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BY

BENJAMIN SMITH LYMAN.

With a Geological and Topographical Map.

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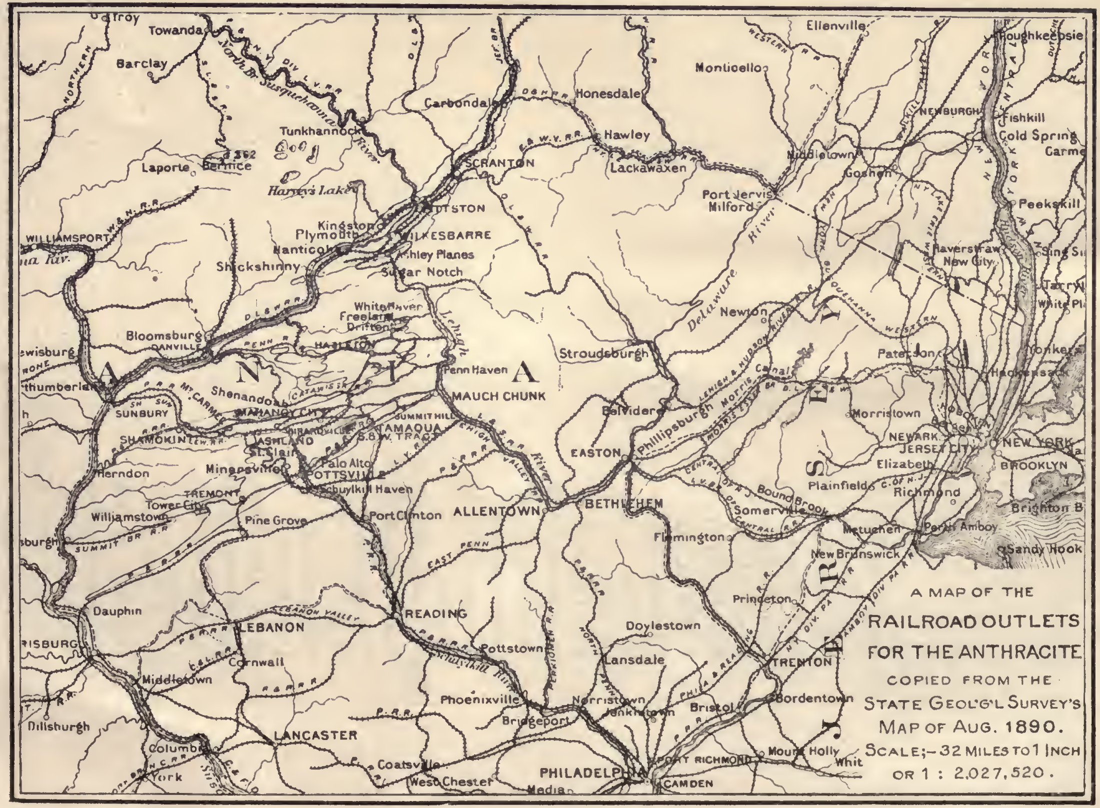


A MAP OF THE
RAILROAD OUTLETS
FOR THE ANTHRACITE
COPIED FROM THE
STATE GEOL'G'L SURVEY'S
MAP OF AUG. 1890.
SCALE;– 32 MILES TO 1 INCH
OR 1 : 2,027,520.

REPORT ON THE SHIPPEN AND WETHERILL TRACT, SCHUYLKILL TOWNSHIP, SCHUYLKILL CO., PA.

BY BENJAMIN SMITH LYMAN.

(With a Geological and Topographical Map.)

1. Situation.

The Shippen and Wetherill Tract, in Schuylkill township, Schuylkill county, Pennsylvania, is a mile and a quarter north of the village of Patterson (at the Brockville station of the Philadelphia and Reading Railroad) half a mile north of the old Potts and Sillyman coal mines, a mile northwest of the old Swift Creek colliery, a mile and a quarter west of the Palmer tunnel of the Kentucky Bank colliery, two miles west of the village of Tuscarora, three miles north of Middleport, four miles southeast of New Boston, four miles and a half southeast of Mahanoy City, five miles southeast of Morea, five miles and a half west-southwest of Tamaqua, and eight miles northeast of Pottsville.

The tract is in the shape of a cleaver, with a long handle towards the northeast, and a broad blade on the southeast side towards the southwest. The handle is 900 yards long and 300 yards wide, and the blade averages about 1200 yards long by 600 yards wide, narrower, however, towards the west, making the total length about a mile and a quarter. According to a very accurate survey made last summer by Mr. Howell T. Fisher, the tract contains 207 acres and 140 perches, or $207\frac{7}{8}$ acres.

2. Lay of the Land.

The tract lies on the southern edge of Broad Mountain, about half a mile north of the Mine Hill ridge formed by the Mine Hill anticlinal. Big Creek flows across the very southwesternmost corner of the tract, and is a stream of a dozen feet in width. Little Creek, only 2 or 3 feet wide, crosses the middle of the broad part of the tract from north to south, and joins Big Creek three-quarters of a mile below the southern boundary.

The general trend of the hills at the northern boundary is nearly parallel to it, and they descend thence rather gently throughout most of the handle-shaped part of the tract, but 40 feet to a comparatively

level bench some 300 yards wide at the blade-end of the handle, and much narrower towards the west. Then, near the middle of the broad part of the tract, the hills fall off steeply about a hundred feet, with an east and west trend, to another broad bench that continues to the southern boundary, with a small parallel ridge at the west and a continuous gentle slope downwards at the east.

The steep bluff through the middle of the tract is cut square across by Little Creek, with a bold crag on the eastern bank, but with gentler slopes on the west. A broad gentle rise in the southern bench separates that small stream from Big Creek, and is in line with the main course of Big Creek up stream, and seems like a strong barrier that dammed back the creek from its former straight easterly course and forced it to cut its way southward across the probably already notched Mine Hill anticlinal, where the gap now forms what is called Moss Glen, a narrow ravine encumbered with big blocks of conglomerate.

A consideration of the geological structure shows that the broad rise in the lower bench is really such a barrier, and composed of the same very hard rock beds that appear in the crag and hill east of Little Creek near the middle of the tract, and in the hill south of the southern bench to the westward, and that the two broad benches with the hills bounding them north and south are occasioned by the basin-like form of the underlying rocks. The topography is not merely a key to the geological structure, but of itself almost a complete demonstration of it without the numerous additional corroborative observations that have been made.

The land rises at the northern boundary to about 1400 feet above sea-level, on the northern bench to about 1360 feet, on the southern bench to about 1250 feet, and at the lowest point, where Little Creek leaves the tract, to about 1150 feet.

The road from Brockville across Locust Valley to Mahanoy City enters the southern edge of the tract 100 yards east of Little Creek and goes out near the northwest corner. The only building on the tract is a small shanty for tools at Blew's slopes, two small slopes on the Mammoth coal bed at the angle formed by the broad part of the tract, or blade, with the handle. An air-hole about 60 yards further east gives access to the old abandoned workings of the Kentucky Bank coal mine. On the east bank of Little Creek, at 60 yards northeast of the great crag already mentioned, there is the mouth of a trial drift driven about five years ago for some 84 yards on a small vein of coal. On the west bank of Little Creek, just north of the

Mahanoy City road, there is a diamond drill hole that was bored a couple of years ago.

3. Geology.

Structure.—The main feature of the geological structure is a deep basin running east and west through the southern part of the broad portion of the tract, sinking eastward, just north of the great Mine Hill anticlinal. The basin is followed on the north, almost without an intervening saddle, by a basin that is shallow at the east end of the tract, but rises and grows narrower westward, so as to become apparently little more than a space of very flat dips at the western end of the tract. This shallow basin appears to have a subordinate slight roll near the middle. The Mine Hill anticlinal axis is to the south of the tract, and is sinking rapidly eastward, and has likewise on its northern side a subordinate roll that perhaps becomes the principal saddle further east, near the mouth of the Palmer tunnel.

The dips on the south side of the main basin are gentle, some 20° or 25° at most at the western edge of the tract, though 37° at the eastern, but on the northern side, for a short space, are much steeper, up to 70°, or a little more. Thence northward, under the northern bench, the dips are very gentle or quite flat; then, northward, steeper again, say 30° or 45°.

The openings of coal beds and the exposures of dips are so numerous both on the tract and adjacent thereto, including several mines, that the geological structure is now worked out in great detail, and is thereby thoroughly demonstrated, even aside from the very strong corroboration of the surface topography.

Rocks.—The rocks just below the surface of the tract belong to the lower part of the productive coal measures, together with a little of the underlying Pottsville conglomerate.

