GEOLOGICAL SURVEY OF KENTUCKY.

N. S. SHALER, DIRECTOR.

REPORT

ON THE

GEOLOGY OF MENIFEE COUNTY,

BY A. R. CRANDALL.

PART II. VOL. IV. SECOND SERIES.

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REPORT ON THE GEOLOGY OF MENIFEE COUNTY.

Menifee county has an area of about two hundred square miles. It reaches from the Licking river to Red river, along the Morgan and Wolf county lines, on the east and southeast, and extends, in a narrowed and somewhat irregular outline, into the valley of Slate creek, to the westward. As will be seen from the accompanying map, the drainage of the county is effected by Beaver creek and its branches; by Salt Lick, the head waters of which are within the county, forming a valley that leads into Bath county on the north; by Clear Fork, Hawkins Branch and other branches of Slate creek, which rise in the western part and flow into Montgomery; by the greater part of Indian and Gilladie creeks, tributaries of Red river, on the south; and by some of the branches of Blackwater creek on the east. The Licking river forms the boundary from the mouth of North Fork to the mouth of Beaver creek, and drains a narrow belt along its tortuous course.

The area of the county is therefore made up of several drainage basins that open outward from the central part. These basins or main valleys are bounded by high ridges, which, together with the almost numberless minor ridges and spurs that determine the local drainage, cover a large part of the area, the main valleys being a complicated system of drainage by multiplied ramifications of narrow valleys, rather than basins, with broad bottom lands.

Geologically the county is stretched across the outcrop of the lower members of the coal measures, and nearly across the belt of the Lower Carboniferous rocks, as represented by the Sub-carboniferous limestone and the Waverly shales and sandstone. This fact, more than any other, carries with it the explanation of the character of the surface, as already de-

scribed; for it brings the hard Conglomerate sandstone of the coal measures in that relation to the surface of the country which makes it the most important factor in the determination of the character of the drainage. The result is what has been described. A general inclination of the rock beds to the east and southeast varies somewhat the results of erosion, as represented by the valleys in the different parts of the county; but the variation is one of degree rather than of kind; for the type of valley, as seen in the middle and eastern part, where the ridges are broad and the cliffs of Conglomerate hem in the narrow valleys, is still preserved on the head waters of Slate creek, where the Conglomerate cliffs, capping the hills, preserve the steepness of the hillsides, and continue the system of ridges and spurs, but with narrowed tops and broader valleys, out into the belt of the Lower Carboniferous rocks. The cliff-making, Sub-carboniferous limestone below the Conglomerate, although no more than forty to sixty feet thick, serves to extend this system beyond the present boundary of the Conglomerate.

The causes which lead to the disposition of the main valleys in a somewhat radiate order, are also closely connected with the geology of the region. Between the hard magnesian and cherty limestone of the Upper Silurian, and the cliff-making, Sub-carboniferous and coal-measure rocks, about five hundred feet, mostly of shaly rock, is interposed—the Devonian black shales and the Waverly shales and sandstone. As might be supposed, this gives rise to a broad valley, having for its boundary the inclined Silurian beds, on the one side, and the receding edges of the Waverly beds, capped by the harder rocks above, on the other side.

Long-continued erosion has widened and diversified this valley, cutting in advance of the receding crests of limestone and conglomerate the smaller valleys that head against Beaver creek and Salt Lick. Thus, the dividing ridge between Slate creek and these streams has come to have a north and south direction, rather than northeast and southwest—the general direction of the line of outcrop. But this

main ridge terminates southward in another main ridge, having its general course east and west, from which the waters of Slate and Beaver flow northward, and the tributaries of Red river southward. The westward extension of this ridge is a continuation of the boundary of the Devonian and Waverly valley already described. The eastward extension, as also the sudden change in the direction of the boundary of Slate creek valley, is explained by another set of conditions. Variations, both in the direction and the steepness of the inclination of the rock beds, becoming important factors in the determination of the direction of the drainage along this ridge. The general eastward dip of all the rocks in this region is modified by a depression which coincides in general with the Red river valley, and also by a slight depression in the direction of the Licking river. This east and west ridge follows the crest of an undulation which has its axis nearly at right-angles to the general outcrop line of the coal measures. It represents an elevation along which the coal-bearing rocks are preserved to the westward, somewhat beyond the general boundary of these rocks, and at the same time it reduces the width of the valley that lies between the coal-measure and the Silurian rocks.

The exact amount and the details of the variation from the general eastward inclination of the several rock formations found in Menifee have not been ascertained, the limited time and means at command forbidding any attempt at accurate measurement. The depression and consequent dip towards Red river is apparent to the most casual observer. That towards the Licking is less noticeable. Mr. Joseph Leslie, in giving the results of his observations, made under the direction of Professor Owen,* speaks of a number of undulations of the rock beds along the outcrop of the coal measures corresponding generally with the drainage basins leading to the westward. A profile section drawn by him illustrates this feature, and gives approximate measurements of these undu-

* Volume IV, page 456, old series.

lations. Not having an opportunity to study this profile section, it can only be referred to in this report in general terms.

