GEOLOGICAL SURVEY OF KENTUCKY.

N. S. SHALER, DIRECTOR.

REPORT ON THE UNFINISHED WORK

OF THE

SURVEY OF THE COMMONWEALTH

UNDER THE

DIRECTION OF DR. DAVID DALE OWEN,

BY N. S. SHALER.

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REPORT ON THE UNFINISHED WORK OF THE SURVEY OF THE COMMONWEALTH, UNDER THE DIRECTION OF DR. DAVID DALE OWEN.

In reconstituting the Geological Survey of Kentucky, the Legislature very properly provided that the new work should be made a continuation of that which had been begun under the direction of Dr. Owen. In pursuance of this command, a careful search has been made for all the material left unpublished by the sudden stoppage of the work in 1860. The death of Dr. Owen in that year, the ravages of the civil war, and various accidents, such as the burning of certain records in the offices of the Commonwealth at Frankfort, has left little to be gathered together. Some few topographical notes have been embodied in the maps given in the first, second, fourth, and fifth volumes of the new series. Some collections of soils made by Dr. Owen's assistants have been analyzed by Dr. Peter, and the results given in his reports.

I present herewith the only two considerable works that have come to me in the records of the old Survey. The first of these, the geological section along the east and west base line of the Survey, made by Sidney S. Lyon, Assistant of the Survey, is all that has been found in the way of records of that arduous work. I have elsewhere expressed the opinion that the labor given to this task was, to a great extent, misplaced, as it was not possible to make a satisfactory map of the State in the way designed by Dr. Owen. The topography planned by him was essentially based on the methods of the only surveys with which he was personally familiar—those made by the General Government in laying out the lands of the new Territories. This method has been unanimously condemned by all cartographers as wanting in those corrections which experience has shown can alone be given by the ac-

curate system of triangulation which is used in all our best modern government surveys. The extension of the triangulation work of the Coast Survey to the interior of the United States, in a way that furnishes a thorough geodetic foundation for the topographical work of any State survey, takes away the need of the class of work which Dr. Owen sought to do in this imperfect fashion. I have, therefore, not thought it worth while to try to recover the bench and distance marks of his base line—a task which, owing to the imperfect method of designation, would be now, after the expiration of twenty years, very hard to accomplish.

The section with the sketch of the topography, which is given in the first plate in this Report, has a certain value, independent of the aim that led to its making. It will be seen that it gives, in considerable detail, a generalized geological section across the Cincinnati, or, as I would prefer to call it, the Ohio axis, which is the key to the structural geology of Kentucky. Although the work seems rudely done, when measured by the advanced standards of our modern geology, it is, in a certain way, an advance on anything that had been done at the time when it was executed. The great disproportion between the horizontal and vertical scales of the section is a defect common to all the work of its day, and it occurs in most of our more modern sections as well. The result is a very much distorted idea of the steepness of all declivities, whether of the surface of the ground or of the slopes of the various strata. The reader should be warned that the eastern part of the section, which seems as rugged as the sky line of the rudest mountains, in fact represents a region of rather gentle slopes, through which railways could be built at scarcely more cost than in the more level central parts of the section. He should also notice that the various separate groups of rocks are but imperfectly given, not half the well marked divisions being taken into account in this diagram.

In making these criticisms upon the work of my distinguished and lamented predecessor, I would not be suspected

of a disposition to disparage his eminent services to the geology of our Commonwealth, as well as to American geology in general. Each step in reviewing his labors confirms me in the opinion that he was a man of great genius and of the most constant fidelity to his work. The only limitations to the goodness of his work were brought about by the slender means at his command, and the necessary restriction of all his labors to reconnoissance surveys, in which branch of geological surveying he deserves the very highest rank.

The third plate given in this Report contains an important piece of topographical work, by Joseph Lesley, Esq., Topographical Assistant with Dr. Owen, now Secretary of the Pennsylvania Railway. This work, like that of Lyon, was designed to serve the purpose of a base line on which to build the topography of the State. It will be seen that the measurements extend from near the Ohio river to the Tennessee border, and that they essentially coincide with the western outcrop of the eastern or Appalachian coal field.

As a piece of topographical work, this base-line Survey of Mr. Lesley's has, I believe, never been surpassed in the western country. Unfortunately, the original map, in twenty large sheets, on the scale of one ten thousandth, was loaned by the State Government to the officers of U. S. engineers during the civil war. The data it afforded were roughly embodied in the so-called military map of the Commonwealth, which was prepared in 1863–'5, but which, owing to the loss of the lithographic plates in the burning of Pike's Opera House, in Cincinnati, was never published, a few copies only being now in existence. The original sheets of Mr. Lesley's work have been anxiously sought for in the Government archives—the officers of the War Department and the U. S. engineers having given me all possible aid in my efforts to recover these records. Fortunately, Mr. Lesley had made a full reduction of his maps to the scale given in this section, which will serve to preserve the most valuable features of his admirable work.

