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REPORT OF INVESTIGATIONS NO. 21

THE LOWER KITTANNING
NO. 5 COAL BED IN OHIO

BY
RUSSELL A. BRANT

Reprinted 1965

COLUMBUS
1954

STATE OF OHIO

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ABSTRACT

The Lower Kittanning coal bed occurs near the middle of the Allegheny rocks of the Pennsylvanian System. The total area underlain by this coal in Ohio is approximately 9,000 square miles, but the area of minable coal considered in this report is about 4,242 square miles. The remainder is either less than 14 inches thick or lies under very deep cover where information is lacking or too meager to make an appraisal.

The original reserve of Lower Kittanning coal greater than 14 inches in thickness is estimated to be nearly 10 billion tons.

Of this amount about 3 billion tons is thought to be in the 28 inches or greater category. Under present mining conditions probably half this amount or 1-1/2 billion tons would be recoverable. The amount mined and lost in mining is not known; however, it may be assumed that between 100 million and 200 million tons of this coal has been mined, and probably a total of 400 million tons mined or lost in mining. If this assumption be used, it would then appear that approximately one billion tons of Lower Kittanning coal at a thickness greater than 28 inches is now available.

Chapter 1

INTRODUCTION

This is the second of a series of reports on Ohio's coal reserves. An earlier report on the Meigs Creek coal was issued in 1952.* It is planned to study the coal beds one at a time and to release the information as soon as possible after completion of each individual summary.

Because knowledge of the coal resources of this State is important to coal operators as well as those who are interested in the total coal reserves of the Nation, this report is presented for the help and advancement of both.

The basis of this report is the original coal reserves of the Lower Kittanning coal. It is recognized that detailed studies of remaining and recoverable reserves are important considerations; however, it is not possible to include such figures with reasonable accuracy at this time. Some estimates of these quantities, based on production statistics, are entered in the report.

PURPOSE

The object of this report is to summarize information about the Lower Kittanning coal and present the results of calculations of the coal reserves, giving the figures by the smallest geographic unit possible. The reserve listings, therefore, are by township and county and are totaled for the entire state. Additional information is given in the county summaries which describe the thickness characteristics and quality of the coal under each appropriate county heading.

*The Meigs Creek No. 9 Coal Bed in Ohio: Division Geol. Survey, Rept. Inv. No. 17, 1952.

This report may serve as a guide to coal operators and owners of coal lands as an aid in prospecting for attractive areas of coal. Information contained herein is based on county reports and the many measured sections in the files of the Ohio Division of Geological Survey and thus represents a summary of all previously known work. Because it is a summary the reader will be referred to the Bibliography for the more complete references on specific areas.

ACKNOWLEDGMENTS

The author wishes to acknowledge the contributions of the following persons who actively aided in the preparation of this report: William H. Smith, Head of the Coal Section of the Division of Geological Survey, who gave valuable assistance and helpful suggestions during the progress of estimation and the preparation of maps; Marian S. Klein, who arranged many of the major tables and suggested ways of handling and presenting data; Doris Runkle, who was responsible for checking measured areas; student assistants who performed much of the detailed work, Lawrence Bronsdon in particular having contributed much to the preparation of the base and outcrop maps for the estimate as well as the line illustrations contained in this report; and Elizabeth Brant who assisted in the editing of the report.

GEOLOGY OF THE LOWER KITTANNING COAL AND ADJACENT ROCKS

The total area in Ohio which is possibly underlain by the Lower Kittanning coal bed is about 9,000 square miles. The total extent of minable coal 14" or more in thickness is not known because of insufficient data in the area of deep cover, but the area of coal greater than 14" in thickness included in this estimate amounts to 4,242 square miles. The outcrop of this coal bed may be traced more or less continuously from the Mahoning-Columbiana County area, where the bed enters the State from Pennsylvania, westward through Stark County, and thence southward through Lawrence County. In much of the area in the northern region the outcrop is buried by glacial drift. Here and there in other parts of the State the bed or its horizon is too thin or obscure to identify positively, or it has been cut out or "replaced" by sandstone. Generally speaking, however, the outcrop of this bed may be traced with continuity in Ohio (Fig. 1).

PHYSIOGRAPHY

The area underlain by the Lower Kittanning coal bed is included in the Appalachian Plateau region. The northern part is the glaciated or southern New York physiographic section, and the southern and larger part of the field is in the Kanawha section (Fenneman, 1938, p. 283, pl. 2). The boundary between the glaciated and nonglaciated portions of Ohio is traced east through central Holmes County, northeast through southern Stark and the border region of Stark and Tuscarawas Counties, thence eastward through Columbiana County (White, 1947).

Both the glaciated and nonglaciated areas have essentially the same general elevation. The striking difference between the two areas is in the characteristics of the development of slopes. Whereas in the north a swell and sag or till plain topography exhibits very gentle slopes as a rule, the area to the south shows development of mature valleys which possess steep walls. The glaciated portion shows few outcrops of bedrock because of the planing action of the ice which smoothed off many of the slopes and because of the various till deposits left by the attrition of the glacier. As a result, prospecting the glaciated portion for coal or other minerals is done by test drilling and analyzing cores; whereas to the south, in the nonglaciated region, much prospecting can be done from surface observation of outcrop. The master drainage for the entire Lower Kittanning area is the Ohio River, and the important tributaries are the Mahoning, the Muskingum, and the Hocking Rivers, and Raccoon and Symmes Creeks.

STRUCTURAL FEATURES

The Lower Kittanning coal lies in the Appalachian coal region of the eastern coal province. The coals in Ohio more specifically lie on the northeastern flanks of the Appalachian structural basin, which also underlies parts of Pennsylvania, Maryland, West Virginia, and Kentucky. The regional dip of the coal beds in Ohio is to the south and east although minor synclines and anticlines are present, resulting in local reversals. In Mahoning and Columbiana Counties and adjacent areas the dip is principally to the south with a slight component

of easterly dip. In this area the regional structure is very gentle, and the components of the dip are only about 1.5 feet per mile east and 4.8 feet per mile south (Stout and Lamborn, 1924, pp. 49-50). Southward, however, the dip becomes more pronounced, and in Coshocton County the dip, as estimated on the Putnam Hill limestone, is about 40 feet per mile to the east southeast. Here there are many reversals with the development of elongated synclines and anticlines as well as structural terraces (Lamborn, 1948). In Vinton County, Stout recorded an average dip of 27 feet per mile to the east and about 10 feet per mile to the south with a resultant dip of 29 feet per mile to the east southeast. In connection with mining plans where dip of the rocks is a consideration in drainage, large scale structure maps should be drawn for the specific area under study.

Major structures that lie in the eastern part of the State which affect the Lower Kittanning coal area are the Parkersburg-Lorain syncline and the complementary Cambridge anticline. These structures are secondary to the regional aspects of the Appalachian basin. Generally speaking, the rocks dip toward the axis of the Appalachian basin which trends in a northeast direction in northeastern West Virginia and southeastern Pennsylvania.

Unusual structures have been reported from time to time and have been attributed to folding, thrust, or normal faulting phenomena. These structures appear, as seen in cross section, as very contorted, folded, and faulted rocks occupying a relatively narrow channel which apparently cut out rocks that formerly occupied the site.

Newberry (1878, p. 65) gives a description of one such structure in the vicinity of Mineral Point (Mineral City), and also in the vicinity of Zoar. Orton (1884, p. 263) described the Mineral Point "disturbance," and attributed the phenomena to ". . . considerable disturbance near the end of the Lower Coal Measures period . . ." A more modern theory for these and other similarly disturbed areas is described by Gray and Arnold (1952, pp. 261-266). Their detailed examination of this and a review of similarly reported structures lead to the belief that the "structures" represent the slumping of valley sides following a brief period of intensive erosion. These features occur at about the same stratigraphic horizon in other places in the northern part of the basin and are probably related to a general uplift which lasted a short time during the Mid-Upper Allegheny Epoch. This phenomenon may be of concern in developing underground mines, but as it now appears, the area affected is apparently not great.

STRATIGRAPHIC ASPECTS

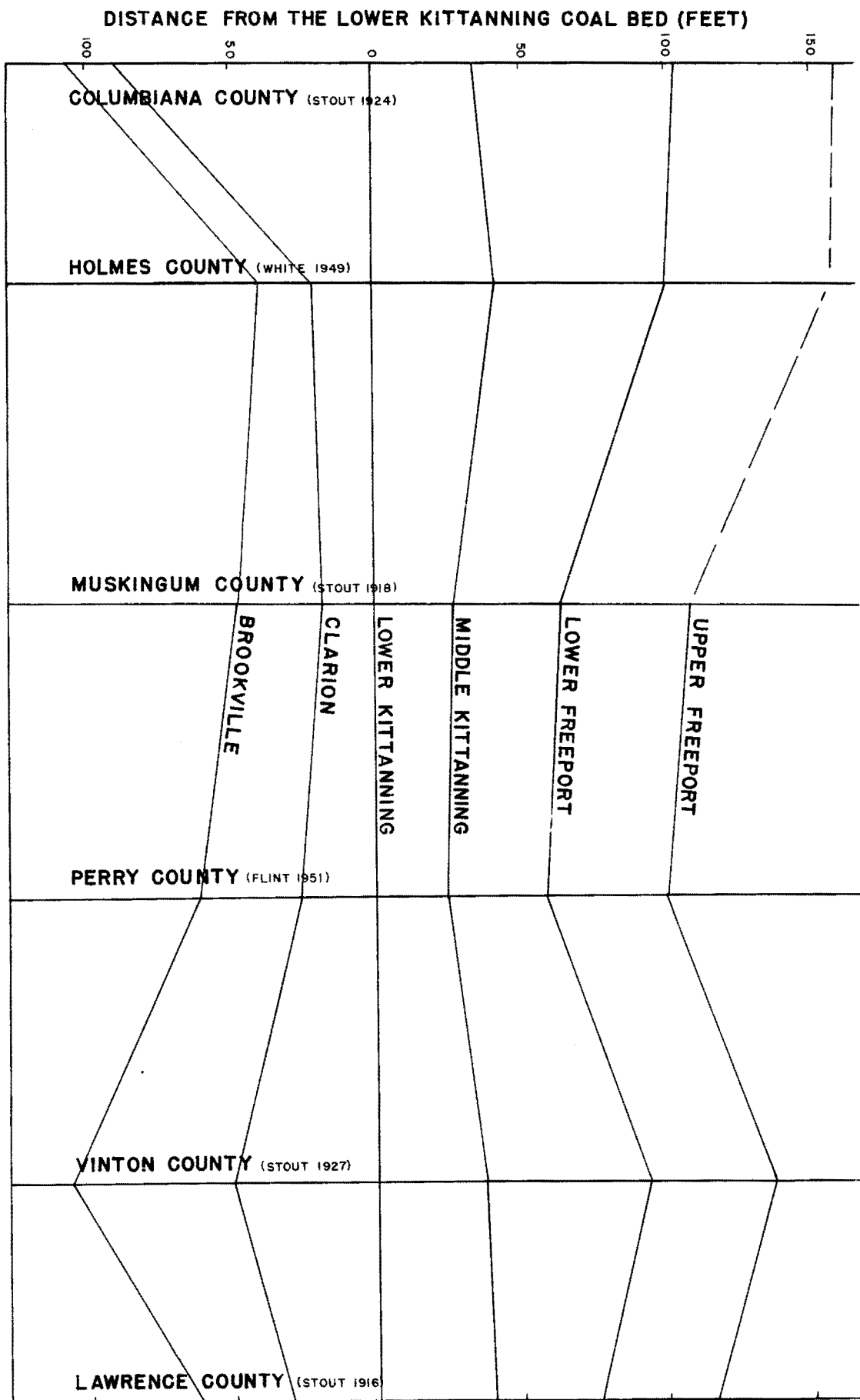
The Lower Kittanning coal bed occurs about midway in the Allegheny formation. This coal was first described by Rogers in Pennsylvania (1858, p. 491), where it was and still is mined in Armstrong County. The coal and its underlying clay are probably the most continuous and well-known members in the Allegheny formation. The Allegheny rocks apparently thin from the north to the central part of the area of occurrence and then thicken somewhat to the southward. This relationship is shown in Figure 2.

In most areas of the Lower Kittanning coal bed the description of "bright, blocky, common-banded coal" applies. However, in the northern portion of the area a canneloid coal is developed. In Mahoning County Lamborn (1942, pp. 28-30) states: "Over sizable areas in Springfield and Beaver Townships the cannel occurs as a block 5 inches to 8 inches thick at the top of the seam." Canneloid coal has been reported from other areas to the west, but it appears to be only local in its development. White (1949, p. 214) reports that in Holmes County small amounts of cannel coal are interbedded with the common-banded coal. Otherwise the coal is usually ordinary bituminous, blocky, and common-banded.

Usually a plastic clay is found immediately beneath the Lower Kittanning coal. As a rule this clay is thick, ranging up to 15 feet or more, and only rarely is it absent in a Kittanning stratigraphic section. The clay is usually of plastic nature, but in some areas, such as Mineral City in Tuscarawas County, the lower part of the bed is flint clay. This lower clay is believed by Stout and others (1931, pp. 11-12) to include possibly the Lawrence clay in southern

LOWER KITTANNING COAL

FIG. 2. ALLEGHENY FORMATION SHOWING INTERVALS OF PRINCIPAL COAL BEDS.



Ohio. In many areas only the Lawrence coal, which is generally thin, separates the two; but in other areas the shale or sandstone is present (Stout and others, 1931, pp. 22-23, 26).

The relationships of the strata above and below the coal in several locations in the field are shown in the following stratigraphic sections.

A measured geologic section from Columbiana County, Madison Township, Section 12 (Stout and Lamborn, 1924, p. 119) including the Lower Kittanning coal is found below:

	Ft.	In.
Shale	10	-
Ore, nodular	-	3
Shale, dark, with some ore nodules	7	6
Shale, dark, bony	1	2
Coal	2	4
Clay, light, part siliceous	3	6
Covered interval, 2 feet to water level		

} Hamden {

} Lower Kittanning {

In Holmes County, Walnut and Paint Townships, a section recorded by G. W. White (1949, p. 288-289) shows the following:

	Ft.	In.
Sandstone	10	-
Coal, <u>Middle Kittanning</u>	-	6
Shale, siliceous to clay-like	31	-
Shale, dark, carbonaceous, fossiliferous	2	-
Shale, coaly	-	2
Coal, good	1	10
Pyrite, not continuous	-	$\frac{1}{2}$
Coal, good	-	9
Pyrite	-	$\frac{3}{4}$
Clay, dark, carbonaceous, sandy, hard	-	4
Clay, sandy, hard, carbonaceous, and covered	20	-
Clay shale, slightly ferruginous	20	-
Limestone, gray, hard, dense, fossiliferous, <u>Putnam Hill</u> , Elev. 1,155	2	10
Clay shale, gray	-	2
Coal, shaly	-	$\frac{1}{2}$
Shale, clay, dark gray	-	$1\frac{1}{2}$
Coal, shaly	-	2
Clay, gray, plastic, siliceous	4	-
Sandstone, light, shaly	6	-
Shale, sandy	20	-

} Lower Kittanning {

A section measured in Muskingum County, Washington Township, is recorded (Stout, 1918, p. 168) as follows:

	Ft.	In.
Shale, calcareous, fossiliferous	4	-
Limestone	-	4
Shale, dark, calcareous	1	1
Coal, bony	-	4
Coal, good	1	7
Shale	-	$\frac{1}{4}$
Coal, good	2	7
Clay	2	-

} Hamden {

} Lower Kittanning {

Commonly the rock section above the Lower Kittanning coal is a shale sequence, the Hamden member, which may be calcareous or ferruginous. Above this the Oak Hill member may be present and represents the underclay of Strasburg coal. The Strasburg coal is developed in Tuscarawas County and its environs, but in other places it is usually manifest only as

a thin coal or streak. In the absence of coal the horizon may frequently be determined by the superposition of the Red Kidney ore member resting upon the Oak Hill clay.

It is noted by examination of the interval chart (Fig. 2) that there is no large difference in interval to the Middle Kittanning, at least for the average of the counties cited. This, together with the predominant occurrence of fine-grained clastic sediment, suggest rather quiet environmental conditions. In some areas it should be noted that locally rapid changes of the interval take place. Examples include parts of Perry County where the Middle Kittanning coal is separated by only a foot of shale from the Lower Kittanning coal. Other places in Perry County are cited by Bowen (1947), particularly Clayton Township where this interval ranges from 5 to 25 feet. The sandstone that enters the section from above the Lower Kittanning coal, possibly the sand unit of the Strasburg cycle, suggests the small degree of uplift in the time of the somewhat younger sediments.

The occurrence of sandstone appears somewhat sporadic and unrelated. Its positive identification is not always clear in the sections observed. It would seem that the sandstone usually takes on an unconformable aspect and is probably related to one of the overlying cyclothem. Frequently, but not always, the occurrence of the sandstone is found to be at the expense of the coal and other members immediately below the coal bed as well as those overlying.

A section measured by Stout and Lamborn (1924, p. 113) in Columbiana County, St. Clair Township, Section 23, revealed the following:

	Ft.	In.
Sandstone	10	-
Shale	1	-
Coal	2	-
Clay	-	5
Coal	-	5

} Lower Kittanning {

In the same section (23) the following rocks were exposed:

	Ft.	In.
Sandstone and shale	10	-
Coal and shale	-	2
Clay	-	$\frac{1}{2}$
Coal, somewhat bony	-	$7\frac{1}{2}$
Coal, good	1	$3\frac{1}{2}$
Clay	-	$3\frac{1}{2}$
Coal	-	5

} Lower Kittanning {

In Section 24 of Liverpool Township of Columbiana County Stout and Lamborn (1924, p. 115) found the following:

	Ft.	In.
Sandstone, massive	46	-
Coal, bony, irregular	-	2
Coal, good	1	11
Clay, gray, plastic	4	-

} Lower Kittanning {

At other places in Columbiana County the sandstone above the coal attains a thickness of as great as 124 feet.