These waves, at right-angles to the outcrop, doubtlessly anticipated the drainage of the country by the formation of geological valleys. The thickening of the beds above the Conglomerate to the eastward, and, finally, the change of the general dip, has caused the drainage to be westward along these geological valleys. In this last respect the thickening of the coal measures east and southeastward is more important, as a factor, than it has been heretofore recognized to be; but as few of the facts that come under this head are found in Menifee, it is only necessary to refer to it in this report.

The Lower Carboniferous belt, as shown in this county, is not entitled to particular notice, except in connection with the topography; and under this head the descriptions already published will suffice to give the general reader a clear notion of the relation of the rocks which it represents to the various economic questions involved. (See report of Mr. Lesley on the topography and geology of the country along the outcrop line of the eastern coal fields, volume IV, old series; also report on the geology of the proposed line of the Elizabethtown, Lexington and Big Sandy Railroad, from Mt. Sterling to the Big Sandy river, volume II, second series.) A glance at the accompanying profile section will show the relation of the rocks of this belt to those of the coal measures above, and also to those of the Devonian and Silurian ages below. The section is drawn to illustrate, in a general way, the succession of beds as found in Menifee and the adjoining counties to the northeast and southwest, and more especially to show the geology along a line from Jeffersonville, in Montgomery county, by Frenchburg, to Blackwater creek, near Sexton's Mill. The section is necessarily somewhat diagrammatic, the thickness of the various beds not having been ascertained at all points along the line. It is still more so as to the rocks below the drainage, the thickness being assumed to be the same as where exposed. The representation is made to aid those who have not been accustomed to trace the rocks

below the surface. It should also be stated that the profile is largely diagrammatic for the Blackwater region, the plan for having a complete survey of Menifee not having been carried out.

The coal measures, as shown in the western part of the county, are represented by a shale series and by the Conglomerate sandstone. The former has come to be known as the Sub-conglomerate shale formation, and the coals found in these beds are known as the Sub-conglomerate coals. In this report the term is used without reference to any general classification of the Carboniferous rocks of this field.

In Greenup and Carter it was found that these shales were present, though not always separated from the shales above the Conglomerate, the Conglomerate sandstone being entirely wanting near the Ohio river, in places, but becoming prominent to the southwest.* In that region the lower limestone ore, a thin coal, and a thick bed of non-plastic fire-clay, are included. In this region this shale series is much more prominent; and being surmounted by a great mass of Conglomerate sandstone, it includes nearly all the productive coal and iron-bearing rocks of Menifee.

The fire-clay bed seems to have fallen off in importance in proportion as the Sub-conglomerate shales become more prominent, the only trace of it in this region, so far as known, being an occasional fragment found upon the surface. These fragments may lead to the discovery of local deposits of this clay. On the other hand, the coal deposits are increased in something like the same proportion. This increase does not always carry with it a corresponding increase in economic values, as will be seen by reference to sections 3 and 4, plate 1 (section plates accompanying this report), in which the number of beds is increased without adding greatly to the thickness of workable beds. Generally, however, the deposit is found mostly in a single bed of what proves to be an exceptionally pure coal of workable thickness.

* Report on the geology of Greenup, Carter, and Boyd counties, and a part of Lawrence, volume II, new series.

The limestone ore bed also proves to be an important deposit, both from the quality and the abundance of the ore. Whether the close association with a coal, apparently well adapted to the smelting of iron ore, gives an additional economic value to both the coal and ore, remains yet to be determined by practical experiment.

The nearness to market is an important factor in any view of the economic value of the coal of this region. Already reached by the narrow-gauge railroad from Mt. Sterling, this field ought, from all the conditions of the case, to supply a large part of Central Kentucky with fuel, and that, too, at much more reasonable rates than has been heretofore exacted, until the heavier deposits of more remote regions are reached by this or other railroads; and even then the nearness to market will warrant a competition with more distant fields, until the best deposits of this region have been exhausted. For the same reasons, the Slate creek coal region is of more immediate importance than that of the central part of the county, although the actual coal area on Slate creek is comparatively small, the coal being found near the tops of the narrow ridges. (See profile section.)

Sections 1 and 5, plates 1 and 2, show the position of the main Sub-conglomerate coal, and also the thickness at the two points indicated. The outcrop of this coal is found at this level, wherever the rocks of this horizon are exposed, in the Slate creek valley. Not being mined, or being opened for local use only by benching, the thickness is rarely shown. It is probable, however, that an average thickness like that at the head of Bull Fork will be found in this region, including the main ridge between Slate and Indian creeks, and between Slate and Beaver.

In this valley the limestone ore is not exposed as frequently as further to the eastward, although there is good reason to suppose that it will be found, in its usual variable thickness, at the top of the Sub-carboniferous limestone, over the most of this region. As yet, no effort has been made to determine the value of this ore in this valley, fragments upon the surface

being the only means of judging as to the range of the bed, as also, for the most part, of the thickness.