The sketch map which accompanies this Report was designed to give the western outcrop of the eastern coal field

in a convenient form, in anticipation of the completion of the topographic work in this section, without which a detailed showing would not be possible. This sketch has already been embodied in the general geological map of the State. It is reproduced here in justice to the work of Mr. Lesley, and in order to show just what work had been done during the direction of Dr. Owen.

In the work of Mr. Lesley, as in that of Dr. Owen, the greater part of the usefulness of the base lines measured has been lost, owing to the change of plan arising from the substitution of triangulation for the method of base lines used by Dr. Owen; but Mr. Lesley's work, unlike that of Mr. Lyon, has a direct value for the amount and accuracy of topographical work done along the base line, and the excelling hypsometric determinations made in connection therewith. Wherever this work of Mr. Lesley's has been reviewed, in the advance of the present Survey, it has been found of the most satisfactory character.

It should be said, in explanation of the delay in bringing out these fragments of Dr. Owen's work, that it was long after the re-institution of the Survey before the materials came into my hands, and only within a few months of the present time that I have been forced to give up all hope of getting access to other original records of the same nature.

THE OUTCROP BELT OF THE EAST KENTUCKY COAL FIELD.

To accompany a Map originally presented to the American Philosophical Society, June 20th, 1873. By Joseph Lesley, Late Assistant on the Kentucky Geological Survey.

Under appointment of David Dale Owen, State Geologist of Kentucky, I began, on the 25th of August, 1858, a geological and topographical survey of the margin of the eastern coal field of the State, to determine its area, and the number, thickness, and attitude of its beds of coal and iron ore, and to get a reliable base for a future survey of the whole eastern coal field as far as to the Virginia line.

The base line of my survey was run upon the common roads of the country—flying side lines, and, in some cases, closed looped lines, being carried out sideways to the western outcrops wherever necessary.

An admirably constructed odometer was used for measuring distances, and a compass with side-telescope and eccentric target for running courses. Aneroid observations, regularly taken at every station, were checked by clinometric measurements made with a vertical circle attached to the telescope, and also by synchronous observations with a barometer stationary in camp.

The main base line was also carefully leveled, for a distance of about two hundred miles, with a spirit-level, which was also used on some of the side lines, in order to tie the parts of the work together, and to give the exact datum above tide-water for all principal stations, in view of adopting them as starting points of the contemplated survey of the whole coal field.

The work thus described was continued from September 1, 1858, to November 1, 1859, seven months being passed in field work, and with the following results:

1st. A large contour-line map was made on a scale of three miles to the inch, which has never been published. The original plottings were on a scale of five hundred feet to the inch.* This map includes only the ground covered by the survey, and shows the positions of towns, county line crossings, coal openings, and other points of interest, as well as the crossing of the long east and west base line run by S. S. Lyon, Assistant on the State Geological Survey.

2d. The map, now published for the first time, to accompany this description, was compiled from the survey sheets of the first named map, from old maps in the Internal Improvement Office, from railway surveys, and from the old State map.

3d. A base line for future use, extending in a general southwest direction along the strike of the formations, beginning at a point five hundred and ninety-seven feet above tide, close by the town of Grayson, in Carter county, Northeast Kentucky, and extending, by a loop embracing a section covered by the Little Sandy river and its tributaries, to the ridge dividing Carter from Rowan counties; thence across the east end of Bath county to Jeffersonville, in Montgomery county; thence to the Red River Iron-works, on the edge of Estill county; thence to the town of Proctor and its coal mines, on the Kentucky river; thence across Owsley county to McKee, in Jackson county; thence to Mt. Vernon, in Rockcastle county, and Somerset, in Pulaski county; thence across the Cumberland river, at the "lower ford," to Monticello, in Wayne county; and thence to its southern terminus on the Tennessee State line, in Clinton county, at a point on the waters of Wolf river, one thousand and nineteen feet above tide.

4th. The establishment of sixty-two bench marks, showing elevation above tide and above low water in the Ohio river at Catlettsburg.

5th. An unpublished geological section to accompany Map No. 1.

*These maps were loaned to the U. S. engineers by the Government of the Commonwealth during the late civil war. The most careful search for them has been unsuccessful. Through the kindness of General Humphreys, the records of the engineer corps at Washington have been ransacked in this fruitless search. N. S. S.

By observations made during the progress of the work, the following points of scientific interest present themselves:

1st. In approaching this coal field from Middle Kentucky, over the lower Silurian formations, one is confronted by a belt of cone-shaped hills, having the Devonian black slates in their gently sloping bases, upon which rise steeper slopes of the olive-colored shales and overlying grit stones of the same system. These shales and grit stones, together, vary in thickness from three hundred and fifty to five hundred and fifty feet, the lower and larger division of the formation having disseminated through it nodular masses of earthy iron ore, giving origin to numerous chalybeate springs, the upper division affording valuable building stone.

