinder, 60″x60″.
Two fly wheels, weight, each, ... 7 tons.

Average yield of furnace 100 tons of iron per week.

This furnace has blown regularly, except when stopped for repairs, from the time of building until 1875, since which it has been out of blast.

No. 2 furnace was built during 1871, by the Glamorgan Iron Company. The stack is circular, with stone base and fire-brick stack cased with sheet iron.

Height of stack, ... 56 feet.
Size at bosh, ... 14 "
Number of tuyeres, (4 inch nozzle,) six.

Hot oven contains 56 straight circular pipes, 12 inches in diameter, and 14 feet high, divided through the middle.

Casting house of stone, 40'x60'.
Upright engine stroke, ... 4 feet.
Diameter of steam cylinder, 40".
Blowing cylinder, 84"x48" inches.
2 fly wheels, weight, each, ... 12 tons.
Revolutions per minute, twenty-one.
Steam pressure, ... 80 lbs.
Blast pressure, - . . . . 4 lbs.
Horizontal air receiver, 30'x6'.
Ore used—Fossil ore, ... 2,000 lbs.
Marcellus ore, ... 1,000 lbs.
Cornwall ore, ... 300 lbs.
Fuel—1 ton anthracite, with 1 ton coke.

Average yield of furnace, 150 tons of iron per week.

CHAPTER VIII.

Chestnut Ridge S. W. from Lewistown.

This anticlinal ridge, which is from 100 to 125 feet high, lies between the Lewistown limestone ridges and the Blue Ridge. It commences about 5½ miles S. W. of Lewistown and continues along the north bank of the Juniata river to a point 3 miles E. of McVeytown. West of this, to its termination near McVeytown, it runs along the south side of the river.

The Upper Clinton lime shale and Upper Clinton fossil ore shale rise to view on the crest of the anticlinal at T. Hoffman's house, 5½ miles W. from Lewistown, and a short distance E. from Three Locks.

There are two gaps in this ridge. The most eastern one, through which Stroud's Run passes, is 6 miles W. from Lewistown. At this gap the S. dip of the Ore sandstone is eroded but the N. dip is exposed.

The second gap is nine miles W. from Lewistown and 3 miles E. from McVeytown. Through this gap the Juniata river passes. On the E. side of the gap, the Ore sandstone is exposed on both N. and S. dips. On the west side of the gap the river has cut diagonally across the ridge, eroding the N. dip for a distance of ½ a mile.

The dip of the measures on the crest of the anticlinal is very flat, but toward the base of the ridge it becomes much steeper.

The N. dip at Three Locks is 16°, which continues with little variation to the W. end of the ridge.

The S. dip at the base of the ridge is 25° at Three Locks; 20° and 35° at the Gap 3 miles E. of McVeytown; 12° S. of McVeytown, and continues flat to the end of the ridge, ¾ of a mile further west.

The Upper Clinton fossil ore shale lies upon the flanks of the ridge. Near the outcrop of the Sand Vein ore-bed it is a soft yellow shale, and forms but a thin covering for the ore. Lower upon the ridge the shale is of an olive green color and quite hard.

The Ore sandstone is 15 feet thick and massive throughout the entire length of the ridge.

The Silicious shale lying under the Ore sandstone and above the Danville ore-beds is 22 to 25 feet thick.

The Danville ore-bed group is calcareous and fossiliferous about 9 feet thick, and embraces 2 ore beds. The top portion of the rock, above the upper ore-bed, is 3½ to 4 feet thick, making the total thickness, between the Sand Vein ore-bed and the Upper Danville bed, from 40 to 43 feet.

The Lower Clinton shale arches over the crest of the anticlinal. At no point is the Medina sandstone on this anticlinal exposed.

Between Stroud's Run Gap and the Juniata River Gap, a distance of 3 miles, the Sand Vein ore-bed has been mined at the outcrop. The mining of this ore has been done, in most cases by stripping the outcrop, and at some few points by means of gangways.

"The ore on S. dip was of a superior quality." The bed has not been as extensively worked on the N. as on the S. dip.

The Danville beds have been opened, but no ore mined. "The upper bed is 16 inches thick at Three Locks. Two beds are exposed at the Juniata River Gap, on the N. dip. They are hard fossiliferous limestone containing little iron. These beds are probably valueless throughout the entire length of the ridge except, perhaps, at the outcrop when not too deep under cover.

Wakefield and Cavenaugh Ore-bank is located near Three Locks. This property was purchased and the Sand Vein ore-bed opened by Etting, Graff & Co., in 1853, and mining was continued until 1873. During that time 45,000 tons of ore was mined and the greater part of it used in the Lewistown furnaces.

The Sand Vein bed is 15 inches thick, and contains an excellent quality of ore. At the level of the gangways, 25 to 40 feet below the top of the ridge, the ore bed dips 25°, but below the gangways it again changes to a low dip. This has the effect of carrying the ore-bed nearly parallel with the surface, and as there is but a moderate thickness of shale covering it, the bed continues soft south of the gangways to near the canal.

Seven acres of land yielded all the ore mined on this property. It was principally obtained by "stripping," though a portion was mined by gangways. The ore from the gangways was not as soft as at the outcrop, but was an excellent quality of medium soft ore.

The Danville beds were opened at the canal, but proved worthless. They were also opened at Stroud's Run by means of a shaft, which was abandoned on account of the inferior quality of the ore.

W. of Stroud's Run Gap the north dip of the Sand Vein ore-bed, on the property of S. Oliver, was stripped many years ago by the Hope Furnace Company. The bed is 6 or 7 inches thick and contains good ore. Since that time the bed has been opened at a lower level where it is 12 inches thick, but contains inferior ore mixed with "Jack." About 2,000 tons have been mined and a portion taken to Lewistown.

On property adjoining this on the west the Hope Furnace Company stripped the outcrop of the Sand Vein bed. The bed was 6 to 7 inches thick and the ore of good quality. Subsequent mining at a lower level has proved the bed to be larger but of inferior quality. About 3,000 tons of ore was mined, a portion of which was used at the furnaces in Lewistown.

On the *Couch farm*, ⅝ of a mile W. from Stroud's Run Gap the Sand Vein bed was opened on the S. dip and proved 15 inches thick. The opening was made in 1860 by Etting, Graff & Co., and 11,000 tons of ore mined and taken to the Lewistown furnaces. The outcrop of the ore-bed was stripped through the entire length of the property, about 1 mile.

At a lower level, where the dip is 45° S., a superior quality of hard ore was mined by means of gangways. A considerable quantity of ore still remains in the property.

The property of the *heirs of Casper Dull* joins the Couch farm on the west. Thirty thousand tons of ore have been mined from the Sand Vein bed on this property. Most of it was mined by Etting, Graff & Co., and a portion of it by C. P. Dull. The length of outcrop is about 1½ miles.

Stripping of the outcrop was commenced in 1863, after which gangways were opened. The work of mining continued until 1874.

The ore is of a good quality, the bed 12 to 16 inches thick and dips 25° S. Length of breast varied from 15 to 35 yards, and in a portion of the range reached 100 yards. A large quantity of ore remains in this property.

West of Casper Dull's to the river, the Sand Vein bed does not vary much in thickness and quality. Mining was commenced in 1863 by C. P. Dull, and several thousand tons have been taken from this portion of the ridge.

On the west side of the Juniata River Gap an opening was made in 1868 by C. P. Dull, on the S. dip of the Sand Vein ore-bed. The bed is 10 to 16 inches thick. Dip 35° S. at the base of the ridge. About 1,000 tons of hard ore was mined and sent to Johnstown and Lewistown.

On William Miller's property S. of McVeytown, in 1868, the Sand Vein ore-bed was stripped at the outcrop, where it dips 12° S. The bed is 7 inches thick, and contains ore of a good quality. Only a small amount of ore was mined.

Chapter IX.

The Blue Ridge. North Flank.

The Blue Ridge is an anticlinal ridge, formed by the Medina white sandstone, and extending from a point 4 miles N. of Mifflin to near Newton Hamilton, a distance of twenty-five (25) miles, the Juniata river flowing along its northern base the whole distance.

At its eastern end the Upper Clinton shales arch over the anticlinal. The flexure rises in proceeding S. W, and in 3½ miles, at the point where the Juniata River breaks through the anticlinal, the Medina white sandstone is exposed, forming a complete arch.

West of the Juniata gap the Ore sandstone has been eroded, and only the Lower Clinton shales occur upon the N. flank of the ridge. Where the Juniata River washes against the Medina sandstone, at the east end of the Long Narrows,* these too have been carried off by erosion.

The narrows extend from the Juniata Gap to a point 1½ miles S. of Lewistown. West of the narrows the Ore sandstone occurs in the synclinal between the Blue Ridge and the west end of East Shade mountain.

Bixler's Gap is 1½ miles S. of Lewistown. The N. dip of the Medina sandstone and the Lower Clinton shales has been eroded down to the base of the ridge.

The "Bird Eye" fossil ore has lately been opened in this gap by means of a short gangway. The bed proved "about 7 inches thick," and contained an inferior quality of ore. The measures dip 56° N.

West from Bixler's Gap the Lower and Upper Clinton shales inclusive, remain undisturbed in the synclinal between East Shade mountain and the Blue Ridge.

At *Granville Gap*, 1½ miles W. from Bixler's Gap, the Juniata River encroaches upon the base of the Blue Ridge.

*"The Long Narrows" of the Juniata were so named fifty years ago, when the State Canal was made through the straight narrow synclinal valley, between the two parallel anticlinal uplifts of the Blue Ridge Mountain on the south, and Shade Mountain on the north.

Erosion has carried away the S. dip of the Ore sandstone at the west end of East Shade mountain, but has left the N. dip on the Blue Ridge undisturbed. The dip of the measures is 30° N.

There has been very little prospecting for ore in this part of the range. One mile W. of Granville Gap is an old shaft, which was sunk on the Sand Vein bed, and abandoned. The ore sandstone is 16 feet thick, and dips 30° N.

West of this, to Doughtrough Hollow, the Juniata River washes against the Ore sandstone, which does not form a prominent ridge. There are but few points along this range, as far west as Minehart Gap, where sufficient breast for profitable working of the ore-beds is obtainable.

Minehart Gap is S. of Granville Station (Penn. RR.) and 4 miles from Lewistown. The Ore sandstone at this gap dips 30° N., and is 16 feet thick. The argillaceous sand-rock under the Ore sandstone, and above the Danville ore-beds rock is 28 feet thick. The Danville ore-beds rock above the upper ore-bed is 4 feet thick, making the whole thickness from the top of the Ore sandstone to the Upper Danville ore-bed 50 feet.

On the east side of the gap, near water level, a short drift opened in 1873 (?) exposes the Upper Danville bed, which is 12 inches thick. The bed is very calcareous, and contains but a small percentage of iron. It is probable that a lower bed can be found, such as exists to the west on this range.

The Sand Vein ore-bed has not been opened. "Prospecting has proved it thin, and of poor quality."

Between Minehart Gap and Jenkins Gap are a number of notches in the crest of the Blue Ridge, but no corresponding ravines breaking through the outcrop of the Ore sandstone.

Jenkins Gap is 2 miles S. E. from McVeytown. The measures dip steeply N., and the Ore sandstone and accompanying ore-beds outcrop high up on the terrace of the mountain.

On the property of George Hoffman, a short distance E. from Jenkins Gap, a shaft has been sunk on the Danville ore-beds. A considerable quantity of altered fossil ore was taken from the shaft, which indicates that the ore-bed is of a workable size.

To the S. W. the dip continues steep, and a considerable amount of altered fossil ore is scattered upon the surface of the terrace near the outcrop of the Danville ore beds.

There are a number of ravines cutting through the Ore sandstone and affording sufficient height of breast for profitable mining.

Carlyle Gap is a ½ mile W. of Jenkins Gap, and 1½ S. E. from McVeytown. There are no openings in the neighborhood of this gap.

At *Holt's Gap*, 1 mile W. from Carlyle Gap, and 3 miles from McVeytown, there are no openings or shaftings, but the same indications of ore exist as further east.

A short distance W. from the gap, on property of J. Miller, the Sand Vein bed was opened in 1868, but did not prove of much value, so was abandoned.

On property of Elisha Graham, a short distance W. of J. Miller's, and E. of Shank's Gap, a number of shafts have been sunk on the Danville ore-beds. The Sand Vein bed is not proven.

From a shaft recently sunk to a depth of 10 feet on one of the Danville ore-beds, there has been a quantity of good hematite ore (altered fossil ore) taken out. "The bed is 2 feet thick." The Ore sandstone is massive and 15 feet thick. It passes N. of Graham's stable, on the adjoining property.

On property of Charles Bratton, near Shank's Gap, S. of Manayunk Station (Penn. RR.) the Danville ore-beds have been opened at water level in a ravine. This opening was made many years ago and re-opened lately. About 50 tons of ore have been shipped from it.

"The ore is a hematite (altered fossil ore,) 3 feet thick, interstratified with small seams of clay."

Between Graham's and Shank's Gaps, ore is scattered upon the surface of the terrace at the outcrop.

Near *Galloway's Gap*, 3½ miles S. E. of Newton Hamilton, on property of George Wharton, the Sand Vein bed has been proved "10 inches thick," and contains soft ore. The outcrop of the Danville beds shows upon the surface.

The next exposure of the Fossil Ore-beds is near "Ochre Mill," where the Juniata river has cut into the Lower Clinton shales, and exposes the Ore sandstone and accompanying Fossil ore-beds.

The Sand Vein bed is not plainly exposed. The Ore sandstone dips 56° N., is 15 feet thick, and underlaid by the usual shale. The Danville ore-beds rock is a calcareous fossiliferous rock 4 feet thick. The Upper Danville ore-bed is 14 inches thick, and is a calcareous ferriferous rock, containing but a small amount of iron. Under this are two beds of similar rock, 20 inches thick, divided by a thin bed of shale. These represent the Lower Danville ore-beds. The thickness of shale between the ore-beds is greater than usual.

The Juniata river cuts diagonally into the Lower Clinton shales, exposing about half their thickness. The upper 20 feet contains numerous thin layers of fossiliferous limestone.

At *Bell's Mills* where the Juniata river first breaks through the Ore sandstone, the Sand Vein ore-bed was opened by Oliver Etnier in 1870 (?) and abandoned in 1871.

The ore is a hard fossil, and "contains 22 to 25 per cent. of iron." About 100 tons have been shipped.

The Danville ore-beds are indistinctly exposed at the end of the hill, at a low level. At this level they contain an insufficient quantity of iron to warrant mining, but it is probable they are as thick as near the "Ochre Mill."

"Near Bell's Mill there commences a little ridge, a few hundred yards from the foot of Blue Ridge, which is formed by the Ore sandstone. Traced S. W., it bends in a semi-lunar crest around the termination of Blue Ridge, and bounds Germany Valley on the N. E. Where it curves round into the mouth of Negro Valley at Bell's Furnace, the Fossiliferous Ore has been mined."*

* A. A. Henderson, in Geology of Pennsylvania, 1858, Vol. I, p. 414.

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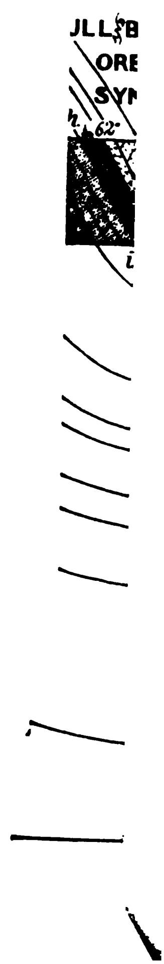


Chapter X.

Mc Veytown to Mt. Union.

Jack's Mountain. South Flank.

*The Mc Veytown Section** shows the relation of the rocks between McVeytown and Jack's Mountain. It includes four synclinal flexures, three of which contain the Oriskany sandstone and the Marcellus ore-bed, on the line of section. The various divisions of the rocks between the Marcellus and Medina are shown, and their thicknesses are given.

McCoy's Ore-bank Synclinal is the most southern one shown on the section. McCoy's Ore-bank and Dull and Bradley's sand-mine are both located in this flexure. Near the sand-mine, the Marcellus ore-bed is from 3 to 5 feet thick.

Ross' Ore-bank Synclinal is the same flexure as the "Squaw Hollow Synclinal" spoken of in connection with the Lewistown Section. (Plate.) Two openings have been made on the Marcellus ore-bed in this synclinal, near the McVeytown Gap. One is ½ a mile N. E. of the Gap, and the other is on the property of General John Ross, on the S. W. side of the Gap. The synclinal continues to the S. W., the dips of the measures flattening.

In the McVeytown Gap, near the Ross ore-bank, is the site of the old Brookline Furnace. This furnace was abandoned years ago on account of the great expense incurred by hauling all the ore used across the mountain from the Kishicoquillas Valley.

Dull and Bradley's Ore-bank Synclinal is the third synclinal flexure N. of McVeytown. It is separated from the Ross Ore-bank Synclinal by a high and wide anticlinal, which, E. of the line of section, forms a prominent ridge of the Lewistown limestone.

In the *fourth synclinal*, the Oriskany sandstone does not appear on the line of section, but is found in it about 1

*See Plate.

mile S. W., where the sinking of the flexure in that direction allows it to maintain its position.

A high and broad anticlinal separates the third and fourth synclinals. This is the same anticlinal which forms the Ferguson Valley ore ridge, N. of the Dunkard Meeting House, at the head of McVeytown Gap. In the middle of the valley, erosion has cut it down, exposing the green shales of the Salina Group.

South-west of the line of section, this anticlinal and the fourth synclinal continue to sink. The Lewistown limestone occurs in the synclinal, and forms the principal farming land. Two miles S. W. of the Dunkard Meeting House, the valley is made very narrow by the Oriskany sandstone forming a ridge in the fourth synclinal. This point is the beginning of a narrow valley, called Kansas Valley, which continues for 3 miles W. to the head of Long Hollow.

The McCoy Ore-bank is in the east side of the gap, N. of McVeytown, on the S. dip of the Marcellus ore-bed in the McCoy's Ore bank Synclinal.

"The bed is 2 feet thick." It is opened near the outcrop and produces a brown hematite ore. The opening has been made quite recently, and no ore has been shipped.

Dull and Bradley's Sand Mine is situated in the gap, N. of McVeytown, on the N. W. dip of the Oriskany Sandstone, in the McCoy Ore-bank Synclinal. Here a pit 80x80 and 30 feet deep has been dug. From it gangways are driven toward the S. W. Chambers are driven N. and S. from the gangways to the extreme edge of the marketable sand.

The mine was opened in 1870, since which time there have been 40,000 tons of sand mined and sent to Pittsburg.

The Oriskany sandstone is about 140 feet thick. The lower portion is yellow, and the upper layers are bluish-grey and yellow. About 100 feet, in the middle of the formation, is an almost pure white sand of an excellent quality for the manufacture of glass.

For an analysis of the sand-rock from this same range, at the Juniata Sand Company's Mines, see p. F. 79.

In the bed, there are some ribs of hard rock, which are generally thrown aside, the power that is now used in crushing being not heavy enough to reduce it. These hard ribs do not run regularly, but are frequently found in lenticular masses through the rock.

The rock is very much broken, and shows cleavage and division planes running in various directions.

The crushing process is very simple, and but little power is required to completely reduce the rock to a very fine sand. Heavy rollers turning in troughs, or on platforms on which the rock is thrown, are used for crushing.

The sand contains very little argillaceous matter, consequently there is but little waste in washing, which is done by means of the water pumped from the mine and screws turning in an inclined trough, which carry the sand to the top of the trough and allow the water to drain off at the lower end.

The Ross Ore-Bank is situated one mile N. of McVeytown, on the S. dip of the Marcellus ore-bed, in the "Squaw Hollow Synclinal," and on the same range, as the Moore Ore-bank, N. W. of Lewistown. (See p. 75.)

This ore-bank was opened in 1868, by General John Ross. The Ross Mining Company was formed in 1870, and they have mined most of the ore sent from here.

From 35,000 to 38,000 tons of ore have been mined and shipped to various points—Harrisburg; Henry Clay Furnace, at Chickies; Eagle Furnace, at Marietta; National Iron Company, at Danville; Duncannon, Newport, and other places. All the openings, except the upper level, are now standing idle.

The gap is deep. The outcrop of the ore-bed in the synclinal in which the Ross ore-bank is situated attains a height of 350 feet on the W. side of the gap.

At a point 75 feet above the creek, a drift was started in the No. VIII shales, N. dip, and driven across the synclinal towards the S. dip, cutting the ore-bed, a brown hematite, 3 to 5 feet thick.

This cross-cut passed through about 28 feet of alternating beds of black limestone, shale, and carbonate ore, each 8 to 12 inches thick.

A specimen of the carbonate ore yielded upon analysis:

Iron,	42.500
Sulphur,	.260
Phosphorus,	.135
Insoluble residue,	3.390

"Carbonate ore, hard and compact; color, bluish black; crust, hematitic; fracture, conchoidal; showing numerous crystals of pyrite."

(A. S. McCreath.)

About 50 feet above the creek, a gangway was driven W. to a point under the opening above described.

"In this gangway, the alternating beds of limestone shale and carbonate ore become more solid, forming a mass from 24 to 28 feet thick. The upper surface of the black ore is very irregular. Above it the grey carbonate exists to where it changes to brown hematite.

"At one point, the gangway was driven through a large mass of this black carbonate ore, formed in the shape of a cone. The base of the cone having been cut away, the weight of the upper part crushed the gangway in, and 1,400 tons of ore were taken away before the gangway could be proceeded with."

A specimen of this ore yielded upon analysis:

Iron,	33.500
Sulphur,	.734
Phosphorus,	.110
Insoluble residue,	18.870

"Carbonate ore, exceedingly hard and compact; surface somewhat hematitic and botryoidal; structure, laminated, and fracture conchoidal; color, various shades of black." (A. S. McCreath.)

About 145 feet above the creek, the bed was again opened by a gangway. "The gangway was driven W. until under the highest part of the hill. Carbonate ore was mined at the level of the gangway, which changed to brown hematite in the breasts." The ore-bed was from 3 to 7 feet thick. The gangway has fallen in.

An opening, on a higher level, about 275 feet above the creek, was made, and a large quantity of ore has been mined from it. The length of breast from the gangway to the outcrop, is from 75 to 100 feet.

The Glamorgan Iron Company subsequently opened the beds at about the same elevation, and are now mining the ore to use in their furnaces at Lewistown.

A specimen of this ore yielded upon analysis:

Iron,	42.500
Sulphur,	.044
Phosphorus,	.078
Insoluble residue,	23.890

"Limonite, compact, argillaceous, and of a light brown color." (A. S. McCreath.)

The above described openings illustrate the changes which the Marcellus ore-bed undergoes at various depths below the outcrop.

It appears that in this bed the change from a carbonate to a limonite ore is regulated by the depth below the outcrop, and by the character of the natural drainage of the bed.

Dull and Bradley's Ore-Bank.—On the S. dip of the Marcellus ore-bed, in the third synclinal N. of McVeytown.

This opening was made by Dull and Bradley, on the property of Robert Clark. It is on high ground, the surface sloping both ways from it, thus affording good "vein-drainage." The ore is hoisted by means of a drum, operated by horse power. Drainage of the mine is secured by means of a tunnel at a lower level.

The bed is 3 to 5 feet thick, and dips 50° S. The ore, mined from a depth of 50 to 75 feet, is a limonite of excellent quality.

Good specimens of this ore yielded upon analysis:

Iron,	51.900
Sulphur,	.033
Phosphorus,	.231
Insoluble residue,	8.970

"Limonite, compact, containing a small admixture of ochreous iron ore; one of the specimens being a section of a geode." (A. S. McCreath.)

Kansas Valley.

From the Head of Ferguson Valley to Long Hollow.

This valley is about 3 miles long and is very narrow, being situated between the Oriskany ridge of the Fourth synclinal of the McVeytown Section and Jack's Mountain.

The ridge S. of the valley is very irregular. The surface of the valley and ridge is strewn with loose rocks, so that little of the land is available for farming purposes. Three miles S. W. of the Dunkard Meeting-House, the Oriskany ridge is broken through by a gap which has cut down into the Water Lime shales.

A bed of ferruginous sand-rock lies mixed with the sand over the Oriskany shales. Many fragments are found strewn upon the surface in the course of the ridge. The deposit is of no value.

West of the Gap the ridge becomes more distinct. The synclinal enlarges, and the Marcellus ore-bed and Black slate are found in it. Before reaching Long Hollow, the flexure rises, and at the end of the valley all the measures above the Water Lime have been swept away by erosion.

North of Kansas Valley the terrace of Jack's Mountain is quite regular. The beds of fossil ore, which crop out on the terrace, can be traced in many places by the Ore sandstone. This is, however, often covered by debris from the mountain.

The outcrop of the Sand Vein bed shows upon the terrace. At James Rhodes' the outcrop is good and gives evidence of a fair condition of the ore-bed.

A deposit of brown hematite may be found upon the Medina sandstone or upon some of the beds of sand-rock which occur in the Lower Clinton Shales.

Where these pockets have been opened, they have been, so far as present observation goes, accompanied by one of the divisions of the Iron Sandstone, carrying with it a white silicious clay on the top of the sandstone and under the ore. This is the case at the old Bell Furnace opening, in West Licking Creek, Negro Valley; and also at Martin's ore-bank, north-west of Orbisonia, in Hill Valley.

A surface specimen of altered fossil ore, from the Lower Clinton shales on the property of James Rhodes, was sent to the laboratory at Harrisburg for analysis. It yielded:

Iron,	46.500
Sulphur,	.028
Phosphorus,	.349
Insoluble residue,	13.830

"Limonite, hard, compact and sandy." (A. McCreath.)

Second Geological Survey of Pennsylvania. 1874. J. H. Dewees, Asst. Geol.

Rhodes' Hemitite ore bank.

DATUM 800 FEET ABOVE TIDE.

Constructed by Chas. A. Ashburner.

This ore, as above stated, is exposed along the terrace, and property holders frequently insist that a large deposit of ore is close at hand. The surface exposures are by no means conclusive proof that such is the case.

Detached beds of "Bog Ore," "from 1 to 3 feet thick," exist in places at the foot of the terrace, near James Rhodes' house, and on the adjoining properties. When analysed it was found to contain:—

Sesquioxide of iron,	29.464
Alumina,	5.639
Oxide of manganese,	14.902
Lime,	.280
Magnesia,	.335
Baryta,	.204
Phosphoric acid,	3.037
Water,	23.270
Insoluble residue,	22.840
Equal to:	
Iron,	20.625
Sulphur,	.034
Phosphorus,	1.326
Manganese,	10.375

"Bog ore, compact, sandy, and of a deep brown color."

(A. S. McCreath.)

South of James Rhodes' house, on the S. dip of the shallow synclinal, an opening has been made on the silicious ore-bed in the Corniferous shales, and on a small bed overlying the Oriskany sandstone. A drift has been driven through the Oriskany sandstone to the ore-bed.

The accompanying section shows the position of the ore-beds, tunnel, &c. The Marcellus ore-bed is not reached by the tunnel. (See plate.)

Analysis of a specimen from the ore-bed (10 to 12 inches thick) overlying the Oriskany sandstone gave:—

Iron,	30.900
Sulphur,	.035
Phosphorus,	.107
Insoluble residue,	44.140

"Hard, compact, arenaceous limonite, deep brown."

(A. S. McCreath.)

Another analysis was made from the silicious ore, 1 to 2 feet thick, in the Corniferous shales. The shales are decomposed, forming a blue gray clay. The ore is a limonite, very silicious, of slaty structure, and somewhat friable:

Iron,	29.500
Sulphur,	.062
Phosphorus,	.039
Insoluble residue,	44.380

(A. S. McCreath.)

Long Hollow.

From Kansas Valley to Mt. Union.

Long Hollow. This name is applied to the narrow valley at the southern base of Jack's mountain, extending from the western terminus of Kansas Valley to the Juniata river at Mt. Union.

Long Hollow has a variety of soils, which have been derived from the formations included between the Lewistown limestone and the Medina white sandstone.

At the N. E. end of Long Hollow the terrace of Jack's mountain is high, and cut by many shallow ravines. The measures dip 47° S. This dip gradually decreases as we proceed S. W., which causes the Ore sandstone to diverge from the mountain, and the terrace to become lower.

From 4 miles N. E. of Mt. Union to the Juniata river, the Lower Clinton shales have been eroded, forming a cove, and leaving the Ore sandstone standing in a monoclinal ridge at the base of the mountain.

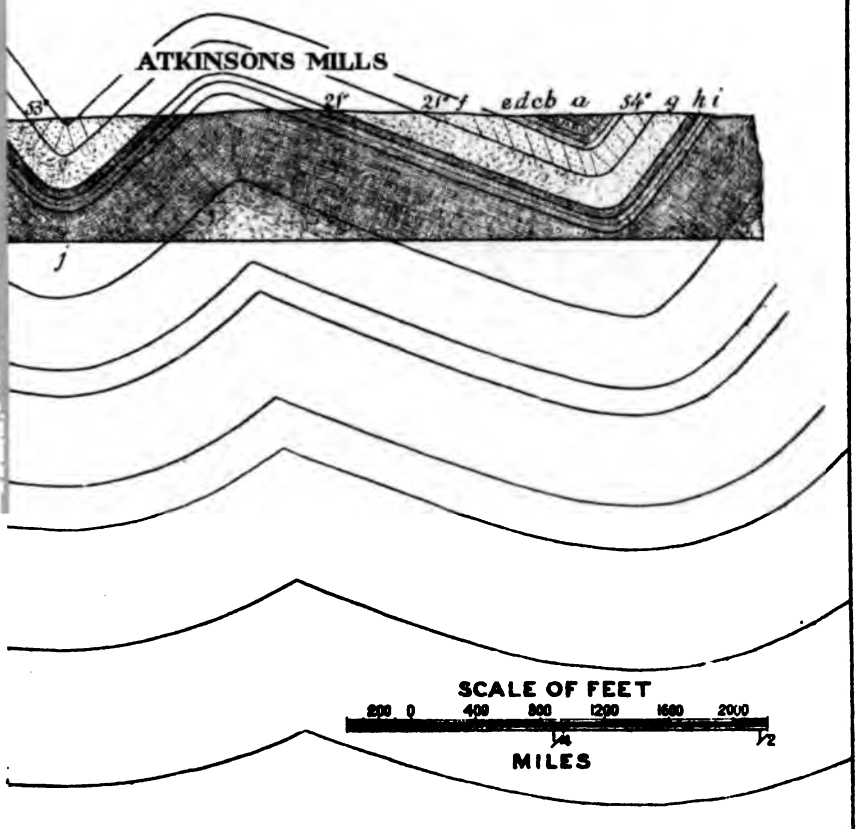
The outcrop of the Sand Vein ore bed, in the terrace of the mountain N. of Long Hollow gives evidence of good ore. At Philip Shade's, 3 miles N. E. of the Juniata river, a shaft has been sunk, and proved the bed to be of good quality, 18 inches thick.

Long Hollow Section (See Plate) extends from Jack's mountain, opposite the head of Long Hollow, to the "Beaver Dam school-house," ¾ of a mile S. E. of Atkinson's Mills.

It embraces the formations from the Marcellus to the Medina, and shows the position of three synclinal and two anticlinal flexures.

The axis of the most *southern synclinal* passes a few hundred feet N. W. of the Beaver Dam school-house. The rocks in this synclinal form the ridge S. of Long Hollow.

district. J. H. Dewees, Asst. Geol.
A. Ashburner.



The Marcellus ore-bed shows a slight outcrop in this synclinal. The thickness of the bed is unknown.

The following table shows the thickness of some of the formations in this section, compared with the same formations in the McVeytown and Lewistown Sections:

	Thickness in Feet.		
	Long Hollow.	McVeytown.	Lewistown.
Oriskany shale, ...	180	160	205
Oriskany sandstone, ...	155	140	120
	335	300	325

At Mt. Union the Oriskany sandstone is 95 feet thick. A decrease of 65 feet in thickness in a distance of 8 miles.

The *middle synclinal* of the section is the same flexure as the Dull and Bradley ore-bank synclinal of the McVeytown section. It passes near the school-house, about a ½ mile N. E. of Atkinson's Mills, on the S. E. side of Long Hollow. The flexure gradually dies away in passing westward.

The Rhodes ore-bank synclinal occupies the ridge near Levi Rhodes', in the E. end of Long Hollow. West of the line of section it dies out.

Matilda Furnace. This furnace is located on the E. side of the Juniata River, opposite Mt. Union. It was built in 1837, by Frederick Cotteral, James Caldwell, and John Fenn. It was six feet wide at the boshes. Power was supplied to a 50-foot overshot wheel by a small mountain stream. After many failures to make a successful run with this power, a small steam engine, of about 12 horse power, was erected to produce the blast, but this also was found to be insufficient. In the year 1851 or 1852, Messrs. Peter and John Haldeman, who then became the owners of the furnace, erected a 35 horse power engine, and used a hot blast. The furnace stood idle from 1853 until 1864, when Messrs. Grube and Pipher, Rober and Garber, of Lancaster county, changed it to an anthracite furnace.

In 1874, B. B. Thomas purchased the property, and owns it at the present time (1875.) The furnace has lately been put in good condition, and is now making iron from a mixture of the fossil ore, mined on the property, and a brown hematite ore, from the Lane ore-bank in Hill Valley.

The Matilda Furnace property contains about 3,000 acres of mountain and terrace land.

Fossil ore mines at Matilda Furnace. The Ore sandstone and accompanying ore-beds dip 25° S.

The ore from the Sand Vein bed has been extensively used at Matilda Furnace ever since its erection. There are over 100 yards of breast on this bed, and it has been opened by several "lifts." In the upper levels, gangways several thousand feet long have been driven.

The lower level contains hard fossil ore. It is opened by a few yards of gangway, above and near high water-mark of the Juniata river. The bed is not so large as on the upper levels, being only 16 inches thick, and subject to rolls, which sometimes reduce the thickness to 8 inches.

A specimen of ore from the Sand Vein bed at this level yielded, upon analysis :

Iron,	40.900
Sulphur,	.014
Phosphorus,	1.018
Carbonate of lime,	18.133
Carbonate of magnesia,	1.408
Insoluble residue,	12.976

"The above ore is hard and compact, of a slaty structure, containing particles of slate and small crystals of calcite, and is of a red color."

(S. A. Ford.)

A second specimen from the same gangway yielded :

Iron,	23.000
Sulphur,	.054
Phosphorus,	.268
Carbonate of lime,	31.272
Carbonate of magnesia,	4.080
Insoluble residue,	25.392

"A fossil ore, very hard and compact, containing particles of slate and large quantities of calcite, of a chocolate color." (S. A. Ford.)

A third specimen of medium hardness, was taken from the breast above the gangway, of the third level of the bed.

The bed is 22 inches thick in this level. This specimen, analyzed by S. A. Ford, yielded:

Iron,	50.000
Sulphur,	.024
Phosphorus,	.006
Insoluble residue,	14.784

"Fossil ore, compact, slaty gangue, with a tendency to break in blocks, of a brownish red color." (S. A. Ford.)

The outcrop of the bed is a soft fossil ore, rich in iron.

"The price paid at this time (1875) for mining hard fossil ore from the Sand Vein bed, is $1.70 per ton delivered in the mine wagons and put to the mouth of the drift," after which it is hauled by rail to the top of the furnace.

Analysis of the Lower Danville ore-beds shows:

Carbonate of lime,	54.792
Carbonate of magnesia,	1.428
Iron,	13.100
Sulphur,	.018
Phosphorus,	.252
Insoluble residue,	15.992

(S. A. Ford.)

The "Bird Eye" fossil ore-bed has not been opened in Jack's Mountain. This bed, which in Shade Mountain lies from 150 to 200 feet above the Medina Sandstone, contains such a good quality of ore wherever it has been mined that it is an inducement to prospect for it in other localities.

The Upper Clinton fossil ore shales at Matilda Furnace are buff at the surface, in the upper level they change to an olive green, and in the gangways of the lower levels, directly overlying the hard fossil ore, they become a tough blue-gray calcareous shale.

The Upper Clinton limestone is of considerable thickness, and much more massive than at Logan Gap.

A bed of fossiliferous limestone a few inches thick, in the lower part of the Clinton red shale, is exposed in the public road S. E. of Matilda Furnace.

The above analysis of ore of the Sand Vein bed, shows a much smaller proportion of insoluble residue than is shown in the analysis of the Ferguson Valley ore ridge.

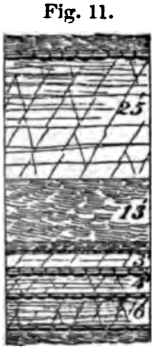
There are several beds of fossiliferous limestone over the Sand Vein ore-bed, within the space of the gangway, which renders the driving of it quite difficult. These beds vary from 2 to 6 inches in thickness. They occur in the gangways along the line of the Ferguson Valley ore ridge, and in other places where the ore-bed is a hard fossil. The ore-bed may be rich in iron where these beds are pure fossiliferous limestone, containing no iron whatever.

The Danville ore-beds show a soft fossil at the outcrop N. E. from here, where the dips increase, and they enter the terrace of Jack's Mountain. They have nowhere in this locality been worked, the large quantity of ore which the Sand Vein bed has always produced, making it unnecessary to prospect in other beds for ore to supply the Matilda Furnace.

The Danville ore-beds, three in number, are a hard ferruginous limestone at the outcrop. The upper bed is from 18 to 24 inches thick, and the other two are each from 10 to 12 inches thick. The rock containing these beds is about 15 feet thick, the upper two beds being about 6 feet apart.

Fig. 11. (see page 100 F.) Section at Matilda Furnace.

Fig. 11.



Fossil-ore shale, olive-green under crop.
Sand-vein ore bed, soft fossil at outcrop.

Ore-sandstone and sand rock.

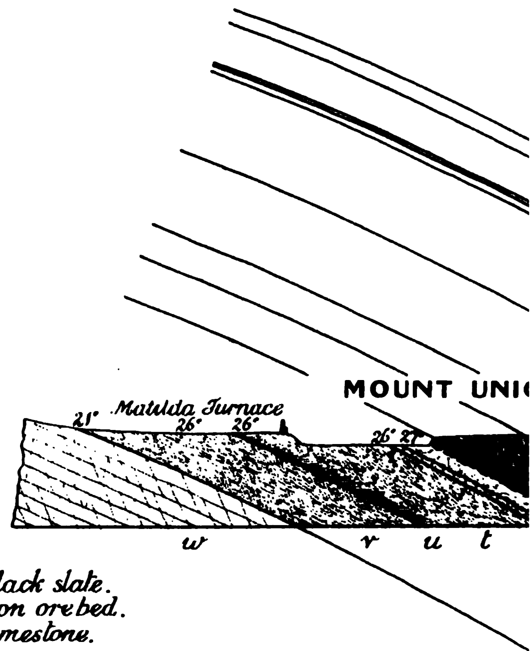
Siliceous shale; . . . . 13′

Argillaceous shale; . . . . 2′
Fossil-ore bed; . . . . 3″ to 4″
Calcareous fossiliferous rock; . . . . . . 3′
Upper Danville bed; ferr. foss. limestone; . . . . 18″
Calc. fossil. rock; . . . . 4′
Danville ore-bed; . . . . 10″
Calc. fossil. rock; . . . . 5′
Lower Danville ore bed; . . . . 8″ to 10″
(Calcareous fossiliferous rock through Lower Danville ore bed: Danville ore beds.)
Argillaceous shale.

Second Geological Survey of Pennsylvani

Mount Union section. Calcul

JACKS
MOUNTAIN
NARROWS



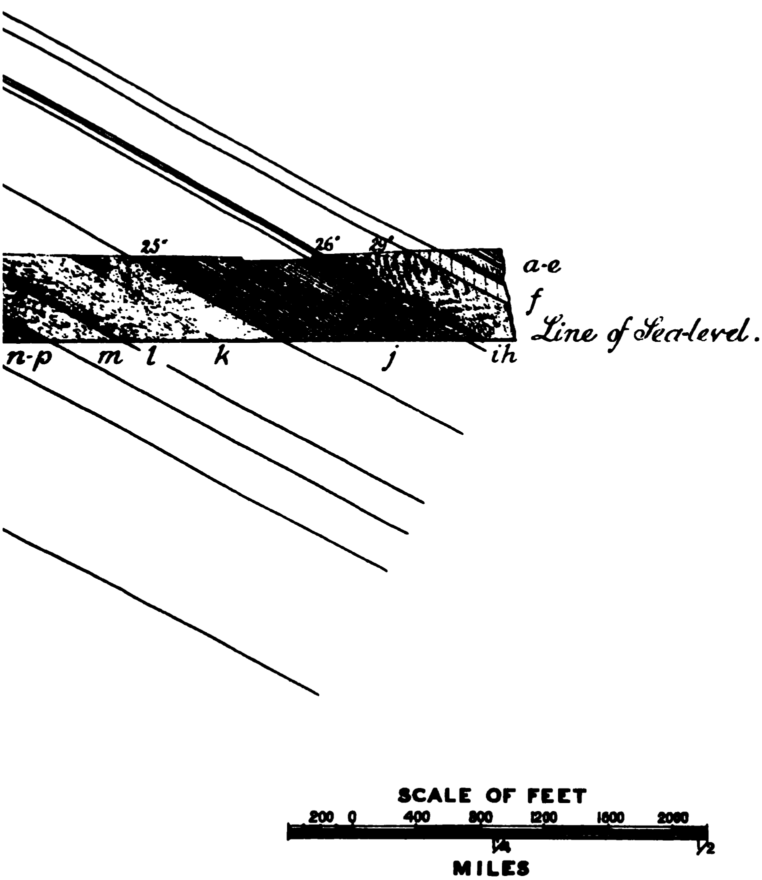
feet.

ae { Marcellus black slate.
Marcellus iron ore bed.
Corniferous limestone.
Schoharie.
Cauda galli. }

95 f Oriskany sandstone.
282 g Oriskany shale.
18 h Lewistown shale.
35 i Lewistown limestone.
544 j Water-lime shale.
473 k Salina variegated marls.
3 l Niagara limestone.
232 m Niagara shale.
285 n-p Clinton (-red) shale.
144 { q Clinton lower lime shale.
r Clinton upper olive shale. }
42 s Fossil ore beds Ore S.S. &c.
359 t Clinton middle olive shale.
2 u Iron Sandstone.
307 v Clinton lower olive shale.
w Medina white sandstone.

'74. Juniata district. J. H. Dewees, Asst. Geol.

nd drawn by Chas. A. Ashburner.



CHAPTER XI.

Mt. Union Section, (Plate.)

The theoretical northwest-southeast straight line of this section crosses the Juniata river twice, owing to a bend in the river; first, at the county bridge above Mt. Union; and again, at a point about 500 yards above the Pennsylvania Railway bridge.

The section shows the position and thicknesses of the formations from the Marcellus down to the Medina.

The dip is constantly S. E., varying in strength from 26° to 31°.

The geographical northeast-southwest distance between the Logan and the Mt. Union sections is 26 miles.

Comparative Table of the Logan and Mt. Union Sections.

FORMATIONS.	THICKNESS IN FEET.		Difference.
	Logan.	Mt. Union.	
Oriskany Sandstone,	110	95	— 15
Oriskany Shale,	205	282	+ 77
Lewistown Lime Shale,	140	18	—122
Lewistown Limestone,	185	35	—150
Water Lime,	470	544	+ 74
Salina Shales,	350	473	+123
Niagara Limestone,	4	3	— 1
Niagara Shales,	70	232	+162
Clinton Variegated Upper Shales, / Variegated Gray Shales, / Clinton Red Shales,	1018	285	—733
Upper Clinton Fossil ore Shale,	251	141	—110
Ore Sandstone and Ore-beds,	38	42	+ 4
Middle Olive Shale,	178	359	+181
Block Ore, (Iron Sandstone,)	7	2	— 5
Lower Clinton Shales,	571	307	—264
Totals,	3597	2818	—779

Vertical Section of the Formations from the Hamilton to the Medina, along the Juniata River at Mt. Union, Mifflin county, Pa.

No. of Speci-mens.	*Marcellus Black Slate.*	Thick-ness.		Total.	Thick-ness of Group
79	Slate, Black, ...	30.	to	30.	
—	———,(?) not exposed, ...	72.5	to	102.5	
	Oriskany Sandstone.				
790	Sandstone, yellow, coarse, argillaceous, the upper portion being hard, massive, and arenaceous, while the lower strata are softer and very calcareous. (This rock is harder here than elsewhere), ...	95.	to	197.5	95
	Oriskany Shale.				
787	Sandstone, yellow and dark ash-colored, calcareous, passing into a purple, pink, and yellow sandshale, the latter color predominating, . . .	282.	to	479.5	282
	Lewistown Shale.				
786 785	Lime shale, friable, sandy, argillaceous, ...	18(?)	to	497.5	18
	Lewistown Limestone.				
783 782 781 780	Limestone, hard, dark gray, massive cryptocrystoline. (This bed is quarried by the Matilda Furnace Company, and used as a flux), . . .	35(?)	to	532.5	35
	Water Lime Shale.				
779	Limestone, dark gray, in thin layers, from one to two inches thick, . . .	30.	to	562.5	
778 777 776	Limestone, dark gray, massive, alternating with a yellow cellular limestone, ...	68.8	to	631.3	
—	Lime shale, dove-colored, hard, . . .	9.6	to	640.9	
—	Lime shales, friable, argillaceous, and sandy, ...	20.8	to	661.7	
775	Lime shale, massive, argillaceous, . .	5.6	to	667.3	
774 773	Lime shale, friable, argillaceous, . .	49.9	to	717.2	
772 771 770 769	Limestone and lime shale, alternating, dove-colored, argillaceous, ...	78.5	to	795.7	
768 to 763	Limestone, friable, argillaceous, sandy, and lime shale, ...	109.	to	904.7	
—	———, not exposed, ...	88.4	to	993.1	

762 to 759	Limestone, dove-colored, argillaceous, containing calcite, ...	23.5	to	1016.6	
758 757 756	Limestone, dove-colored, alternating with cellular limestone and lime shales, ...	27.1	to	1043.7	
755 754	Limestone, dark gray, massive, alternating with a blue shaly limestone,	15.	to	1058.7	
753 752	Limestone, dull dark gray, containing calcite, alternating with a dove-colored argillaceous lime shale, . .	18.1	to	1076.8	544.3
	Salina (?) Variegated Shale.				
751					
750	Lime shale, thin, flaky, ...	19.8	to	1096.6	
749 to 745	Limestone, dark gray, massive, argillaceous, containing calcite, ...	25.4	to	1122.0	
744	Limestone, blue gray, hard, sandy, alternating with a sandy lime shale,	37.1	to	1159.1	
743 to 740	Lime shales and sand shales, yellow and gray, containing veins of calcite,	90.7	to	1249.8	
739 to 736	Limestone, bluish gray, massive, argillaceous, containing lime shales and veins of calcite, ...	40.4	to	1290.2	
736 to 732	Lime shales and sand shales, containing seams of sandstone, ...	33.1	to	1323.3	
732 to 728	Lime shales, variegated purple and green, containing occasional veins of calcite, ...	33.1	to	1356.4	
727 to 724	Sand shales, gray and green, alternating, calcareous, ...	203.4	to	1559.8	483
	Niagara (?) Limestone.				
719	Limestone, blue, hard, massive, . . .	3.	to	1652.8	3
	Niagara Shale.				
718 to 715	Shales, variegated red, green, and bluish gray, with occasional seams of limestone, ...	53.6	to	1616.4	
714 to 708	Shales, blue and green, variegated, underlying a gray laminated lime shale, ...	55.	to	1671.4	
—	Shales, yellow and red, ...	123.5	to	1794.9	232
	Clinton Red Shale.				
707	Shale, red, ...	28.5	to	2079.9	285
	Clinton Lower Lime Shale and Clinton Upper Olive Shale.				
—	Limestone, dark blue, in thin seams, alternating with dove-colored sand shales, ...	100.5	to	2180.4	
703 to 699	Limestone, alternating blue and gray, with several seams of dove-colored argillaceous lime shale, ...	23.	to	2203.4	
692	Shales, dark olive, ...	14.	to	2217.4	

603	Shale, blue, calcareous, ...	1.	to	2218.4	
602	Shales, dark olive, greasy to the touch,	3.	to	2221.4	141.5
	Fossil Ore-Beds, Ore Sandstone, &c.				
600 to 597	Fossil Iron Ore, ...	1.3	to	2222.7	
601	Sandstone, shaly, ferruginous, "Jack" at center of vein, ...	.1	to	2222.8	
604 to 609	Sandstone, gray, very hard, ferruginous, ...	40.	to	2262.8	
614 615 616 620	Iron Ore, hard fossil, ...	1.7	to	2263.5	42.1
	Clinton Middle Olive Shale.				
	Sandstone, dark, alternating with red and green shales, ...	30.4	to	2294.9	
610	Limestone, fossiliferous, sandy, in layers from two to six inches thick, alternating with red and green shales, ...	2.	to	2296.9	
611 612	Sand shales, variegated yellow and green, containing thin seams of fossiliferous limestone, ...	56.3	to	2353.2	
619 621	Sandstone, very hard, gray, flaggy, .	.5	to	2353.7	
622	Shale, purple, hard, flaggy, ...	19.5	to	2373.2	
623	Limestone, fossiliferous, alternating with seams of gray shale and sandstone, ...	39.	to	2412.2	
624 to 628	Shales, dark olive, alternating with a green flaggy sandstone and gray sand shale, ...	107.9	to	2520.1	
629 630	Sand shale, bluish gray, with occasional seams of sandstone, ...	27.3	to	2547.4	
631 632 633	Shales, purple and gray, with occasional seams of sandstone, ...	76.8	to	2624.2	359.7
	Iron Sandstone.				
	Sandstone, gray, ferruginous, ...	2.	to	2626.2	2
	Clinton Lower Olive Shale.				
635	Shales, dark green, alternating with specimens (631,) (632,) and (633,). .	46.6	to	2672.8	
638 639	Shales, variegated, with occasional seams of sandstone, ...	59.5	to	2732.3	
640	Sand shales, light gray, ferruginous, .	12.5	to	2744.8	
641	Sand shales, yellow, gray, and green, .	61.	to	2805.8	
643	Shale, purple, containing occasional seams of sandstone, ...	16.5	to	2822.3	
—	Shales, not exposed, ...	111.5	to	2933.8	307.6
644 to 654	Sandstone, greenish gray, hard, massive, covered with ferruginous specks and stained with ferrous oxide, . . .				

FOOT NOTE.—(79,) Survey Stations—1654+325 to 1654+265 (?). (——,) 1654+265 to 1654+120. (790,) 1654+120 to 1653+125. (787,) 1653+125 to 1650

+160 (?). (786,785,) 1650+160(?) to 1649+228. (783,782,781,780,) 1649+228 to 1645+230.