Sections 2, 3, and 4, plate 1, show a considerable variation in the character and thickness of the Sub-conglomerate series on Indian and Gilladie creeks. At the head of Indian creek the thickness continues to be about the same as on the head waters of Slate, while near the Red river and in the ridge eastward, between Gilladie and Beaver creeks, an increased thickness is found, and also an increased number of coals. Near the mouth of Indian creek, in Powell county, the thickness of the Sub-conglomerate shale series exceeds one hundred feet. Near the mouth of Gilladie creek the shales measure one hundred and twenty-five feet, as shown in section 4.

Section 3, on the farm of Green Gibbs, on Muddy Fork of Indian creek, shows a local feature that has been thought to promise better results from coal mining than elsewhere in this region. A considerable thickness of highly bituminous shale, in some parts an impure coal, gives to the unpracticed eye the appearance of a heavy coal deposit. Nearly the same feature, but in less thickness, is shown on one of the branches of Leatherwood Fork of Indian creek, a little to the westward. At the head of Cane creek a considerable thickness of cannel slate is found at the base of the shale series. There appears to be nothing in these beds to warrant any expectation of local deposits of exceptional value. On the contrary, it may be found that the impure coal of this locality is the equivalent of the coal of section 1. If this should prove to be the fact, then the area of the workable coal would be somewhat reduced. This feature appears to be local, however, and the main coal in workable thickness is found at the head of Leatherwood Fork, and also at a number of points on East Fork of Indian creek.

The sections on Gilladie creek show an increased number of coals, and a change in the relative position of the main bed. Whether this last fact is owing to a decrease in the importance of the coal of section 1, or to an increase in the

thickness of the shales below this coal, is not made clear from the facts at hand. It is quite probable, however, that one of the upper beds is the equivalent of the Bull Fork coal. No openings have been made in this locality to determine the real thickness of these beds. The exposures are such, however, as to show that the upper beds only may be expected to prove valuable.

Near the mouth of Chimney-top creek, in Wolfe county, a section similar to section 4 is found. Coal of very superior quality has been shipped in small quantity to Mt. Sterling from the upper beds. The coal was obtained by benching. No authentic information has been gathered as to the exact thickness of the beds, which are now mostly covered.

The limestone ore is present in all this region, as is shown from the fragments on the surface. It is exposed in large blocks, particularly on the left fork of Gilladie creek, and in the ridge between Middle and Leatherwood Forks of Indian creek. Specimens have been sent in for the State cabinet.

Sections 6 and 8, plate 2, show the extremes in the thickness of the Sub-conglomerate shales in the valley of Beaver creek. A comparison with the sections near the Red river shows a decrease in thickness northward from that river; but it will be seen that, north of the main east and west ridge (known as Dry Ridge), the place of the main coal is the same as at the head of Slate creek, and that the decrease in the thickness of the shales is from the absence of the upper beds; the coal on Brushy creek, near Old Beaver Furnace, being immediately under the Conglomerate cliff. Further to the northeast, in Morgan county, this coal is again separated from the Conglomerate sandstone by shales. South of Dry Ridge, as has already been stated, the increase in the thickness of the shales appears to be mostly below the main coal. The evidence on this point is somewhat conflicting. It is an important matter only as it relates to the more general question of the equivalency of the coal beds to the south and southwest, where the Sub-conglomerate shales become still more

prominent. It was the opinion of Mr. Leslie* that the lower part of the Conglomerate, changed in character to shale and shaly sandstone, and containing several beds of coal, contributes to the thickness of the Sub-conglomerate beds in this direction. In Menifee the variation in thickness of the Sub-conglomerate shales is not accompanied with a corresponding variation in the thickness of the Conglomerate sandstone. On the contrary, in the Red River valley, where the shales are the most prominent, the Conglomerate is also at its maximum thickness, as shown near the mouth of Gilladie creek, the Conglomerate being more than 200 feet thick at this point, the shales reaching 125 feet, and including four coal seams, the number reported by Mr. Leslie to the southwest.

It will be noticed that the position of the cannel coal in sections 3 and 4 indicates a thickening of the lower part of the shale series. On the other hand, the coal in section 6, near the base of the shales on the Beaver creek side of the ridge, appears to be the equivalent of the Bull Fork and Hawkins Creek beds, sections 1 and 5.

In the valley of Beaver creek, except perhaps along Dry Ridge, where the shale series is in considerable thickness, only one coal bed of importance will be found. The sections of plate 3, together with those already referred to, show the position of this bed. In thickness it is not uniform, varying where exposed from twenty inches to thirty inches, at the outcrop.

The limestone ore is exposed at a great number of places in Beaver Creek valley. In the immediate region of Old Beaver Furnace it was formerly opened and worked. (See sections 13 and 14, plate 3.) In the region of Clear Creek Furnace it is now obtained in abundance for furnace supply. (See sections 7, 12, and 15.) The region near the head of Beaver creek promises, so far as surface indications go, to become a more important iron ore region than the localities already mentioned. Sections 6, 9, and 11 show the surround-

*See report on the Topography and Geology of the Western Margin of the Eastern Coal Field of Kentucky, vol. IV, old series, page 454.

ings of this bed as noted in this region. On the Old State Road branch, above Frenchburg, the ore is particularly abundant on the surface, as also at some points along the face of the ridge between the upper Beaver valley and the head of Salt Lick.