Upon the above named rocks lies the Mountain or Sub-carboniferous limestone, varying in thickness from seventy feet, at the north end of the line, to four hundred feet and more at the southern end. This formation is composed of alternating layers of white, grey, and buff-colored strata, ranging in quality from argillaceous claystone to the purest plaster limestone. The lowest members of the series hold large dark green flint pebbles, and exhibit traces of galena. Dry valleys and numerous caves distinguish this formation.

Above these limestones lies the millstone grit formation (the Conglomerate No. XII of the Pennsylvania Survey), in two members, the lower made up of thin sandstones and shales, inclosing beds of coal and iron ore. This is named the "Sub-conglomerate" member. The upper or "Conglomerate" proper consists of a massive, coarse-grained ferruginous sand-rock containing pebbles.

The two members of this formation thicken southwestwardly, as do also the rocks of the previously mentioned formations, on which they repose, but under different and peculiar conditions.

At Grayson the whole formation measures ninety feet, with the "lowest" coal bed—a mere streak—jammed between its base and the top of the limestone.

At the north fork of Licking river the upper member is one hundred and fifty feet thick; while the lower one is only eight feet thick, and contains a well-defined bed of iron ore and a twelve-inch coal bed.

In Estill county the upper member measures two hundred feet; the lower has also increased to fifty feet, its accompanying ore bed being now workable, and its coal bed measuring twenty-seven inches in thickness.

From this last named point to the south end of the line at the Tennessee State line the peculiar character of this formation shows itself in a marked manner, its lower member increasing to an average thickness of two hundred and twenty-five feet, and containing two workable and three other thin beds of coal, and three well-defined horizons of shale containing iron ore, its upper member nowhere exceeding eighty feet in thickness.

The point of sudden change lies geographically between the top of the ridge dividing the Red and Kentucky rivers and the valley of the Kentucky river itself.

The "lowest" coal bed holds its place throughout the belt, the other Sub-conglomerate coals mentioned above coming in, one by one, above it, and in proportion to the constant thickening of the lower member of the formation.

Back from the greatly eroded and boldly rising wall of the Conglomerate, which always marks the western margin of the East Kentucky coal field, lie, thinly spread over a plateau trenched by ravines, the lowest layers of the lower coal measures proper.

2d. All the formations mentioned above dip to the southeast, making the western side of a wide and shallow synclinal trough.

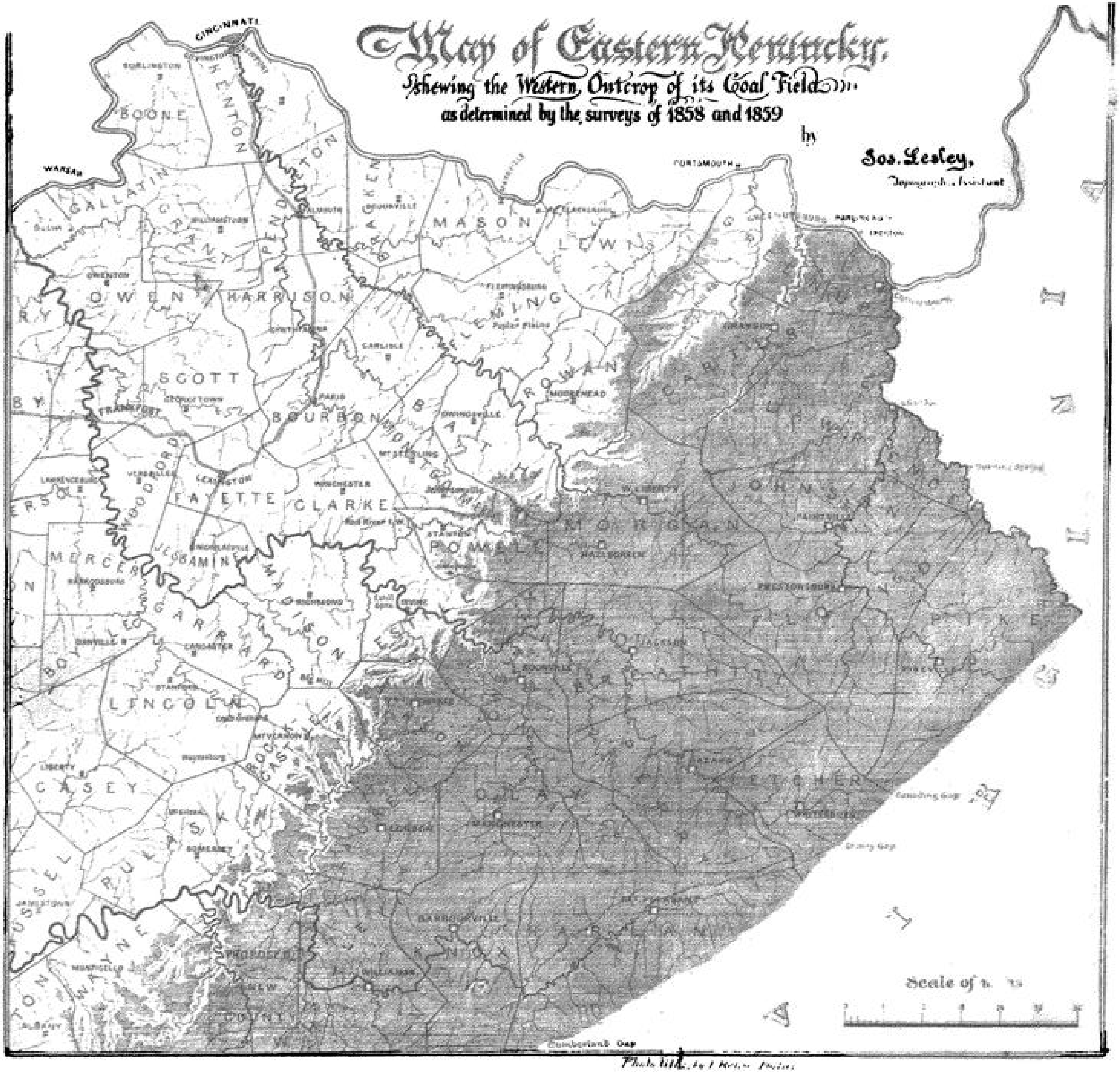
3d. This great wave, having its axis in a direction north northeast and south southwest, is itself crossed by undulations of no great height and depth, having their axes west northwest and east southeast. Gentle as those undulations were, they were quite sufficient to determine the principal