The occurrence of sandstone associated with the coal is important for two reasons: (1) where the sandstone appears it is possible that the coal bed may be cut out to a somewhat unpredictable extent; (2) sandstone may lie on or very near the top of the coal bed. By providing more suitable roof conditions for underground mining, the sandstone may represent a very important factor in recovery of the coal.

APPROACH TO THIS RESERVE STUDY

DEFINITIONS AND PREMISES

Methods and definitions used in coal resources studies are rather well standardized among the various states and with the U. S. Geological Survey and the U. S. Bureau of Mines. However, examination of the literature does reveal that there are differences of opinion regarding the details of calculating and reporting reserves of coal. In this report the practice has followed that of the Illinois Geological Survey (Cady, 1952, pp. 14-20). However, as will be seen, coal thickness of 14 to 28 inches is given consideration here as a future reserve. It is probable that it will be many years until a decision is made as to whether the very deep thicker coals will be mined before the shallower thin coals. Divergence of the definitions from the practice of the U. S. Geological Survey is only in degree. Where the U. S. Geological Survey (Averitt, 1949, pp. 224-228) considers all coal beyond two miles from established data as inferred, this report, following the Illinois procedure, considers an additional category of reliability. Beyond four miles from a point of measurement the coal estimated is considered to be "weakly inferred" and from two to four miles, "strongly inferred." Thickness categories of the estimated coal are as follows: 14 to 28 inches, 28 to 42 inches, 42 inches and over.

RELIABILITY CATEGORIES

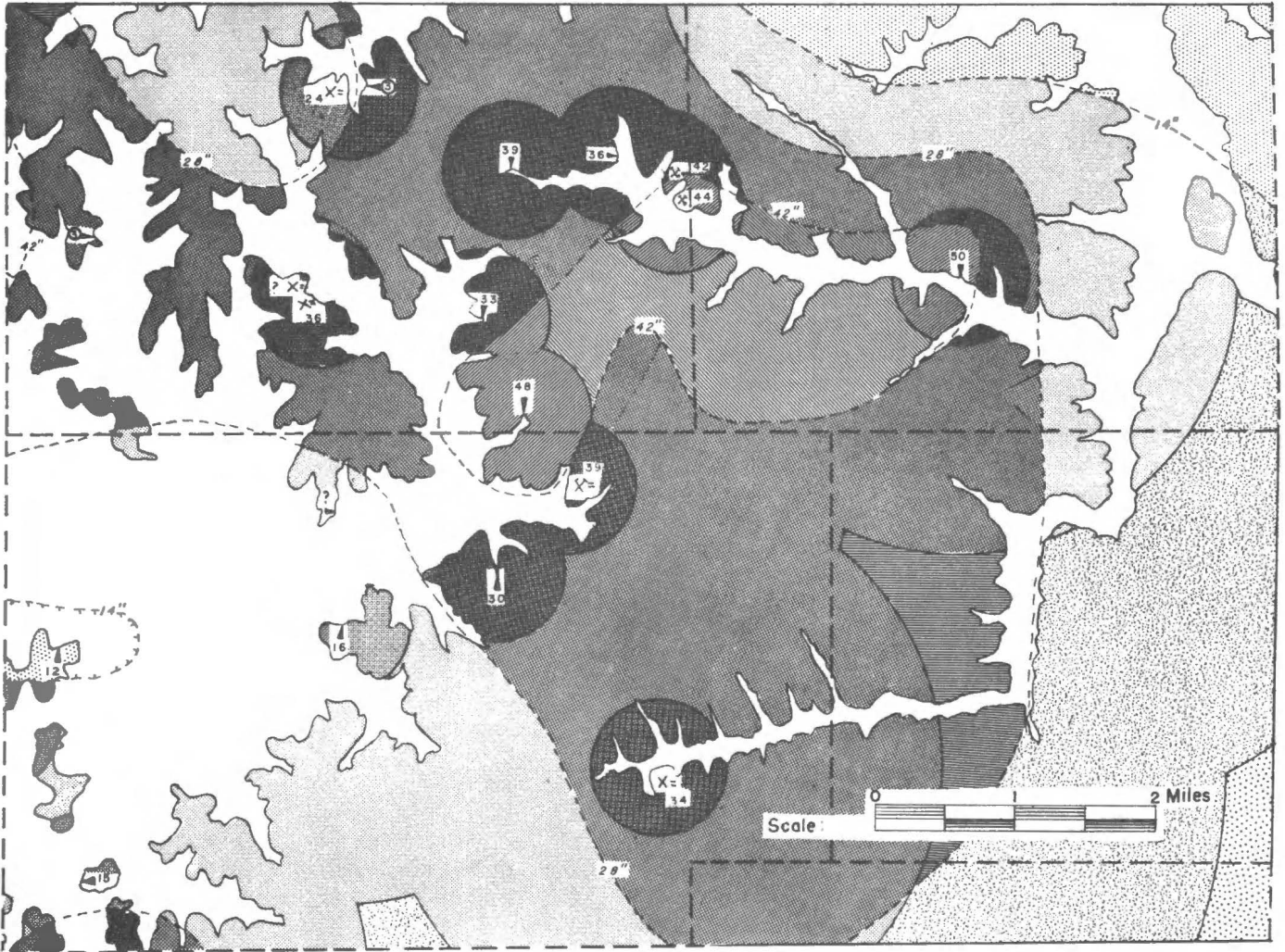
Reliability categories are used in connection with coal estimates to show the relative certainty of the estimate. The various categories are based on the distance from a point of definitely known thickness of coal. The farther away from the point of known thickness the less certain is the estimation of the quantity of coal.

Points of known thickness of coal are the starting points for a series of concentric arcs spaced at $\frac{1}{2}$ mile, 2 miles, and 4 miles. The terms that refer to the coal surrounded by the above arcs are proven, probable, and strongly inferred. Weakly inferred coal lies in the area outside the 4-mile arc. All are on the area of coal that is considered to have a thickness of 14 inches or greater. (See Fig. 3.) The specific definitions follow. (See Averitt, 1949, pp. 225-226; Cady, 1952, pp. 16-20.)

PROVEN RESERVES

Those reserves which lie within one-half mile of definite information are proved, and the estimate is considered to be within 20% of the true tonnage. Points of definite information are measurements from outcrops, from mines, and from drill cores. It is assumed that a zone of coal around any mine for a distance of one-half mile constitutes a proven area of coal. Similarly, a one-half-mile circle around any core test constitutes a proven area of coal. The term "proven" as used in this report is equivalent to the term "measured" of the U. S. Geological Survey and the U. S. Bureau of Mines.

FIGURE 3. SAMPLE WORK MAP



PROBABLE RESERVES

This class of reserve lies outside the proven area and extends to two miles from the point of definite information. Probable reserves occupy an area extending from one-half mile from the point of actual measurement to two miles from that point; hence, it is one and one-half miles wide and extends beyond the boundary of the proven coal. This term is equivalent to the term "indicated" used by the U. S. Geological Survey and the U. S. Bureau of Mines.

STRONGLY INFERRED RESERVES

Strongly inferred reserves are estimated in an area beyond the two-mile limit for probable reserves and extend to four miles from the point of definitely established data. Coal within this definition lies in a band two miles wide, extending beyond the probable area. The degree of certainty of actual tonnage in this area is naturally less than that of either the proven or probable categories. The "inferred reserves" used by the U. S. Geological Survey and the U. S. Bureau of Mines include both the strongly and weakly inferred reserve categories of this report.

WEAKLY INFERRED RESERVES

Coal estimated to lie beyond the four-mile limit of strongly inferred reserves constitutes weakly inferred reserves. It rarely happens that sufficiently well-spaced data are available to insure adequate estimations; yet the general aspects of the geology may indicate that the coal is present at minable thickness. Therefore, because the reliability and hence the confidence in the results are diminished, a fourth category of "weakly inferred reserves" is established.

OVERBURDEN

Overburden is the material from the surface of the ground down to the coal bed and is usually reported in steps of 1,000 feet as 0-1,000 feet, 1,000-2,000 feet, and 2,000-3,000 feet in regional resources studies. However, the estimated coal of the Lower Kittanning bed does not lie at a depth greater than 1,000 feet; overburden figures are, therefore, not included in this report.

METHODS USED

IN MAKING THIS ESTIMATE

The preceding general ideas are embodied in the estimate of the Lower Kittanning coal bed reserves. At the outset a series of work maps of 1° longitude by $\frac{1}{2}$ ° latitude were drawn from U. S. topographic maps at a scale of 1:62,500. On these maps were traced all of the political subdivision boundaries: sections, townships, counties, and larger cities. (See pages 55 and 56 for index of work maps, O'Neill areas.)

The outcrop was traced, and all of the localities and file numbers of the data were accurately plotted. A copy of the map was then made for a work map. Thickness information was placed on the map. All partings exceeding $\frac{3}{8}$ inch in thickness were excluded from the measurements of thickness data. After all data were properly plotted at appropriate locations, lines (isopachous lines) were drawn to connect points of equal thickness. The line values used were the 14", 28", 42", and 54". The average thickness for the block of coal between two isopachous lines was taken as the average between the two lines. Thus, the coal between the 14" and 28" thickness lines averages 21"; that between 28" and 42" averages 35"; and that between the 42" and 54" averages 48".

After the thickness lines were established, arcs were made around each point of definite data to determine the different categories of reliability. An arc, with a $\frac{1}{2}$ -mile radius around the point and on the coal, defines the proven coal; an arc with a 2-mile radius limits the probable coal; and the arc with the 4-mile radius limits the strongly inferred coal. The 14"-thickness line forms the boundary or outer limit of weakly inferred coal except where the outcrop forms a natural limit. Certain data could not be used except to confirm, to a small extent, deductions made from other points. Such data include "reported" thickness of coal (thus not seen, and not measured), coal blossom (not definite, actual thickness of bed questionable), and mines not reporting thickness. These could only be used in a general way in conjunction with nearby positive data.

Figure 3 is an actual sample map of the Lower Kittanning coal preparation described to this point. This is, however, only a very small part of one of the work maps (pattern is added).

METHOD OF CALCULATION

In order to calculate the amount of coal contained in a given bed in a given area it is necessary to find two factors, namely the volume and the density of the coal. The volume is determined by measuring the area and multiplying the result by the average thickness; the density is determined from the specific gravity and is equivalent to 96,000 tons per square mile inch.

The volume in square mile inches is multiplied by the density to determine the tons for a given area. Eighteen hundred (1,800) tons per acre foot (one acre in area one foot thick) is frequently used as a convenient density factor in estimating small areas.

In calculation of the estimate, the areas of the different categories and thicknesses of the coal were measured with a planimeter and the figure placed on a special form for tabulating the data. After completion of the tabulation of the measurements by township, the data were then punched onto business machine cards. These punched cards were then used in electronic business machines to calculate, record, and summarize the results. Summaries of the calculations are found in Tables 1 and 31 and under the individual county descriptions.

ESTIMATE OF THE RESERVES

The total of original reserves of the Lower Kittanning coal bed in Ohio is estimated to be 9,913,989,000 short tons. The following table indicates the general summary by various classes of reliability and thickness.

The total is a large amount, but it should be pointed out that most of the estimated reserves lie in the weakly inferred, thin coal class. In spite of this, however, a substantial quantity is also to be found in the thicker and more reliable categories. In view of the fact that relatively large amounts of this coal are recovered by strip methods at present, the thinner category coals will be of interest. (See Table 4.) Of course only a small part of any of these categories will be considered as strippable in most areas, and the larger part of the reserve would necessarily be considered in terms of underground recovery. Under present conditions underground methods of recovery would probably be restricted to the coal 28 inches and more which in this estimate amounts to over 3 billion tons. (See Fig. 4.)

Table 1
Estimated original Lower Kittanning coal reserves in Ohio (State totals)
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	171,234	381,749	105,266	658,249
Probable	955,713	1,470,017	197,338	2,623,068
Strongly inferred	1,189,035	793,631	18,520	2,001,186
Weakly inferred	4,381,986	249,500	-	4,631,486
Total	6,697,968	2,894,897	321,124	9,913,989

Considering present methods of underground recovery we would expect that half of the total of 28-inch and thicker coal could be extracted, approximately one and one-half billion tons. However, since most of the present recovery is by surface methods, it would seem likely that large-scale underground operations in this coal will be deferred until other more easily won reserves are depleted.

COMPARISON OF PAST AND PRESENT ESTIMATES

In the past geologists have presented estimates of this and other coal beds in Ohio. Clark (1917, p. 95) reports 14,674,000,000 tons of original reserves for the Lower Kittanning bed. Sometime later Ray (1929, p. 339) estimated only 439,296,000 tons as original tonnage. Actually, in examining Ray's notes, one finds that his original reserves are really predicated in terms of recoverable coal. The present figure of 9,913,989,000 short tons is not strictly comparable with the other two older estimates for this bed. The Clark estimates are based on average thickness over large areas, not taking into account the mappable variations in

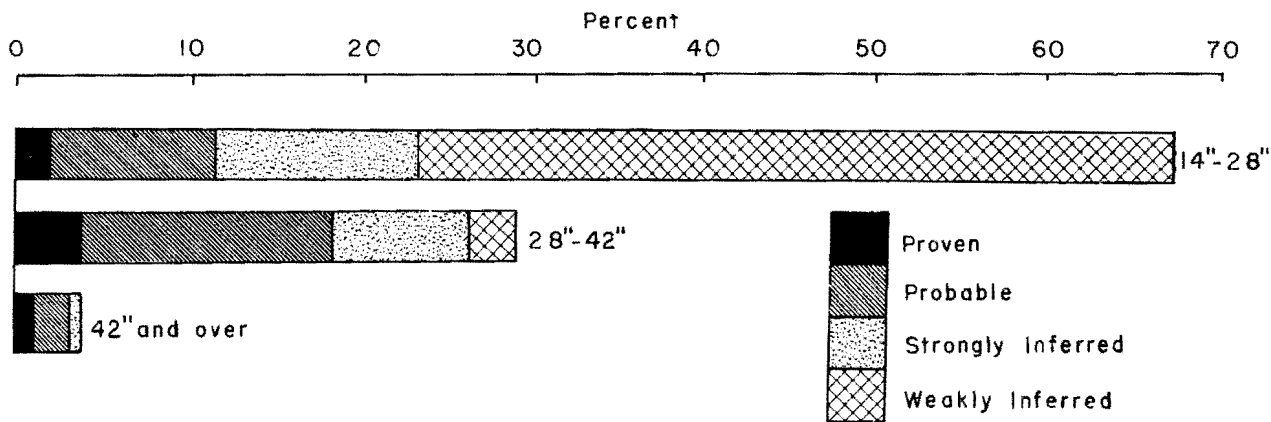


Figure 4. Comparison of the Thickness Categories.

thickness; and Ray limited the calculations to thicker coal and appears to have reported recoverable tonnage only. Since he used a minimum thickness of 2.7 feet (1930, p. 330) his figure is roughly comparable to the present estimate of 42 to 54 inch coal. Clark (1917, p. 88) used 14 inches as the minimum thickness for his estimates, and on this basis his estimate is more comparable with the present estimate.

LIMITATIONS OF THIS STUDY

It has been found that in many areas the thickness of Lower Kittanning coal is exceedingly variable and may change in the course of a few feet from almost nothing to a comparatively thick deposit.

Inasmuch as the control points that are available at this time are, in general, rather widely spread, it is likely that some of the areas which are reported upon may vary considerably more than indicated by the reserve estimates. The erratic variability should be looked for in the thicker as well as the thinner bodies of this coal. It is believed that, although such unpredictable variations occur and are cause for concern for the coal prospector, the major framework of the characteristics of the Lower Kittanning coal bed as presented here is essentially correct.

Figure 5 emphasizes the relatively small amount of control data for the study of this coal bed by indicating relative amounts of the estimate in the various reliability categories. Note the relatively small amount of proven coal as compared with the weakly indicated coal.

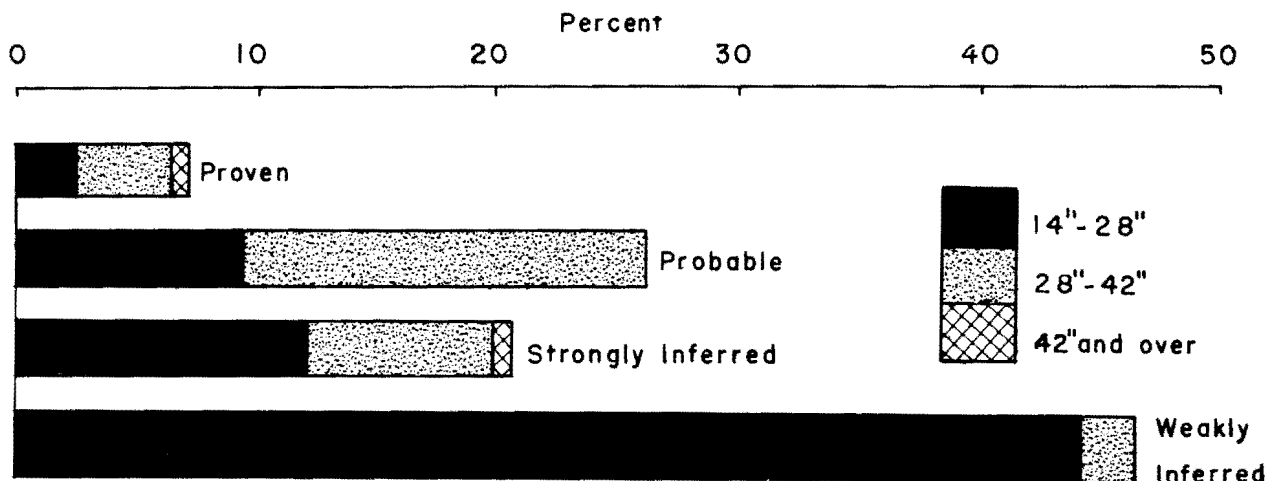


Figure 5. Comparison of the Reliability Categories.

