

III. GEOLOGY

Little information is available concerning the geology of Sullivan County. In fact, little descriptive geologic work has been done in this area since before the turn of the century, and consequently, geologic quadrangle maps and published geological reports and studies are minimal. The information presented here is based on the study of existing publications, original deep mine maps, available drilling records, as well as air photographic interpretation, on site field investigations, and discussions with knowledgeable sources.

The area of primary concern for this geological discussion and the area of appreciable mining activity and coal resources is being defined as the Bernice Basin. The Bernice Basin is an isolated basin, about five miles long by one mile wide, which has been separated by erosion from the anthracite coal basins to the east and the bituminous coal fields to the west. The coals, which have been mined for more than a century, are classified as semi-anthracite. For convenient reference in this report, the Basin has been subdivided as shown on Plate I and the subdivision have been named as follows from west to east: Lewis, Gutten, Bliss, Connell, and Northern Anthracite. Since these are somewhat arbitrary designations it is important to define the boundaries of each of these areas. The major axis of the basin trends generally from west to east and thus the boundaries listed are the westerly and easterly limits.

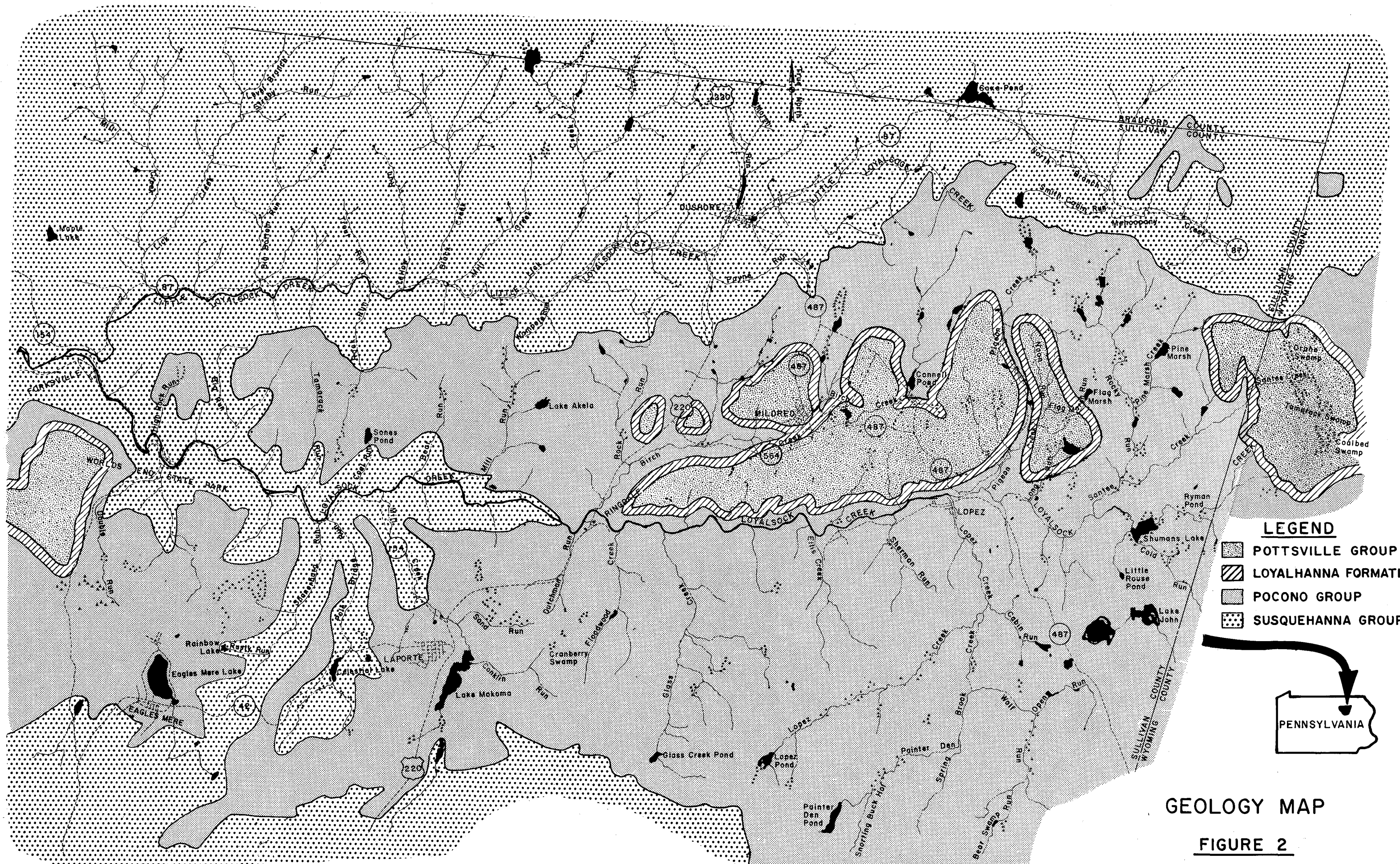
	<u>Westerly Boundary</u>	<u>Easterly Boundary</u>
Lewis	U.S. Route No. 220	Westerly most fault
Gutten	Westerly most fault	Middle fault
Bliss	Middle fault	Bernice fault
Connell	Bernice fault	State Route No. 487
Northern Anthracite	State Route No. 487	Pigeon Creek Tributary