lines of drainage which issue from the mountain country into the plain.

4th. All the formations examined along the base line thicken, and also rise above sea level, going towards the southwest.

5th. The lowest Sub-conglomerate coal varies in thickness, but is persistent throughout the whole extent of the belt surveyed, a distance of about two hundred miles.

6th. Different species of trees mark the outcrops of the different geological formations. The sugar-tree and other maples, and the white oak, are characteristic of the base of the Devonian "knobstone" series. Beech and red cedar grow on the Sub-carboniferous limestones. Pine, hemlock, laurel, and holly possess the Conglomerate cliffs and peaks. Chestnut and oak forests cover the shales and sandstones of the great plateau bordered by the Conglomerate bluffs.


Map of Eastern Kentucky,
Shewing the Western Outcrop of its Coal Field
as determined by the surveys of 1858 and 1859
by
Jos. Lesley,
Topographical Assistant
Scale of Miles
CINCINNATI
PORTSMOUTH
BOONE
KENTON
GALLATIN
GRANT
PENDLETON
BRACKEN
MASON
LEWIS
OWEN
HARRISON
FLEMING
ROWAN
SCOTT
BOURBON
BATH
MONTGOMERY
CARTER
JOHNSON
MORGAN
FAYETTE
CLARKE
WOODFORD
JESSAMINE
MERCER
MADISON
GARRARD
LINCOLN
BOYLE
CASEY
PULASKI
WAYNE
RUSSELL
CLAY
PERRY
FLOYD
PIKE
BREATHITT
LETCHER
HARLAN
KNOX
FRANKFORT
LEXINGTON
PARIS
WINCHESTER
MOREHEAD
OWINGSVILLE
FLEMINGSBURG
GEORGETOWN
CARLISLE
GRAYSON
HAZLE GREEN
PRESTONSBURG
PAINTSVILLE
JACKSON
MANCHESTER
BARBOURVILLE
LIBERTY
STANFORD
LANCASTER
DANVILLE
SOMERSET
MONTICELLO
ALBANY
WILLIAMSBURG
Cumberland Gap
WARSAW
BURLINGTON
COVINGTON
FALMOUTH
WILLIAMSTOWN
OWENTON
CYNTHIANA
VERSAILLES
LAWRENCEBURG
HARRODSBURG
NICHOLASVILLE
RICHMOND
STANTON
IRVINE
MT. STERLING
MT. VERNON
JAMESTOWN
WEST LIBERTY