Presented below in Table 2 is a detailed comparison of the results of the several estimates of the Lower Kittanning coal bed.

Table 2

Estimated original reserves of the Lower Kittanning coal bed in Ohio,
by county and author
(In thousands of short tons)

County	Author		
	Clark (1917)	Ray (1929)	Brant (1954)
Total	14,674,000	439,296	9,913,989
Athens	968,000	--	322,552
Carroll	1,172,000	30,720	917,189
Columbiana	1,296,000	--	1,173,585
Coshocton	711,000	--	209,085
Gallia	806,000	61,440	948,029
Guernsey	1,140,000	--	1,044,519
Harrison	1,089,000	--	669,297
Hocking	117,000	--	48,271
Holmes	101,000	--	93,072
Jackson	168,000	122,880	169,635
Jefferson	1,138,000	--	563,114
Lawrence	595,000	153,600	812,702
Mahoning	188,000	15,360	458,348
Meigs	402,000	--	226,413
Morgan	1,141,000	--	100,413
Muskingum	1,394,000	--	458,099
Noble	69,000	--	70,474
Perry	459,000	--	295,884
Scioto	--	--	4,908
Stark	374,000	--	362,216
Tuscarawas	1,092,000	36,864	749,643
Vinton	254,000	18,432	203,967
Wayne	--	--	12,574

A further limitation of this study is included because it is primarily based on the original coal reserves. "Original reserves," of course, defines the amount of coal that was in the ground before mining operations began. Inasmuch as considerable amounts of mining have taken place in this bed of coal, it would seem more appropriate to present remaining and recoverable reserves. However, none of the reported coal tonnages prior to 1946 is listed in the records by seam, and therefore it is nearly impossible to determine the total amount mined in most areas. A detailed survey of the mine maps would ordinarily be the most suitable approach; but because of insufficient funds and personnel, this approach had to be deferred. It remains true, nevertheless, that this publication will be a guide in the exploration and development of the Lower Kittanning coal deposits and an indicator of the amount of the reserve that may be expected from this bed.

MINING ACTIVITY

Although there is little specific information concerning the mining and production of Lower Kittanning coal, many references pertaining to the use of this coal indicate that production started in a small way at an early date.

References are given to the early mining of Lower Kittanning coal in the older reports of the Ohio Geological Survey, particularly in the county reports of Volumes I, II, and III. Much of the earlier mining of the coal was in connection with the extraction of the valuable Lower Kittanning clay which lies immediately below the coal. In many places, however, it appears that the coal was left for roof support and was only taken in roof-robbing procedures. With the change to strip recovery both coal and clay are removed.

The Lower Kittanning coal bed ranks fifth in the production of coal in the State, accounting for 1,810,853 tons out of a total of 34,112,748 tons mined in 1953. Production from this bed was exceeded only by that from the Pittsburgh, Middle Kittanning, and Meigs Creek beds.

Most of the coal removed from the Lower Kittanning bed was recovered by stripping; although a small amount of production was from underground operations. Tables 3 and 4 illustrate the production characteristics of the Lower Kittanning coal for the years 1946-1953 inclusive. Table 3 shows the relationship of the stripped coal to the total production while Table 4 gives the total production by counties. Because a large amount of the reserves of this bed is fairly near to market, it will probably continue to be mined at a relatively high rate for a number of years. At present the production is mostly from strip operations, and indications are that, that type of recovery will continue to prevail for some time.

Table 3

Production of Lower Kittanning coal by stripping, 1946 - 1953

(Short tons)

Year	Lower Kittanning Production		Percent Stripped
	Total	Stripped	
1946	1,281,000	1,132,099	88.4
1947	2,283,500	2,029,665	88.9
1948	2,479,358	2,097,265	84.6
1949	2,002,044	1,819,957	90.9
1950	2,102,796	1,908,713	90.8
1951	2,066,291	1,949,442	94.3
1952	2,215,831	2,118,944	95.6
1953	1,810,853	1,741,881	96.2

Table 4

Production of coal from the Lower Kittanning bed, by county, 1946 - 1953
(Short tons)

County	1946	1947	1948	1949	1950	1951	1952	1953
Total	1,281,000	2,283,500	2,479,358	2,002,044	2,102,796	2,066,291	2,215,831	1,810,853
Athens	--	--	--	--	--	--	--	--
Belmont	--	--	--	--	--	--	--	--
Carroll	238,703	211,090	290,785	214,244	185,227	203,105	169,553	191,107
Columbiana	--	7,522	--	--	--	13,522	2,968	8,237
Coshocton	--	6,930	9,209	692	1,787	13,766	--	--
Gallia	--	--	--	--	--	--	--	--
Guernsey	--	--	--	--	--	--	--	--
Harrison	--	--	--	--	--	217	454	--
Hocking	--	640	--	--	--	--	--	2,135
Holmes	111,001	48,325	--	--	514	599	811	1,619
Jackson	50,897	92,983	116,685	46,489	47,431	26,195	25,325	18,291
Jefferson	12,136	24,257	32,345	17,952	8,839	7,099	62,429	5,635
Lawrence	19,260	15,831	61,865	85,139	65,443	118,387	153,565	24,765
Mahoning	47,952	57,393	58,125	30,146	8,491	--	14,609	31,329
Meigs	--	--	--	--	--	--	--	--
Morgan	--	--	--	--	--	--	--	--
Muskingum	--	--	40	--	--	339	804	18,115
Noble	--	--	--	--	--	--	--	--
Perry	183,200	643,110	752,579	484,447	419,264	452,972	493,493	314,917
Portage	--	--	--	629	--	--	--	--
Stark	32,883	120,383	402,619	361,507	455,720	351,786	483,938	381,599
Tuscarawas	535,425	965,880	644,346	631,563	783,362	767,490	704,085	717,696
Vinton	19,834	--	1,805	361	7,235	5,865	2,699	2,782
Washington	--	--	--	--	--	--	--	--
Wayne	29,709	89,156	108,955	128,875	119,483	104,949	101,098	92,626

TABLE 5

ANALYSES OF LOWER KITTANNING COAL, OHIO

Location		File Number	Source ¹	Year	Condition ²	Proximate Analysis				Ultimate Analysis					Heat Value	
County	Township					Moisture	Volatile Matter	Fixed Carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulphur	Calories	B. t. u. 's
Carroll	Washington	580	Spec.	-	1	2.95	42.43	50.17	4.45	-	-	-	-	1.90	7,700	13,860
					2	-	43.72	51.69	4.59	-	-	-	-	1.96	7,934	14,281
					3	-	45.82	54.18	-	-	-	-	-	2.05	8,316	14,968
					4	-	45.30	54.70	-	-	-	-	-	-	8,386	15,094
					5	3.13	43.88	52.99	-	-	-	-	-	-	8,122	14,620
Columbiana	Center	314	OGS	1921	1	2.53	43.66	46.24	7.57	5.38	70.64	1.13	10.26	5.02	7,372	13,270
					2	-	44.80	47.44	7.76	5.24	72.48	1.17	8.20	5.15	7,564	13,615
					3	-	48.57	51.43	-	5.68	78.58	1.27	8.89	5.58	8,200	14,760
					4	-	47.44	52.56	-	-	-	-	-	-	8,358	15,044
					5	2.85	46.08	51.07	-	-	-	-	-	-	8,121	14,618
Columbiana	Knox	313	OGS	1921	1	4.55	42.60	45.33	7.52	5.38	68.57	1.24	13.05	4.24	7,119	12,815
					2	-	44.63	47.50	7.87	5.11	71.84	1.30	9.44	4.44	7,458	13,425
					3	-	48.44	51.56	-	5.55	77.97	1.41	10.25	4.82	8,095	14,572
					4	-	47.41	52.59	-	-	-	-	-	-	8,236	14,825
					5	5.08	45.01	49.91	-	-	-	-	-	-	7,819	14,074
Columbiana	Liverpool	140	USBM	1916	1	2.66	41.73	43.99	11.62	-	-	-	-	8.03	7,085	12,753
					2	-	42.87	45.19	11.94	-	-	-	-	8.25	7,278	13,100
					3	-	48.68	51.32	-	-	-	-	-	9.37	8,265	14,876
					4	-	46.77	53.23	-	-	-	-	-	-	8,537	15,366
					5	3.20	45.27	51.53	-	-	-	-	-	-	8,264	14,875
Columbiana	St. Clair	136	USBM	1916	1	4.03	36.69	53.03	6.25	5.46	74.65	1.64	9.39	2.61	7,496	13,493
					2	-	38.23	55.26	6.51	5.22	77.79	1.71	6.05	2.72	7,811	14,060
					3	-	40.89	59.11	-	5.58	83.21	1.83	6.47	2.91	8,355	15,039
					4	-	40.03	59.97	-	-	-	-	-	-	8,457	15,222
					5	4.39	38.28	57.33	-	-	-	-	-	-	8,086	14,554
Columbiana	St. Clair	315	OGS	1921	1	3.67	37.68	51.81	6.84	5.31	73.13	1.20	11.02	2.50	7,414	13,345
					2	-	39.12	53.78	7.10	5.09	75.91	1.25	8.05	2.60	7,696	13,853
					3	-	42.11	57.89	-	5.48	81.70	1.35	8.67	2.80	8,284	14,912
					4	-	41.27	58.73	-	-	-	-	-	-	8,387	15,096
					5	4.02	39.61	56.37	-	-	-	-	-	-	8,050	14,490
Columbiana	Yellow Creek	142	USBM	1916	1	2.67	38.46	50.19	8.68	-	-	-	-	5.71	7,340	13,212
					2	-	39.51	51.57	8.92	-	-	-	-	5.87	7,541	13,574
					3	-	43.38	56.62	-	-	-	-	-	6.44	8,280	14,903
					4	-	41.83	58.17	-	-	-	-	-	-	8,467	15,241
					5	3.05	40.56	56.39	-	-	-	-	-	-	8,209	14,776
Columbiana	Yellow Creek	143	USBM	1916	1	4.46	40.86	49.73	4.95	-	-	-	-	3.52	7,540	13,572
					2	-	42.77	52.05	5.18	-	-	-	-	3.68	7,892	14,206
					3	-	45.11	54.89	-	-	-	-	-	3.88	8,323	14,982
					4	-	44.26	55.74	-	-	-	-	-	-	8,432	15,178
					5	4.81	42.12	53.07	-	-	-	-	-	-	8,027	14,448

TABLE 5 (Continued)

ANALYSES OF LOWER KITTANNING COAL, OHIO

Location		File Number	Source ¹	Year	Condition ²	Proximate Analysis			Ultimate Analysis						Heat Value		
County	Township					Moisture	Volatile Matter	Fixed Carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulphur	Calories	B. t. u. 's	
Holmes	Killbuck	312	OGS	1928	1	7.58	40.77	43.58	8.07	5.58	65.88	1.33	15.20	3.94	6,693	12,048	
					2	-	44.11	47.16	8.73	5.13	71.28	1.44	9.16	4.26	7,242	13,036	
					3	-	48.33	51.67	-	5.62	78.09	1.58	10.04	4.67	7,935	14,283	
					4	-	47.27	52.73	-	-	-	-	-	-	8,074	14,534	
					5	8.51	43.25	48.24	-	-	-	-	-	-	7,388	13,298	
Holmes	Walnut Creek	311	OGS	1928	1	6.34	43.21	44.06	6.39	-	-	-	-	3.65	6,973	12,551	
					2	-	46.13	47.05	6.82	-	-	-	-	3.90	7,444	13,400	
					3	-	49.51	50.49	-	-	-	-	-	4.19	7,989	14,381	
					4	-	48.65	51.35	-	-	-	-	-	-	8,107	14,593	
					5	6.96	45.27	47.77	-	-	-	-	-	-	7,543	13,578	
Jackson	Milton	310	OGS	1907	1	8.39	35.18	49.01	7.42	5.47	66.63	1.37	16.46	2.65	6,772	12,189	
					2	-	38.40	53.50	8.10	4.96	72.73	1.50	9.82	2.89	7,392	13,306	
					3	-	41.78	58.22	-	5.40	79.14	1.63	10.69	3.14	8,044	14,479	
					4	-	40.82	59.18	-	-	-	-	-	-	8,155	14,679	
					5	9.27	37.03	53.70	-	-	-	-	-	-	7,399	13,318	
Jackson	Milton	563A	USGS	1905	1	9.38	36.74	46.26	7.62	-	-	-	-	4.08	6,610	11,898	
					2	-	40.54	51.05	8.41	-	-	-	-	4.50	7,294	13,129	
					3	-	44.26	55.74	-	-	-	-	-	4.91	7,964	14,335	
					4	-	43.04	56.96	-	-	-	-	-	-	8,106	14,590	
					5	10.48	38.53	50.99	-	-	-	-	-	-	7,257	13,062	
			563B	USGS	1905	1	8.95	37.82	43.89	9.34	-	-	-	-	4.41	-	-
						2	-	41.54	48.20	10.26	-	-	-	-	4.84	-	-
						3	-	46.29	53.71	-	-	-	-	-	5.39	-	-
						4	-	44.96	55.04	-	-	-	-	-	-	-	-
						5	10.23	40.36	49.41	-	-	-	-	-	-	-	-
Jefferson	Knox	309	OGS	1907	1	2.46	38.48	51.66	7.40	5.38	74.20	1.27	7.93	3.82	7,591	13,664	
					2	-	39.45	52.96	7.59	5.24	76.07	1.30	5.88	3.92	7,782	14,008	
					3	-	42.69	57.31	-	5.67	82.32	1.41	6.36	4.24	8,421	15,159	
					4	-	41.58	58.42	-	-	-	-	-	-	8,559	15,407	
					5	2.74	40.44	56.82	-	-	-	-	-	-	8,325	14,985	
Jefferson	Saline	144	USBM	1916	1	3.44	37.17	46.71	12.68	-	-	-	-	7.30	6,907	12,433	
					2	-	38.49	48.38	13.13	-	-	-	-	7.56	7,154	12,877	
					3	-	44.31	55.69	-	-	-	-	-	8.70	8,235	14,823	
					4	-	42.14	57.86	-	-	-	-	-	-	8,503	15,306	
					5	4.18	40.39	55.43	-	-	-	-	-	-	8,147	14,665	
Jefferson	Saline	145	USBM	1916	1	2.21	39.63	47.50	10.66	5.28	71.04	1.34	6.72	4.96	7,236	13,025	
					2	-	40.53	48.57	10.90	5.14	72.65	1.37	4.87	5.07	7,400	13,320	
					3	-	45.49	54.51	-	5.77	81.53	1.54	5.47	5.69	8,305	14,949	
					4	-	44.04	55.96	-	-	-	-	-	-	8,496	15,293	
					5	2.58	42.90	54.52	-	-	-	-	-	-	8,277	14,899	

ESTIMATE OF THE RESERVES

TABLE 5 (Continued)
ANALYSES OF LOWER KITTANNING COAL, OHIO

LOWER KITTANNING COAL

Location		File Number	Source ¹	Year	Condi- tion ²	Proximate Analysis				Ultimate Analysis					Heat Value	
County	Township					Moisture	Volatile Matter	Fixed Carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulphur	Calories	B. t. u. 's
Lawrence	Elizabeth	308	OGS	1907	1	8.07	34.54	47.68	9.71	5.44	65.54	1.23	15.95	2.13	6,626	11,926
					2	-	37.57	51.87	10.56	4.94	71.29	1.34	9.55	2.32	7,207	12,973
					3	-	42.01	57.99	-	5.52	79.71	1.50	10.68	2.59	8,058	14,505
					4	-	41.00	59.00	-	-	-	-	-	-	8,180	14,724
					5	9.13	37.26	53.61	-	-	-	-	-	-	7,433	13,379
Lawrence	Upper	146	OGS	1907	1	7.57	38.51	45.13	8.79	5.59	66.71	1.27	14.44	3.20	6,777	12,199
					2	-	41.66	48.83	9.51	5.14	72.18	1.37	8.34	3.46	7,332	13,197
					3	-	46.04	53.96	-	5.68	79.77	1.51	9.22	3.82	8,103	14,584
					4	-	44.99	55.01	-	-	-	-	-	-	8,238	14,829
					5	8.53	41.16	50.31	-	-	-	-	-	-	7,537	13,566
Muskingum	Newton	306	OGS	1917	1	7.96	39.18	46.87	5.99	5.54	68.40	1.37	16.30	2.40	6,893	12,407
					2	-	42.57	50.92	6.51	5.06	74.31	1.49	10.02	2.61	7,489	13,480
					3	-	45.53	54.47	-	5.41	79.49	1.59	10.72	2.79	8,010	14,419
					4	-	44.80	55.20	-	-	-	-	-	-	8,102	14,584
					5	8.63	40.93	50.44	-	-	-	-	-	-	7,403	13,325
Muskingum	Washington	305	OGS	1902	1	5.05	39.75	47.43	7.77	5.37	68.07	1.18	12.81	4.80	6,983	12,569
					2	-	41.86	49.96	8.18	5.07	71.69	1.24	8.76	5.06	7,354	13,237
					3	-	45.59	54.41	-	5.52	78.08	1.35	9.54	5.51	8,009	14,416
					4	-	44.33	55.67	-	-	-	-	-	-	8,162	14,691
					5	5.68	41.82	52.50	-	-	-	-	-	-	7,699	13,858
Muskingum	Wayne	304	OGS	1917	1	5.87	41.52	43.91	8.70	5.38	66.67	1.16	13.30	4.79	6,771	12,188
					2	-	44.11	46.65	9.24	5.02	70.83	1.23	8.59	5.09	7,193	12,947
					3	-	48.60	51.40	-	5.53	78.04	1.36	9.46	5.61	7,925	14,265
					4	-	47.39	52.61	-	-	-	-	-	-	8,084	14,552
					5	6.67	44.23	49.10	-	-	-	-	-	-	7,546	13,583
Perry	Pike	302	OGS	1902	1	6.74	37.05	49.09	7.12	5.47	68.34	1.24	15.25	2.58	6,885	12,393
					2	-	39.73	52.64	7.63	5.06	73.28	1.33	9.93	2.77	7,382	13,288
					3	-	43.01	56.99	-	5.48	79.33	1.44	10.75	3.00	7,992	14,386
					4	-	42.12	57.88	-	-	-	-	-	-	8,096	14,572
					5	7.42	39.00	53.58	-	-	-	-	-	-	7,496	13,493
Perry	Pike	303	OGS	1902	1	6.85	35.22	47.77	10.16	5.26	64.78	1.22	13.86	4.72	6,591	11,864
					2	-	37.81	51.28	10.91	4.83	69.54	1.31	8.34	5.07	7,075	12,735
					3	-	42.44	57.56	-	5.42	78.06	1.47	9.36	5.69	7,941	14,295
					4	-	40.86	59.14	-	-	-	-	-	-	8,117	14,610
					5	7.93	37.62	54.45	-	-	-	-	-	-	7,474	13,453
Stark	Sandy	301A	OGS	1926	1	3.81	44.34	45.80	6.05	-	-	-	-	3.44	7,268	13,083
					2	-	46.09	47.61	6.30	-	-	-	-	3.58	7,556	13,601
					3	-	49.19	50.81	-	-	-	-	-	3.82	8,064	14,515
					4	-	48.40	51.60	-	-	-	-	-	-	8,174	14,713
					5	4.16	46.39	49.45	-	-	-	-	-	-	7,833	14,099