Foot Note.—(779,) Survey Stations, 1645+230 to 1645. (778, 777, 776,) 1645 to 1644+30. (—,) 1644+30 to 1644. (—,) 1644 to 1643+88. (775,) 1643+88 to 1643+71. (774, 773,) 1643+71 to 1642+375. (772, 771, 770, 769,) 1642+75 to 1642+218. (768—763,) 1642+218 to 1642. (—,) 1642 to 1641+50. (762—759,) 1641+50 to 1641. (758, 757, 756,) 1641 to 1640+183. (755, 754,) 1640+183 to 1640 +98. (753, 752,) 1640+98 to 1640+56.

Foot Note.—(751, 750,) Survey Stations, 1640+56 to 1640+10. (749—745,) 1640+10 to 1639+230. (744,) 1639+230 to 1639+151. (743—740,) 1639+151 to 1638+248. (739—736,) 1638+248 to 1638+154. (736—732, (?)) 1638+154 to 1638 +77. (732—728,) 1638+77 to 1638. (727—724,) 1638 to 1636+103. (719,) Sta., 1636+103. (718—715,) 1636+103 to 1636.

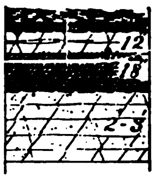
Foot Note.—(714 to 708,) Survey Stations, 1636 to 1635+142. (—,) 1635+142 to 1634+100. (707,) 1634+100 to 1630+335. (—,) 1630+335 to 1630. (703—699,) 1630 to 1631. (602,) 1567±. (603,) 1567±. (602,) 1567±(600—597), 1567 ±. (601.) ——.

Foot Note.—(604 to 609,) Survey Stations, 1569 to 1569+31. (614, 615, 616, 620,) 1569+31. (——,) 1569+31 to 1569+100. (610,) 1569+100 to 1569+109. (611, 612,) 1569+109 to 1570. (621, 622,) 1570 to 1570+50. (623,) 1570+50 to 1570+150. (624—628,) 1570+150 to 1573+227. (629, 630,) 1573+227 to 1574. (631, 632, 633,) 1574 to 1574+256.

Foot Note.—(—,) Survey Stations, 1574+256 to 1574+262. (635,) 1574+262 to 1575+80. (638, 639,) 1575+80 to 1575+285. (640,) 1575+285 to 1576. (641,) 1576 to 118. (643,) 118 to 117+386. (—,) 117+386 to 117+48. (644—654.) 117 +48 to ——.

Fig. 12. *(see page 133 F.)* *Section at Mine No. 2, or Rockhill Gap, Orbisonia.*

Fig. 12.

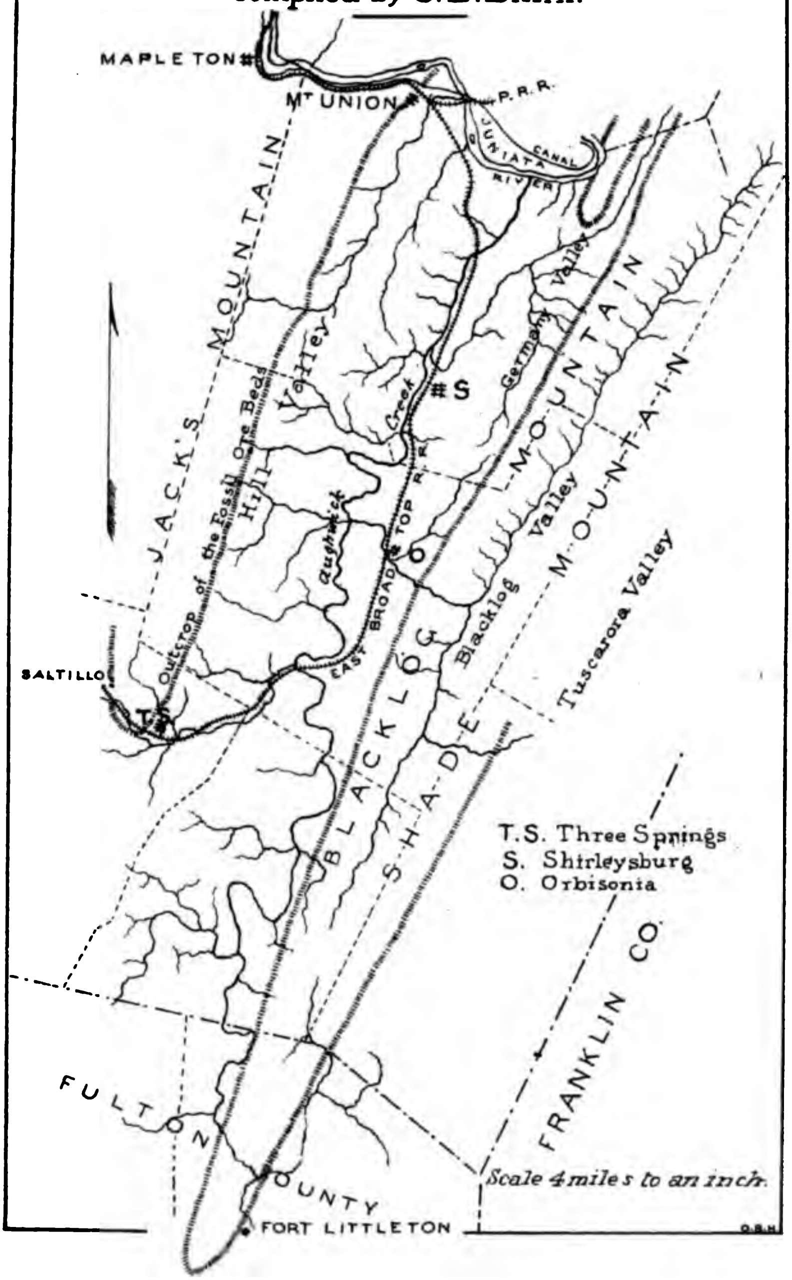


Fossil ore shale, light colored.
Hard fossil ore; 8" to 10"; (thick, s. side gap.) . . . 10"
Friable ferrug. sandstone; . . . . 12"
Sand-vein ore bed; . . . . 18"

Sand rock; . . . . 2' to 3'

MAP OF THE OUTCROPS OF THE FOSSIL IRON ORE BEDS IN HUNTINGDON AND FULTON COUNTIES

compiled by C. E. Billin.



Chapter XII.

Mount Union to Three Springs.
Along the Foot of Jack's Mountain.
In Huntingdon County.

Fossil ore ranges. South-west from Mt. Union the Ore sandstone forms a low monoclinal ridge, which continues through Hill Valley 5 miles S. W. to the "Factory." In this distance it is cut by eight ravines, some of them very close together, which are good points for opening the ore.

Behind this ridge the Lower Clinton shales have been eroded, leaving a cove, which decreases toward the S. W., and finally "heads up" N. of the Factory.

At the Factory the Ore sandstone passes into the terrace of the mountain. The terrace is low and broken by frequent ravines, which form good points for opening the ore-beds. At some points erosion has cut the terrace so low that but little breasting remains above water level.

About 6½ miles S. W. from Mt. Union the mountain is broken at a point called Singer's Gap. Through this Sinking Run passes and enters the Juniata River a short distance below Mt. Union.

Hill Valley, opposite and on both sides of the gap, is covered with dóbris, making the soil unfit for agricultural purposes.

At Mt. Union the measures dip 25° S. E. In going S. W. this dip first increases, being 50° to 55° S. E. at the Factory, and it then decreases to 35° or 40° S. E. at Three Springs.

On the S. W. side of Jack's Narrows, near Mt. Union, a bog material is found scattered in small quantities among the loose rocks. It contains iron and pieces of Medina sandstone cemented together. It is of no economic value. A specimen forwarded to Mr. McCreath for analysis yielded :

Iron,	33.300
Sulphur,	.126
Phosphorus,	.238
Insoluble residue,	43.752

"Limonite 'Bog,' very hard, cellular, containing masses of quartz, somewhat iridescent, and of a dark brown color."

(A. S. McCreath.)

At Mt. Union the Sand Vein ore-bed has been shafted upon on the property of Mr. John Dougherty. "It is 18 inches thick, and contains medium soft ore of good quality."

The Danville ore-beds have been proven by Mr. Dougherty. They are about the same size as on the east side of the river at Matilda Furnace, but the ore is much richer.

The Sand Vein beds afford but short breasts along the S. flank of the ridge to the Factory.

A short distance S. W. from Mt. Union a large amount of shafting has been done in the Lower Clinton shales, near the Ore sandstone, in search of the Danville ore-beds.

Most of this work is away from the range of the ore-beds. A tunnel driven through the Ore sandstone, near the top of the ridge, was not carried far enough to cut the beds.

S. W. of Mt. Union the Danville ore-beds have not been proven.

From Mt. Union S. W. to the Factory, there is a range of high hills, formed by the Upper Clinton shales in the center of Hill Valley. This ridge is cut by frequent ravines, making the intervening hills mound shaped.

The cultivated land in Hill Valley extends from the Ore sandstone in the terrace of the mountain to the Water-lime shales in Chestnut Ridge. S. W. of the Factory, Chestnut Ridge is lower, and is generally cultivated. Where the terrace of the mountain is low, the farms extend back to the Lower Clinton shales.

The considerable amount of altered fossil ore occurring on the surface of the mountain terrace throughout the whole distance from Mt. Union S. W. is a guarantee of their existence.

At many points between the Factory and Three Springs, where the ore-beds are not exposed by ravines, short tunnels, affording sufficient breast for profitable working, could be used to reach them.

The *Martin Ore-bank*, on the terrace of Jack's mountain, 5 miles N. W. from Orbisonia, and S. W. of the "Logan Farm," is on iron ore of the Lower Clinton shales. The dip is 47° S. W.

"A shaft was sunk on a deposit of brown hematite ore, from 2 to 3 feet thick accompanying and lying between beds of block ore rock."

A bed of silicious rock, several feet in thickness, overlies the ore-bed. This rock lies in thin layers, between which are thin sheets of white silicious clay, containing numerous imprints of crinoid stems. The bottom rock is not exposed, the gangway having fallen in.

A sample of the ore from this bank, yielded, upon analysis:

Iron,	34.800
Sulphur,	Trace.
Phosphorus,	.726
Manganese,	3.696
Insoluble residue,	25.010

(A. S. McCreath.)

"Some of this ore was hauled to Matilda Furnace."

The *Whitzell Ore opening* is in Hill Valley, on the property of Philip Whitzell, 5 miles N. of Orbisonia, and N. of the "Logan Farm Ore-bank." At the outcrop of one of the Fossil ore-beds (Sand Vein?) a shaft has been sunk producing altered fossil ore.

An analysis of this ore yielded:

Iron,	37.900
Sulphur,	.010
Phosphorus,	.386
Manganese,	.915
Insoluble residue,	31.300

"Limonite, exceedingly silicious, laminated." (A. S. McCreath.)

On the property of Thomas Orbison, 3½ miles N. E. of Three Springs, the Sand Vein bed has been proven by a shaft upon the outcrop "to be 14 inches thick."

"At Three Springs the bed is a hard fossiliferous limestone, on N. W. dip, 20 inches thick."*

*Ashburner.

South of the East Broad Top Railroad prospecting for the bed has been done with not very encouraging results. "It proved 14 inches thick. The dip of the ore measures is about 40° S. E., strike about 65° N. E.*

Between Three Springs and Saltillo the anticlinal of the the Medina sandstone sinks S. W. under the Lower Clinton shales.

* Ashburner.

CHAPTER XIII.

Chestnut Ridge Southwest from Mt. Union.

S. W. from Mt. Union this is a prominent ridge, formed by the S. E. dip of the Oriskany sandstone, and the underlying Lewistown limestone. It continues for seven miles, with a very regular and even crest, except where Youngwoman's creek passes through it.

Seven miles from Mt. Union, and about 5 miles N. of Orbisonia, there is a gap in the ridge where the Oriskany sandstone dips 26° S. E., and is cut down to the level of the creek. The sandstone is from 125 to 140 feet thick. It is very fragile, and consists of alternating layers of various colors, resembling in appearance the Variegated Upper Clinton shales.

The Oriskany shales are unusually thin, being but 15 or 20 feet thick.

The Lewistown lime shales and the Lewistown limestone are exposed in the gap.

Lane Ore-Bank. This is on the N. E. side of the gap, on the property of James R. Lane. It was opened in the year 1871 or 1872 by James R. Lane, after which time the property was leased by the proprietors of the Matilda Furnace.

The ore is being mined and hauled in wagons a distance of 8 miles to Matilda Furnace, where it is mixed with ore from the Sand Vein bed, mined at that place.

It is a brown hematite ore, varying in thickness from 6 to 12 feet, and occurs in the Oriskany sandstone 15 to 20 feet above its base.

There are thin beds of white and yellow clay, very plastic and smooth, running through the ore-bed. These clay beds *average from 2 to 4* inches in thickness, and run generally with the dip of the measures. Some of the ore occurs as shells containing clay.

The process of mining this ore is as follows: A gangway is driven, taking out the full thickness of the bed, the top being secured with heavy timbers. Chambers are worked from the upper side, and pillars of ore are allowed to stand as a support to the top wall. Above the ore-bed, *as well as below*, there is a shell of hard, tough, silicious ore, which, by careful mining, can generally be kept in place. It does, however, sometimes fall in small quantities during the operation of mining.

Some fine sandy ore, which is mixed with this ore, is screened out in the process of washing. The washing is done by horse power.

The washer is a cylinder 10 feet long, 6 feet in diameter at one end, and 4 feet at the other. Inside the cylinder are taps to throw and agitate the ore, which is fed into the large end of the cylinder and discharged at the small end. A large quantity of ore can be passed through a washer of this kind by an increase of power.

A specimen of this ore yielded, upon analysis :

Iron,	47.500
Sulphur,	Trace.
Phosphorus,	.402
Insoluble residue,	17.260

"Limonite, sandy, with a large admixture of ochreous earth."

(A. S. MCreath.)

It will be seen from the analysis that this ore contains a much smaller quantity of silicious matter than would be expected in an ore formed within the body of a sandstone bed. It is also richer in iron than the average of brown hematite ores.

On the property of David Douglass, on the S.W. side of the gap, ore of the same character has been opened. The deposit does not run as regular as on the N. E. side. Gangways following the deposit have been driven in various directions. At this time (1874) mining has been suspended.

A specimen of this ore yielded, upon analysis :

Iron,	47.300
Sulphur,	Trace.
Phosphorus,	.491
Insoluble residue,	17.900

(A. S. McCreath.)

Where the rocks are much contorted the ore is more silicious.

For a short distance S. W. of the gap the ore continues, as is evident from the outcrop. The Oriskany sandstone, throughout the entire length of the ridge to Three Springs, continues to contain a large quantity of ferruginous matter in its mass. In many places ferruginous sandstone is strewn over the ground in large quantities. It, however, contains too little iron for furnace use.

The ridge is much broken by ravines, and in some places, is very low. The sandstone forms a very rough crest, and frequently occurs as large and prominent castles or "pulpit rocks" on the top of the ridge.

The Corniferous shale over the Oriskany sandstone is from 75 to 80 feet thick. Considerable ore belonging to these shales is scattered over the surface, at no point, however, appearing of good enough quality, or in sufficient quantity, to warrant the opening of the bed.

The Marcellus ore-bed, S. W. from the Lane ore-bank, promises to be of good quality and of sufficient size for profitable working.

Logan Farm ore-bank, on the Marcellus ore-bed, is situated about 2 miles S. W. of the Lane ore-bank, and 4½ miles N. W. of Orbisonia. It belongs to the Rockhill Iron and Coal Co., who in 1873 sank a shaft in the N. W. end of an old open cut.

This old open cut was made many years ago by the Chester Furnace Company, and extends for nearly 200 feet along the outcrop. The ridge is very low, and the open cut is shallow.

The ore is a semi-carbonate, changing in the shaft to a carbonate. At the foot of the shaft, which is said to be 70 feet deep, the carbonate ore is nearly cut out, and a carbonate clay formed in its stead. From 3½ to 4 feet of ore are exposed by the shaft.

A specimen of this ore yielded, upon analysis:

Iron,	35.500
Sulphur,	.480
Phosphorus,	.081

Insoluble residue,	14.790

"Clay ironstone, compact, of a light gray color." (A. S. McCreath.)

Hick's Ore-bank is on the Marcellus ore-bed, in Chestnut Ridge, a ½ mile W. of the Logan Farm ore-bank.

The Rockhill Iron and Coal Company opened it in 1873, by a shaft on the east slope of the low ridge. The ore is a brown hematite. There are now from 1,000 to 1,500 tons of ore on the bank. "The bed contains 6 feet of ore."

The shaft has not been sunk to the lowest point of natural drainage. The Logan Farm shaft is no deeper from the common level than the Hick's shaft, but the drainage at the Logan Farm shaft is much inferior to that in the Hick's. The shales at the Logan Farm form a wide flat as high as the top of the shaft, while the Hick's shaft is on the slope of the ridge.

A specimen of ore from the Hick's ore-bank yielded upon analysis:

Iron,	47.500
Sulphur,	.013
Phosphorus,	.111
Insoluble residue,	14.100

"Limonite, cellular, cells mostly filled with ochreous ore." (McCreath.)

The Wilson Farm ore-bank is in Hill Valley, 5 miles W. of Orbisonia. The following is an analysis of a specimen taken from a thin seam of silicious ore found in a break of the Oriskany sandstone:

Iron,	29.800
Sulphur,	.060
Phosphorus,	.082
Insoluble residue,	48.190

"Limonite, silicious, exceedingly hard and tough; structure, somewhat laminated; color, reddish brown." (A. S. McCreath.)

Between Hick's ore-bank and the Stewart ore-bank the Marcellus ore-bed has not been opened, though its outcrop indicates that it exists in paying quantities.

There is a bed of "bog ore" in the meadow N. E. of the Wilson Farm. Small quantities of it were used many years ago in the old Rockhill Furnace.

Stewart Ore Bank, on the Marcellus ore-bed, 1½ miles S. W. from Hick's ore-bank, and over 5 miles from Orbisonia.

"The old Chester furnace made an open cut at this bank 150 feet long, 40 years ago," and at the end of the open cut drove under cover, the old opening under cover being now partially exposed.

In 1873, the Rockhill Iron and Coal Company sunk two shafts a short distance W. of the old Chester furnace open cut, one 65 feet deep and the other 80 feet deep. About 200 feet of gangway have been driven upon the bed, which is said to contain 6 feet of ore.

About 1,600 tons of ore have been mined, and are now (1874) lying on the bank. The ore is of the same kind and quality as that from the Hick's ore-bank, except that there is a small quantity of carbonate ore taken from the 80 foot shaft mixed with that lying upon the bank. The measures dip about 50° S. E. (?). There are 80 acres belonging to this property.

Isaiah Fleck's property adjoins the Stewart property on the south-west. There is a good outcrop of ore on it. The ore is the same in quality as the Stewart and Hick ore.*

"Many years ago the ore cropping out on the surface of the ground was hauled from this point to Rockhill furnace. Shafting has been done, which promises well." †

Chester Furnace was built about the year 1834 (?) It was in blast about five years, after which it was abandoned. The furnace stack is now standing, the masonry appearing to be in good condition. It is situated about three miles west of Orbisonia.

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* See analysis in Ashburner and Billin's report.

† See Ashburner and Billin's report for description of the ridge S. W. of Fleck's.

Fig. 13. *(see page 134.)* *Section at Opening No. 1, Rockhill gap.*

Fig. 13.

Upper Clinton fossil ore shale, olive green.	
Hard fossil ore bed;	3"
Shale	8"
Fossil ore bed (medium)	3"
Sandstone, fragile,	**20"**
Fossil ore bed, (medium soft)	**16**
Sand rock.	

Chapter XIV.

Royer's Ridge, Sandy Ridge, &c.

An Oriskany sandstone and Lewistown limestone ridge lies N. W. of Blacklog mountain, and runs parallel to it, from a point N. E. of Orbisonia, in Huntingdon county, to Fort Littleton, Fulton county.

The sinking of the Blue Ridge anticlinal toward the S. W. allows the Oriskany sandstone and Lewistown limestone to form ridges which bound Germany Valley on the S. W.

From where the monoclinal ridges join, and the Oriskany arches over the anticlinal, to Orbisonia, the large, regular ridge is known as Royer Ridge.

Two miles N. E. of Orbisonia, from the S. E. side of the main anticlinal, there issues a small anticlinal flexure, which in sinking S. W. produces two ranges of the Marcellus ore, extending for about 1½ miles.

Running close along the base of Blacklog mountain is a monoclinal ridge formed by the Oriskany sandstone, and known locally as "Sandy Ridge." Four or five miles N. E. of Blacklog Gap, the ridge ends in an abrupt bluff.

Between Sandy Ridge and Royer Ridge are two small coves, formed by the synclinals. In these coves the Marcellus and Corniferous shales, with their accompanying ore-beds, rise toward the N. E., and eventually "spoon out." They continue much further N. E. in the western than in the eastern cove.

The map of the Environs of Orbisonia (See Plate) shows seven ranges of ore outcrop. Of these, the five most western are the outcrop of the Marcellus ore-bed. One is the outcrop of the Oriskany ore, while the most eastern is the outcrop of the Fossil ore-beds.

The description of openings on the Fossil ore-beds is given in Chapter 15. Other openings in the vicinity of Orbisonia are described below, in the order of the Ranges.

Range 2. Openings 5 and 6. Oriskany and Corniferous ore. General dip N. W.

Opening No. 5. On a deposit of silicious ore in the Oriskany shales, which are here over 100 feet thick. The opening is on the property of the Rock Hill Iron and Coal Company, and is now (1874) being worked "light handed," by means of a gangway driven into the deposit. This method will probably be abandoned for that of an open cut.

The ore is mixed with clay, and requires washing. It is very silicious, and in fracture is much the same as the Oriskany shale, the ore being nothing more than decomposed shale, which has absorbed oxide of iron. The bed is from 6 to 12 feet thick. Several hundred tons of ore have been mined, and now lie upon the bank.

Shaftings and outcroppings along this range to the N. E. do not promise sufficient quantities of ore for working.

A specimen of the ore analyzed yielded:

Iron,	33.250
Sulphur,	Trace.
Phosphorus,	.315
Insoluble residue,	41.750

"Limonite, hard, compact, and highly silicious."

(A. S. McCreath.)

Opening No. 6, locally known as the "Hawk opening," has been made to work out pots of ore in the Corniferous shales.

The ore is very silicious, and consists of shale highly charged with iron. It exposes in the center, when broken, a core of silicious slate. It varies greatly in quality, and occurs nowhere in large quantities.

Range 3. Openings 7, 8, 9, 10, 11, and 12. Marcellus ore. General dip N. W.

Opening No 7. "Vein carbonate of iron worked by drift running N. E."*

Opening No. 8. Abandoned. Open cut in which a large quantity of Corniferous shale ore has evidently been mined. Specimens of ore found scattered on the surface are rich in iron.

* Ashburner.

Opening No. 9. Open cut known as "Bedford Pit." "This was made in 1780 (?), at the time when the Bedford Furnace was built." It is wide, and its size would indicate that a large bunch of ore was found here. The piles of wash ore thrown upon the waste bank show that when the pit was opened the small or wash-ore was rejected and only lump-ore used.

"The vein is folded and locally contorted."*

Opening No. 10, known as the "Orbison Slope."

This was first opened by Thomas Orbison, who sank a shaft upon the ore-bed in 1841. An open cut was made and worked at intervals until 1846. About 4,000 tons of ore were mined during that time, and used at the charcoal furnace at Rock Hill. The bed is 5 feet thick at the outcrop, and at one place is 14 feet thick.

In 1872, the property was leased by the Rock Hill Iron and Coal Company, who sank a slope "about 70 feet deep from the outcrop." At the bottom of the slope there is a mixture of carbonate and semi-carbonate ores. Carbonaceous clay occurs with the carbonate ore.

The bed at the foot of the slope will probably average 3 feet of ore. The top of the slope is on the west side of the ridge, and its depth is about that of natural drainage.

A specimen of average quality, from the run of the bank, analyzed by McCreath, yielded:

Iron,	42.200
Sulphur,	.122
Phosphorus,	.130
Carbonate of lime,	.990
Carbonate of magnesia,	.756
Insoluble residue,	19.740

A specimen of carbonate ore from this opening, analyzed by McCreath, yielded:

Iron,	33.700
Sulphur,	.533
Phosphorus,	.045
Insoluble residue,	18.520

"Carbonate ore, compact, with seams of brown oxide of iron."

* Ashburner.

Opening No. 11, known as the "Jordan ore-bank," was opened many years ago, and the ore used at the Rock Hill and Winchester Furnaces. There are large open cuts along the outcrop. The bed of ore in the cuts was from 1 to 4 feet thick, and ran in bunches. Specimens lying upon the bank show the ore to have been of good quality.

The opening is on the western slope of Sandy Ridge, over a mile S. W. from Black Log Gap. It is probable that a large amount of ore could be opened at a lower level than that of the old workings.

Opening No. 12, known as the "Peirce Ore-bank." The Marcellus ore-bed is opened, probably 20 feet below the outcrop, producing a good brown hematite ore. The bed is irregular, being from 1 to 4 feet in thickness. A small quantity of ore has been hauled from here.

South-west of this point, there are shallow outcrop workings. This mode of working must necessarily result in the loss of much valuable ore. The danger is that after a place of this kind is abandoned, the ore remaining will not be sought after, and even if it should, there will always be increased expense in re-opening the old "pits.'

The hematite ore continues at variable depths in the bed to the carbonate ore, being controlled by the drainage and local topography, which is accordingly some guide in making an estimate of the probable amount of hematite.

Range 4. Openings 13, 14, and 15. Marcellus ore. General dip S. E.

Opening No. 13 is an open cut, a few feet deep. Worked down to water level, where carbonate ore is exposed. The bed is thin.

Opening No. 14 is a shallow, open cut, near water level, and is from 100 to 150 feet long.

Opening No. 15, an abandoned open cut, from which a large quantity of Corniferous ore has been mined.

Range 5. Openings 16, 17, 18, and 19. Marcellus ore. General dip N. W.

Opening No. 16 is a drift through the Marcellus Shales, driven at water level. Carbonate ore, in small quantities, was found at this level, mixed with carbonaceous clay. At the outcrop of the bed, 25 or 30 feet higher, is an old open cut, from which a small quantity of brown hematite ore was mined.

North-east of this opening, a considerable quantity of the Corniferous shale ore occurs on the surface.

Opening No. 17. A slope, 80 feet deep, was sunk by the Rockhill Iron and Coal Company in 1873. It is now filled with water.

From 35 to 50 feet down the slope, the bed contained a good quality of brown hematite ore from 1 to 3 feet thick. Further down, it changed to a carbonate, finally becoming a carbonaceous clay.

About 21 feet below the top of the slope a cross-cut has been driven through the Marcellus shales, cutting a small anticlinal, and reaching the Marcellus ore-bed. From the end of the cross-cut a gangway has been driven about 1,050 feet N. E., and still continues to produce ore. The ore-bed, at the face of the gangway, is about 4 feet thick.

Specimens of ore from openings 16 and 17, yielded upon analysis:

Iron,	51.700
Sulphur,	.023
Phosphorus,	.068
Insoluble residue,	10.490

"Brown hematite, very hard and compact, dark brown, containing considerable ochreous iron."

(A. S. McCreath.)

South-west of Opening No. 17, the ore has been worked by Messrs. Royer and Dewees within the last 4 years. "The bed is from 3 to 5 feet thick, and contains an excellent quality of ore."

A shaft was put down 75 feet, and the ore was raised by horse power. Gangways were driven 150 feet N. E. and S. W. from the shaft.

"Only brown hematite ore was found, with no carbonate." If this was the case it is an exception to the rule, that the carbonate ore commences at a point where drainage* of the

*Our experience is, that at an uncertain distance below the outcrop, the hematite changes first to a carbonate, and then to a black clay, but we have no evidence that *drainage* has anything to do with it. In fact, what is *drainage?* The level of the nearest water course, or of the bottom of the valley?

bed stops. This bed may, however, have obtained its drainage from the fall of the valley to the S. W.

It will be noticed that all the openings named are near surface level, consequently there cannot be a large quantity of ore mined from them. What there is is generally the Carbonate ore, which does not extend to a great depth.†

Opening No. 18, is a shaft recently dug, with a short cross-cut, near the outcrop of the bed. Dip 70° N. W. There is but a short "breast," and the ore-bed is too small for profitable working.

Opening No. 19, is an open cut, which, judging from the fact that "wash ore" has been thrown on the bank, was probably opened by the Bedford Furnace Company. The wash ore is now being used by the Rockhill Iron and Coal Company.

The pit is deep, being cut nearly to the lowest point of natural drainage, and is carried back to the Corniferous shale ore. It does not appear that any carbonate ore was mined.

Range 6. Opening 20. Marcellus ore. General dip S. E.

Opening No. 20. Royer and Dewees Tunnel. This tunnel was driven several hundred feet through the Marcellus shales, crossing an anticlinal or roll, and cutting the east dip of Royer Ridge. The Marcellus ore-bed was less than 1 foot thick, and contained a brown hematite ore. Gang-

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I think the deposits are lenticular in shape, and along the edges are carbonates. If this is the case, the thickest part of the deposit would also be the deepest, and there are some facts to show this. But we do not yet know enough about it to theorize." *Wm. A. Ingham.*

[By the term "drainage," used here and elsewhere in this report by Mr. Dewees, is not meant a perfectly horizontal plane at the datum level of the outcrop, where it is traversed by a stream of water; but a plane, irregularly ascending, from that datum level into the hills, on both sides of the ravine in which such stream flows. The irregularity of the upward slope of this plane is determined in each case by the various porosity and solubility of the bed itself and its enclosing country. In the case of limestone strata, the datum level of the "plane of drainage" (geologically speaking) may be taken at some unknown depth *beneath* the level of the bed of the stream where it crosses the outcrop.—*J. P. Lesley.*]

†The mines are along a ravine, rising at its upper end 200 feet above the valley. *Wm. A. Ingham.*

ways were driven from the end of the tunnel, and an air shaft was made. The ore-bed did not change, so the place was abandoned.

Range 7. No openings have been made. Marcellus ore N. of Royer Ridge. General dip N. W.

Orbisonia Furnaces.

During the last hundred years several iron furnaces have been built and operated in the neighborhood of Orbisonia. The following information concerning them was kindly furnished by Mr. Thomas Orbison.

Bedford Furnace was built in the year 1780. It was located on the site of the present hotel, (Franklin House,) in the town of Orbisonia. The size of the furnace at the boshes was 6 feet. The iron was manufactured into stoves and household ware, *as was the custom of the country* at that time. In 1792, a forge was built by the owners of the Bedford Furnace, at a point on the Aughwick Creek, 4 miles from Orbisonia. The mason work of this forge was done by John Harper, whose family still reside at Orbisonia. The manufactured articles were carried to market on pack-saddles.

Winchester Furnace, the same size as the Bedford Furnace, was built in 1833, by Thomas J. Cromwell, and operated by Bracken and Still. About 4 years afterwards a person named Allen operated it for 3 years. Then Col. Wm. Pollock operated it for 3 years. After Pollock, Samuel Isett ran it for 2 years. Isett, Wigdon & Co. then took possession of the furnace and ran it 10 or 12 years.

"Openings Nos. 19, 8, and 14 were the only ones from which they procured ore for the Winchester Furnace."

The *Rock Hill Furnace*, which is now standing, was built in 1830 by Morrison and Thomas Divin, who ran it for a few years. James bought it about the year 1835, and operated it for 10 or 12 years. Then Isett, Wigdon & Co. took possession of it, and carried it on until 1855 or 1857. About the year 1861, Lawrence & Lamer started the furnace again, and ran it for 3 years. In 1868, Royer & Dewees purchased the property, which then consisted of 6,000 acres of mountain land, the Rock Hill Furnace, etc. They operated the furnace until 1871, when they sold the property. The purchasers and their associates formed a stock company, under the name of the Rock Hill Iron and Coal Company, to which the property was transferred.

The Rock Hill Iron and Coal Company, in 1873, commenced the erection of two large blast furnaces. One of them was completed and put in blast on January 1, 1876.

They were designed by Jaws & Hartman, of Philadelphia, and constructed under the supervision of Mr. Casimir Constable, C. E., Superintendent for the Company.

The stacks are brick, with sheet-iron casing.

Height of stack, ... 65 feet.
Outside diameter, ... 27 "
General shape circular—
Height to bosh, ... 18 "
Inside diameter at bosh, ... 17 "

Size of hearth—7 feet high, 7 feet 3 inches in diameter at bottom, and 7 feet 9 inches at top.

5 tuyeres—3½ inch nozzles.

Diameter of stack at tunnel head, ... 12 feet.

Engine house for two engines; size, 40x50 feet; 2 upright, direct acting, low pressure engines, built by Henry G. Morris, of Philadelphia.

Diameter of steam cylinders, ... 48 inches.
Stroke, ... 7 feet.

Fly wheel, 24 feet diameter; 14 revolutions per minute.

Steam pressure 35 lbs.—25 lbs. in vacuum. Blast pressure about 5 lbs.

One blowing cylinder for each engine, 96 inches in diameter, 7 foot stroke.

Two vertical air receivers, 60 feet high, 6 feet in diameter.

Two horizontal receivers, 50 feet long, 6 feet in diameter.

Two boiler houses, 52x27 feet.

Two iron draft stacks, 84 feet high; inside diameter, 5 feet 9 inches; lined from the base to height of 42 feet, with 9 inches of fire brick. Upper portion lined with red brick.

Twelve boilers, 51 feet long, 36 inches in diameter.

Twelve mud boilers, 51 feet long.

Boilers set in two nests, six for each engine.

Two hot ovens for each furnace; 2 sets of U. pipes to each oven; 40 pipes to a set; U. pipes, 9 inches inside diameter by 14 feet high.

Stock house, 280x60 feet. Erected in position to accommodate both furnaces. Air hoist for each furnace.

Two casting houses, 120x50.

The ores used are ¾ Blacklog fossil and ¼ Marcellus hematite, averaging 36 per cent. iron per ton of ore. Grades of iron made, No. 1 and 2 gray forge; fuel coke, made from East Broad Top coal, in Belgian ovens.*

Number of ovens, 68, of two sizes.

Size No. 1, 20 ovens, 22 feet long, 6 feet high, 28 inches wide.

Size No. 2, 48 ovens, 24 feet long, 6 feet high, 22 inches wide.

The 20 No. 1 average 1 ton of coke per charge.
" 48 " 2 " 1¼ tons " " "

The ovens were designed by J. King Mc Lanahan.

The coal is brought on the East Broad Top RR. (narrow gauge) from the mines to the furnace where the coke ovens are located. The distance is 18 miles.

The iron is shipped to Mt. Union, a distance of 12 miles, where it is transferred to Penna. R. R. cars.

The above facts were obtained from Mr. H. G. H. Tarr, Superintendent for the Company.

South-west from Orbisonia. Three miles S. W. of Orbisonia the Marcellus ore-bed has been proved, by shaftings and openings, to contain from 2 to 4 feet of ore. The high dip of the measures, and the facilities for natural drainage, indicate that this ore-bed exists in fair dimensions as far S. W. as Meadow Gap, which is 6 miles S. W. from Orbisonia. In the neighborhood of Meadow Gap this ore-bed has not been opened or prospected upon.

The Marcellus black shales on this range are thick, and at the outcrop on high dips, are changed to a dark gray color.

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*For description and illustration of Belgian ovens see Report L, (1875.)

"Sandy Ridge" continues for a few miles S. W. from Orbisonia, and then, owing to the high dips, the rocks forming it pass into the terrace of Blacklog mountain.

About ¾ of a mile S. W. of Meadow Gap the Great Aughwick Creek encroaches upon the terrace of the mountain. The Lewistown limestone is well exposed at a sudden bend of the creek in the S. W. end of "Dug Hill." Southwest of this the decreasing dip of the measures allows the Lewistown limestone and Oriskany sandstone to pass out of the terrace and form a low ridge, which follows close along the base of the mountain.

The outcrop of the Marcellus ore-bed, S. W. from the end of "Dug Hill," passes through the flat formed by the creek for ¾ of a mile, and then into a small ridge, continuing past the farm buildings of Isaiah Matthew's. The Corniferous shales are from 125 to 140 feet thick. The ore occurring in these shales is scattered upon the surface in small quantities, at different points along the range. The Oriskany sandstone contains a considerable amount of iron. The measures dip 55° N. W.

At Wm. Stambach's barn, N. E. of R. A. Ramsay's property, the Upper Helderberg limestone is exposed as a green, shaly rock at the outcrop. Considerable "blossom" of ore lies in the vicinity, and in crossing the road the Marcellus bed is exposed, 18 inches thick. The shales are all dove-colored at the outcrop, with but little black shale exposed.

Analysis of specimen of the Marcellus ore from Wm. Stambach's property, 5 miles N. E. from Fort Littleton. At this point the ore-bed gives better promise of proving valuable than at any point between this and Fort Littleton:

Iron,	44.700
Sulphur,	.031
Phosphorus,	.197
Insoluble residue,	18.820

"Limonite, cellular; the cells for the most part being filled with yellow clay; brittle, and of a light brown color." (D. McCreath.)

On the property of Robert A. Ramsey, 5 miles from Fort Littleton, a large quantity of the Corniferous shale ore occurs on the surface, and in water washes on the slope of the ridge.

It seems to exist more plentifully about the middle of the strata. Some pieces of the outcrop ore weigh 15 or 20 lbs.

The Marcellus ore is nowhere observed to be exposed on this property, either upon the surface, or in the washes. From this point S. W. to the gap in the ridge, 4 miles N. E. of Fort Littleton, the valley widens, and the slope of the ridge decreases. No evidence of the Marcellus ore has been observed. The Upper Helderberg limestone is 45 feet thick, and dips 48° N. W.

Between this gap and the next one, where the Aughwick Creek passes through the ridge, the valley becomes narrower. "Blossom" of the Marcellus and Corniferous ore occurs in small quantities. The Oriskany sandstone is solid, 25 or 40 feet thick, and dips 48° N. W.

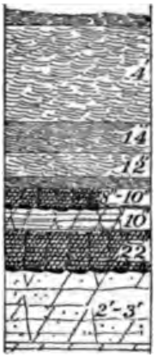
For a ½ mile S. W. of the gap, to a summit in the valley, the line of outcrop of the ore-beds follows the N. W. base of the Lewistown limestone ridge. "Blossom" of the Marcellus ore exist upon the surface in small quantities. The evidences of ore, and the facilities for mining it, are superior to those in this valley S. W. of the summit. The valley is cut by many cross ravines, leaving short ridges or mounds between them. A large quantity of Oriskany sandstone is scattered along the N. W. base of the ridge, some of it is ferruginous, and is often mistaken for ore.

S. W. of the summit the Corniferous shale ore is exposed. Some of it is rich in iron, but there are no evidences that it exists in large quantities.

The outcrop of the ore-beds follows the base of the Oriskany sandstone ridge, except where the valley widens by a flattening of the dip, when the outcrop is pushed out toward the flat. West from Fort Littleton, and N. of the Broad Top road, the ridge is quite prominent, (several hundred feet high.) The Oriskany sandstone forms the west slope, and crops out near the crest. It is solid under cover, but near the surface lies in the form of small beds of sand. The Upper Helderberg limestone, at the surface, is a rotten green shale, and does not appear to be as thick as it is E. of Fort Littleton. The Lewistown limestone contains no chert.

Fig. 14. (see page 134.) Section at No. 3 opening, Rockhill Gap.

Fig. 14.



Upper Clinton Fossil ore shale.	
Shale, soft, yellow and green;	4′
Shale, light green (decomposed);	14″
Shale, sandy, ferruginous;	12″
Shale, soft, argillaceous;	5″
Fossil ore bed, medium soft;	8′ to 10″
Sandstone, ferruginous, fragile;	10″
Sand-vein ore bed, medium soft;	22″
Sand rock; fragile;	2′ to 3′
Ore sandstone.	

CHAPTER XV.

Black-Log mountain.

Bell's Furnace to Fort Littleton.

Fossil-Ore Range.

At Bell's Furnace the terrace of Blacklog mountain is high, and broken by frequent ravines. The outcrop of the Sand Vein ore-bed is far up on the terrace, and indicates the probable existence of paying quantities of ore. The Upper Clinton red shale and the variegated shales occupy the foot of the terrace, and are cut through by the ravines. The distance from Bell's Furnace to Blacklog Gap is 8 miles. The cultivated land of the valley extends up on to the mountain terrace for several miles S. W.

Six miles S. W. of Bell's Furnace, on land of the Rockhill Iron and Coal Company, the surface of the terrace is strewn, for a short distance, with boulders of brown hematite ore, which lie N. W. from the top of the Upper Clinton red shale, and probably came from a pocket in the variegated gray shales. Shaftings in these shales, and above, have proven the existence of small quantities of this ore.

This being an unusual deposit, it is not probable that large quantities exist.

A specimen yielded upon analysis:

Iron,	39.000
Sulphur,	.095
Phosphorus,	.096
Insoluble residue,	28.210

"Limonite, compact, silicious, surface somewhat velvety."

(A. S. McCreath.)

Blacklog Gap Section.

The thickness of the measures represented in section A B, (Plate 13,) is as follows:

		Feet.
VIII.	Hamilton,	350
	Marcellus Black and Olive Slate,	(?)750
	Marcellus Iron Ore-Bed,	4 to 7
	Corniferous Limestone, (Upper Helderberg),	absent

VII.	Schoharie, Cauda Galli } Shale,	155
	Oriskany Sandstone, (150 feet±), Oriskany Shale, Lewistown Lime Shale,	195
VI.	Lewistown Limestone,	125
	Water Lime Shale,	600
V.	Salina Green Shale, Niagara Variegated Red and Green,	230
	Clinton Red Shale,	233
	Clinton Upper Olive Shale,	163
	Sand Vein Ore-Bed, (opened,)	*2
	Ore Sandstone,	35
	Olive Shale,	5
	Danville Ore-Bed,	thin
	Olive Shale,	11
	Danville Ore-Bed,	thin
	Lower Clinton Olive and Gray Shale,	660
IV.	Medina White Sandstone,	400
	Medina Red Sandstone and Shale,	930
	Oneida Red Conglomerate,	158
	Oneida Gray Sandstone,	410
III.	Hudson River Shales, 800 feet,± Utica Shales, 1,070 feet,±	1,870
	Total,	7,434

The measures dip 64° N. W. The Ore sandstone crops out on the terrace, at an elevation of about 400 feet above the creek, both N. and S. of the gap.

The Sand Vein ore-bed has been worked by two gangways on each side of the gap.

The Danville ore-beds do not appear to be of workable size. The breaks, however, which have produced soft ore in the Sand Vein bed would have the same influence upon the ore of the Danville beds.

Both north and south of the gap, there are frequent faults in the form of jumps or slips, causing the rocks to rise in the line of the gangways. This makes an extra expense in driving, it being necessary to cut through the rock to maintain a good alignment of the gangway.

These jumps are generally from 1 to 3 feet, though sometimes greater. When the jump is 3 feet or less, the gangway is driven through the Sand rock overlying the

*Measured exactly, 22 inches.

Ore sandstone, which is soft and fragile. When more than 3 feet, the gangway is turned to avoid the Ore sandstone, which is a hard laminated rock more difficult to drive through than the Sand rock.

The comparatively small extra expense in driving the gangways is more than compensated for by advantages arising from the faults. They form water channels from the outcrop through the Ore-beds and the Upper shales.

These faults probably continue through the Lower Clinton shales and the Medina sandstone, for they are caused by the rapid bending of the mountain to the S. W.

The Upper Clinton fossil ore shale shows the effect of the faults, it having changed its character from a gray, blue, calcareous shale to a white and buff shale, and above the ore bed to a soapy white shale, approaching, in some places, a plastic clay.

The course of the south gangway, (No. 3,) extended across the gap, a distance of 550 feet to the north gangway, (No. 2,) shows an offset, or fault of 94 ± feet. This was discovered by Mr. Constable, former Superintendent of the Rock Hill Iron and Coal Company, when the opening was first made and verified by a survey made by Charles E. Billin, in 1874.

Opening No. 2, (Plate 2,) is about 15 feet above the level of Blacklog Creek. It was made by the Rock Hill Iron and Coal Company, later than the openings on the south side of the gap.

In this gangway, 175 feet from the mouth of the drift, there are 22 inches of hard fossil ore. The hard fossil continues for 100 feet, when it changes to soft ore of much the some quality as that on the south side of the gap.

The gangway is 767 feet long. One hundred and forty feet from the mouth of the drift, there is a jump of 18 inches in the Ore sandstone. From 250 to 255 feet, there are three offsets of 1 foot each. At 425 feet from the mouth, there is an offset of 18 inches; at 650 feet, an offset of 9 feet, and at 715 feet, an offset of 8 feet.

A specimen of hard fossil ore from Opening No. 2, analyzed by Mr. McCreath, yielded:

Iron,	27.250
Sulphur,	Trace
Phosphorus,	.203
Carbonate of lime,	36.007
Carbonate of magnesia,	1.180
Insoluble residue,	16.610

"Hard, compact, reddish brown, fossiliferous ore, with numerous small crystals of calcite."

Another specimen of soft fossil ore, from the same gangway, (No. 2,) analyzed by Mr. McCreath, yielded:

Iron,	23.800
Sulphur,	Trace
Phosphorus,	.238
Carbonate of lime,	39.132
Carbonate of magnesia,	6.976
Insoluble residue,	12.850

Opening No. 1, (Plate 2,) was made by the Rock Hill Iron and Coal Company, at about the same time that they opened the lower gangway, No. 2. The length of the gangway, (May 1875,) is 707 feet.

One hundred and twenty-five feet from the mouth of the gangway is a counter chute from the lower gangway. The counter chute is 99 feet long on a dip of 64° N. W.

At a point 200 feet from the mouth of the gangway, there is a jump of about 1 foot in the Ore sandstone; at 250 feet, a jump of 3 feet; at 300 feet, a jump of 6 feet. At this last named point, the gangway was driven 50 feet through the Ore sandstone before again taking the true course of the ore-bed.

At 500 feet, a series of 10 offsets of 1 foot each commences, continuing for 50 feet. At 565 feet, there is an offset of 7 feet, rising 40° S. W. diagonally along the dip. At 600 feet there is an offset of 1 foot rising at an angle of 40° S. W. At the face of the gangway there is an offset of 2 feet. The dip of the measures is 64° N. W.

Opening No. 3, (Plate 2,) is on the Sand Vein ore-bed, on the south side of Black Log Gap, about 15 feet above the level of the Black Log Creek.

At the face of the gangway the ore bed is 22 inches thick. Above it, is another bed of fossil ore of about the same quality, from 8 to 10 inches thick, and separated from it by

10 inches of ferruginous sandstone. The upper ore-bed is constant throughout the gangway.

This gangway is driven (May 1875,) 1,374 feet. Its end is 400 feet below the outcrop of the ore bed.

There are said to be a number of small jumps in the bed, beginning almost at the mouth of the gangway. At 470 feet from the opening, a jump of 1 foot in the Ore sandstone is exposed. The course of the break runs diagonally across the dip of the rock, rising toward the S. W. at an angle of about 20°.

At 550 feet there is a jump of 11 feet. The gangway has been driven through the rock 40 feet to meet the rock on its course line. After this, a number of small breaks are reported, which are now *concealed.*

The course of the gangway, for 1,050 feet from the mouth, is 19° 30′ S. W.

At 1,250 feet, an offset of 1 foot is exposed, the break rising to the S. W. at an angle of about 30°.

At 1,350 feet, a break of 18 inches in the bottom wall is exposed.

This gangway was opened in 1872 by the Rock Hill Iron and Coal Company.

The gangway has a 7 foot collar, 8½ foot leg, and is 7 feet high from the rail; sufficiently large to admit a mine locomotive.

Opening No. 4, (Plate 2,) is about 100 feet above the lower gangway. It was first made by Royer and Dewees, about the year 1869. Ore taken from it was mixed with Sandy Ridge Ore, in making iron at the Rock Hill Charcoal Furnace.

The gangway was continued by the Rock Hill Iron and Coal Company, in 1872. In May, 1873, it had been driven 946 feet.

At *this* point, a *counter* chute is carried up in the ore-bed to an *upper* gangway. The upper gangway is driven 580 feet S. W. from the chute.

Both these gangways, like the lower one, have jumps and breaks in the bottom rock under the ore-bed. It is said that small jumps occurred at the mouth of the gangway.

At a distance of 280 feet from the mouth of the gangway, there is a jump of 3 feet. At 350 feet, another jump of 3 feet; at 375 feet, a jump of 2 feet. Beyond this, small offsets occur at intervals to the end of the gangway, at the counter chute, 947 feet from the mouth.

The ore bed, in the upper gangway, measures:

Soft fossil ore, (top ore-bed,)	8 inches.
Sandy fragile rock,	6 to 8 "
Soft Fossil Ore, ("Sand Vein" bed,)	18 "

At a point in the upper gangway, 310 feet S. W. from the counter chute, there is an offset or jump of 9 feet in the Ore sandstone. At the end of the gangway, 580 feet from the chute, there is another offset of 19 feet.

This shows that the *faults run through the entire length of the dip of the* Ore sandstone from the *counter* chute to the lower level, and undoubtedly to the outcrop of the measures, thus forming channels for the conveyance of surface water to the fossil ore-beds.

A specimen of ore taken from the Sand Vein ore-bed at the face of the gangway, (No. 4,) and analyzed by Mr. McCreath, yielded:

Sesquioxide of iron	72.571
Alumina,	4.723
Oxide of manganese,	.320
Phosphoric acid,	.256
Sulphuric acid,	Trace
Lime,	.174
Magnesia,	.309
Water,	3.440
Insoluble residue,	18.650
	100.413

Iron,	50.800
Phosphorus,	.112

"Compact, oolitic, reddish brown, highly fossiliferous ore."

Analysis of small ore-bed overlying the Sand Vein bed in Openings 3 and 4, S. side of Black Log Gap, (McCreath:)

Sesquioxide of iron,	72.428
Alumina,	4.211

Oxide of manganese,	.269
Phosphoric acid,	.281
Sulphuric acid,	Trace
Lime,	.319
Magnesia,	.432
Water,	4.620
Insoluble residue,	17.000
	99.560
Iron,	50.700
Phosphorus,	.123

South-west from Black Log Gap the terrace is regular, and slopes gently toward "Sandy Ridge." For several miles the Water-lime forms the flat land at the base of the terrace. Beyond this, it and the Lewistown limestone enter the terrace, and continue in it most of the distance to Pott's Gap, near the S. W. end of the mountain.

There are not many deep ravines, nor good opportunities for opening the ore-beds without the use of cross-cuts. The high dip of the measures along the entire length of the terrace, and the probable fact that the faults continue for several miles S. W., warrant the belief that there is much soft fossil ore in the beds.

"A shaft on the Sand Vein bed, 2 miles S. W. of Blacklog Gap, struck 18 inches of soft fossil ore." At a point 4 miles from the gap the outcrop is a rich, hard fossil ore, apparently of good thickness.