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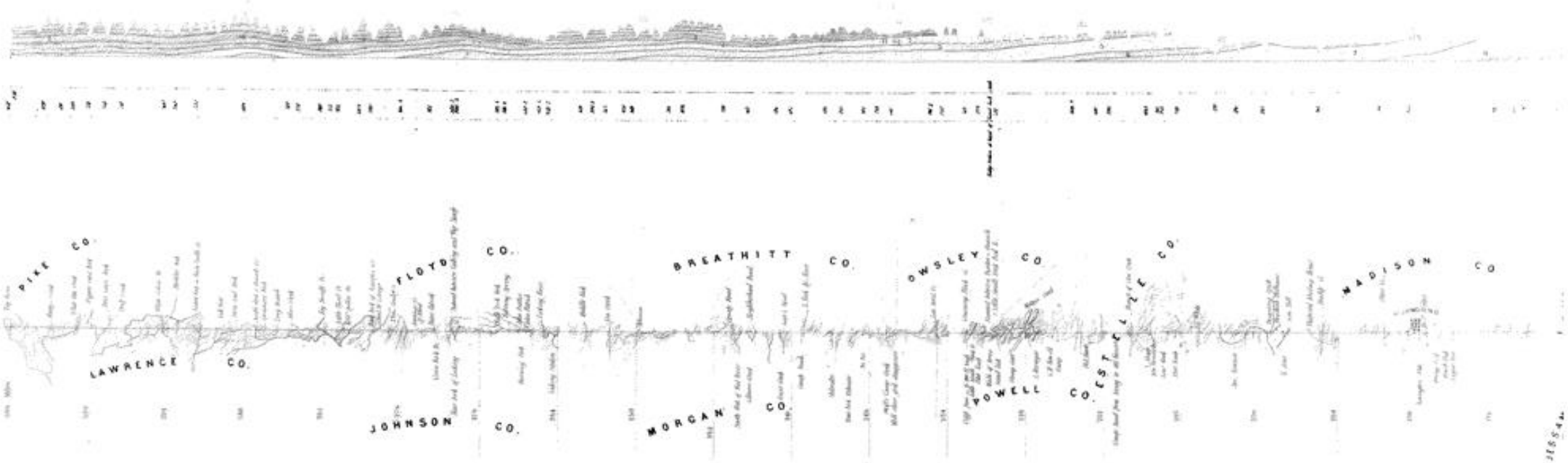
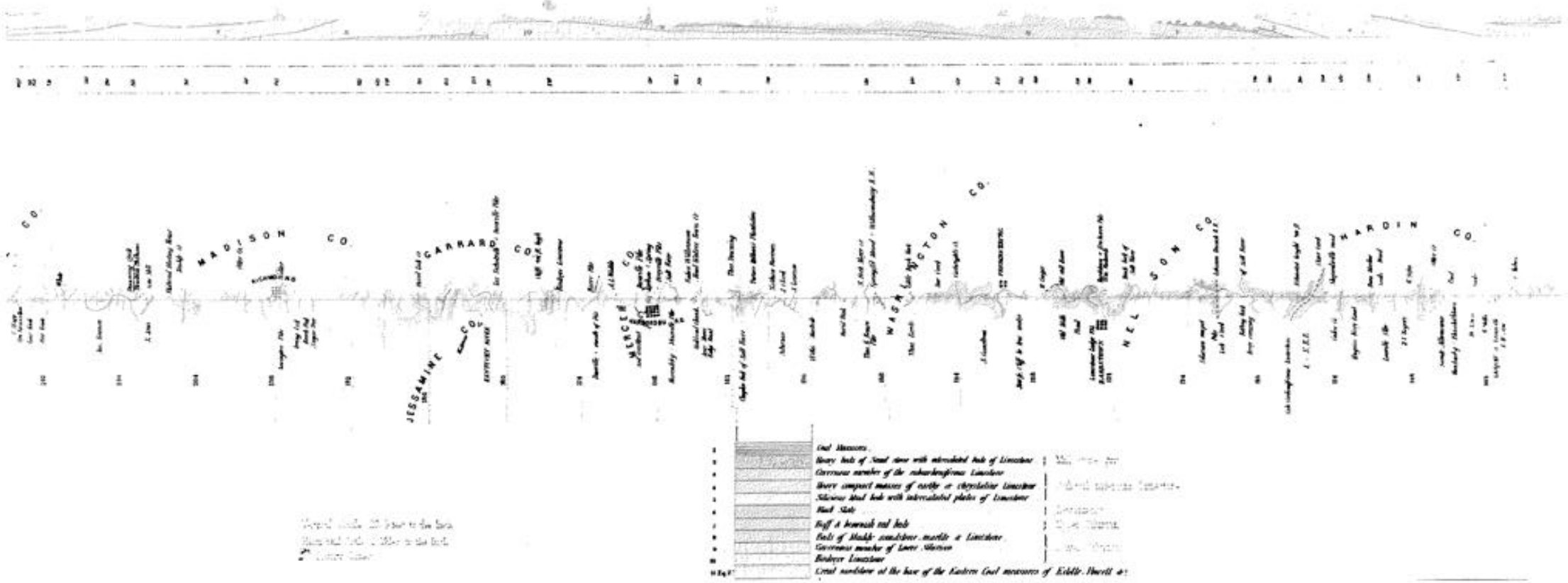
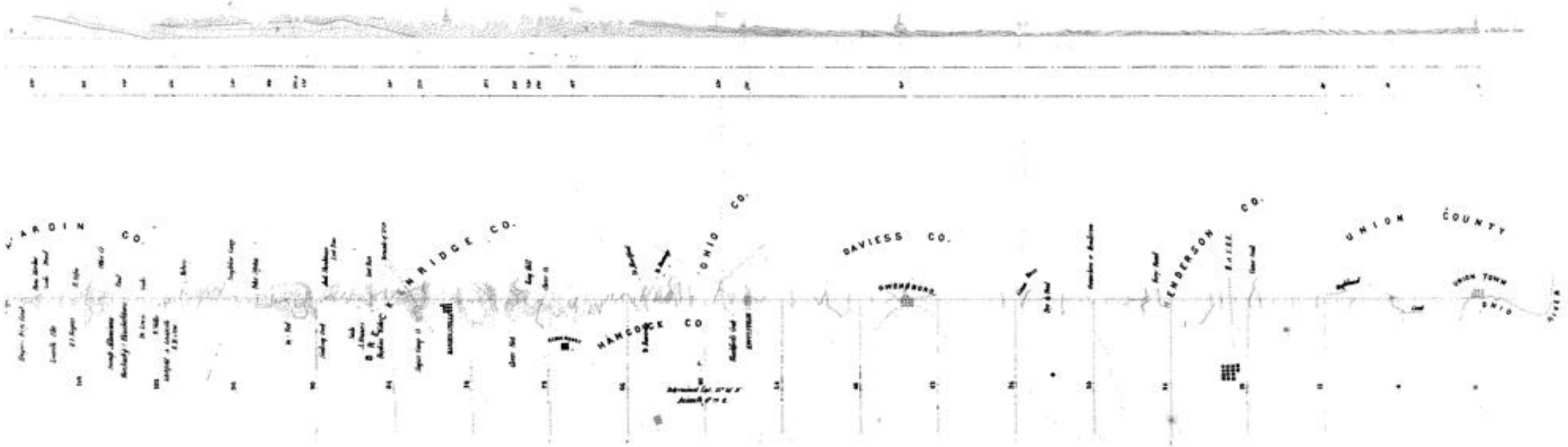