TABLE 5 (Continued)
ANALYSES OF LOWER KITTANNING COAL, OHIO

Location		File Number	Source ¹	Year	Condition ²	Proximate Analysis				Ultimate Analysis					Heat Value	
County	Township					Moisture	Volatile Matter	Fixed Carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulphur	Calories	B. t. u. 's
Tuscarawas	Sandy	562A	USGS	1906	1	5.61	36.25	49.42	8.72	-	-	-	-	2.89	-	-
					2	-	38.40	52.36	9.24	-	-	-	-	3.06	-	-
					3	-	42.31	57.69	-	-	-	-	-	3.37	-	-
					4	-	41.25	58.75	-	-	-	-	-	-	-	-
					5	6.30	38.65	55.05	-	-	-	-	-	-	-	-
		562B	USGS	1906	1	4.46	39.89	47.11	8.54	-	-	-	-	3.73	7,136	12,845
					2	-	41.75	49.31	8.94	-	-	-	-	3.90	7,469	13,444
					3	-	45.85	54.15	-	-	-	-	-	4.28	8,202	14,764
					4	-	44.76	55.24	-	-	-	-	-	-	8,346	15,022
					5	5.03	42.50	52.47	-	-	-	-	-	-	7,926	14,267
		562C	OGS	1907	1	5.30	38.73	48.26	7.71	5.46	69.75	1.18	12.65	3.25	7,168	12,902
					2	-	40.90	50.96	8.14	5.14	73.66	1.25	8.38	3.43	7,569	13,624
					3	-	44.52	55.48	-	5.60	80.19	1.36	9.12	3.73	8,240	14,831
					4	-	43.52	56.48	-	-	-	-	-	-	8,367	15,061
					5	5.90	40.95	53.15	-	-	-	-	-	-	7,874	14,173

1. OGS - Ohio Geological Survey
 USBM - United States Bureau of Mines
 USGS - United States Geological Survey
 Spec. - Special analysis from private source

2. 1 - As received
 2 - Moisture-free
 3 - Moisture- and ash-free
 4 - Dry mineral-matter-free (unit coal)
 5 - Moist mineral-matter-free

CHARACTER OF THE COAL

As a rule the coal forms a more or less solid block with a well developed cleating and with no persistent partings, although usually minor shale, clay, or pyrite partings are found with little lateral continuity. In the past this coal has been coked on small scale and used in blast furnaces in the vicinity of Leetonia in Columbiana County. (See Bownocker and Dean, 1934, p. 55.) It has good heating value and is useful for steam coal; the sulphur is somewhat high as is the ash, but these are not overly objectionable for industrial heating purposes. Table 5 is a listing of available mine face sample analyses, proximate and ultimate. Except for the Stark County samples, these analyses were not made in accordance with modern day standards (A. S. T. M., 1938). They will, however, serve to give at least a general idea of the chemical characteristics.

The rank, as shown from analyses of the Lower Kittanning coal, is high volatile A bituminous. It appears to be constant over its extent in Ohio, although small variations occur from place to place. (See Table 5.) Table 6 shows the range of the analytical results of the several analyses. It is interesting that the results of tipple sample analyses of recent years, as reported by the U. S. Bureau of Mines (Fieldner et al, 1948), fall within this range for 4-inch lump and mine run samples. The smaller sizes tend to fall outside the limits given here.

Table 6

Range in values after analysis of 26 mine samples,
Lower Kittanning coal, Ohio*

Item	B. t. u. 's	Percent	
		Ash	Sulphur
Minimum	11,864	4.45	1.90
Maximum	13,860	12.68	8.03
Average	12,740	8.03	3.94

*See also Table 5.

GERMANIUM IN THE COAL

One of the considerations in selecting the Lower Kittanning coal bed for appraisal at this time was the announcement in February 1953, of the discovery of germanium in comparatively greater than usual amounts. A leaflet was issued by the Ohio Chamber of Commerce in 1953, and later the U. S. Geological Survey (Stadnichenko and others, 1953) published specific information on several coals of the United States including the Lower Kittanning coal bed in Ohio. At present germanium is not being produced from coal on a commercial scale in this country. The immediate source is from the processing of the associated ores of lead and zinc in the Joplin, Missouri, area. This source is apparently adequate for the present demand, but to insure a continuing supply for a growing demand, agencies of both the Federal Government and private industry are conducting searches for this element. The second best domestic source yet announced is the Lower Kittanning coal bed in Ohio. The ultimate future of germanium from Ohio coal remains doubtful, for it is entirely possible that other coal beds or other mineral sources will be discovered to lower the present relative attractiveness of the Lower Kittanning coal as a possible germanium source.

DESCRIPTION OF THE RESERVES BY COUNTY

County descriptions of the Lower Kittanning coal are arranged geographically for the sake of continuity.

JEFFERSON COUNTY

Outcrops of the Lower Kittanning coal bed are found in Jefferson County along the Ohio River and in the valley of Yellow Creek in Saline and Knox Townships. Although obscured because of its occurrence low in the valleys, the bed probably goes below drainage in Section 25 of Knox Township. From the outcrop and drill hole information it is believed that the bed underlies this area at minable thickness. Lamborn (1930, pp. 51-52) describes the coal and notes that few exposures are to be found because of its unfavorable topographic position in the valleys, but where measured the thickness ranges between 27 and 38 inches. A large area in Saline, Brush Creek, Knox, and Island Creek Townships is believed to contain this coal at a thickness of approximately 35 inches. The northeastern part of the county is believed to contain coal ranging from 14 to 28 inches; however, coal is not estimated in the southern two-thirds of the county because of the lack of information together with the regional indication of the coal thinning to less than 14 inches. Test hole information in Harrison County just west of Wayne Township indicates that the coal in that area may average as much as 35 inches (Fig. 6).

The estimated reserves for the Lower Kittanning coal from Jefferson County are summarized in Table 7.

Table 7
Estimated Original Lower Kittanning Coal Reserves, Jefferson County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	503	10,179	-	10,682
Probable	3,506	65,855	-	69,361
Strongly inferred	14,292	121,293	-	135,585
Weakly inferred	293,123	54,363	-	347,486
Total	311,424	251,690	-	563,114

Mining of the coal has been mostly in connection with clay mining operations. A small amount of production from the Lower Kittanning coal is reported. In 1952 it amounted to about 62,429 tons; for 1953 it was only 5,635 tons. Reported production statistics are greater than this by far and reflect mistaken identity of the coal beds being mined.

COLUMBIANA COUNTY

Although this bed was mined in the past in northern Columbiana County, mining of the Lower Kittanning coal today is at a low ebb, and is probably pursued only in connection with clay mining operations. In 1953 only about 8,000 tons of this coal was reported mined, a small amount in comparison with the potential of the county which is shown in Table 8.

Table 8

Estimated Original Lower Kittanning Coal Reserves, Columbiana County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	40,819	43,372	5,989	90,180
Probable	166,233	222,022	31,149	419,404
Strongly inferred	269,852	115,782	8,754	394,388
Weakly inferred	260,542	9,071	-	269,613
Total	737,446	390,247	45,892	1,173,585

From the data available thickness variations of the Lower Kittanning coal seem to be somewhat erratic. Stout and Lamborn (1924, pp. 98-127) describe the outcrop characteristics of this coal in moderate detail, and they provide the basic data for the present estimate and description.

Outcrops of the coal are found along the valleys of the Ohio River, Little Beaver Creek, and the Yellow Creek drainage area. Outcrops may also be found in the northern tier of townships extending from Mahoning County. Although a number of exceptions occur, the majority of the county is underlain by a more or less continuous block of coal 14 inches or more in thickness. In the northern part of Knox Township, the northern two-thirds of Butler, the northern half of Salem, the northwestern corner of Fairfield, and all of Perry Township, the coal probably ranges from 28 to 42 inches in thickness. Most of Perry Township is underlain by an average of 48 inches of coal. A drill hole in Salem Township reveals a thickness of 58 inches of the coal. The eastern part of Perry Township and Sections 2, 3, 10, and 15 of Salem Township show coal ranging from 10 to 40 inches in thickness. Outcrops do not occur in Fairfield and Unity Townships, but existing data indicate that the coal in this area ranges from 14 to 28 inches in thickness. A sizable area of thin coal is found in southern Middleton and north central St. Clair Townships where the thickness ranges from 2 to 14 inches.

East of this area in Madison Township and central Elk Run Township outcrops of the coal reveal a thickness of 28-42 inches. In the valley of the Middle Fork of Little Beaver River, in southern Salem Township and adjacent parts, drill hole information indicates the thickness of the coal to average 21 inches. Along the Ohio River in Liverpool and Yellow Creek Townships there are several areas where the coal is less than 14 inches thick. One such area is located in Sections 18, 35, and 36 of Liverpool Township where a maximum known thickness is 6 inches and where in some places the coal is absent. There appear to be many of these areas along the Ohio River where the Lower Kittanning coal bed is thin or absent. Another such area is about 3 square miles in the southwestern corner of Yellow Creek Township. To the south of this, however, the coal reaches as much as 35 inches average thickness. In the remainder of the county not previously described, the inferred coal averages 21 inches (Fig. 6).

MAHONING COUNTY

The Lower Kittanning coal is found in the following townships in Mahoning County: Smith, Goshen, Green, Beaver, Springfield, Berlin, Ellsworth, Canfield, Boardman, and Poland. Over a large portion of this area the coal probably ranges from 28-42 inches in thickness. Only small areas are believed to be underlain by coal less than 28 inches in thickness (Fig. 6). Outcrops are present in all of the above named townships, but in many of the areas the glacial drift covers or obscures the outcrop. The thickness in the Mill Creek Valley area in Beaver and Boardman Townships is probably of the order of 21 inches; although indications are that the coal thickens both east and west from this area. In eastern Beaver Township a small area

of the bed is more than 42 inches thick. To the west, in Green Township, an elongated, lens-like body of the coal averages 48 inches in thickness. The greatest thickness found in the county occurs in Section 9 of Green Township, and the minimum thickness known is 14 inches in Section 13 of Springfield Township. Outcrops either exposed or buried are found in the valley walls of Mill Creek, Meander Creek, Yellow Creek, and the Mahoning River, as well as in the Middle Fork of the Little Beaver Creek. Lamborn (1942, pp. 28-30) has described the coals, including the Lower Kittanning, in this area. He notes that a moderate portion at or near the top of the bed is cannel coal.

Currently mining activity in this bed in Mahoning County is confined for the most part to two larger strip-type operations. In the past, however, there were a considerable number of small-scale, underground mines. In 1953 production amounted to 31,329 tons.

Table 9

Estimated Original Lower Kittanning Coal Reserves, Mahoning County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	7,355	47,071	9,583	64,009
Probable	39,973	237,042	24,605	301,620
Strongly inferred	18,807	66,521	2,165	87,493
Weakly inferred	120	5,106	-	5,226
Total	66,255	355,740	36,353	458,348

HARRISON COUNTY

Coal of the Lower Kittanning bed probably underlies the northern part of the county. Information from several drill holes is used to estimate the extent of the bed. These data, coupled with regional information, are interpreted to give an estimate for the original reserves in the county. No reserves are calculated for the southern third of the county because of lack of information. (See Table 10 and Fig. 7.) No mining of this coal is known in the county.

Table 10

Estimated Original Lower Kittanning Coal Reserves, Harrison County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	262	3,023	2,211	5,496
Probable	14,413	27,383	1,750	43,546
Strongly inferred	88,841	21,940	-	110,781
Weakly inferred	509,474	-	-	509,474
Total	612,990	52,346	3,961	669,297

In the extreme northeastern part of the county several drill holes reveal coal that is probably Lower Kittanning at rather variable thicknesses. In Section 23 of German Township the Lower Kittanning was not encountered. In Section 17 two holes show 35 and 40 inches of coal respectively. An area of thin coal less than 14 inches in thickness and an area of coal of

35-inch average thickness both exist within German Township. In the southern part of Green Township, southern Cadiz Township, Moorefield Township, and the area to the south, the Lower Kittanning coal is not estimated because of lack of information.

GUERNSEY COUNTY

A large part of the estimate of the original reserves of the Lower Kittanning coal bed fall into the inferred classes. Table 11 summarizes the estimated reserves of this bed for Guernsey County. The complete estimate by township may be seen in Table 31.

Table 11

Estimated Original Lower Kittanning Coal Reserves, Guernsey County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	1,411	2,015	8,017	11,443
Probable	26,771	51,776	35,664	114,211
Strongly inferred	83,055	117,194	7,095	207,344
Weakly inferred	609,044	102,477	-	711,521
Total	720,281	273,462	50,776	1,044,519

Guernsey County exhibits outcrops of the Lower Kittanning coal in Wheeling, Knox, and Liberty Townships. The coal in this area is usually over 28 inches thick, but a moderately large pocket of the coal in central Liberty Township averages over 42 inches. The coal goes under deep cover to the east and to the south and is assumed, from the data available, to average 21 inches in thickness for nearly all of the rest of the county (Fig. 7). Drill hole information indicates the presence of the No. 5 coal in Valley and Spencer Townships where the records showed 14 to 42 inches of coal. No mining activity in the Lower Kittanning bed is known in this county.

CARROLL COUNTY

Estimated original reserves of the Lower Kittanning coal are listed in Table 12. Detailed summary by township is found in Table 31 at the end of this report.

Table 12

Estimated Original Lower Kittanning Coal Reserves, Carroll County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	2,681	22,444	3,225	28,350
Probable	26,953	113,063	22,763	162,779
Strongly inferred	66,140	75,800	-	141,940
Weakly inferred	575,184	8,936	-	584,120
Total	670,958	220,243	25,988	917,189

LOWER KITTANNING COAL

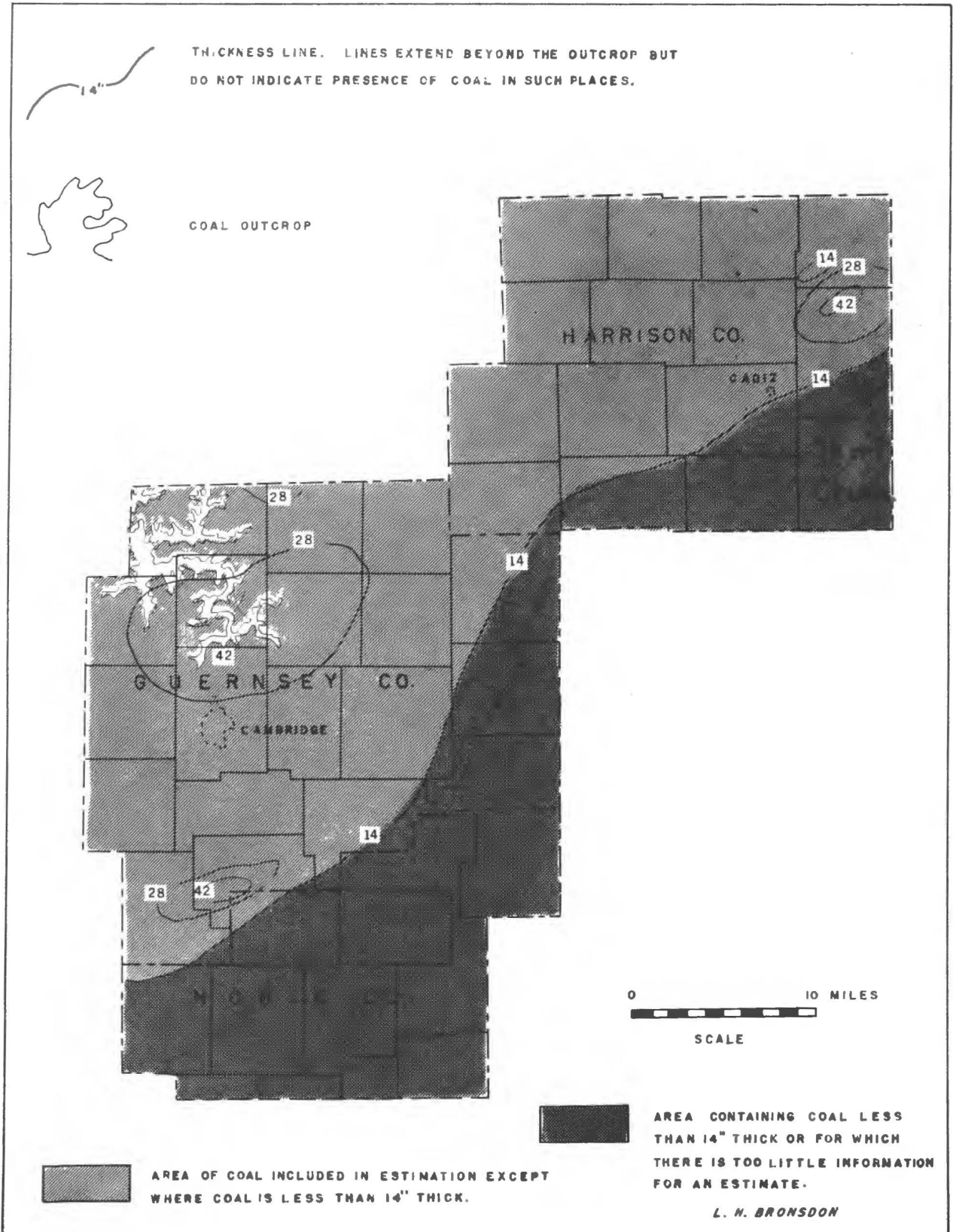


FIGURE 7. The Lower Kittanning Coal in Guernsey, Harrison, and Noble Counties.