Altered fossil ore crops out on the property of Alexander Ramsey, ¾ of a mile from the Fulton county line. The dip of the measures is there 40°, and becomes less to the S. W., being 30° at J. P. Forbes'.

At J. P. Forbes' the Ore sandstone passes into the flat at the foot of the terrace, and crops out upon the low ridge, which is formed by the Lower Clinton shales and the Ore sandstone. The low dips carry the Lewistown limestone away from the terrace of the mountain, forming a valley of the Salina and Upper Clinton shales between the Limestone ridge and the Ore sandstone.

This is about 1½ miles N. from Fort Littleton, and opposite where the Medina sandstone, on the anticlinal of Blacklog mountain, sinks under the surface.

The Lower Clinton shales of the west dip continue south to Fort Littleton, forming a high ridge. The shales on the east dip have been eroded.

The Ore sandstone forms a low anticlinal ridge west of the church at Fort Littleton, and sinks under the Upper Clinton shales. There are no ravines convenient for ore openings on this ridge south of J. P. Forbes'. The Ore sandstone is massive, and maintains a good size throughout, being 18 or 20 feet thick in the ravine at J. P. Forbes'.

The Upper Clinton Fossil Ore shale is of dark color, indicating a hard fossil ore in the beds below.

On the top of the mountain, 4 miles S. W. from Blacklog Gap, is a crevice in the Medina white sandstone, containing a deposit of brown hematite ore. The opposite ends of the Medina sandstone exposed in the crevice fit into each other, and appear to have been stretched apart. The thickness of the ore varies, having been "14 feet in one place, and at other points much less."

The course of the crevice is about 50° S. E. The ore crops out in the crevice as far back as the Medina red sandstone.

A tunnel has been driven about 160 feet below the outcrop, with a gangway driven on the strike from the tunnel, cutting the line of the course of the crevice. No ore has been found at that depth and at that distance into the mountain. The crevice may run in a zigzag direction at this depth, and should this be the case, the distance from the tunnel to the crevice would be very uncertain.

"This opening was made by Mr. Bell, when he operated the Rock Hill furnace, and a considerable quantity of the ore was used."

A specimen of the ore analyzed by Mr. McCreath, yielded :

Iron,	45.000
Sulphur,	.032
Phosphorus,	.187
Insoluble residue,	26.580

Some sulphur is mixed through the ore, which alternates with thin seams of yellow clay.

It is probable that similar deposits of ore may exist at other low points, which are of frequent ocurrence in the crest of the mountain between Blacklog Gap and Potts' Gap.

The same kind of ore was scattered among the loose and broken rocks along the terrace of the mountain as far S. W. as Potts' Gap, and can be traced to the steep slope of the Medina sandstone. It can also be seen on the surface of the ground at some of the low points in the crest of the mountain.

Specimens of this surface ore from the terrace of the mountain, 1 mile S. W. from Meadow Gap, analyzed by Mr. McCreath, yielded:

Iron,	35.500
Manganese,	3.566
Sulphur,	——
Phosphorus,	.478
Insoluble residue,	29.575

"Limonite, compact, brittle, sandy; color, various shade of dark brown and reddish brown." (A. S. McCreath.)

A specimen of the same ore, from the surface on Alexander Ramsey's property, 4 miles N. E. from Fort Littleton, Fulton county, analyzed by Mr. McCreath, yielded:

Iron,	40.700
Manganese,	2.269
Sulphur,	——
Phosphorus,	.709
Insoluble residue,	18.100

"Limonite, hard, arenaceous, somewhat cellular; color, various shades of light and dark brown." (A. S. McCreath.)

REPORT OF THE AUGHWICK VALLEY

AND

EAST BROAD TOP DISTRICT.

CHAPTER I.

Boundaries of the District.

The Aughwick Valley survey covers that portion of Huntingdon County, bounded on the east by Shade Mountain, on the south and southwest by the line between Fulton and Huntingdon Counties, on the west by Broad Top Mountain, and on the north by a line drawn through Orbisonia parallel with the south line of the county. It includes Springfield, Clay and parts of Cromwell, Cass, Todd and Carbon townships. The total number of square miles covered by the survey is about one hundred and twenty-five.

From Blacklog Valley lying between the Shade and the Blacklog Mountains on the east, to the top of Broad Top Mountain near Broad Top City on the west, the distance, in an air line parallel to the southern boundary of the county, is 12.5 miles. This line is nearly at right angles to the general strike of the rocks and along it there are exposed the basset-edges of three miles and a half (19,000 feet) of the stratified rocks of the Palæozoic Age, from the Calciferous limestone of Blacklog Valley to the Mahoning sandstone, which overlies the productive coals of the East Broad Top coal-basin. This estimate does not include the repetition of the same formations on each side of the anticlinals and synclinals.

Topography.

The surface of the district is extremely regular in its general outline, and the character of the topography bears a very close and intimate relation to the character and kind of the rocks. Topographically the district is made up of parallel ranges of mountains and ridges, from 500 to 1,500 feet high, which run nearly from north to south, separated by a parallel system of valleys which have the same general trend and are more or less broken by ridges and hills.

From east to west the more prominent mountains, ridges and valleys arrange themselves in the following order:

Shade Mountain formed of Medina sandstones of IV dipping E. S. E. Blacklog Valley formed of the Lower Silurian limestones of No. II and the slates and shales of III in an anticlinal arch, dipping under Shade Mountain on the east and Blacklog Mountain on the west. Blacklog Mountain formed of Medina sandstone, of IV dipping W. N. W. The narrow valley between Blacklog Mountain and Sandy Ridge is eroded out of the shales of V and the limestones of VI. This valley has no well-known local name, it may be considered the extension to the southwest of Negro Valley and is so spoken of in the report of 1858. It is sometimes called Germany Valley but this is a misnomer. Germany Valley although eroded out of the same formations lies in the Blue Ridge anticlinal 3 miles northeast of Shirleysburg in Shirley township. The geological structure of the two valleys is quite different and sufficient to distinguish them, although topographically the former valley might be considered a prolongation of Germany Valley to the southward.

West of the valley just described lies Sandy Ridge formed of the Oriskany sandstone of VII, dipping west.*

*The name Sandy Ridge is in this report applied exclusively to the ridge of Oriskany sandstone lying between Royer Ridge and Blacklog Mountain, The ridges and hills formed of Oriskany at the foot of the mountain, within the district, all belong to the same range and should be designated by the same name.

What is called Royer Ridge in this report is known as Sandy Ridge in the report of 1858. Locally the latter name is indiscriminately applied either to Royer or to Sandy Ridge. The distinction which is here made seems to be

Royer Ridge lies to the west of Sandy Ridge. It is formed by the Blue Ridge anticlinal, which ends topographically at Orbisonia. Royer Ridge, properly speaking, is the continuation of Blue Ridge, but the former name has been proposed for that portion of the ridge formed by the anticlinal between Germany Valley and Orbisonia.

Between the two ridges just described lies a synclinal valley, eroded out of the Marcellus shales of VIII, which is only a lateral branch of the Great Aughwick Valley.

The valley between Royer Ridge and Sandy Ridge on one side and Jacks Mountain and Sideling Hill on the other is known under the general name of the Great Aughwick Valley. The valley is broken up by hills and ridges, which are comparative regular in outline having a general trend parallel to Blacklog and Jacks Mountains. These ridges though more or less continuous have been locally named; the better known and more prominent among them are the following:

Saddle Back ridge, formed of Hamilton sandstones VIII with a W. N. W. dip, runs parallel with and west of the East Broad Top R. R. from the northeast boundary line of Cromwell township to 2 miles south of Orbisonia.

It is bold and prominent, being broken in several places by gaps cut transversely through the measures and occurring every mile or so apart. From the gap in the ridge, just outside of the limits of the accompanying map (plate 2), to the gap N. W. of Orbisonia the sandstone has very nearly a constant dip to the W. N. W., although the angle of dip does decrease slightly southward from the former to the latter gap where the dip is 12°, W. N. W., a consequence of the subsidence of the Blue Ridge anticlinal. In a gap in Saddle Back ridge one mile to the S. W. of the town, where the East Broad Top R. R. curves to the right as it approaches Aughwick creek, the Hamilton sandstone is exposed in a quarry opened by the R. R. where the dip is 35° W. N. W., showing an increase in the dip of the strata of 23°, from the gap back of the town, to this quarry.

desirable to avoid further confusion. Royer Ridge is named in honor of Dr. Lewis Royer, who, in conjunction with Hon. P. P. Dewees, was instrumental in bringing about the present iron development in the vicinity of Orbisonia.

The Blue Ridge anticlinal, as has been said, sinks along the line of its axis to the north of the town with an angle of 10° to the S. W.; as a consequence of the sudden increase in the subsidence, we find Saddle Back ridge rapidly approaching Blacklog Mountain, from the gap back of the town to a point about half a mile south, where the ridge makes a bend of about 8° to the right and continues on from thence southward nearing the mountain gradually. The latter fact shows that the Blue ridge anticlinal, which at Orbisonia, as seen in section AB (plate 13) is broad and flat, becomes at or about opposite the turn in Saddle Back ridge sharper and assumes a much lower angle of subsidence than 10°, the flexure almost entirely disappearing in the valley of the Aughwick within a mile or more to the southward some distance to the northeast of the East Broad Top R. R. section.

The next most prominent ridge to the westward is Coaling ridge formed of the Chemung shales and sandstones in the centre of the Aughwick Valley synclinal, extending from Beersville southwest to Brownsville. Cave Hill, formed of the Oriskany sandstone, VII, and Lewistown limestone VI, extends southward from Three Springs. Cave Hill is geologically the same as Chestnut ridge in Shirley township. Clear ridge, formed of the Chemung, dipping westward, extends from the Juniata river southward parallel with Sideling Hill through Union, Cass and Clay townships. Hill Valley is but a branch of the great Aughwick Valley and is eroded out of the shales of V and limestones of VI lying along the southeast flank of Jacks' Mountain.

Great Aughwick Valley contains many more smaller hills and valleys having purely local names, which are not known oftentimes five miles away.

West of the northeastern part of the valley lies Jacks Mountain, an anticlinal mountain of No. IV, formed by the union of the monoclinal mountains Jacks and Stone northeast of the Juniata river, between Mount Union and Mapleton. Although the two ridges of Stone and Jacks Mountain are distinctly visible south of the river the latter name has been exclusively applied to the mountain from the river to its end at Three Springs.* The little valleys lying between Clear ridge and Jacks Mountain, and extending from the Juniata river southward to the E. B. T. R. R., are known under the general name of Hares Valley.

Sideling Hill is a monoclinal mountain of X dipping westward under the Broad Top coal basin. This mountain is the boundary between Clay township and Carbon and Todd townships, and its position in Cass and Union townships would be marked by the prolongation of this line northward to the Juniata.

The Pocono sandstone X entirely encircles the Broad Top Mountain and forms as it were a fortress wall to the coal basin. To the south of the mountain plateau, the sandstone forms Harbour Mountain and to the west Terrace Mountain. To the northeast, 5 miles below Huntingdon on the Juniata river, Sideling Hill and Terrace Mountain unite, enclosing the synclinal red shale basin of Plank Cabin and Trough Creek Valleys. In like manner to the south Sideling Hill joins Harbour Mountain in a broad synclinal summit only to separate again into two synclinal mountains. The eastern one of these continues into Maryland under the name of Sideling Hill while the broader and western mountain has its crest denuded and encloses the narrow valley of Brush creek.

Between Sideling Hill and Clear ridge and co-extensive with them lies Smith's Valley eroded out of the Catskill red shale and sandstone of IX.

I confine the name Long's ridge to the high land in Todd township to the west of Sideling Hill (with which it is very nearly parallel from the turn in Trough creek, 2 miles north of the Wray's Hill tunnel, southward to the tunnel). It has been called Wray's Hill.†

Long's ridge is capped with Pottsville conglomerate (XII) and in some places by one of the lower productive coal

*Its highest summit seen from Three Springs is Standerfer's Knob.

†The name Wray's Hill is applied solely to the hill south and southwest of the tunnel. A different name seems to be desirable for each hill on account of the difference of geological structure.

seams. At first the hill is a succession of short low knobs along the east side of Shirley's knob and Rocky ridge but becomes a ridge three miles south of Cassville * and 2 miles north of the tunnel. Southeast of Robertsdale in Carbon township Wray's Hill unites with the main plateau of the Broad Top Mountain and continues southwest merely as a rim to the mountain.

Ground Hog Valley lies between Sideling Hill on the east and Wray's Hill and Long's ridge on the west. It is eroded out of the shales of the Mauch Chunk Formation (XI.)

Shirley's Knob lies southwest of Cassville in Cass township and is directly northeast of Rocky ridge, which extends southwest to the E. B. T. R. R., between Wray's Hill tunnel and Cook's Station where it ends in a high knob.

Round Knob is north of Cook's Station while Grave Mountain is northwest. All of these summits are capped by the Pottsville conglomerate (XII,) overlaid in places by the lower productive seams. The valley in which Robertsdale is situated, lying between Rocky ridge, Round knob, Grave Mountain and Broad Top mountain on the west and Wray's Hill and Long's ridge on the east drained by Big Trough creek is known as Big Trough Creek Valley. The valley in Cass township between Terrace Mountain and Sideling Hill, drained by Little Trough creek, is called Little Trough Creek Valley, while the southern part of the same valley lying to the south of Great Trough creek is designated by the name of Plank Cabin Valley. South of this latter valley and west of Big Trough Creek Valley lies the plateau of the Broad Top Mountain proper.

Water Sheds.

As may be imagined from the comparative regularity of the mountains and valleys, the drainage system of the district cannot be very complex. The general course of the streams is either N. N. E. and S. S. W. parallel to the strike of the rocks or in a direction perpendicular to this along the dip. The whole area is drained by the tributaries of Great Trough creek which flows into the Raystown branch of the Juniata river in the southern part of Penn

* Formerly Chilcoatstown.

township, and the Great Aughwick creek which flows into the Juniata river southeast of Mount Union in Shirley township.

The principal tributary streams of the Great Aughwick creek are: Blacklog creek which drains Blacklog Valley and the environs of Orbisonia and flows into the main stream at Saddle Back Gap 1.5 miles northwest of Orbisonia; Three Springs creek, which empties into the Aughwick at Beersville, draining parts of Smith's, Hare, Hill and the Great Aughwick Valleys; and lastly Sideling Hill creek which unites with Little Aughwick creek at Maddensville to form Great Aughwick creek and drains parts of Smith's, Ground Hog and the Great Aughwick Valleys.

By a study of that portion of the water shed of the Aughwick within the district the direction of the streams, which at first sight seems to be very irregular, will be found to mark more or less distinctly either the strike or dip of the rocks. The most sinuous of the streams is the Aughwick itself, while the ones which mark most distinctly the strike are the two branches of Blacklog creek in Blacklog Valley. The mouth of the Aughwick is about 4 miles west of the head of Blacklog creek in the northern part of Shirley township, while at Meadow Gap in Springfield township there is just a distance of 1.5 miles between the Aughwick and Craig creek which is the head water of Shade creek, the southern tributary of Blacklog creek. The streams in Blacklog Valley mark the strike of the rocks. Aughwick creek from its mouth to Meadow Gap, a distance along the stream of 22 miles and by air line of 15 miles, approaches 2.5 miles nearer the general strike line of Blacklog Valley, and this is effected almost entirely by the stream running along the dip, after making turns at right angle to its general direction. In the windings of the stream the flow with the dip to the east is greater than that with the dip to the west. A more accurate delineation of the streams than that shown on the accompanying map (which is reduced from the county map) would illustrate better the general law of the flow of the streams, either with the dip or along the strike of the rocks.

There are two principal tributaries to Great Trough creek, Big Trough creek and Little Trough creek which unite to form the main stream near Todd P. O. The former branch flows northeast draining the Big Trough Creek valley, which contains the East Broad Top and Rocky Ridge coal basins in Carbon and Todd townships, and Broad Top township in Bedford county.

The same general law governs the direction of the branches of Great Trough creek, although not quite so well defined, from the fact that the dip of the rocks in the water shed of this creek is not so great as in that of the Aughwick, and therefore have not so marked an influence on the direction of the streams.

There are some very interesting structural features in the district which have determined locally the flow of the streams. Among these we may note the sudden deflection of Big Trough creek at the west end of Wray's Hill tunnel; Three Springs creek in its cut through Jacks Mountain anticlinal; and Blacklog creek in its course through Rockhill Gap. These are described further on in the report.

Fall of the Streams.

The fall of the main streams in the district is comparatively slight and very variable, being greatest near the source of the streams and rapidly diminishing to their mouths. The fall is in inverse proportion to the size of the stream.

Aughwick creek from the mouth of Sideling Hill creek in Springfield township to the mouth of Three Springs creek in Cromwell township, a distance of 10 miles, falls 144′; from the latter point to Saddle Back Gap, a distance of about 4 miles and a quarter, the fall is 40′, a slight diminution in the rate per mile. From Saddle Back Gap to its mouth the average fall per mile rapidly diminishes. From the gap to the R. R. bridge three quarters of a mile south of Aughwick mills, a distance of 9 miles, the fall is only 40′.

Three Springs creek from its forks in Clear Ridge Gap to Saltillo a distance of 1¾ miles falls 100 feet. Between Saltillo and Three Springs it falls 65 feet in a distance of 2 miles; while from the latter village to its mouth a distance of 3½ miles the fall is 100 feet.

Sideling Hill creek from New Grenada at the junction of Wells and Taylor townships Fulton county, and Clay and Carbon townships Huntingdon county, to the centre of Jacks Mountain anticlinal, a distance of 3 miles, falls 100 feet. From the anticlinal to Dublin mills, a distance of about 1½ miles, the fall is 23 feet; while in the two miles from the mills to T. Wilson's farm the fall is only 15 feet; from this latter point to its mouth a distance of about 5 miles the creek falls 138 feet.

Trough Creek.—In the Aughwick survey no levels were obtained of Big Trough creek further southwest than the road crossing between the Hoover farm and Alloway coal mines. From this point to Robertsdale the distance along the stream is about 1½ miles and the fall 100 feet. From Robertsdale to Cook's station it falls 245 feet in 2½ miles; and from the station to the west end of Wray's Hill tunnel a distance of about 1½ miles it falls 86 feet. From the tunnel to the road crossing below Stapleton's* the fall is very rapid, being 255 feet in 2 miles. From this locality to the dam between Shirley knob and Rocky ridge the fall is comparatively slight, being only 66 feet in 2½ miles.

Soil.

The soil of the district is extremely variable. From the total absence of glacial and foreign drift and the small amount of local detritus the character of the soil is almost entirely dependent on the character of the underlying rock. The best and most fertile soil is found on top of the limestone strata, and from this it passes through almost imperceptible gradations to the poor barren soil found overlying the sandstone and argillaceous sand shales. The most fertile areas are in those valleys cut out of the limestones of No. II and No. VI. The only valley of the former class is Blacklog valley; while in the latter class we find Germany

* Near the road summit crossing the Rocky Ridge.

valley and the continuation of this valley to the southward along the foot of Blacklog Mountain; Hill and Hare's valleys on each side of Jacks Mountain; and the crescent shaped valley south of the E. B. T. R. R. between Saltillo and Three Springs. In these valleys the uneven and broken character of the topography renders farming difficult, although the soil for its richness and fertility can scarcely be surpassed anywhere in the State.*

The farming as a rule is poorly conducted, with shallow ploughing; and the limited use of animal manures and the too frequent use of lime on soils already strongly alkaline from the underlying limestone give results not so satisfactory as might be desired. With a more liberal use of animal and a more restricted use of the mineral manures there is no reason why the soils of these valleys should not be made much more productive.

Next in fertility come Plank Cabin and Trough Creek Valleys which are eroded out of the shales of No. XI. The soil is quite good, and the topography not being as rugged as that in Ground Hog Valley which is cut out of the same formation the farming is easier and the result greater. There are some very fertile spots in that portion of the Great Aughwick Valley which derives its soil from the shales and sandstones of No. VIII and No. IX. The poorest soil in this valley is probably that on the shales and sandstones of the Marcellus and Hamilton groups; while that covering the upper part of the Chemung series may be considered the best. The soil of Smith's Valley cut out of No. IX is fair, but the roughness of the topography renders its cultivation difficult.

The soils of the Big Trough Creek Valley and of the Broad Top plateau are excellent in some localities, but like all the soils derived from the shales and sandstones of the coal measures they vary considerably in fertility.†

* It is even asserted that some portions of Germany Valley can raise more bushels of wheat to the acre than can be produced in Lancaster county.

† The potatoes raised on the Broad Top Mountain are noted for their size. I have never eaten any with greater relish than at the Mountain House.

Chapter II.

Anticlinals, Synclinals and Faults.

The district under discussion may be divided structurally into 4 distinct belts. 1. Blacklog and Blue Ridge anticlinals; 2. Aughwick synclinal; 3. Jacks Mountain anticlinal, and 4. Broad Top synclinal.

The strata in these belts are more or less bent into minor anticlinals and synclinals which however are only local in extent, while the main features of the major flexures remain the same for long distances.

The Blacklog and Blue Ridge belt is composed of two distinct anticlinals, with a separating synclinal.

Blacklog Anticlinal.

This anticlinal is first seen in the No. VIII measures six or seven miles east of McAllisterstown, Juniata county. It passes the town a quarter of a mile to the S. W., ranges through Lost Creek valley and becomes the axis of Lost Creek ridge. It crosses the Juniata, about a mile above Mifflin, and is the centre of Forge ridge, and enters the West Shade mountain, which rises to the south of Licking Creek valley. As the anticlinal continues on to the S. W. the mountain is broken into two monoclinal crests, which enclose Blacklog valley, from which the flexure takes its name.

The axis ranges through the valley as a single anticlinal roll, except opposite Rockhill Gap at the point where the valley attains its maximum width, where the crest of the primary flexure is depressed, forming two secondary anticlinals, as seen in the section of Blacklog valley (pl. 15.) From here the axis continues on into Fulton county, after the two monoclinal crests have again united, forming the anticlinal mountain of No. IV which ends near Fort Littleton.

From the N. E. extremity to the S. W. end of Blacklog mountain the distance is about 50 miles, the total length of the anticlinal being about 60. In this distance the mountain changes its direction from S. 45° W. to S. 25° W.

The valley opposite Blackhill Gap (where the section of plate 15 was constructed) has its maximum width, from mountain to mountain crest, of about a mile and a half, and here is the point of greatest elevation of the anticlinal; the flexure sinking both to the N. E. and S. W. The primary anticlinal has its crest depressed forming a low rolling anticlinal at the foot of Blacklog mountain and a sharp slightly overturned anticlinal to the east at the foot of Shade Mountain.

Blue Ridge Anticlinal.

This anticlinal has its northeast terminus on the Juniata river 3 miles northwest of Mifflin in Juniata county, where it dies down in the south slope of East Shade Mountain, so that the two axes overlap. The ridge to the southwest of the Juniata rises very gradually, becoming wider and broader until it attains its maximum height 4½ miles from its origin, when it becomes cleft over the line of the axis and stretches southward with a double crest and intervening valley for 20 miles, when the crests again unite and the mountain with a broad rounded summit gradually descends and terminates northeast of Germany Valley, in Shirley township.

The anticlinal passes through Germany Valley, south of which it forms Royer ridge, which extends as far as Orbisonia. Directly northeast of the town the flexure sinks away more rapidly, assuming an angle of subsidence of 10 degrees. Although the anticlinal does not make a ridge further south than Orbisonia, it apparently exists in the strata to a point about midway between Orbisonia and Sypestown. The length of the anticlinal, from the Juniata to its end near Orbisonia, is about 38 miles. The narrow synclinal valley between Blacklog Mountain and Blue Ridge as far southwest as Bell's furnace in Shirley township is called Licking Creek Valley; southwest of the furnace it is known as Negro Valley although the two valleys are strictly continuous.

Aughwick Synclinal.

The synclinal of the Aughwick valley has as extensive a range through the centre of the State, as the anticlinals just described. It forms a long narrow valley from the Susquehanna to the Maryland State line. That portion of the valley from Lewistown to the Juniata river, at Newton Hamilton, is known as the Lewistown valley. The structure of this portion is shown by the cross sections illustrating Mr. Dewees' report. From the Juniata river south into Fulton county the valley is known as the Great Aughwick. The following description is taken from the Final Report of 1858:

"The valley is bounded on the northwest by Jacks mountain, and beyond the termination of that ridge by Sideling Hill. On the southeast it is bounded by a succession of chiefly anticlinal mountains of the Medina (IV) sandstone, arranged in echelon. These are, in their order southwest—the Shade mountain ending 1½ miles southeast of Lewistown; the Blue Ridge, terminating 22 miles further southwest near the great bend of the Juniata; Blacklog mountain, ending at Fort Littleton 19 miles southwest of the end of the former; and, finally, the ridge bounding the McConnellsburg cove on the northwest, known as the Little Scrub Ridge and dividing mountain, rising near the termination of the last and ending at the State line. The entire length of the belt is about 107 miles, and its breadth is 4 or 5 miles from the Susquehanna to the end of Jacks mountain, but from that point to the State line it raises from 7 to 8 miles. The whole tract curves steadily more and more south as it advances from the Susquehanna."

The general structure of the belt is that of a great synclinal trough, diversified by a series of narrow, nearly parallel low ridges, which divide the general valley into several lesser ones, known by distinct appellations.

The synclinal within our district is extremely regular throughout, containing fewer secondary flexures than to the northeast. Two of the most interesting and important structural features discovered in this basin in the course of this survey are—1st. The existence of a fault of considerable magnitude near the end of Jacks mountain northeast of Three Springs, and 2d. The existence of a sub-anticlinal and sub-synclinal axis between the Aughwick valley synclinal and the Blacklog valley anticlinal commencing northeast of the Sideling Hill section. Although these flexures have not been traced to the southwest it seems quite probable that the anticlinal may prove to be that of Pigeon Cove and the synclinal that of Big Scrub Ridge. If this be so the connection of the structure in Huntingdon county with that in Fulton county will somewhat differ from that indicated in the Final Report and on the geological map of 1858.

Jacks Mountain Anticlinal.

The anticlinal which forms Jacks mountain, from the Juniata river southward to its extremity, is a prolongation of the uplift of Kishicoquillas valley. The flexure originates probably in the southwest part of Armagh township, Mifflin county, between Beatties' knob and Jacks mountain northeast of Reedsville. "It ranges almost absolutely straight through the center of Kishicoquillas Valley for more than 12 miles to the foot of Stone mountain, where taking an abrupt bend southward, it follows the base of this ridge to the head of the cove where the valley ends: thence maintaining a new and nearly straight course it pursues the crest of Jacks mountain across the Juniata, terminating south of that ridge in the great Aughwick valley."

There would seem to be a double anticlinal in Jacks Mountain. No examination was made in 1874 of the mountain structure either to the north or south of Jacks Narrows, and it is not easy to say what may be the extent of the duplicated flexure. The anticlinal from the river to the E. B. T. RR. section line has a general and more or less regular subsidence to the southwest; at the section line the rate of subsidence increases.

The horizontal distance between the section line and the outcrop of the fossil iron ore measured along the axis of the anticlinal is 8,400 feet, the difference of elevation between the points is 700. The geological position of the bottom of the white Medina sandstone on the section over the center of the anticlinal is assumed to be 500 feet above the present surface of erosion. There is a vertical thickness of rock between the fossil iron ore bed and the bottom of the white Medina sandstone of about 1,100 feet, so that the actual axial subsidence of the anticlinal between the section line, point A, and the outcrop of the fossil iron ore point B of the accompanying axial section would be (700 + 500 + 1,100) 2,300 in a length of 8,400 feet.

The distance measured along the axis of the anticlinal between the out-crop of the fossil iron ore and the Marcellus iron ore is 6,700 feet. The stratigraphical distance between these two beds is 1,732 feet, which makes an axial subsidence of the anticlinal between Three Springs creek and the end of Cave Hill of 1732 feet more or less or 1 foot vertical to 3.87 feet horizontal or 14° 30′.

The regularity of the outcrop lines of the formations around the anticlinal would seem to indicate that this angle of subsidence is continued from a point 1800 feet northeast of the outcrop of the fossil ore seam. Glancing at the topography directly to the southwest of the section line, and along the axis, there is a fall of only 100 feet in a distance of 3500 feet; here the profile of the mountain steepens and falls 750 feet to a point 1800 feet northeast of the fossil ore crop. The change of slope at 3500′ from the section line marks the bottom of the white Medina sandstone; so that in this interval there is a subsidence of (500+100) 600 feet (1 foot vertical to 5.8 feet horizontal) or about 9¾°. Between this latter point and that 1800 feet northeast of the fossil ore outcrop there is a subsidence of 34° 5′. The axial subsidence of the anticlinal is shown in the accompanying longitudinal section. The elements of this section have a very important bearing on the occurrence of the Three Springs fault which is described further on.

The axial subsidence between the outcrop of the Marcellus ore bed at the foot of Cave Hill and the Sideling Hill section is 1,200 feet, or 1 foot vertical in 17 feet horizontal or 3° 21′.

The anticlinal is exposed along the bank of Sideling Hill Creek about 800 feet north of Wm. Shue's house. The exposed flexure is formed by the upper part of the Hamilton sandstone dipping 58°, north 70° west; and 44°, south 60° east.

Although the face of the rocks is very much grown over with shrubs and trees, yet the arch is distinctly visible. The accompanying illustration of the anticlinal is made from photographs taken by John C. Brown, Dr. E. Wallace and Percival Roberts, jr.

From the character of the erosion and the cropping of the formations around the anticlinal at Sideling Hill creek it seems quite probable that along the creek there is a depression over the axis of the anticlinal, through which the creek has found it easier to cut its way than at any other point.

The anticlinal was not traced south of the creek, but it probably vanishes entirely in a distance of 10 miles.

Broad Top Synclinal.

It has Tussey Mountain for its northwestern boundary and Stone Mountain, Jacks Mountain and Sideling Hill for its southeastern. "In this deep and broad trough in the strata, which consists in the main of but one ample synclinial basin, there are contained the whole of the Palæozoic strata of the State from the Trenton limestones of II up to the Pittsburg seam in the upper productive coal measures. In the limited coal basin of Broad Top Mountain we have an outlying patch of bituminous coal measures, denoting not only the depth of the great synclinal wave, but in its remoteness from the main coal region west of the Allegheny Mountain the enormous extent of denudation which the intervening anticlinal belt of country has experienced."

Although the basin is remarkably regular throughout that portion included within the Pocono sandstone rim of Terrace Mountain, Sideling Hill, and Harbour Mountain, yet it is undulated by longitudinal flexures, which have very materially influenced the erosion of the basin and are distinctly marked by the resultant topography. These anticlinal flexures have a very important and direct bearing upon the coal area and the position and lay of the coal seams. They will be treated of more at length in the report on Rocky Ridge and Big Trough Creek basins.*

*A description of the Broad Top Coal Field is reserved for a future report.

Chapter III.

Cross Sections.

In the general description of the structure of the district it was impossible to describe the minor features of the anticlinals and synclinals, embraced within the boundaries of the survey, until the structure of the cross sections was understood, and yet the more detail study of the sections could not be rendered as comprehensive unless preceded by a general statement of the main structural features. For this reason many facts will be found in this chapter which more properly would be in place in the last.

In the grouping of the sections the same general order has been observed as in chapter I.

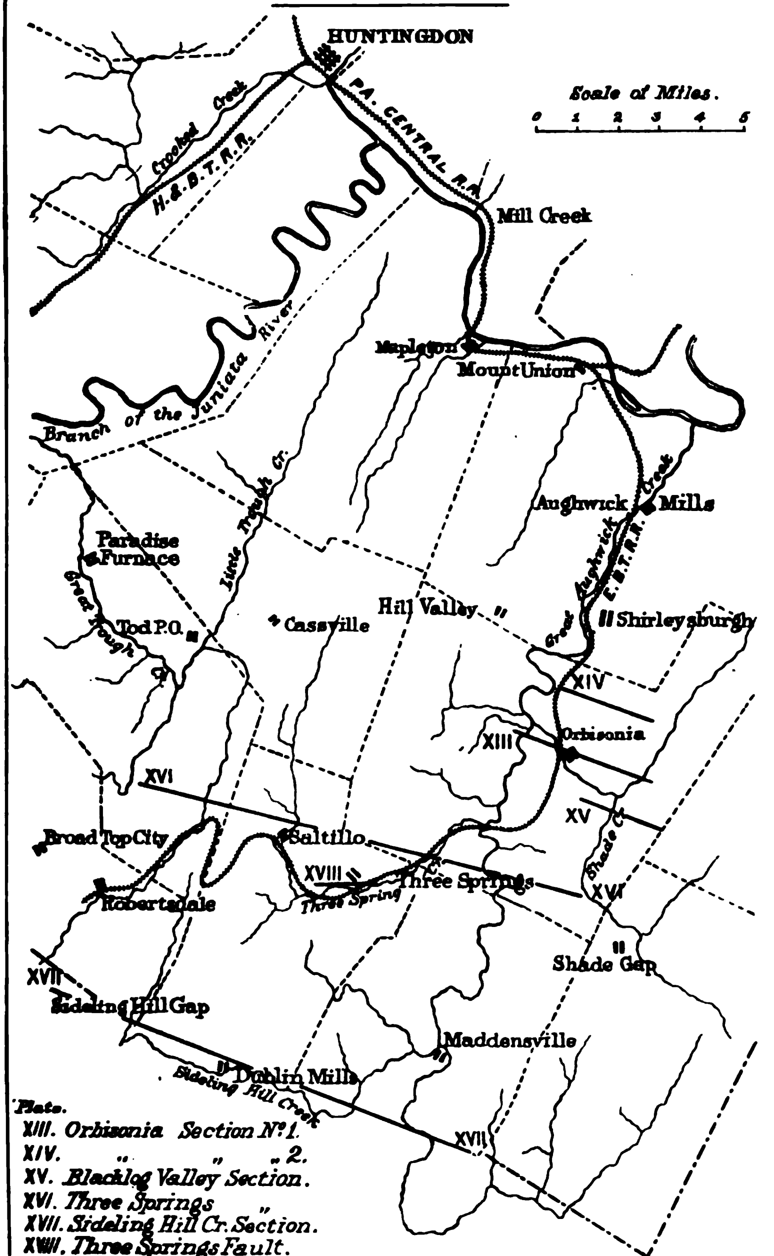
They are described in the following order:

1. Blacklog Valley section.
2. Orbisonia section No. 1.
3. Orbisonia section No. 2.
4. East Broad Top R. R. section. (Three Springs Section.)
5. Sideling Hill creek section.

The general structure of the Rocky Ridge and Broad Top mountain sections is shown in the Railroad and Sideling Hill creek sections, and the description of those sections wil be found in conjunction with that of the coal basins in a subsequent chapter.

The sections are all projected on vertical planes crossing at right angles the average strike of the rocks along the line of the section. In the case of a rapidly sinking or rising anticlinal or synclinal the thicknesses of the formations must necessarily be exaggerated on the plane of the section. The absolute thickness of the formations can only be shown where the section plane cuts them at right angles to the strike or along the line of dip. The strike of the rocks vary so comparatively little, and the scale on which the sections are drawn is so small, that any distortion of rock thickness cannot be appreciated. The right hand end of the sections in every case is to the east, while the left

PORTION OF HUNTINGDON COUNTY
showing position of the Sections of the Aughwick Valley Report.

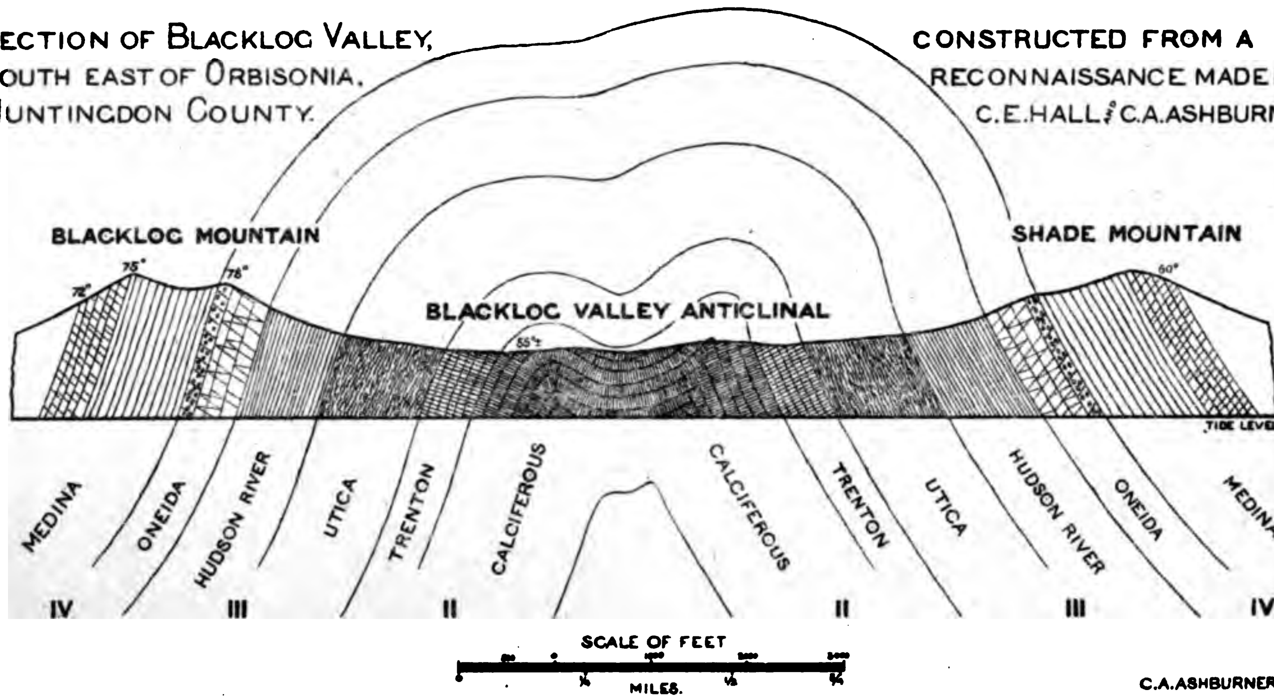


F. PLATE 15.

SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA, JUNIATA DISTRICT, 1875.

SECTION OF BLACKLOG VALLEY, SOUTH EAST OF ORBISONIA, HUNTINGDON COUNTY.

CONSTRUCTED FROM A RECONNAISSANCE MADE BY C.E. HALL & C.A. ASHBURNER.



C.A. ASHBURNER, DEL.

hand is to the west, and the observer is supposed to be looking north.

1. *Blacklog Valley Section* (pl. XV.) This section was constructed from data obtained in a reconnaissance made with the assistance of Mr. Charles E. Hall. The dips of the limestone are from isolated outcrops and at quarries embraced in an area of half a mile to the north and south of the section line. They have not been recorded on the section, which may hardly be considered an absolute construction. To represent the exact structure it would require a very careful instrumental survey.

To the northeast and southwest of the section line there is but one main anticlinal, while directly in front of Rockhill Gap the crest of the main flexure is depressed, forming two anticlinals. The influence which this duplication has on the occurrence of the fault in the gap (to be described below) is very important and is noticed in a subsequent chapter.

The measurements for the section to the east of Blacklog Creek were taken from the township map.

The Trenton limestone is about 500 feet thick and outcrops along the sides of the valley at the foot of each mountain. The Calciferous sandstone, or the auroral magnesian limestone of Prof. Rogers' system, occur on the crest of each of the secondary anticlinals. The bottom of this formation is not reached by the surface of erosion. It is probable that the Magnesian rocks in this part of Pennsylvania are at least 3000 feet thick, which would place the top of the Potsdam sandstone (the lowest member of the Palæozoic series) at least three quarters of a mile vertically beneath the present surface in the centre of Blacklog Valley.

Both the Trenton and Magnesian limestones have been opened in a number of quarries.

A vertical section of the bottom beds of the Trenton limestone, opened in the Grove quarry opposite the gap, will be given in the notes on Formation No. II, in a subsequent chapter. The amount of the carbonate of lime contained in each stratum was determined by Dr. Charles M.

this latter formation are in a descending series ranging from 79° at the bottom to 75° at the top. The white Medina sandstone dips from 70° to 72°. The average dip of the Clinton ore sandstone underlying the fossil iron ore beds has been assumed to be 65°, north 65° west.

The Iron sandstone with its associate iron ore beds seems to be entirely wanting in the Clinton lower olive shales in Rockhill Gap. The strata from the ore sandstone down to the top of the Medina sandstone were well exposed and not the slightest indication of either the Iron sandstone or of a bed of iron ore was found.

The bottom of the Water-limestone and lime-shale was located near Dewees grist-mill with a dip of about 60° N. W. and the top of the same formation was placed at Orbison's limestone quarry at the end of Sandy Ridge; the dip at the quarry being 76° N. 65° W. If the Water-limestone along the section line had a northwestern dip ranging from 60° at the bottom, to 76° at the top, its thickness would have to be 1,000 feet, which is 400 feet greater than the thickness of the same formation at Saltillo, Three Springs or Mount Union. There are evidences of a basin to the north of the section line between Sandy Ridge and the mountain.

The folds and contortions seen at the Furnace water-limestone quarry which is located east of Rockhill Furnace, and south of Blacklog creek, making three or four distinct folds or flexures, and contained in a distance of 150 feet along the dip, occur in strata about 250 feet above the lower horizon of the formation. Similar folds or flexures were exhibited in trenches dug near the quarry in exploring for limestone. These sharp flexures seem to be merely local contortions, from the fact that if they were regular synclinals and anticlinals extending into the formations above and below, they would reduce the thickness of the water limestone beyond its probable limit. Supposing such were the case no evidences of similar flexures were found to the N. E. or S. W. of this locality. These folds are undoubtedly but local contortions existing near the centre of the synclinal shown in the section.

The construction was made by assuming a thickness for the Water-limestone of 600 feet. The position of the lines of bedding, as shown, are of course hypothetical as there were no reliable dips obtained throughout the formation to indicate the exact structure. From the horizon between the Water and Lewistown limestones upwards to the Marcellus iron ore bed the dips range from 76° to 80°.

The thickness of 475 feet from the Marcellus ore bed (in the Orbison slope) to the bottom of the Lewistown limestone is absolute, although it was impossible to determine with precision the exact position of any one horizon separating the included formations, between the two limits. The strata between the same two horizons at Saltillo and Three Springs measure only 280 feet. At Mount Union (on the same range as Three Springs,) the aggregate thickness of the same strata, exclusive of the Corniferous limestone and clay beds representing the Schoharie and Canda-galli grits is 430 feet. In the Ross' ore bank synclinal of McVeytown Gap, northeast of Mount Union, the thickness of the same beds is 550 feet, and with the Corniferous, Schoharie and Canda-galli 660 feet thick.

Back of Lewistown the same rocks are 773 feet thick.

The following table shows the thickness of each formation in the several localities:

	Lewistown.	McVeytown.	Mount Union.	Orbisonia.	Three Springs.
Corniferous limestone,	40				60
Schoharie, ...	53	110	. . . . .	155	wanting.
Canda-galli, ...	40				wanting.
Oriskany sandstone, .	110	140	95		58
Oriskany shale, . . .	205	65	283	195	wanting.
Lewistown shale, . .	140	130	18		wanting.
Lewistown limestone,	185	215	35	125	162
Total, ...	773	660	430	475	280
Water-limestone, . . .	470	520	544	600±	580

NOTE.—The ground measurements in the Lewistown, McVeytown, and Mount Union sections, were made by Mr. Dewees, the construction by Mr. Ashburner; while at Orbisonia and Three Springs, both ground measurements and office construction were made by Mr. Ashburner. The Canda-galli, Schoharie, and Corniferous were not measured at Mount Union.

These sections show a very rapid thinning of the formations to the southwest. Between Lewistown and Three Springs, on the Jacks Mountain range, a distance of 35 miles south 40° west, 773 feet of rocks thin to 280 feet. From Orbisonia to Three Springs, only 6 miles to the west in an air line, the same rocks thin 195 feet. These measures have been compared in bulk because they are limited above and below by well determined horizons while those in between them were arbitrarily assumed.

The Water-limestone along the Jacks Mountain range from Lewistown to Three Springs increases from 470 feet to 580 feet; the thinning being inversely to that of the upper formations.

The author questions whether the rocks which have been considered the representatives of the Schoharie and Cauda-galli in the Lewistown Valley do not properly belong either to the Oriskany or Corniferous epochs. It seems questionable of the grits of the lower part of the Upper Helderberg formation in New York have a well defined representation in middle Pennsylvania.

A comparison of the formations from the bottom of the Water-limestone down to the top of the Trenton limestone will show that they also thin rapidly to the southwest.

The section line cuts the Marcellus iron ore bed about 700 feet northeast of the Orbison slope, where the dip is 80°, north 65° west. The synclinal between Sandy Ridge and Royer Ridge is the same flexure which ranges through Licking Creek and Negro valleys. Between Orbisonia sections No. 1 and No. 2 this basin is divided into two smaller basins by a central anticlinal which is first seen in the open cuts on the Marcellus ore bed half a mile northeast of Orbisonia. Both are shown in section No. 2. (pl. XIV.)

The dip of the bottom of the Marcellus shale on the western side of the synclinal of section No. 1 is 29°. The section cuts the Blue Ridge anticlinal directly under the town. The construction of the anticlinal is based on observations made in the Corniferous limestone along Blacklog creek, between the grist mill and R. R. bridge. The anticlinal is flat and broad, and has a slight depression in its crest as indicated by a dip of 5° to the east at a point a little west of the axis. The Corniferous limestone and Marcellus iron ore bed dip 19° on the west side of the anticlinal, and have a continuous downward dip to the centre of the Aughwick synclinal, when they begin to rise to the west, coming again to the surface of erosion along the western flank of the continuation of Chestnut Ridge which limits Hill valley on the east. The section cuts Saddle Back ridge about 2,200 feet south of Saddle Back gap and ends on the west side of Aughwick creek 2,000 feet southwest of the county bridge. The construction of the section of Saddle Back ridge is made from observations in the gap. No reliable dips were obtained through the Marcellus shale. The dips of the Hamilton sandstone range from 10° at the bottom, to 12° in the sandstone exposed along the banks of the creek, directly north of the county bridge.

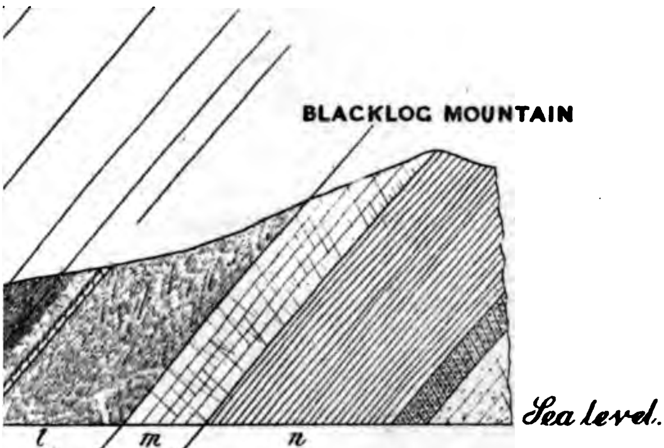
Orbisonia Section No. 2. (pl. XIV.)

The Orbisonia Section No. 2 extends from the crest of Blacklog mountain north 65° west to the crest of Saddle Back ridge. It is parallel to Section No. 1, and a mile and a quarter to the northeast. The rock thicknesses used in the construction were taken from Section No. 1. The general structure of the two sections is similar, being limited at each end by a monoclinal ridge with a main synclinal and anticlinal between. There is a general subsidence of the measures to the southwest of the section; in consequence of which, the dip of the Medina sandstone forming the mountain is increased, the Blue Ridge anticlinal becomes broader and flatter, and the two Marcellus shale basins between Royer Ridge and Sandy Ridge in Section No. 2 are merged into one main basin between the same ridges in Section No. 1.

Four Marcellus ore ranges cross Section No. 2, between the two ridges, while only two cross Section No. 1. The two ranges which cut Section No. 2 on each side of the central anticlinal extend southwest as far as the open cuts half a mile northeast of the town, where the outcrop of the

...ta district. J.H. Dewees.

C.A. Ashburner.



VIII	a	Hamilton sandstone.
	b	Marcellus black slate.
	c	Marcellus iron ore bed.
	d	Corniferous limestone, Schoharie; Cauda galli;
VII	e	Oriskany sandstone. Oriskany shale. Lewistown shale.
VI	f	Lewistown limestone.
	g	Water lime shale.
	h	Salina. Niagara;
V	i	Clinton red shale.
	j	Clinton upper olive lime shale.
	k	Fossil ore bed Ore S.S. &c.
	l	Clinton lower olive & grey.
IV	m	Medina white sandstone.
	n	Medina red sandstone & shale

two ranges unite as they pass around the end of the rapidly dying anticlinal.

In consequence of the dip between the mountain and ridge becoming steeper, and the mountain and ridge remaining about the same distance apart, an anticlinal is seen to begin between the two about midway between the two sections. This anticlinal is shown in Section No. 1, where it occurs in the Water-limestone. It is probable that this flexure dies away entirely directly south of the Furnace Water-limestone quarry.

East Broad Top Railroad Section.

This section is 60,900 feet long, or a little over eleven miles and a half (air line), and extends from Blacklog Valley north 68° west to Plank Cabin Valley. It exhibits a thickness of about 19,000 feet of strata.

In the wide, deep basin between Jacks Mountain and Blacklog mountain the strata from the bottom of the white Medina sandstone up into the Chemung series, (for 500 feet,) are exposed on each side, while the same strata are seen to outcrop again to the northwest of the former mountain. So too on each side of the Rocky Ridge basin at the northwest end of the section the strata from the top of the Pocono No. X, up to the coal beds, are exposed.

The thickness of repeated rock which a pedestrian would pass over in starting at one end of the line and walking eleven miles and a half to the other extremity would amount in all to six miles and a half.

If we should consider the section for a moment as extending all the way across Plank Cabin Valley, and cutting Terrace Mountain, which is formed of Pocono sandstone (X,) and ending in the valley of the Raystown Branch of the Juniata, the main features in the structure of the section would consist of a monoclinal mountain at each end;* the rocks of which would dip toward each other, with a central anticlinal, Jacks Mountain, between which and the terminal mountains would lie two synclinals, that of the Aughwick Valley and that of the Broad Top Mountain.

The principal elements used in the construction of the

* Blacklog and Tussey Mountains.

section were determined along the E. B. T. RR., between Orbisonia and Wray's Hill tunnel. These were verified by examinations made for some distance on each side of the section line. The portion of the section in Blacklog valley was taken from Orbisonia Section No. 1. The structure of the section from the Oriskany sandstone to the crest of Blacklog mountain was determined along the line near Sypestown, the thicknesses of the included formations being assumed to be the same as at Orbisonia. The dips range from 63 degrees, more or less, in the white Medina forming the crest of the mountain, which has a course of south 27° west, down to 50° in the Marcellus shales.