The highest beds, those in the middle of the main basin at the eastern boundary line, are about 75 feet above the middle of the Orchard (or Grier) coal bed. That bed has never been opened on the tract, though formerly worked at a small mine a mile to the south, and in the Palmer tunnel, where its average thickness of good coal was 6 feet (H. D. Rogers's Final Report on the Geology of Pennsylvania, 1858, vol. ii., p. 414).

From the middle of the Orchard down to the middle of the Primrose, the next lower coal bed, is a thickness here of about 115 feet, the character of which has not been observed on the tract, except

the lower 34½ feet sand-rock, bored through at the diamond drill hole near the middle of the tract; but would appear from the cross-section in Rogers's Report, vol. ii., p. 106, to be chiefly shaly, with some sand-rock layers. The Primrose bed, so far as known, on the tract and close to it, has an average thickness there of about 18 inches.

Below the middle of the Primrose bed there is a thickness of about 120 feet down to the middle of the Holmes (or Palmer) coal bed. According to the diamond drill boring, the whole thickness was alternating beds of sand-rock and conglomerate, except some 17 feet of slate near the middle. The Holmes bed may be taken as averaging 18 inches in thickness.

From the middle of the Holmes coal bed down to the middle of the coal bed sometimes called the Top Split of the Mammoth, there is a thickness of about 188 feet, only conglomerate so far as observed on the tract in the diamond drill hole, except a little fire clay under the upper coal and some sand-rock in the upper 30 feet or so, and practically the same is seen on the Mahanoy City or Locust Valley road up from Brockville; but Rogers's report mentions two beds of coal, the upper one 2 feet thick and the lower one 4 feet, in that space at the Palmer tunnel; and the upper one has there only slate above it, and below it only sandstone down to the lower one of the two. The upper of the two coal-beds seems to occur to the south of the tract in the cross-sections M N and O P; and the lower one in M N (see p. 30). That report described the rest of the space down to the so-called Top Split, or Seven-Foot bed, in the Palmer tunnel, as "hard pebbly rock" (vol. ii., p. 103), and so it is at the place just mentioned on the Mahanoy City road, with some pebbles as large as walnuts. The coal bed here sometimes called the Top Split of the Mammoth, may be taken as averaging about 3½ feet in thickness on the tract.

From the middle of the so-called Top Split of the Mammoth down to the middle of the main Mammoth bed is a thickness of about 90 feet, both at the Palmer Tunnel and on the tract and at the old mines to the south. Rogers gives the intervening rock beds as "hard pebbly rock" (vol. ii., p. 103), and so they appear on the road up from Brockville towards Locust Valley and Mahanoy City. The diamond drill borer near the middle of the tract found them conglomerate, with a little sandstone towards the bottom. The beds are in great part exposed here and there in the hill eastward from Little Creek, and are everywhere conglomerate, and for a thickness

of 30 feet at the crag already mentioned just east of that creek are very coarse, with pebbles up to 3 inches in diameter. The increase in coarseness is only very local; but coarse conglomerate at this horizon is not unusual in the anthracite region, and has been observed four miles further west, near Silver creek, also on the Riehle tract, next west of Morea, at the Otto colliery, near Branchdale, and at many other places (see the paper on "An Occurrence of Coarse Conglomerate above the Mammoth Anthracite Bed," read before the American Institute of Mining Engineers at the Reading meeting, October, 1892). The average total thickness of the main Mammoth coal bed on the tract may be taken as 11 feet.

From the middle of the Mammoth coal bed down to the middle of the coal bed of the old trial drift is a variable thickness. At Blew's slopes it amounts to about 50 feet; but at the air hole of the old drift the two beds are only 10 feet 3 inches apart. The whole space between the beds appears to be filled with hard gray sand-rock, except half a dozen feet of fire-clay under the upper coal bed near the slopes. The drift coal bed may be taken as averaging possibly 3 feet on the tract. It is the same as the Skidmore bed of Morea and New Boston and the Wharton bed of the middle and northern anthracite fields. The name, Skidmore, however, is sometimes given in the southern field to the next lower coal bed, if it is at any point the thicker of the two.

From the middle of the Drift coal bed down to the middle of the Ten Foot coal bed is a thickness of about 50 feet, all apparently composed, between the coals, of gray sand-rock. The Ten Foot bed is 10 feet 7 inches thick at the only point where it has been opened on the tract.

From the middle of the Ten Foot coal bed down to the middle of the Buck Mountain coal bed is a thickness of 70 feet, apparently all filled, except the coal, with sand-rock. The Buck Mountain coal bed may be taken on the tract as averaging 8 feet in total thickness.

From the middle of the Buck Mountain coal bed down to the middle of the Spring coal bed is a thickness of about 35 feet; and all between the coals is apparently sand-rock, except a foot or more of fire-clay at the top. The Spring coal bed was opened last summer near the northwest corner of the tract, some 20 yards north of the Buck Mountain coal opening and was 3 feet thick. The bed is known at Morea, and is there about 2 feet thick.

From the middle of the Spring coal bed down to the middle of the Lykens Valley coal bed is about 390 feet at New Boston,

Morea and the East Mahanoy tunnel, and the Boston Run tunnel, and not far from that thickness near Tamaqua (see State Geological Survey Atlas, Southern Coal Field, Pt. I., Cross Section Sheet III., Section 12), and presumably about the same on this tract; and the interval between the coals is filled with conglomerate. The Lykens Valley coal bed at New Boston is about 2½ feet thick. It does not crop out on this tract and has never been opened anywhere in the immediate neighborhood, and its thickness hereabouts is quite unknown. There is no workable coal known below it.

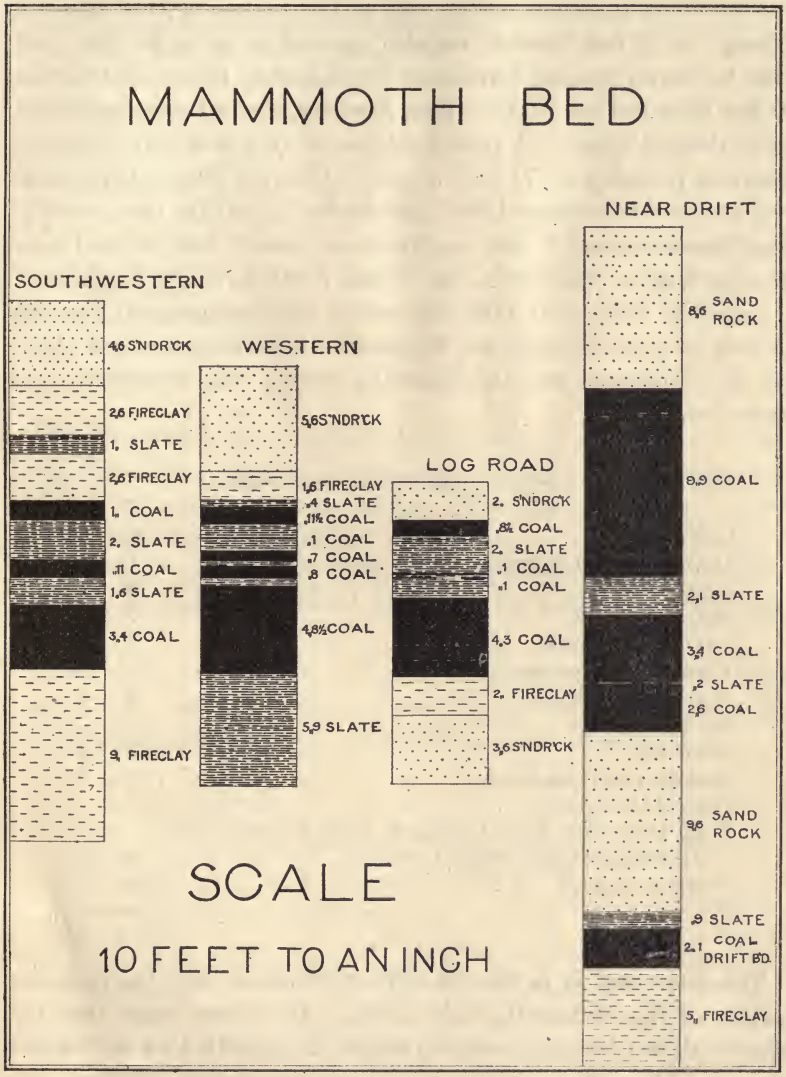
4. Coal Beds.

Mammoth Coal Bed.—The Mammoth coal bed has been slightly worked on the tract, and extensively so within a short distance outside, and has been proved by several trial openings inside as well as by a great number outside.