A. STRATIGRAPHY

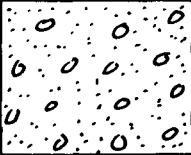
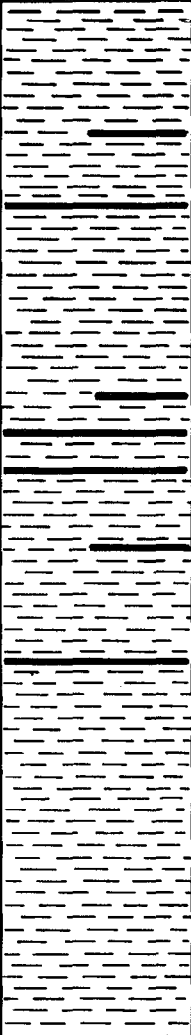
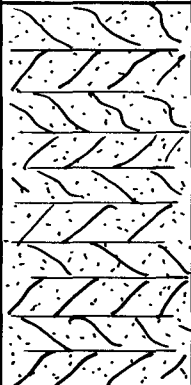
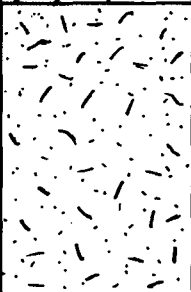
The oldest rocks exposed in the vicinity of the Bernice Basin are in the Loyalsock Creek valley on the south side of the Basin, where the uppermost fifteen feet or more of the Pocono Formation is exposed. The Pocono here is a buff colored, poorly sorted, fine, medium and coarse grained sandstone, cross-bedded, with no calcareous cement. The Pocono is overlain by the Loyalhanna Sandstone, which is ninety-eight feet thick. The Loyalhanna is a very light gray, fine grained sandstone with calcareous cement, and some calcareous nodules. Overlying the Loyalhanna Sandstone are more than two hundred feet of interbedded sandstone, conglomerate, shale, clay and coal of the Pottsville Formation. Because of the isolation of the Basin, it is not possible to make any correlation of the coals, or their enclosing rocks with either the standard section in the anthracite basins, or the well established sequence of the Allegheny Plateau to the west. It is believed, however, that all of the rocks and coals are in the Pottsville Formation (Birx, 1974). All other areas which may be defined within the limits of the study area belong to the Susquehanna Group.

Figure No. 2 shows the geologic formations that comprise the area, from information as presented in the Pennsylvania Geological Survey, Fourth Series, Geologic Map of Pennsylvania.

Figure No. 3 is a composite column for the region based in part on published data from Lycoming County and an observations in the basin vicinity.