Section 10, near the head of Beaver creek, and section 16, near the mouth of the same creek, show a feature which is not uncommon in the Sub-carboniferous limestone of this region—a bed of so-called lithographic limestone, varying from a few inches to two feet in thickness. In the latter region this band is exposed at a number of points; and from Mr. McMurtry's quarry, on the opposite side of the Licking river, blocks were some time since obtained and tested for lithographic use, with satisfactory results. The band is not so uniform in quality, where seen, as to insure equally good results without careful selection.

The valley of Salt Lick is not properly within the coal region, the westward boundary ridge being entirely Sub-carboniferous and Devonian. But the main ridge, between Salt Lick and Beaver creek, is capped by the Conglomerate sandstone with the underlying coal and iron-bearing shales, giving to this valley whatever advantages the coal and iron deposits of this ridge may offer. On Clear creek, a branch leading against this ridge, an iron industry has already sprung up, Clear Creek Furnace having been in successful operation for years previous to the late financial crisis. (See report of Mr. Moore on the Geology of the Red River Iron District.)

East of the Beaver Creek basin the Sub-conglomerate beds are below the drainage, except near the Licking river. Most of that part of Blackwater creek which is within Menifee has its bed in the Conglomerate sandstone. The Sub-conglomerate beds are, therefore, of little economic value east of the Beaver Creek valley. In this part of Menifee the hills are capped by the shales above the Conglomerate. (See profile section.) These shales usually include one or two coals. In this belt no coals of considerable thickness have been observed. Eastward, in Wolfe and Morgan counties, the Con-

glomerate falls below the drainage, and the whole height of the hills is made up of the rocks of the productive coal measures.

The following table of analyses by the chemists of the Survey, Dr. Peter and Mr. Talbutt, shows the quality of the Menifee coal. The analyses were made from samples carefully taken to represent the whole thickness of the bed at the several points:

	Adams' Bank, Old State Road, Branch of Beaver Creek.	Hawkins' Creek Coal.	Brushy Creek, Steele's Bank.	Bull's Fork Coal, Main Bank.
Moisture	5.00	2.94	3.80	5.00
Volatile combustible matter	32.40	33.06	38.60	39.06
Fixed carbon	58.40	56.60	52.00	55.94
Ash	4.20	7.40	5.60	2.76
Sulphur	.614	.997	not determ'd.	1.199
Specific gravity	1.300	1.319	1.301	1.300

SOILS.

The soil of Menifee is mostly sandy loam. Where the shales below or above the Conglomerate supply the greater part of the surface material, the soil is more clayey. The disintegration of the Conglomerate sandstone, the most prominent rock of the greater part of Menifee, gives to the soil a large per cent. of coarse sand. The presence of the Subcarboniferous limestone, no doubt, adds considerably to the richness of the soil of the valleys where it is exposed; while the woodlands, which comprise by far the greater part of the county, are rich in vegetable mould. The unevenness of the surface is unfavorable for extensive tillage. Pasturage should become an important part of husbandry in this region. The steep hillsides are particularly unsuited to tillage. Rich in vegetable mould when first cleared of timber, it takes but a few years of plowing and washing to render them barren, and, for a time, nearly worthless. When this result has been reached, it is too late to seed for pasture. With the system, or want of system in farming, that tends to this result, there is nothing to do but to clear another tract, and to sacrifice it in the same way. It is largely owing to this way of farming

that the apparent barrenness of the hill country, where cleared, so belies the natural fertility of the soil. Well directed enterprise in farming would do very much to offset the disadvantages of a hilly and broken surface.

TIMBER.

The timber of Menifee includes the following species, besides some others, which doubtless have been overlooked, no time having been at command for a special study of this subject. For a general view of the distribution of species, see report on the Timber Growth of Greenup, Carter, Boyd, and Lawrence Counties, vol. I, new series:

First in importance, both in value and in abundance, is the white oak (*Quercus alba, L.*) The black oak (*Q. tinctoria, Bartram*) is abundant on the hillsides. The red oak (*Q. rubra, L.*) has about the same range as the black oak, but is less abundant. The chestnut oak (*Q. prinus var. montacola*) is abundant along the ridges. In the report referred to above, this species was, by some mistake, given as *Q. castanea.* The pin oak, or perhaps the scarlet oak (not in season to determine species), generally present on the low spurs between the smaller streams. The Spanish and the laurel oak (*Q. falcata L.* and *Q. imbricaria, Mx.*) are found along the border of the county on Slate creek. The beech (*Fagus sylvatica, L.*) is abundant in the valleys generally. The sugar tree (*Acer saccharinum, Wang.*), the white or soft maple (*A. dasycarpum, Ehrh.*), and the red maple (*A. rubrum, L.*) are present—the first in considerable numbers, the last only met with here and there as a single tree. The tulip tree (*Liriodendron tulipifera, L.*), generally known as the yellow poplar, is abundant on the hillsides. The chestnut (*Castanea vesca, L.*) is found in great numbers towards the top of the hills. The hickories (*Carya tomentosa, Nutt., C. alba, Nutt.*, and *C. amara, Nutt.*) are well represented, and in the second growth, as on the hill west of Old Beaver Furnace, they often largely predominate, the first two species being most abundant. The black gum or gum tree (*Nyssa multiflora, Wang.*) is found