A large quantity of the Lower Kittanning coal is considered "thin." However, about one-third of the estimate, or nearly 250 million tons, is 28 inches thick or more. The thickest category, 42 inches and over, is estimated at approximately 25 million tons and is of interest because most of it is in the proven or probable class.

Nearly the entire county is underlain with the Lower Kittanning coal, and all but a small area is believed to occur at minimum minable thickness, 14 inches or greater. Very few outcrops of the Lower Kittanning coal are found in Carroll County. However, exposures are present in the upper Sandy Creek drainage in Brown Township, in Still Creek, and in other valleys around the Malvern and Minerva area.

Because precise data are available only for the northwestern part of the county, detailed appraisal and classification of coal into the more reliable categories can be made only in the Malvern-Waynesburg area. Number 5 coal in the Brown Township area is mostly 28-42 inches in thickness; however, in the southwestern part and extending into Stark County, an area of 42-inch coal is present. In the Malvern to Minerva area, where the coal lies low in the valleys, thickness is known to range from at least 28 inches to 42 inches. The remainder of the county has been appraised only in a general way by assuming the coal averages 21 inches (Fig. 6).

STARK COUNTY

Lower Kittanning coal is found in the southeastern part of the county. The estimated original reserves of the bed are summarized in Table 13, and a complete report by township is listed in Table 31.

Table 13
Estimated Original Lower Kittanning Coal Reserves, Stark County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	7,255	10,882	10,229	28,366
Probable	46,161	89,274	9,492	144,927
Strongly inferred	63,782	83,527	-	147,309
Weakly inferred	35,096	6,518	-	41,614
Total	152,294	190,201	19,721	362,216

As can be observed from the preceding table, the greatest amount of the coal is believed to be in the 28-to 42-inch class. A somewhat smaller amount is in the 14-to 28-inch class, and the smallest reserve is in the 42-inch and over class. The coal in the 42-inches-and-over thickness category is, of course, the most attractive; however, this category of coal probably does not average more than 48 inches where it does occur in the county.

The extent of the coal in the southern parts of Marlboro, Nimishillen, and Lexington Townships has been estimated by projection because the outcrop is largely obscured by glacial drift. However, mining operations, drill holes, and a few outcrops reveal that in this area the coal thickness is usually more than 28 inches. In the immediate vicinity of Alliance this coal averages more than 42 inches in thickness, but there are some variations from this figure. From the central part of Washington Township to the central part of Paris Township the coal appears to be generally thin, probably averaging 21 inches or less in thickness. To the south of this area the coal again increases in thickness to as much as 28 inches in southern Harris Township and adjacent areas in Osnaburg and Canton Townships. An area

of thick coal is also found in the central part of Pike Township where the thickness exceeds 42 inches in Sections 3, 4, 9, and 10. Generally speaking, most of the Lower Kittanning coal in Stark County is more than 14 inches thick, in some areas approaching 42 inches in thickness. Only two areas of exceptionally thin coal have been described: one of these is in Sandy Township in Sections 19, 20, 29, and 30; the other in southwestern Pike Township, Sections 29 and 30 (Fig. 8).

All of the Lower Kittanning coal in Stark County is above drainage, thus being exposed for strip mining and rather extensively mined in that manner.

Production from this coal bed has fluctuated since 1946 when 32,883 tons was reported mined to 1953 when 381,599 tons was reported. Strip mining has accounted for nearly all of the Lower Kittanning production in Stark County, only a few thousand tons having been mined underground since 1945.

TUSCARAWAS COUNTY

The outcrops of the Lower Kittanning coal are widespread in Tuscarawas County. The circumstances that have brought this about are: (1) the low dip of the rocks in this area; (2) the nearness to the surface of this bed in the area; and (3) the relatively deeply dissected valleys. These factors are responsible for extensive stripping operations in the county.

A summary of the estimated reserves of the Lower Kittanning coal is found in Table 14. For detailed estimates by township, however, refer to Table 31.

Table 14
Estimated Original Lower Kittanning Coal Reserves, Tuscarawas County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	25,473	54,057	12,346	91,876
Probable	178,487	157,912	16,770	353,169
Strongly inferred	100,733	82,720	-	183,453
Weakly inferred	66,849	54,296	-	121,145
Total	371,542	348,985	29,116	749,643

Of the total of nearly 750 million tons of estimated reserves, nearly half occurs in the thin class, 14 to 28 inches. Thus, there is left an appreciable quantity of coal estimated at greater than 28 inches in thickness. Even the 42-inch or greater thickness category is a substantial amount of over 29 million tons.

The thickness characteristics of the Lower Kittanning coal in Tuscarawas County are rather erratic. There are moderate areas where the coal is 42 inches or more and also large areas where the thickness never attains 14 inches.

In the northeastern part of the county there is a belt in the New Philadelphia to Uhrichsville and Dennison area where the thickness of No. 5 coal is less than 14 inches. To the south and west of this belt the coal thickens, and over a wide area in this direction it is from 14 to 28 inches or more thick.

In Sandy and Lawrence Townships there are irregular bodies of coal that attain 42 inches of thickness, but from this area the coal thins in all directions. In a small area in southern Franklin Township the coal does exceed 42 inches, but again it thins from this area to the west.

A roughly elongated body of the coal, generally more than 28 inches thick, occurs in the central part of the county and appears to extend from the north to the south borders. Roughly paralleling this body of thicker coal is an area of thin coal in southern Fairfield, southern Warren, eastern Dover, and Goshen Townships and small areas adjacent thereto. To the south and west minable thickness is apparently regained, except in Auburn, Salem, and southern Oxford Townships and some adjacent parts. In areas other than those described above, the coal probably averages from 14 to 28 inches in thickness. The thickness variations of the Lower Kittanning coal appear to be as irregular in other parts of the State; therefore, here as in other areas, detailed drilling must be used in appraising the value of the coal in even small areas (Fig. 8).

Mining in the Lower Kittanning clay and coal zone has been carried on for many years, and although no records by seam prior to 1946 are available, the production for that year is listed at 535,425 tons. The maximum reported during the past 8 years from Tuscarawas County was in 1947 when over 900,000 tons of the coal was reported recovered, in 1953 the amount mined was 717,696 tons. There has been no particular trend noted in the production from this coal bed. It is significant that virtually all of the tonnage is from strip mines, and little or no reported production is from underground operations. This factor further attests to the variable nature and generally thin character of the bed in this area.

WAYNE COUNTY

In Wayne County the Lower Kittanning coal bed is found only in southeastern Franklin Township, southeastern corner of Salt Creek Township, and the southern half of Paint Township. The coal is of minable thickness throughout its occurrence in the county. It attains a thickness of 42 inches and more in the outliers in Franklin Township, and although no specific measurements have been made, the coal in other outliers is believed to be between 14 and 28 inches in thickness (Fig. 9).

Table 15 is a resume of the estimated original Lower Kittanning coal reserves for the county, and Table 31 lists a detailed summary by township.

Table 15

Estimated Original Lower Kittanning Coal Reserves, Wayne County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	1,733	1,477	875	4,085
Probable	544	2,620	92	3,256
Strongly inferred	403	2,755	-	3,158
Weakly inferred	463	1,612	-	2,075
Total	3,143	8,464	967	12,574

HOLMES COUNTY

Allegheny rocks and the Lower Kittanning coal bed in particular underlie only the eastern third or less of the county. The coal in this district is found relatively high in the hilltops and is subject to strong variations such as have been noted for Tuscarawas County. Generally the northeastern part of the Lower Kittanning coal area is underlain by this bed at minable thickness or greater. In the outliers in Paint, Salt Creek, and Walnut Townships and part of Berlin Township, the coal is of variable thickness. In Clark Township and extending into outliers in

ESTIMATE OF THE RESERVES

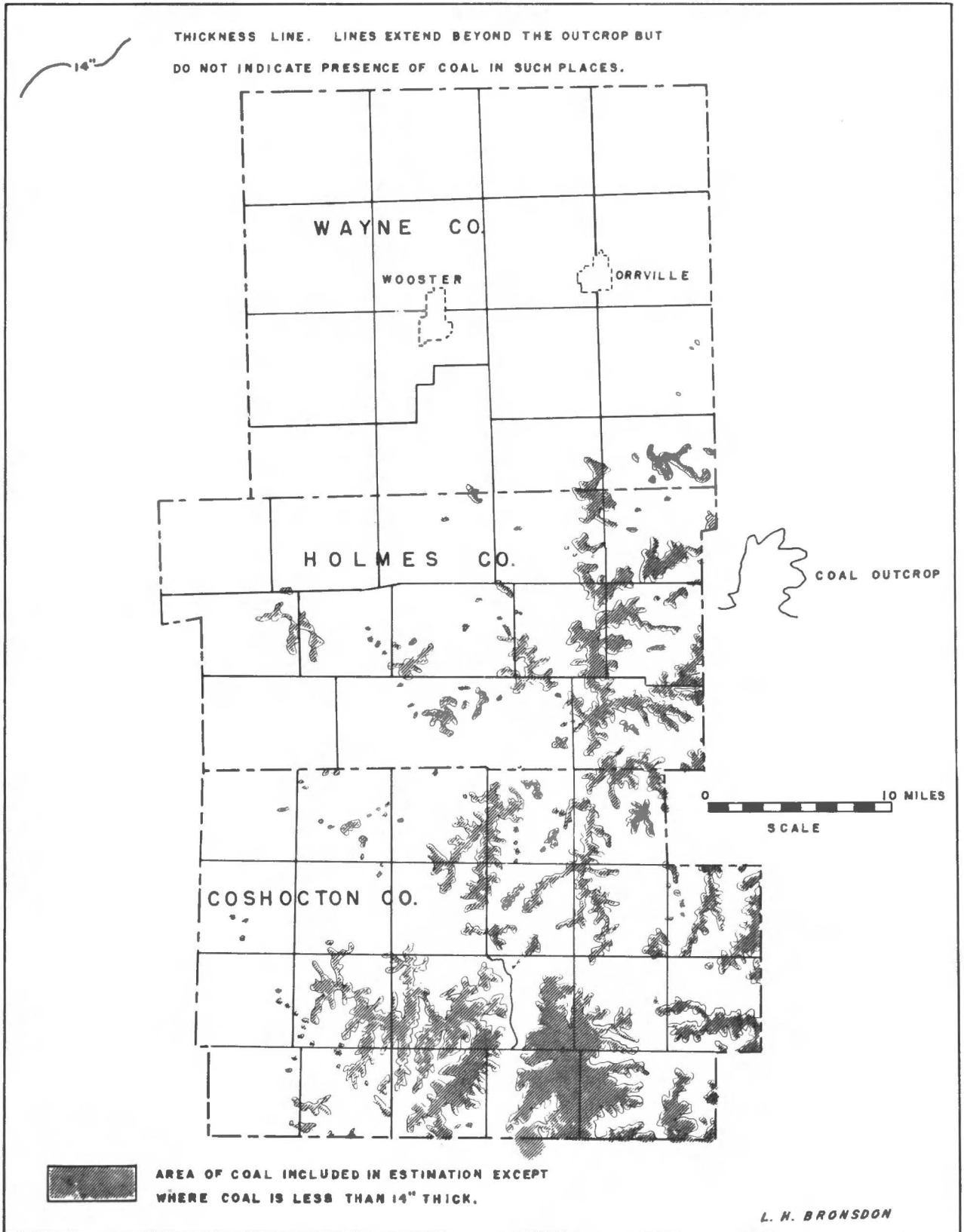


FIGURE 9. The Lower Kittanning Coal in Coshocton, Holmes, and Wayne Counties.

Mechanic, eastern Hardy, western Berlin Township, and a few outliers in Prairie and westernmost Salt Creek Township, a large area of thin coal is apparently present. The thickness ranges up to 12 inches, but usually measurements of $\frac{1}{2}$ to 6 or 8 inches are recorded in this area by various workers (White, 1949, pp. 170-259). An outlier in Killbuck Township and southern Hardy Township exhibits rather thick coal extending to over 42 inches in thickness. Within the large area of thin coal of the Lower Kittanning bed are a few places where the thickness attains or exceeds 14 inches. A summary of the estimated original reserves of the Lower Kittanning coal bed is listed in Table 16. For detailed estimates see Table 31.

Table 16

Estimated Original Lower Kittanning Coal Reserves, Holmes County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	6,970	18,912	5,895	31,777
Probable	11,746	34,369	1,012	47,127
Strongly inferred	1,872	8,601	-	10,473
Weakly inferred	-	3,695	-	3,695
Total	20,588	65,577	6,907	93,072

Only small amounts of this coal are mined, although in the past moderate amounts have been removed. In 1946 and 1947, 111,001 and 48,325 tons were mined respectively. Since that time maximum annual production has been only a few thousand tons at the most. White (1949, p. 213) notes that in Holmes County the Lower Kittanning is often erroneously called the No. 6 or Middle Kittanning coal.

COSHOCTON COUNTY

The estimated Lower Kittanning coal reserves of Coshocton County amount to slightly more than 209 million tons and are summarized in Table 17. Following the general trend of this coal, a large part of the reserves is in the thin category (14-28 inches). A substantial amount of the total, however, is in the greater than 28-inch class, and only about 9 million tons is in the 42-inch or over thickness class. The coal is erratic in its thickness changes; however, it is apparent that large areas of this coal in the county never attain even minimum minable thickness. Table 31 lists the complete summary by township of the Lower Kittanning coal estimate for this county.

Table 17

Estimated Original Lower Kittanning Coal Reserves, Coshocton County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	3,667	12,025	3,915	19,607
Probable	39,002	64,609	5,297	108,908
Strongly inferred	32,125	31,145	230	63,500
Weakly inferred	17,070	-	-	17,070
Total	91,864	107,779	9,442	209,085

The outcrops (Fig. 9) of the Lower Kittanning coal extend southward from Holmes County and westward from Tuscarawas and Guernsey Counties, and the coal thickness appears to be similar to the irregularities found in Tuscarawas County and others.

In the northeastern part of the county in Mill Creek and Crawford Townships and the adjacent environs in Keene and White Eyes Townships the coal is generally thin, less than 14 inches. From this area to the southwest the coal thickness increases gradually; and in Clark, Bethlehem, and southwestern Keene, White Eyes, Tuscarawas, and Lafayette Townships the coal attains a thickness of over 28 inches. To the south and west of this area the coal again thins, and in Jackson and southwestern Bethlehem Townships an area of about 30 square miles of the coal is less than 14 inches thick. To the south in the southern half of Virginia, Franklin, and the western portion of Linton Township a large area contiguous with adjacent Muskingum County is believed to contain only thin (less than 14 inches) coal in the Lower Kittanning bed. There is very little actual supporting data, but in consideration of the lack of mines in the Lower Kittanning coal, combined with the data found in adjacent areas, it appears that the coal is generally thin. It is possible that local thickening or lensing of the bed occurs, but such areas have not been described.

Mining of this bed in Coshocton County is very slight, and currently there is no reported production. It is possible that some mining in the bed is done but that identification of the bed is in error. Even with this possibility, it is unlikely that the amount would be very large.

NOBLE COUNTY

Lower Kittanning coal is present in the very northwesternmost part of Noble County in parts of Buffalo and Noble Townships. This is the border area between acreage for which coal is estimated and that for which distance from positive data is too great to form a reasonable estimate. All of the rest of Noble County and the area southeast to the Ohio River is omitted for purposes of this estimate. Gross and detailed summaries may be found in Tables 18 and 31 respectively.

Table 18
Estimated Original Lower Kittanning Coal Reserves, Noble County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	-	369	506	875
Probable	685	8,400	92	9,177
Strongly inferred	16,752	2,889	-	19,641
Weakly inferred	40,781	-	-	40,781
Total	58,218	11,658	598	70,474

MUSKINGUM COUNTY

The Lower Kittanning coal in Muskingum County is predominantly of less than minable thickness. Table 19 is a summary of the estimated reserves for the county, and a detailed listing may be consulted in Table 31.

Table 19

Estimated Original Lower Kittanning Coal Reserves, Muskingum County
(In thousands of short tons)

Reliability category	Thickness			
	14" - 28"	28" - 42"	42" & over	Total
Proven	4,836	4,031	11,288	20,155
Probable	27,496	43,847	11,795	83,138
Strongly inferred	53,702	19,756	-	73,458
Weakly inferred	281,348	-	-	281,348
Total	367,382	67,634	23,083	458,099

From the data thus far gathered for the Lower Kittanning coal in Muskingum County it appears that the bed is generally too thin to support mining over most of its extent in the county. A few of the exceptional areas which do contain minable thicknesses of this coal are as follows: (1) in Newton Township a small area of about 1.5 square miles in the east central part shows thicknesses up to 16 inches; (2) in the east central portion of the county just to the south and east of Zanesville, a linear area of coal more than 28 inches thick is found just east of the Muskingum River, and within this area is a smaller deposit of coal in excess of 42 inches; (3) a moderately wide expanse of the coal at minable thickness is believed to underlie Salt Creek, Rich Hill, Union, and Perry Townships, part of Washington Township and Highland Township, and a portion of Monroe Township. This conjecture is made on the basis of information from along the Muskingum River and from adjacent counties (Stout, 1918, pp. 164-172). To the south of this area the coal is either thin or there are insufficient data to make a satisfactory appraisal (Fig. 10).