Palmer Tunnel.—The Mammoth coal bed was formerly worked in the Kentucky Bank mines from Palmer Tunnel, not only eastward, but westward "2250 yards" (Rogers's Final Report, 1858, vol. ii., p. 413); that is, more than a 100 yards into the eastern edge of the tract, a statement that agrees with local tradition. According to that report the bed there "averages 20 feet" (p. 103); or "its normal thickness is 18 feet" (p. 413); but at 850 yards to the west the part worked, supposed to be only one split, had a thickness of 7½ feet. Mr. H. S. Thompson in his report on the tract, cites the original map of the tunnel made in 1853 by Mr. George K. Smith, mining engineer, and shows the Mammoth coal bed to be 20 feet thick there, and that "Mr. Smith's map shows it after separating from the top split to be about 9 feet thick with about 8 feet 9 inches of coal (2 feet of it soft coal) at one place, and 7 feet of good coal at another place."

Old Air Hole.—Near the western end of the Palmer Tunnel workings and only 60 yards east of the eastern boundary of the broad part of the tract, an air hole still gives admission to the old mine; and it has been entered by Mr. A. D. W. Smith and many others in the past season, as well as in former years. They say that at one point there the bed is 17 or 18 feet thick, but with an average apparently of about 12 feet total thickness. He has found in his recent elaborate researches for the State Coal Waste Commission that 235 sections of various coal beds in the southern anthracite field give an average of 72 per cent. of coal in the total thickness; and that 1144 such sections in the middle anthracite field give an average of

77 per cent. of coal. A total thickness of 12 feet would therefore have probably 9 feet of coal. The sections of the Mammoth measured in the trial pits of the past season in the tract itself and close



to it give a slightly larger average percentage of coal in the total thickness.

Blew's Slopes.—Just inside the eastern boundary of the broad part of the tracts there are two small slopes, within a few yards of each

other, sunk in 1886 or 1887, and worked by Mr. William Blew. The older, eastern one of the two is reported by Mr. H. S. Thompson in November, 1886, to be 110 feet deep, but for the lower 40 feet already inaccessible, partially fallen closed and full of water. He quotes the thickness of the bed at the bottom of that slope as "from 9 to 10 feet," and it was also reported to us as 10 feet; and from his investigations hereabouts he takes it at 10 feet. At about 40 feet from the top of the slope, however, the bed measures about 5 feet thick, all coal. A total thickness of 10 feet would indicate a thickness probably of 7½ feet of coal. The roof here is hard sand-rock with a few inches of black slate under it; and the floor is dark-gray fire-clay about 5 feet, overlying at least 6 feet of sand-rock growing harder downwards, and at that depth having pea pebbles.

Near Old Drift.—At 1100 feet west of Blew's slopes and near the air-hole of the old drift, the Mammoth bed was opened last October on its outcrop, and the following section was measured, from above downward :

	Ft.	Ins.
Bluish-gray fine hard sand-rock, exposed in the shaft, 8 or 9 feet, say,	8	6
Coaly clay,	0	0¼
COAL, rather soft at present.	1	2
COAL, bony,	0	4
COAL, rather soft,	0	11
COAL, firm and good,	7	4
Black carbonaceous slate,	2	1
COAL, very hard, good,	3	4
Black slate,	0	2
COAL, soft,	2	6
Dark-gray shaly sand-rock,	9	6
Coaly shale, "clod,"	0	9
COAL, DRIFT-BED, 1 foot 8 inches to 2 feet 6 inches, but just here, 2 feet to 2 feet 5 inches, say,	2	2½
Fire-clay, about,	5	0
	43	9¾

The lower coal is in the old drift, into which they dug from the bottom of the Mammoth, only 7 feet. It is seen, then, that the Mammoth bed here is 17 feet 10 inches thick, with 15 feet 7 inches of coal. The softer portions of the coal will perhaps be firm at a better distance from the outcrop. The shaft is about 28 feet deep to the outcrop of the bottom of the bed, and is driven thence horizontally across the bed. The dip near the top of the bed is 37° southerly.

Log Road.—At 350 yards further west, on the log road, the Mammoth bed was opened in December, 1892, by a trial shaft on its outcrop; and the following section was measured, from above downward:

	Ft.	Ins.
Gray sand-rock exposed in the shaft, about,	2	0
Coal, rather soft (so near the outcrop),	**0**	**8½**
Black slate rather decomposed,	2	0
Coal,	**0**	**1**
Black slate,	0	2
Coal,	**0**	**1**
Black slate,	0	11
Coal,	**2**	**6**
Coal, softer,	**0**	**10**
Coal, harder,	**0**	**7**
Coal, softer,	**0**	**4**
Black slaty fire-clay,	2	0
Gray, hard sand-rock,	3	6
	15	8½

The Mammoth bed has here, then, 5 feet 1½ inches of coal in a total thickness of 8 feet 2½ inches. The softer parts are again affected by nearness to the outcrop. The shaft is wholly vertical, and 36 feet deep to the bottom of the bed. The dip at the top of the bed is 70° and at the bottom 55°, both southerly. The divergence shows that it happens to be just at the point of a small local squeeze.

West End of Tract.—At 325 yards still further west and 90 yards short of the west boundary, the same bed was opened last July, and the following section was measured, from above downward:

	Ft.	Ins.
Light-gray sand-rock,	5	6
White fire-clay,	1	6
Black slate,	0	4
Coal, bony,	**0**	**3**
Coal, soft,	**0**	**8½**
Black slate,	0	7½
Coal, bony,	**0**	**1**
Black slate,	0	7
Coal, good,	**0**	**7**
Black slate,	0	3
Coal, good,	**0**	**8**
Black slate,	0	4
Coal, 4 feet 5 inches to 5 feet, say,	**4**	**8½**
Black slate, with some coal specks, growing hard below,	5	9
	21	10½

The lower main bench of coal has at one point an inch of bony

coal at 10 inches above the bottom. It is seen, then, that the Mammoth bed here has from 6 feet 8½ inches to 7 feet 3½ inches, or say a mean of 7 feet of coal, within a total thickness of 9 feet 1 inch. The coal is mostly very firm and good; as the distance from the very decomposed outcrop is somewhat better than in the more eastern trial shafts and the pit is in a drier situation. The depth here is 35 feet; and the surface wash was only about 20 feet deep. The dip at the bottom is 60° southerly.

Southwest.—At 250 yards easterly from the southwest corner of the tract and 60 yards south of the southern boundary line, the Mammoth bed was opened the past season and the following section measured, from above downwards:

	Ft.	Ins.
White, fine sand-rock, about,	4 „	6
Fire-clay, about,	2 „	6
Black slate, about,	1 „	0
Fire-clay, about,	2 „	6
Coal, 9 inches to 1 foot 3 inches, say,	**1 „**	**0**
Black slate,	2 “	0
Coal, rather soft,	**0 „**	**11**
Black slate,	1 „	6
Coal, hard,	**3 „**	**4**
Fire-clay,	9 „	0
	28 „	3

The Mammoth coal-bed then, has here a total thickness of 8 feet 6 inches or nine feet, say 8 feet 9 inches, with 5 feet or 5 feet 6 inches, say 5 feet 3 inches of coal. The trial pit is a vertical shaft 11 feet deep prolonged on the coal bed into a slope about 38 feet long, with some digging into the roof at the face. The dip is 20° northerly.

The opening is on the south side of the basin, and as the identity of the bed is clear from its very section, as well as from the position of the two other well-identified beds opened above it near by, and from its own position on its long southern outcrop, fixed here and there by numerous trial pits and several extensive mines, it is one link in the irrefragable chain of evidence that the rocks of the main southern body of the tract do lie simply in the form of a basin. The outcrop continues hence eastward around the descending Mine Hill anticlinal, and is found on the Brockville and Mahanoy City road near the springs, and further to the southeast was formerly opened near the top of the axis at several trial shafts, and still further southward and westward was formerly opened with drifts and slopes and

extensively mined, as shown on the map. Westward of the two last-described openings, the same Mammoth bed was formerly opened by three trial pits on the south side of the basin and by one on the north side near Big Creek, as shown on the map; and there were also two other openings of it further up the creek, 400 yards beyond the western limit of the map and near the "spoon of the basin" of that coal-bed.

Average Thickness.—From the figures already given some idea of the average thickness of the bed on the tract may be obtained, as may be seen by the following table:

Opening.	Total. ft. in.	Coal. ft. in.
Near the old drift,	17 „ 10	15 „ 7
On the log road,	8 „ 2½	5 „ 1
Near western edge of tract,	9 „ 1	7 „ 0
At the southwest,	8 „ 9	5 „ 3
Sum, to be divided by four,	43 „ 10½	32 „ 11
Average,	10 „ 11¾	8 „ 2¾

or say, eight feet and a quarter of coal in a total thickness of eleven feet.