everywhere in small numbers. The white ash (*Fraxinus Americana, L.*) and the linden or linn, as it is sometimes called, are found in some of the valleys. The former is exceptionally abundant in the valley of Leatherwood Fork of Indian creek. The buckeye (*Æsculus glabra, Willd.*) is found in the larger valleys; the sycamore (*Platanus occidentalis, L.*) has about the same range. The elm (*Ulmus Americana, L.*) ranges from the creek bottoms well up on the hillsides. The black walnut and the white walnut grow in all the main valleys. The locust tree (*Robina pseudacacia, L.*) is seen occasionally on the hillsides. The cucumber tree (*Magnolia acuminata, Lam.*) is seen occasionally on the heads of streams, but rarely large enough to be valuable for lumber. The mulberry (*Morus rubra, L.*) is found along the base of the hills. The sassafras tree (*Sassafras officinale, Nees.*), the dogwood (*Cornus florida, L.*), and the sourwood (*Oxydendrum arborinum, D. C.*) are each of frequent occurrence. The redbud (*Circis canadensis, L.*) is occasionally, and the ironwood (*Ostrya virginica, L.*) is rarely, found on the hillsides. The hornbeam (*Carpinus Americana, Mx.*) and the willows are scattered along the streams. The holly (*Ilex opaca, Ait.*) is limited to the vicinity of the most precipitous cliffs. The pawpaw is abundant on the water-courses. The persimmon is less abundant.

Of the cone-bearing trees, the hemlock (*Abies Canadensis, Mx.*) and the yellow pine are the most abundant—the former on steep rocky surfaces near the streams, the latter along the ridges. The white pine (*Pinus strobus, L.*) is abundant in some parts of the Red River valley, but only a few trees of this species fall within the county line. A few red cedars (*Juniperus virginica, L.*) occur near the limestone cliffs or ledges.

The timber of Menifee, as of all the hilly counties, should be held in high estimation among those things that go to make up the natural wealth of the region.

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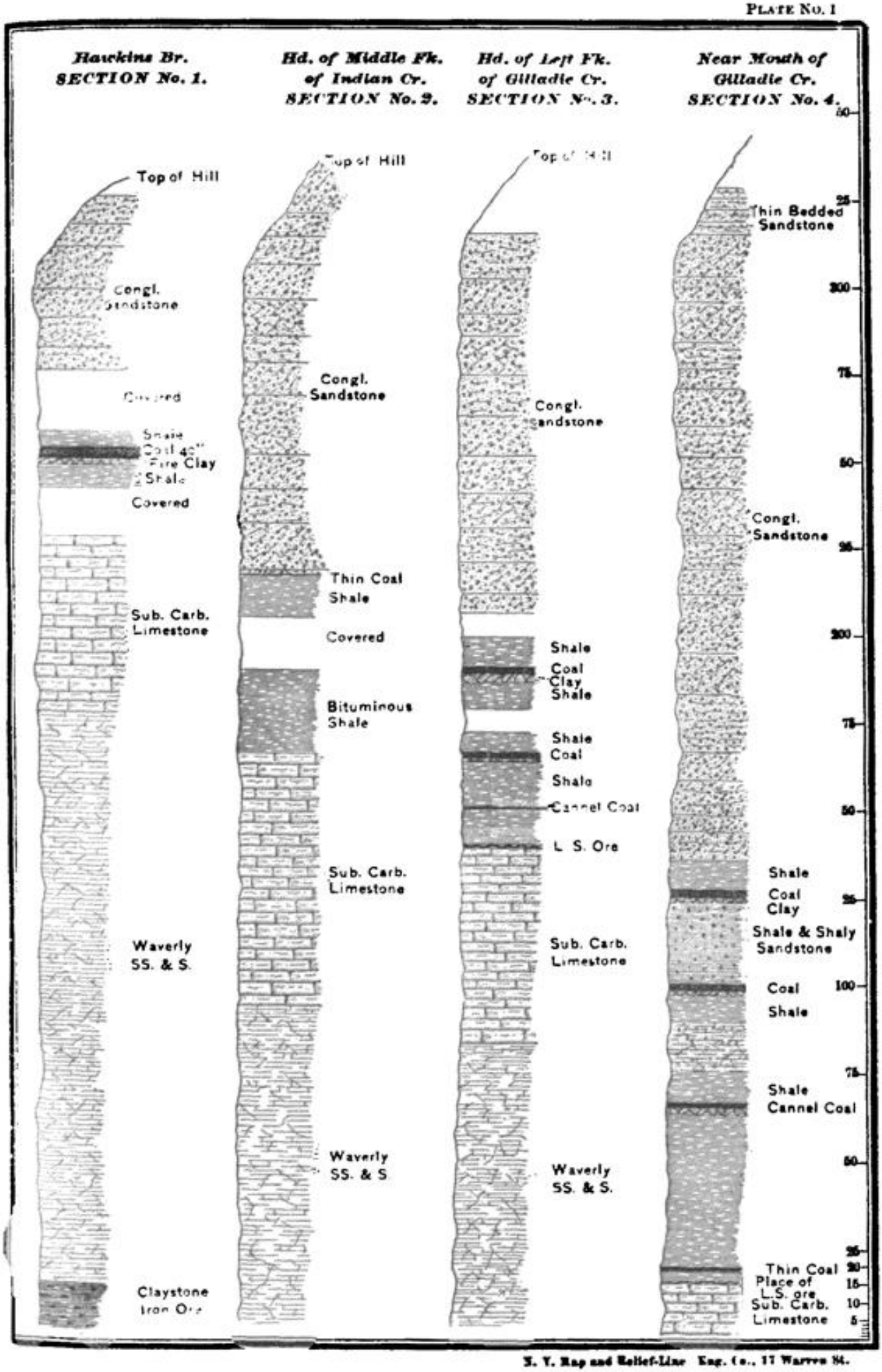