AL SECTION OF BASE LINE, SURFACE AS PER BAROMETRICA

GEOLOGICAL SURVEY OF KENTUCKY



DIMETRICAL OBSERVATIONS.



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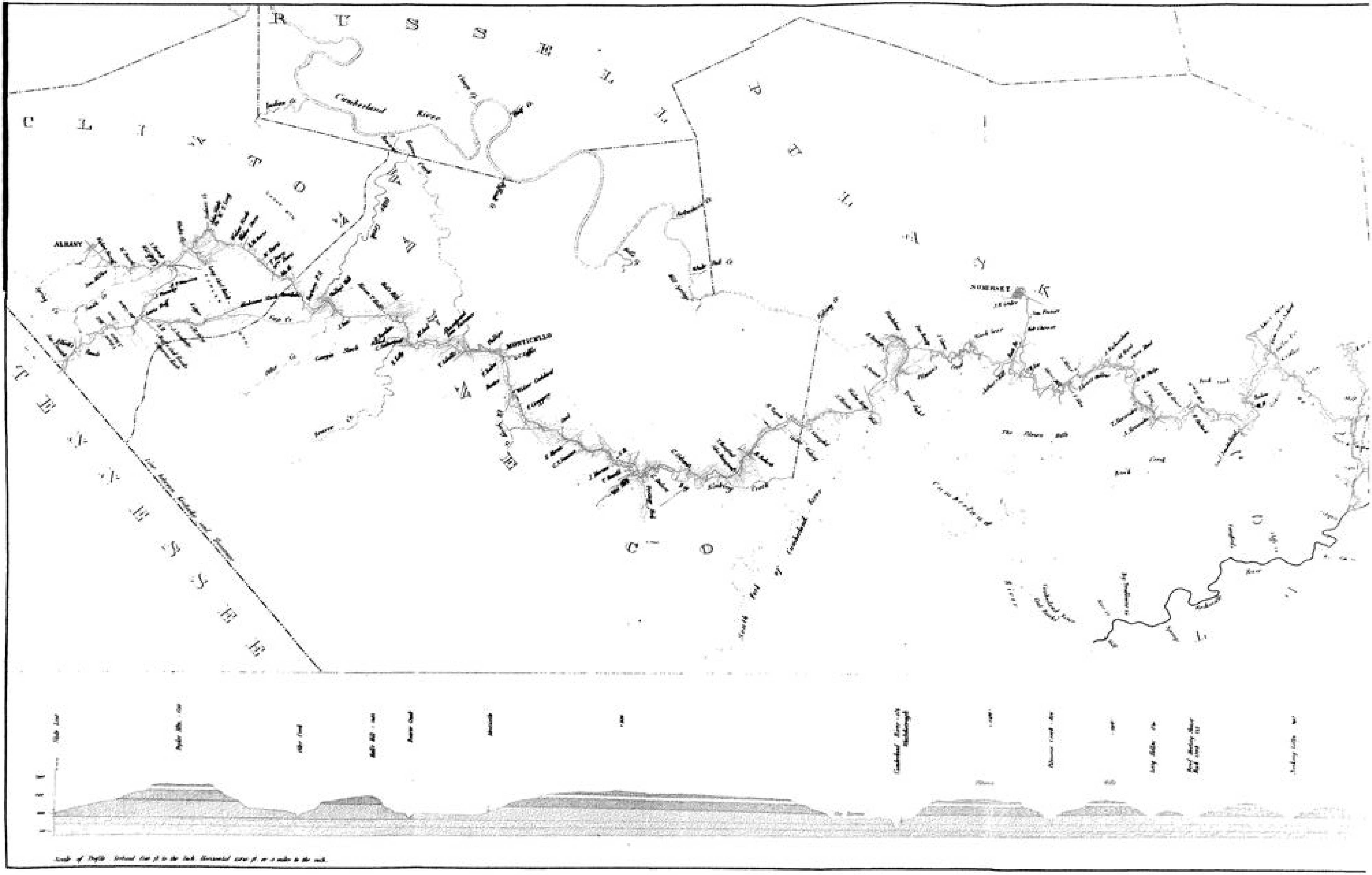