If the reported and estimated thickness of the bed at Blew's slopes and in the adjacent portion of the Kentucky Bank mine be counted, as given above, the result is identical:

Opening.	Total. ft. in.	Coal. ft. in.
Near west end of Kentucky Bank mine,	12 „ 0	9 „ 0
Blew's Slope bottom,	10 „ 0	7 „ 6
Sum, to be divided by two,	22 „ 0	16 „ 6
Average,	11 „ 0	8 „ 3

These results may then probably be taken pretty safely as not very far from correct, but for greater safety, as well as simplicity, we may, in estimating the quantity of coal, take the thickness as only 8 feet.

Outcrops.—The outcrop of the Mammoth bed has been carefully drawn on the map both within and without the tract, taking account of the dips, the strikes, the height of the surface of the ground and the position of the bed in numerous cross sections (not all of them printed), according to the new and old trial pits and mine workings. Towards the northeast, however, along the workings of the Kentucky Bank mine, the old crop-falls have been taken as the main guide to the places of outcrop. The outcrop has everywhere been

marked as if 20 feet below the surface of the ground, to allow for the surface wash that is unusually deep over most of the tract and often nearly or quite that depth. In any case, the coal itself is more or less decomposed almost everywhere to fully that depth, sometimes deeper, especially where the dip is steep and the circulation of water abundant.

Quantity.—Measuring then the portion of the tract underlain by the Mammoth bed, we find it to be 95 acres. Taking account of the greater extent of the bed itself by reason of its basin shape, we find there are 126 acres of the bed. Reckoning 1976.5 tons of coal to the acre for every foot of thickness, according to the average specific gravity of Panther Creek coals, our nearest investigated neighbors, as given (more precisely 1976.583 tons) in Report A A, 1883, p. 136, of the State Geological Survey, we have for the number of tons of coal in the Mammoth bed, within the tract, 1,990,000 tons. Of that amount, 830,000 tons are above the level of 1000 feet above the sea; that is, about the level of the main gangway of the Kentucky Bank mine at the eastern edge of the tract, and a level easily accessible by tunnels from the south or southeast. The position of the middle of the bed at different levels 100 feet apart, as required by the numerous cross sections drawn, is marked on the map, and clearly shows the basin shape of the bed. The greatest depth of the bed below the surface of the ground, anywhere in the tract, is at the eastern edge of the tract, and appears to be less than 700 feet.

Ten-Foot Coal Bed.—Until last October the Ten-Foot bed had not been opened anywhere on the tract. One trial opening on it was then made, and the place of its outcrop has lately been proved at another place. The bed has been formerly opened at several places, more or less distant, outside the tract, but is no longer accessible at any of them.

Near Blew's Slopes.—The only opening of the Ten-Foot bed on the tract is a trial shaft dug last October behind the shanty and 70 yards north of Blew's slopes, with the following section from above downwards:

	Ft.	Ins.
Sand-rock,	17	0
Coal dirt, rotten coal,	0	6
Coal,	6	7
Black slate,	0	1½
Coal,	3	4½
Fire clay, exposed	0	3
	27	10

The upper 6 inches of rotten coal may prove to be coal that is merely affected by its nearness to the outcrop, and at a greater depth may be of passable quality. Leaving it out of account for the present, however, we have 9 feet 11½ inches of coal in a total thickness of 10 feet 1 inch. The dip here is 30° southerly. The coal is much affected by the nearness of the outcrop, but appears to be in character intermediate between the Mammoth and the Buck Mountain coals. At 36 feet to the north the wholly-decomposed outcrop of the bed was found in a trial shaft, with a thickness of 5½ feet of black dirt, at 5½ feet below the surface of the ground.

On the log road, off from the Mahanoy City road, in the western part of the tract, the outcrop of the bed was bored into in the surface wash a few days ago, as a test of the map, and found exactly as already laid down. Six feet of coal dirt were found, much as at the trial shaft just mentioned.

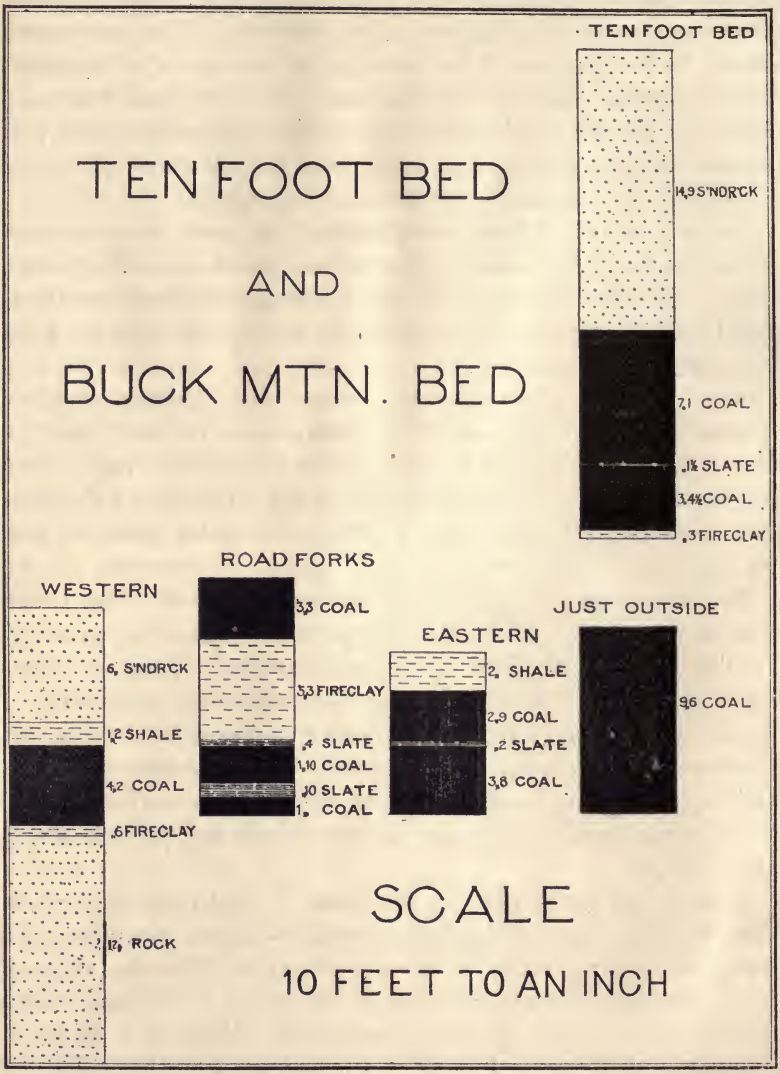
Other Openings.—The same bed occurs at the Newkirk colliery, 4½ miles to the east, and has there a thickness of 10 feet 1 inch in the water-level tunnel and 4 feet 1 inch in a lower-lift tunnel. (See the State Geol. Survey's Southern Coal Field Atlas, Part IV., Sheet IV., Columnar Sections 5 and 6.) The bed is called there the Bottom Split of the Mammoth.

Two miles west of the tract, and 400 yards east of Silver Creek dam, there are a couple of old openings on the same bed apparently. The two holes are 200 yards apart north and south, one on either side of the basin. The northern one had, acccording to the notes of Mr. P. W. Sheafer, 12 feet of coal with 6 inches of bony at 2 feet 9 inches above the bottom; consequently with a section much resembling that of the opening on the tract. The southern of the two holes had a total thickness of 9 feet 3 inches, with 8 feet 8 inches of coal.

South of the tract, and not far from the Sillyman and Potts mines, the Ten-Foot bed has been opened at several trial shafts, as shown on the map and in the cross-sections; but they are all long since fallen shut, and the thickness of the bed is not known. The place of the bed there, however, corresponds closely with its place as found on the tract, and therefore corroborates well the geology of the map.

Average Thickness.—It appears, then, that the thickness found in the only opening of the bed on the tract, and the only one recorded within a couple of miles, is not unlike the nearest ones known outside of that distance. It is, therefore, perhaps not unsafe to take it

as indicating the thickness of the bed throughout the tract, and to reckon the average thickness there at 10 feet of coal, within a total thickness of $10\frac{1}{2}$ feet.



Quantity.—The outcrop through the tract was drawn, and the area underlain by the bed was found to be 115 acres. Allowing for the basin shape, the area of the bed itself was found to be $143\frac{1}{2}$ acres. Reckoning a thickness of 10 feet and the same specific gravity as before, the quantity of coal was found to be 2,840,000 tons. Of that, 1,400,000 tons are above the level of 1000 feet above

the sea. That level was drawn on the manuscript map in order to measure the area, but to avoid too great complication is not marked on the printed one.