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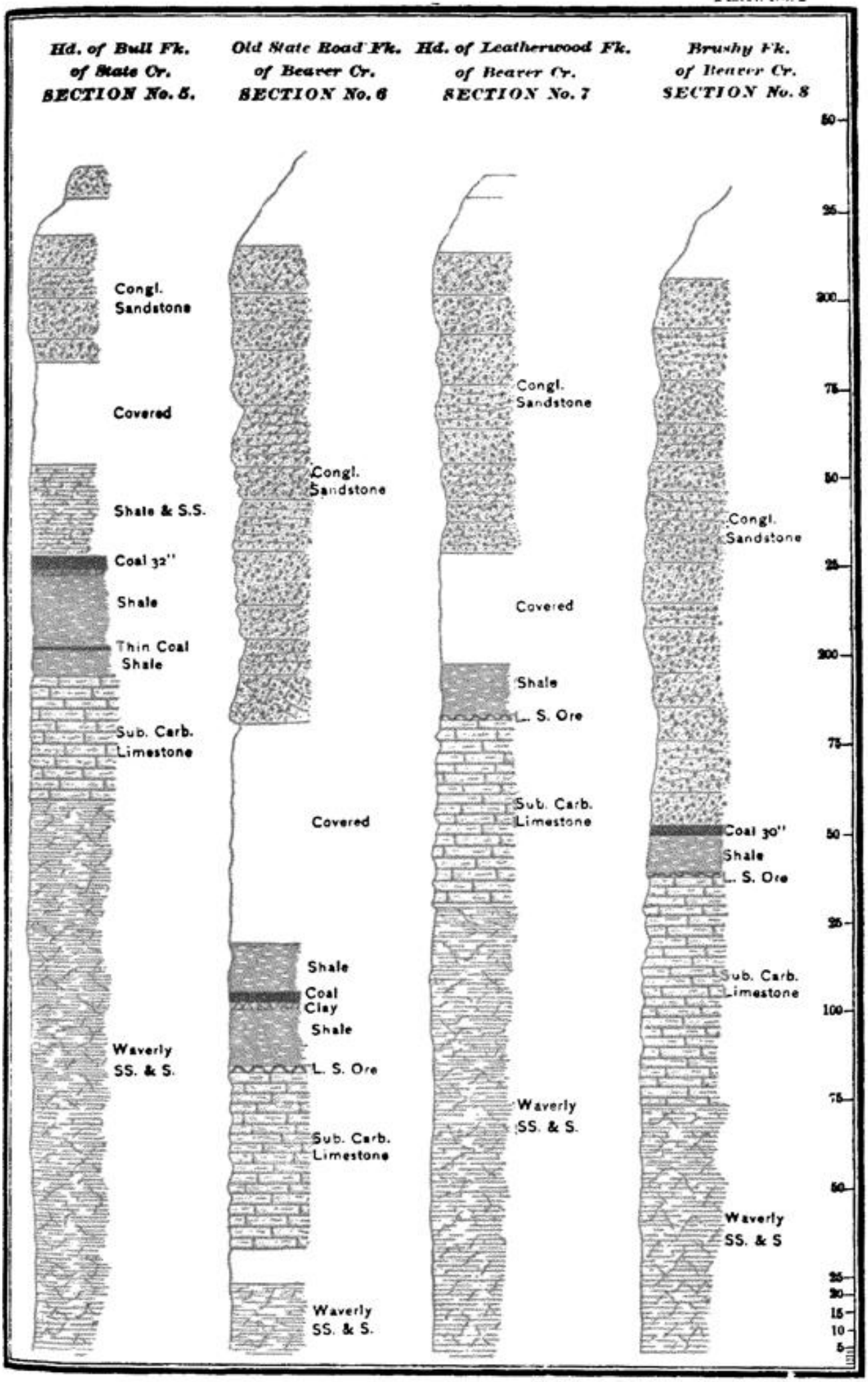