GENERALIZED GEOLOGIC COLUMN — BERNICE BASIN

System	Formation	Approximate Thickness	Section	Character of Member Coals	General Character of Formation
PENNSYLVANIAN	GLACIAL DRIFT	0 - 40'		No Coals	Ground Moraine, Mostly Boulder Clay, Some Permiable Sandy Material
	POTTSVILLE	270' ±		D' Very Local, Thin D Variable C' Very Local 1/2'-3' Tk C Continuous 2'-5' Tk B Most Continuous 2 1/2'-6' Thick 2-4 Benches A Thin Locally Present A Variable	Interbedded Sandstone, Conglomerate, Shale, Clay and Coal
MISSISSIPPIAN	LOYALHANNA SANDSTONE	100'		No Coals	Light Gray, Fine Grained Sandstone, With Calcareous Cement, Some Calcareous Modules
	POCONO	Only Upper Portion Shown		No Coals	Buff Colored Poorly Sorted, Fine Medium and Coarse Grained Sandstone, Cross Bedded, No Calcareous Cement

SCALE: 1" = 50'

B. COAL BED CORRELATIONS

Coal mine operators in the Bernice Basin recognize four coals, which they designate A (lowest), B, C, and D. The drill records and mine maps available for this study have made it possible to make a somewhat detailed interpretation, which is shown on Figure No. 4. The location of this geologic section is shown on the composite map, Plate No. I.

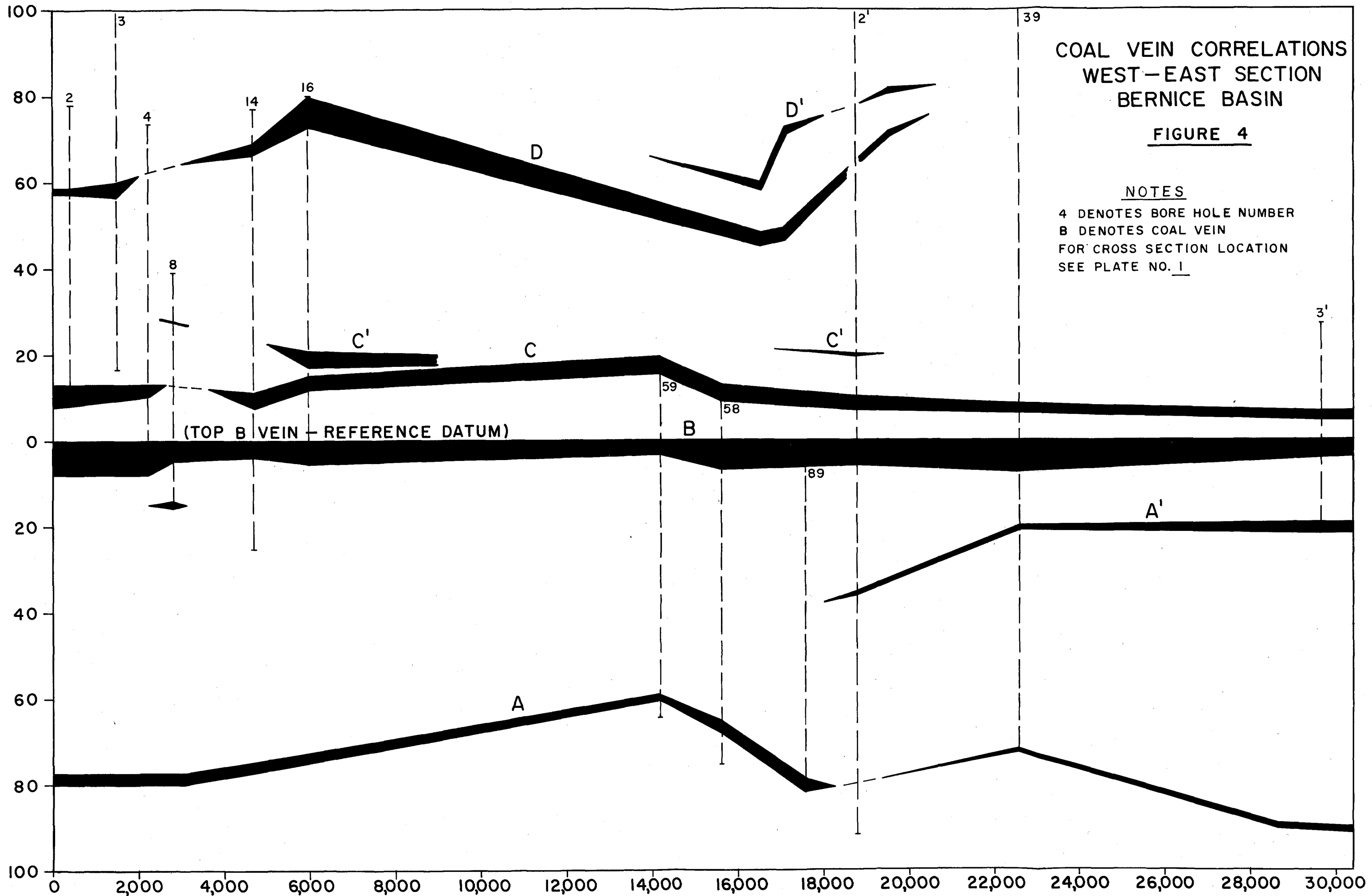
The B coal is the most extensively mined and apparently the most continuous, although variations in thickness and in number of partings do occur. In the Lewis and Gutten areas, the B seam varies in total thickness from three to six feet, occurring in two benches separated by from one to one and one-half feet of binder. In the Connell area, the B coal has as many as four benches and contains from two feet four inches to six feet of recoverable coal. In the Northern Anthracite area at the eastern end of the basin, the benches appear to be absent and up to six feet of recoverable coal is present. Information in the Bliss area is lacking even though mining did take place and presumably a considerable thickness is present.