Buck Mountain Coal Bed.—The Buck Mountain coal bed has never been worked on the tract nor anywhere within at least nearly 2 miles of it, but a number of old and now inaccessible trial pits have been sunk upon it east of the tract and to the south beyond the Mine Hill anticlinal, and the past season three trial openings of it have been made on the tract itself.

Just Outside East End of Tract.—A dozen yards east of the northeastern end of the tract there is an old opening on the Buck Mountain coal bed, with a recorded thickness of 9½ feet of coal.

Northeast Hole.—Sixty yards to the southwest of that, and inside of the northeast end of the tract, an old hole on the outcrop of the Buck Mountain bed was reopened the past season, and the following section was measured from above downward:

	Ft.	Ins.
Strong sand-rock roof.		
Dark gray shale, about	2	0
Coal, rotten,	**2**	**9**
Black slate, 4½ feet to 0 inches, say,	0	2
Coal, rotten,	**3**	**8**
	8	7

The bed appears, then, to have here a total thickness of 6 feet 7 inches, with 6 feet 5 inches of coal. The coal is mostly decomposed from nearness to the outcrop, though small pieces showed it to be of good quality; but the hole was a wet one and difficult to supply with air, and was not driven deeper. The abundant circulation of the water has no doubt aided in the decomposition of the coal. The hole was a shaft 12 feet 6 inches deep, continued by a slope 25 feet long on the coal bed. The dip was 43° southeast.

Road Forks.—At the forks of an old road, about 300 yards further west, another opening of the Buck Mountain coal bed was made the past season, and the following section measured from above downward:

	Ft.	Ins.
Coal, 2 feet 8 inches to 3 feet 10 inches, say,	**3**	0
Gray fire clay,	5	3
Coaly shale, "clod," 6 inches to 2 inches, say,	0	4
Coal dirt, rotten coal,	**1**	**10**
Slate, decomposed,	0	10
Coal dirt, rotten coal,	**1**	**0**
Fire clay, exposed about	3	6
	16	0

This was also a very wet hole, and the coal, particularly in the lower part, has been much decomposed by the circulation of the water. The coal of the upper bench was of good quality, with much of the birdseye texture common in the bed. The total thickness of the bed is apparently 11 feet 11 inches to 13 feet 1 inch, or, in the mean, 12 feet 6 inches, with coal 5 feet 6 inches to 6 feet 8 inches, or say 6 feet and 1 inch. The hole was a shaft about 23 feet deep, continued by a slope 23 feet long on the lower coal benches, with one 25 feet long on the upper bench. The dip was 35° southerly in the upper bench and 53° southerly in the lower, with a mean of 44°—nearly the same as at the eastern hole.

Western Hole.—At 260 yards easterly from the northwest corner of the tract, the Buck Mountain coal bed was opened last summer, and the following section was measured from above downward:

	Ft.	Ins.
Gray sand-rock,	6	0
Blackish shale, about	1	2
COAL, still rather soft,	**4**	**2**
Fire clay, about	0	6
Hard rock, bored,	12	0
	23	10

The bed here is, then, 4 feet 2 inches thick in a single bench, though it is possible that another coal bed, some feet higher up, apparently opened formerly in two holes 100 and 170 yards to the east, but now inaccessible, might be regarded as an upper split of the Buck Mountain bed. The coal of the present hole is of good quality, though affected and softened by atmospheric influences. The hole is about 35 feet deep, the lower 15, or so, sloping with the coal bed. The dip is 66° southerly.

Crop Boring.—On the 14th of January, 1893, after the map was photo-lithographed, the black coal dirt of the outcrop was bored through in the surface wash near the point where the cross-section line A B, of the map, crosses the outcrop of the Buck Mountain bed, about half a mile east of the western trial shaft and about a third of a mile west of the one at the road forks, and the essential accuracy of the outcrop as laid down was proved. The borings appear to show that the bed is there in two benches some 14 feet apart horizontally, confirming the conclusion already arrived at that there is an upper bench just south of the western trial shaft. The black coal dirt of the northern, or geologically lower, boring was found 2 feet thick at 18 feet below the surface, and that of the

southern, or geologically upper one, 6 feet thick; but the real thickness of the two benches cannot be known without actual digging, and perhaps even their relative thickness is not indicated by those numbers. The northern boring was inside the narrow markings of the outcrop on the map, perhaps slightly south of its centre line; the southern one was close outside the southern edge of the same marking. The real outcrop of the lower bench at the boring may be a few feet further north and thicker there, and the true position of the bench in place, below the wash, may be not only, as already appears, within a very few feet or inches of the point indicated by the map, but exactly there. Boring here was undertaken, like the Ten-Foot crop boring on the log road, as a severe test of the map at a somewhat difficult point, but was delayed by rough weather. The result shows great regularity in the coal measures hereabouts.

South of the Tract.—The Buck Mountain coal bed was formerly opened at a number of holes on the south side of the Mine Hill anticlinal, not far from Sillyman's slope; but none of them are now accessible, and there is no record of their sections. Their place, however, as shown in our map and cross-sections, fully agrees with the positions of the beds on the tract, and confirms our geological interpretation of the facts observed.

Neighboring Mines.—The State Geological Survey's Southern Coal Field Columnar Section Sheet IV. gives the thickness of the Buck Mountain coal bed at several neighboring mines as follows:—At Buckville, 3 miles to the northeast, in two splits, 8 feet 10 inches above and 6 feet 3 inches below, separated by 15 feet (slate 3 feet 9 inches; sand-rock, 6 feet 3 inches and slate 5 feet), making 15 feet 1 inch in all of the two splits. At Newkirk, $4\frac{1}{2}$ miles to the northeast of the tract, 17 feet in the water-level tunnel, and 12 feet 3 inches in another. In the Northdale tunnel of the Kaska William colliery, $2\frac{1}{4}$ miles to the southwest of the tract, 6 feet 4 inches; besides another split, 21 feet 6 inches (of hard sandstone) higher up, 3 feet 1 inch thick, shelly coal; and another, 12 feet 8 inches (of slate) still higher, 6 feet 5 inches, coal dirt and slate. Moreover, in Sharp Mountain, where the identity of beds is less certain:—At Gorman's colliery water-level tunnel, less than 2 miles southeast of the tract, 10 feet 10 inches. At Bell's tunnel, over 2 miles southeast of the tract, 2 feet 6 inches—perhaps more doubtful in identity than the others. At Reevesdale, $3\frac{3}{4}$ miles east of the tract, 11 feet 11 inches. The bed is generally, in the whole region, a very important one in thickness as well as in quality.

Average Thickness.—Taking the thickness of the Buck Mountain coal bed, as given above at only the four openings in the northern part of the tract and just outside, and leaving out of account the recent very encouraging crop-boring, we have the following table, with an alternative column for the extreme supposition that the recorded 9 feet 6 inches may have been intended to mean the total thickness of the bed, and that the coal, as in the case of the Mammoth, may be only three-quarters as much:

Opening.	Total, in feet and inches.	Coal, in feet and inches.	Or Coal, in ft. and inches.
Just Outside	9 „ 6	9 „ 6	7 „ 1½
Northeast	6 „ 7	6 „ 5	6 „ 5
Road Forks	12 „ 6	6 „ 1	6 „ 1
Western	4 „ 2	4 „ 2	4 „ 2
Sum to be divided by four	32 „ 9	26 „ 2	23 „ 9½
Average	8 „ 2¼	6 „ 6½	5 „ 11⅜

Taking the thickness as given above for the nearest neighboring mines, and counting in even those of more doubtful identity and least thickness, we have:

Mines.	Ft.	Ins.
Buckville,	15 „	1
Newkirk,	17 „	0
Newkirk,	12 „	3
Northdale,	15 „	10
Reevesdale,	11 „	11
Gorman's,	10 „	10
Bell's tunnel,	2 „	6
Sum to be divided by 7,	85 „	5
Average,	12 „	2½

Leaving out the three somewhat doubtful Sharp Mountain beds, we have:

Mines.	Ft.	Ins.
Buckville,	15 „	1
Newkirk,	17 „	0
Newkirk,	12 „	3
Northdale tunnel,	15 „	10
Sum to be divided by 4,	60 „	2
Average,	15 „	0½

It seems then, that, although it is hardly possible, that the four holes on the northern outcrop of the bed, in the tract and close to it, with their comparatively small thickness, give a fair average for the wide extent southward of this great bed through the tract, it would be, at any rate, safe to count on 6 feet in thickness as the average for the whole area.