RUSSELL
CLINTON
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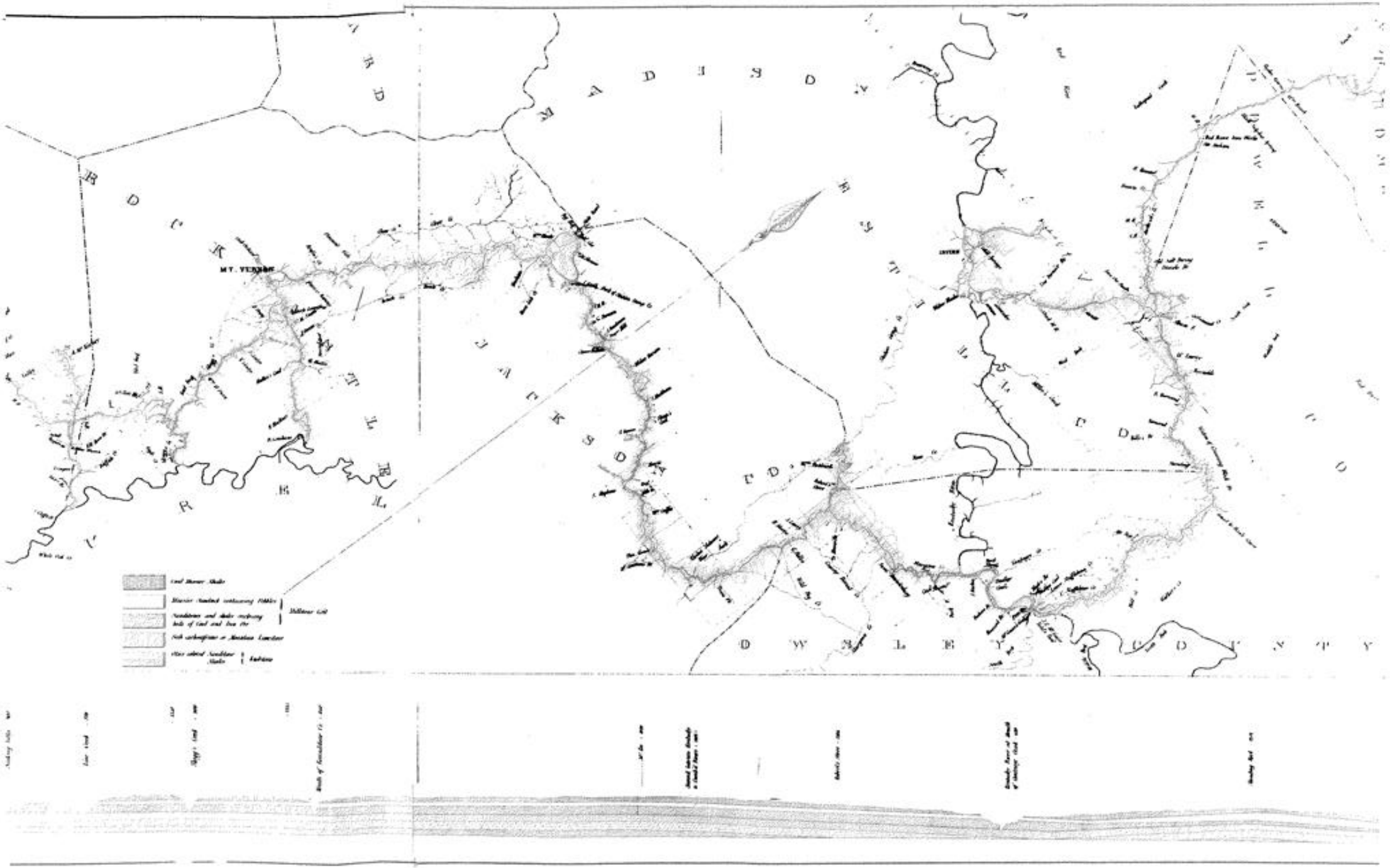
WAYNE
TENNESSEE
Cumberland River
ALBANY
MONTICELLO
SOMERSET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UNION CO.
MASSAC CO.
POPE CO.
HARDIN CO.
Coal Measure Shales
Millstone Grit
Limestone and shale containing beds of coal and iron ore
Millstone Grit
Coal Measures
Devonian
Silurian
Ordovician
Cambrian