Below the B, there are at least two thin coal seams, both called the A by miners, and designated the A and A' on Figure 4 of this report. The A coal lies from fifty to seventy feet below the B and has been reported locally present throughout the basin. It is nowhere sufficiently continuous for extensive mining. The A' coal is present from twenty to thirty feet below the top of the B in the Connell and Northern Anthracite areas. Throughout the Connell Mine area where both the B and C coals were mined underground, the C coal lies from ten to fifteen feet above the B; in a few places the interval may be as much as twenty to twenty-five feet and as little as six feet. To the west, in the Lewis and Gutten areas, the top of the C, where present, varies from nine to twelve feet above the top of the B.

In the Lewis area, the C may have been mined with the B in some of the strip mines. It is even possible that on the south side only the C was removed by stripping. The extent or existence of any deep mines in this area has not been clearly documented. Strip mines in the Gutten area probably removed the C with the B coal.

The C coal is present in the Northern Anthracite area of the basin where it lies as little as six feet above the B coal and has an average thickness of two feet. It appears that the C coal was not mined underground here because it is too thin or is too close to the B seam. In the process of stripping in this area, both its B and C coals are removed in the same operation.

A discontinuous coal, the C', varying from one-half foot to three feet thick, is present in the Lewis and Gutten parts of the basin and lies from four to twelve feet above the C.



There are at least two coals above the C and C' seams which have been called the D, one which is fifty-three to sixty-five feet above the B in the Connell section. In the Connell area, there is a thin (one foot-two feet) coal ten to twenty feet above the D which is labeled D'.

One drill hole in the Northern Anthracite area indicated the presence of a coal about thirty feet above the top of the B, too high to be the C and too low to be the D. It is apparently very local as it is not reported in any other available drill records.

The beds enclosing the coals are extremely variable in their lithology, and it has not been possible to correlate any units for any distance within the basin--shale, sandstone conglomerate and fire clay are all present. Plant fossils are abundant in the shales and sandstones. Pyrite is an accessory mineral in the sandstones and shales as well as in the coals themselves. Because of the limited exposures examined, no conclusions were drawn concerning the abundance or distribution of the pyrite.