Quantity.—The outcrop of the bed has been drawn, as in the case of the other beds, and the portion of the tract underlain by the bed has been measured, and found to be 148 acres. Allowing for the basin-shape, the area of the bed itself is found to be 182½ acres. Taking the average thickness at 6 feet, and the specific gravity the same as given above for the other beds, the coal is seen to amount to 2,170,000 tons; of that amount 850,000 tons are above the level of 1000 feet above the sea. That level, though not on the printed map, was drawn on the manuscript for purposes of measurement.

The lowest point on the bed in the tract is at the eastern boundary, and is about 850 feet from the surface.

Other Coal Beds.—The other coal beds are in part workable, and in part very useful in studying out the geology of the tract.

Orchard Coal Bed.—The Orchard (or Grier) coal bed is reported by Rogers (vol. ii., p. 414), to have at the Palmer tunnel an average thickness of 6 feet of good coal; and it was formerly worked also at the Swift Creek mines, and half a mile south of the tract. It has never been opened on the tract itself, but would seem to exist there, in the middle of the basin, next to the eastern boundary. Its area, however, would appear to be only 4 acres of the tract and 5 acres of bed surface; and consequently it would amount only to about 60,000 tons.

Primrose Coal Bed.—The Primrose coal bed is an important bed at the Palmer Tunnel, and Rogers (p. 414) says it has "from 8 to 16 feet of coarse bird's-eye coal." It has, however, the past season, been opened on its outcrop a dozen yards outside the eastern boundary of the tract and found to have there only a thickness of 15 inches, with a dip of 64° southerly. It is also clearly the upper bed in the old diamond drill hole near Little Creek, on the tract, and was found there to have a thickness of only about 21½ inches. Though it was formerly mined at the Swift Creek mines and half a mile south of the tract, and though it may possibly be of workable thickness towards its southern outcrop on the tract, it would nevertheless not be safe to count upon it as a workable bed here. It is useful, however, as a guide to the geology of the tract,

and a confirmation of the explanation given by our map and sections; it was formerly opened by trial pits at several points to the southwest near the Potts and Sillyman mines, and at every place inside and outside of the tract, agrees perfectly in position with its place in the Palmer Tunnel section.

Holmes Coal Bed.—The Holmes (or Palmer) coal bed was formerly worked at the Palmer Tunnel, and Rogers (p. 414) says it "averages ten feet of good coal" there; but at some 630 yards to the west it could not be traced further, having no doubt grown thin. On the tract, however, it has been opened the past season on the outcrop at the foot of the hill 300 yards southwest of Blew's slopes, and found to have only 19 inches of coal with about 4 feet of black slate above and as much below, and with a dip of 74° southerly. It was likewise opened at its "spoon of the basin" 580 yards to the west, and found to have there a thickness of 17 inches, with a dip of 7° southerly. Likewise, again, it was opened 35 yards south of that, and found to have a thickness of 18 inches, with a dip of 6° easterly. Another hole a dozen yards further south, and four other holes in a line northward from the last-described hole towards the preceding one were formerly dug on the same bed, but are now inaccessible. The same bed was also bored through at the old diamond drill hole, the second coal bed from the top, and found to be about 11 inches thick. Of course, so thin a bed is not to be counted on as workable within the tract, though it is barely possible that the thickness may be better along the southern outcrop towards the eastern boundary.

The great use of the bed here is its aid in proving the geology of the tract. Its course between the eastern opening and the northern one at the "spoon of the basin" is so closely parallel with that of the Mammoth bed, well indicated by the numerous trial shafts, and the steepness of the dip leaves so little room for question, and the correspondence in distance apart of the two beds in every cross section is so exact, and the opening on the Primrose bed comes in so perfectly as confirmation, that no doubt whatever can remain of the identity of the beds of the diamond drill hole, which by their perfect agreement give still further corroboration. The perfect agreement again of the same beds in the cross sections half a mile to the south makes the identification yet more convincing, if possible. In addition, there is further corroboration in the position at all points of the coal bed next to be described.

"*Top Split of the Mammoth.*"—The bed that is hereabouts, some-

times called the Top Split of the Mammoth, and sometimes the Seven Foot bed, seems to be everywhere, from the Palmer tunnel through the tract to the Potts and Sillyman mines on the southwest, so very closely at a uniform distance of 90 feet above the main Mammoth bed, center to center, as perhaps hardly to justify calling it a split of this bed. That uniformity of distance at so many points is a valuable confirmation of the geological explanation of the tract.

The so-called split has the past season been opened on the log road just off from the Mahanoy City or Locust Valley road, and had there the following section, from above downward:

	Ft.	Ins.
Black slate,	0	1
Coal,	**0**	**4**
Coaly black clay, "clod,"	1	3
Coal,	**1**	**0**
Black slate,	0	1
Coal,	**2**	**5**
Clay,	1	6
Reddish gray sand-rock,	2	6
	9	2

The coal, then, is 3 feet 9 inches thick, within a total thickness of 5 feet 1 inch. The coal is of very good quality, though somewhat unfavorably affected by atmospheric influences. The hole is a shaft 19 feet deep prolonged into a slope on the coal bed 23 feet long.

The same coal bed was also opened last summer inside the southwest corner of the tract, and had the following section from above downward:

	Ft.	Ins.
Reddish gray sand-rock, exposed	0	6
Black dirt, rotten coal,	**1**	**4**
Coal, hard and good,	**2**	**0**
Black fire-clay, exposed, about	0	6
	4	6

The coal here, then, is at least 2 feet thick; but apparently the black dirt above it is merely coal, perhaps somewhat slaty, decomposed by atmospheric influences, and should be added to the rest, making a thickness of 3 feet 4 inches, in the same total thickness.

At the old diamond drill hole, a thickness of only about 9 inches was found for this bed according to the record. It is, of course, not impossible that the bed should be thinner there; but it is also perhaps possible that a portion of the bed may have been overlooked.

At the Palmer tunnel, this bed is given by Rogers (vol. ii., p. 103) as 5½ feet thick; and by the present State Geological Survey's South-

ern Coal Field Columnar Section Sheet IV., as 5 feet. The same sheet gives it as 5 feet and 5 feet 2 inches in two tunnels at Buckville, and as 4 feet 10 inches at the Northdale tunnel, and 4 feet at the Kaska William shaft.

It is certain then, that the bed is of workable thickness and quality on the tract at the log road, and on the whole quite probably so all over its area on the tract with an average thickness of 3½ feet (the mean of 3 feet 9 inches and 3 feet 4 inches). As the portion of the tract underlain by the bed is 81 acres, and the area of the bed itself (allowing for the basin shape) is 102½ acres there would be, at a thickness of 3½ feet, 710,000 tons.

Drift Coal Bed.—The Drift coal bed was formerly opened by the old drift, 84 yards long, just east of Little Creek ; and is of good quality; and had there a thickness of 20 to 30 inches. Its section is shown in the figure of the Mammoth bed columnar sections.

The same bed was the past season opened 52 feet north of Blew's eastern slope, at a geological depth of about 45 feet below the Mammoth bed; and had the following section, from above downward :

	Ft.	Ins.
Black dirt, 0 to 3 inches, say,	0	1½
Black hard fire-clay,	1	3
Coal, rotten, 1 foot 8 inches to 2 feet 6 inches, say,	2	1
	3	5½

The bed, then, has a mean of 2 feet 1 inch of coal, in one bench. Although a bed of coal of good quality, as seen in the long drift just mentioned, it shows here the great power of atmospheric influences at the very bottom of the hole. The hole is about 8 feet deep, prolonged 22 feet further in a slope on the bed. The dip is 58° southerly.

The same bed was opened formerly at the tunnel close by Sillyman's slope, half a mile south of the tract, and was a few years ago still accessible, and was measured by Mr. F. A. Hill, then in charge of the anthracite survey of the State Geological Survey, as follows, from above downward :

	Ft.	Ins.
Slate,	0	6
Coal, shelly,	0	4
Coal,	0	5
Coal, shelly,	0	3
Fire-clay, soft,	1	8
Hard slate,	1	2
Coal, shelly,	1	10
Coal,	1	0
Coal, shelly,	1	4
Slate bottom.		
	8	6

The bed then, contains here 5 feet 2 inches of coal within a total thickness of 8 feet.

The bed was formerly opened at three holes south of Big Creek within a quarter of a mile west of the southwest corner of the tract; but they are inaccessible and there is no record of the thickness of coal found.

The bed is no doubt the same as the one called the Skidmore at Morea, with a total thickness of 3 feet 6 inches, and at New Boston, with a thickness of 5 feet 4 inches within a total of 6 feet 4 inches, an average of four well-scattered sections.