The Clinton fossil ore bed crosses the line of the section about 3,300 feet east of the road and the Marcellus ore bed 1,100 feet. The latter ore bed outcrops along the west flank of the Oriskany ridge, through which a gap has been cut at this point, forming an outlet to the small valley eroded out of the limestones of VI which lie to the east of the ridge.

The gap cut through the Hamilton ridge to the northwest of Sypestown is of considerable geological interest. A difficulty arose in the construction of the Sideling creek section, through the Marcellus shales, in front of Potts' Gap, explained elsewhere, which may possibly have some connection with the apparent inconsistencies in the dips in Sypestown Gap.

The dips in the upper part of the Hamilton Sandstone vary from 48° to 70° in a short distance. At first the construction was made by assuming an average dip, and that the wide range of dip merely indicated a local contortion which would have little effect on the general structure; but after a second and closer examination it was concluded that this irregularity of dip was the first evidence of the weakening of the strata and the commencement of the McConnelsburg synclinal, which shows more prominently in the Sideling Hill creek section.

The Aughwick Valley synclinal may be considered to be a more regular basin for a mile directly north of the section than at any other point throughout its extent in the district.

The Blue Ridge anticlinal which forms a prominent feature in the Orbisonia Section, No. 1, dies out to the southwest and probably ends entirely opposite the end of Saddle Back ridge, 2 miles southwest of Orbisonia. Between this latter point and the E. B. T. R. R. section there is no minor flexure in the eastern side of the basin ; while at the section line we have the first indications of what ultimately may prove to be the Big Scrub ridge basin*. Then again in this distance Saddle Back ridge lies nearer Blacklog mountain than we find it to the north, and nearer than it apparently does to the south, beyond the limits of the E. B. T. map. This fact is a necessary consequence of the geological structure of the Aughwick basin which we have just described and gives weight to our structural interpretation.

The Genesee slate range crosses the section line at the western end of Sypestown gap, while the Portage rocks directly above outcrop between the Aughwick creek and the western slope of Saddle Back ridge. The strata in the lower part of the Portage dip 38°, north 63° west, and in the upper part 32° in the same direction. What we have taken as the horizon between the Portage and Chemung crosses the section line directly to the southeast of the Aughwick creek, and continues about north 28° east, running through the turn of the road near H. R. Beer's house, near Beersville, where the rocks dip 33°. The axis of the Aughwick valley synclinal crosses the section line about midway between J. Painter's house and the Great Aughwick creek.

The bottom of the Chemung shales lies about 500 feet underneath the crest of Coaling ridge to the east of his house. The ridge rises to the southwest as the basin sinks in the same direction, so that as we ascend toward the summit of the ridge we rise very rapidly in the stratification. The great comparative height of Coaling ridge, from the summit of which there is a very fine view, is due to the fact that it lies in the centre of a basin, with a gentle inward dip of the rocks on each side, a condition favorable for resisting erosion.

The division between the Portage and Chemung rocks

* In Fulton County.

runs along the western slope of the ridge, about 1,000 feet southeast of the road-forks at Price's Siding, on the E. B. T. R.R., where the dip is 14°, to the southeast. The strike of the rocks to the northwest of this locality bends considerably to the west, being influenced by the Three Springs fault.

The Genessee slate forms the ravine about midway between T. Hooper and A. Nelson's houses, and crosses the section line directly east of the latter house.

The dip of the Genesee slate is 29°, southeast. The dip gradually increased to about 50°, or more, in the vicinity of the Marcellus iron ore bed, which cuts the section line south of Isaac Fleck's house. The fossil iron ore bed crosses the section line about 2,000 feet due west of Fleck's house. Between the two iron ore beds the measures maintain a dip of about 50°. The creek flowing across the section line between the two crests of Jacks mountain marks the axis of the anticlinal. The dip from the outcrop of the fossil seam to the creek diminishes very rapidly, until at the creek the rocks lie horizontal. Each crest of the mountain is formed by the white Medina sandstone dipping away from the creek on both sides. The hollow between the crests is eroded out of the red Medina sandstone.

On the northwestern side of the mountain the dips increase more rapidly than on the southeastern side. The Water-limestone dips 77°, and the Marcellus shale and slate 80°, north 72° west. The Clinton fossil ore bed crosses the section 2,400 feet, more or less, east of the road corners at J. F. Meminger's, while the Marcellus ore range passes directly east of Meminger's house.

The best opportunity for studying the section of No. VIII, from the ore bed to the top of the formation, is along the E. B. T. R. R. between Cohill's and Clear Ridge gap. The dip at this locality ranges from 80° at the bottom to 76° at the top, and in an average direction of north 72° west.

The sub-divisions of No. VIII along the R. R. have been somewhat arbitrarily assumed, and can be located from the descriptive catalogue of specimens which were collected in this vicinity.

The horizon between the Chemung No. VIII, and Catskill No. IX, lies on the northwestern side of Clear Ridge, and passes through the RR. cut at the end of the ridge. The section plane cuts Sideling Hill 2½ miles north 18° east of the tunnel.

The dip of the Pocono sandstone No. X, which forms the crest of the hill is 58°, N. 72° W. The section through the hill was constructed by assuming that stratum No. 152 of the vertical section, which forms the crest over the tunnel, and which is the hardest and most massive portion of the middle member of No. X, forms the crest of the hill where the section cuts it.

The dips of the Mauch Chunk strata in Ground Hog valley range from 55° to 27°; the latter being the dip at the bottom of the Pottsville conglomerate which caps Wray's Hill. Wray's Hill, or what we have more properly called Long's Ridge, has a synclinal structure and is separated from the Rocky Ridge synclinal by an anticlinal of No. XI, out of which Big Trough Creek Valley at this point has been eroded. The section cuts Rocky Ridge at the old Dougherty coal opening, which lies directly over the central anticlinal which ranges through the coal basin of Rocky Ridge, and which is described more in detail in the report of Todd township. The dip of the conglomerate on the eastern escarpment of Rocky Ridge is 16° northwest, and on the western 39° southeast. The lower part of the upper member of No. XI on the west side of the ridge dips 35° southeast.

The remaining portion of the section shows the comparatively flat measures of the Plank Cabin Valley, the surface of which along the section line is eroded out of the lower member of No. XI, the limestone of the middle member being gone.

If we should consider the rocks from one end of the section line to the other as having a constant dip in one direction, the angle which such an imaginary dip would make with the horizon would be 34° 23′.

The force which has contorted these rocks into the flexures shown in the section from the horizontal position in which they were originally laid down by the depositing waters of the ancient palæozoic sea may be imagined by supposing plate or belt of rock 11½ miles long and 3½ miles thick lying perfectly horizontal, and afterwards tilted at an angle of 34°. Fairly speaking this is not a complete statement or true illustration of the force of upheaval, since a great deal of the force which has contorted the rocks has been a horizontal thrust and not a vertical uplift.

Sideling Hill Creek Section. (pl. XVII.)

Sideling Hill Creek section is 56,300 feet or a little under eleven miles long. It extends from the crest of Blacklog mountain at Potts, gap north 65° west to the East Broad Top or Big Trough Creek coal basin, ending about ¾ of a mile south 35° west of the Alloway coal opening. About 2¾ miles vertical thickness of the Palæozoic rocks are exposed, exclusive of the repetition of the same strata on each side of the anticlinals and synclinals.

The strata from 300 feet below the top of the Hamilton shale and sandstone to within 500 feet of the top of the Catskill No. IX are exposed on each side of the Aughwick basin, and again repeated to the northwest of Jacks Mountain anticlinal. The actual vertical thickness of rock which the section line crosses would amount (in sum) to a little over 5 miles, or a mile and a half less than is exposed along the E. B. T. R. R. section. The principal elements used in the construction of the section were determined along the water courses in the vicinity of the line of the section.

The top of the Medina sandstone was located in Potts' gap, and the bottom of the Lewistown limestone, dipping 50°, north 65° west, on Aughwick creek east of Charltan's Heirs place. The thickness of the measures between the Marcellus iron ore bed and the top of the white Medina sandstone as determined at Rockhill gap, which is on the same range, were used in the construction. From the Marcellus iron ore bed to the bottom of the Hamilton sandstone at the bend of Great Aughwick creek a difficulty was encountered in the construction which renders the structure of this portion of the section hypothetical. The elements obtained were hardly conclusive enough to permanently settle the structure although they strongly indicate the proposed solution.

Commencing the description at the northwestern end, the position of the coal seam at the Alloway opening was assumed to be at the same distance above the Conglomerate as at Robertsdale where the opportunities for measurement were more favorable.

From the Alloway opening to New Grenada the elements of the section were determined along the county road between the two localities. The top of the Conglomerate was located at the opening on coal seam A on the south side of the road and from 300 to 400 feet east of the crest of Wray's Hill at the road crossing. The horizon between the conglomerate XII and red shale XI was located a short distance above the spring at the first sharp turn in the road as it descends the hill. The dip of the Conglomerate at one or two places along its outcrop was 5° west. Between the Alloway opening and the edge of the Conglomerate escarpment a flat broad anticlinal undoubtedly exists as shown in the section. It would be impossible to make the construction without it. Aside from the not altogether reliable data determined along the road between the Alloway opening and the opening on coal seam A, there are other facts which tend to support the above conclusion.

The elevation of the bottom of the Conglomerate under the Alloway opening is 300 feet lower than the elevation of the same horizon along the escarpment of the hill where the dip is 5°. If there was no anticlinal the Conglomerate would dip 2° 30′ to the west along the section line. This supposed dip is only one half of what the dip is both along the escarpment of the hill and at the coal opening.

If the Conglomerate should have a constant dip to the west as great as at either of the above localities the whole of the productive coal series would be found under the crest of Wray's Hill. As there are no indications of a constant dip between the two points, and as it is quite certain that the productive coal series do not underlie the summit of Wray's Hill, there can be little doubt of the existence of the anticlinal.

The anticlinal commences to the southeast of Cook's Station on the high red shale summit of the Martin tract, southwest of Stambaugh's coal openings, along the line of Rocky Ridge section No. 6, and directly west of the point where the central Rocky Ridge anticlinal ends. The influence of this flexure on the Big Trough Creek coal basin is rather important and is noticed elsewhere.

From the bottom of the Conglomerate to the Mountain limestone exposed at New Grenada the observations in the upper member of the Mauch Chunk series, XI, were not considered reliable. The thickness of the whole formation was determined in Ground Hog Valley, opposite Sideling Hill tunnel; that of the middle and lower members at New Grenada; the thickness of the upper member being the difference between the two. The top and bottom horizon of the upper member being located along the line of the section, the former at the iron ore at the bottom of No. XII and the latter at the top of the mountain limestone, the structure was completed by plotting the thickness of the upper member. The anticlinal and synclinal indicated are the Long's Ridge synclinal and the Ground Hog valley anticlinal which are shown to the northeast in the E. B. T. R. R. section. The synclinal or shallow basin shown on the edge of Wray's Hill is no doubt the southwestern extremity of the Rocky Ridge synclinal. These flexures may be traced on the E. B. T. map. The mountain limestone crops along the northwestern edge of the village of New Grenada, the dip is 38° north 65° west. The horizon between the Pocono sandstone No. X and the bottom member of No. XI passes directly through the village.

The structure from New Grenada southeast to the central part of the northwestern dipping Chemung rocks between the Miller and Gladfetter farms is extremely simple, the dip varying from 38° at the former locality to 41° at the latter; the maximum dip between being 44° at the bottom of the Catskill shale No. IX.

Sideling Hill gap is a straight regular gap cut through the Pocono sandstone No. X. The regularity of the sides of the gap is due to the even character of the rock through which the cut has been made. Stratum No. 152 of the vertical section forms the crest of the hill as in the E. B. T. R. R. section. The dip of the sandstones of No. X range from 31° at the bottom, in the eastern end of the gap, to 38° at the top. The horizon between No. IX and No. X runs parallel with the hill about 700 feet west of the Methodist church.

The transition strata between the Chemung and Catskill pass to the west of G. Miller's house and the grist mill on the north side of Sideling Hill creek.

The dips of the Catskill red shale and sandstone range from 31° at the top, to 44° at the bottom, being in the inverse order of the dips in the Pocono sandstone.

Two series of dips were observed in the centre of the Chemung shales along the creek to the southwest of Gladfetter's house.

The top layers of the Chemung cross Sideling Hill creek to the west of the grist mill; the bottom layers pass through Benj. Wollard's house.

The thickness of the Chemung rocks was determined in the E. B. T. R. R. section, and in the great Aughwick basin along the Sideling Hill creek section. The construction of the section through the Chemung being made with the dip series 41°, 65°, 39°, the thickness of the formation came out several hundred feet greater than in any other locality. Using the series 41°, 23°, 39°, the result was approximately the same as obtained by measurements on other ranges, while a combination of the two series produced a result much greater than elsewhere determined without revealing any peculiarity of structure. The thickness of the other formations varied so slightly between the two section lines and on the several ranges where they were examined that it was thought best to use the lower series of dips.

The belt of the Portage rocks on the northwest side of Jacks Mountain anticlinal is nearly 2,000 feet broad along the section line, or, in other words, the horizon between the Portage and Genesee is about 2,000 feet east of Benj. Wollard's house. The dip of the formation ranges from 39° at the top, to 45° in the centre, and 68° at the bottom. The Portage belt to the southeast of the anticlinal is about 1,800 feet broad. The bottom horizon passes directly to the west of M. Grisinger's house, and the top or that separating the Portage from the Chemung, 1800 feet to the east of Grisinger's. The average dip of the strata in this belt is 56°, south 55° east.

The peculiar course of Sideling Hill creek as it flows around Jacks Mountain anticlinal is worthy of attention, as it has not been determined by chance. The creek, from New Grenada, breaks through Sideling Hill gap and crosses the formations to the top of the Portage shales, with a course very nearly in the actual direction of the dip. As soon as it cuts its way into the Portage belt, it turns very nearly a right angle, flowing in a general course parallel with the strike of the rocks, north 20° to 25° east, for about a mile; its bed in that distance laying very nearly over the middle Portage measures. To the southeast of D. F. Stevens' house the creek makes a sudden bend to the right, and flows due east to the centre of the anticlinal, where it is deflected to the southeast, and flows over the Portage rocks until it enters the bottom of the Chemung, $\frac{3}{4}$ of a mile south of where it crossed the horizon between the Genesee slate and the Portage. It would seem as if the Portage offered a barrier through which the creek was unable to cut until after it had made several unsuccessful attempts; and the very point where it finally succeeds seems to have been determined by a depression in the declining axis of the Jacks Mountain anticlinal.

A careful study of the section of the Portage rocks partially reveals the cause of this peculiar form of erosion. The strata have the same general character throughout the series; they consist of extremely argillaceous compact shales, alternating with sandstones in comparatively thin beds. The name of mud rocks, given them in some localities, does not seem to be inconsistent with their character here. The rocks have no definite lines of fracture or cleavage, and do not break into distinct rhombohedral forms as the layers above them. There is nothing in the structure of the rocks to give direction to the streams along the dip.

The Genesee slate outcrops directly on each side of the anticlinal; the two ranges unite inside of the U formed by the creek, within the limits of the map. The slate to the west of the anticlinal dips 68°, north 70° west, and that to the east of the flexure 50 to 55°, south 60° east. The anticlinal is exposed on the north bank of the creek, about 800 feet north of William Shue's house, and is formed of the upper part of the Hamilton sandstone.

The Chemung on the southeastern side of the anticlinal occupies a narrower belt than on the northwestern side. The top of the Chemung crosses the section line about 600 feet east of the road leading from Dublin Mills to Three Springs. The dip of the strata for two thirds of the distance from the bottom of the Chemung is 55°, south 60° east, while the dips of the remaining third range from 55° to 46° to 42°±

The Catskill red sandstone No. IX occupies the centre of the Aughwick basin, the belt having a breadth of nine thousand nine hundred feet, or about a mile and three quarters. The Aughwick basin, where the section cuts it, contains 2,100 feet of the Catskill rocks. The geological position of the bottom of the Pocono sandstone approaches within 500 feet the present surface of erosion to the northeast of Joseph Waters' house.

The bottom of the Catskill on the western side of the basin dips 38°, south 65° east, and on the eastern side 48°, north 65° west. The two sides of the basin are very nearly symmetrical. The horizon between the Chemung and Catskill on the eastern side of the basin passes between James Wibles and T. Everhart's house.

The division lines between the bottom of the Catskill and the bottom of the Hamilton sandstone on the eastern side of the basin were not absolutely located on the ground, but were geometrically determined by getting good reliable dips between these two limits, and assuming the thicknesses to be the same as on the other ranges. The dips range from 47° as a minimum to 51° as a maximum, and in a direction north 65° west. The ridge upon the summit of which is S. Taylor's house is formed by the Chemung rocks; it is sometimes known locally as Clear Ridge.

Silent Hill creek, which empties into the great Aughwick just to the north of its turn, rises in the Portage measures and cuts through the Genesee slate and Hamilton sandstone.

The top of the Marcellus shale is just to the east of the mouth of Silent Hill creek. The bottom of the same formation passes through Charlten's heirs' place. If the general dip of the rocks above and below the Marcellus shale continued throughout this formation, the Marcellus itself would approximate 3,000 feet. But the thickness of these shales at Orbisonia, and in the E. B. T. R. R. section was less than 900 feet. It is hardly possible, since the thickness of the other formations remains so constant, for it to have thickened to 3,000 feet in the distance between the Railroad and Sideling Hill creek sections.

Although in the rapid examination of this portion of the section no reliable dips were obtained, yet there are evidences to support the method of construction which has been adopted. The structure adopted, showing an anticlinal and synclinal, is undoubtedly correct, although the exact position of the horizons are purely hypothetical for want of reliable dips.

On the south bank of the Little Aughwick creek, to the southwest of J. B. Linn's house, there is an exposure of Marcellus shale presenting a perpendicular wall, about 10 feet high and 300 feet long, which is very near the centre of the synclinal. The shale shows evidence of having been subjected to great pressure; it readily breaks into long fingers and into a sort of concretionary masses stained on the surface with bituminous matter. The lines of stratification are almost entirely obliterated.

The maximum dip along the section line is 68° at the bottom of the Portage to the northwest of the anticlinal. The minimum dips are in the Aughwick basin.

The resultant dip of the rocks, or the dip which they would have did they all dip in the same direction, would be 28° 20′, which is 6° less than in the Railroad section. As each section extends about the same distance into the Broad Top synclinal, where the strata are very flat, this decrease in the resultant dip by 6° shows an absolute flattening of the measures to the south-west. The general structure of the section is similar to that of the E. B. T. R. R. section. The most striking difference between the two is the existence of an anticlinal and synclinal at the southeastern end of the Sideling Hill creek section.

Faults.

Rockhill Gap Fault. In 1874, Mr. Cassimer Constable, former superintendent of the Rockhill Iron and Coal Company, found that by extending the line of the gangway of the south fossil ore mine (No. 3) across Rockhill gap, a distance of about 550 feet, to the north gangway (No. 2) there was an offset or fault in the strike of the ore bed of 94±feet; the north gangway being to the east of the prolongation of the course of the south gangway.

From measurements which I made in April, 1875, I came to the conclusion that it was impossible to determine the exact amount of the fault, because the strike on the two sides of the gap was not the same. It may safely be stated, however, to be something between 90 and 100 feet.

Mr. Constable asserted that before the construction of a dam in Blacklog creek by which the Medina formations exposed in its bed were covered, he was able to walk along the line of fault, from the division between the Medina red and white sandstone on the north bank, 94 feet, west, to the corresponding line of division on the south bank.

Minor faults occur in the measures on both sides of the gap, and are described at length in report F, page 133. They have been crossed in the gangways which have been driven both north and south in the fossil vein. The ore bed is thrown at one time to the east, and at another time to the west, although it seems to be thrown more frequently to the east, or into the foot wall on the north side and to the west, or into the hanging wall on the south side, which, it will be noticed, is the direction of the major fault. According to Mr. Constable, the face of the minor faults dip at about an angle of 30° towards the north east.

The major fault cannot be accounted for by the continuation of the minor faults across the creek between the fossil ore openings. If we prolong the general course of the ore bed both ways across the gap the lines will not intersect, showing conclusively that a greater fault than any which have been encountered in the mine gangways must exist between the mines on opposite sides of the creek.

The character of the gap itself indicates the existence of a fault. Instead of the creek through the gap assuming the shape that we find those having through Logan Gap, Schuylkill Gap, &c., we find its bed at right angles to the general direction of the mountain crest, undoubtedly along the line of fault. The fault does not extend further east than the division line between the Oneida red and Oneida gray formations; for the position of this dividing horizon is determined on either side of the gap independently, was found to be in the same line.

By a careful study of the structure of Blacklog Mountain on both sides of the gap I am led to believe that the upper limit of the fault would be marked by a plane perpendicular to the plane of dip and passing through the horizon between the Oneida red and gray formations at water level. If a line should be drawn, on Orbisonia section No. 1 through this point and perpendicular to the dip, which is 78°, it would be the vertical trace of the plane marking the upper limit of the fault.*

This view seems to be confirmed by the character of the faces of the gap. Unlike the course of the creek at its present level they are S shaped, showing that when the creek bed was at the higher levels where the fault was inappreciable, it was guided in its course by the common rules of erosion which govern the formation of gaps in mountains of No.

*Note.—Properly speaking, this upper limit of the fault would not be a plane, but a warped surface, because the dip to which this surface is perpendicular is constantly changing.

IV, and did not have its course determined by the line of fault, which, as a simple construction will show, was much smaller at the higher levels.

These faults could be produced by any force or forces which would have a tendency to push the mountain, north of the gap, to the east, and south of the gap to the west. If we draw a line on the map (plate 2) through Rockhill Gap at right angles to the direction of the mountain, we find that the greatest point of elevation of the Blacklog Valley anticlinal is to the south of it, and that the Blue Ridge anticlinal sinks more rapidly directly in front of the gap, and to the south of the line, than it does to the north of the line.

In the breadth of Blacklog Valley opposite the gap, and in the duplication of its anticlinal axis, mentioned elsewhere, we find evidences of a tendency to push the mountain south of the gap to the west.

The force which the Blue Ridge anticlinal exerted to resist any force in a westward direction being very much weakened by the rapid subsidence of the anticlinal, the result was the shoving of the mountain and adjoining strata south of the gap to the west, producing thereby the Rockhill fault. If the change in the subsidence and elevation of the anticlinals on either side of the mountain had been a gradual, instead of a rapid change, the effect should have been merely to bend the strike of the strata into a gentle curve, rather than to produce a sharp break along the line of the dip, which is the general direction of the present fault. The fault does not extend further west than the axis of the synclinal in the Water-lime measures shown in the Orbisonia section. It is reasonable to suppose that the measures directly south of the fault and near the axis of this synclinal would be very much broken and contorted; and we find them so in the Furnace Water-lime quarry.

Three Springs Fault. This fault shows in the Silurian and Devonian rocks from the Clinton shales No. V, to the Portage shales No. VIII, inclusive, on the eastern side of Jacks Mountain directly north of Three Springs in Clay township.

The fault was first detected by Mr. Billin in mapping the topography of the Oriskany and Hamilton ridges to the east of Mr. R. L. Green's house. It was found that there was a break in the topographical features to the N. E. and S. W. of Green's. After carefully tracing the outcrop of the Marcellus iron ore bed from Fleck's bank southwest to Three Springs, I found that in the gap at Green's the outcrop stopped abruptly about a thousand feet east of his house, and continued on, to the southwest, from a point 1,400 feet (a little north of west) from the point at which it stopped coming from the northeast; this fact plainly showed the existence of a fault, which, by a study of the outcrop of the formations directly above and below the ore bed, proved to extend from the Portage rocks down into the Clinton shales, ending probably before reaching the outcrop of the Medina sandstone.

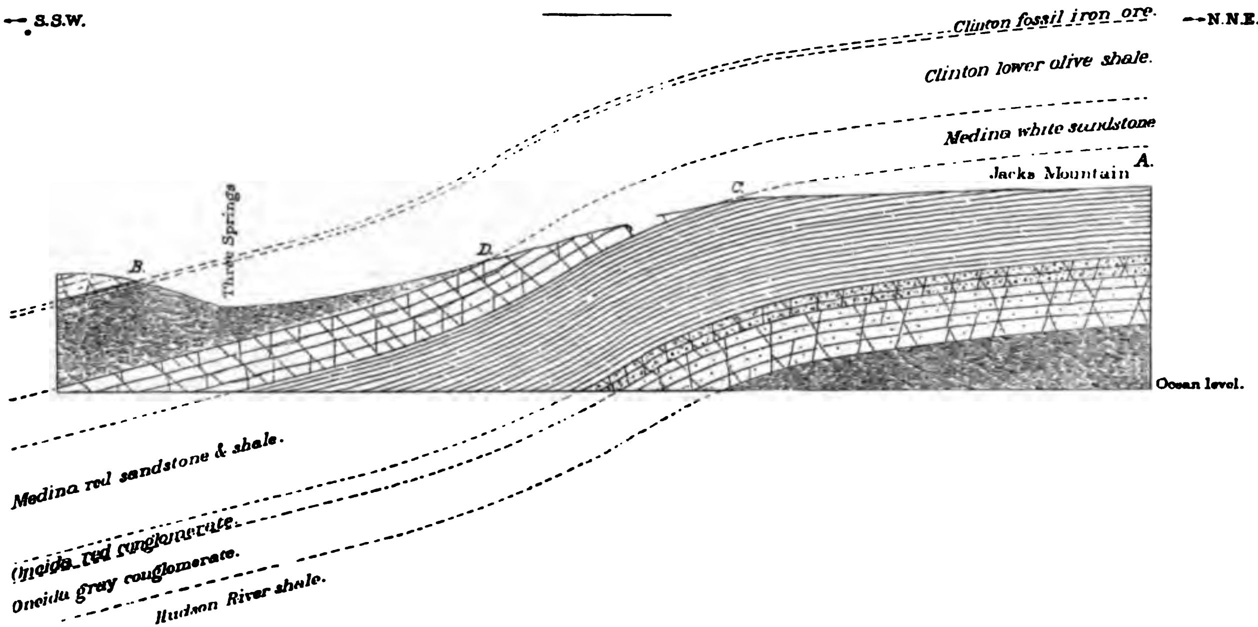
The line of the fault, or the intersection of the plane of the fault with the surface of erosion, extends from the outcrop of the upper part of the Portage at the foot of Coaling ridge, 600 feet east of the Aughwick creek, and 2,800 feet south west of the railroad bridge at Price's siding, in a direction north 86½° west for 2.37 miles, to a point on the county road five eighths of a mile (.62 miles) north west of Three Springs station, ending in the lower Clinton olive shales.

The greatest break in the outcrop of any of the formations occurs in the gap east of Green's, where the Marcellus ore bed is thrown 1,400 feet, to the west, on the south side of the fault plane. The vertical throw in the gap is between 1,000 and 1,100 feet. This is the maximum *vertical* displacement, and is situated a little to the west of the center of the line of fault. The amount of displacement at the surface diminishes of course to the east and west from this point. The horizontal break in the outcrop of the Clinton fossil ore bed, half a mile to the west of Green's house, is 300 feet, more or less.

The outcrops of the formations on each side of the fault are shown on the accompanying geological map of a belt of country along the railroad. The horizon separating the Portage from the Chemung on the west side of Coaling

Longitudinal Section of Jacks Mountain midway between Three Springs and Saltillo showing the subsidence of the Anticlinal at the end of the Mountain. by Chas. A. Ashburner.

Scale 3200 ft. to an Inch.



ridge and that separating the Medina from the Clinton are found to be continuous, while the intermediate horizon lines are broken at the line of fault.

The fault is caused by the subsidence of the Jacks Mountain anticlinal. This anticlinal has its maximum subsidence to the west of the fault, as may be seen by the accompanying longitudinal section of the mountain. In 3,500 feet south of the point where the railroad section cuts the anticlinal the subsidence is 9¾°, while in the next 3,200 feet south, the subsidence is over 34°, showing an increase of nearly 25°. In the remaining distance of 1,800 feet to the outcrop of the Clinton fossil ore bed the subsidence diminishes to 14°, more or less.

The distance between the railroad section and the outcrop of the fossil ore is 8,500 feet.

As the anticlinal declines, the outcrop lines of course converge toward the axis in the direction of subsidence.

If the force which tended to depress the flexure southward or elevate it northward had been exerted constantly and gradually, there probably would not have occurred any sharp break in the strata, on either side of the anticlinal, of sufficient magnitude to be detected by surface observation. On the other hand, if the action was paroxysmal, a break would naturally occur in the strata opposite the point of greatest subsidence, resulting in a downthrow on that side of the fault, in the direction of subsidence. This has undoubtedly been the case with the Three Springs fault. From the straightness of the line of fault and the sharpness of the break, as evidenced by the fact that the strata are but slightly broken and twisted on either side of the plane of fault, the force which produced the throw was probably a paroxysmal one.*

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*It is impossible to determine whether the fault is an uplift or downthrow. If the strata in the process of plication from their original horizontal position were being depressed at the time the fault occurred, then we would naturally imagine it a downthrow on the south side of the fault plane, but if, on the contrary, the rocks were in the process of elevation, then the fault would be the result of an uplift on the north side.

The strata in which the fault occurs being over 8,000 feet below the coal measures, which, at one time, covered the entire area now marked by Jacks

The influence of the fault on the topography, as seen by the railroad map, is very marked, and irrespective of the geological structure would indicate the presence of a break in the strata. It will be observed that the western side of Coaling ridge is regular in its slopes south of the line of the railroad section. The dip of the Chemung here is 14° S. E., and there is nothing to show that the strata are broken by the fault. The fault has been thought to end 600 feet east of the Aughwick creek.

The railroad crosses the line of fault 3,600 feet south of Price's siding, and follows it in a gap cut through the Portage for more than a quarter of a mile to the west. Here the railroad curves to the south, taking a course very nearly parallel to the direction of the tangent at Price's siding. The position of this Portage gap has undoubtedly been determined by the fault plane. Directly to the west of the gap lies a nearly circular hill, the greater part of the crest of which is formed by the Hamilton sandstone. The north western part of the crest is formed by Marcellus shale. Considerable difficulty was experienced at first in locating the exact position of the fault on account of this hill, for it was thought hardly possible that the fault could pass through the hill without having a more marked influence on its topography.

The Genesee slates to the east of the hill and north of the fault abutt against the Portage shale to the south of the fault; while to the west of the hill the Oriskany sandstone butts against the lower part of the Hamilton sandstone. These facts established the undoubted position of the fault through the hill. There are three gaps in the vicinity of the fault,

Mountain, and these overlying Carboniferous and Devonian rocks having only been removed through erosion, there is some reason to believe that the force or forces which produced the plications of the district were rather of upthrust along Jacks Mountain anticlinal than of downthrust in the Broad Top or Aughwick synclinals. If the fault was produced at this time, then it is probably an uplift. We have no guarantee that the faulting took place during the time of original plication, it may have only been produced long after the erosion of the upper measures had commenced, and during a time when there was still crust movement going on. The break may have happened during a secondary oscillation, when after the anticlinal had been elevated it was being depressed, and in this latter case we would consider the fault a downthrow.

and with the exception of the Portage gap spoken of above, they cross the fault obliquely, a feature which is quite distinctive of the Three Springs fault when compared with the fault in Rockhill gap. Plate XVIII is an isometric projection of the topography in the vicinity of the Three Springs fault, showing the direction and amount of throw along the plane of fault.

On account of the structure and the position of the plane of fault relatively to the dip and strike of the rock, considerable difficulty was experienced in attempting to represent graphically this interesting case of structural geology. The isometric projection does not show the structure as perfectly at first sight as was hoped. The present illustration is the result of much study and experimentation, and I place it before the student as the best representation I could design.

The structure is not shown on the plane of fault D,D′, D″ D‴, on account of the confusion which was found to result in attempting to represent on the same plane the structure of both sides of the fault at the same time. I have therefore represented it on two planes 800 feet apart, one north of the fault (X, X′, X″, X‴) and the other south of it (Y, Y′, Y″, Y‴).

BB′ shows the break in the outcrop of the Marcellus ore bed, CC′ the break in the Clinton fossil ore bed and AA′ the break in the horizon between the Genesee slate and Portage shale.

CHAPTER IV.

Section across Southern Huntingdon County.

The following general vertical section of Lower Carboniferous, Devonian, Silurian, and Siluro-Cambrian formations, with their subdivisions, groups and individual beds, represents a total thickness of about 18,400 feet:

Lower Carboniferous:			
Lower coal measures,	XIII.	256′	3,769′
Pottsville conglomerate,	XII.	280′	
Mauch Chunk red shale,	XI.	1,100′	
Pocono grey sandstone,	X.	2,133′	
Devonian:			
Catskill red sandstone,	IX.	2,680′	8,033′
Chemung, Portage, Hamilton, Upper Helderberg,	VIII.	5,295′	
Oriskany sandstone,	VII.	58′	
Silurian:			
Lower Helderberg, limestone, &c.,	VI.	1,182′	4,225′*
Clinton red shale,	V.	1,145′	
Medina and Oneida sandstones,	IV.	1,898′	
Siluro-Cambrian:			
Hudson River and Utica slates,	III.	1,870′	2,370′+
Trenton limestone,	II.	500′+	
Total, measured and estimated,			18,397′

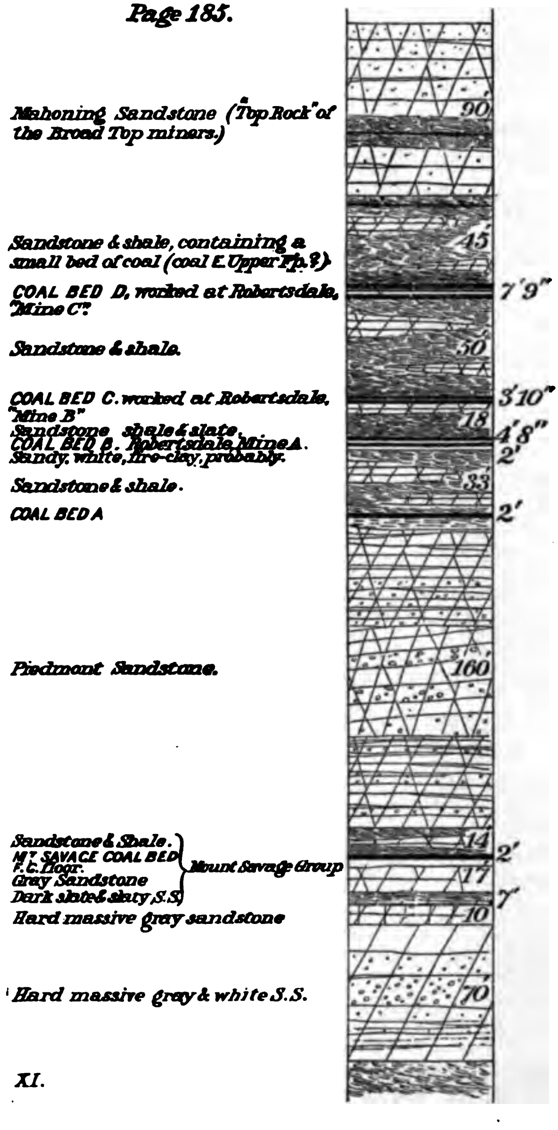
The thicknesses assigned to the divisions and subdivisions of the Section were obtained partly by direct measurement of single outcrops, or series of outcrops,—partly by geometrical construction along one line, by means of occasional, but neighboring outcrops,—and partly by construction on one or more lines of observation.

The planes or horizons between the groups and formations of the Section are in some cases arbitrarily assumed, not being based exclusively either upon lithological or palæontological grounds, as the descriptive text of the section shows.

* In this summation the Clinton ore rocks are taken to be 53′ thick as measured at Orbisonia.

Section of the Lower Productive Coal Measures and Pottsville Conglomerate in the Big Trough Creek Coal Basin.

Page 185.



In a number of instances the division or subdivision line has been necessarily drawn at the end of an exposure, or at a sudden break in, or change of, the topography.

The section must therefore not be considered a final statement. Many of its lacunæ will no doubt be filled up by future explorers, and some of its zero points may have to be shifted.

The original numbering of the Palæozoic formations from I to XIII has been retained, as the numbers stand in the third and subsequent annual reports of the First Geological Survey (1836–1841). The names given to the formations in the Final Report of 1858, *Seral*, *Umbral*, *Vespertine*, &c., are added for comparison, in the body of the section.

The top of the section is assumed at the horizon of the Mahoning Sandstone (the base of the Barren Coal Measures) at Broad Top City, where it forms the surface, riding over the principal anticlinal of the coal field. Higher rocks outcrop along Shoup's run, Six Mile run, and Sandy run, three streams descending westward to the Juniata river, but their measurements must be reserved for a future report. In Round Top, south of Six Mile run, the highest point in the Broad Top region, nearly 1,000 feet of coal measures overlie the Mahoning Sandstone.

XIII. Carboniferous.

Lower Productive Coal Measures.

Alleghany River Series.

Number of stratum.	Description of Formation.	Thickness.	Total from bottom.
		Feet.	Feet.
267	Mahoning sandstone, ("Top Rock" of the Broad Top miners.) A white conglomerate sandstone, in two divisions, between which lie softer shaly sands and shales, containing a thin coal bed, . .	90.	256.3
266	Sandstone and shale, containing a small bed of coal, (coal E, Upper Freeport?) a short distance below the bottom of the Mahoning sandstone. Lower part, directly over coal D, a hard and rather massive black slate, ...	45.	166.3

	Coal bed D, worked in the Robertsdale "Mine C," and divided thus:—		
265	Top bench, coal, ... 2′ 1″		
264	Black fisile slate containing seams of coal, varying in thickness from ¼″ to ½″, . . 0′ 4″		
263	Middle bench coal, ... 0′ 2″	7.9	121.3
262	Slate containing a stratum of sandstone about the center. . . . . 2′ 1″		
261	Bottom bench coal, ... 3′ 1″		
260	Sandstone and shale; the lower part being composed of black slate, ...	50.	113.6
	Coal bed C, worked in the Robertsdale "Mine B," and divided thus:—		
259	Top bench coal, ... 1′ 6″		
258	Hard greyish black slate, of variable thickness, ... 0′ 4′	3.10	63.6
257	Bottom bench coal, ... 2′ 0″		
	Fire clay floor, thickness unknown.		
256	Sandstone, shale and slate, ...	18.	59.8
	Coal bed B, worked in the Robertsdale "Mine A," and divided as follows:—		
255	Top bench coal, ... 1′ 6″		
254	Rock and fire clay parting, ... 1′ 4″	4.8	41.8
253	Bottom bench coal, ... 1′ 10″		
	Sandy, white, fire clay, probably, ...	2.	3.7
252	Sandstone and shale, ...	33.	35.
251	*Coal bed A*, underlaid by a carbonaceous black fire clay, locally called "black gravel,"	2.	2.0

Notes of localities.—Nos. 267, 266, 260, 256 and 252 were studied at Robertsdale, in the Trough Creek coal basin, Carbon township, Huntingdon county.—Nos. 265 to 261, in a measured section about 400′ from the mouth of Mine C¹.—Nos. 259, 258, 257, measured about 200′ from the mouth of Mine B¹.—Nos. 255, 254, 253, were measured by Mr. Wm. Foster in Mine A, and No. 251 is from Mr. Foster's report of the Monkey Drift.

The Mahoning Sandstone, No. 267 of the section, caps the hill to the north-west of Robertsdale in the East Broad Top or Big Trough Creek Coal Basin, where the top of the section ends. A thickness of 90 feet is here given, although a portion of it may have been eroded from the surface of the hill.

The coal measures beneath it (Nos. 266 to 251 inclusive), are 166 feet thick and consist of shales, slates, and sandstones, containing 3 workable seams of coal (2 benches each). On account of a number of rolls in the strata and the varying dip of the rocks at Robertsdale, where the coals have been most extensively developed, and for the want of a system of levels throughout the workings on the coal seams, it was impossible, with any degree of certainty, to determine the precise intervals between the several coal beds. The given thicknesses between the coals are only approximate, and may be found to vary as much as 10 feet, although the total thickness of the series is probably as fair an estimate as can be made.*

The Big Trough Creek coal basin is very shallow, and its rocks nearly horizontal. It is in fact a plateau elevated (at Robertsdale) 1785′ above ocean level, and bordered on the west by an anticlinal ridge to the east of Broad Top City Mountain House 1997′, and at the summit between New Granada and Robertsdale 2151′. The coal terraces are faintly marked. The terrace made by the outcrop of the Mahoning Sandstone is steeper and most continuous. Gentle rolls in the floor of the basin which swing the gangways out of course are scarcely noticeable at the surface. Big Trough Creek, after collecting the drainage of the coal field, east of the anticlinal, cuts northward down through the conglomerate into the red shale, along the synclinal where it is narrowed by steep opposing dips, through the gorge in Rocky Ridge, as shown upon the map.

Of the three workable beds of coal shown in the section, only two (C and D) have been developed to any great extent in the East Broad Top basin, at the Robertsdale collieries of the Rockhill Iron and Coal Company, and the Alloway openings on the property of E. L. Anderson's heirs about one mile distant from Robertsdale.

Specimens were selected from the *lower* (specimen 310) and *upper* (310†) *benches of coal bed C*, in different parts of Mine B^1, and from the *lower* (313) and *upper* (317) *benches of coal bed D*, in different parts of Mine C^1. The following results were obtained by Mr. A. S. McCreath in the laboratory of the survey at Harrisburg; the specimens being sampled November 29, 1875, and analyzed between March 13 and February 28, 1876:

*This part of the section will be found to differ slightly from that published in a paper which I read before the Amer. Phil. Soc., Feb. 16, 1877, on the "Palæozoic Formations in Middle Penna." From recent measurements which have been made the above section is more correct.

† See catalogue of specimens in the collection. Chapter VI of this report.

	(310)	(312)	(313)	(317)
Water,	.560	.395	.535	.450
Volatile matter,	16.002	16.140	15.910	16.210
Fixed carbon,	73.091	72.942	71.898	70.601
Sulphur,	1.115	2.483	3.434	4.170
Ash,	9.232	8.040	8.223	8.569
	100.000	100.000	100.000	100.000
Coke, per cent.,	83.438	83.465	83.555	83.340
Color of ash,	Dirty gray.	Reddish gray.	Reddish gray.	Reddish gray.
Sulphur left in coke,	.....	1.676	2.428	
Sulphur, per cent. in coke,	.....	2.008	2.905	
Iron, per cent. in coal,	.....	1.960	2.828	
Sulphur taken up by iron,	.....	2.240	3.232	
Sulphur not combined with iron,	.....	.243	.202	

A series of analyses, by Mr. J. Blodgett Britton, of Philadelphia, are added for comparison:

	(310)	(312)	(313)	(317)
Moisture,	1.13	.91	1.58	1.31
Volatile matter,	15.56	15.83	14.30	15.15
Fixed carbon,	74.73	72.99	77.15	75.71
Ash,	8.58	10.27	6.97	7.83
	100.00	100.00	100.00	100.00
Coke, from raw coal,	83.31	83.26	84.12	83.54
Sulphur, per cent. in coke,	.466	1.974	1.057	1.438
Sulphur in coal,	.762	2.431	1.475	2.416

Very different amounts of fixed carbon, ash and sulphur are obtained by analysis from the different parts of both beds, and especially of the upper bed (D). Judging merely by the first series of analyses above given, bed C would be expected to furnish the best commercial coal; judging merely from the second series of analyses bed D would be preferred. In point of fact, chemical analysis by itself is insufficient for establishing the value of a coal bed. A bed is to be judged by the kind of coal it yields as years go by and its underground works extend themselves. In 1875 the coal sent down from the collieries on bed C (mine B') was the favorite; in 1877 bed D (mine C') produced the better coal. The advance of the galleries has altered the relative commercial value of the beds, so that it is practically impossible to establish the value of a coal bed in any mining tract in the Big Trough basin by a chemical analysis alone.

The following analysis of specimens (319^a, 319^b) of *Rockhill Furnace* (Orbisonia) *Belgian Oven Coke* was made by Mr. A. S. McCreath; No. 319^a of mixed coal from Mines B^1 and C^1, and No. 319^b of coal from Mine C^1 alone:

	(319^a)	(319^b)
Water,	.850	.400
Volatile matter,	.930	.750
Fixed carbon,	86.136	88.162
Sulphur,	1.824	1.318
Ash,	10.760	9.370
	100.000	100.000
Color of ash,	Reddish gray.	Reddish gray.

The following analyses of *coke made in the Gobiet oven, from washed coal*, from the Kelly seam, on the west side of the Broad Top coal field, was made by Mr. McCreath, for comparison:

Water,	.150
Volatile matter,	.780
Fixed carbon,	86.734
Sulphur,	1.452
Ash,	10.884
	100.000
Color of ash,	Reddish gray.

The coal of the East Broad Top basin does not contain as high a percentage of volatile matter as might be desirable to be quickly coked. An arrangement which has been made at the Rockhill Furnaces at Orbisonia (1875), to convey some of the waste gases from the furnace to the ovens has been found to work well; the influx of the gases is under perfect control, being increased or diminished according to the heat required. A specimen of coal from the Alloway opening (in bed C) in the East Broad Top Basin, about one mile from Robertsdale yielded an analysis (David McCreath):

	(321)
Water,	.250
Volatile matter,	14.510
Fixed carbon,	77.042
Sulphur,	1.338
Ash,	6.860
	100.000
Coke, per cent.,	85,240
Color of ash,	Gray.

The analysis is of a specimen from both benches of the seam mixed together. The coal at this opening contains 4 per cent. more fixed carbon, 1.5 per cent. less volatile matter, .45 per cent. less sulphur, and 1.75 per cent. less ash than an average specimen from both benches of the same seam at Robertsdale. This difference goes to prove what a local variation there may be in the chemical constitution of a coal bed at two points not far apart.

Specimens of coal taken from unidentified beds in Rocky Ridge Basin yielded on analysis (A. S. McCreath):

	(323)	(324)	(324*a*)
Water,	.390	1.020	.210
Volatile matter,	18.165	17.840	17.540
Fixed carbon,	75.421	74.623	67.154
Sulphur,	.994	.797	1.496
Ash,	5.030	5.720	13.600
	100.000	100.000	100.000
Coke, per cent.,	81.445	81.14	82.25
Color of ash,	Cream.	Cream.	Red'h gray.

323 Curfman (Savage) opening.

324 Petriken (Taylor) opening.

324*a* Dougherty opening.

Specimen 324*a* was collected by Mr. John Dougherty* from the opening which he made in the early part of 1877 near Wray's tunnel. The coal was taken from the mine in March, 1878, and analysed about April 6, by S. S. Hartranft. Mr. McCreath reports the coal to be of a "deep black

* Judging from the analysis it is probable Mr. Dougherty has failed to obtain an average specimen of his coal.

lustre, rather firm and compact. It carries numerous thin knife edges of slate; also bands of grayish black ashy coal and shows considerable pyrites in thin scales."

The Rocky Ridge coal bed of the Petriken (Taylor) Dougherty and Curfman (Savage) openings has not yet been identified with any of the beds at Robertsdale. In the Broad Top report a section will be given to show the relative position of the bed to the top of the Conglomerate. Merely judging by analysis the coal is quite different. It is less ashy and less sulphurous, which might or might not be expected. But it contains more gas, which would be surprising (in view of the fact that the beds are much uptilted in Rocky Ridge, but at Robertsdale lie flat,) were the analytical difference greater. After all however there is only two per cent more volatile matter in the Rocky Ridge coal than in the Robertsdale coal, and the steep dips of Rocky Ridge are produced by subordinate rolls in the great synclinal of Trough Creek Valley. We are only called upon to contrast two semi-bituminous coals, after all; and not two coals, one an anthracite, and the other a high gas coal.

*XII.—Pottsville Conglomerate.** (*Seral Conglomerate, of the Final Report of 1858.*)

Number of stratum.	Description of Formation.	Thickness.	Total from bottom.
		Feet.	Feet.
250	Upper Member—Piedmont sandstone:— . . .	160	280
	Top—White and reddish-white and gray, flaggy sandstone and conglomerate.		
	Middle—Conglomerate beds predominate; pebbles larger, but irregularly distributed; false bedding strongly marked.		
	Bottom—Chiefly thin-bedded and conglomeratic sandstone.		
	Middle Member—Mount Savage group:— . . .	40	120
249	Sandstone and shale, ... 14'		
248	*Mt. Savage coal bed*, ... 2'		
	Fire clay floor not measured.		

*The names Pottsville conglomerate, Mauch Chunk red shale and Pocono sandstone have been substituted by the State Geologist for *Seral*, *Umbral* and *Vespertine*, XII, XI and X to make the geographical nomenclature harmonious and to indicate the localities where these formations are in force.

247	Gray false-bedded sandstone, ... 17′		
246	Dark gray and black slate and slaty SS., . . . 7′		
245	Lower Member—The Conglomerate proper:—	80	80
	Top—Hard massive gray sandstone, strata fractured in a perpendicular and also oblique direction to the bedding, surface stained and coated with ferric oxide and manganic oxide, containing impressions of calamites, lepidodendra leaves and sigillaria, ... 10′		
244	Bottom—Top, hard, massive, gray and white SS. and cong. Pebbles large and abundant in the middle part, . . Bottom, less conglomerate, the sandstone becoming dark gray and flaggy, and containing specks of mica, 70′		

Notes. No. XII forms the mountain rim of the Broad Top Coal Field, on all sides, and the synclinal prongs and knobs which project from it northward and southward, between anticlinal coves or short ravines. Rocky Ridge and Wray's Hill make the longest of these synclinal spurs and the section of No. XII, above given, was measured both near the Wray's Hill RR. tunnel, in Todd township, along Wray's Hill in Carbon township, overlooking the Red Shale valley on the east, and facing Sideling Hill, and along the same hill to the west of New Grenada.

The beds of conglomerate do not seem to be persistent. It would appear as if a bed, which is in force in one locality, feathers out from a center of maximum thickness in all directions and disappears entirely, while an upper or lower conglomerate bed has its minimum thickness at the very locality where the other is at its thickest.

The beds of the middle member of No. XII containing the Mount Savage Coal bed resemble the Coal Measures. The coal bed (No. 248) is overlaid by sandstone and shale No. 249, and underlaid by massive gray sandstone No. 247, exhibiting false bedding, with probably a bed of fire clay between the sandstone and coal. It appears in many places on Wray's Hill and Rocky Ridge; but there was only one locality (Rocky Ridge, at the west end of Wray's Hill tunnel) where its thickness could be determined, and it was impossible on account of water in the opening to ascertain the exact nature of the underlying stratum.

No. 246 at the bottom of the middle member consists of dark gray and black slate and slaty sandstone; the slate predominating. A small seam of coal was reported to have been found in the black slate, but it is a little doubtful, as no traces of its existence could be found, although some parts of the slate itself seem to be slightly carbonaceous. The whole member is quite argillaceous and contains a great deal of oxide of iron, which, on weathering, renders the surfaces of the strata of a dull brown color.