The generally thin nature of the Lower Kittanning bed has discouraged much mining in it, but there have been a few small-scale operations from time to time in the past. Most of these have been underground with production of less than 1,000 tons annually until 1953 when production exceeded 18,000 tons.

MORGAN COUNTY

The Lower Kittanning coal is estimated on the basis of data from surrounding areas, and the appraisal is listed in Tables 20 and 31.

Table 20

Estimated Original Lower Kittanning Coal Reserves, Morgan County
(In thousands of short tons)

Reliability category	Thickness			
	14" - 28"	28" - 42"	42" & over	Total
Proven	-	-	-	-
Probable	-	-	-	-
Strongly inferred	3,124	-	-	3,124
Weakly inferred	97,289	-	-	97,289
Total	100,413	-	-	100,413

ESTIMATE OF THE RESERVES

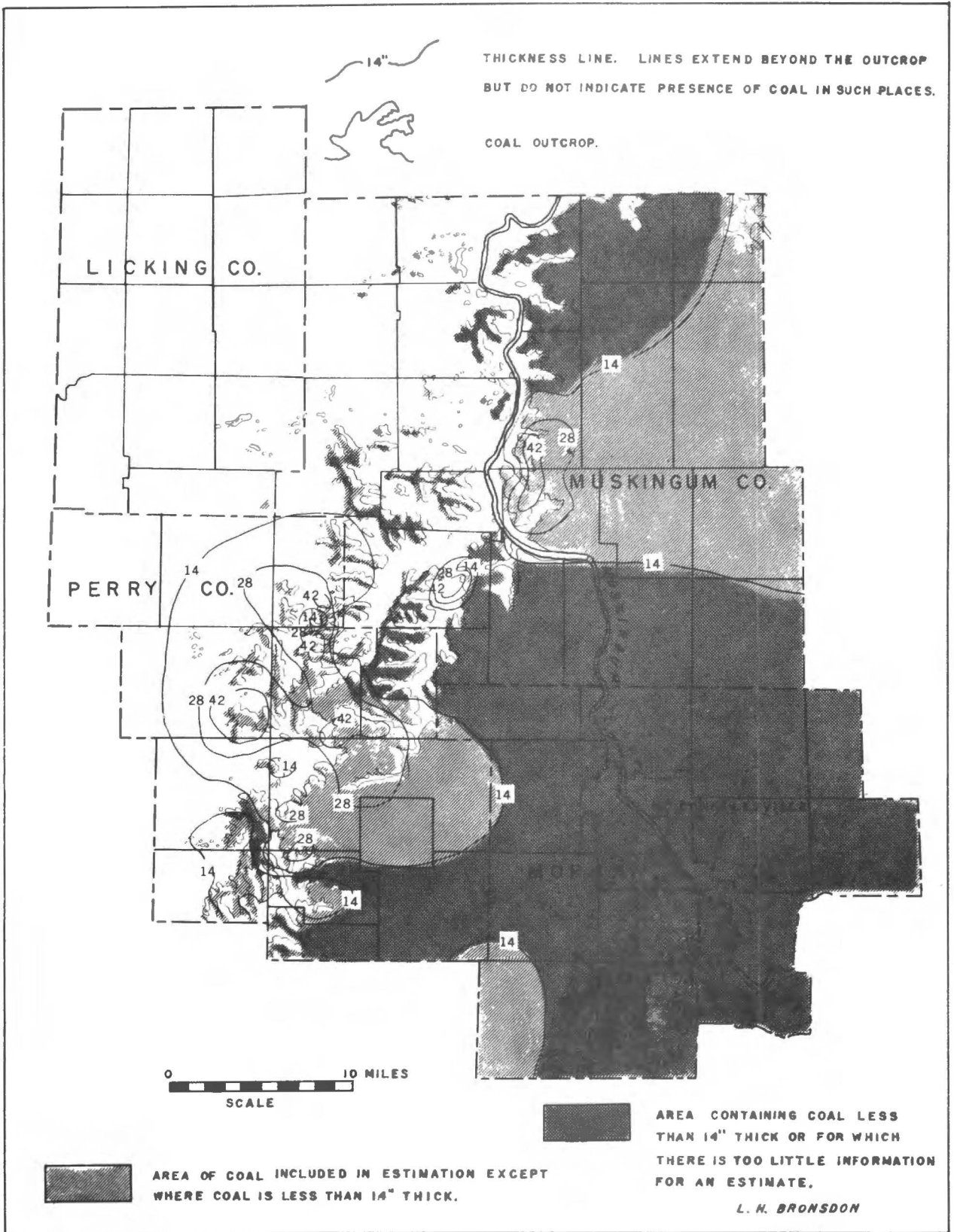


FIGURE 10. The Lower Kittanning Coal in Licking, Perry, Muskingum, and Morgan Counties.

A very small part of Morgan County is considered in the estimate of the Lower Kittanning coal, because the coal bed dips under deep cover to the southeast, and too little information exists to make a worthwhile estimate. However, part of the county contains minable thickness of this coal, and certain portions of the county are reported upon at this time. The southern portion of York and the western portion of Deerfield Townships probably have coal in the Lower Kittanning bed that may range up to 28 inches or greater (Fig. 10). No mining of this bed is known in Morgan County.

PERRY COUNTY

The present report of 295,884,000 tons of estimated original Lower Kittanning coal reserves is at variance with three previous estimates made for the county. Table 22 summarizes original reserves by township and author, Table 21 lists the reserves of the county by thickness and reliability category, whereas more detailed listing by township and various categories is found in Table 31.

Table 21
Estimated Original Lower Kittanning Coal Reserves, Perry County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	7,605	24,962	13,084	45,651
Probable	60,373	67,261	18,200	145,834
Strongly inferred	45,496	7,961	-	53,457
Weakly inferred	50,942	-	-	50,942
Total	164,416	100,184	31,284	295,884

Flint (1951, pp. 99-104) gives a figure of 171,175,680 tons as the original coal reserve for the county, and Clark (1917, p. 94) estimates 459,000,000 tons as the original coal reserve of this bed. Although his approach is not published, Flint's was more conservative than the present author's in dealing with coal below drainage. On the other hand, Clark (1917) used an average thickness over the entire area of Lower Kittanning coal in Perry County which apparently did not take into account the persistently thin areas of coal.

Here the bed has the same general habit as it exhibits to the north in Tuscarawas County and adjacent counties southward. The central and northern portions of the county contain coal of 14 inches thickness or greater. In the northern part of the county in Reading, Clay, Bearfield, Harrison, and Pike Townships, the coal exceeds 28 inches thickness in many areas. In central Reading Township local thickening of up to 64 inches is recorded. In southeast Clayton Township up to 58 inches of coal is recorded for this bed, but the thickness is generally very erratic (Bowen, 1947, pp. 40-41).

To the south there is a rather large area of thin coal in the central part of the county, but minable thickness is regained still farther south in Monday Creek and Salt Creek Townships. The bed goes beneath drainage in the southeast central portion of the county. (See Fig. 10.) Moderate amounts of mining have taken place in the Lower Kittanning coal bed, and Flint (1951) reports that over 13 million tons has been mined or lost in mining. Since that time an additional $1\frac{1}{2}$ million tons more has been removed, making the total tonnage removed approximately 15 million tons. Current production is reported at 314,917 tons (1953), production from the Lower Kittanning bed having substantially decreased during the last seven years. During 1946 the bed was not so extensively mined, for in that year the tonnage reported was only 183,200. The peak year was 1948 when 752,579 tons were reported mined. Nearly all of the

Table 22

Estimated Original Reserves of the Lower Kittanning Coal Bed in Perry County,
By Township and Author
(Short tons)

Township	Author*	
	Flint (1951)	Brant (1954)
Total	171, 175, 680	295, 884, 000
Bearfield	33, 891, 840	58, 408, 000
Coal	2, 488, 320	362, 000
Clayton	45, 999, 360	51, 761, 000
Harrison	19, 042, 560	25, 039, 000
Hopewell	--	643, 000
Jackson	8, 657, 280	7, 152, 000
Madison	7, 084, 800	10, 036, 000
Monday Creek	7, 067, 520	8, 526, 000
Monroe	--	6, 229, 000
Pike	32, 745, 600	59, 806, 000
Pleasant	--	31, 809, 000
Reading	12, 539, 520	18, 865, 000
Salt Lick	1, 658, 880	17, 248, 000

*Clark's estimate (1917) for Perry County amounted to 459 million tons. See Table 2.

production the past few years has been by stripping; prior to this a greater percent was probably produced by underground mining. In a number of places the Lower Kittanning and Middle Kittanning coals lie close together and are mined simultaneously in stripping operations.

HOCKING COUNTY

Of the northern two tiers of townships only in Falls Gore Township, part of Ward and part of Green Townships does the coal exceed 14 inches in thickness. One exceptional thickness of 51 inches is recorded, but the coal is usually thinner than this. It is generally thin over most of the rest of the county. Certain exceptions do occur as in the central portion of Starr Township and the border area of Washington and Starr Townships where the coal exceeds 42 inches in thickness in an outlier (Fig. 11). The estimated reserves for this bed in Hocking County may be found in Tables 23 and 31. Only a little of this coal has been mined.

VINTON COUNTY

The reserves estimate of the Lower Kittanning coal in this county is classed as thin, 14-28 inches. Table 24 summarizes the estimated original coal reserves of the bed, and Table 31 gives a listing by township.

Table 23

Estimated Original Lower Kittanning Coal Reserves, Hocking County
(In thousands of short tons)

Reliability category	Thickness			
	14" - 28"	28" - 42"	42" & over	Total
Proven	5,984	234	1,105	7,323
Probable	31,749	2,923	1,519	36,191
Strongly inferred	4,757	-	-	4,757
Weakly inferred	-	-	-	-
Total	42,490	3,157	2,624	48,271

The Lower Kittanning coal bed in this county is a poor contributor to the total resources of this bed in Ohio. In only a few areas in Vinton County is the coal sufficiently thick to be considered a reserve. It has been mined for local use only. In the east central part of Brown Township an area of the coal is estimated to range from 14 to 28 inches in thickness. In southwestern Clinton Township an outlier shows 28 inches or more of this coal. To the north the coal thins to less than 14 inches in the northeastern part of Clinton Township and adjacent areas, but in the outliers in Elk and Madison Townships the thickness increases to over 28 inches in places. North of this area, however, in western Brown and eastern Swan Townships, the coal thins to less than 14 inches thickness (Fig. 11).

Table 24

Estimated Original Lower Kittanning Coal Reserves, Vinton County
(In thousands of short tons)

Reliability category	Thickness			
	14" - 28"	28" - 42"	42" & over	Total
Proven	17,838	24,726	1,105	43,669
Probable	99,748	37,530	-	137,278
Strongly inferred	22,133	-	-	22,133
Weakly inferred	887	-	-	887
Total	140,606	62,256	1,105	203,967

Mining of the coal is on a very small scale, and during the past few years has seldom exceeded a few thousand tons. In 1946, however, 19,834 tons was reported mined. Probably some of the coal has been removed in connection with clay mining for the ceramics industry.

ATHENS COUNTY

The No. 5 coal outcrop enters the county in the northwestern corner in York Township and follows the Hocking River valley and its tributaries for about 5 miles downstream (Fig. 11). The coal thickness is not exceptional and probably averages 21 inches in this area. This coal also underlies the northwestern quarter of the county. In the southeast the area is contiguous to areas of known thin coal and to those of little or doubtful thickness. The outcrop is also found in northern Waterloo Township where the coal measures only 13 inches at the county line. Table 25 gives a resumé of the estimated original reserves of the Lower Kittanning bed in the county, and Table 31 lists the estimates by township. Very little mining of this coal is known in the county.

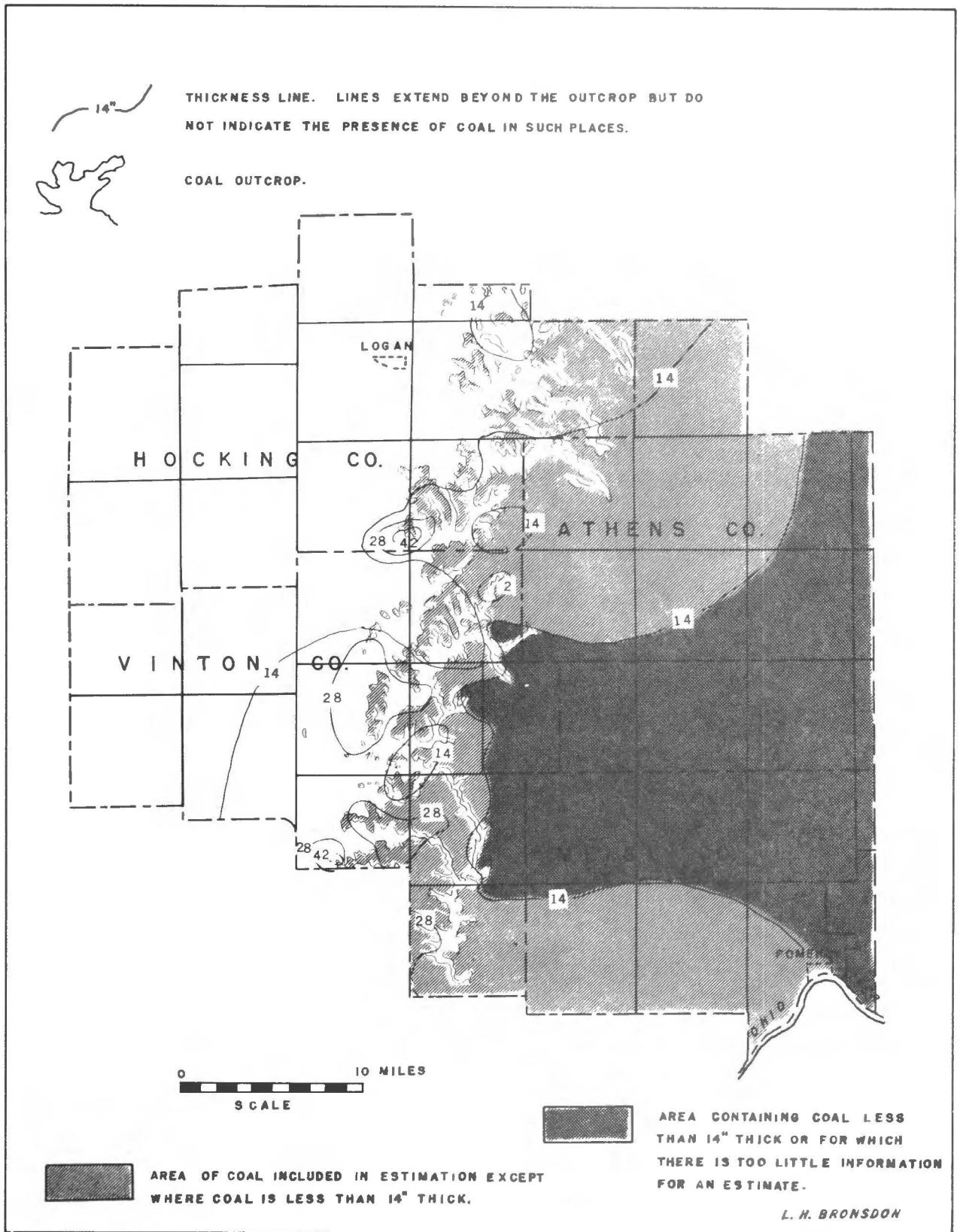


FIGURE II. The Lower Kittanning Coal in Athens, Hocking, Meigs, and Vinton Counties.

Table 25

Estimated Original Lower Kittanning Coal Reserves, Athens County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	3,931	-	-	3,931
Probable	22,840	-	-	22,840
Strongly inferred	63,058	-	-	63,058
Weakly inferred	232,723	-	-	232,723
Total	322,552	-	-	322,552

MEIGS COUNTY

No outcrops of the Lower Kittanning coal occur in this county, but on the basis of information from surrounding areas, the southern tier of townships probably contains coal between 14 and 28 inches in thickness. See Tables 26 and 31 for an estimate of original reserves and Figure 11 for the estimated areal extent.

Table 26

Estimated Original Lower Kittanning Coal Reserves, Meigs County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	-	-	-	-
Probable	-	-	-	-
Strongly inferred	10,301	-	-	10,301
Weakly inferred	216,112	-	-	216,112
Total	226,413	-	-	226,413

JACKSON COUNTY

The Lower Kittanning coal underlies the eastern border region of the county. Although the estimate of the original reserves is not large, 169,639,000 tons, it is interesting that a substantial amount, 119,680,000 tons, falls into the 28-42 inch class. (See Tables 27 and 31.)

The coal is generally well developed over the area of its occurrence at thicknesses ranging over 14 inches (Fig. 12). The largest apparent area of thin coal in the Lower Kittanning bed, less than 14 inches, is in southeastern Madison Township. This coal bed is somewhat more uniform in its thickness than has been found in the region to the immediate north. There are no known extensive areas of exceptionally thick coal, however, and in general it averages only about 28 inches. In western Milton Township and in north central Bloomfield Township there are moderately large areas of coal that exceed 28 inches in thickness. A moderate area of coal over 42 inches occurs in the northern part of Madison Township. Areas not otherwise described are probably underlain by coal ranging from 14 to 28 inches in thickness.