It is therefore, by no means improbable that, although the bed is at present not of workable thickness at the old drift and at Blew's slopes, yet some portions of the extent of the bed within the tract may hereafter be found to be 3 feet or more in thickness. Even the average at those two places, 2 feet and 1 inch, with coal of such good quality may prove to be workable at some not extremely distant day.

It underlies 98½ acres of the tract, with 122 acres of the bed itself; and at an average thickness of 3 feet would contain 720,000 tons.

Spring Coal Bed.—The Spring coal bed was opened last summer at a trial shaft 65 feet northerly from the western opening of the Buck Mountain bed, and the following section was measured from above downward:

	Ft.	Ins.
Conglomerate, ...		
Coal, rotten, ...	3	„ 0
Hard rock, ...		

The coal was still soft and rotten, from the effect of atmospheric influences, particularly the percolating water; but at a greater depth will probably prove to be firm coal. The hole was a vertical shaft 20½ feet deep. The dip was perhaps 80½° southerly.

No other opening of the bed is known in the immediate neighborhood of the tract; but, as already mentioned, the bed is known at Morea.

The Spring coal bed underlies about 155 acres of the tract; or, allowing for the basin shape, has an area of about 191 acres of bed surface; and, if its thickness should average three feet, as it was found at the only opening on the tract, would contain 1,130,000 tons.

Lykens Valley Coal Bed.—The Lykens Valley coal bed has never been opened on the tract nor anywhere near it, and its thickness here is quite unknown. At New Boston it has a thickness of about 2 feet 7 inches. Near Tamaqua it was opened by a long drift; but there appears to be no record of the thickness.

It is then, perhaps safe to count on a thickness of 2½ feet for the bed here; and as it underlies the whole tract, there would be, allowing for the basin-shape, about 257½ acres of the bed, or 1,270,000 tons.

The quality of the coal of this bed is reckoned very good, and it may therefore be found to be workable at no very distant day. Its least depth below the surface of the ground, in the valley of Little Creek at the northern edge of the tract would be about 250 feet; and its greatest depth at the bottom of the basin on the eastern edge of the tract would be about 1275 feet.

5. Summary of Workable Coal.

The coal of the three principal beds may be summarized in the following table:

Bed.	Average Thickness.	Horizontal, Acres.	Bed Surface, Acres.	Tons in all.	Tons above 1000 foot Level.
Mammoth	8	95	126	1,990,000	830,000
Ten Foot	10	115	143½	2,840,000	1,400,000
Buck Mountain	6	148	182½	2,170,000	850,000
	24	148	452	7,000,000	3,080,000
To that amount might be added the following:					
		Acres.	Acres.		
Orchard	6	4	5	60,000	Probably.
Top Split of Mammoth	3½	81	102½	710,000	Perhaps.
Drift (or Skidmore)	3	98½	122	720,000	Possibly.
Spring	3	155	191	1,130,000	Perhaps.
Lykens Valley	2½	208	257½	1,270,000	Perhaps.
	15	208	678	3,890,000	

If this last more or less doubtful amount should be counted, the tract would have a total of 10,890,000 tons.

6. Mining and Shipment.

It is seen from the map, as well as from the foregoing pages, that the coal of the tract is still practically untouched, as far as mining is concerned; that the three principal beds lie wholly within 850 feet of the surface and the Mammoth within 700 feet of it; that over 3,000,000 tons of the whole amount are above the level of 1000 feet above the sea; that this level is about that of the old Kentucky Bank main drainage gangway at the eastern boundary of the tract, and is also accessible by a tunnel 420 yards long from Little Creek, 500 yards long from Big Creek, or 1000 yards long from Swift Creek; that a very large share of each bed has comparatively gentle dips, and no part of them has steeper dips than are common throughout the southern anthracite field, with seldom an approach to verticality and never an overturning; that the beds are not generally of such great thickness as to occasion a large percentage of waste in mining; and that there is no evidence whatever of any faults, none even of small ones.

The nearest existing railroad line is shown at the southern edge of the map, a siding of the Philadelphia and Reading Railroad $\frac{5}{8}$ of a mile from Brockville station, and $\frac{3}{4}$ of a mile by Little Creek valley from the middle of the main basin of the coal-beds. Brockville station is by rail 9 miles from Mt. Carbon, and 102 miles from Philadelphia; 6 miles from Tamaqua, 22 miles from Mauch Chunk, 143 miles from Jersey City.

The tract might be approached from the Reading Railroad Line by Little Creek or Big Creek; or by a line $2\frac{3}{4}$ miles long from 750 yards above Brockville over the old grading, $1\frac{1}{8}$ mile long, past the Swift Creek mines; or by a line $2\frac{3}{4}$ miles long from 700 yards above Tuscarora over the old grading, $1\frac{1}{4}$ miles long, past the Kentucky Bank mines, and thence by a nearly level route to the tract.

The central part of the main basin of the tract, is 5 miles from the Pennsylvania Railroad at the Morea breaker, over a not very uneven country; and likewise 4 miles from New Boston Junction.

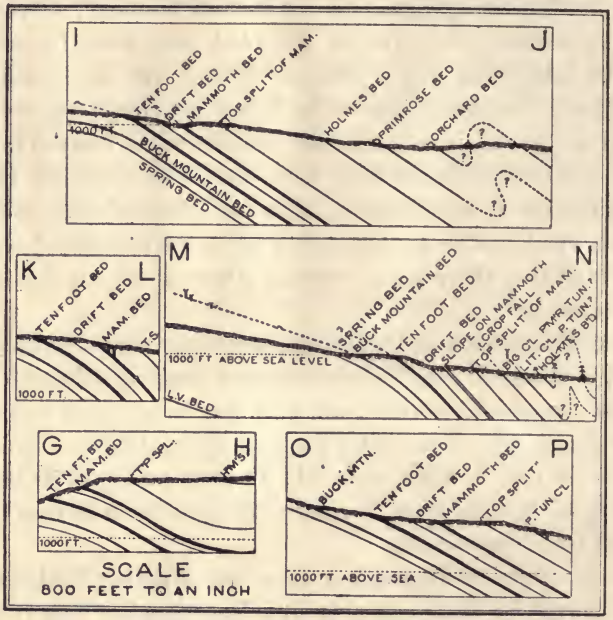
It is also 3 miles in a straight line from the Central Railroad of New Jersey at East Mahanoy Tunnel.

7. Map and Sections.

The cross-sections printed herewith give additional confirmation of the geological structure shown in the map, and show that all the important beds have been opened south of the Mine Hill anti-

clinal, and that they almost invariably maintain with remarkable precision the same distance apart from one another as on the tract and at the Palmer Tunnel.

The outlines of the tract, the important roads and trial pits were laid down on the map by Mr. Howell T. Fisher under the direction of Mr. A. DW. Smith from a very accurate transit survey made by Mr. Fisher last summer, with rectangular co-ordinates computed



and closing extremely well; and he also computed the area of the tract from them. Mr. Charles J. Wright, likewise under Mr. Smith's special guidance, did much surveying of the other features, adding to the work already done by the State Geological Survey. Mr. Wright drew the contour lines, copying the topography from the original note books, with my own supervision and correction. I worked out the final details of the geology and drew the outcrops, the equidistant strike curves and the cross-sections, aided by Mr. Smith's very intelligent criticism, and everywhere with our full final agreement.

The map was drawn on a scale of 300 feet to an inch, and in photo-lithographing was reduced to 800 feet to an inch.

We have a strong personal interest in the tract; but, of course, our professional reputation is, still more important to us, and the facts

have been set down impartially and correctly, it is believed; and, at any rate, they can readily be verified by any skilled geologist. Any such expert will surely admit our deductions from the facts to be incontestable, and to give not merely the most natural explanation but the only possible consistent one. The former bad success of explorations on the tract, with so many barren trial pits now clearly seen to be within a few feet of excellent coal beds, has forced us to make the present exploration much more thorough than is commonly considered necessary before the actual opening of mines, and has required an unusually complete, irrefutable demonstration in the report and map.

BENJ. SMITH LYMAN.

708 LOCUST STREET, PHILADELPHIA, January 18, 1893.

I concur fully in the foregoing report,

A. DW. SMITH.

ROOM 18, 4TH FLOOR, POST OFFICE BUILDING, PHILADELPHIA, January 18, 1893.

We hold the Shippen and Wetherill tract under an option, with the expectation of completing the purchase, and anybody desiring to interest himself in operating the tract, or to lease, or buy it, may address us directly.

BENJ. SMITH LYMAN,
A. DW. SMITH.

PHILADELPHIA, January 18, 1893.

[FROM TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING ENGINEERS.]

AN OCCURRENCE OF COARSE CONGLOMERATE ABOVE THE MAMMOTH ANTHRACITE-BED.