No. XII which at Pottsville, in Schuylkill county, is 1,030 feet thick, and in Clinton county on the West Branch of the Susquehanna river only 25 feet (although this may represent only the Piedmont sandstone) is here 280 feet thick, with a coal bed in its midst. But it grows thicker southwards until it becomes in Virginia 1,200 feet thick with nine distinct coal beds shut in between top and bottom massive conglomerates.

Around Broad Top its massive layers produce bold escarpments facing outward and overhanging the steep slopes* of Mauch Chunk Red Shale, No. XI. The rim of the coal field thus produced is several hundred feet higher than the surface of the basin, towards the center line of which the Conglomerate dips at the rate of 3° to 4°. The slope of the surface is somewhat less, giving room for the coming in first of Coal bed A, and then of the others over it. The structure will be understood by means of the cross sections to accompany the Broad Top report; and the map of the Basin with its surrounding red shale valley and long projecting ridges north of the railroad will give the geographical position of the sharp synclinal and anticlinal rolls of Long's Ridge, Wray's Hill and Rocky Ridge, the crests and scarps of which are made by the outcropping Conglomerate rocks; Long's Ridge being capped by the Conglomerate proper, and the Mt. Savage coal group; while an intermediate, third and lower ridge of the upper members of the red shale, No. XI, intervenes between Long's Ridge and Rocky Ridge.

* The average angle of this slope is about 25°.

The Mount Savage Coal Bed of Long's Ridge. This geologically important coal bed which crops out along the hillside in many places to the west of Jacob Long's house, and which has been opened near the northern end of the ridge, is a seam in the middle member probably identical with No. 248 of the section. This coal bed which has been detected in a number of localities and which is generally considered to be one of the lower productive coals, is calculated to mislead if measurements are based upon its position without taking into account the 160 feet of conglomerate which lies above it and below the workable seams which are opened at Robertsdale.*

The measured section given above, was constructed on Rocky Ridge at the west end of Wray's Hill Tunnel. At this point the Rocky Ridge synclinal seems to be traversed by an anticlinal which makes the strike of the rocks vary as they dip in toward the center of the basin. A number of inconsistencies in the dip, and the difficulty in some cases of distinguishing the true dip from the false bedding, made the determination of the total thickness a little uncertain. This however, was verified afterwards by measurements made on Wray's Hill west of Sideling Hill Tunnel and on the road crossing from Robertsdale to New Grenada. The top of the conglomerate in the latter locality was assumed at the coal opening on bed A on the south side of the road, a few hundred feet to the east of the summit of the hill. The bottom of the formation was located near the spring at the turn in the road, further down the hill.

XI. Mauch Chunk (Umbral) Red Shales and Mountain Limestone.

c.	*Upper shales and sandstones,*	910′	1,100′
b.	*Mountain limestone,*	49′	
a.	*Lower shales and sandstones,*	141′	

* I am convinced that this fact has misled many explorers in the West Broad Top coal fields, judging from their sections.

Number of stratum.	Description of Formation.	Thickness.	Total from bottom.
	c.	Feet.	Feet.
243	Brown silicious and shaly hematite, varying in thickness, ... ?		
242	Yellow argillaceous sandy shale, ... 5′		
241	Yellow and greenish-yellow flaggy sandstone, with slight alternations of green argillaceous shale, ... 20′	150	1,100
240	Red and gray sandstones and shales, rather argillaeous and flaggy, ... 125′		
239	Bright red very soft shale, at the west end of Wray's Hill tunnel, ...	59	950
238	Hard grayish-red sandstone showing false bedding,	41	891
237	Red sandstone containing white calcareous seams along planes of false bedding, ...	48	850
236	Softer red sandstone, ...	28	802
235	Dark grayish-red sandstone, much harder and exhibiting false bedding and perpendicular fracture, ...	14	774
234	Friable soft bright red sandstone and shale at the east end of Wray's Hill Tunnel,*	93	760
233	Partly concealed. Probably composed of red and gray sandstone with alternations of red and gray shales and flags, ...	300	667
232	Probably red shales and sandstone, ...	177	367
	b. Mountain Limestone.		
231	Red shaly limestone, ...	3±	190
230	Red shale very argillaceous, ...	10∓	187
229	Soft argillaceous red shale, ...	5	177
228	Massive silicious red limestone (easily weathered) containing *Terabratula Rœmingeri*, *Grammysia*, *Strophodonta*, *Rhynchonella*, ...	2.6	172
227	Very soft red shale, ...	2	169
226	Red and gray mottled, calcareous shale (concretionary) contains *Centronella*, ...	3	167
225	Red calcareous shale and limestone, ...	9	164
224	Variegated red and gray massive limestone, ...	1	155
223	Gray massive limestone,.	3	154
222	Red shale, ...	6	151
221	Greenish-gray argillaceous limestone, ...	4	145
	a.		
220	Concealed, ...	3	141
219	Partly concealed. Probably composed of massive red silicious sandstone and shale with alternations of gray sandstone and flags, ...	114	138
218	Coarse grained greenish-gray sandstone overlaid by red shale, ...	3	24
217	Heavy argillaceous gray sand shale, conchoidal fracture containing streaks of hematite and manganese, ...	7	21
216	Reddish-gray, sandy slate colored with ferric oxide,	3	14
215	Very hard, flinty greenish-gray, massive sandstone, ...	7	11
214	Alternating brittle green and red shale, ...	2	4
213	Hard, dark gray sandy slate, ...	2	2

*Section from Stratum 234 to 239 inclusive, measured in Wray's Hill tunnel.

Notes. The rocks of No. XI were studied in the following places, where measurements could be best obtained, viz:

Nos. 243, 242, 241 and 240. Wray's Hill and Rocky Ridge.

No. 239 to 234 inclusive. Wray's Hill Tunnel E. B. T. R. R.

Nos. 233 and 232. Ground Hog and Plank Cabin Valleys, Carbon Township.

Nos. 231 and 230. New Grenada, Taylor Township, Fulton County.

No. 229 to 220 inclusive. Limestone quarry worked by John Whitney, Esq., near Todd P. O., Plank Cabin Valley.

No. 219. Ground Hog and Plank Cabin Valleys.

No. 218 to 213 inclusive. Well on Ezra Heater's farm, one mile south of Todd P. O., section reported by Mr. Chas. E. Billin.

XIc. The Upper Mauch Chunk in the above section, is a mass of red shales and red sandstones with alternations of flaggy gray sandstones and gray shales. Its lower limit is placed on the red, shaly limestone of the middle member *XIb.* The three-fold character of the upper member, which Professor William B. Rogers mentions as being everywhere discernible in Virginia, is to some extent noticeable here, for we have the upper 209 feet (243–239) formed of variegated and alternating red and gray sandstones and shale; below this 524 feet of harder strata (238–233) composed principally of gray and red sandstones, flags and shale, the upper part exhibiting false bedding; while the the 177 feet (232) overlying the limestone are made up of red shales and sandstones, the former predominating.

The iron ore of XI, (243,) as it was always called by the geologists of the First Survey, underlying the conglomerate at Ralston in Lycoming county, at the Barclay mines in Bradford county, on Queens run and the Tangascootac in Clinton county, and in general everywhere throughout the State where the conglomerate has been preserved, except in the Southern Anthracite coal fields, is a layer of gray mottled carbonate of iron, never more than 4 feet thick, and often split into several thinner beds, with intervening shales sometimes highly carbonaceous, even genuine coal beds. Along the outcrop the ore is often changed to brown-hematite.

In many places on Wray's Hill in Todd and Carbon Townships, the blossom of the ore bed, along its outcrop, is a silicious and shaly brown hematite, and on Iron Knob, directly to the south of Wray's Hill tunnel, loose fragments of the ore were found as a very silicious brown hematite associated with and containing pieces of red and green shale.*

No. 242 is probably persistent associate of the overlying ore. It is extremely argillaceous and at times seems to be formed of clay. Small specks of carbonaceous matter were found scattered through the mass on the south-east flank of Wray's Hill near the road crossing to Cook's station.

No. 241 is, probably, more variable in character than 242. In some localities it seems to change into or be replaced by red shale, not being distinguishable from 240.

Nos. 240 and 239 are more like argillaceous marlites, easily weathering, and producing a deep red soil.

On account of the very imperfect exposure of this part of No. XI, the section may not reveal the minuter and more important alternations of the strata which doubtless exist. On the west side of the Broad Top coal field, facing the Juniata river, much better opportunities are offered in the gaps of Sandy run and Six Mile run for studying the upper layers of No. XI, as is shown by the following section extracted from the Final Report of 1858, Vol. I, p. 531, introduced by Prof. Rogers with the remark that "the strata [of No. XI, ascending] become more silicious as they approach the Conglomerate, and in the form of green, buff, and hard reddish argillaceous sandstones embrace impure calcareous beds."

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*In the Report of 1858, Vol. II p. 734, is given an analysis of the ore taken from the outcrop on Rocky Ridge, near the Curfman (Savage) opening, as follows: Iron, 69.93, Water 11.00, Silica a trace. This analysis is of course of no value, and is only introduced here to exhibit the worthlessness of many of the old determinations, as the ore at this very locality is not commercial, although reported to contain 70 per cent. of metallic iron.

Section made at a point on the Juniata River half a mile below Riddlesburg. (From the Report of 1858.)

(17.) No. XII, seral conglomerate not 100 feet thick, the lowest coal bed above it being only about 100 feet above the limestone No. 14. [Mt. Savage Coal bed ?]

(16.) Interval of a few feet unknown.

(15.) Silicious slate, dull brown color, 10 feet.

(14.) Limestone, hard, silicious, reddish, embracing plates of red shale; its fragments strew a blank space of 40 feet occupied probably by red shale below its apparent outcrop.

(13.) Sandstone, fine-grained, micaceous, green, passing downward into olive shale, 20 feet.

(12.) Sandstone, gray, 3 feet (exposed).

(11.) Interval, 10 feet, probably red shale.

(10.) Sandstone, laminated, greenish-gray, micaecous, 3 feet (exposed).

(9.) Shale and fine, micaceous, argillaceous sandstone, 20 feet.

(8.) Sandstone, ferruginous, massive, close-grained.

(7.) Sandstone, coarse-grained, massive and distinct quartz grains in contact apparently cemented by an oxide of iron resembling the Clinton Block ore near Beavertown, Union county. Thickness 3 feet.

(6.) Sandstone, rather massive, greenish, interstratified with green and yellow shales, 20 feet.

(5.) Sandstone, dirty green, pretty compact, becoming micaceous downwards, brown and very ferruginous, 13 feet.

(4.) Limestone, greenish, very silicious with pebbles and plates of green shale, hard and weathering with a worm-eaten aspect, 2 feet.

(3.) Sandstone, green, argillaceous, micaceous, laminated, 7 feet.

(2.) Interval, 45 feet.

(1.) Sandstone, light brown, micaceous, laminated; beneath the red shale at the river bank.

The measurements from (16) down to (2) aggregate 196′, and there are in addition two unmeasured intervals (8) and (16). The distance between the two sections at Wray's

Hill and Riddlesburg is about 9 miles in an air line. As the thickness of No. XI in that distance would probably not vary appreciably, the Riddlesburg section may be said to represent the upper subdivision of XI*c*.

(238–233.) The middle sub-division of XI*c*. is composed principally of gray and red sandstone, flags and shales, and is 520±feet thick. It is somewhat harder than the overlying mass and exhibits false bedding in the sandstones towards the top, as seen in Wray's Hill tunnel; the seams along the bedding contain calcite. The strata are not as argillaceous as those in the next lower sub-division.

232. The lower sub-division is made up of very argillaceous shales and sandstones, easily weathered, forming a deep red-colored, clayey soil.

XIb. The Mountain Limestone, (*"Lewisburg Limestone" of the Greenbrier region in Virginia; "St. Louis and Chester Limestone" of the Mississippi Valley*) is made up of beds of red and gray argillaceous limestone and red shale. The limestone and shale alternate so irregularly that it is hardly possible to distinguish any well-marked subdivisions. The whole thickness of this member is 49 feet, the correctness of which depends upon the identification of the variegated red and gray massive limestone No. 224 at New Grenada with that at the quarry worked by John Whitney, near Todd P. O.

The thickness of the series exposed at New Grenada is 35 ± feet. At the quarry worked by Whitney the highest limestone stratum exposed is No. 229, and the lowest No. 221, making 36 feet in all. But if the variegated red and gray limestone bed at New Grenada be the same as that near Todd P. O., then we neither found the lowest stratum at the former locality nor the highest at the latter; but the lowest exposure at New Grenada is 14 feet above the bottom of the series, while the highest near Todd P. O. is 13 feet below the top. The possible error (in the event of the erroneous identification of limestone No. 224) is 13 feet, which would make the thickness 36 feet instead of 49.

An analysis of the section shows the following divisions:

Upper.	Red limestone, No. 231,	3′
	Red shale, Nos. 229 and 230,	15′
	Red limestone, No. 228,	2′ 6″
Middle.	Red and gray calcareous shale, Nos. 227 and 226,	5′
Lower.	Red and gray limestone, Nos. 225, 224, and 223,	13′
	Red shale, No. 222,	6′
	Gray limestone, No. 221,	4′

Where the limestone was studied in Smith's and Plank Cabin Valleys, the *upper* member is composed of more impure and argillaceous beds than the *lower*, and the only parts of the series which have as yet proved of any very great economical value, are the variegated red and gray limestone No. 224, and the more massive gray stratum No. 223; the latter by analysis containing 92.32 per cent. of carbonate of lime.

The aggregate thickness of the two at Whitney's quarry Plank Cabin Valley is 4 feet.

Some of the other strata have been worked elsewhere, but these two seem to be the most important.

The following is an analysis of the limestone of No. 224 (Whitney's quarry) made in the Laboratory of the Survey at Harrisburg by A. S. McCreath.:

	(*Sp. 274, stratum 224*)
Carbonate of lime,	92.323
Carbonate of magnesia,	1.089
Carbonate of iron,	.683
Alumina,	.180
Sulphur,	.034
Phosphorus,	.014
Insoluble residue,	4.640

The value of this limestone in the East Broad Top district is extremely limited and must be purely local, first, on account of its proximity to the thicker and more massive Lewistown limestone developed at Saltillo and Three Springs, and, second, on account of its thinness and consequent difficulty and expense of quarrying, never paying to work except along its outcrop.*

*In many places there is scarcely any dip to the limestone, and the expense of working it is very great.

This limestone deposit in No. XI, thins away and disappears northward and eastward and cannot be recognized around the Anthracite Coal Fields. But it increases to 822 feet and more in Virginia, and is described by Mr. Platt and Prof. Stevenson in their Reports of Progress HHH on Somerset county, and KK, KKK on Westmoreland and Fayette counties, to which the reader is referred. It is also described by Prof. Rogers in the Final Report of 1858, vol. 1, p. 472. Prof. Fontaine has proposed, in a valuable paper in American Journal of Science of Art, January, 1877, to make this limestone the base of No. XI in Virginia. But this cannot be done in Pennsylvania, because of the heavy mass of red shale (XI*a*) under it, as shown in our section; because of its absence in the 3,000 feet of red shale upon the Schuylkill and Lehigh Rivers, where the limits of the Mauch Chunk (umbral) red shale were first established; and because of the marked features of the surface produced by the contrast between the massive gray sandstone *top* of X and the overlying *bottom* red shales of XI. The transition is sufficiently sudden to throw them into separate formations without, however, suggesting nonconformability. The bottom of XI is rather argillaceous; while the top of X is very silicious. The sandstones in XI are fine-grained, thinly bedded and flaggy, while those in X are coarse-grained, more massive, and recur with fewer alternations of shale than in the former case. The strata are thicker and the change from sandstone to shale less frequent.

In two localities *fossil* remains were found in the *upper* member. In Well's Valley to the south of Broad Top Mountain, near Wishard's old saw-mill, a bivalve shell and a coral were found (Rogers' Vol. I, page 530), and at the quarry, near Todd P. O., in Plank Road Cabin Valley, the following genera and species were collected from stratum No. 228, *Grammysia*, *Strophodonta*, *Rhynchonella*, and *Terabratula Rœmingeri*. In No. 226 a *Centronella* was disclosed. A close study of the outcrop in Plank Cabin Valley would no doubt result in finding other species.

XIa (220–213) is made up principally of red sandstones and shales, with alternations of coarse-grained, gray and greenish-gray, flaggy sandstones and shales; the latter predominating toward the bottom.

No animal remains have been here found either in *XIa*, or in *XIc*. But large foot prints have been discovered in the same red shale series on the Schuylkill river, and described by Dr. Isaac Lea,* and more recently smaller batrachian footprints in the same formation and near the same place.

Iron Ore bed at the base of XI. In the layers transitional between XI and X occurs an iron ore bed of some local importance in Trough Creek basin. Its precise stratigraphical position was not determined; but it is probably not far above what we have considered the top of X. It was once developed to some extent at the old workings of the Trough Creek furnace, at the eastern base of Terrace Mountain. "Here the bed occurred in balls closely imbedded in a little earth and was of a number of varieties."

"Several of these varieties were of a common compact brown ore, seldom exhibiting any hematitic structure, but having a smooth jaspery surface and brittle fracture.

"The Hopewell ore-openings display the ore bed on both sides of the gap cut through Terrace Mountain by Yellow creek. A tunnel 90 feet long reached the ore on the south side of the gap 90 feet below its outcrop, the ore being from 20 inches to 3 feet thick, interposed between the sandstone below and the red shale above, and interstratified with more or less clay. The adjoining red shale lies in thick but very soft strata, is friable and of an intense red color directly below the ore. Thin layers of a more sandy ore are interleaved with the red shale." (Final Report of 1858, Vol. 1, p. 529).

This ore bed is a much more local deposit than the bed at the top of the Mauch Chunk series. It seems to be limited to the synclinal basin of Trough Creek, not being found in other localities through the State. It occurs as massive lumps or nodules inclosed in the very lowest beds of red

*Specimens of these prints have been deposited by Dr. Lea in the Museum of the Phila. Academy of Natural Science.

shale. Prof. Rogers says of it, (vol. 11, page 735): "It is usually a very dense and compact form of the ordinary brown per oxide of iron, and for the most part contains too large a proportion of foreign matter, particularly silica and manganese, to permit it to yield a good cast-iron. When smelted alone, the product has invariably been a weak or 'cold-short' metal. This ore has been derived apparently from the ferruginous matter diffused through the highly-colored layers of shale in the inferior portion of the Umbral red shale," and he gives the following analyses to show its character in Trough Creek Valley:

	I.	II.
Sesquioxide of iron,	60.00	84.00
Oxide of manganese,	trace.	trace.
Carbonate of lime,	0.40	
Alumina,	2.50	trace.
Water,	4.50	13.50
Silica and insoluble matter,	32.10	2.30
	99.50	99.80
Iron,	42.00	58.80

I. Hopewell Furnace (Old Bank) Trough Creek ore, red, brown and nodular.

II. Hopewell Furnace, Terrace Mount mine. Ore, dull chocolate brown, compact.

Ground Hog, Plank Cabin and other valleys surrounding the Broad Top Mountain are all excavated in the soft red shales of XI, and are themselves, in turn, shut in from the outside, by Sideling Hill, Terrace and Harbor mountains formed No. X. This continuous system of circumvallation is broken by the gap in Sideling hill affording an outlet to the drainage waters of the red shale valleys eastward, and by numerous gaps in Terrace Mountain through which the main drainage of the Broad Top Mountain mass gets an exit westward by the Juniata river.

The upper member (XI*c*) rises high on the steep slopes of the Broad Top Mountain (Wray's Hill) to the foot of the Conglomerate escarpment forming the brow of the mountain. The lower member (XI*a*) sends its layers half way up the gentler slope of the opposite mountain of X, Sideling Hill. The limestone series (XI*b*) forms a chain of little hills along the bed of the valley, or rather at the foot of the slope of Wray's Hill; and between these limestone knolls issue the brooks which descend the slope from their fountains at the base of the Conglomerate; the clay shales (241, 242) being the water bed of the coal field. The united streams make Sideling Hill creek which flows in the lower red shales (XI*a*) at the foot of Sideling Hill. The limestone is therefore to be looked for always close to the west or right bank of Sideling Hill Creek.

In Plank Cabin and Trough Creek valleys where the strata lie flat or roll in anticlinals and synclinals, the outcrop of the limestone requires another description and can be understood only by inspection of the colored geological map of the county.

This report has to do only with Ground Hog valley, lying like a deep trench between Wray's Hill (XII) on the west and Sideling Hill (X) on the east, and watered by Sideling creek, which turns sharply to the east at New Grenada and breaks through Sideling Gap.

The elevation of the surface above tide here, at the forks of the road, is 939′. The spring of water on the road over Wray's Hill toward Robertsdale coal mines is 1845′, and M'Lain's openings on top of Wray's Hill are 2132′.

On the other hand the crest of Sideling Hill at the road crossing, northwest of the RR. tunnel, is 1517′ (the grade of the rails in the center of the tunnel being 1232′) so that the valley of XI has been excavated by the erosion of Sideling Creek at least 1200 feet below the top of the wall of Pottsville conglomerate (XII) on its western side, and at least 600′ below the top of the wall of Pocono sandstone (X) on its eastern side. But this is its *maximum* excavation at New Grenada where the creek breaks away from it through the gap. Ascending the valley from New Grenada towards the railway its bed, of course, rises; in other words the red shale valley fills up, until a high divide at its head, leading over into Trough Creek and Plank Cabin valleys, permits the railway to cross it at an elevation of over 1300 feet, or only 200 or 300 feet below the crest of Sideling Hill. Similar high divides are characteristic of the steep outcrops of XI, and prove that wherever *deep* erosion does occur it has been the product of large streams.

Wells Valley is merely the repetition and prolongation of Ground Hog Valley southward from New Grenada, leading round the south end of the Broad Top coal field and coming out at Riddlesburg.

The total thickness of No. XI was determined along the line of the E. B. T. R. R. section where it crosses Ground Hog valley, about a quarter of a mile to the north of Cole's station. A study of the Rocky Ridge sections will show the difficulties encountered in determining this thickness.

Section No. 3 through Dougherty's old opening is merely a reproduction of that portion of the E. B. T. R. R. section.

Long's Ridge is formed by the synclinal which lies between Wray's Hill proper and Sideling Hill. This ridge which is only a little over a mile and a half long extending northeast from Wray's Hill tunnel, is the only locality where the surface of erosion rises above the restored position of the conglomerate No. XII in the synclinal. As the exposures of No. XI are extremely poor along any one continuous line crossing the formation at right angles to the strike, it was found to be absolutely necessary to determine the top of No. X, and the bottom of No. XII on a line of dips through No. XI continuous and regular from one horizon to the other; and this is the only locality throughout the whole district where these conditions are satisfied.

There is a good exposure of conglomerate on the top of Long's Ridge near the section line dipping 25°, N. 65° W.

The position of the top of No. X was determined by constructing the section west from the summit of Sideling Hill, which is formed of stratum No. 152 of the vertical section, dipping 58°, N. 65° W. The relative position of No. 152 to the top of No. X being known, the horizon between No. X and No. XI was readily located. The structure being completed, the interval of 1100 feet between the bottom of No.

XII on the summit of Long's Ridge and the top of No. X in the valley must represent the total thickness of No. XI.

X. *Pocono (Vespertine) Sandstone.*

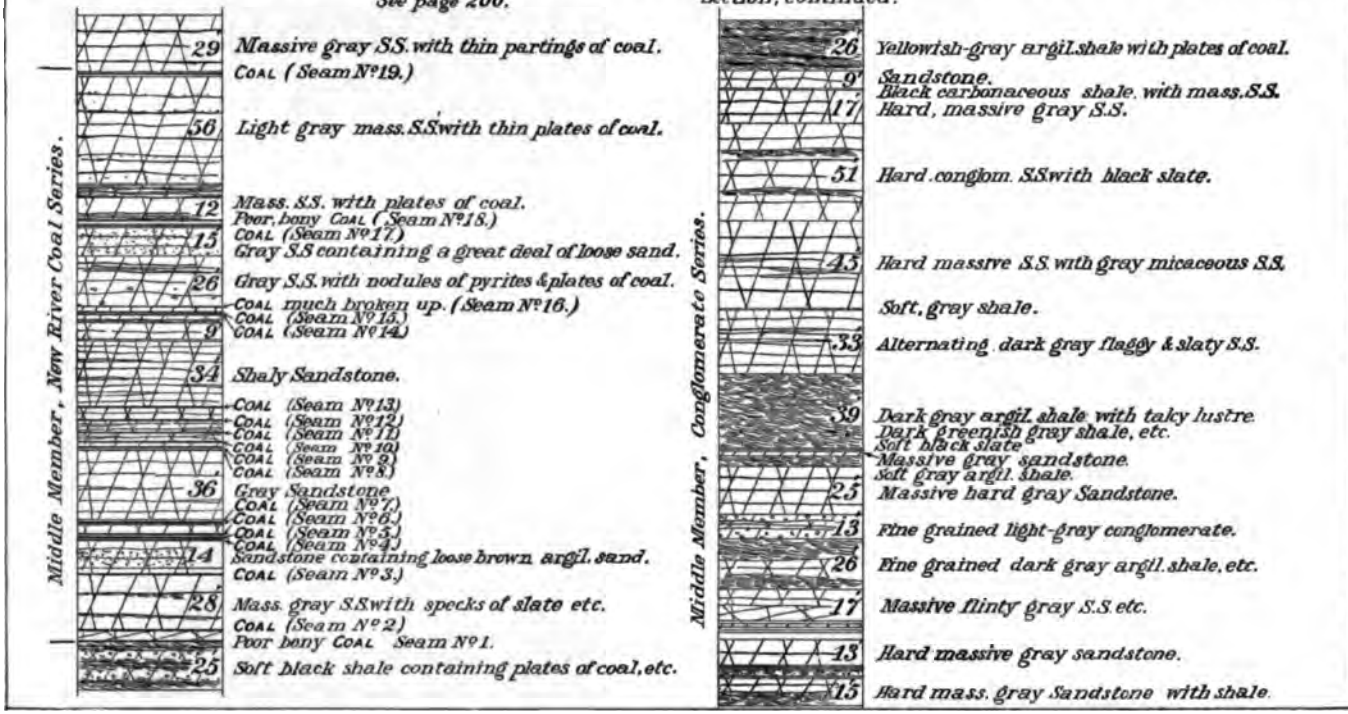
This great formation, 2,133 feet thick, is divisible into three numbers, or four groups, Upper (X*d*,) Middle (X*c*,) (X*b*,) and Lower (X*a*,) thus:—

Xd. Upper.	Massive and flaggy sandstones, Nos. 212, 211, 210,		610′
Xc. Middle.	Coal bearing (New River) series, Nos. 219 to 158,	313′	693′
Xb. Middle.	Barren series, with conglomerate beds, false bedded, Nos. 157 to 127,	380′	
Xa. Lower.	Sandstones and shales, Nos. 126 to 117,		830′
			2133′

No. of stratum.	*Description.*	Thickness.	Total from bottom.
	Xd. Upper Gray Sandstone Group.	Feet.	Feet.
212	(Partly concealed.) Composed, for the most part, of hard, coarse-grained, massive, brownish-gray and gray sandstone, alternating with thinly bedded and flaggy sandstone, and shale of the same color. Near the top, a few beds of red shale and sandstone,	580.	2133. 0
211	Massive gray sandstone surfaces, coated with ferric oxide, at the west end of Sideling Hill tunnel, .	8. 0	1553. 0
210	Alternating massive gray and greenish-gray sandstone, containing a twelve inch seam of black slate, showing impressions of minute plants, . .	22. 0	1545. 0
	Xc. New River Coal Series.		
209	Massive gray sandstone, containing thin partings of coal,	29. 0	1522.11
208	Gray argillaceous sand,	0. 5	1493.11
207	Coal, (Seam No. 19,)	0. 2½	1493. 6
206	Soft greenish-gray micaceous shale,	1. 3	1493. 4
205	Light gray, massive sandstone, containing thin plates of coal and micaceous specks,	56. 0	1492. 1
204	Sandstone, containing thin partings of coal,	1. 0	1436. 1
203	Soft, loose sandstone, containing seams of coal, running irregularly through the mass, amounting in all to about 5 inches,	6. 0	1435. 1
202	Massive sandstone, containing in its lower part plates of coal,	12. 0	1429. 1
201	Poor, bony coal, (Seam No. 18,)	0. 2	1417. 1
200	Sandstone,	1. 6	1416.11

New River Coal Series & conglomerate of Pocono S.S. No. X in Sideling Hill Tunnel, Huntingdon Co. Pa.

See page 206. Section, continued.



199	Argillaceous sand,	0. $\frac{1}{8}$	1415.5$\frac{1}{8}$
198	Coal, (Seam No. 17,) maximum thickness, 9 inches,	0.3	1415. 5
197	Argillaceous sand, containing plates of coal,	0.4	1415. 2
196	Gray sandstone, containing between the strata a great deal of loose sand,	15. 0	1414.10
195	Gray sandstone, containing nodules of pyrites and plates of coal in the upper portion of the mass,	26. 0	1399.10
194	Coal very much broken up. (Seam No. 16,)	0. 1	1373.10
193	Sandstone containing nodules of iron pyrites,	2. 6	1373. 9
192	Coal, (Seam No. 15); brilliant luster, rhombohedral fracture, resembling bituminous coal,	0. 1	1371. 3
191	Sandy fireclay,	0. 6	1371. 2
190	Coal, (Seam No. 14,)	0. 1	1370. 8
189	Sandstone, with thin partings of coal in the lower portion,	4. 0	1370. 7
188	Sandstone,	9. 0	1366. 7
187	Fireclay,	0. 1	1357. 7
186	Shaly sandstone,	34. 0	1357. 6
185	Coal, (Seam No. 13,)	0. 1	1323. 6
184	Alternating shaly and massive, gray sandstone,	6. 0	1323. 5
183	Poor bony coal, (Seam No. 12,)	0. 3	1317. 5
182	Shaly sandstone,	6. 0	1317. 2
181	Coal, (Seam No. 11); very much broken up and associated with red sand,	0. 1	1311. 2
180	Shaly sandstone,	4. 0	1311. 1
179	Coal, (Seam No. 10) maximum thickness, 6 inches,	0. 3	1307. 1
178	Shaly sandstone,	2. 0	1306.10
177	Coal, (Seam No. 9,)	0. 1	1304.10
176	Shaly sandstone,	1. 0	1304. 9
175	Coal, with sandstone above and below, (Seam No. 8,)	0. 1	1303. 9
174	Gray sandstone,	36.	1303. 8
173	Steel-gray shale, of a greasy luster,	0. 8	1267. 8
172	Coal, (Seam No. 7,)	0. 1	1267. 0
171	Fire clay,	0. 1	1266.11
170	Sandstone,	5. 0	1265.10
169	Coal, (Seam No. 6,)	0. 1	1261.10
168	Sandstone,	0.10	1261. 9
167	Coal, (Seam No. 5,) resembling very much specimens from Montgomery county, Virginia,	0. 2	1260.11
166	Soft sandstone,	0. 5	1260. 9
165	Coal, (Seam No. 4,)	0. 2	1260. 4
164	Sandstone, containing loose brown, argillaceous sand,	14. 0	1260. 2
163	Loose sand shale, surfaces coated with acicular crystals of sulphate of alumina, formed by the decomposition of pyrites,	3. 0	1246. 2
162	Coal; very much broken up by false bedding, and containing a great deal of iron pyrites, (Seam No. 3,)	0. 2	1243. 2
161	Massive, gray sandstone, having a rhombohedral fracture, and containing specks of slate and ferruginous matter,	28. 0	1243. 0
160	Coal, (Seam No. 2); very much broken up by false bedding,	0. 1	1215. 0
159	Soft, gray, shaly sandstone, exhibiting false bedding,	5. 0	1214.11
158	Poor bony coal, (Seam No. 1,)	0. 1	1209.11
	Xb. Middle Conglomerate Group.		
157	Soft, black shale, containing plates of coal and impressions of minute plants, surfaces stained with ferric oxide; alternating with a fine-grained conglomerate, containing micaceous specks,	25. 0	1209.10
156	Yellowish-gray, argillaceous shale, containing thin plates of coal. Surfaces showing "slicken sides,"	26. 0	1184.10

155	Sandstone,	9. 0	1158.10
154	Black, carbonaceous slate, enclosed in hard massive sandstone,	0. 2	1149.10
153	Hard, massive, gray sandstone,	17. 0	1149. 8
152	Hard, conglomeratic, light-gray sandstone, containing a few alternations of black slate,	51. 0	1132. 8
151	Hard, massive sandstone, alternating with gray slaty micaceous sandstone,	45. 0	1081. 8
150	Soft, gray shale,	1. 0	1036. 8
149	Alternating dark gray, flaggy and slaty sandstone, containing micaceous scales,	33. 0	1035. 8
148	Dark gray, argillaceous shale, with talcy luster,	39. 0	1002. 8
147	Dark greenish-gray shale, with talcy luster, containing acicular crystals of sulphate of alumina, formed by the decomposition of pyrites,	0.10	963. 8
146	Soft, black slate,	0. 3	962.10
145	Massive, gray sandstone,	3. 0	962. 7
144	Soft, gray, argillaceous shale,	5. 6	959. 7
143	Massive, hard, gray sandstone,	25. 0	954. 1
142	Fine-grained, light-gray conglomerate, alternating with thin strata of black micaceous sandstone,	13. 0	929. 1
141	Fine-grained, dark gray, argillaceous shale, alternating with a hard, gray sandstone, interstratified with a black, micaceous sandstone,	26. 0	916. 1
140	Massive, flinty, gray sandstone, alternating with yellowish-gray sandstone, showing false bedding,	17. 0	890. 1
139	Soft, gray shale,	1. 3	873. 1
138	Hard, gray sandstone,	1. 6	871.10
137	Soft, gray shale,	1. 6	870. 4
136	Soft, yellowish-gray shale, of a talcy luster,	1. 6	868.10
135	Very hard, massive, bluish-gray sandstone, with occasional seams of a lead-colored clay,	4. 0	867. 4
134	Hard, massive, gray sandstone,	13. 0	863. 4
133	Gray, slaty sandstone,	0.10	850. 4
132	Carbonaceous shale,	0. 5	849. 6
131	Gray shale,	0. 3	849. 1
130	Black coal slate,	0. 2	848.10
129	Gray sand shale,	3. 4	848. 8
128	Black slate,	0. 4	845. 4
127	Hard, massive, gray sandstone, alternating with yellowish-gray, argillaceous sand shales,	15. 0	845. 0
	Xa. Lower Green Sandstone Group.		
126	Dark bluish-gray, slaty sandstone, alternating with a shale of close texture,	22.	830.
125	Alternating gray, green, and yellow shale,	25.	808.
124	Green shale, containing *Cypricardina* and *Orthis*, at the east end of Sideling Hill tunnel,	5.	782.
123	Partly concealed. Alternating as above, but softer,	25.	777.
122	Hard, coarse-grained, reddish-gray sandstone, alternating with soft, yellow, sandy shale,	165.	753.
121	Coarse-grained, yellow sandstone. Surfaces stained with iron, alternating with grayish-brown sandstone,	12.	588.
120	Alternating yellow, gray, and green, shaly sandstone,	44.	576.
119	Soft, yellow, sandy shale, interstratified with a gray, flaggy sandstone, alternating with a brown sandstone, containing micaceous specks,	50.	532.
118	Flaggy, olive sandstone, alternating with a greenish-gray sandstone, containing iron concretions. Partly concealed,	42.	482.
117	Partly concealed. Soft, green, and olive sandstone, alternating with soft, yellow, flaggy and hard, massive, gray sandstone, containing ferruginous specks, and having a distinct rhombohedral fracture,	440.	440.

Notes. Of the above numbers, No. 212 was studied on the west flank of the mountain in Ground Hog and Plank Cabin Valleys; Nos. 211 to 124 in Sideling Hill Tunnel of the East Broad Top railroad; and Nos. 123 to 117 in Smith's Valley on the east flank of the mountain, in Clay, Cass and Uniontown townships.

X c. The coal bearing strata contain 19 seams of coal, with an average individual thickness of one inch and a half. Their thickness, if added together and combined with that of the numerous thinner seams and partings scattered through the strata and not precisely located in the section, would be sufficient to form a solid seam of coal about four feet thick.

The following analysis of the section shows the position of each coal bed and the intervals between them, filled generally with sandstone:

	Sandstone interval, thickness,	29' 5 "
19.	Coal, (207) 2½ inches thick.	
	Sandstone,	76' 3 "
18.	Coal, (201) 2 inches.	
	Sandstone,	1' 6¼"
17.	Coal, (198) 3 inches.	
	Sandstone,	41' 4 "
16.	Coal, (194) 1 inch.	
	Sandstone,	2' 6 "
15.	Coal, (192) 1 inch.	
	Sandy fireclay,	0' 6 "
14.	Coal, (190) 1 inch.	
	Sandstone,	47' 1 "
13.	Coal, (185) 1 inch.	
	Sandstone,	6' 0 "
12.	Coal, (183) 3 inches.	
	Sandstone,	6' 0 "
11.	Coal, (181) 1 inch.	
	Sandstone,	4' 0 "
10.	Coal, (179) 3 inches.	
	Sandstone,	2' 0 "
9.	Coal, (177) 1 inch.	
	Sandstone,	1' 0 "
8.	Coal, (175) 1 inch.	
	Sandstone and shale,	36' 8 "
7.	Coal, (172) 1 inch.	
	Fireclay and sandstone,	5' 0 "
6.	Coal, (169) 1 inch.	
	Sandstone,	0' 10"

5. Coal, (167) 2 inches.	
Sandstone,	0' 5"
4. Coal, (165) 2 inches.	
Sandstone,	17' 0"
3. Coal, (162) 2 inches.	
Sandstone,	28' 0"
2. Coal, (160) 1 inch.	
Sandstone,	5' 0"
1. Coal, (158) 1 inch.	
Black slate plant bed,	25' 0"

Grouping the coal beds which lie close together, we have the following series:

Sandstone, top of the series,	29' 5"
One coal bed, 2¼ inches thick.	
Sandstone, mass of,	76' 8"
Two coal beds, in 24 inches of space.	
Sandstone, mass of,	41' 4"
Two coal beds in 3' 3" of distance,	
Sandstone mass of,	47' 1"
Six coal beds in 19' 10" of distance,	
Sandstone mass of,	36' 8"
Four coal beds in 6' 10" of distance,	
Sandstone mass of,	17' 0"
One coal bed 2 inches thick,	
Sandstone mass of,	28' 0"
Two coal beds in 5' 2" of distance.	

Fireclay occurs only under seams Nos. 7 and 15; that under No. 15, being very sandy.

The sandstone between the several seams has a great sameness of character, and is very much broken up by false bedding and fractures; in many cases it contains thin seams or partings of coal. The numbered seams and partings generally lie parallel with the true bedding of the strata, although in many instances *they are found along the planes of false bedding.* The thicknesses are very variable, in places increasing from 1 and 2 inches up to 10 inches and 1 foot; and sometimes a seam will be very much broken up and separated by a mass of sandstone, which splits the bed for some distance, but afterwards disappears, permitting the several portions to unite again.

The almost total absence of fireclays under the coal seams, and the occurrence of coarse sandstone in many places directly above them seems to show that the coal has been derived from plants which may have grown at some distance from the locality and been afterwards floated and caught in the falling sediment, forming "drift beds." The period was undoubtedly one of continuous local current agitation as indicated by the coarseness and false bedding many of of the strata.

Xb. The lower part of the middle member is characterized more particularly by its beds of conglomerate and conglomeritic sandstone, both of which exhibit false bedding in a marked degree.

At the top of it, directly under coal seam No. 1, comes No. 157 of the section, 25 feet thick, composed of soft black shale containing plates of coal and impressions of minute plants, alternating with a fine-grained conglomerate which contains micaceous specks. The surfaces of the shale are very much stained with iron. Directly below these alternating beds occur (No. 156) 26 feet of a yellowish-gray argillaceous shale also containing plates of coal and showing slickensides, giving evidence of some contortion and slipping of the strata.

The first well defined and massive sandstone (No. 155 of the series) occurs below the shale; is 9 feet thick, and is separated by 2 inches of black carbonaceous slate (No. 154) from 113 feet (Nos. 153, 152, and 151) of hard massive and conglomeritic sandstone *showing a greater amount of false bedding than any other part of the section.* No. 152 contains a few alternating beds of black slate, but is as a whole the hardest and most massive part of the Pocono series.

This forms the crest of Sideling Hill, apparently throughout its whole extent; its position in the mountain can be seen in both Sideling Hill creek section and the East Broad Top R. R. Below these harder and more massive strata there are 82′ 7″ (150 to 144) of shale, with a few beds of sandstone; the whole underlaid again by 25 feet of hard, massive sandstone (143); and 13 feet (142) of fine-grained conglomerate containing thin beds of black micaceous sandstone. Then succeed in descending order:

Shale and sandstone, (141,)	26	0″
Massive sandstone, showing false bedding, (140,) . . .	17′	0″
Shale and sandstone, (136,)	5′	9″

Sandstone, (135, 134, 133,)	17′ 10″
Shale, (132 to 128,)	4′ 6″
Sandstone and shale, (127,)	15′ 0″

The sandstone and conglomerate beds when grouped together are seen to alternate with the shale beds, thus:

Shale,	51′	380′
Sandstone,	122′	
Shale,	83′	
Sandstone,	38′	
Shale,	26′	
Sandstone,	40′	
Shale,	5′	
Sandstone,	15′	

Fossil Plants. Throughout the upper member of the Pocono (Vespertine) Formation, X*d*, and the coal-bearing strata of the middle member, X*c*, remains of a terrestrial vegetation are more or less abundant both in the sandstone, and in the shale and slate. The following genera and species have been determined by Prof. Leo Lesquereux in specimens collected from the débris at the west end of Sideling Hill Tunnel:

1. *Sphenopteris flaccida*, (Crépin), a new species for America, but recently discovered in Belgium, stage of the *Psammites du Condroz*, which corresponds to the upper part of the Catskill (IX) of Pennsylvania; for the same formation has besides a *Psilophyton* and a *Palaeopteris hybernica.*

2. A species of *Ulodendron* with scar leaves obsolete. It seems to be quite near to if not identical with *Ulodendron majus* Sternb. a species found in the sub-conglomerate coal of Alabama, but which ascends to and above the Conglomerate.

3. *Knorria acicularis* Göpp. from the transition measures of Silesia. It is new to this country but passes by decortication into the following:

4. *Stigmaria minuta* Lesq. First Geological Report of Pennsylvania, Plate XVI, fig. 1 and 2, from the Pocono (Vespertine) of Mauch Chunk.

5. A branch referable to *Stigmatocanna Wolkmanniana* Göpp, but not positively ascertainable, the bark of the tubercles being destroyed.

6. A *Lepidodendron* (?) in four twisted and compressed fragments, so much deformed that the outlines of the scars are not discernible.

Sphen. flaccida and *Stig. minuta* predominate and are represented by many fragments.

"The specimens were very hard to study and determine, as they are twisted in many directions and the vegetable fragments are covered with a coating of coal as hard as graphite." These specimens I procured in 1875.

In April, 1877, I collected a large number of additional specimens which were forwarded for examination to Prof. Lesquereux, who replied: "They mostly represent one species: *Sphenopteris* (*Hymenophyllites*) *furcata* Brongt., which is not rare in the Lower Carboniferous, and which I found in 1851 in the Vespertine (No. X) of Mauch Chunk. The numerous specimens which you have sent represent it better than I ever saw it, with large stems, branches and even roots. The other specimens are fragments of species already examined."

The following analyses of specimens of the coal taken from three separate beds in the upper part of the middle member, were made in the Laboratory of the Survey at Harrisburg by Mr. A. S. McCreath."

	No. 167. Seam No. 5.	No. 179. Seam No. 10.	No. 198. Seam No. 17.
Water,	.340	.350	.470
Volatile matter,	13.660	16.290	21.340
Fixed carbon,	53.295	61.785	51.972
Sulphur,	.465	7.180	1.033
Ash,	32.240	14.395	25.185
	100.000	100.000	100.000
Color of Ash.	Gray.	Red.	Reddish gray.
Per cent. of iron,	. . . .	6.25	
Sulphur taken up by iron,	. . . .	7.143	

The high percentage of ash is a noticeable feature which supports the theory that these coals in No. X are drift beds.

The great interest attaching to the discovery of the numerous small coal beds locked in between the sandstone plates of Sideling Hill and only revealed by the happy accident of tunneling the mountain for the passage of the coal trains from mines in beds of Carboniferous age, makes it proper to add a few words indicating both their true relationship in the Palæozoic column and the origin of the name "New River Series" given to them in the section above.

Prof. W. B. Rogers, as State Geologist of Virginia from 1836 onwards, reported the existence of workable coal beds far below the Conglomerate base of the Coal Measures, on the New River, in Montgomery Co., near Augusta Springs and elsewhere in Virginia.

An illustrated report of two workable beds, 4′ and 8′ feet thick respectively, on Tom's Creek, at the gap of the New River through Brushy Ridge; of a dozen unworkable beds in a belt of the same Pocono and Mauch Chunk (Vespertine and Umbral) measures along the west slope of Peak Mountain in Wythe Co., Va.; of several larger beds of the same age back of Christiansburg; and of numerous worthless outcrops of these beds along a range of a hundred miles, may be found in the published Proceedings of the American Philosophical Society, at Philadelphia.

In 1877 Prof. W. M. Fontaine of the West Virginia University at Morgantown published in the numbers of Silliman's Journal for January and February the results of a careful survey which he had made of the same (Pocono) group of coal beds where they have been recently exposed to view in constructing the Lewis Tunnel of the Chesapeake and Ohio Railroad through the Alleghany Mountain. The beds are four in number, and none of them are 12 inches thick, as may be seen from the following condensed recast of his section:—

Dark shales; olive and reddish marlites,	80′	135′
Firm, thick-bedded dark shale, *Local coal bed*, 12 inches thick.	10′	
Firm, silicious, rather coarse, bluish-gray sandstone, holding bits of lower rock, drifted stems, and coal beds.		

Black sandy slates,	15′	
Sandstone,	8′	
Coal, slaty, 6 inches thick.		
Fireclay containing rootlets,	5′	
Coal, 2 inches thick.		
Fireclay, 1 inch thick.		
Gray sandstone, with films and streaks of coal, (floated,)	30′	
Black slate and coal, 12 inches thick.		
Brown flaggy sandstone,	3′	215′
Coal, 8 inches thick.		
Fireclay, 5 inches thick.		
Bluish-black sandy shales,	5′	
Gray flags,	50′	
Interval (?) feet thick.		
Olive sandstone,	20′	
Argillaceous thickly bedded sandstone, with thin films of coal and black shale,	40′	
White, pebbly, silicious sandstone, very persistent, concealing the underlying rocks, and having themselves a thickness of at least,		60′
Interval of flaggy sandstones and inter-stratified shales, dingy yellow when freshly fractured, and weathering brown: down to the red marls and sands of the Catskill formation No. IX,		500′

This interval of 500′ which Prof. Fontain finds reason in his district to exclude from X and insert in IX, I find analogous to the lowest member of the Pocono (*Xa*) in my section, described above.

Xa. The *lower member* in its general character bears some resemblance to the upper member in as far as it is made up of alternations of sandstones and shales. But the sandstones are more argillaceous and not as massive; they are coarse grained and stained with iron and at times contain red and yellow specks. The shales are both argillaceous and silicious, and the alternations with the sandstone are more frequent than in the upper member.

The predominating colors of the sandstone and shale are gray, yellow, olive and green.

This member seems to contain more ferruginous matter disseminated through the strata than either of the other members, and quite frequently iron concretions are found.

The horizon between the Pocono (X) and Catskill (IX) is not very distinctly marked. The greatest distinction between the two formations is one of color, X being gray, and IX red. The upper strata of the Catskill are more argillaceous than those at the bottom of the Pocono, which fact determines in a measure the topography of the southern slope of Sideling Hill.

The shape of Sideling Hill in cross section is determined by the various characters exhibited along their outcrops by the four members of the Pocono Formation: *Xd* making the middle part of its western slope; *Xc* the upper part; *Xb* the crest; *Xa* the upper part of the eastern slope. The west slope is steep and almost a plane, seldom being cut into by runlets. The massive conglomeritic layers of *Xb* furnish a remarkably straight and even crest to the mountain. The coal series *Xc* outcrop on an even slope just below and west of the crest. The straightness of the crest is primarily due to the persistent regularity of the general westward dip, the exact force of which is shown in the plate sections of this report.

IX. Catskill (Ponent, Old Red,) Sandstone.

No. of stratum.	*Description.*	Thickness.	Total from bottom.
		Feet.	Feet.
116	Concealed. Probably composed of red shales and sandstone, alternating with white and gray sandstones, ...	175	2680
115	Greenish gray, slaty sandstone, containing micaceous specks, alternating with soft, bright red shale, ...	100	2505
114	Massive, coarse-grained, reddish-gray sandstone, alternating with red shale and sandstone, ...	125	2405
113	Very silicious brown hematite; thickness undetermined, but variable, ...		2280±
112	Partly concealed. Consisting for the most part of red flaggy sandstone and shale, alternating with massive yellow, gray, and white shaly sandstone, ...	1520	2280
111	Red, sandy, and argillaceous shale; lower part containing fucoid stems, and showing a fine exhibition of ripple marks, ...	270	760
110	Red, massive sandstone and shale, with slight alternations of green, sandy shale and massive brown sandstone, particularly toward the lower part, ...	140	490
109	Red shale and sandstone, alternating with gray shale and massive gray sandstone; containing small deposits of coal, ...	290	350
108	Light yellow, sandy shale, alternating with friable red shale; surfaces stained with bituminous matter. Lower part brownish-gray sandstone, containing micaceous specks, ...	60	60

Notes.—The study of Nos. 116, 115, and 114, was made in Smith's Valley; that of No. 113 on Mr. J. B. Moreland's farm, Smith's Valley near Sideling Hill Tunnel; that of No. 112 to 108 inclusive in Smith's Valley, along the line of the East Broad Top Railroad and Sideling Hill Creek. Deposits of "drift coal" in No. 109 were found on Mr. Wm. Smith's farm, 1½ miles from Mapleton, Union Township.

Character.—The Catskill formation No. IX in this region consists for the most part of thick alternating masses of red argillaceous shale and sandstone, with occasional beds of gray, yellow, white and green sandstone and shale. It does not admit of sub-division either by its fossils or mineral composition. It may however be remarked that:

The *upper* part is composed of red shale and sandstone alternating with gray and whitish sandstone, containing micaceous specks.

The *central* part seems to be made up principally of red flaggy sandstone and shale alternating with thin massive yellow, gray and white shaly sandstone; toward the bottom the red shale becomes more sandy, contains fewer alternations of gray shale and a number of imperfect remains of what apparently was a terrestrial vegetation, the accumulation in some localities being sufficient to form small "drift beds" of coal.