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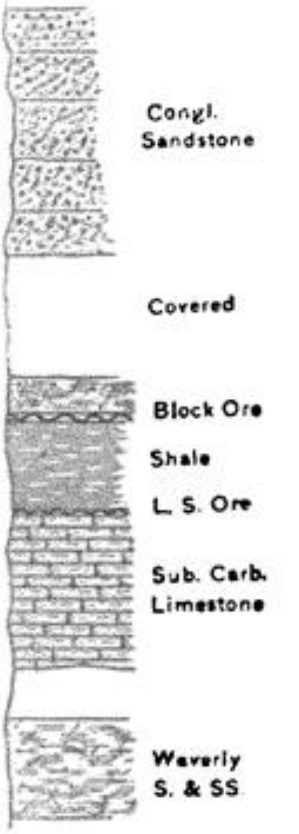
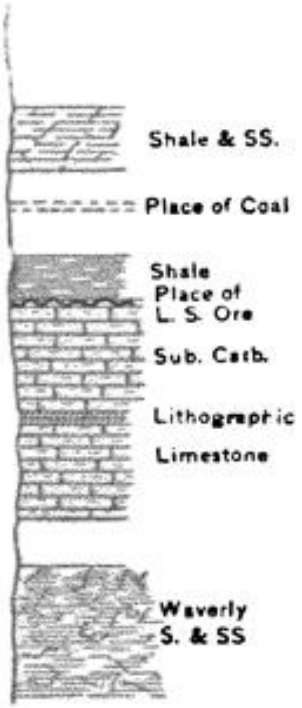
At Phelps', near Hd. of Beaver Cr.
SECTION No. 9

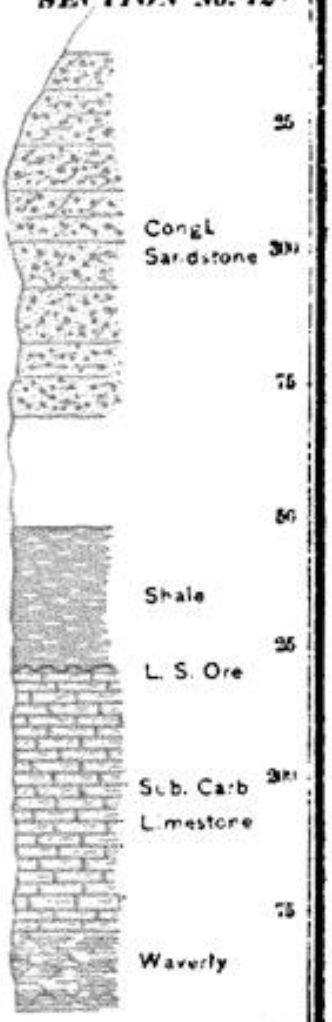


Hathaway Br. of Beaver Cr.
SECTION No. 10

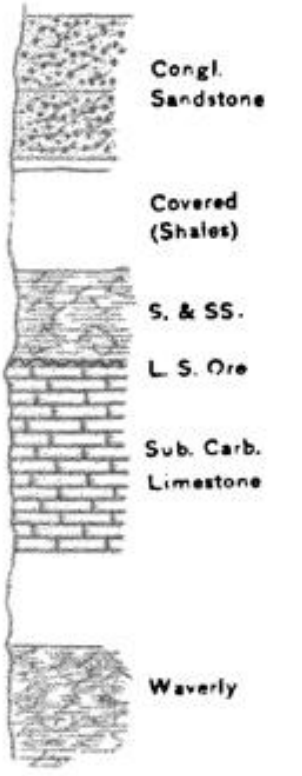


Hd. of Stone Quarry Br. of Salt Lick
SECTION No. 11

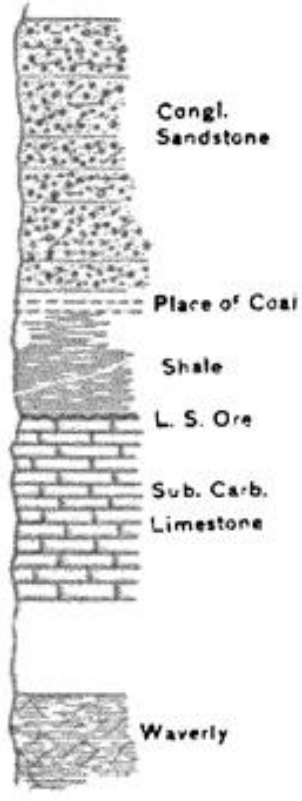
Hd. of Ratcliffe Br. Beaver Cr.
SECTION No. 12



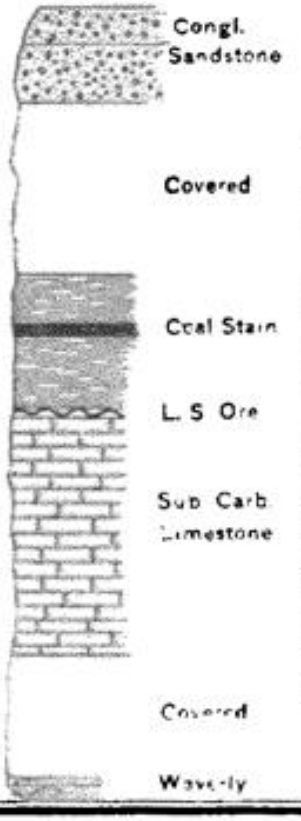
Myers Fk. of Beaver Cr.
SECTION No. 13



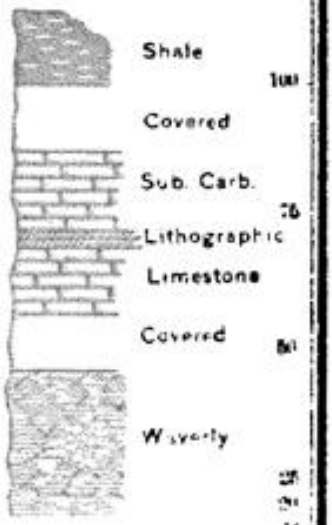
Hill West of Old Beaver Fur.
SECTION No. 14