Table 27

Estimated Original Lower Kittanning Coal Reserves, Jackson County
(In thousands of short tons)

Reliability category	Thickness			
	14" - 28"	28" - 42"	42" & over	Total
Proven	8,768	39,983	7,002	55,753
Probable	19,957	71,835	11,011	102,803
Strongly inferred	2,921	7,862	276	11,059
Weakly inferred	20	-	-	20
Total	31,666	119,680	18,289	169,635

Above the Lower Kittanning bed, at intervals ranging from a few inches to a few feet, Stout (1916, p. 252) reports the occurrence of the "Lost Seam." This bed is found with the Lower Kittanning coal in some places and is noted in Section 2 of Milton Township. Reserves in the "Lost Seam" are not included in the estimate, since it is only local in development and may very likely be left for roof in underground operations. This seam, however, also makes its appearance in Lawrence County.

Mining in the Lower Kittanning bed apparently was much more developed in the past than it is today. Records for the past few years show production has varied from 18,000 tons to as much as the 116,000 tons produced in 1948. Since that year production has gradually declined, and in 1953 somewhat over 18,000 tons was recovered. Most of the production in recent years has been by strip methods, but in the 1945-47 period over half of the reported tonnage still came from underground operations.

GALLIA COUNTY

Outcrops of the Lower Kittanning coal enter the county from the northwest in Huntington Township. In southern Huntington Township an area of the coal exceeds 28 inches in thickness, and based on information taken from drill holes in Gallipolis and Addison Townships, most of the remainder of the county probably contains coal of this bed at minable thicknesses. A summary of the estimate of the original coal reserves of the Lower Kittanning bed appears in Table 28, and Table 31 lists the estimate by township. As can be seen, most of the estimate is in the inferred category, having been based on the broader aspects of the bed as seen in its surrounding exposures and on the core information from Addison Township. Outcrops enter the county from the west and north from Jackson and Vinton Counties, and specifically the coal is exposed in Greenfield and Huntington Townships. A measurement in Huntington Township,

Table 28

Estimated Original Lower Kittanning Coal Reserves, Gallia County
(In thousands of short tons)

Reliability category	Thickness			
	14" - 28"	28" - 42"	42" & over	Total
Proven	7,738	7,526	-	15,264
Probable	63,702	41,629	-	105,331
Strongly inferred	148,592	6,854	-	155,446
Weakly inferred	671,988	-	-	671,988
Total	892,020	56,009	-	948,029

LOWER KITTANNING COAL

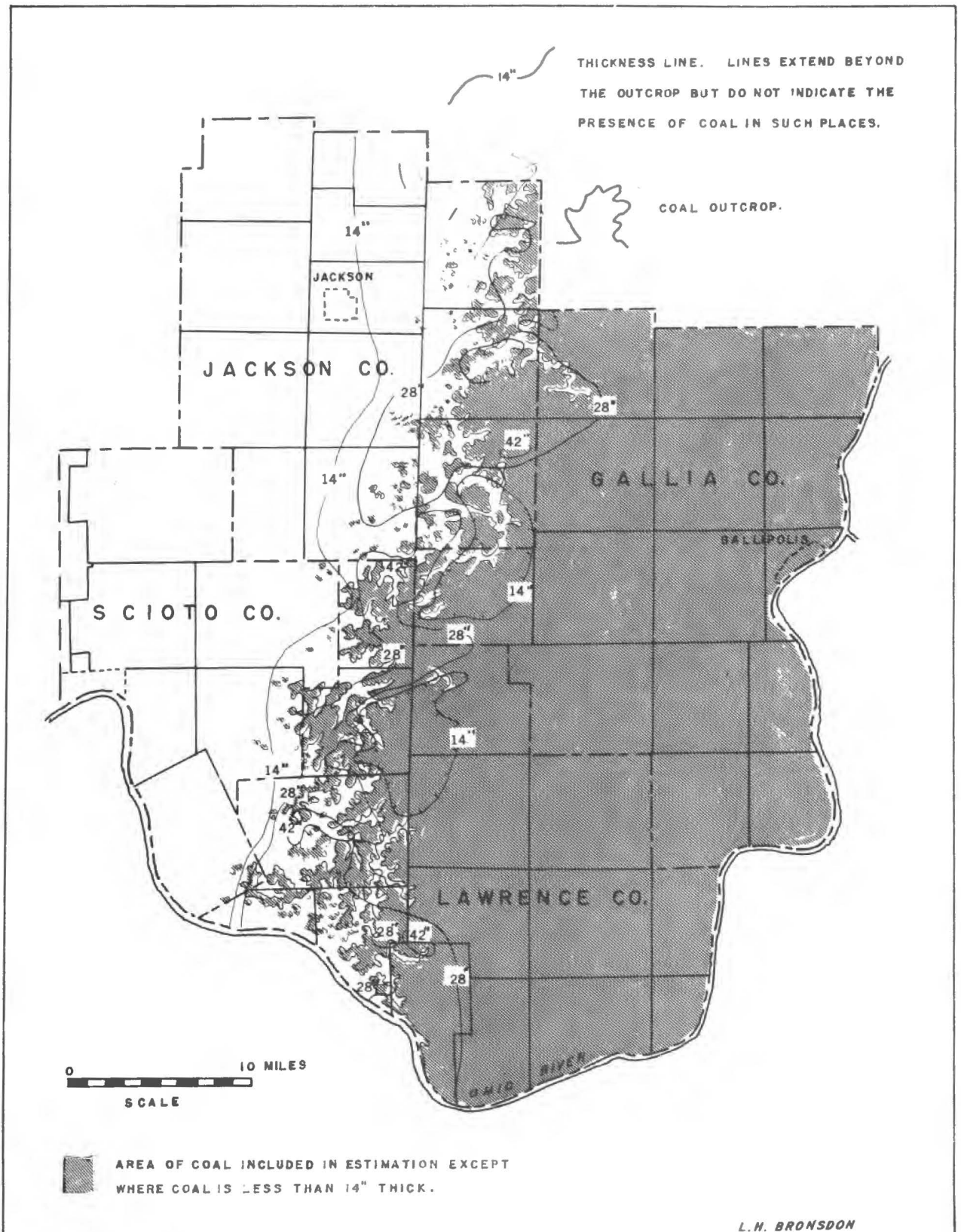


FIGURE 12. The Lower Kittanning Coal in Gallia, Jackson, Lawrence, and Scioto Counties.

Section 7, indicates 30 inches of coal. The coal in most of the rest of the township averages 21 inches in thickness. The area of exposure, Greenfield Township, shows variable thickness for this coal, and from the data available, the central and northeastern portions of the county are apparently underlain by the Lower Kittanning coal of less than minable thickness. An anticlinal flexure brings nearer the surface beds that would be ordinarily expected at greater depths, and in Walnut Township in Section 12 along Symmes Creek, the Lower Kittanning coal is exposed and shows as a 24-inch thick blossom. It is estimated that the rest of the township contains the Lower Kittanning coal at thickness in excess of 14 inches (Fig. 12).

There has been no reported production from the Lower Kittanning bed in recent years, but in the past it was one of the important contributors to the fuel supply of the area.

LAWRENCE COUNTY

This county is one of the principal producing areas of the Lower Kittanning coal. It also contains one of the larger original reserves of this bed. The reserves are summarized in Table 29 and listed by township in Table 31. Exposures are found in the outcrop areas in the following townships: Washington, Symmes, Decatur, Elizabeth, Hamilton, Lawrence, Upper, and Aid.

Table 29

Estimated Original Lower Kittanning Coal Reserves, Lawrence County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	16,285	53,487	8,891	78,663
Probable	73,097	129,492	6,127	208,716
Strongly inferred	77,935	21,031	-	98,966
Weakly inferred	422,931	3,426	-	426,357
Total	590,248	207,436	15,018	812,702

In most of the area of exposure of the outcrop of the Lower Kittanning bed minable thicknesses of coal are found. The Lower Kittanning coal, however, appears thinner than 14 inches in an area including central and southwestern Symmes Township, east central and southeast Decatur Township, northeastern corner of Elizabeth Township, and probably northwestern part of Aid Township. Other minor areas of thin coal, less than 14 inches, are found in parts of Upper and southern Elizabeth Townships. Apparently the coal "rolls" considerably in some areas. A large part of the coal in the outcrop region exceeds 28 inches in thickness, and in places such as central Elizabeth Township, a moderate area exceeds 42 inches average thickness. Most of the rest of the Lower Kittanning coal area probably contains this coal at 14 inches thickness or greater (Fig. 12).

The "Lost Seam" is described by Stout (1916, pp. 387-388). It overlies the Lower Kittanning at an interval of 1 to 6 feet. It has, in some places, been recovered in the same operation, but because it occupies only a small area and because the quality is not high, it is not included in the estimates for the Lower Kittanning bed.

Since 1948 annual production of all coal from Lawrence County has varied from 100,000 to 200,000 tons and over. Prior to that time total production was usually well under 100,000. During the last seven years (1947-1952) annual production from the Lower Kittanning bed rose from 15,831 to 153,565 tons, but in 1953 production reported from the same seam decreased to only 24,765 tons. Most of the older production from this bed was from underground operations; but in recent years, substantial tonnage was removed by stripping.

LOWER KITTANNING COAL

SCIOTO COUNTY

The small outliers of the Lower Kittanning coal of minable thickness are in Vernon, Green, and Bloom Townships. It is estimated that slightly more than 2 square miles contained the coal before any mining began. The estimated original reserves are listed in Table 30 and 31.

Table 30

Estimated Original Lower Kittanning Coal Reserves, Scioto County
(In thousands of short tons)

Reliability category	Thickness			Total
	14" - 28"	28" - 42"	42" & over	
Proven	120	974	-	1,094
Probable	2,277	1,175	-	3,452
Strongly inferred	362	-	-	362
Weakly inferred	-	-	-	-
Total	2,759	2,149	-	4,908

Table 31

ESTIMATED ORIGINAL RESERVES OF THE LOWER KITTANNING COAL BED IN OHIO

(In thousands of short tons. To obtain total tonnage add three zeros to end of each figure.)

County and Township	Proven coal				Probable coal				Strongly inferred coal				Weakly inferred coal				Total			
	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total
ATHENS																				
Ames	--	--	--	--	--	--	--	--	--	--	--	--	32,517	--	--	32,517	32,517	--	--	32,517
Athens	--	--	--	--	--	--	--	--	--	--	--	--	34,917	--	--	34,917	34,917	--	--	34,917
Canaan	--	--	--	--	--	--	--	--	--	--	--	--	1,008	--	--	1,008	1,008	--	--	1,008
Dover	--	--	--	--	--	--	--	--	12,680	--	--	12,680	62,697	--	--	62,697	75,377	--	--	75,377
Trimble	--	--	--	--	--	--	--	--	6,229	--	--	6,229	57,032	--	--	57,032	63,261	--	--	63,261
Waterloo	--	--	--	--	2,701	--	--	2,701	16,591	--	--	16,591	31,711	--	--	31,711	51,003	--	--	51,003
York	3,931	--	--	3,931	20,139	--	--	20,139	27,558	--	--	27,558	12,841	--	--	12,841	64,469	--	--	64,469
Total	3,931	--	--	3,931	22,840	--	--	22,840	63,058	--	--	63,058	232,723	--	--	232,723	322,552	--	--	322,552
CARROLL																				
Augusta	--	--	--	--	--	4,368	--	4,368	11,773	5,510	--	17,283	38,343	--	--	38,343	50,116	9,878	--	59,994
Brown	--	9,609	3,225	12,834	--	66,830	22,763	89,593	4,979	31,617	--	36,596	1,935	--	--	1,935	6,914	108,056	25,988	140,958
Center	--	--	--	--	--	--	--	--	--	--	--	--	40,078	--	--	40,078	40,078	--	--	40,078
East	--	--	--	--	--	--	--	--	--	--	--	--	46,630	--	--	46,630	46,630	--	--	46,630
Fox	--	--	--	--	--	--	--	--	--	--	--	--	73,906	--	--	73,906	73,906	--	--	73,906
Harrison	--	--	--	--	--	--	--	--	745	10,550	--	11,295	51,649	8,836	--	60,485	52,394	19,386	--	71,780
Lee	--	--	--	--	--	--	--	--	--	--	--	--	65,116	--	--	65,116	--	--	--	65,116
Loudon	--	--	--	--	--	--	--	--	--	--	--	--	51,972	--	--	51,972	51,972	--	--	51,972
Monroe	--	--	--	--	1,270	--	--	1,270	16,551	571	--	17,122	36,489	--	--	36,489	54,310	571	--	54,881
Orange	2,399	--	--	2,399	22,196	--	--	22,196	19,212	1,008	--	20,220	887	--	--	887	44,694	1,008	--	45,702
Perry	--	--	--	--	--	--	--	--	3,265	--	--	3,265	53,182	--	--	53,182	56,447	--	--	56,447
Rose	282	12,835	--	13,117	3,487	41,865	--	45,352	9,172	26,544	--	35,716	2,661	100	--	2,761	15,602	81,344	--	96,946
Union	--	--	--	--	--	--	--	--	443	--	--	443	46,105	--	--	46,105	46,548	--	--	46,548
Washington	--	--	--	--	--	--	--	--	--	--	--	--	66,231	--	--	66,231	66,231	--	--	66,231
Total	2,681	22,444	3,225	28,350	26,953	113,063	22,763	162,779	66,140	75,800	--	141,940	575,184	8,936	--	584,120	670,958	220,243	25,988	917,189
COLUMBIANA																				
Butler	--	201	--	201	403	23,251	46	23,700	11,229	51,609	921	63,759	5,281	6,988	--	12,269	16,913	82,049	967	99,929
Center	2,096	7,089	2,211	11,396	15,361	41,764	322	57,447	15,361	11,155	--	26,516	1,814	--	--	1,814	34,632	60,008	2,533	97,173
Elk Run	10,604	4,603	--	15,207	30,844	15,556	--	46,400	13,043	4,032	--	17,075	--	--	--	--	54,491	24,191	--	78,682
Fairfield	241	33	--	274	13,345	13,507	--	26,852	44,412	--	--	44,412	6,814	--	--	6,814	64,812	13,540	--	78,352
Franklin	--	--	--	--	--	--	--	--	--	--	--	--	46,972	--	--	46,972	46,972	--	--	46,972
Hanover	--	--	--	--	--	--	--	--	19,635	--	4,884	24,519	53,000	--	--	53,000	72,635	--	4,884	77,519
Knox	201	5,443	--	5,644	9,757	15,926	--	25,683	12,760	19,958	--	32,718	6,491	2,083	--	8,574	29,209	43,410	--	72,619
Liverpool	6,088	--	--	6,088	8,588	--	--	8,588	--	--	--	--	--	--	--	--	14,676	--	--	14,676
Madison	1,995	1,041	--	3,036	10,624	15,254	--	25,878	33,183	11,188	--	44,371	9,334	--	--	9,334	55,136	27,483	--	82,619
Middleton	3,286	--	--	3,286	18,809	--	--	18,809	26,288	--	--	26,288	3,790	--	--	3,790	52,173	--	--	52,173
Perry	--	3,864	3,778	7,642	--	17,908	30,781	48,689	--	5,208	2,949	8,157	--	--	--	--	--	26,980	37,508	64,488
St. Clair	8,588	873	--	9,461	27,982	--	--	27,982	5,544	--	--	5,544	--	--	--	--	42,114	873	--	42,987
Salem	806	15,321	--	16,127	9,394	47,443	--	56,837	6,552	--	--	6,552	--	--	--	--	16,752	62,764	--	79,516
Unity	80	33	--	113	8,930	6,820	--	15,750	33,989	302	--	34,291	16,672	--	--	16,672	59,671	7,155	--	66,826

ESTIMATE OF THE RESERVES

Table 31 (continued)

ESTIMATED ORIGINAL RESERVES OF THE LOWER KITTANNING COAL BED IN OHIO

(In thousands of short tons. To obtain total tonnage add three zeros to end of each figure.)