The *lower* part seems to contain a predominant amount of ferruginous matter, and the surfaces of the strata are sometimes slightly stained with a bituminous coating. No fossils were found in this mass other than a few remains of fish bones and scales, having a white and bluish tint in contrast with the red and brownish-red shale.

Throughout the whole formation the beds are very argillaceous, weathering easily, as may be well seen in the deep cuttings recently made along the line of the railroad.

No. 113 of the section is a bed of impure iron ore, apparently of no practical value, lying about 400 feet below the assigned top of the formation. Its outcrop runs along the western side of Smith's Valley. No valuable beds of iron ore have ever been discovered in this formation in other parts of the State, but numerous balls and nodules of iron ore are occasionally seen in the sandstones, and the red color of most of the strata is of course produced by the general diffusion of iron oxide through the mass. No. IX is a red formation from the Hudson river far south; and in England it is called the Old Red Sandstone.

In the Catskill mountains of New York and in Eastern Pennsylvania No. IX contains beds of massive conglomerate ; but in the Aughwick Valley district it shows nothing more massive than coarse sandstones. These are very solid when first quarried; but are poorly adapted for building purposes, because they cannot bear the action of the weather.

In the Catskill mountains No. IX holds beds of impure limestone ; but none were noticed in our district.

Fish beds characterize this formation and are of importance to the geologist because they seem to hold a fixed position near the base of the formation. Their scales and bones are so numerous in some localities of northern Pennsylvania and eastern New York as to cover the outcropping rocks with white blotches. Those which Mr. Sherwood describes in his reports on Bradford, Tioga, and Lycoming counties belong partly to the Chemung series. But other and higher fish beds appear in the true Catskill series. The following extract from Mr. Sherwood's section, made for Professor James Hall in 1874, published in the Proceedings of the American Philosophical Society, April 19, 1878, will show that they come in about 100 feet above the top of the Chemung. It is possible that the bituminous coating to the rock surfaces mentioned in describing N. 108 of our section, and even the "small deposits of coal" in No. 109, may be explained by the diffusion rather of animal than of vegetable matter.

Section of the Fish-beds in the Catskill mountains, at Palenville, in New York. Thickness given in feet.

440	S. S. coarse, *gray sandstone*,	Gray beds, X,	719′
48	Concealed,		
16	S. S. coarse, gray,		
130	Concealed,		
32	S. S. coarse, gray,		
53	Concealed,		
200	S. S. coarse, gray, with many pebbles,		200′

27	Shaly rock, red,		27
37	Concealed,	Gray beds, X,	466'
23	S. S. coarse, gray; scattered pebbles,		
340	Concealed,		
19	S. S. coarse, gray,		
20	Concealed,		
50	Shaly rock, red,	Red beds, IX,	2319'
15	Concealed,		
33	S. S. coarse, gray,		
14	Shaly rock, red,		
35	S. S. coarse, gray,		
2	Shaly rock, red,		
5	S. S. coarse, gray,		
50	Concealed,		
16	Conglomerate, coarse,		
10	S. S. reddish,		
11	Shaly rock, red,		
63	S. S. coarse, gray,		
152	Conglomerate, coarse,		
47	Shaly rock, red,		
88	S. S. coarse, gray; pebbles,		
37	Shaly rock, red,		
38	S. S. coarse, gray; scattered pebbles,		
480	Concealed,		
29	S. S. coarse, gray,		
219	Concealed,		
15	S. S. coarse, dark gray,		
22	Shaly rock, red,		
60	Concealed,		
12	S. S. coarse, dark gray,		
140	Concealed,		
40	S. S. gray, (reddish toward the top,)		
103	S. S. red and gray; beds of red shaly rock,		
103	Shaly rock, red,		
8	S. S. gray. FISH-BONE bed, 1 ft. near the bottom of the 103 ft.,	Fish beds,	103'
4	Shale greenish and dark blue, (some Fish-bones,)		
20	S. S. gray,		
68	Shaly rock red,		
½	FISH-BONE bed, 6 to 8 in.,		
1½	Shaly rock, red, mottled with green,		
¾	FISH-BONE bed, 6 to 12 in.,		
2	Shaly rock, greenish,	Red and green beds, IX—VII,	105'
6	S. S. bluish-gray,		
7	Shaly rock, red, somewhat mottled green,		
6	Shaly rock, greenish,		
9	S. S. bluish-gray,		
3	Shale greenish-gray,		
3	Shaly rock, rubbly, variegated, ferriferous,		
47	S. S. bluish-gray,		
6	Shales, red and green,		
10	Shaly rock, gray and greenish,		
6	Shaly rock, red and green,		
	S. S. bluish and gray; of great thickness at the village of Palenville.		

Smith's Valley is excavated in Catskill (IX), and its main stream has excavated its channel along the outcrops of the soft upper rocks. The mountain slope of Pocono (X) rises on the west, and Clear ridge, made by the outcrop of Chemung (VIII), on the east of it. The smaller streams on each side descend into the main stream through winding channels, now perpendicular to the strike of the rocks and now comformable to it.

The Catskill outcrops, leaving Smith's Valley, sweep southeastward and eastward around the end of Jacks mountain, being flattened and broadened by its dying anticlinal, and then fill the valley of Sideling Hill Creek towards Brownsville. The headwaters of Lick Run (which enters Great Augwick Creek at Maddensville) mark the northeastern border of Catskill outcrop in the Aughwick basins, near the house of Mr. T. Lambertson.

Creeped outcrop. This interesting phenomenon may be studied to advantage in the railroad cutting through the end of Clear Ridge, where it enters Smith's Valley to ascend Sideling Hill slope. The accompanying illustration* shows how the slates near the bottom of the Catskill formation are bent over, down hill, making what is called an "outcrop creep."

At the bottom of the cut the strata, where solid and unmoved, dip at an angle of 78° towards the N. 73° W. but at the top of the cut their outcropping edges are bent over westward, down hill, until they make a right angle with the dip.

The creep extends along the western slope of Clear Ridge, for a mile and a half, or two miles, south of the gap. The valley bed at the foot of the ridge is filled with "demoralized" material from the disturbed and eroded outcrops. The cause of the creep therefore need not be sought for in glacial or any other foreign action. It is evidently produced by the ordinary annual freezing and thawing of the rain water, opening the leaves of the mass, admitting vegetable roots and soil, and pushing every part of the steep hill side downwards.

*From photographs taken by Mr. John C. Brown, Dr. E. Wallace, and Mr. Percival Roberts, Jr.

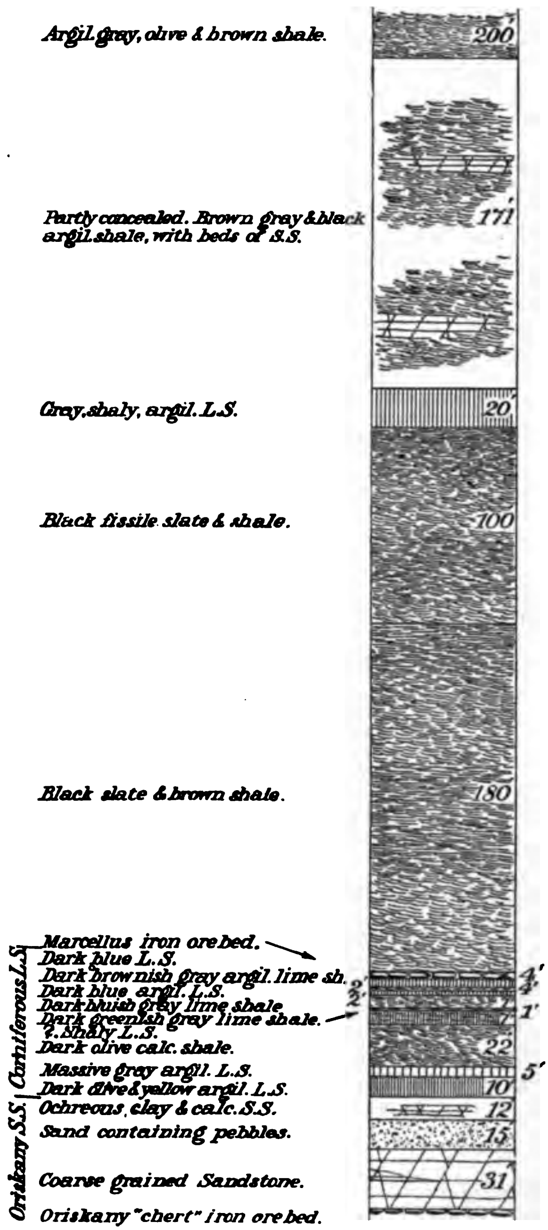
VIII. Lower Devonian Series.

VIII. D. *Chemung.*	b. Transition red and olive shales,		90′
	a. Olive (*Vergent*) shales,		1860′
VIII. C. *Portage,* (*Vergent flags,*)			1450
VIII. B. *Hamilton.*	c. *Genesee* (*Cadent Upper*) slates,		325′
	b. *Hamilton* (*Cadent*) shale,		635′
	a. *Marcellus* (*Cadent Lower*) black slate,		875′
VIII. A. *Upper Helderburg.*	Corniferous (*Postmeridian*) limestone,		60
Total thickness of VIII,			5295′

No. of stratum.	Description.	Thickness.	Total from bottom.
	Catskill and Chemung Transition beds.	Feet.	Feet.
107	Yellowish-white, argillaceous sand shale, lower part containing lepidodendra and calamites,	8.	90.
106	Red sandstone and shale, containing ripple marks, with slight alterations of green shale,	18.	82.
105	Alternating olive-green sandstone and shale, lower part of a darker green color,	10.	64.
104	Greenish-gray sandstone and shale; upper 10 feet containing quartz crystals; lower part fossiliferous,	15.	54.
103	Alternating red sandstone and shale,	25.	39.
102	Green fissile shale,	1.	14.
101	"Larry's Cr. ore bed," ranging from 4 inches to 1 foot thick, containing *Spirifer disjuncta* and *Rhynchonella,*	.8	13.
100	Green fissile shale, containing two sandstone strata, 2 inches thick, upper surfaces showing ripple marks, and under surfaces containing impressions of fucoid stems,	3.	12.3
99	Fossiliferous, brownish-gray sandstone, containing *Spirifer disjuncta,* &c.,	1.	9.3
98	Dirty white sand shale, containing plant impressions,	.3	8.3
97	Yellowish-red sandstone,	5.	8.
96	Red shale, easily weathered, containing occasional seams of sandstone and green shale a few inches thick,	3.+	3.
	Chemung shales.		
95	Partly concealed. Consisting, for the most part, of olive and brown argillaceous sandstone and shale, containing alternations of red fissile shale. Readily weathered into clay,	245	1860
94	Massive dark-gray sandstone, containing ferruginous specks, alternating with reddish-gray, flaggy sandstone,	15	1615
93	Upper part fossiliferous greenish-gray sandstone; lower part alternating soft red and light-green sandy shale,	100	1600
92	Massive brown sandstone. Surfaces stained with iron and coated with minute quartz crystals, alternating with light red shale, showing impressions of fucoids,	70	1500

91	Red, brown, and gray sandstone. The lower part is composed principally of red and olive sand shale, containing micaceous specks; surfaces of the olive shale very much stained with iron, . .	140	1430
90	Partly concealed. Consisting, for the most part, of hard, massive, gray and brown sandstone, containing micaceous specks, alternating with softer shaly strata, ...	500	1290
89	Partly concealed. Composed principally of massive, gray and brown sandstone, containing yellow and red specks, alternating with softer sandstone and shale; the softer strata predominating more than in No. 90, being marked by sharp, narrow ravines, running parallel with the strike,	490	790
88	Brown, green, and gray massive and flaggy sandstone; surfaces very much stained with iron, . .	80	300
87	Partly concealed. Consisting, for the most part, of red and olive shale and sandstone; former predominating, ...	100	220
86	Massive reddish-brown sandstone, containing micaceous specks, ...	10	120
85	Massive reddish brown sandstone, containing micaceous specks, and shale alternating with brown argillaceous sandstone, containing crinoid stems,	110	110
	Portage flags.		
84	Partly concealed. Consisting, for the most part, of hard, massive, brown and gray sandstone, with alternating strata, from 10′ to 30′ thick, of soft olive and gray shale, marked, in some cases, by sharp, narrow ravines, running parallel to the strike, ...	500	1450
83	Massive brown sandstone, containing iron specks, alternating with shale, ...	40±	950
82	Light fawn colored, argillaceous shale, alternating with greenish yellow, flaggy sandstone; surfaces coated with minute quartz crystals, ...	70	910
81	Partly concealed. Composed principally of yellow, green, and light olive shale, alternating with occasional beds of brown and gray sandstone, .	140	840
80	Light fawn colored, yellow and green argillaceous shale, alternating with soft, olive brown and green flaggy sandstone; latter containing yellow and red specks, and surfaces stained with iron, .	100	700
79	Light olive shale, with yellow and red stains; lower part very fissile, ...	80	600
78	Yellow shale, containing a few alternating beds of sandstone, ...	80	520
77	Dark olive and yellow argillaceous shale, ...	120	440
76	Light olive shale, containing alternations of thinly laminated sandstone strata, from 1 to 2 inches thick, ...	100	320
75	Same character as No. 76, but with the sandstone predominating, ...	60	220
74	Dark olive shale, containing beds of shaly sandstone, stained bright red with ferruginous matter,	50	160
73	Olive, red, and yellow shale, ...	10	110
72	Gray sandstone, with a few alternating beds of olive shale, ...	35	100
71	Fine grained, greenish-gray sandstone, in beds from 4 to 6 inches thick, alternating with fine-grained, olive fissile shale, ...	65	65

Section of the Oriskany S.S. and Marcellus slate, showing position of iron ore beds, at Three Springs and Saltillo in Huntingdon Co. Pa. Page 223.



	Genesee Slate.		
70	Partly concealed. Olive slaty and shaly sandstone, alternating with brownish-gray, flaggy sandstone, and a few beds of olive shale, ...	100	325
69	Light olive and greenish-gray argillaceous shale and slate, ...	75	225
68	Partly concealed. Probably same in character as No. 69, ...	100	150
67	Dark olive, fissile slate, with occasional beds of a bright brown-colored sandstone, 2 to 4 inches thick, ...	50	50
	Hamilton Shale.		
66	Partly concealed. Consisting, for the most part, of gray sandstone flags and shales, containing fossils, as in No. 65, but not as abundant, ...	250	635
65	Upper part hard, massive, greenish-gray and flaggy olive sandstone; lower part light, olive, slaty sandstone. Surfaces very much stained with iron. Contains: *Aviculopecten princeps*, *Chonetes mucronatus* and *coronata*, *Grammysia*, *Spirifer granulifera*, and *mucronatus*, and *Tentaculites*. *Algæ* more particularly *Spirophyton caudagalli*, ...	85	385
64	Partly concealed. Consisting, for the most part, of massive gray and flaggy sandstone, alternating with beds of thinly laminated, fissile shale, (fossiliferous,)	250	300
63	Thin, gray, calcareous, flaggy sandstone, and beds of greenish-gray, fragile sandstone, alternating with gray and dark olive shale, ...	100	100
	Marcellus Black Slate.		
	Upper member, ... 571 feet. Middle member, ... 20 feet. } 875′ Lower member, ... 284 feet.		
	Upper Member.		
62	Partly concealed. Composed principally of gray and brown shale, alternating with flaggy and slightly calcareous sandstone, ...	200	875
61	Argillaceous gray, olive, and brown shale, very much stained with iron and bituminous matter,	200	675
60	Partly concealed. Consisting, for the most part, of brown, gray, and black argillaceous shale, with occasional beds of sandstone, ...	171	475
	Middle Member.		
59	Gray, shaly, argillaceous limestone, alternating with greenish-gray lime-shale, (local deposit?) .	20	304
	Lower Member.		
58	Black fissile slate and shale; surfaces very much stained with iron, and coated with bituminous matter, ...	100	284
57	Black slate and brown shale; surfaces stained with iron, and coated with bituminous matter; the shale in the lower part, directly above the iron ore bed, is very argillaceous, ...	180	184
56	Marcellus iron ore bed; of varying thickness, . .	4	4

	Upper Helderburg Limestone.		
55	Dark blue limestone, containing seams of calcite, .	4	60
54	Dark brownish-gray argillaceous lime shale, . . .	2	56
53	Dark blue argillaceous limestone, ...	2	54
52	Dark bluish-gray lime shale and light olive calcareous shale, ...	7	52
51	Dark greenish gray lime shale, ...	1	45
50	Concealed. Shaly limestone?	7	44
49	Dark olive calcareous shale, easily weathered, . .	22	37
48	Massive gray argillaceous limestone, ...	5	15
47	Fragile dark olive and yellow argillaceous limestone, ...	10	10
	46. *Schoharie* and *Caudagalli*, both wanting, but perhaps represented by clay and shale on top of the Oriskany.		

NOTES—The above strata were studied and specimens collected at the following localities, viz:—

No. 107 to 96 inclusive. Transition strata. Railway cut end of Clear Ridge, north-west of Saltillo, Clay Township.

No. 95 to 85 inclusive. Line of E. B. T. R. R., north-west of Saltillo and Sideling Hill Creek, Clay Township, and Coaling Ridge, Cromwell Township.

No. 84 to 71 inclusive. Line of the railroad north-west of Saltillo, and north-east of Three Springs, Clay, Springfield and Cromwell Townships.

No. 70 to 67 inclusive. Sideling Hill Creek and the line of the railroad north-west of Saltillo, Clay Township and north-east of Three Springs, Springfield and Cromwell Townships.

No. 66 to 63 inclusive. North-west of Saltillo, Clay Township and Saddleback Ridge, Springfield and Cromwell Townships.

Nos. 62, 61, 60, 58, 57, and 56. North-west of Saltillo, north-east of Three Springs and Aughwick Valley near Orbisonia.

No. 59. Quarry near I. Engeart's house, 1 mile from Orbisonia.

No. 55 to 47 inclusive. Railroad cut at Three Springs.

Description of the Section of VIII.

The *Transition Layers* consist of yellow, red, green and olive shale and sandstone, the surfaces of some of which exhibit fine ripple marks and impressions of fucoids and characteristic Chemung fossils, *Spirifer disjuncta*, *Rhynchonella*, &c.

The Chemung and Portage, taken together as one grand group, have well defined limits, the upper being topped by the transition strata at the base of the red Catskill, and the lower being bottomed by the olive slaty and shaly sandstone of the Hamilton period.

The horizon between the two epochs, however, is not as well defined, and has been located rather arbitrarily. There are certain general distinctions between the two which it may be well to notice before describing each in detail.

Both are made up of alternations of shales and sandstones. In the Chemung the strata are more silicious, while in the Portage they are more argillaceous. In the latter the sandstone is always finer grained and the shale more clayey than in the former.

The Portage sandstones are flaggy and at times very shaly, and their alternations with the shale are very frequent, although the individual strata are quite thin, the shale predominating.

The Chemung sandstones are more massive, occur in thicker strata, their alternations with the shale are less frequent, and they seem to contain more ferruginous matter, and more micaceous specks.

The Chemung strata, particularly the shaly sandstones toward the top, are replete with marine mollusca, particularly brachiopods; while the Portage is extremely poor in fossil life, with the exception of crinoid stems and sea weeds, or fucoids; although the occurrence of fossil fucoids would not distinguish the epoch, since these are very abundant in the upper part of the Chemung also but possibly the two are of different types.

Chemung. The *upper part* is composed of olive-brown and gray massive, and sometimes argillaceous, sandstone alternating with flaggy sandstone, and red and green shale, both shale and sandstone containing ferruginous specks.

The *central portion* of the mass is made up principally of brown, red and gray sandstone and shale; the sandstone is probably more massive than it is in the upper part, and besides ferruginous matter contains micaceous specks.

In the *lower part* the general character of the strata is very much the same, although apparently containing less iron and mica than the central part.

In descending from the top to the bottom of the group the sandstone, which in the upper part seems to predominate, diminishes, while the shale increases; and the alternations of the two are greater; although of course the sandstone strata must be thinner. The upper part contains the greatest number of remains of fossil life.

In New York, Prof. Hall reports (1843) that "the upper part of the Chemung is characterized by a general tendency to conglomerate, or gravel. In a few localities the mass becomes a well characterized pudding-stone. This conglomerate (continues Mr. Hall) nowhere attains sufficient thickness or importance to merit a distinct description." See also Mr. Sherwood's description of it in Bradford County, (Report G), and Mr. Carll's in Report I.I.I.

Such conglomerates seem to be without representatives in our district. Although the sandstones toward the top of the Chemung are massive and coarse grained, yet there seems to be no tendency to conglomerate or gravel.

Portage. The general character of this formation seems the same throughout. The upper part is composed of rather massive brown and gray sandstone, alternating with beds of olive and gray shale from 10 to 30 feet thick. Toward the center the sandstone becomes more flaggy, and occurs in thinner strata, while the shale becomes more argillaceous, forms thicker beds and is more varied in color. As we approach the bottom the sandstones become thinly laminated, and occur in beds but a few inches thick, and the shale is extremely argillaceous and weathers readily into clay. The shale throughout the whole formation contains more or less iron, which on exposure readily washes out and is oxydized on the surface, coloring the shale to various shades of yellow, brown and red.

Cross lamination, or oblique, or current bedding, concretions and limestone strata which are so abundant in the

Chemung and Portage Epochs in New York, are wanting in Central Pennsylvania. The ripple marks, also abundant in New York, are comparatively rare, and may easily be overlooked, especially after studying the fine exposures of them in the transition layers between No. VIII and No. IX along the railroad; those in the lower Catskill in Smith's Valley; and at the bottom of the Hamilton on the Aughwick near Potts' Gap.

The absence of limestone or limy shale and concretions may be attributed to the limited remains of marine life. These in New York are found in great colonies. In our district, not only do we not find any limestone or limy shale, but the whole period is particularly devoid of any calcareous matter in the cementing material of the sediment. This is readily shown by the rapid weathering of not only the shale but also the harder sandstone strata in the cuts along the railroad.

In the Final Report of 1858 (Geology of Pennsylvania, Vol. 1, page 141) a thickness of 3200 feet is assigned to the Chemung, at Huntingdon. No *instrumental* measurement of it has ever been made there, and the estimated thickness of 3200 feet is probably an exaggeration.

Genesee. This formation consists of olive, slaty and shaly sandstone, alternating with brownish-gray flaggy sandstone and dark olive shale; toward the lower part the sandstone strata disappear, and the shale becomes more argillaceous, until finally at the bottom we have dark olive fissile slate with occasional beds of a bright brown-colored sandstone from 2 to 4 inches thick. The shale and slate are slightly bituminous and stained with iron.

Hamilton. The *upper part* is made up of gray sandstone flags and shales; toward the central part the sandstones predominate in a three-fold character of massive, flaggy and slaty to the exclusion of the shale. Surfaces of the sandstone are stained with iron and exhibit the following fossils: *Aviculopecten princeps*, *Chonetes mucronatus* and *Chonetes coronata*, *Grammysia*, *Spirifer granulifera*, *Spirifer mucronatus*, *Tentaculites*, and *Algæ*, more particularly *Spirophyton caudagalli.*

In the *lower part* the sandstone is not so massive, being more flaggy and shaly; the flaggy sandstone at times becoming quite calcareous, and very much stained with iron. Shale alternates with sandstone, and toward the bottom predominates, being of a gray and dark olive color, sometimes thinly laminated and fissile.

Ripple marks are finely exhibited on the lower strata exposed along Aughwick Creek near Potts' Gap.

Marcellus. This formation might be more properly divided into an upper and lower portion as the lithological characters of each are quite distinct; what we have called the middle member may prove to be nothing more than a local variation.

The *upper member* consists of brown, gray, olive and black argillaceous *shale* with occasional beds of flaggy and slightly calcareous sandstone in the upper part, and beds of non-calcareous sandstone in the lower part. The sandstone and shale, but more particularly the latter, are very much stained with iron and bituminous matter.

The *middle member* is made up of shaly argillaceous *limestones*, alternating with greenish-gray lime shale. The exact position of this member of the series may be a little above or below that given in the section. The only place where it seemed possible to study this portion was in the valley of Blacklog creek, near Orbisonia; where the dip of the strata was rather uncertain, and too far from the section line to make its position certain. Although it has been thought best to suggest that this *limestone* is only a local deposit, economically considered, yet it seems quite certain that the horizon may be lithologically as calcareous in one locality as another; but, through the rock, the associated strata being very argillaceous, the carbonate of lime may be in some places more generally disseminated, producing nothing but a calcareo-argillaceous shale, instead of an argillaceous limestone.

The *lower member* consists of black fissile *slate* and black and brown shale, the surfaces of both being very much stained with iron and coated with bituminous matter. In Perry county there occur irregular beds of coal, the vestiges of a vegetation which appears to have been air breathing or terrestrial. The lower horizon of the series is marked by an important ore bed (No. 56) which primarily is a proto-carbonate of *iron*, but which has been changed at its outcrop by atmospheric action into brown hematite.

It is not an infrequent thing to find the black shale and slate of the lower member very much contorted, and dipping in an opposite direction to the general lay of the strata. These transverse dips are seldom of any extent and are apt to lead to errors in constructing a section. It seems probable that some of the faults which have been located in the Marcellus and associate strata may have been based upon deceptive dips in this lower member.

Upper Helderberg (*Corniferous*). This consists of dark blue and gray argillaceous limestones alternating with green, olive and gray calcareous shales. These are included in the Marcellus formation by Prof. H. D. Rogers, in his Final Report of 1858, where he says: "The post meridian series may scarcely be called a Pennsylvania deposit, as it only enters the eastern borders of the State near the Delaware Water Gap." But since limestone strata belonging to this horizon outcrop extensively through Middle Pennsylvania beneath Marcellus black slates and were deposited under conditions very different from what prevailed afterwards during the deposite of the overlying black slate, it seems more reasonable to consider them the representatives of the New York Upper Helderberg.

Topography of the outcrops of No. VIII.

The surface features determined by No. VIII are somewhat varied from the bottom to the top of the formation and are by no means constant.

Chemung and Portage. The upper part forms a ridge the summit of which is quite rounded, the back slope (toward the valley of No. IX) being steeper than the front slope at the base of which outcrop the lower members of the series.

The lower part of the Chemung makes very much the same kind of topography as the Portage: ridges broken into knolls, with graceful rounded profiles, by steep and narrow vales which at times run parallel to the strike, but more generally have no constant direction, the erosion being influenced apparently by other than purely strati-grphical causes.

Hamilton. The sandstones and shales of this group generally form a monoclinal ridge, separated from the ridge of Portage rocks by a rather sharply defined valley of Genesee slate; and from the ridge on the other side, made by the Oriskany sandstone, by a broader valley of more irregular contour excavated along the outcrop of the Marcellus shale and slate.

Beds belonging to the upper part of the Marcellus are sometimes found very near the crest of the Hamilton ridge; occupying the position generally held by the lower rocks of the Hamilton.

Upper Helderberg. The *Corniferous* limestone, with the Marcellus iron ore bed directly above it, flank the Oriskany ridge on the side next to the Marcellus shale Valley.

Geographical limits of the outcrops of VIII.

Rocks of Chemung age form Clear Ridge, extending from the Juniata River west of Mapleton about south 25° degrees west, parallel with Smith's Valley. It is crossed by the line of the Three Spring section just north of the gap in the ridge through which the railroad passes.

Clear ridge continues to the southwest on almost the same course, and is crossed by the Sideling Hill Creek section west of the crook in the creek, where it flows northeast, before winding around Jacks Mountain.

The Chemung measures re-cross the section line, with a southeast dip, east of the anticlinal, near the boundary line between Clay and Springfield townships, and so pass on northeastward near Brownsville.

South of the railroad, and west of Beersville, the Chemung outcrop forms Coaling ridge, in which the dip of the strata is very low, being near the center of the Aughwick synclinal.

The northwest dipping Chemung rocks form a more or less broken ridge, from their extreme northern limit in the synclinal southwestward, alongside of the Blacklog mountain. This ridge is crossed by the Sideling Hill creek section about a mile and a half southwest of Maddensville. Mr. Solomon Taylor's house stands on the summit of this ridge, which is here known locally as Clear Ridge, probably because a ridge of Chemung strata is very seldom thickly wooded. Its surface is generally smooth, and clear of broken stone and loose rocks.

The belt of outcropping Portage rocks is co-extensive with that of the Chemung, and is crossed by the Three Springs section east of Clear Ridge, and by the Sideling Hill creek section on each side of the Jacks Mountain anticlinal. The creek in its sinuous course around the flexure flows northeast and southwest in the Portage measures. The outcrop belt on the eastern side of the anticlinal passes northeastward, in the Aughwick Valley basin, to the west of Coaling ridge, and makes the valley to the northeast of that ridge.

The same strata cross the first section line again on the Blacklog Mountain range east of the point where the section crosses the Aughwick Creek. They then pass on southwestward, intersecting the Sideling Hill creek section on each side of the headwaters of Silent Hill creek.

The area of the Genesee, Hamilton and Marcellus outcrops is included between the edge of the Portage belt and the Marcellus iron ore bed. The upper part of the Hamilton sweeps round over the Jacks Mountain anticlinal south of the Sideling Hill creek section line; while the lower part, together with all of the Marcellus, makes the curve between the two section lines.

The Marcellus iron ore bed outcrop is readily traceable throughout the district. The line of the west dipping ore, west of the anticlinal, passes beyond the limits of the E. B. T. R. R. map (plate) where it crosses the section line directly to the east of Mr. J. F. Meminger's house, and continues in an apparently unbroken range northward through Hare's valley, crossing the Juniata river and Pennsylvania railroad near Mapleton.

From Meminger's the outcrop of the ore runs about south 16 degrees west to Mr. C. R. McCarthy's ore bank, crossing the county road about 500 feet northwest of Mr. G. W. Cohill's house.

The Oriskany ridge, which carries the ore on its northwestern flank, is eroded in the valley of the Mountain Branch creek between Cohill's and McCarthy's.

The McCarthy ore bank lies west of the Oriskany, and on the south side of the creek. The ore is principally a carbonate of iron, and the bed is from 3 to 4 feet thick. The ore is very shaly and contains a great deal of clay. Prior to June 1875 only about 100 tons had been mined.

From the McCarthy bank the ore range passes on southwest along the flank of the ridge and crosses the road from Glasgow's to Saltillo directly west of the lime kiln, and a quarter of a mile northwest of Mr. Richard Hudson's house. The bed is extremely silicious at the outcrop.

Near the lime kiln is a sand quarry on the outcrop of the Oriskany sandstone. The sand is of a loose, fine texture and would serve well for glass manufacture, were it not for the iron which it contains.

From the lime kiln the outcrop of the ore holds a course about south 25 degrees east, crossing the road southwest from Glasgow's and about 700 feet more or less southwest of Black & Co.'s lime kilns. It then passes to the rear of Mr. J. R. Black's house, keeps to the left of the road, and swings round over the Jacks Mountain anticlinal.

At this point the Oriskany sandstone ridge terminates in a high anticlinal knob, two miles and a quarter directly south of Saltillo. South of this the Oriskany sandstone and the Marcellus ore sink beneath the surface with the sinking anticlinal. The outcrop of the ore bed curves round in the rear of Mr. William Johns' house, and takes a course east northeast, for about 1,000 feet, to Hudson's ore bank, where the bed has been extensively developed in several open cuts on the flank of Cave Hill, which is a ridge made by the Oriskany sandstone and Lewistown limestone, dipping southeast.

From Hudson's opening the ore crop keeps very nearly a due northeast course to where it crosses the railroad at the eastern end of the cut through the Oriskany sandstone at Three Springs.

In this railway cut the ore is represented by an iron conglomerate dipping 39°, south 32° east.

From this point the bed holds a course north 35° east, to the line of the Three Springs fault, which crosses the Hill Valley road at a turn in the road about 800 feet southwest of Mr. R. L. Greene's house. Here the ore bed is thrown to the right, or east, by the fault, so as to abut against the Hamilton rocks. The extent of the side-throw is 1400 feet and the ore bed is seen at that distance to the east abutting against Hamilton rocks.

From the line of the fault the range of ore follows the southeastern slope of the Oriskany ridge, having a general course north 30° east, to where it crosses the road east of Mr. J. Dever's house. Here the range seems to bend to the northeast, crossing the road which passes Mr. Isaac Fleck's to the east of his house.

The Marcellus ore has been worked in several open cuts on the Fleck farm, and is reported to be 12 feet thick. All the openings are old workings, very much fallen in, the ore being now not exposed. But in a recent shaft (1875), 25 feet deep, on the hillside directly in front of the road leading to Price's Siding, the upper part of the bed was got as a very cellular, honey combed brown hematite, overlaid by from 2 to 4 feet of clay containing scattered balls of ore. Directly above the clay was found a brown shale (Marcellus), alternating with layers of a darker carbonaceous shale. The strike of the bed was about N. 25° E and the dip N. W. showing some disturbance; for, the general dip of the strata at this locality is in a reverse direction, towards the south-east.

After passing the Fleck open-cuts the Marcellus ore range continues north-east through Hill valley along the eastern slope of Chestnut ridge crossing the Juniata river and Pennsylvania railroad east of Mount Union.

The next Marcellus iron ore range to the east of the last described lies along the western slope of Royer ridge formed by the Blue Ridge anticlinal.

It crosses Orbisonia section No. 2 (plate No. 14) a quarter of a mile southeast of the point where the railroad cuts the section line. Continuing southwest it crosses the Orbisonia section line (plate No. 13) about 200 feet southeast of the railway and circles round the Blue Ridge anticlinal. Its position above the limestone may be seen along Blacklog creek northwest of the grist mill.

It crosses the section line again in a northeast direction (with a southeast dip) near the center of the town of Orbisonia, and continues northeast as range No. 6 of the Orbisonia map (plate No. 2), along the southeastern flank of Royer ridge; passing through the head of Royer and Dewees' tunnel, where it cuts section No. 2 (plate No. 14); and extends thence northeastward outside of the limits of the Orbisonia map, for about half a mile, (J. H. Dewees).

Hence, as the basin rises to the northeast, the ore range curves backward, with a northwest dip, to run nearly parallel with range No. 6, south 25° west, to the old Kelley open cuts at the first fork of Blacklog run, about half a mile northeast of Orbisonia.

At this point the range curves again around a small anticlinal which divides the main basin into two minor subbasins, as seen in section No. 2.

This central anticlinal at the Kelley open cuts is apparently very flat and seems to disappear entirely before reaching the Orbisonia section.

The Marcellus ore bed now runs northeast, as a third parallel range, as far as section No. 2. Here it bends slightly to the east, curving round near the Hawk mine (No. 6 on the map) where the eastern sub-basin is rising in the air towards the northeast.

The ore crop now runs southwest, as a fourth parallel range, as far as the Old Bedford cut (No. 8), where the ore bed has been folded and locally contorted.

The line of the ore then passes through the Orbison slope (No. 10); crosses Blacklog creek a quarter of a mile to the east of the Rockhill furnaces, where it has been recently opened on the south bank of the creek; keeps on, southwest, parallel with Blacklog mountain; passes through the Old Jordan open cuts (No. 11); crosses the E. B. T. R. R. section 1100 feet southeast of the Orbisonia and Fort Littleton road; passes near Meadow Gap P. O. and cuts the Sideling Hill Creek section on Mr. S. C. Charlten's heirs' place to the west of the Oriskany hill.

The crop of the Marcellus ore bed then curves over the dying south end of the Blacklog Valley anticlinal, near Fort Littleton, and commences a new northeast course, with a south southeast dip, along the eastern flank of West Shade Mountain.

The *Corniferous* belt follows the Marcellus iron ore bed, side by side in all the windings above described.

Minerals in No. VIII.

Larry's Creek Ore. Thirteen feet from the bottom of the Transition layers between the Chemung and Red Catskill occurs a brown ferruginous sandstone, No. 101, weathering readily on the surface from the oxydation of the iron. This is probably the representative of the Larry's Creek ore bed on the flank of the Allegheny Mountain.

The following is an analysis of a specimen of the sandstone (Specimen No. 101) made by Mr. Reuben Haines of the University of Penna. under the direction of Dr. F. A. Genth:

Analysis of Larry's Creek Ore.

	No. 197.
Silica,	69.31
Sesquioxide of iron,	16.00
Alumina,	3.32
Oxide of manganese,	1.47
Lime,	1.54
Magnesia,	.89
Soda, (anhydrous,)	4.98
Potassa,	1.45
Ignition,	1.65
	100.58

The manganese of this analysis occurs as wad on the surface of the casts of *Spirifer disjuncta* and *Rhynchonella* found in the bed.

The bed was located in the section, at a point where the railway cut at the end of Clear Ridge, northwest of Saltillo, exhibits the bed of a thickness varying from 4 inches to 1 foot.

The *Marcellus iron ore* bed is of great importance from the Juniata River to the Maryland State line and supports a large iron industry. Its course through the Aughwick Valley has been geographically described above.

It varies in thickness from 3 and 4 up to 10 feet, occurring as a series of solid gray layers separated by thin seams of slate. In its native proto-carbonate condition it is a bluish-gray or lead colored ore, sometimes massive, breaking into square pieces, and at other times of a slaty or laminated structure. Where the ore has not been properly subjected to atmospheric action the change to brown peroxide is only partial, a solid nucleus forming the interior of the lump, while the peroxide occurs on the surface as a crust of greater or less thickness.

Between the crust and the undecomposed nucleus, the earthy particles originally in that portion of the proto-carbonate which has been converted into the peroxide having been deserted by the iron in assuming its new state of concretion, lie loose in the intervening space, and form a gray dust when dry, and when moist a tenacious clay. The ore when roasted becomes reddish-brown, and is then strongly attracted by the magnet.

The following is a complete analysis of a specimen of ore taken from the most northern of Fleck's open cuts made in the Laboratory of the Survey at Harrisburg by Mr. D. McCreath:

Analysis of Marcellus Ore.

	139c.
Sesquioxide of iron,	71.142
Sesquioxide of manganese,	.195
Alumina,	1.965
Lime,	None.
Magnesia,	.198

Sulphuric acid,	.182
Phosphoric acid,	.343
Water,	10.395
Carbon,	.390
Silica,	13.435
Undetermined,	1.755
	100.000

The following are partial analyses of Fleck's ore bed also made by Mr. David McCreath:

	No. 1, (139a.)	No. 2, (139b.)	No. 3, (139c.)
Iron,	51.700	46.500	49.80
Manganese,	. . . .	. . . .	.136
Sulphur,	.062	Trace.	.073
Phosphorus,	.058	.133	.150
Insoluble residue,	9.320	17.120	13.435

The specimens were taken from open cuts on the eastern flank of the Oriskany hill. The strike of the bed is N. 25 E. Open cut No. 2 is 800 feet northeast of No. 1; and No. 3 is about 900 feet northeast of No. 2.

The ore on this range maintains a rather constant quality to the northeast, it contains at Lane's ore bank 47.5 iron; at Douglas' ore bank 47.3; and at Hick's ore bank 47.5 iron (Report M page 67). To the southwest of Fleck's the ore seems to be extremely poor, judging from its outcrop; while at Three Springs the ore bed is represented by an iron conglomerate or pudding stone. Further to the southwest as we approach Hudson's open cuts the bed becomes better again.

A specimen from McCarthy's ore bank at Saltillo yielded to an analysis by Mr. A. S. McCreath:

Analysis of Marcellus Ore.

	139d.
Protoxide of iron,	25.714
Sesquioxide of iron,	27.000
Bisulphide of iron,	.429
Sesquioxide of manganese,	.289
Oxide of cobalt,	.580
Alumina,	2.002
Lime,	1.143

Magnesia,	.832
Sulphuric acid,	.502
Phosphoric acid,	.137
Carbonic acid,	15.938
Carbonaceous matter,	2.681
Water,	6.460
Insoluble residue,	16.211
	99.918
Iron,	39.100
Manganese,	.201
Sulphur,	.430
Phosphorus,	.060

This is the only specimen that was examined from the northwest Jack's Mountain range. The yield of iron is not as great as from the ore east of the mountain.

Limestone Quarries. Some of the more massive limestone strata of the Corniferous formation are quarried in our district. The stone on being burned makes a poor lean lime. In some places the formation contains a rather poor argillaceous carbonate of iron (ore bed). The Hawk mine No. 6 Orbisonia map (plate 11), worked by the Rockhill Iron and Coal Co., north of Orbisonia, is located on this, which appears to be a local deposit.

The Upper Helderberg L. on account of its great impurity is of little importance and only of local value.

Building Stone. Some of the sandstone's layers of the Chemung and Portage formations are quarried to a limited extent for building stone.

The conglomerate "oil sands" of northwestern Pennsylvania, are not represented in the district covered by this report. The rocks of the Genesee and Hamilton belts in the Aughwick Valley produce nothing of value not even such flagstone quarries as characterize the Hamilton outcrops of the State of New York.

VII. *Oriskany* (*Meridian*) *Sandstone.*

Number of stratum.	Description of Formation.	Thickness.	Total from bottom.
		Feet.	Feet.
45	Upper part ochreous clay; lower part coarse-grained ferruginous and calcareous sandstone, .	12.	58.
44	Friable sand, containing pebbles size of a pea, . .	15.	46.
43	Coarse-grained arenaceous sandstone, more fragile than above, and breaks into more irregular shapes. Mass stained with ferruginous matter, and surfaces coated with red hematite. Contains: *Cyrtoceras expansus*, *Dalmania micrurus*, *Eatonia peculiaris*, *Megambonia lamellosa*, *Orthis hipparionyx*, *Platyceras ventricosa*, *Pterinea texilis*, *Rensselæria marylandica*, *Rennsselæria ovalis*, *Rensselæria ovoidcs*, *Spirifer arenosus*, *Spirifer arrectus*. Oriskany hematite ore bed, locally deposited at the lower horizon, ...	31.	31.

NOTES.—Nos. 45, 44 and 43, were collected in the railway cut at Three Springs. Fossils were found at the end of Royer and Sandy ridges near Orbisonia.

The Oriskany is 58′ thick at Three Springs, and more than 150′ thick at Orbisonia.

The *upper part* of the formation is composed of a coarse-grained ferruginous and calcareous sandstone containing a great deal of iron towards the top, and is surmounted by a bed of ochreous clay.

The *central portion* is made up of a loose, friable sandstone containing pebbles the size of a pea, larger than any found in the upper or lower parts.

The *lower part* consists of a coarse-grained, arenaceous sandstone more fragile than any toward the top of the mass, and breaking into more irregular shapes. The sandstone contains a great deal of ferruginous matter and the surfaces are at times coated with peroxide of iron.

Oriskany (No. VII) fossils: *Cyrtoceras expansus*, *Dalmania micrurus*, *Eatonia peculiaris*, *Megambonia lamellosa*, *Orthis hipparionyx*, *Platyceras ventricosa*, *Pterinea texilis*, *Rensselæria marylandica*, *Rensselæria ovalis*, *Rensselæria ovoides*, *Spirifer arenosus* and *Spirifer arrectus*.

The species of marine life found in the lower Helderberg limestone (No. VI) seems to have been cut off by the changes which ushered in the Oriskany epoch, a group of fossils peculiar to itself assuming their place. Most of the fossils are remains of mollusks; no vertebrates or remains of land plants have yet been found.

Some geologists assign to the Oriskany formation an intermediate position between the Silurian system below and the Devonian system above. Others regard the change from limestone to sandstone as sufficient evidence of the beginning of a new order of things, and therefore make the Oriskany the bottom formation of the Devonian system. It is not a question of any practical importance.

The Oriskany rocks commonly make a monoclinal ridge running along the foot of the mountain formed by the Medina (No. IV.) The profile as a rule is not quite as sharp as that of the Hamilton ridge, and is generally of less height.

The hill between Hares valley and the north west flank of Jacks mountain; Cave hill, south west of Three Springs; Royer ridge carrying the end of the Blue Ridge anticlinal at Orbisonia; and Sandy ridge running along the foot of Blacklog mountain—are all formed by the Oriskany sandstone.

Oriskany iron ore and glass sand. There is no ore bed of value in this district at the top of the Oriskany as on the James River in Virginia, but the upper sandstone layers are often impregnated with iron.

But at the bottom of the course sandstones, where they overlie soft, yellow, calcareous layers, an iron ore bed has been worked by the Rockhill Iron and Coal Co. near Orbisonia, and in Hill valley.

Glass sand deposits like those at McVeytown, and below Huntingdon, have not been seen in the Aughwick Valley.

Silurian System.

VI	*c. Lewistown (Pre-meridian) Limestone,*	1182 (1117')
	b. Water-Lime (Scalent) Cement-beds, ...	
	a. Onondaga (Scalent) Marls, ...	

No.	Description.	Thickness.	Total from bottom.
	c. Lewistown (Lower Helderberg) Limestone.	Feet.	Feet.
42	Partly concealed. Upper part composed principally of shaly, argillaceous limestone, with probably a few beds of crystalline limestone, while the lower part is made up principally of the latter,	30	162
41	Massive, dark-blue, crystalline limestone,	42	132
40	Massive, bluish-gray limestone, parts of which are characterized by a conchoidal fracture,	20	90
39	Massive, brownish-gray, and blue crystalline limestone, containing alternating beds of gray shale limestone,	20	70
38	Massive, gray, crystalline and dark-blue, argillaceous limestone, with occasional beds of light-gray, shaly limestone and lime shale. Contains: *Acervularia, Alveolites minima, Astylospongia inornata, Merista levis, Orthis oblata, Pentamerus galeatus, Rhynchonella formosa, Atrypa reticularis, Aulopora, Conophyllum, Merista arcuata, Stromatopora, Trematospira formosa, Zaphrentis,*	50	50
	b. Water-lime Cement Beds.		
37	Partly concealed. Consisting, for the most part, of blue and gray, thinly laminated, argillaceous limestone,	150	580
36	More massive, bluish-gray, argillaceous limestone, thinly laminated. The massive strata have a conchoidal fracture,	110	430
35	Massive, dark-gray and bluish-gray limestone; surfaces coated with carbonaceous matter, and showing slicken-sides. Also, contains calcite, with a marked cleavage. Lower part contains impressions of fucoids and bivalve shells,	30	320
34	Partly concealed. Similar to No. 35, but containing lime shale,	90	290
33	Massive, bluish-gray limestone, alternating with slaty argillaceous limestone and green and yellow calcareous shale,	50	200
32	Partly concealed. Principally yellow and gray, argillaceous lime shale,	60	150
31	Gray and bluish-gray, slaty, argillaceous limestone and shale,	20	90
30	Thinly laminated, blue and yellow argillaceous limestone, alternating with gray lime shale,	20	70
29	Brownish-gray and gray, slaty limestone, containing seams of calcite,	30	50
28	Bluish-gray, slaty limestone and lime shale,	20	20
	a. Onondaga Marls.		
	Thickness. Saltillo and Three Springs. Orbisonia. Upper member, ... 170'± 145' Lower member, ... 270'± 230'		
	Upper Member.		
27	Yellow, brown, gray, and green, argillaceous and calcareous shale,	20	440

26	Partly concealed. Composed principally of olive and gray calcareous shale, ...	50	420
25	Gray, shaly limestone, alternating wilh olive, calcareous shale, ...	100	370
	Lower Member.		
24	Partly concealed. Composed, for the most part, of yellow and green, calcareous shale, alternating with red, argillaceous shale, ...	70	270
23	Partly concealed. Composed, for the most part, of green, yellow, and gray, calcareous shale, alternating with red shale, ...	150	200
22	Olive and gray, calcareous shales, with a few alternating beds of red shales, ...	50	50

NOTES.—No. 42 to 38 inclusive, were collected near Three Springs, Saltillo and Orbisonia; fossils were found at the latter locality.

Nos. 37, 36 and from 34 to 28 inclusive, near Saltillo, Three Springs and Orbisonia.

No. 35, at the Rockhill furnace water-lime quarry near Orbisonia.

No. 27 to 22 inclusive, near Saltillo and Three Springs.

Lewistown Limestone. This consists of massive, dark blue and gray, semi-crystalline limestone, containing toward the upper and lower parts alternating layers of gray shaly limestone and argillaceous lime shale.

In the Juniata Valley between Mount Union and Lewistown, the shale at the top of the mass becomes a thicker and more distinctive formation. Fine exposures occur along the Kishicoquillis creek, near Lewistown, where it was found necessary to apply a new geographical name in the failure to identify the series with any of the sub-divisions of the lower Helderberg group in New York.

The following fossils have been determined: *Acervularia, Alveolites minima, Astylospongia inornata, Merista lævis, Orthis oblata, Pentamerus galeatus, Rhynchonella formosa, Atrypa reticularis, Aulopora, Conophyllum, Merista arcuata, Stromatopora, Trematospira formosa,* and *Zaphrentis.*

Water-lime. This is made up for the most part of blue and gray flaggy and thinly bedded limestones having a wavy stratification. Toward the top the beds are massive, slightly argillaceous and of a dark gray and bluish-gray color; but toward the bottom the mass becomes flaggy, thinly laminated and shaly, having a brownish-gray and yellow color. In the lower part limestone alternates with green, yellow and gray argillaceous shale.

The strata in the central part contain a great deal of calcite; and the surfaces of the stone are oftentimes coated with carbonaceous matter, and show slickensides.

Onondaga (*Salina.*) The upper member consists of yellow, gray and greenish, shaly argillaceous fossiliferous limestone in thin beds, alternating with olive, green and gray calcareous shales.

The lower member consists of green, yellow and gray calcareous shales, alternating with red shale and containing occasional beds of fossiliferous, shaly limestone.

The Salina group in this district thins away in a south east direction, being thicker on the Jacks mountain range than it is along Blacklog mountain. It makes a valley and is of no economical value.

Niagara Limestone. This formation seems to be uncertainly represented in this district; but some of its characteristic fossils occupy horizons in the Clinton group below.

In the section at Mount Union a limestone bed 3′ thick was located 232 feet above the top of the Clinton red shale. It was supposed to be the representative of the Niagara limestone; the intervening space between this and the Clinton being filled with a soft, argillaceous, calcareous shale. At Logan gap, 25 miles further east, a similar bed, 4 feet thick, was found. A careful search for it at Rockhill gap in Blacklog mountain, and on each side of the Jacks Mountain anticlinal at Three Springs, and Saltillo, failed to discover its existence. Since the Salina rocks, which come in order directly above the Niagara, seem to differ widely in character from the New York strata, composed of shales, marls and marly sandstones, with impure limestone (ours being almost entirely destitute of fossils), it is not impossible that the beds between the bottom of our Water lime shale and the top of our Clinton red shale may represent equally or conjointly the Salina and Niagara groups of New York.

While the Lewistown limestone combines with the Oriskany to form ridges, the Water-lime and Onondaga together occupy small valleys lying between such ridges and the mountains of Medina (No. IV).

The Lewistown limestone carries its outcrop along the flank of the Oriskany ridge; and all three members of No. VI (Lewistown, Water-lime and Onondaga) swing round over the dying Jacks Mountain anticlinal.