BY BENJAMIN SMITH LYMAN, PHILADELPHIA, PA.

(Schuylkill Valley Meeting, Reading, October, 1892.)

It is a time-honored saying in the anthracite region that "under the conglomerate there is no coal;" and the adage is generally reckoned a sure guide in coal-exploration. Yet there are many places where conglomerate, even coarse conglomerate, occurs above important coal beds, and, among others, above the great Mammoth bed. One of the most striking of such occurrences is on the Shippen and Wetherill tract, half a dozen miles west of Tamaqua; and it illustrates remarkably the disastrous effect of a too unquestioning blind confidence in the sweeping literal truth of a broad generalization.

Here there is a conspicuous crag formed by a twenty-foot bed of egg-conglomerate, dipping 60 degrees southerly, and jutting out boldly at the western end of a hill, where it is cut through by the small stream of Little Creek. The hill runs eastward for half a mile, with occasional exposures of pebbly rock along the western half of the crest. Eastward from the exposures lies the old Kentucky Bank mine, abandoned thirty years ago, where the Mammoth bed was worked down to water-level through a space of a mile and a quarter westward from the Palmer tunnel to the very edge of the Shippen and Wetherill tract, apparently just below where the eastern prolongation of the same conglomerate should be, though, in fact, it is not exposed. Indeed, in the Palmer tunnel itself, its place is recorded in Rogers's Final State Geological Report of 1858, vol ii., p. 103, as filled by "hard pebbly rock."

Many, however, doubted whether the Mammoth could continue undisturbed westward under the egg-conglomerate crags. It was believed by many that there must be a great fault that had brought up the coarse Pottsville conglomerate of the bottom of the productive coal-measures, and had cut off all southern extension of the Mammoth; and that even the Buck Mountain bed and its companions, that should overlie that conglomerate, had been reduced in thickness to the insignificant beds that were found there.

A few were more hopeful, and tried to prove the continued exist-

ence of the Mammoth by actual opening. About five years ago, it is said, two brothers, who owned a farm, spent their whole substance vainly in persistent efforts with trial-shafts and drifts to open the Mammoth bed, just north of the westernmost egg-conglomerate crag, and some 25 feet geologically below it. Their best success was to find a seam of coal there, which they took to be the Mammoth, and upon which they drifted eastward for more than eighty yards; but it was only 20 inches thick, swelling up in places to 30 inches. Had they dug only ten feet higher in the measures, they would have found the Mammoth bed with a thickness of about 18 feet, with 15 feet 7 inches of coal, where it was opened last week.

Two or three years after their failure, an unsuccessful attempt was made by others, at an expense of four or five thousand dollars, they say, to find the Mammoth by boring with a diamond-drill, 200 yards southward from the egg-conglomerate crag. After boring through two or three coal beds of trifling thickness, a great mass of conglomerate, and at length a few feet of sandstone, the hole was abandoned in despair at the depth of 470 feet. A comparison of the drill section with that of the Palmer tunnel shows that less than 30 feet more would have reached the top of the Mammoth bed. The upper beds are, it is true, remarkably reduced in thickness; but they are in their appropriate places, and have now recently been proved of like small thickness, with quite consistent dips, by trial-shafts on the outcrop.

Indeed the geological structure has been fully demonstrated to be essentially what the State Geological Survey map (Mine-Sheet V.), published two or three years ago, showed it to be, in the face of the conflicting opinions then rife. The crag in question is on the north side of a basin that is bounded on the south by the Mine Hill anticlinal, rapidly sinking to the east. The mere topography shows that the conglomerate-beds above the Mammoth extend 350 yards westward from the crag, though less prominent there; then bend round, in shape like the end of a spoon, forming the divide between Little Creek and Big Creek; then pass eastward again, making a decided ridge with low cliffs; and soon again bend southward, and even westward, round the Mine Hill anticlinal to the neighborhood of the old Potts and Sillyman slopes, just north of Patterson. On the Locust Valley road up the hill, past the old Mammoth working of those mines, there are ample exposures of the conglomerate-beds in question; only the pebbles are smaller than at the crag, though in part as large as walnuts. Nowhere is there anything whatever

to indicate the existence of any such great fault as was imagined to account for the egg-conglomerate of the crag.

This is a case in which the needless resort to a fault to account for appearances, as if a fault were the commonest and easiest thing in the world, has led to heavy pecuniary loss. For, as the fault explained so readily the repeated failure to work out the geology of the tract, it very naturally led to a general belief among the (not too geological) business community that the tract contained but a small fraction of the coal now proved really to exist there; and consequently no capitalist could be found willing to purchase it, even at a very low price.

There are numerous other places where coarse conglomerate is found within a short distance above the Mammoth bed. Conspicuous among them is the Silver Creek district, only four miles west of the Shippen and Wetherill tract. Rogers's Final Report, 1858, vol. ii., p. 228, speaks of "the egg- and nut-conglomerate which overlies" what is now known to be the Mammoth bed. See also his Silver Creek section on Plate 1 of vol. ii. The assistants of the first Geological Survey were at first much puzzled by the conglomerate thereabouts, as they were then tyros; and they too devised faults to explain the observed facts; but later, with increased experience, they understood better. Rogers, further on (p. 229), speaks of the corresponding rock beds on Mill creek as "coarse pebbly sandstone."

On the Riehle tract, next west of Morea, there is exposed a great ledge of coarse conglomerate, overlying the Mammoth bed, which was formerly opened some 20 feet thick at not many yards distance.

At the Otto colliery, near Branchdale, the occurrence of an extremely coarse conglomerate between two splits of the Mammoth bed gave rise to much controversy as to the identity of the beds; and the question was only settled by actual mining.

Many other cases of conglomerate over the Mammoth may be seen marked on Sheets IV., V., VI., IX., and X., of the State Geological Survey's Atlas of the Southern Anthracite Coal-Field, as follow:

At Kaska William colliery, between the middle (or "upper") and lower splits of the Mammoth "conglomerate." Sh. IV., Sect. 15.

At St. Clair shaft, over the Seven-Foot (or top split of the Mammoth) "conglomerate." Sh. V., Sect. 7.

At Thomaston colliery, over the Daniel bed (or lower split of the

Mammoth), in the water-level tunnel, much "conglomerate," and "hard conglomerate." Sh. VI., Sect. 6, Also at the first lift, much "conglomerate." Sh. VI., Sect. 9.

At the Oakdale colliery, over the same bed, at shaft-level, much "conglomerate." Sh. VI., Sect. 10.

At Payne's colliery, over the same bed, much "conglomerate." Sh. VI., Sect. 13.

At Richardson's colliery, over the same bed, a little "conglomerate." Sh. VI., Sect. 14.

At Greenwood tunnel, over the same bed, "very hard conglomerate." Sh. VI., Sect. 17.

At South Pine colliery (near the Otto), over the top split of the Mammoth, "conglomerate," 24½ feet. Sh. X., Sect. 2.

At the Middle Creek colliery, over the same bed, "conglomerate." Sh. X., Sect. 3.

At the Colket colliery, over the Four-Foot bed (or top split of the Mammoth), "fine conglomerate." Sh. X., Sect. 6.

At the East Franklin colliery, over the Mammoth, "conglomerate." Sh. X., sect. 9 and 10.

Also, at the same colliery, over the Blackheath (or Holmes) bed, "coarse conglomerate," 18 feet, and "fine conglomerate," 19 feet. Sh. X., Sect. 9.

At the Good Spring colliery, over the same bed, "coarse conglomerate," 7 feet. Sh. X., Sect. 9.

These instances, from the southern field alone, are enough to show that it is by no means a rare exception for the sand-rock above the Mammoth to become pebbly, and even to be a coarse or extremely coarse conglomerate.

It would be interesting to inquire what might have been the cause of the laying down of beds of such coarse material, that must have been moved by violent currents during comparatively short intervals, in the midst of the generally very quiet deposition of the Coal-measures. It is, however, imaginable, that the temporary obstruction of a sea-channel in one direction might cause a very rapid current in some other direction; or, the current might arise from the removal of some obstruction. It would not be necessary that the obstruction, or its removal, should occur through any especially violent earth movements. A channel might, by degrees, become obstructed with silt or sand, or another might, by gradual denudation, become sufficiently opened for the passage of currents that would rapidly enlarge it.

In any case, the causes of the coarse conglomerates would seem to have had no influence upon the thickness of the coal beds a few yards beneath, as is amply seen in the cases just described; and none upon beds equally near above, as is shown by the good thickness of the Buck Mountain coal bed, one of the thickest anthracite coal beds, though close over the Pottsville conglomerate; the variable thickness of the coal not seeming to correspond in the least with the coarseness or fineness of the pebbles.