Workman's Point, Near Clear Cr. Furnace, P. N. M.
SECTION No. 15



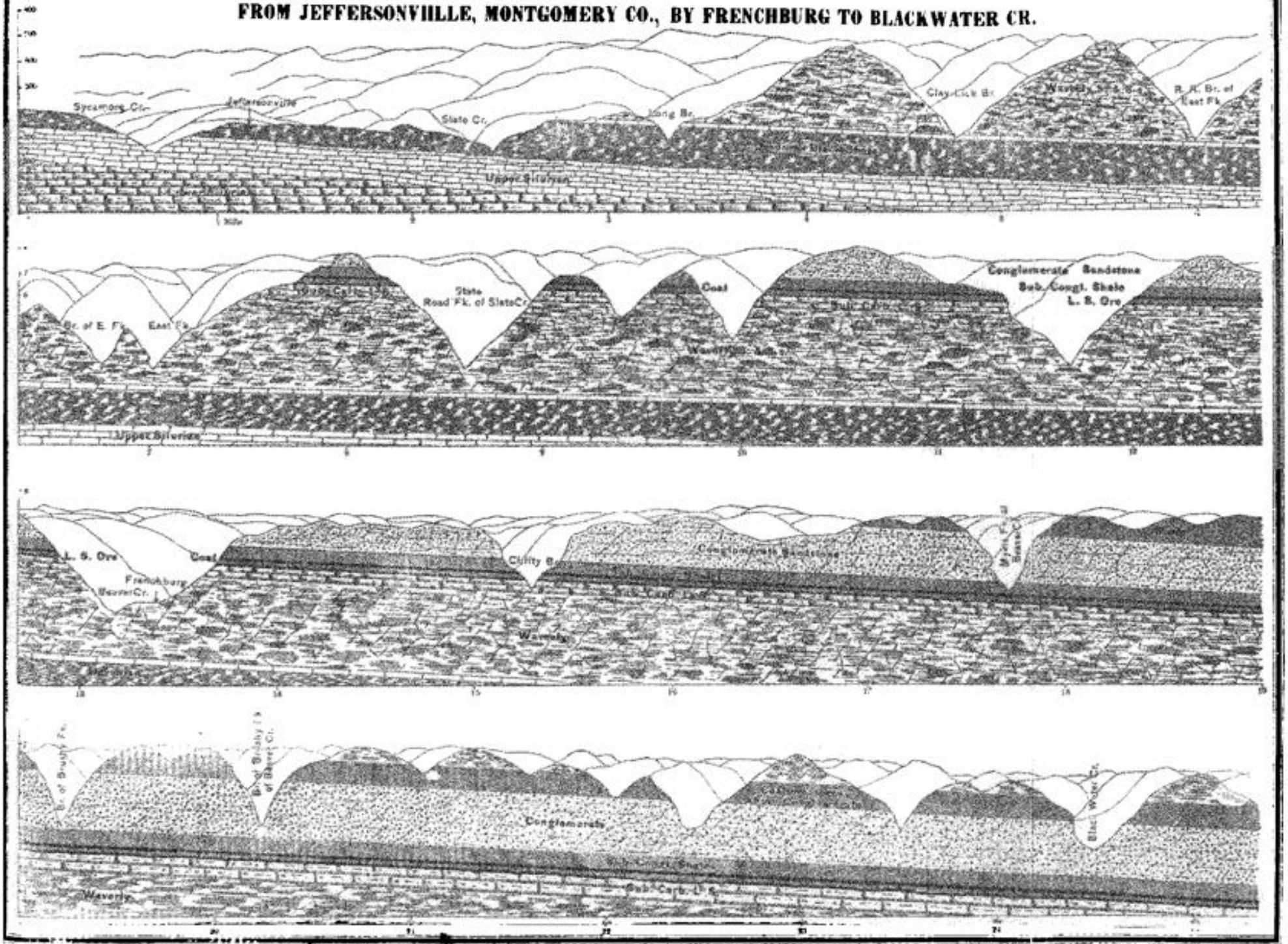
Licking River Mouth of Beaver
SECTION No. 16



N. Y. Map and Relief-Line Eng. Co., 11 Warren St.

Profile Section

FROM JEFFERSONVILLE, MONTGOMERY CO., BY FRENCHBURG TO BLACKWATER CR.



N. Y. MAP & RELIEF LINE ENG. CO. 17 WARREN ST.