The two upper limestone members are exposed at Saltillo in the McCarthy quarry, and at Three Springs in the Hudson quarry.

The outcrop of the group continues from Saltillo northward to near Mapleton; and from Three Springs northward to Mt. Union.

The same formations make Germany Valley in the Blue Ridge anticlinal; and are found along the foot of Blacklog mountain and between it and the Oriskany ridge.

The Lewistown and Water limestones (especially the former) furnish good lime for building and for agricultural purposes, besides being a good flux in the iron furnace.

The following analyses of Lewistown limestone specimens were made in the Laboratory of the Survey at Harrisburg:

No. 113*b*. A massive dark blue *crystalline* limestone from C. R. McCarthy's quarry, near Saltillo, taken 125′ from bottom of formation. Analyzed by D. McCreath.

No. 113*a*. Massive dark blue *silicious* limestone, from the same quarry, about 100′ above bottom of formation; a good representative of some of the flinty beds which exist in the series. (D. McC.)

No. 111. Massive blue limestone from Hudson's quarry Three Springs, 70′ above bottom of formation. (A. S. McC.)

No. 109. Massive bluish-gray limestone; same quarry; 60′ above bottom of formation. (D. McC.)

No. 106. Massive gray crystalline limestone; same quarry; 50′ above bottom of formation. (D. McC.)

Analysis.	*No. 113b.*	*No. 113a.*
Carbonate of lime,	89.202	47.300
Carbonate of magnesia,	2.557	2.011
Carbonate of iron, / Alumina,	1.783	1.667
Sulphur,	.059	.146
Phosphorus,	.027	.027
Insoluble residue,	5.300	49.030

	No. 111.	*No. 109.*	*No. 106.*
Carbonate of lime,	90.904	94.035	91.125
Carbonate of magnesia,	2.162	1.965	1.572
Carbonate of iron,	1.642	.697	1.139
Alumina,	.123		
Sulphur,	.081	.056	.030
Phosphorus,	.010	.012	.014
Insoluble residue,	5.700	2.330	5.040

The price of limestone, when sold at the Hudson, McCarthy and adjoining quarries, is 10 cents a bushel, or $2 25 per ton; the ton averaging 25 bushels. The limestone is hauled to Plank Cabin valley, and south to Sideling Hill creek, and is used extensively for agricultural and building purposes.

The Lewistown limestone outcrop, between Saltillo and Mapleton, is much covered with local drift, which makes quarrying difficult and expensive. An idea is prevalent among the farmers of Hare's valley, that the Saltillo limestone does not exist between that place and Mapleton. The idea is an erroneous one; for the limestone occupies the same position relative to Jacks mountain the whole length of the valley, that it does at Saltillo and at Mapleton.

Analyses of three specimens of Water-lime rock, Nos. 99, 91, 90, from beds quarried at Saltillo, and lying respectively 375′, 190′, and 160′ above the bottom of the formation, were made in the Laboratory of the Survey at Harrisburg, with the following results:

No. 99. Massive bluish gray limestone from Saltillo; taken at 375 feet above bottom of formation. (D. McC.)

No. 91. Dark blue limestone; Saltillo; 190 feet above bottom of formation. (A. S. McC.)

No. 90. Massive bluish gray limestone; Saltillo; 160 feet above bottom of formation. (D. McC.)

	No. 99.	No. 91.	No. 90.
Lime,	89.537	47.080	14.120
Magnesia,	8.821	4.598	9.571
Protoxide of iron,	.638	.576	3.342
Alumina,	1.260	.550	14.066
Carbonic acid,	41.528	42.090	24.592
Water,	. . . .	.020	1.005
Silicic acid,	8.150	5.320	33.220
	99.934	100.234	99.916

No attempt has been made to manufacture hydraulic cement from any of the limestones of the Water-lime group. They contain notable quantities of silicates, and slack imperfectly when burned.

Mineral waters. The following analyses made by Dr. F. A. Genth, show the contents of two mineral waters collected near Saltillo, at McVitty's and McCarthy's springs. One gallon of 231 cubic inches, contains:

	McFitty's Spring.	McCarthy's Spring.
Sulphate of magnesia,	0.00456 grains.	41.79795 grains.
Sulphate of lime,	——— grains.	72.19060 grains.
Sulphate of soda,	1.00664 grains.	7.79412 grains.
Sulphate of potash,	0.15624 grains.	0.22291 grains.
Chloride of sodiun,	0.06329 grains.	0.20571 grains.
Bicarbonate of iron,	0.14022 grains.	0.08108 grains.
Bicarbonate of magnesia,	1.87476 grains.	0.88262 grains.
Bicarbonate of lime,	9.84013 grains.	22.24300 grains.
Phosphate of lime,	*Trace.*	Trace.
Silicic acid,	0.59007 grains.	1.16846 grains.
Hydrosulphuric acid,	0.01490 grains.	0.01589 grains.
Total,	13.69081 grains.	146.60834 grains.

McVitty's spring, on the property of Messrs. Leas and McVitty, is located in the Clinton upper olive shales (Formation No. V) northwest of Jacks Mountain anticlinal.

McCarthy's spring on C. R. McCarthy's property is located at the lower horizon of the Lewistown limestone

(Formation No. VI) northwest of Jack's Mountain anticlinal.

Iron ore. Small pieces of a lean shaly hematite were found in a number of localities scattered through the soil overlying the limestones of No. VI. The occurrence of an iron ore bed in these measures is extremely rare. The shallowness of the soil on the slopes, and the small amount of ferruginous loam in it, render impossible the presence of large accumulations of ore. No workable deposit, like that of the Baker mine between Tyrone and Altoona for example, has been discovered.

V. *Clinton (Surgent) Shales.*

		Saltillo.	Orbisonia.
Thickness.	d. Red Shale group,	270′	233′
	c. Upper Olive shale,	162′	163′
	b. Fossil ore group,	42′	53′
	a. Lower Olive shale,	——	660′

No.	*Description.*	Thickness.	Total from bottom.
	d. Red Shale.		
21	Red, sandy shale containing irregular deposits of green shale. The red shale is more silicious and massive toward the upper part, where it exhibits a rhombohedral fracture,	120	1145
20	Partly concealed. Probably composed of red, argillaceous shale containing alternations of green and gray, calcareous shale,	100	1025
19	Red, shaly sandstone containing irregular seams of calcite, becoming argillaceous toward the bottom,	50	925
	c. Upper Olive Shale.		
18	Gray, olive and yellow calcareous shale containing seams of blue fossiliferous limestone,	30	875
17	Olive and olive-brown argillaceous and calcareous shale containing seams of blue fossiliferous limestone,	80	845
16	Similar to No. 17, but containing more seams of limestone toward the bottom,	40	765
15	Blue and gray argillaceous limestone alternating with dark olive shale; lower part composed of light yellow argillaceous lime shale, forming the hanging wall of the fossil ore bed. The Clinton upper olive shale contains the following fossils, more particularly in the lower part: *Atrypa reticularis, Beyrichia lata, Buthotrepis gracilis, Dalmania limulurus, Homalonotus delphinocephalus, Orthis elegantula, Platyostoma niagarensis, Pterinia emacerata, Rhynchonella neglecta, Strophomena rhomboidalis,*	12	725
	b. Fossil Ore Group.		
14	Upper fossil ore bed, . . . 10 inches,	3 feet.	713
13	Red sandstone and white shale, . . . 12 "		
12	Lower ore bed, . . . 14 "		
	These are asserted to be safe average thicknesses of these three beds, by H. G. H. Tarr, superintendent of Rock Hill Iron and Coal Company, at Orbisonia.		
11	*Ore Sandstone.* Its upper part is composed of massive yellow sandstone under ore bed at Rockhill, while at Saltillo the upper part is very calcareous. The central part is composed of yellow and green fossiliferous sandstone (crinoid stems) alternating with shale, while the lower part becomes much more massive,	50	710

Section of Clinton Red and Upper Olive Gray Shales and Fossil Iron Ore beds

at Orbisonia. at Saltillo,

Huntingdon Co. Pa.

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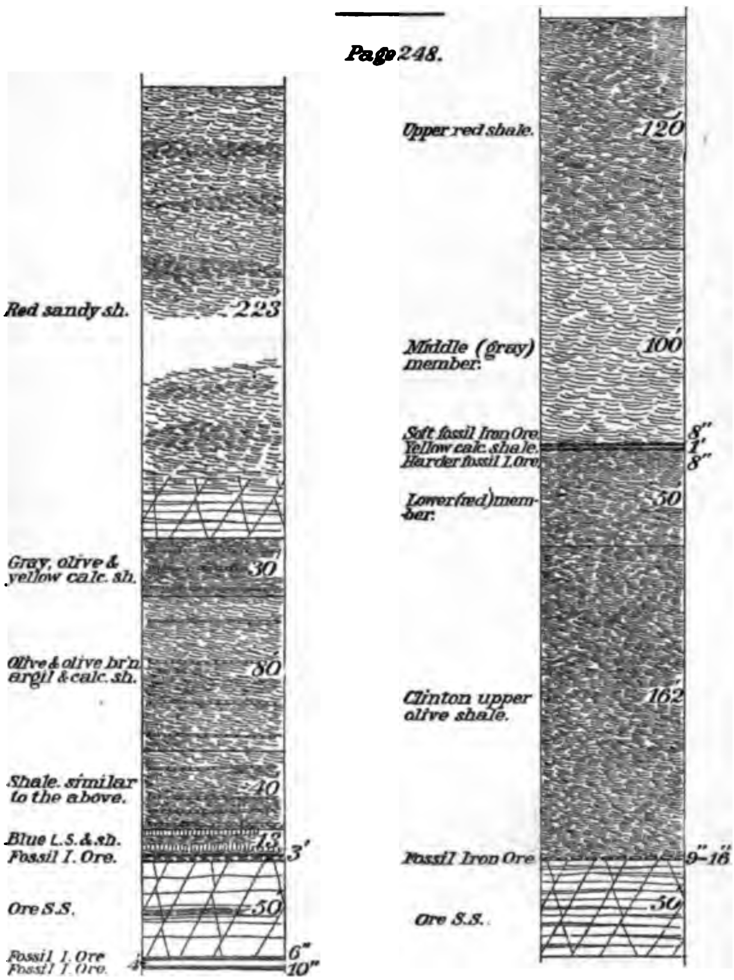

	a. Lower Olive Shale.		
10	Yellow, gray and green, argillaceous shale weathering olive and claret color. Near the lower part the surfaces of the shale are stained with iron and bituminous matter, ...	660	660
9	Same as No. 10. Lower part containing soft olive shale, showing impressions of crinoid stems (Three Springs), and red shale (Rockhill), containing by analysis 4.29 per cent. of metallic iron, ...	60	60

NOTES. Nos. 21 to 19 were got near Saltillo and Three springs. Nos. 18 to 15 near Saltillo and in Rockhill gap. Fossils were got in Rockhill gap. Nos. 14 to 12 at the south fossil ore mine in Rockhill gap. Nos. 10 and 9 in Rockhill gap.

d. Red shale. This group may generally be subdivided into three members, which are more distinct in some localities than in others. The upper and lower red shale members are composed of red shales and sandstone; while the middle member is made up chiefly of gray, green and yellow argillaceous shale, with only occasional bands of red shale.

At Saltillo, in Clay township, *two fossil iron ore beds* were found at the bottom of the middle member of the Red Shale group, or directly on top of the lower red shale. About 800 feet north-east of Benjamin Swoope's barn, where the beds were opened in a pit on the hill side, they showed the following section:

Middle (gray) member, ...		——
No. 19b.	Soft fossil iron ore, ...	0′ 8″
	Yellow calcareous shale, ...	1′ 0″
	Harder fossil iron ore, ...	0′ 8″
Lower (red) member, ...		50′
Clinton upper olive shale, ...		162′
Fossil ore beds and ore sandstone, ...		——

These beds are about 210 feet above the fossil ore beds proper; and the drift into them is at an elevation of 100 feet above Saltillo station.

These same beds were also opened on the south bank of the creek along the railroad, about 600 feet north of the above pit, and 80 feet lower elevation. The following section was here shown:

Ferruginous limestone in layers from 1 to 3 inches thick interstratified with olive shale, (representative of upper ore bed),	2' 0"
Olive calcareous shale,	1' 8"
Fossiliferous, ferruginous limestone, (representative of lower ore bed),	0' 10"
Below this soft olive shale,	2' 0"

Then the lower member of the Clinton red shale.

These beds seem to be local in extent. The ore is somewhat similar in character to that of the regular fossil ore bed overlying the sandstone at Saltillo.

The following are two analyses of the lower bench of the latter ore bed made by J. B. Britton and furnished to the Survey by Mr. Wm. A. Ingham:

I. Benj. Swoope's farm near Saltillo.

II. Whitsel's farm in Hill valley.

	No. 53. a.	
	I.	II.
Pure metallic iron,	46.64	57.47
Lime,	5.03	1.84
Phosphorus,	2.963	1.062
Insoluble silicious matter (white sand),	8.94	6.21

c. Upper Olive Shale. This group consists of yellow, olive and gray calcareous shale containing layers of blue fossiliferous limstone; the lower part, forming the hanging wall of the fossil ore beds proper, is a light yellow argillaceous lime shale.

b. Fossil Iron Ore beds proper, overlying the ore sandstone.

These have been extensively developed in Rockhill Gap by the Rockhill Iron and Coal Co.

[Two other small beds lie below the sandstone. The first, from 4 to 6 inches thick, directly *underlies* the sandstone, at about 50 feet below the upper beds (C. Constable). The second is 10 inches thick and about 4 feet below the first. These two beds have never been worked, but have been encountered in several cross-cuts made through the Ore Sandstone for the purpose of getting round the faults or side thrusts encountered in the gangways.]

The amount of ore increases from the gap northward and diminishes from the gap southwards in the water level gangways ; but the reverse is true in the levels driven nearer the outcrop higher up the mountain, thus:—

North.	Thickest.—Upper level. Medium.—Middle level. Thinnest.—Water level.	Gap.	Upper level.—Thinnest. Middle level.—Medium. Water level.—Thickest.	South.

The Ore-sandstone forms a terrace on the otherwise even slope of the mountain, and this is an excellent guide to the miner, in his search for the fossil ore beds, which are sure to be in its immediate neighborhood.

The Ore-sandstone has a thickness of 42 feet at Saltillo and 50 feet at Orbisonia. On account of the difficulty of identifying the representative of the ore bed which marks the top of the sandstone from the more calcareous layers of the sandstone itself at Saltillo, the thickness of 42 feet may be too small; it is in fact more likely to be as much as 50 feet; for, a more recent location of the ore bed, which I made in April, 1877, would increase its thickness to that extent.

The Ore-sandstone varies very much in character in different localities as to the amount of calcareous matter which it contains. At Rockhill gap it is very silicious. At Saltillo it is quite calcareous.

The fossil ore bed has been opened in a number of places along the crest of the hill formed by the Ore-sandstone, and south of the railroad between Saltillo and Three Springs.

On the top of the ridge about a quarter of a mile south of Benj. Swoope's barn, and 120 feet above Saltillo station, this bed is about 2 feet thick. Its outcrop is rather silicious.

Along the creek to the south of the railroad it is represented only by 6 or 7 inches of ferruginous fossiliferous limestone.

One range of the *fossil iron ore beds* crosses the Three Springs (E. B. T. R.R.) section 2,000 feet east of the Marcellus iron ore range, and continues in a north north-east direction along the western flank of Jacks Mountain to the Juniata River near Mapleton.

In the other direction from the section line its course is a little west of south, to where the Ore-sandstone crops out in the banks of the creek at Saltillo, opposite Leas and McVitty's tannery; continues around the Jacks Mountain anticlinal, in the ridge formed by the Ore-sandstone, on the right bank of the Mountain Branch creek; crosses the railroad again on the eastern side of the anticlinal about 1,800 feet north-west of Three Springs station; and keeps on north-east to where it meets the Three Springs fault, about 2,000 feet N. 61° W. of J. B. Swoope's house. Here there is an offset in the range of probably 300 or 400 feet, to the east, along the line of fault; here it commences again on its north-east course, and after curving considerably to the east continues in a direction about N. 33° E. to recross the Three Springs (E. B. T. R.R.) section line, at a point 1,100 feet N. W. of the Hill Valley road.

This range passes along the eastern flank of Jacks Mountain through Mt. Union, and is known as the "mountain range" from Mt. Union to Logan gap.

The next range to the east enters the district on the north-western flank of Blacklog Mountain; cuts the Orbisonia section No. 2 about 1,700 feet S. E. of the point where Blacklog Run cuts it; and then has a course of S. 27° W. to the north fossil ore mines of the Rockhill Iron and Coal Company in Rockhill gap.

Here the range is thrown 94 feet to the west by the fault in the bed of the creek.

South of the fault the ore range passes through the south fossil ore mines, and continues along the flank of Blacklog Mountain, in a line about parallel with the crest line of the mountain, to and across both the Three Springs and Sideling Hill Creek sections, to and around the end of the mountain near Fort Littleton.

Analyses of Fossil Ores made in the Laboratory at Harrisburg, by Mr. A. S. McCreath:

No. 12. "South side of Rockhill gap, No. 1 gangway, large (underlying) fossil ore bed, 20 inches in thickness. Rockhill Iron and Coal Co."

No. 14. South side Rockhill gap, small (overlying) fossil ore bed; No. 1 gangway. Rockhill Iron and Coal Co."

	No. 12.	No. 14.
Sesquioxide of iron,	72.571	72.428
Alumina,	4.723	4.211
Sesquioxide of manganese,	.320	.269
Lime,	.174	.319
Magnesia,	.309	.432
Phosphoric acid,	.256	.281
Sulphuric acid,	trace.	trace.
Water,	3.440	4.620
Insoluble residue,	18.650	17,000
	100.443	99.560
Iron,	50.800	50.700
Sulphur,	trace.	trace.
Phosphorus,	.112	.123

	I.	II.
Iron,	27.250	23.800
Sulphur,	trace.	trace.
Phosphorus,	.203	.238
Carbonate of lime,	36.007	39.132
Carbonate of magnesia,	1.180	6.976
Insoluble residue,	16.610	12.850

I. "North side of Rockhill gap, near Orbisonia. Bottom bed, (drift No. 1,) 20 inches thick. Fossil ore, hard, compact, with numerous small crystals of calcite, of a reddish brown color."

II. "Rockhill gap, near Orbisonia. No. 1 north gangway. Fossil ore, hard, compact, reddish color."

Analyses of Fossil Ores, over Ore-sandstone, at Rockhill mines, near Orbisonia, by Mr. J. B. Britton, communicated by Mr. C. Constable, C. E., through Mr. Wm. A. Ingham:

	Soft Fossil, South side.	Hard Fossil, North side.		Ferruginous limestone.	Yellow Hanging Wall, South side.	Gray Hanging Wall, North side.	Lower 10'' Fossil Ore Bed.
SiO^2	31.81	15.99	14.54	8.49	53.14	54.94	
FeO	. . . .	. . . .	. . . .	. . . .	16.25	9.00	
Fe^2O^3	58.60	42.21	34.71				
CO^2	. . . .	. . . .	. . . .	. . . .	. . . .	9.27	
MnO	.59						
Al^2O^3	3.31	. . . .	. . . .	. . . .	21.97	22.14	
CaO	.11	13.28	19.51	*47.74	.30	1.53	
MgO	.05	. . . .	. . . .	. . . .	.40	1.43	
PhO^5	.55	.48	.34	.20			
S	.00	. . . .	. . . .	. . . .	. . . .	.14	
HO	4.10	. . . .	. . . .	. . . .	7.44		
Organic	.88	. . . .	. . . .	. . . .	. . . .	1.55	
	VI.	VII.	VIII.	IX.	X.	XI.	XII.
Metallic iron .	41.02	29.55	24.30	11.59	11.38	7.00	41.77

* Carbonate.

"Notice the decrease of phosphorus and increase of lime in VII, VIII and IX, with the corresponding decrease of iron. From I to V *the ores* do not appear to be associated with sand, but rather with clay in the beds."

Analyses of Marcellus brown hematite and carbonate ores, by Mr. J. B. Britton, communicated by Mr. C. Constable, C. E., through Wm. A. Ingham. (See page 238 F. above).

Nos. I, II, III and IV are from the openings between Orbisonia and Sandy ridge, (two miles north). No. V from Logan farm, Hill valley, foot of Jacks mountain.

The iron sandstone of the Juniata Valley has not been recognized in the Aughwick Valley. At Logan gap it is 7 feet thick and 571 feet above the top of the Medina Sandstone (IV.) At Mount Union it is 2 feet thick and 307 feet above No. IV. It was not seen in the cross-cut, at Orbisonia, made through the Clinton Lower Olive shale, and extending from the Ore sandstone down to the Medina sandstone, in searching for the rock-ore bed.

	Limonite.		Carbonate.		
	I.	II.	III.	IV.	V.
$Si O^2$	21.21	33.86	24.08	22.49	12.90
$Fe O$	....	....	37.86	....	41.53
$Fe^2 O^3$	62.43	52.87	1.29	....	3.21
$C O^2$	....	....	24.39	25.64	28.11
$Mn O$	2.45	.06	1.88	.93	1.60
$Al^2 O^3$	1.98	2.34	4.37	2.12	5.57
$Ca O$	.07	.07	.93	1.09	2.88
$Mg O$	.03	.04	89	.56	.90
$Ph O^5$	.30	.53	.33	.11	.49
S	.00	.11	.49	.32	.30
$H O$	11.04	9.92			
Organic	.88	.20	3.49	....	2.51
	I.	II.	III.	IV.	V.
Metal iron	43.7	37.01	30.35	33.72	32.3

a. The Lower Olive Shale group is sufficiently described in the section above.

Mountain rock ore. Search has been made along Blacklog mountain and in Rockhill gap, for what has been called the "Levant ore," and which is supposed to occur in the Lower Clinton olive shale, directly above the Medina sandstone. Extensive prospecting was done in the shales in the gap, but without success. A red shale was found, directly above the Medina sandstone, which has been thought to be the representative of the bed; but the shale contained on analysis only 4.29 per cent. of metallic iron.

IV. { *Medina Sandstone.* / *Oneida Conglomerate.* } *Levant.*

No.	*Description.*	Thick-ness.	Total from bottom.
	Medina Sandstone.		
8	Massive, white and light gray, fine-grained, hard sandstone alternating near its upper limit with beds of red and greenish shale. Contains *Arthrophycus harlani,*	400	1898
	Medina Shale.		
7	Soft, argillaceous brown and red sandstone and shale, the sandstone in the central part softer, and more friable and contains specks of ferruginous matter,	930	1498
	Oneida Sandstone.		
6	Red and greenish gray, silicious breccia and conglomerate, ...	158	568
5	Hard, massive, greenish sandstone and gray conglomerate, ...	410	410

NOTES.—The section was made in Rockhill gap.

c. The Upper Medina white sandstone contains in New York several characteristic fossils, some of which, the marine plants, and more particularly the *Arthrophycus harlani,* are found throughout its whole range from Pennsylvania to the south border of Tennessee.

b. The Lower Medina red sandstone and shale member is in Pennsylvania entirely destitute of fossils, and is a coarser and more sandy rock than in New York, where it is composed principally of a finely comminuted red marl or a calcareous red clay, containing a few organic remains.

a. The Oneida is a conglomerate in New York, and sometimes in Pennsylvania. Fossils in it are rare.

The Medina and Oneida formations (No. IV) make most of the mountains of middle Pennsylvania.

Jacks, Blacklog and Shade mountains are separate portions of these elevated outcrops of IV.

When the dips are all one way the Medina White sandstone makes the mountain crest; the Oneida the brow of the terrace, or in some cases a lower crest; while the terrace itself, or the short double-headed ravines which replace it at intervals, is made by the intermediate softer red sandstones and shales, called in the reports of the old survey, the "Middle of IV."

The Medina sandstone beds afford good building material and railway ballast.

A deposit of iron ore exists in the white Medina forming the crest of Blacklog mountain 4 miles south-west of Orbisonia. The ore and clay in which it lies seem to fill a transverse fissure or cleft in the white sandstone, at a point where there is a slight indentation in the crest of the mountain.

III. { *Hudson River Slates.* / *Utica Slate.* } *Matinal.*

No.	*Description.*	Thickness.	Total from bottom.
	b. Hudson River Shale.		
4	Brown and bluish-gray shales and sandy slates, containing, especially in upper part beds of argillaceous sandstone. A reddish-gray shale in upper portion contains crinoid stems, ...	800±	1870
	a. Utica Slates.		
3	Brown, brownish-gray and black fissile slate, parts very carbonaceous, toward lower part becomes slightly calcareous, ...	1070±	1070

NOTES.—The section was made in Rockhill gap.

The upper limit of No. III is well defined by the sudden transition from the Oneida gray sandstone and conglomerate to the argillaceous sandstone at the top of the Hudson River slates.

The lower limit has been provisionally assumed at a very lean shaly brown hematite ore at the base of the Utica slates, overlying the blue calcareous shale at the top of the Trenton limestone.

The division between Hudson and Utica was not positively determined, and may possibly be above or below the position assigned to it. Unconformability between the

Hudson and Oneida, such as Prof. H. D. Rogers assumes, is not observable in this district.*

The Hudson River Slate formation makes the inside flank of the Blacklog mountain. The slope of the flank is broken by streams which rise near the Medina crest and descend through hollows or gullies arranged at short intervals along the mountain. The little streams which descend through these ravines generally head up in two branches, which flow toward each other, making a V with the main stream, where it begins to erode the Hudson river slates.

Roofing slate is found in this formation on the Lehigh and Delaware rivers. But none has been seen in this district and none need be expected.

Small pieces of a substance like coal, looking like anthracite, but flaming like semi-bituminous coal, are found in this formation in so many different parts of Pennsylvania that they may be discovered hereafter in Blacklog Valley. Those who find such pieces ought to know that they are geological curiosities, but of no practical value. They do not indicate the existence of coal beds; and money spent in digging where they are found will be thrown away.

Mr. Constable reports the occurrence of a blossom of brown hematite outcropping along both sides of Black Log Valley, and marking the line of contact of the Trenton limestone and Utica slate formations; that it was formerly worked for ore in several places north and south of the gap; but that it was not of superior quality nor found in any great quantities. This must be the representative both of the Leathercracker ore of Morrison's cove, and of the Mt. Pleasant furnace ore beds of Path valley.

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* Prof. Rogers speaks of it as follows: * * * * * "The relations of the Matinal series to the overlying Levant strata * * * * plainly shows that * * * * the earth's crust experienced a prodigious movement at the close of the Hudson period. This agitation of the floor of the sea, which had just received the materials of the Hudson shales, appears to have been everywhere attended by an extensive displacement of its level, accompanied in some districts by undulations amounting even to a close plication or corrugation of its sediment, and in some districts to a lifting up of wide areas above the general sea level into dry land."

II. { *b. Trenton Limestone. Matinal.*
c. Calciferous Sandstone. Auroral.

No.	*Description.*	Thick-ness.	Total.
	b. Trenton Limestone.		
2 .	Dark blue and bluish-gray, soft, argillaceous limestone, alternating with blue, calcareous shale particularly toward its upper limit.	500±	
	a. Calciferous, or Magnesian Limestone.		
1 .	Massive, light-bluish-gray, magnesian limestone. Upper part only exposed, lower horizon below surface of erosion.	. . . .	

b. Trenton limestone. The thickness of this could not be well determined from its limited exhibition in Blacklog valley. A very distinct palæontological break exists between it and the underlying Magnesian limestone, the upper strata of which are exposed in the centre of Blacklog valley opposite Rockhill gap. It is probable that the magnesian rocks in this part of Pennsylvania are nearly 5000* feet thick, which would place the top of the Potsdam sandstone (the lowest group in the Palæozoic column), at least a mile vertically beneath the present surface in the middle of Blacklog valley.

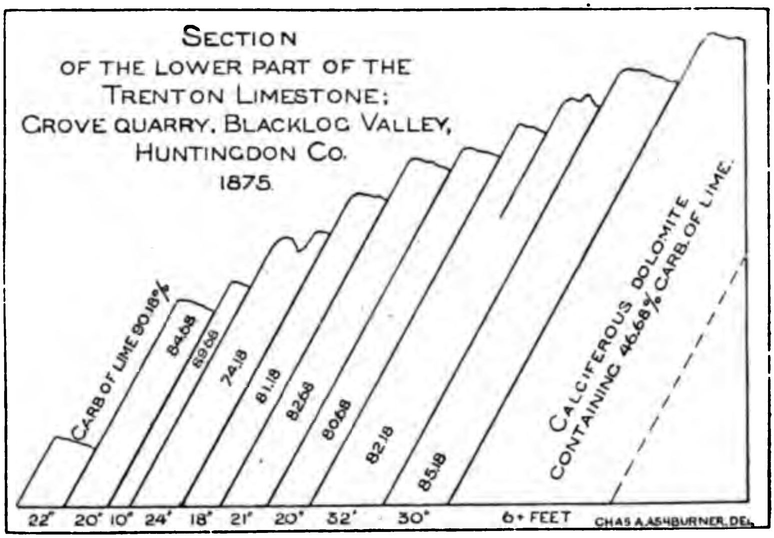
The Trenton limestones are rather argillaceous.

a. Auroral magnesian limestone. This is much purer. The different strata in the upper part of the formation vary as to the amount of carbonate of lime contained. The following chemical section was made by Dr. Charles M. Cresson and furnished to the survey by Mr. Wm. A. Ingham:

"Each stratum contains silica and alumina with a small percentage of iron and from 1 to 14.28 per cent magnesia."

No brown hematite iron ore deposits of importance have as yet been discovered in Blacklog valley.

* Very accurate measurements have been made in Blair county, and will be published in Mr. F. Platt's Report on that county.


SECTION
OF THE LOWER PART OF THE
TRENTON LIMESTONE;
GROVE QUARRY. BLACKLOG VALLEY,
HUNTINGDON CO.
1875.
CARB OF LIME 90.18%
84.68
89.68
74.18
81.18
82.68
80.68
82.18
85.18
CALCIFEROUS DOLOMITE
CONTAINING 46.68% CARB. OF LIME.
22" 20" 10" 24" 18" 21" 20" 32" 30" 6+ FEET
CHAS A. ASHBURNER, DEL.

APPENDIX.

Section of the Palæozoic Rocks in Blair County, by Mr. Franklin Platt and Mr. R. H. Sanders, of the Second Geol. Surv. of Penna. in 1877.

(*Communicated to the American Philosophical Society, April 19, 1877.*)

The following section of the Palæozoic rocks, exposed in Blair County, was made by compiling the sections taken from the following points:

From the summit of the Allegheny Mountain at Bennington along the Pennsylvania Railroad to Altoona for XII, XI, X, IX, and VIII. At Frankstown for VII. At Hollidaysburg for VI. At McKee's Gap for V. At Tyrone and Spruce Creek Gaps for IV and III. From Spruce Creek to Tyrone Forges for II. The measurements are based on the railroad lines and from the topographical survey of Blair County.

From the Mahoning Sandstone to coal A is taken from Report HH.

XII to VIII was measured by plotting on the railroad map the various cuts, measuring the rocks in each cut, and then projecting them upon a section line. This method would introduce errors, but only of a small magnitude.

The entire thickness of VII could not be measured at Frankstown, where the best exposures are.

A good measurement of VI was obtained at the "Chimney Rocks" at Hollidaysburg.

The measurement of V taken along the railroad cut at McKee's Gap is good except of the lower part which is concealed, and which should contain the "Frankstown" ore beds.

The Medina Sandstone shows best on the Pennsylvania Railroad, east of Spruce Creek Tunnel. The remainder of IV shows best in Tyrone Gap, but the rocks are crushed and the measurement is not reliable.

A complete section of the slates of III does not show anywhere in the county.

The thickness of the limestones and dolomites of II is taken from a carefully measured section along the Little Juniata from Spruce Creek to Tyrone Forges.

R. H. SANDERS.

345′	XIII	Lower Productive Coal Measures.
223′	XII	Pottsville Conglomerate.
283′	XI	Mauch Chunk Red Shale.
1,274′	X	Pocono Sandstone.
2,560′	IX	Catskill Sandstone and Shale.
6,519′	VIII	Chemung, Portage, Hamilton, Upper Helderberg.
50′	VII	Oriskany Sandstone.
900′	VI	Lower Helderberg Limestones.
1,328′	V	Clinton Red Shale.
2,366′	IV	Medina and Oneida Sandstone.
900′	III	Hudson River and Utica Slates.
6,600′	II and I (?)	Trenton, Calciferous and perhaps Potsdam.
23,348′		Palæozoic rocks exposed in Blair County.

	Mahoning Sandstone.
2′	8″ Coal bed.
20′	Drab slates.
5′	Olive shales.
10′	Massive slates.
20′	Olive slates and shales.
5′	6″ Coal bed E.
2′	Impure fire-clay.
20′	Sandstone and black slate.
3′	Limestone.
20′	Ferruginous slates and shales.
20′	Sandstone and sandy shales.
3′	Coal bed D^1.
1′	Fire-clay.
21′	Sandstone, drab.
20′	Black slate.
2′	10″ Coal bed D.
11′	Drab slates holding ore balls.
0′	7″ Sandstone.
13′	Blue slates.
15′	Sandstone, massive, drab.
12′	6″ Slate.
	6″ Coal } Bed C.
	6″ Slate } Bed C.
1′	8″ Coal } Bed C.
6′	Fire-clay.
12′	Sandstone.
1′	3″ Slate.
0′	4″ Coal.
7′	Sandstone.
8′	10″ Black slates, with calamites.
3′	6″ Coal bed B.
3′	Fire-clay.
29′	Shales.
2′	Black slate.
1′	8″ Coal bed A^1.
23′	Slates.
4′	Sandstone, gray.
4′	Coal bed A.
9′	Fire-clay.
	XIII. Total, ... 345′ 4″
14′	SS., coarse-grained iron stained.
0′	1″ Coal.
9′	Fire-clay.
4′	Slaty sandstone.
15′	Fine-grained grayish-white SS.
81′	Massive white sandstone.
100′	Concealed.
	XII. Total, ... 223′ 1″
110′	Red shale.
40′	Gray slate.
5′	Red shale.
12′	Gray slate.
2′	Red slate.
4′	Fine-grained sandstone.
6′	Red slate.
4′	Greenish-gray slate.
6′	Red shale.
2′	Gray slate.
52′	White and grayish-white coarse-grained sandstone.
10′	Gray slate.
5′	Red slate.
10′	Gray sandstone.
10′	Red shale.
	XI. Total, ... 283
2′	Gray shale.
200′	Gray sandstone.
3′	Red shale.
334′	Massive gray sandstone.
20′	Dark gray slates.
266′	Massive gray sandstone.
15′	Olive-gray sandstone.
20′	Red shale.
60′	Gray sandstone.
40′	Gray slate.

30′ Gray sandstone.
5′ Greenish-gray slate.
2′ Gray sandstone.
10′ Gray slate.
15′ Massive gray sandstone.
5′ Brown shale.
20′ Red shale and slate.
15′ Brown sandstone.
5′ Gray slate.
20′ Red shale and slate.
20′ Massive gray sandstone.
29′ Red shale.
11′ Gray sandstone.
10′ Gray slaty sandstone.
17′ Brown slaty sandstone.
10′ Red shale.
1′ Gray micaceous sandstone.
1′ Iron ore, greenish-gray.
0′ 1½″ Gray micaceous sandstone.
1′ 9″ Iron ore, greenish-gray.
26′ Massive gray sandstone.
5′ Red slate.
1′ 6″ Iron ore, greenish-gray.
14′ Gray micaceous thin bedded SS.
1′ Ferruginous sandstone.
38′ Gray sandstone.
7′ Gray slate.
3′ Red slate.
1′ Brown sandstone.
2′ Red slate.
15′ Gray slate.
16′ Gray sandstone.
5′ Red shale.
7′ Red slate.
45′ Gray sandstone.

X. Total, ... 1,274′ 4″

9′ Red shale.
3′ Gray shale.
15′ Red shale.
12′ Brown sandstone.
25′ Red shale.
20′ Gray sandstone.
25′ Red shale.
196′ Concealed.
Red sandstone.
167′ Concealed.
30′ Brown shale.
50′ Brown sandstone.
35′ Red shale with three small layers of olive shale.
30′ Brownish-gray sandstone.
10′ Gray slaty sandstone.
30′ Reddish-brown sandstone.
3′ Red shale.
20′ + Yellowish-gray sandstone.
264′ Concealed and reddish sandstone and slate.
6′ Gray shale.
50′ Red shale and sandstone.
10′ Gray slaty sandstone.
265′ Red shale and sandstone.
20′ Red sandstone.
10′ Red shale.
15′ Red sandstone.
15′ Red shale and sandstone.
15′ Red sandstone.
80′ Red shale.
305′ Concealed.
15′ Gray shale.
14′ Red SS. with some gray shale.
10′ Red shale.
10′ Red and gray shale.
2′ Gray shale.
4′ Red sandstone.
15′ Red slate with some gray SS.
20′ Gray shale.
70′ Red shale.
5′ Gray sandstone.
40′ Red shale.
15′ Reddish-brown sandstone.
60′ Red shale with layers of gray sandstone.
25′ Gray sandstone with red shale; small layers of gray shale.
40′ Gray sandstone and slate.
480′ Concealed.

IX. Total, ... 2560′.

20′ Red slate with gray sandstone, mostly sandstone.
40′ Gray slates.
20′ Gray sandstone.
3′ Gray slate.
20′ Gray sandstone.
40′ Gray slate.
90′ Gray sandstone and slate, with a slight reddish tinge.
40′ Gray sandstone and slate.
410′ Concealed.
192′ Gray slate.
8′ Gray sandstone.
10′ Light gray slate.
1′ Gray sandstone.
8′ Dark gray slates.
10′ Gray sandstone.
86′ Dark gray slates and concealed.
15′ Dark gray slates.
1′ Gray sandstone.
50′ Gray slates.
2′ Gray sandstone.
4′ Gray slate.
10′ Gray sandstone.
0′ 2″ gray slate.
1′ Gray sandstone.
70′ Gray slate.
300′ Concealed.
20′ Gray slate.
260′ Slaty sandstone.
20′ Gray shale.
30′ Gray sandstone and slates, thin bedded.
505′ Concealed.
50′ Gray sandstone thin bedded with slate.
460′ Gray slate with thin layers of gray sandstone.
50′ Gray slate.
50′ Concealed.
35′ Gray slate with a few layers of gray sandstone.
50′ Gray slate, cleavage planes iron stained.
780′ Concealed, mostly gray slates.
185′ Olive and gray slates with 10′ red slates.

5′ Red slates.
418′ Gray slate and sandstone.
75′ Slaty sandstone and gray slate.
10′ Gray sandstone.
100′ Gray slates, some of the slates have ripple marks.
600′ Gray slaty sandstone, thin.
1365′ Gray and black slates, the black slates are the lowest. Thickness not known.

VIII. Total, . . . 6519′ 2″.

50′ ± Sandstone, coarse grained, some conglomerate. The thickness cannot be measured at any place in the county.

VII. Total, ... 50′.

900′ Limestone, not all exposed, mostly a dark blue massive limestone.

VI. Total, ... 900′.

120′ Gray slaty limestone.
30′ Concealed.
60′ Gray slate with some limestone.
5′ Dark gray slate.
14′ Slaty limestone.
1′ Limestone.
3′ Gray slate.
26′ Red shale.
1′ Gray slate.
0′ 10″ Limestone.
5′ Gray slate.
0′ 6″ Green shale.
1′ Red shale.
1′ Gray shale.
14′ Red shale.
5′ Gray slate.
1′ Impure limestone.
5′ Dark brown slate.
2′ Olive gray slate.
7′ Red slate.
45′ Gray slate with some small layers of limestone.
1′ 9″ Fossiliferous dark blue lime.
1′ 6″ Gray slate.
0′ 6″ Limestone.
4′ Gray slate.
0′ 2″ Limestone.
30′ Olive slate.
3′ Limestone.
3′ Gray slate.
2′ Limestone.
6′ Gray slate.
2′ Red shale.
3′ Olive shale.
6′ Red shale.
2′ Green shale.
3′ Red shale.
2′ Olive shale.
6′ Red shale.
5′ Gray shale.
30′ Gray slate and concealed.
50′ Concealed. Fossil ore.
20′ Gray slate.
30′ Concealed.
30′ Brown slate.
640′ Concealed. Frankstown fossil ore in this interval.

V. Total, ... 1328′ 3″.

100′ ± White sandstone.
255′ Red sandstone with layers of red slate from 6″ to 5′ thick.
84′ Massive red sandstone.
1′ 8″ Green slaty sandstone.
87′ Red sandstone with a few layers of red shale.
0′ 6″ Green slate.
10′ Red sandstone.
5′ Red shale.
5′ Green slate.
5′ Red sandstone.
20′ Gray sandstone.
1′ Red shale.
10′ Gray sandstone.
0′ 6″ Red shale.
10′ Red sandstone.
15′ Grayish-red sandstone.
1′ Red slate.
1′ 6″ Green slate.
15′ Gray sandstone.
1′ Gray slate.
20′ Brown sandstone.
1′ Gray slate.
8′ Brown sandstone.
0′ 6″ Red shale.
75′ Reddish-brown sandstone.
1′ Red slate.
200′ Red and gray sandstone.
9′ Red sandstone.
4′ Red shale.
2′ Red sandstone.
3′ Red slate.
1′ Green slate.
4′ Red slate.
2′ Green slate.
6′ Red sandstone.
15′ Red sandstone (some gray).
10′ Red sandstone.
2′ Gray slate.
18′ Red sandstone.
0′ 5″ Gray slate.
12′ Grayish-brown sandstone.
0′ 3″ Red shale.
20′ Brown sandstone.
0′ 2′ Green shale.
4′ Brown sandstone.
1′ Red shale.
150′ Brown and gray sandstone and concealed.
409′ Concealed and gray sandstone.
320′ Gray sandstone.
440′ Gray sandstone and slaty SS.

IV. Total, ... 2365 10″.

900′ Slates, gray and black; they do not show in any place in the county.

III. Total, ... 900′.

5400′ Limestone, dark blue, blue, and gray.
40′ ± White sandstone, some of it iron-stained.
1160′ Limestone, towards the bottom comes in slates and SS.

II and I (?). Total, . . 6600′.

APPENDIX B.

A measured section of the Palæozoic rocks, between Lock Haven and Farrandsville, in Clinton county, Pennsylvania. By H. Martyn Chance, May 31, 1878.

The measurements of this section do not extend below the top of the Lower Siluro-Cambrian slates of III. Nos. IV and V were measured at Mill Hall Gap, through Muncy or Bald Eagle Mountain. Nos. VI to XIII, inclusive, were measured on the Susquehanna river, between Lock Haven and Farrandsville.

Total thickness of the strata described, 13,636+ ft., which may be divided by the Pennsylvania numbers as follows:

Carboniferous, 215′ +	86′	XIII	Lower Productive Coal Measures.
	129′	XII	Pottsville Conglomerate.
Sub-Carboniferous, (Bernician.) 1275′.	100′	XI	Mauch Chunk Red Shale.*
	1175′	X	Pocono Sandstone. Bottom merging into IX.
Devonian, 7870′.	2106′	IX	Red Catskill. Red S. S. and Shale.
	5764′	VIII	Chemung, Portage, Hamilton.
		VII	Oriskany S. S. wanting at Lock Haven.
Silurian, 1975′.	895′	VI	Lower Helderberg Limestones.
	1080′	V	Clinton Shales, with fossil ore.
Middle Silurian, 2301′.	2301′	IV	Medina and Oneida Sandstones.
Siluro-Cambrian,	?	III	Hudson River Slates, Utica Slates.
	?	II & I	Lower Silurian Limestone and Potsdam S. S

Lower Productive Coal Measures. XIII.

Surface,	35′
Coal; variable 3′ to 4′, upper bed,	3′
Fire-clay; used for fire-brick,	5
—— Concealed, Shale and Sandstone,	40
Coal; middle bed,	3
Total,	86′

* This red shale is only local, disappearing in half a mile, its place being filled by Sandstone and Conglomerate belonging to XII.

Pottsville Conglomerate. XII.

S. S. and Shale,	40′
Coal; lower bed, 2′ 0″ to 3′ 6″,	2′
Fire-clay; 6 to 8 ft., used for fire-brick,	7′
——— Concealed. Some Sandstone,	80′
Total,	129′

Mauch Chunk Red Shale. XI.

——— Concealed; trace of red shale,	20′
Red and olive shale. Red shale is only a local deposit,	20′
———Concealed,	55′
Red shale,	5′
Total,	100′

Pocono Sandstone. X.

S. S. white and gray, rather coarse,	15′
Limestone and S. S. in one massive bed. The limestone lies in layers or lenticular patches, ¼ to 1 inch thick. In some parts of the rock it lies in nodules resembling pebbles, and giving the rock the appearance of being a conglomerate. The lime is pure, and free from any admixture of sand.	3′

N. B.—This is the northern Knife-edge of the siliceous limestone in the gaps of the Conemaugh, Loyalhanna and Youghiogheny rivers. See Reports KK, KKK.

S. S. gray and greenish gray, false bedded,	25
——— Concealed,	10′
S. S. gray. Some thin-bedded layers, only partially exposed,	70′
———Concealed; contains a band of red shale,	60′
S. S. hard, gray; contains a layer of cannel slate, 2″ to 3″ thick,	80′

N. B.—This is one of the coal beds described by Mr. C. A. Ashburner in Report F, as cut by the Sideling Hill tunnel Huntingdon County.

———Concealed,	65′
S. S. gray, hard and massive,	5′
———Concealed,	40′
S. S. hard gray,	35′
S. S. coarse gray, with a pebble layer 12″ thick near middle,	15′
S. S. coarse gray with a pebble layer 12″ thick at base,	10′
Red Shale; soft,	20′
S. S. and Shale alternating; S. S. is hard and gray,	68′
S. S. gray and hard, massive,	47′
S. S. thin-bedded, greenish gray, alternating with shale,	59′
Red shale,	5′
Olive shale,	8′
Red shale,	3′
S. S. thin-bedded, alternating with olive shale and dark slate,	41′
Principally shale, few bands red shale,	71′
S. S. hard, greenish gray, upper part streaked with red,	45′
Olive shale, some sandy bands,	20′
S. S. hard gray,	20′

——Concealed softer S. S. and shale,	285′
S. S. gray, reddish gray, and greenish gray, beds parted by shale,	50′
Total,	1175′

Catskill. IX.

Red shale,	10′
S. S., very hard, massive, gray, reddish, and greenish gray, some red,	95′
S. S., Greenish gray, with red and olive shale partings,	30′
Red shale; soft,	53′
Red S. S., hard and massive, micaceous, with one thin band red shale,	20′
Red shale, one band massive red S. S. partly concealed,	131′
Red and greenish gray S. S., massive and hard,	30′
Red shale; partly concealed,	56′
S. S. red and grayish red,	32′
—— Concealed; principally red shale with S. S.	73′
S. S. red and greenish gray, massive,	20′
Red and olive shale,	19′
Red Conglomerate Fish bed. Pebbles of S. S. and limestone (?) irregular. Full of iron concretions, 2′4″	2′
Red shale; few bands of red S. S.	31′
S. S. massive red and greenish gray,	4′
Red shale; soft, with a few sandy bands,	131′
Red S. S. massive, parted into sub-divisions by two or three bands red shale 5 to 10 feet thick,	148′
Red S. S. and shale, alternating very regularly in bands from 5 to 10 feet thick. The S. S. is massive and the shale soft. Complete exposure,	985′
Red Shale and Red S. S. alternating, with a few bands of gray S. S. streaked with red,	285′
Total,	2,106′

Chemung, Portage. VIII.

Olive Slate,	20′
Shale; olive and gray alternating in thin bands with gray S. S.,	217′
—— Concealed, contains some gray slaty shale, and gray S. S.,	110′
Olive shales and gray slates with two bands purplish red slate,	134′
Red shaly S. S.	9′
Olive shales and gray and purplish red slate, some sandy layers,	38′
S. S. massive gray,	20′
S. S. hard gray alternating with slates and shales,	51′
Slates and shales; soft, dark, with a little reddish slaty shale,	77′
S. S. hard gray, massive,	13′
Slates and shales; soft olive, gray and purplish red,	57′
S. S. massive red,	2′
S. S. hard gray,	4′
Purplish red slate and shale with some reddish and gray S. S.	83′
S. S. and shale (gray) alternating,	9′
Red S. S. and shale,	41′
S. S. massive,	2′
Shale and slate, dark and soft,	18′

S. S. massive gray,	4′
Shales; olive and gray, soft,	37′
S. S. massive gray,	5′
S. S. hard gray, alternating with dark slates and shales,	36′
S. S. massive dark gray,	10′
S. S. hard gray with slate partings,	39′
S. S. massive gray	6′
S. S. gray and dark slate alternating,	12′
Shales and slates alternating with bands of hard gray S. S.	125′
Slate; soft dark,	5′
S. S. hard gray,	11′
Shales; gray and olive with dark slates and a few bands of gray S. S near middle of the mass,	88′
S. S. gray, alternating with gray slaty shale,	57′
Purplish red and gray slaty shale,	12′
S. S. hard gray, some greenish slaty shale partings,	30′
S. S. massive light gray,	13′
Slates and shales, purplish red, olive and gray. Red predominates near base,	77′
S. S. [gray] slates and shales alternating,	92′
Red and gray shales, soft,	69′
Red and reddish gray S. S.; shale partings,	9′
Slates and shales: red, olive, and gray—soft with some sandy bands,	22′
S. S. gray, with red slate and gray shale partings,	57′
Red and reddish gray S. S. with purplish red slates and shale,	22′
Purple shaly slate,	6′
S. S. thin bedded, alternating with slate,	15′
Slates; soft gray with some shale,	53′
Gray S. S. gray shale, and dark slate alternating,	84
Shale, dark gray and olive, with two thin bands of S. S.,	53′
S. S. gray thin bedded, slate and shale alternating,	17′
Shale; soft olive and gray ferruginous,	7′
S. S. fine grained bluish gray, parted by dark slates,	15′
Shale; very soft olive,	39′
Purplish red slaty shale,	4′
——— Concealed,	303′
Slaty shale, gray and sandy,	15′
Slates and shales alternating with thin bands of very dark S. S.,	70′
Slates; dark, with two thin bands of S. S.,	30′
Olive shales and dark blue slates,	78′
S. S. dark gray, alternating in bands 6″ to 12″ thick with dark bluish shale,	63′
Shale; soft olive with a few thin bands of S. S.,	172′
S. S. hard massive gray,	7′
Olive shale, soft,	21′
S. S. gray, hard and massive,	4′
Olive shales, soft; slaty near bottom,	128′
Soft shales, not well exposed,	183′
Slate; soft bluish black,	15′
S. S. gray alternating with dark gray slates and olive shales,	189′
Total,	3,314′

Genesee. VIII.

Soft dark gray and olive slates, some bands of slate,	560′

Hamilton flags. VIII.