C. SURFICIAL DEPOSITS

The Bernice Basin lies entirely within the limits of the Wisconsin Ice sheet and there are abundant deposits of glacial origin in the area. Most of the upland area of the Basin is covered by ground moraine a few feet to several tens of feet thick. This moraine is mostly boulder clay, but in places may contain more permeable sandy material. Depressions in the ground moraine are filled with peat bogs, the largest of which are around the eastern end of the basin. Because the thickness of the surficial deposits is not known, the outcrop of the coal on Plate No. I is generally shown where the structure contours intersect the present topographic surface. In many areas the coal never did crop out, but was terminated in the subsurface by the glacial till. This is indicated on the old mine maps by notations that headings ended in "clay" or "mud".

D. STRUCTURE

The structure of the Bernice Basin is illustrated by Plate I which shows the structure contours on the top of the "B" coal. This map is based on the available drill records and mine maps. Detailed control was available only in the Connell and Northern Anthracite areas. Almost no subsurface information was available in the Bliss section. However, the general picture of the basin has been derived.

The Bernice Basin is a doubly plunging syncline striking about N.85°E. The dips in the basin are generally very low, particularly when

contrasted with the dips of beds in the other anthracite coal fields of Pennsylvania. The steepest dips, about 7° , are at the eastern end, elsewhere the dip seldom exceeds 2° or 3° .

In detail, the shape of the basin is very irregular, and the basin is broken into four parts by cross faults. The synclinal axis has a different trend in each one of the segments. There is some indication that the faulting and at least part of the folding was simultaneous with deposition of the sediments.

In the Lewis area, the structural relief (depth of the syncline) is less than fifty feet. The axis of the fold trends about $N.80^{\circ}E$. The lowest point on the B coal in this area has an elevation of about 1855 feet.

Data on the Gutten area is limited, and the structure appears to be complex. There appear to be two synclinal axes here, separated by a low anticline. The axes of these folds trend about $N.35^{\circ}E$. The deepest point on the B coal in this area is in the easternmost of the two small synclines, and is below 1860 feet. On the south side of the basin, the B coal reaches elevations higher than 1900 feet, while on the north side the outcrop is as low as 1870 feet at the Gutten Mine adit.

The Gutten area is bounded on the east by a fault, also upthrown on the east. The offset of the B coal is about ten feet near the axis of the basin. The strike of this fault, based on topographic expression is $N.10^{\circ}E$.

In the Bliss area, where geologic control is most limited, the axis of the syncline bends from $N.55^{\circ}W$ to $N.50^{\circ}E$. The axis has almost no plunge in this segment and has an elevation of about 1855 feet. The area is limited on the east by the best documented fault in the basin, here named the Bernice Fault. This Fault, which was recognized by the miners, is downthrown on the east side. The apparent offset on the B coal is twenty to fifty feet. The strike of the fault is $N.25^{\circ}W$.

In the Connell area, immediately east of the Bernice Fault the axis of the syncline strikes $N.55^{\circ}E$., and plunges to the northeast. In the middle of the Connell area, the axis loses its identity, and there are several isolated low points, all below 1800 feet on the B coal.

The C vein drainage tunnel intersects the C coal at one of these low points, where the C coal has an elevation of below 1840 feet. This tunnel must also pass through the B Coal, in an area of old mine workings. The B drainage tunnel intersects the B coal in an isolated low area, the lowest point on the B coal in the entire basin, at about 1790 feet elevation.

In the Northern Anthracite area, the basin is terminated by sudden upturn of the beds. Some of this upturn is beyond the limits of the underground workings where control is limited to a few drill holes, and some faulting may be present. The preferred interpretation, however, is a sharp, north-south trending anticline as shown on the contour map.

In this area, the B coal apparently terminates against glacial drift in the valley of the northern tributary to Pigeon Creek, and under the swamp in its headwaters.