RECONNOISSANCE OF A BASE LINE

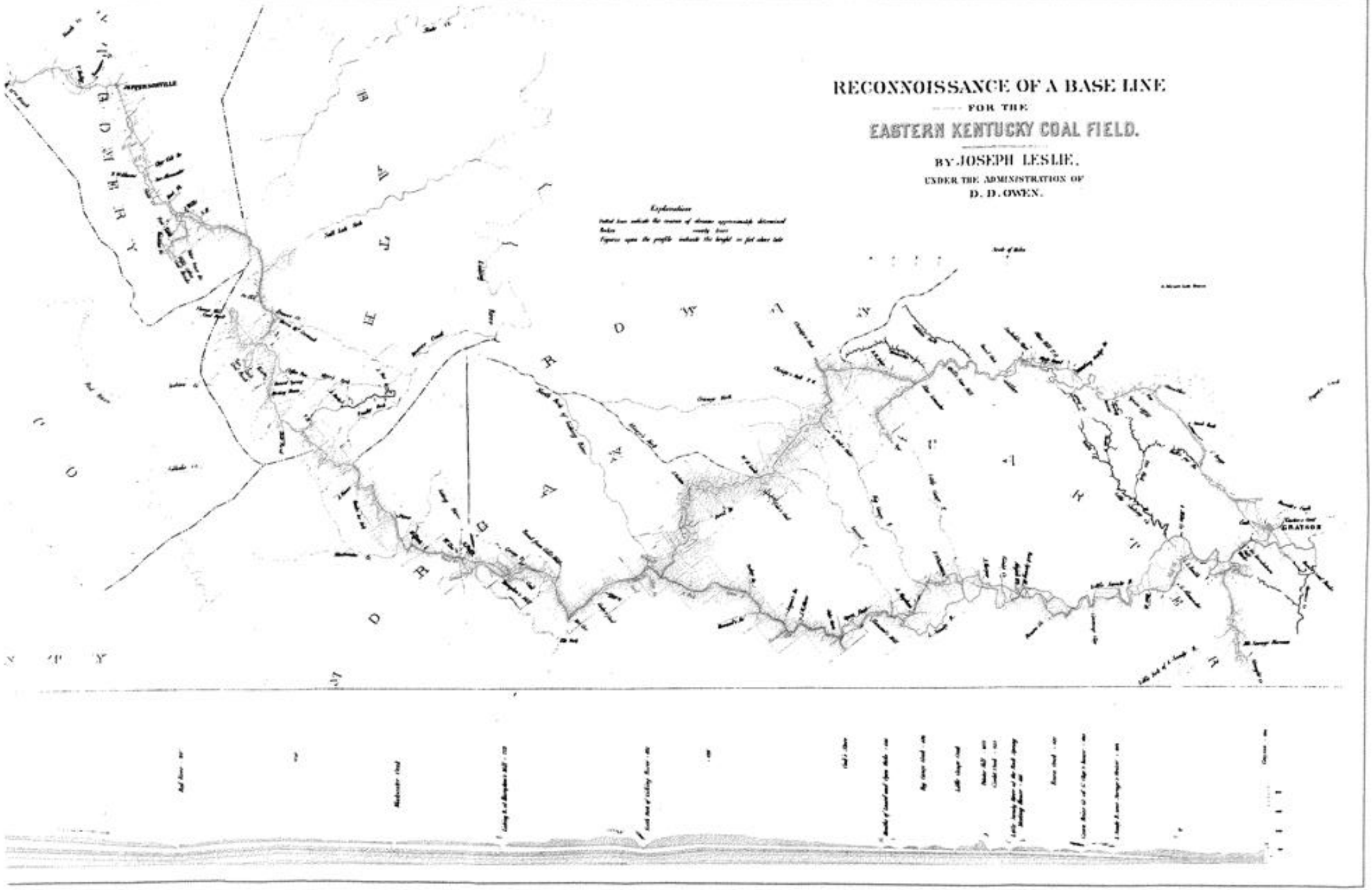
FOR THE

EASTERN KENTUCKY COAL FIELD.

BY JOSEPH LESLIE,

UNDER THE ADMINISTRATION OF

D. D. OWEN.



RECONNOISSANCE OF A BASE LINE

FOR THE

EASTERN KENTUCKY COAL FIELD.

To Accompany Part VIII, Vol. III,

SECOND SERIES,

GEOLOGICAL SURVEY OF KENTUCKY.

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