S. S. thin bedded dark gray, alternating with olive and gray shaly slate,	110′
Slate; bluish gray and blue, with some olive shale and an occasional band of S. S.,	225′
Soft shaly and slaty measures not well exposed,	127′
S. S. thin and flaggy with some slaty shale,	248′
Shale and slate, not well exposed,	176′
S. S. dark; thin beds, some shale and some thick beds blue sandy slate,	245′
Total,	1,131′

Marcellus black shale. VIII.

Shales; soft with some thin flags not well exposed,	96′
Slate, shaly with some thin sand bands,	68′
Slate, very dark,	68′
Slate; dark blue and black, soft,	158′
Slate; dark, some few thin bands gray S. S.,	45′
Slate; soft black and dark gray,	324′
Total,	759′

[Total, VIII. Chemung, Portage and Hamilton, 5,764′]

Oriskany. VII. Wanting at Lock Haven.

Lower Helderberg Limestone. VI.

Limestone, massive, impure, shaly on top,	80′
Lime shale and impure limestone,	83′
Soft dark bluish black slates, upper part calcareous,	177′
Limestone, shaly and massive,	30′
Concealed in Valley of Susquehanna. [Limestone?]	+500′
Limestone massive, quarried,	25′
Total,	895′

Clinton. V.

Nearly all concealed at Mill Hall Gap, shales, slates and sandstones containing the "fossil" and "block" iron ores, both of which have been mined by Mill Hall Furnace Co. The fossil ore is here about 10″ to 12″ thick,	1,080′

Medina and Oneida S. S. IV.

S. S. hard and massive, red, gray, and white; not well exposed,	695′
Softer S. S. and shale, forming the valley between the two mountain crests,	705
S. S. hard and massive; white with a few beds of gray S. S. mottled with ferric oxide,	188′
——— Concealed; probably softer S. S. and shale with some red bands,	118′
S. S. hard, massive, siliceous, dark gray and greenish gray, iron specked,	155′
Not well exposed, principally hard, massive S. S.,	440′
Total,	2,301′

APPENDIX C.

Catalogue of specimens collected by Mr. Ashburner to illustrate the character of the individual strata, with the observed dip of each where the specimen was obtained, its vertical height above the bottom of the formation, and its horizontal distance from some designated locality.

NOTE.—The numbers of the specimens from 325 to 1 *descend* in regular order of superposition from the Coal Measures, No. XIII, down to the Siluro-Cambrian magnesian limestones of No. II.

NOTE.—The dip of the rock from which the specimen was taken is given *in brackets*.

NOTE.—In some places it will be found that several specimens of distinct lithological characteristics are noted as being at the same distance above the bottom of the formation. This indicates that the stratum does not remain constant in character but is liable to change in a short distance.

337 (XII). Reniform wad, coating surfaces of Pottsville conglomerate; from Rocky ridge, at the end of Wray's Hill tunnel.

336 (XI). Manganiferous calcite, occurring as a coating on the surfaces (stratified) of the Mauch Chunk red shale; from Wray's Hill tunnel.

335 (XI). Manganiferous calcite and specular iron ore, coating surface of Mauch Chunk red shale; from ditto.

334 XI). Mauch Chunk red shale coated with fibrous calcite, quartz and a fibrous silicate; ditto.

333 (XI). Same as No. 334, but coated with fibrous calcite and an asbestus like mineral; ditto.

332 (XI). Same as 334, coated with fibrous calcite and quartz; ditto.

331 (VIII). Brown sandstone coated with calcite; from railroad cut, end of Clear ridge, Clay township.

330 (VII). Barite, associated with brown hematite from the "Chert vein" in the lower Oriskany measures of Sandy ridge, near Orbisonia.

329 (VII). Wavellite, with a finely radiated structure, formed on the surface of Oriskany sandstone; Sandy ridge, ditto.

328 (Between VIII and IX). Brownish-gray S. S. showing fucoids and Spirifer disjuncta on lower stratigraphical surface and ripple marks on upper. [76° > N. 73° W.] Railroad cut east end of Clear ridge.

327 (Top of IV; loose). White Medina sandstone, showing ripple marks. [72° > N. 65° W.] Rockhill gap.

326 (II.) Calciferous L. S. showing peculiar forms of weather cracks. Grove quarry, in Blacklog Valley, Cromwell township.

The following are from the Coal measures of East Broad Top:

325. Concretionary sandstone above coal seam at Curfman (Savage) opening. [13°>S. 50° E.] Rocky ridge.

324. Coal from Petriken (Taylor) opening. [Variable.] Ditto.

323. Coal from Curfman (Savage) opening. [13°>S. 50° E.] Ditto.

322. Brown hematite above coal at Alloway opening. [6°>S. 20° W ?] E. L. Anderson tract, Trough creek basin.

321. Coal from Alloway opening.

320. Brown hematite above Rockhill I. & C. Co.'s coal seam of mine C′ at Robertsdale. [5°>S. 30° W.]

319. Coke made in Belgian oven from coal of mine C′.

318. Coke made in Pit from coal of mine C′.

317. Coal from upper bench, C′. 2nd room 1st entry. 5°>S. 32° W.

316. Separating slate between upper and middle benches of mine C′.

315. Coal from middle bench of mine C′.

314. Separating slate between middle and lower benches of mine C′.

313. Coal from lower bench of mine C′.

312. Coal from upper bench of mine B′. [4°>S. 33° W.]

311. Separating slate between upper and lower benches of mine B′.

310. Coal from lower bench of mine B′.

309. Hard dark-gray fireclay under lower bench of mine B′.

308. Hard light-gray S. S. above coal, mine A′ [3°>S. 70° W. Foster.]

307. Carbonaceous fireclay commonly called black gravel. [3° to 4°> N. 50° W. Foster.] Coal opening south of road from Robertsdale to New Grenada.

The following are from strata of No. XII, Pottsville or Seral conglomerate, the base of the Coal measures, on the M. J. Martin tract, Rocky ridge, near Wray's Hill tunnel, Todd township, Huntingdon county:

306 (Top of XII). Hard reddish-white conglomeritic S. S. surfaces coated with red hematite. [0°.]

305. Sandstone, very similar to No. 306 with which it alternates.

304. Ferruginous sandstone.

303. *Sigillaria* in sandstone.

302. *Sigillaria* in sandstone.

301. (85′ up in middle member of XII.) Dark-gray slaty sandstone alternating with shale and sandstone. [7° to 11°>N. W.]

300. Gray massive sandstone. [Ditto.]

299 (Lower member of XII). White S. S. stained with iron. [28°>N. W.]

298. Massive coarse-grained yellowish white sandstone. [Ditto.]

297. Pea conglomerate containing deposits of coal.

296. Conglomerate with pebbles the size of a hickory nut.

295. Coarse-grained gray sandstone containing impressions coal plants. [30°>N. 30° W.]

294 (Upper part). Hard white mustard seed conglomerate. [Ditto.]

293. Hard coarse-grained yellowish-grey sandstone stained with iron. [Ditto.

292. Very similar to 293, but quite massive. [Ditto.]

291 (Lower part). Dark-gray flaggy sandstone containing micaceous specks. [33°>N. 30° W.]

The following were collected from strata of No. XI, Mauch Chunk or Umbral shale:

289 (Top of XI). Brown hematite. [0°.] M. J. Martin tract, Wray's Hill, near Cook's Station, East Broad Top railroad.

288. Brown hematite. Ditto.

287. Yellow sandy shale directly under the ore bed.

286 (850′ up in XI). Reddish-gray sandstone, surfaces coated with calcite. [Dip at west end of tunnel 8°>N. 70° W.] M. J. Martin tract, Wray's Hill.

285. Reddish-gray shale with ferruginous calcite on surfaces showing "slickensides;" alternates with Nos. 286 and 284. [8°>N. 70° W. at 310′ from west end of tunnel. Same at 880′. 22°>N. 70° W. at east end of tunnel.]

284. Massive reddish-gray sandstone alternates with Nos. 286 and 285.

283 (190′). Red shale. [38°>N. 60° W.] New Granada, Sideling Hill gap, Taylor township, Fulton county.

282. Shaly argillaceous limestone alternates with 281 and 283. [Ditto.] Ditto.

281. Shaly red limestone directly below alternations of 282 and 283.

280 (175′). Red calcareous shale. [1°>S. 50° E.] Limestone quarry worked by Jno. Whitney, near Todd P. O.

279 (170′). Red limestone. [Ditto.] Ditto.

278 (170′). Red limestone very similar to No. 279. [Ditto.] Ditto.

277 (167′). Mottled argillaceous red and gray limestone. [Ditto.] Ditto.

276 (164′). Red lime shale. [Ditto.] Ditto.

275 (155′). Variegated red and gray limestone. [38°>N. 60° W.] New Granada, Sideling Hill gap.

274 (155′). Hard massive gray limestone. [Ditto.] Ditto.

273 (155′). Variegated massive red and gray limestone. [1°>S. 50° E.] Limestone quarry worked by Jno. Whitney near Todd P. O.

272 (152′). Brittle massive gray limestone. [Ditto.] Ditto.

The following were collected from strata in formation No. X, Pocono or Vesportine sandstone, forming the mass of Sideling Hill.

1. Upper member of X:

271 (1970′). Hard brownish-gray sandstone. [38°>N. 60° W.] Sideling Hill gap, near New Granada.

270 (1900′±). Coarse-grained gray sandstone. [Ditto.]

269 (1830′) Coarse grained gray sandstone. [Ditto.]

268 (1552′). Hard ferruginous sandstone. [59°>N. 73° W.] West end of Sideling Hill tunnel.

267 (1523′). Massive gray sandstone. [Ditto.] Ditto.

2. *Middle member, of X;*

Upper part of the coal bearing strata (New River Series).

266 (1493′). Coal seam (lignitic) No. 19, 2¼ inches. [Ditto.] Ditto.

265 (1490′). Pink coarse-grained gray sandstone containing micaceous specks. [38°>N. 60° W.] Sideling Hill gap.

264 (1450′). Massive coarse-grained sandstone containing micaceous specks. [59°>N. 73° W.] Sideling Hill tunnel west end.

263 (1450′). Very similar to specimen No. 264 and from the same stratum.

262 (1415′). Coal seam No. 17. Average thickness 3″. Maximum 9″.

261 (1414′). Light gray shaly sandstone.

260 (1372′). Nodules of iron pyrites.

259 (1322′). Hard massive gray sandstone.

258 (1306′). Coal seam No. 10. Average thickness 3″. Maximum 6″.

257 (1260′). Coal seam No. 5. Thickness 2 inches.

256 (1250′). Soft brown sandstone.

255 (1242). Coal containing a great deal of iron pyrites and broken up by false bedding. Seam No. 3. Thickness 2″.

254 (1230′). Massive gray sandstone, rhombohedral fracture, surfaces stained with iron.

253 (1213′). Yellowish-red sand.

252 (1209′). Poor bony coal or coal slate. Bed No. 1.

3. *Middle member, of X;*

Lower part, conglomeritic strata, characterized by false bedding.

251 (1184′). Dark gray argillaceous shale.

250 ("). Massive fine-grained conglomerate containing micaceous specks alternating with 251.

249 (1170′). Yellowish-gray shale containing plates of coal, surfaces showing "slicken sides." [59½°>N. 73° W.] Sideling Hill tunnel.

248 (1105′). Hard massive light gray sandstone. Ditto.

247 (1060′). Gray slaty micaceous S. S. Ditto.

246 (1010′). Dark gray flaggy sandstone containing micaceous scales. Ditto.

245 (985′). Dark greenish-gray shale containing acicular crystals of sulphate of alumina formed by the decomposition of the pyrites. Ditto.

244 (962′). Dark gray argillaceous shale. Ditto.

243 (915′). Fine-grained light gray conglomerate. Ditto.

242 (900′). Fine-grained dark gray argillaceous shale. Ditto.

241 (890′). Hard gray S. S. interstratified with a black micaceous sandstone. Ditto.

240 (880′). Yellowish-gray S. S. showing false bedding. [30°>N. 60° W.] 2000 feet S. E. of New Granada, Sideling Hill gap.

239 (878′). Greenish-gray shaly sandstone. Ditto.

238 (866′). Soft yellowish-gray shale, talcy lustre. [65°>N. 73° W.] Sideling Hill gap.

NOTE.—Specimens 264 to 241 include from Sideling Hill tunnel.

237 (863′). Hard massive gray sandstone. Ditto.

236 (848′). Dark gray sandy shale. Ditto.

235 ("). Gray massive argillaceous shale exhibiting twisting and contortion of laminæ; alternating with 236.

234 (838′). Yellowish-gray S. S. shale. [30° > N. 60° W.] 2000 feet S. E. of New Granada, Sideling Hill gap.

From Lower member of No. X.

233 (807′). Dark blue-gray shale of close texture. [65° > N. 73° W.] Sideling Hill. gap.

232 (800′±). Yellowish-brown sandstone containing iron concretions. [30° > N. 60° W.] 2000′ S. E. of New Granada, in Sideling Hill gap.

231 (800′±). Very similar to No. 232 and from the same stratum.

230 (782′). Green fossiliferous shale. [65° N. 73° W.] East end Sideling Hill tunnel.

229 (587′). Coarse-grained yellow sandstone surfaces stained with iron. [Ditto.] R. R. cut 450 feet east of Sideling Hill tunnel.

228 (587′). Very similar to No. 229 with which it alternates.

227 (490′). Gray flaggy sandstone. [35° > N. 60 W.] 3000 feet S. E. of New Granada, Sideling Hill gap.

226 (480′). Brown sandstone containing micaceous specks, alternates with Nos. 224 and 225. [68°± > N. 73° W.] R. R. cut 1200 feet east of Sideling Hill tunnel.

225 (480′). Yellow flaggy sandstone alternates with Nos. 224 and 226. [Ditto.] Ditto.

224 (480′). Massive reddish-yellow sandstone, alternates with Nos. 225 and 226. [Ditto.] Ditto.

223 (170′). Yellowish-gray flaggy sandstone. [28° (?) N. 60° W.] 3300 feet S. E. of New Grenada, Sideling Hill gap.

222 (170′). Massive yellowish-gray sandstone alternating with No. 223. [Ditto.] Ditto.

221 (Bottom of X). Brownish-gray S. S. containing micaceous specks. [31° N. 61° W.] Ditto.

The following were collected from the Devonian strata belonging to formation No. IX. Catskill (Ponent or Old Red) Sandstone:

220 (2505′). Greenish-gray slaty S. S. containing micaceous specks. [31° N. 61° W.] Sideling Hill gap.

219. Soft bright red shale. Railroad cut E. of Sideling Hill tunnel. Alternating with 218.

218. Bright red shale harder than No. 219, from same place. These rocks (218 and 219) weather readily and deteriorate rapidly.

217 (2390′). Massive coarse-grained reddish-gray sandstone. [35° ? N. 60° W.] 350 feet N. W. of M. E. church, Sideling Hill gap.

216 (2280′). Very siliceous brown hematite. [70° ? N. 70° W.] J. B. Moreland farm near Sideling Hill Tunnel.

215 (2280′). Brown hematite, very similar to 215. Ditto.

214 (750′). Greenish-yellow sandstone. [76° N. 76° W.] R. R. cut 1 mile S. W. of end of Clear Ridge near Sideling Hill tunnel.

213 (750′). Red flaggy sandstone. [Ditto.] Ditto.

212 (750′). Massive reddish-gray sandstone. [Ditto.] Ditto.

NOTE.—Specimens 212 and 213 alternate with each other and with 214.

211 (480′). Red sandy shale containing *fucoid* stems. [75° N. 76° W.] R. R. cut $\frac{3}{4}$ mile S. W. of end of Clear Ridge near Sideling Hill tunnel.

210 (370′). Red massive sandstone. [79° N. 77° 30′ W.] R. R. cut $\frac{1}{4}$ mile S. W. of end of Clear Ridge.

209 (370′). Red S. S. less massive than No. 210 with which it alternates. [Ditto.] Ditto.

208 (340′). Green sandy shale. [Ditto.] Ditto.

207 (340′). Massive brown sandstone alternating with No. 208. [Ditto.] Ditto.

206 (150′ to 200′). Massive gray S. S. containing small deposits of *coal* and *coal plants*. Wm. Smith's farm, near Mapleton, Union Twp.

205 (150′ to 200′). Same as No. 206, but less massive.

204 (60′). Light yellow sandy shale alternating with yellow shale. [76° N. 73° W.] Smith's Valley, line of E. B. T. R. R., N. W. from Saltillo, Clay Twp.

203 (60′). Greenish-yellow flaggy sandstone; alternates with Nos. 202 and 204. Ditto.

202 (60′). Friable red shale surfaces stained with bituminous matter; alternates with Nos. 203 and 204. Ditto.

201 (Bottom). Brownish-gray S. S. containing micaceous specks. [41° N. 60° W.] 250 feet S. E. of W. Bergstresser's house, Sideling Hill creek.

The following were collected from strata belonging to formation No. VIII, Chemung and Portage, Genesee, Hamilton, Marcellus and Corniferous or Upper Helderberg:

From the transition strata between Nos. IX and VIII.

200. Dark-red flaggy sandstone. [76° N. 73° W.] End of Clear Ridge, line of E. B. T. R. R., N. W. from Saltillo, Clay Twp.

199. Light-yellow sand shale containing impressions of *plants*. [Ditto.] Ditto.

198. Same sandstone as No. 199, but containing impressions of different variety of *plants*. [Ditto.] Ditto.

197. Brown ferruginous sandstone weathering readily on surfaces from oxidation of iron. Representative of *Larry's Creek ore bed*. [Ditto.] Ditto.

196. Mottled green and brown ferruginous sandstone. [Ditto.] Ditto.

195. Shaly sandstone coated with quartz. [Ditto.] Ditto.

194. Green shaly sandstone containing micaceous specks. [Ditto.] Ditto.

193. Brownish-gray sandstone 1″ to 2″ thick, showing *fucoid* stems on one side and *ripple marks* on other. [Ditto.] Ditto.

192. Similar to No. 193. [Ditto.] Ditto.

191. Brown ferruginous sandstone. [Ditto.] Ditto.

From Chemung strata.

190 (1615′). Massive dark-gray sandstone containing ferruginous specks. [76°>N. 73° W.] Ditto.

189 (1600′). Reddish gray flaggy sandstone. [Ditto.] Ditto.

188 (1600′). Greenish-gray sandstone containing *Spirifer disjuncta* alternates with No. 189. [Ditto.] Ditto.

187 (1505′). Soft red shale. [Ditto.] Ditto.

186 (1505′). Light-green sandy shale, alternates with No. 187. [Ditto.] Ditto.

185 (1445′). Massive brown sandstone surfaces stained with iron and coated with minute quartz crystals. [Ditto.] Ditto.

184 (1445′). Light-red shale showing impressions of *fucoid* stems, alternates with No. 185. [Ditto.] Ditto.

183 (1295′). Red sandy shale containing micaceous specks and surfaces stained with iron. [Ditto.] Ditto.

182 (1295′). Dark olive shale alternates with 183 and 181. [Ditto.] Ditto.

181 (1295′). Light olive sandy shale cleavage planes stained with iron, alternates with Nos. 182 and 183. [Ditto.] Ditto.

180 (820′). Gray massive sandstone containing micaceous specks. [Ditto.] Ditto.

179 (760′). Massive brownish-gray S. S. containing yellow and red specks. [80°>N. 70° W.] Ditto.

178 (235′). Massive green sandstone surfaces stained with iron. [33°>N. 86° 30′ W.] Sandstone quarry on Aughwick creek near Beersville, Cromwell twp.

177 (235′). Olive flaggy sandstone alternates with Nos. 176 and 178. [Ditto.] Ditto.

176. Light-gray massive S. S. alternates with Nos. 177 and 178. [Ditto.] Ditto.

175 (200′). Red sandy shale. [79°>N. 70° W.] 700 feet N. W. of T. Skipper's house, line of E. B. T. R. R., N. W. from Saltillo, Clay Twp.

174 (110′). Massive reddish-brown sandstone containing micaceous specks. [80°>N. 74° W.] 500′ ditto.

173 (100′). Brown argillaceous sandstone containing *crinoid stem.* [39° N. 78° W.] 1200 feet S. E. of J. Gladfetter's house, Sideling Hill Creek.

From Portage strata.

172 (930′). Massive brown sandstone containing iron specks. [79° N. 70° W.] Directly south of T. Skipper's house, line of E. B. T. R. R., N. W. from Saltillo.

171 (850′). Light fawn-colored argillaceous shale. [Ditto.] Ditto.

170 ("). Greenish-yellow flaggy sandstone surfaces coated with quartz. Alternates with 171. [Ditto.] Ditto.

169. Bog iron ore deposited on lower Portage. [0°.] H. R. Beer's meadow, Beersville, Cromwell Twp.

168 (690′). Light fawn-colored argillaceous shale. [80° N.>72° 30′ W.] 200 feet west of school house, line of E. B. T. R. R., N. W. from Saltillo.

167 (690′). Light yellowish-green shale, alternates with Nos. 168 and 166. [Ditto.] Ditto.

166 (690′). Green flaggy S. S. containing yellow and red specks, surfaces stained with iron. Alternates with Nos. 167 and 168. [Ditto.] Ditto.

165 (620′). Soft olive-brown flaggy sandstone. [Ditto.] Ditto.

164 (340′). Dark olive shale. [Ditto.] South of school house.

163 (140′). Light olive shale. [Ditto.] 400 ft. S. E. of school house.

From Genesee strata.

162 (Top). Olive shaly sandstone. [80° N. 72° W.] 500 ft. S. E. of school house.

161 (230′). Olive slaty sandstone. [Ditto.] Ditto.

160 ("). Brownish-gray flaggy sandstone, alternates with Nos. 159 and 161. [Ditto.] Ditto.

159 (230′). Light olive slaty sandstone, alternates with Nos. 160 and 161. [Ditto.] ¼ mile N. W. of Wm. Shue's house.

158 (175′). Greenish-gray concretionary shale. [64° (?) N. 78° W.] Sideling Hill Creek.

157 (155′). Light olive argillaceous shale. [80°>N. 72° W.] 800 ft. S. E. of school house, line of E. B. T. R. R., N. W. from Saltillo, Clay Twp.

156 (155′). Greenish-gray slate, alternates with No. 157. [Ditto.] Ditto.

From Hamilton strata.

155 (near top). Gray S. S. containing *Spirifer mucronatus* and *Tentaculites*. [Ditto.] Ditto.

154 (380′). Greenish-gray flaggy sandstone. [12°>N. 70° W.] Augh wick Creek, 1 m. from Orbisonia and 400 N. E. of bridge, Cromwell Twp.

153. Massive greenish-gray sandstone. [Ditto.] Ditto.

152. Very similar to No. 153 but less massive, containing *Spirifer mucronatus*, *Chonetes*, &c. [Ditto.] Ditto.

151. Olive-gray flaggy sandstone. [Ditto.] Ditto.

150. Massive greenish-gray sandstone. [Ditto.] Ditto.

Specimens 150 to 154 inclusive are from alternating strata.

149 (295′). Light olive slaty sandstone surfaces stained with iron. [80° N. 72° W.] 1000 ft. west of road fork near J. F. Meminger, line of E. B. T. R. R., N. W. from Saltillo, Clay Twp.

From Marcellus strata.

148 (300′±). Gray argillaceous sandstone. [33° N. 65° W.] Near I. Enyeart's house, line of E. B. T. R. R., 1 m. from Orbisonia, Cromwell Twp.

147 (300′±). Greenish-gray lime shale, alternates with No. 148. [Ditto.] Ditto.

146 (220′). Black fissile slate surfaces stained with iron. [80° N. 72° W.] 900 ft. N. N. W. of G. W. Cohill's house, line of E. B. T. R. R., N. W. from Saltillo, Clay Twp.

145 (Near bottom). Black slate stained with iron. [Ditto.] Railroad.

144 (Bottom.) Brown shale surfaces stained with iron and bituminous matter. [39° S. 82° E.] R. R. cut in front Hudson's Hotel, Three Springs, Clay Twp.

143 (Bottom). Black slate surfaces stained with iron, alternates with Nos. 142 and 144. [Ditto.] Ditto.

142 (Bottom). Black slate directly under Nos. 143 and 144, Marcellus iron ore bed. [Ditto.] Ditto.

141 (Bottom). Brown hematite, Hudson's ore bank (abandoned).

140 ("). Iron conglomerate representative of ore bed. [39° S. 82° E.] Ditto.

139 (Bottom). Honeycombed brown hematite. Isaac Fleck's ore bank, Cromwell Twp.

138 (Bottom). Nodular carbonate of iron and brown hematite (blossom). West flank of Royer Ridge near Orbisonia, Cromwell Twp.

From Upper Helderberg strata.

137 (Top). Dark greenish-gray shaly limestone directly below Marcellus ore bed. [78° N. 65° W.] Sandy Ridge No. 1 near Orbisonia.

136 (Top). Dark bluish-gray argillaceous limestone. [5° S. E.] Quarry near R. R. bridge, Orbisonia.

135 (Top). Dark blue lime shale. [Ditto.] Ditto.

134 (Near top). Massive gray argillaceous limestone. [50°±N. 65° W.] Sandy Ridge No. 2 near Orbisonia.

133 (56′). Dark blue limestone containing seams of calcite. [39° S. 82° E.] R. R. cut, Three Springs, Clay Twp., in front of Hudson's Hotel.

132 (54′). Dark brownish-gray argillaceous lime shale. [Ditto.] Ditto.

131 (51′). Dark-blue argillaceous limestone. [Ditto.] Ditto.

130 (45′). Dark bluish-gray lime shale. [Ditto.] Ditto.

129 (45′). Light olive calcareous shale alternates with No. 130. [Ditto.] Ditto.

128 (44′). Dark greenish-gray lime shale. [Ditto.] Ditto.

127 (15′). Dark olive calcareous shale. [Ditto.] Ditto.

126 (10′). Massive gray argillaceous lime shale. [Ditto.] Ditto.

125 (10′). Fragile dark olive calcareous shale alternates with No. 126. [Ditto.] Ditto.

From Oriskany strata.

124 (Top). Iron ore shale. [Ditto.] Ditto.

123 (Top). Ferruginous sandstone. [Ditto.] Ditto.

122 (Top). Massive yellow calcareous sandstone. [Ditto.] Ditto.

121 (Top). Mottled yellow and red calcareous sandstone. [Ditto.] Ditto.

120 (Near top). Gray calcareous S. S. containing impressions of *spirifer*. [11° S. 7° 30′ W.] End of Royer Ridge near Orbisonia.

119 (Near top). Friable yellow sandstone. Near Orbisonia.

118 (Bottom). Brown hematite. C. R. McCarthy's property near Saltillo, Clay Twp.

117 (Bottom). Ferruginous sandstone associated with jaspery clay iron.

[89° S. 32° E.] In front of Hudson's Hotel, R. R. cut, Three Springs.

116 (Bottom). Ferruginous conglomerate. [78° N. 65° W.] Sandy Ridge No. 1, Cromwell Twp.

115 (Bottom). Ferruginous sandstone. [50°±N. 65° W.] Sandy Ridge No. 2.

From Upper Silurian, Lower Helderberg, (Lewistown Limestone) strata, No. VI.

114 (Near top). Massive gray crystalline limestone. [50°±N. 65° W.] Sandy Ridge, near Orbisonia.

113 (125′). Massive dark-blue crystalline limestone. [45° ? N. 72° W.] C. R. McCarthy's lower quarry, near Saltillo.

112 (70′). Massive bluish-gray limestone. Upper quarry. [Ditto.]

111 (70′). Massive blue limestone with a conchoidal fracture alternating with No. 112. [Ditto.] Ditto.

110 (60′). Brownish-gray crystalline limestone. [50°±N. 65° W.] Sandy Ridge No. 2, near Orbisonia.

109 (60′). Massive bluish-gray limestone. [38° S. 30° E.] E. Hudson's quarry, Three Springs.

108 (60′). Gray shaly limestone. [Ditto.] Ditto.

107 (60′). Gray limestone, alternating with strata represented by Nos. 107 to 110. [Ditto.] Ditto.

106 (50′). Massive gray crystalline limestone from 2 to 6 inches thick. [Ditto.] Ditto.

105 (50′). Light-gray shaly limestone alternating with No. 106. [Ditto.] Ditto.

104 (Bottom). Dark-blue argillaceous limestone. [76° N. 65° W.] Mr. T. E. Orbison's quarry, Orbisonia.

From the Water lime strata.

103 (Top). Blue argillaceous (fossiliferous) limestone. [76° N. 65° W.] Ditto.

102 (Top). Blue slaty limestone. [Ditto.] Ditto.

101 (Top). Bluish-gray slaty limestone. [Ditto.] Ditto.

100 (Top). Grayish-yellow thinly laminated limestone. [Ditto.] Ditto.

99 (375′). Massive bluish-gray limestone of conchoidal fracture. [65° N. 80° W.] 400 ft. S. E. of C. R. McCarthy's lime kiln, near Saltillo.

98 (200′ ?). Dark-gray limestone surfaces showing slickensides and coated with carbonaceous matter. (See the text.] [Ditto.] Rockhill furnace water L. S. quarry, near Orbisonia.

97 (?). Gray limestone and calcite. [Ditto.] Ditto.

96 (?). White crystallized calcite. [Ditto.) Ditto.

95 (?). Gray thinly laminated limestone containing seams of calcite. [Ditto.] Ditto.

NOTE.—The strata exposed in the Furnace water-limestone quarry are probably 50 to 200 feet above the bottom of the formation.

94 (300′). Crystalline gray limestone containing impressions of *fucoid* stems and bivalve *shells*. [61° N. 80° W.] 600 ft. S. S. E. of C. R. McCarthy's lime kiln, near Saltillo.

93 (300′). Gray slaty L. S. containing *impressions* similar to No. 94 with which it alternates. [Ditto.] 350′ N. W. of P. P. Dewees' grist mill.

92 (205′). Bluish-gray shaly limestone. [62° N. 65° W.] Near Rockhill gap.

91 (190′). Dark-blue limestone. [64° N. 80° W.] 800 ft. S. S. E. of C. R. McCarthy's lime kiln, near Saltillo.

90 (160′). Massive bluish-gray limestone of conchoidal fracture. 1′ thick. [Ditto.] Ditto.

89 (160′). Slaty argillaceous limestone alternating with Nos. 88 and 90. [Ditto.] Ditto.

88 (160′). Greenish-yellow calcareous shale alternating with Nos. 89 and 90. [Ditto.] Ditto.

87 (110′). Variegated gray and yellowish-gray argillaceous lime shale. [82° (?) N. 65° W.] 250 ft. N. W. of P. P. Dewees' grist mill, near Rockhill gap.

86 (110′). Yellowish-gray lime shale containing seams of calcite alternates with No. 87. [Ditto.] Ditto.

85 (78′). Massive bluish-gray L. S. seams 1″ to 2″ thick. [40° S. 34° E.] R. Ashman's quarry, near Three Springs, alternating with 84 and 83.

84 (78′). Bluish-gray lime shale. [Ditto.] Ditto.

83 (78′). Gray slaty argillaceous limestone. [Ditto.] Ditto.

82 (73′). Bluish-gray slaty limestone. [62° N. 79° W.] 1000 ft. S. S. E. of C. R. McCarthy's lime kiln, near Saltillo.

81 (60′). Blue limestone of conchoidal fracture. [77° N. 72° W.] West flank of Jacks Mtn., 1 m. from Saltillo, alternating with 80 and 79.

80 (60′). Gray lime shale. [Ditto.] Ditto.

79 (60′). Thinly laminated yellow argillaceous limestone. [Ditto.]

78 (45′). Brownish-gray slaty limestone containing seams of calcite. [42° S. 34° E.] Near Ashman's grist mill, Three Springs.

77 (45′). Gray thinly laminated L. S. alternating with No. 78. [Ditto.]

76 (Bottom). Massive blue crystalline limestone alternating with shale. [62° N. 79° W.] Benj. Shope's water limestone quarry, Saltillo.

75 (Bottom). Gray slaty limestone. [40° S. 34° E.] Near Ashman's grist mill, Three Springs.

74 (Bottom). Bluish-gray limestone in seams from 1 to 2 feet thick. [70° (?) N. 65° W.] 150 ft. N. N. W. of P. P. Dewees' grist mill, near Rockhill gap.

73 (Bottom). Brownish-gray lime shale. [Ditto.] Ditto.

From Onondaga (Salina) Marl strata.

72 (Top). Alternating yellow and brown argillaceous lime shale. [62° N. 79° W.] Benj. Shope's water limestone quarry, Saltillo.

71 (Top). Yellowish-gray calcareous shale. [40° S. 34° E.] Near Ashman's grist mill, near Three Springs.

70 (Top). Greenish-gray shale. [62° N. 65° W.] 150 ft. N. N. W. of P. P. Dewees' grist mill, near Rockhill gap.

69 (Top). Gray shale slightly calcareous. [Ditto.] Ditto.

68 (Top). Light greenish-yellow shale. [Ditto.] Ditto.

67 (420′). Friable olive shale. [40° S. 34° E.] 250 ft. N. N. E. of Ashman's grist mill, near Three Springs.

66 (375′). Calcareous olive shale. [Ditto.] Ditto.

65 (300′). Gray shaly limestone. [63° N. 79° W.] Near Royer House, near Saltillo.

64 (295′). Light greenish-yellow shale. 50 ft. N. E. of P. P. Dewees' grist mill, near Rockhill gap.

63 (200′). Green calcareous shale. [63° N. 79° W.] 200 ft. south of Royer House, near Saltillo.

62 (5′). Bluish-gray lime shale. [Ditto.] 500 ft. S. S. E. of Royer House.

61 (5′). Friable olive calcareous shale, alternating with No. 62. [Ditto.] Ditto.

From Clinton Red and Upper Olive Shale, Fossil ore and Ore S. S. strata, No. V.

60 (Top). Red sandy shale. [63° N. 85° W.] Ditto.

59 (Top). Red shale containing irregular deposits of green shale. [Ditto.] Ditto.

58 (Top). Greenish red shale. [65° N. 65° W.] N. E. of P. P. Dewees' grist mill, Rockhill gap.

57 (Top). Red shale. [Ditto.] Ditto.

56 (263′). Green shale irregularly distributed in red shale. [39° S. 34° E.] 800 ft. N. W. of Ashman's grist mill, near Three Springs.

55 (263′). Dull-colored red shale alternating with No. 263. [Ditto.]

54 (260′). Red shale. [Ditto.] Ditto.

53e. (245′). Red shale rhombohedral cleavage. [63° N. 85° W.] 500 ft. S. S. E. of Royer House, Saltillo, Clay Twp.

53d. (52′). Fossil iron ore. (Upper bench of bed. [60° W.] 800 ft. N. E. Benj. Swoope's barn, Saltillo.

53c. (50±). Fossil iron ore. Lower bench of bed. [Ditto.] Ditto.

53b. (52). Ferruginous limestone, representative of upper bench of bed. [63° N. 85° W.] Opposite Lea's and McVitty's tannery, Saltillo.

53a. (50±). Fossil iron ore. Lower bench of bed. [Ditto.] Ditto.

52 (30). Red shaly S. S. containing irregular seams of calcite. Upper olive shale. [82° (?) S. 7° E.] 1,200 ft. N. N. W. of Ashman's grist mill, near Three Springs, Clay Twp.

51 (Top). Soft olive shale. [65°±N. 65° W.] Rockhill gap, Cromwell Twp.

50 (140′). Blue fossiliferous L. S. containing *rhynconella neglecta.* [39° S. 30° E. (?)] 1,200 ft. N. N. W. of Ashman's grist mill, near Three Springs, Clay Twp.

49 (140′). Bluish-green argillaceous limestone (fossiliferous) alternating with olive and yellow shale and with No. 50. [Ditto.] Ditto.

48 (135±). Similar to No. 49.

47 (110′). Olive calcareous shale. [51° west.] Opposite Leas and McVitty's tannery, Saltillo.

46 (90′). Olive brown argillaceous shale. [Ditto.] Ditto.

45 (90′). Blue fossiliferous limestone containing seams of calcite. Thickness 1 inch ±, alternates with No. 46. [Ditto.] Ditto.

44 (10′). Blue fossiliferous limestone alternating with olive shale. [Ditto.] Ditto.

43 (10′). Olive brown fossiliferous shale alternates with Nos. 42 and 44. [Ditto.] Ditto.

42 (10′). Gray argillaceous fossiliferous limestone alternates with Nos. 43 and 44. [Ditto.] Ditto.

41 (2′). Friable dark olive shale. [Ditto.]

40 (2′). Gray argillaceous limestone alternating with No. 41. [Ditto.]

39 (Bottom). Light-yellow argillaceous lime shale hanging wall of fossil bed [65°±N. 68° W.] Mines of Rockhill Iron and Coal Co., Rockhill gap.

38. Clinton fossil iron ore bed. Soft ore. [68±N. 70° W.] Ditto.

37. Hard ore. [Ditto.] Ditto.

36. Reddish white S. S. associated with a hematitic fossil ore. West flank of Jack's Mtn., near Saltillo, Clay Twp.

35c. Hard siliceous fossil iron ore. [S. W.] Ore sandstone ridge ½ mile S. E. of Saltillo.

35*b*. Hard calcareous fossil iron ore. [51° W.] Opposite Leas & McVitty's tannery, Saltillo.

35*a*. Gray fossiliferous ferruginous limestone representative of the fossil ore bed. [51° west.] Opposite Leas & McVitty's tannery, Saltillo.

34. Siliceous ferruginous sandstone.

33 (Top). Yellow massive sandstone foot wall of fossil ore bed. [68°±N. 70° W.] Mines of Rockhill Iron and Coal Co., Rockhill gap.

32 (Top ?). Light gray fossiliferous sandstone. [Ditto.] Ditto.

31 (34). Gray siliceous limestone stained with iron. [51 west.] Opposite Leas & McVitty's tannery, Saltillo.

30 (Centre). Gray shaly sandstone. [68°±N. 70° W.] Rockhill gap.

29 ("). Yellowish-green fosiliferous sandstone alternating with shale. Ditto. Ditto.

28 (Centre). Greenish-gray sandstone 1 to 2 inches thick alternating with olive shale. [Ditto.] Ditto.

From the Lower Olive Shale Strata.

27. Cellular brown hematite (blossom). West flank of Jacks Mtn., near Saltillo.

26. Shaly brown hematite. Ditto.

25–24 (Near bottom). Light yellowish-green shale surfaces stained with iron and bituminous matter. [10° 30′ > South ?.] R. R. cut between Saltillo and Three Springs.

23 (Near bottom). Soft olive shale showing impressions of *fucoids*. West of Three Springs.

22 (Bottom). Mottled red shale. [72° N. 70° W.] Rockhill gap.

21 (Bottom). Same.

Specimens 21 and 22 comprise a 3 ft. seam of shale containing 4.29 per cent. metallic iron and probably occupies the same stratigraphical horizon as the iron ore bed found on the east flank of Tussey Mountain.

20 (Bottom). Variegated red and greenish-gray shaly sandstone. [Ditto.] Ditto.

From the Medina White S. S. strata No. IV.

19. Botryoidal brown hematite. Mountain ore bank, Rockhill Iron and Coal Co.'s tract, crest of Blacklog mtn., S. W. of Orbisonia, Cromwell Twp.

18 (Top). Light-yellow sandstone. [72°>N. 70° W.] Rockhill gap, Cromwell Twp.

17 (Bottom). Hard reddish-white sandstone. [75°>N. 70° W.] Ditto.

From the Medina Red S. S. strata.

16 (Top). Soft red sandstone united with a harder white sandstone showing lithological horizon between Medina white and red sandstone. [Ditto.] Ditto.

15 (Top). Friable red shaly sandstone. [Ditto.]

14 (Bottom). Friable red sandstone. [78°>N. 70° W.] Ditto.

From the Oneida red strata.

13 (Top). Red breccia. [Ditto.] Ditto.

12 (Top). Coarse light reddish-gray sandstone. [Ditto.] Ditto.

From the Oneida gray strata.

11 (400′). Hard massive greenish-gray conglomerate. [Ditto.] Ditto.

From the Hudson River slate strata No. III.

10 (Top.) Reddish-gray shale containing *crinoid* stem. [75°>N. 70 W. ?.] Ditto.

9 (420′). Yellowish-brown shaly sandstone. [Ditto.] Ditto.

From the Utica slate strata.

8 (250′). Brownish-gray shaly sandstone surfaces coated with bituminous matter. [Ditto.] Ditto.

7 (Bottom). Dark-brown slate surfaces stained with bituminous matter. [Ditto.] Ditto.

6 (Bottom). Thinly stratified brown slate. [Ditto.] Ditto.

From Trenton Limestone strata No. II.

5 (Top). Dark-blue thinly stratified limestone. [Ditto.] S. Bolinger's farm, Blacklog Valley, near Orbisonia, Cromwell Twp.

4 (Top). Dark-blue limestone containing small nodules of crystalized calcite, central part of which is ferruginous. [Ditto.] Ditto.

3 (Top). Dark-blue limestone of conchoidal fracture. [Ditto.] Ditto.

From the Calciferous magnesian limestone strata.

2 (Top). Massive light bluish-gray limestone of conchoidal fracture. D. Grove's quarry, Blacklog Valley, near Orbisonia, Cromwell Twp.

1 (Top). Light bluish-gray limestone of cubical cleavage. [Ditto.] Ditto.

APPENDIX D.

Railway and other levels above tide of points mentioned in Report of Progress F. (*See N.*)

1. On the Pennsylvania R. R.

	Above tide.
Philadelphia; Market street; R. R. grade,	32′
Harrisburg (105 miles from Philadelphia),	320′
Duncannon, *at the mouth of the Juniata river* (120 miles),	356′
Perryville (151 miles),	441′
Mifflin (154 miles),	441′
Black Log, east end of Black Log mountain,	462′
Bixler's,	482′
Lewistown station (166 miles),	498
Railway junction,	499′
Granville (170 miles),	498′
Anderson's (171.5),	500′
Anderson's water station,	499′
McVeytown station (opposite McVeytown on the south side of the river, 173 miles),	522′
Manayunk (183 miles),	519′
Vineyard (185 miles),	548′
Newton Hamilton (188 miles),	599′
Mount Union, *junction of East Broad Top railroad* (191 miles),	597′
Jackstown, *in Jacks narrows,*	595′
Mapleton (194 miles),	593′
Mill Creek (198 miles),	604′
Huntingdon (203 miles from Philadelphia),	622′

2. On the Mifflin and Centre Co. R. R.

Lewistown station junction,	499′
Logan (furnace; 4 miles),	512′
Yeagertown (5 miles),	534′
Mann's (6 miles,) *in Logan Gap,*	573′
Reedsville (7 miles,) *in Kishicoquillis Valley,*	593′
Honey Creek (10 miles), " "	647′
Nagney (11 miles), " "	678′
Milroy terminus (13), " "	746′

3. Along the foot of Jacks Mountain.

Lewistown station,	498′
Juniata river at Lewistown,	447′
Kishicoquillis creek at Logan,	501

	Above tide.
Kishicoquillis creek below road bridge in Logan gap, ...	543′
James Mann's house; Logan gap, ...	592′
F. Mean's house on Ferguson Valley road, ...	568′
R. Mean's " "	543′
Jack's mountain crest, opposite ditto, ...	1760′
S. Myers on Ferguson Valley road; (water shed), ...	747′
J. Shahen's on mountain road, ...	938′
Jack's mountain crest on mountain road, ...	1823′
A. McKee's front gate-post (top), ...	729′
Road-forks (Ferguson Valley and Hope furnace), ...	605′
Jack's mountain crest on McVeytown road, ...	1894′
Dunkard meeting-house, ...	632′
McVeytown station (P. R. R.), ...	522′
Juniata river *at McVeytown*, ...	476′
Gen. Ross' curbstone (top) *at McVeytown*, ...	524′
Dull & Bradley's sand pit (bottom), "	482′
" " road above pit "	536′
McCoy's ore opening "	677′
Ross ore bank, upper drift "	719′
Ross ore bank, lower drift "	630′
Physic ore opening, "	801′
Dull & Bradley's hematite bank (head of shaft), ...	966′
Road-forks (Kansas and McVeytown), ...	687′
Road forks (Kansas and Musser's), ...	764′
J. Rhodes' ore bank (mouth of drift,) (water shed between valleys),	1024′
J. Rhodes' brook (in front of house), ...	959′
Atkinson's mills (in front of grist mill), ...	744
Jacks mountain crest opposite "	2212′
W. R. McDowell's (in front of house), ...	612′
Matilda furnace reservoir, ...	659′
Mt. Union old county bridge (N. end), ...	584′
Jacks mountain crest, 1¾ miles N. 12° 30′ E. from the bridge, . . .	2354′

4. East Broad Top Railroad.

Mount Union, junction with P. R. R., ...	597′
Morrison's summit, ...	615′
Aughwick creek (4 miles), ...	560′
Shirleysburg (7 miles), ...	572′
Douglass summit, ...	598′
McMullen's summit, ...	669
Rockhill (11 miles), ...	624′
Jordan's summit, ...	709′
Beersville, ...	658′
Three Springs	717′
Saltillo (19 miles), ...	781′
Sideling Hill tunnel, ...	1232
Cole's station (24¼ miles), ...	1359′
Cook's station, ...	1541′
Robertsdale (30 miles), ...	1785′
Terminus on Broad Top mountain, ...	1817′

5. *Orbisonia and its mines.*

			Above tide.
Rockhill station (11 miles),			624′
Orbison's mill,	at Orbisonia,		641′
Dewees & Co.'s grist mill	"		654′
Black log creek, surface of dam	"		673′
Road-forks in gap (N. side),			687′
Black Log mountain crest (N. side),			1727′
Black Log mountain crest (S. side),			1584′
Forks of Black Log and Aughwick creeks,			578′
Mine	(in North fossil ore) No. 2	(No. 1 map),	762′
Mine	(in South fossil ore) No. 1	(No. 3 "),	669′
Mine	(" " " ") No. 2	(No. 4 "),	728′
Chert bank	(in Oriskany ore,	No. 5 "),	782′?
Hawk bank	(in Corniferous ore,	No. 6 "),	937′
Drift	(in Marcellus ore,	No. 7 "),	746′
Open cut	(" " "	No. 8 "),	714′?
Bedford cut	(" " "	No. 9 "),	709′?
Orbison slope	(" " "	No. 10 "),	762′
Jordan bank	(" " "	No. 11 "),	778′
Drift	(" " "	No. 12 "),	788?′
Open cut	(" " "	No. 13 "),	742′
Open cut	(" " "	No. 14 "),	694′?
Open cut	(" " "	No. 15 "),	714′?
Drift	(" " "	No. 16 "),	941′
Drift and slope	(" " "	No. 17 "),	817′
Drift and shaft	(" " "	No. 18 "),	730′
Open cut	(" " "	No. 19 "),	674?′
Royer & Dewees' tunnel		(No. 20 "),	770′

6. *In Aughwick Valley.**

Jordan's Summit (railway track),	709′
Forks of Aughwick and Three Springs creeks,	618′
Malinda Furnace (in road; 1011),	660′?
Coaling ridge crest,	1110′?
Beersville (railway track),	658′
T. Fleck's ore bank (Marcellus; 1147),	882′
R. L. Green's house (road; 954),	798′
Three Springs (railway track),	717′
Cave Hill crest,	1210′?
S. L. Glasgow's (road forks 981),	791′
Jack's mountain crest, 2¼ miles north from Three Springs,	2220′
Saltillo (railway track),	781′
G. W. Cohill's (road, 508),	794′
McCarthy's ore bank (Marcellus),	835′
Road-forks, south of E. Walker's (1019),	925′
Clear ridge crest (on road, 1028),	1300′
Clear ridge gap (level of stream),	885′
Road-forks, (east of J. B. Morland's, 557),	1134′
Sideling Hill tunnel (center),	1232′
Sideling Hill crest (over tunnel (627),	1360′
Sideling Hill crest (road, N. of tunnel 1265),	1517′

*The numbers attached are those of the stations on Billin and Ashburner's lines.

7. *On Wray's Hill and Broad Top.*

	Above tide.
Cole's station (railway track),	1359'
Long's ridge (road bend at N. end, 1364),	1226'
Trough creek (road crossing below Stapleton's),	1200'
Rocky ridge crest (road W. of Stapleton's 1382),	1467'
Dougherty's old coal mine (1 mile S. W. of Stapleton's 1382,)	1607
Petriken coal bank (Rocky ridge),	1456'
Curfman (Savage) coal bank (Rocky ridge),	1531'
Trough Cr. dam (between Rocky R. and Shirley's Knob),	1144'
J. Taylors (cross-roads, 1213),	1213'
Bagdad (bridge over run),	1136'
Whitney's lime quarry (1707),	1135'
Road summit between Rocky R. and Round Knob,	1750'
Round Knob summit (near Cook's station),	2304'
Trough creek (W. end of Wray's Hill tunnel),	1455'
Wray's Hill crest (over tunnel),	1740'
Iron Knob summit (S. of tunnel),	1860'
Wray's Hill summit (road from Sideling Hill tunnel over to Cook's station, 673),	1760'
Cook's station (railway track),	1541'
Summit in road between railway track and Eagle foundry,	1683'
Eagle foundry (N. E. corner of shop, 1520),	1261'
Grave mountain crest,	2170'?
J. Diggin's (cross roads),	1634'
Broad Top crest (between cross roads and Broad Top city, 2255),	2054'
Broad Top city (N. E. corner of Mountain House, 1258),	1997.2'
Church (X roads, 1¼ miles S. W. of " 2320),	1996'
Trough creek (between Hoover's and Anderson's),	1848'
Alloway coal bank (2107),	1883'
Robertsdale (railway track),	1785'
Monkey drift (east of railway track),	1772'
Mine A, at Robertsdale,	1813'
Mine No. 1 (B^1) (mouth, 1214),	1789.3'
Mine No. 2 (B^2) (nail, top of 1st beam, 1220),	1799.6'
Mine No. 3 (C^1) (right hand rail; mouth, 1217),	1814.8'
Mine No. 4 (C^2) (left hand rail; mouth, 1223),	1816.7'

8. *Line from Robertsdale through Sideling Gap.**

Wray's Hill crest (road bet. Robertsdale and New Granada, 2776),	2151'
Coal bed A opened near road,	2114'
McLean's coal openings (E. of Robertsdale),	2132'
Spring, descending road above New Granada,	1845'
New Granada (shop at road forks, 1004),	939'
Methodist church (S. of Sideling gap, 1132),	921'
Sideling Hill creek (at the anticlinal, 1195),	838'
Dublin mills dam,	815'
Sideling Hill creek, at T. Wilson's,	800'
Sideling Hill creek, junction with Aughwick creek,	762'?
Clear ridge crest, at Sol. Taylor's,	1144'
Blacklog mountain crest in Potts' gap,	1540'

*The levels on this long line being taken with the vertical circle, cannot be depended on as correct within 5 or 10 feet.

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