LOWER KITTANNING COAL

County and Township	Proven coal				Probable coal				Strongly inferred coal				Weakly inferred coal				Total			
	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total
Washington	--	100	--	100	--	6,988	--	6,988	12,841	6,182	--	19,023	25,320	--	--	25,320	38,161	13,270	--	51,431
Wayne	--	--	--	--	--	--	--	--	9,676	--	--	9,676	41,348	--	--	41,348	51,024	--	--	51,024
West	--	--	--	--	--	2,889	--	2,889	23,203	4,065	--	27,268	43,706	--	--	43,706	66,909	6,954	--	73,863
Yellow Creek	6,834	4,771	--	11,605	12,196	14,716	--	26,912	2,136	2,083	--	4,219	--	--	--	--	21,166	21,570	--	42,736
Total	40,819	43,372	5,989	90,180	166,233	222,022	31,149	419,404	269,852	115,782	8,754	394,388	260,542	9,071	--	269,613	737,446	390,247	45,892	1,173,585
COSHOCTON																				
Adams	--	1,948	--	1,948	2,439	12,936	--	15,375	3,225	3,024	--	6,249	--	--	--	--	5,664	17,908	--	23,572
Bedford	--	1,512	230	1,742	443	10,987	2,672	14,102	221	9,240	46	9,507	40	--	--	40	704	21,739	2,948	25,391
Bethlehem	--	--	--	--	--	1,276	--	1,276	2,318	4,368	--	6,686	161	--	--	161	2,479	5,644	--	8,123
Clark	--	537	--	537	201	6,787	--	6,988	1,874	1,982	--	3,856	80	--	--	80	2,155	9,306	--	11,461
Crawford	725	470	--	1,195	2,136	840	--	2,976	40	--	--	40	--	--	--	--	2,901	1,310	--	4,211
Franklin	--	--	--	--	302	--	--	302	221	--	--	221	--	--	--	--	523	--	--	523
Jackson	1,169	33	1,428	2,630	12,640	11,928	276	24,844	3,427	3,628	--	7,055	141	--	--	141	17,377	15,589	1,704	34,670
Jefferson	--	--	--	--	40	--	--	40	1,008	--	--	1,008	40	--	--	40	1,088	--	--	1,088
Keene	--	1,915	645	2,560	1,975	6,148	--	8,123	705	3,360	--	4,065	--	--	--	--	2,680	11,423	645	14,748
Lafayette	--	--	--	--	504	--	--	504	2,983	336	--	3,319	322	--	--	322	3,809	336	--	4,145
Linton	--	--	--	--	--	--	--	--	3,185	--	--	3,185	15,744	--	--	15,744	18,929	--	--	18,929
Mill Creek	--	1,646	--	1,646	1,814	3,696	--	5,510	1,330	336	--	1,666	--	--	--	--	3,144	5,678	--	8,822
Monroe	20	403	--	423	--	--	--	--	282	--	--	282	341	--	--	341	643	403	--	1,046
Oxford	1,028	--	--	1,028	5,523	--	--	5,523	3,729	--	--	3,729	--	--	--	--	10,280	--	--	10,280
Perry	--	--	--	--	--	--	--	--	181	--	--	181	--	--	--	--	181	--	--	181
Pike	--	--	--	--	--	--	--	--	60	--	--	60	201	--	--	201	261	--	--	261
Tuscarawas	665	67	--	732	5,644	33	--	5,677	1,975	--	--	1,975	--	--	--	--	8,284	100	--	8,384
Virginia	--	672	1,336	2,008	2,399	6,384	92	8,875	4,394	1,041	--	5,435	--	--	--	--	6,793	8,097	1,428	16,318
Washington	--	--	138	138	221	1,041	2,257	3,519	544	2,654	184	3,382	--	--	--	--	765	3,695	2,579	7,039
White Eyes	60	2,822	138	3,020	2,721	2,553	--	5,274	423	1,176	--	1,599	--	--	--	--	3,204	6,551	138	9,893
Total	3,667	12,025	3,915	19,607	39,002	64,609	5,297	108,908	32,125	31,145	230	63,500	17,070	--	--	17,070	91,864	107,779	9,442	209,085
GALLIA																				
Addison	3,003	--	--	3,003	23,022	--	--	23,022	26,792	--	--	26,792	3,064	--	--	3,064	55,881	--	--	55,881
Cheshire	--	--	--	--	--	--	--	--	2,600	--	--	2,600	60,560	--	--	60,560	63,160	--	--	63,160
Clay	--	--	--	--	--	--	--	--	--	--	--	--	45,622	--	--	45,622	45,622	--	--	45,622
Gallipolis	1,310	--	--	1,310	10,684	--	--	10,684	8,064	--	--	8,064	1,270	--	--	1,270	21,328	--	--	21,328
Green	--	--	--	--	--	--	--	--	6,914	--	--	6,914	71,124	--	--	71,124	78,038	--	--	78,038
Greenfield	2,620	2,184	--	4,804	8,991	12,062	--	21,053	10,200	--	--	10,200	40	--	--	40	21,851	14,246	--	36,097
Guyan	--	--	--	--	--	--	--	--	--	--	--	--	64,270	--	--	64,270	64,270	--	--	64,270
Harrison	--	--	--	--	--	--	--	--	--	--	--	--	64,935	--	--	64,935	64,935	--	--	64,935
Huntington	805	5,342	--	6,147	17,095	24,359	--	41,454	32,557	336	--	32,893	5,342	--	--	5,342	55,799	30,037	--	85,836
Morgan	--	--	--	--	--	--	--	--	141	--	--	141	63,947	--	--	63,947	64,088	--	--	64,088

Table 31 (continued)

ESTIMATED ORIGINAL RESERVES OF THE LOWER KITTANNING COAL BED IN OHIO

(In thousands of short tons. To obtain total tonnage add three zeros to end of each figure.)

County and Township	Proven coal				Probable coal				Strongly inferred coal				Weakly inferred coal				Total			
	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total
Ohio	--	--	--	--	--	--	--	--	--	--	--	--	48,121	--	--	48,121	48,121	--	--	48,121
Perry	--	--	--	--	1,915	--	--	1,915	15,724	--	--	15,724	60,379	--	--	60,379	78,018	--	--	78,018
Raccoon	--	--	--	--	1,995	5,208	--	7,203	31,812	6,518	--	38,330	35,743	--	--	69,550	69,550	11,726	--	81,276
Springfield	--	--	--	--	--	--	--	--	6,531	--	--	6,531	69,310	--	--	69,310	75,841	--	--	75,841
Walnut	--	--	--	--	--	--	--	--	7,257	--	--	7,257	78,261	--	--	78,261	85,518	--	--	85,518
Total	7,738	7,526	--	15,264	63,702	41,629	--	105,331	148,592	6,854	--	155,446	671,988	--	--	671,988	892,020	56,009	--	948,029
GUERNSEY																				
Adams	--	--	--	--	--	--	--	--	--	--	--	--	38,727	19,924	--	58,651	38,727	19,924	--	58,651
Cambridge	--	--	--	--	--	7,627	7,280	14,907	262	35,448	414	36,124	36,489	11,020	--	47,509	36,751	54,095	7,694	98,540
Center	--	--	--	--	--	--	--	--	1,270	8,131	--	9,401	43,263	--	--	43,263	44,533	8,131	--	52,664
Jackson	--	--	--	--	--	--	--	--	8,346	--	--	8,346	41,388	--	--	41,388	49,734	--	--	49,734
Jefferson	--	--	--	--	--	1,377	5,944	7,321	--	31,113	5,207	36,320	16,934	18,984	--	35,918	16,934	51,474	11,151	79,559
Knox	--	--	--	--	--	--	--	--	--	5,544	--	5,544	14,273	46,972	--	61,245	14,273	52,516	--	66,789
Liberty	--	1,310	5,760	7,070	383	21,067	21,242	42,692	181	21,940	1,474	23,595	--	--	--	--	564	44,317	28,476	73,357
Londonderry	--	--	--	--	--	--	--	--	--	--	--	--	51,508	--	--	51,508	51,508	--	--	51,508
Madison	--	--	--	--	--	--	--	--	--	--	--	--	50,480	--	--	50,480	50,480	--	--	50,480
Millwood	--	--	--	--	--	--	--	--	--	--	--	--	765	--	--	765	765	--	--	765
Monroe	--	--	--	--	--	--	--	--	8,164	10,718	--	18,882	33,828	5,174	--	39,002	41,992	15,892	--	57,884
Oxford	--	--	--	--	--	--	--	--	--	--	--	--	15,160	--	--	15,160	15,160	--	--	15,160
Richland	--	--	--	--	--	--	--	--	--	--	--	--	46,771	--	--	46,771	46,771	--	--	46,771
Spencer	--	--	--	--	40	672	--	712	24,192	235	--	24,427	36,247	--	--	36,247	60,479	907	--	61,386
Valley	--	705	2,257	2,962	5,826	17,841	1,198	24,865	21,268	2,856	--	24,124	5,140	--	--	5,140	32,234	21,402	3,455	57,091
Washington	--	--	--	--	--	--	--	--	--	--	--	--	48,706	--	--	48,706	48,706	--	--	48,706
Westland	--	--	--	--	--	--	--	--	362	--	--	362	51,871	--	--	51,871	52,233	--	--	52,233
Wheeling	1,411	--	--	1,411	20,522	3,192	--	23,714	19,010	1,209	--	20,219	3,165	403	--	3,568	44,108	4,804	--	48,912
Wills	--	--	--	--	--	--	--	--	--	--	--	--	74,329	--	--	74,329	74,329	--	--	74,329
Total	1,411	2,015	8,017	11,443	26,771	51,776	35,664	114,211	83,055	117,194	7,095	207,344	609,044	102,477	--	711,521	720,281	273,462	50,776	1,044,519
HARRISON																				
Archer	--	--	--	--	--	--	--	--	8,668	--	--	8,668	43,363	--	--	43,363	52,031	--	--	52,031
Cadiz	--	--	--	--	--	--	--	--	--	--	--	--	55,379	--	--	55,379	55,379	--	--	55,379
Franklin	--	--	--	--	--	--	--	--	4,536	--	--	4,536	41,932	--	--	41,932	46,468	--	--	46,468
Freeport	--	--	--	--	--	--	--	--	--	--	--	--	49,593	--	--	49,593	49,593	--	--	49,593
German	--	2,990	1,474	4,464	6,048	12,700	1,198	19,946	20,865	8,937	--	29,802	6,410	--	--	6,410	33,323	24,627	2,672	60,622
Green	--	33	737	770	846	14,683	552	16,081	16,410	13,003	--	29,413	20,905	--	--	20,905	38,161	27,719	1,289	67,169
Monroe	262	--	--	262	7,519	--	--	7,519	25,401	--	--	25,401	21,530	--	--	21,530	54,712	--	--	54,712
Moorefield	--	--	--	--	--	--	--	--	--	--	--	--	17,861	--	--	17,861	17,861	--	--	17,861

ESTIMATE OF THE RESERVES

Table 31 (continued)

ESTIMATED ORIGINAL RESERVES OF THE LOWER KITTANNING COAL BED IN OHIO

(In thousands of short tons. To obtain total tonnage add three zeros to end of each figure.)

County and Township	Proven coal				Probable coal				Strongly inferred coal				Weakly inferred coal				Total			
	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total
North	--	--	--	--	--	--	--	--	--	--	--	--	47,355	--	--	47,355	47,355	--	--	47,355
Nottingham	--	--	--	--	--	--	--	--	--	--	--	--	51,488	--	--	51,488	51,488	--	--	51,488
Rumley	--	--	--	--	--	--	--	--	10,704	--	--	10,704	37,416	--	--	37,416	48,120	--	--	48,120
Short Creek	--	--	--	--	--	--	--	--	--	--	--	--	52,819	--	--	52,819	52,819	--	--	52,819
Washington	--	--	--	--	--	--	--	--	2,257	--	--	2,257	63,423	--	--	63,423	65,680	--	--	65,680
Total	262	3,023	2,211	5,496	14,413	27,383	1,750	43,546	88,841	21,940	--	110,781	509,474	--	--	509,474	612,990	52,346	3,961	669,297
HOCKING																				
Falls	201	--	--	201	2,197	--	--	2,197	--	--	--	--	--	--	--	--	2,398	--	--	2,398
Green	664	--	--	664	3,991	--	--	3,991	--	--	--	--	--	--	--	--	4,655	--	--	4,655
Starr	3,165	201	414	3,780	17,740	2,688	1,059	21,487	2,036	--	--	2,036	--	--	--	--	22,941	2,889	1,473	27,303
Ward	1,954	--	--	1,954	7,801	--	--	7,801	2,721	--	--	2,721	--	--	--	--	12,476	--	--	12,476
Washington	--	33	691	724	20	235	460	715	--	--	--	--	--	--	--	--	20	268	1,151	1,439
Total	5,984	234	1,105	7,323	31,749	2,923	1,519	36,191	4,757	--	--	4,757	--	--	--	--	42,490	3,157	2,624	48,271
HOLMES																				
Berlin	745	6,384	--	7,129	725	7,560	--	8,285	362	--	--	362	--	--	--	--	1,832	13,944	--	15,776
Clark	3,325	705	138	4,168	1,511	637	--	2,148	--	--	--	--	--	--	--	--	4,836	1,342	138	6,316
Hardy	141	1,142	783	2,066	141	1,982	414	2,537	--	--	--	--	--	--	--	--	282	3,124	1,197	4,603
Killbuck	281	638	1,981	2,900	60	--	276	336	--	--	--	--	--	--	--	--	341	638	2,257	3,236
Knox	403	806	--	1,209	2,056	33	--	2,089	201	--	--	201	--	--	--	--	2,660	839	--	3,499
Mechanic	40	268	1,566	1,874	442	1,512	230	2,184	20	--	--	20	--	--	--	--	502	1,780	1,796	4,078
Monroe	--	--	--	--	906	33	--	939	1,108	--	--	1,108	--	--	--	--	2,014	33	--	2,047
Paint	161	3,897	--	4,058	2,298	8,467	--	10,765	141	3,091	--	3,232	--	134	--	134	2,600	15,589	--	18,189
Prairie	161	67	230	458	--	--	46	46	--	--	--	--	--	--	--	--	161	67	276	504
Richland	--	201	92	293	--	--	--	--	--	--	--	--	--	--	--	--	--	201	92	293
Ripley	--	--	--	--	201	--	--	201	20	--	--	20	--	--	--	--	221	--	--	221
Salt Creek	161	--	--	161	20	2,251	--	2,271	20	5,510	--	5,530	--	3,561	--	3,561	201	11,322	--	11,523
Walnut Creek	1,552	4,804	1,105	7,461	3,386	11,894	46	15,326	--	--	--	--	--	--	--	--	4,938	16,698	1,151	22,787
Total	6,970	18,912	5,895	31,777	11,746	34,369	1,012	47,127	1,872	8,601	--	10,473	--	3,695	--	3,695	20,588	65,577	6,907	93,072
JACKSON																				
Bloomfield	1,270	11,860	4,100	17,230	1,653	31,852	8,017	41,522	--	5,947	276	6,223	--	--	--	--	2,923	49,659	12,393	64,975
Franklin	--	168	--	168	--	571	--	571	20	--	--	20	--	--	--	--	20	739	--	759
Jefferson	1,229	907	691	2,827	403	1,512	322	2,237	--	--	--	--	--	--	--	--	1,632	2,419	1,013	5,064
Lick	--	--	--	--	--	--	--	--	100	--	--	100	--	--	--	--	100	--	--	100
Madison	1,653	17,304	2,211	21,168	11,753	24,360	2,672	38,785	2,056	1,915	--	3,971	--	--	--	--	15,462	43,579	4,883	63,924
Milton	4,616	9,744	--	14,360	6,148	13,540	--	19,688	745	--	--	745	20	--	--	20	11,529	23,284	--	34,813
Total	8,768	39,983	7,002	55,753	19,957	71,835	11,011	102,803	2,921	7,862	276	11,059	20	--	--	20	31,666	119,680	18,289	169,635

LOWER KITTANNING COAL

Table 31 (continued)

ESTIMATED ORIGINAL RESERVES OF THE LOWER KITTANNING COAL BED IN OHIO

(In thousands of short tons. To obtain total tonnage add three zeros to end of each figure.)

County and Township	Proven coal				Probable coal				Strongly inferred coal				Weakly inferred coal				Total			
	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total
JEFFERSON																				
Brush Creek	--	134	--	134	--	11,928	--	11,928	8,326	14,448	--	22,774	23,788	--	--	23,788	32,114	26,510	--	58,624
Island Creek	--	--	--	--	--	6,283	--	6,283	--	24,158	--	24,158	40,199	22,881	--	63,080	40,199	53,322	--	93,521
Knox	483	5,845	--	6,328	1,249	21,336	--	22,585	--	35,481	--	35,481	3,064	29,265	--	32,329	4,796	91,927	--	96,723
Ross	--	--	--	--	--	--	--	--	1,008	6,350	--	7,358	57,879	2,217	--	60,096	58,887	8,567	--	67,454
Salem	--	--	--	--	--	--	--	--	705	--	--	705	73,987	--	--	73,987	74,692	--	--	74,692
Saline	20	4,200	--	4,220	2,257	26,308	--	28,565	887	32,524	--	33,411	--	--	--	--	3,164	63,032	--	66,196
Springfield	--	--	--	--	--	--	--	--	--	--	--	--	62,757	--	--	62,757	--	--	--	62,757
Wayne	--	--	--	--	--	--	--	--	3,366	8,332	--	11,698	31,449	--	--	31,449	34,815	8,332	--	43,147
Total	503	10,179	--	10,682	3,506	65,855	--	69,361	14,292	121,293	--	135,585	293,123	54,363	--	347,486	311,424	251,690	--	563,114
LAWRENCE																				
Aid	887	--	--	887	9,535	--	--	9,535	19,656	--	--	19,656	39,009	--	--	39,009	69,087	--	--	69,087
Decatur	6,672	9,172	1,428	17,272	6,733	10,987	--	17,720	--	--	--	--	--	--	--	--	13,405	20,159	1,428	34,992
Elizabeth	3,568	10,516	5,944	20,028	11,350	20,630	2,718	34,698	--	268	--	268	--	--	--	--	14,918	31,414	8,662	54,994
Fayette	--	--	--	--	--	--	--	--	6,813	436	--	7,249	48,705	1,948	--	50,653	55,518	2,384	--	57,902
Hamilton	60	739	--	799	--	2,856	--	2,856	--	3,057	--	3,057	--	--	--	--	60	6,652	--	6,712
Lawrence	1,350	--	--	1,350	16,410	4,872	1,152	22,434	25,522	--	--	25,522	22,317	--	--	22,317	65,599	4,872	1,152	71,623
Mason	--	--	--	--	--	--	--	--	--	--	--	--	81,668	--	--	81,668	--	--	--	81,668
Perry	40	7,458	460	7,958	5,221	35,078	1,797	42,096	7,398	17,270	--	24,668	--	1,478	--	1,478	12,659	61,284	2,257	76,200
Rome	--	--	--	--	--	--	--	--	--	--	--	--	70,378	--	--	70,378	70,378	--	--	70,378
Symmes	866	3,494	--	4,360	13,567	11,961	--	25,528	18,164	--	--	18,164	13,204	--	--	13,204	45,801	15,455	--	61,256
Union	--	--	--	--	--	--	--	--	--	--	--	--	67,172	--	--	67,172	67,172	--	--	67,172
Upper	947	7,022	1,059	9,028	4,072	24,998	460	29,530	322	--	--	322	--	--	--	--	5,341	32,020	1,519	38,880
Washington	1,895	15,086	--	16,981	6,209	18,110	--	24,319	60	--	--	60	181	--	--	181	8,345	33,196	--	41,541
Windsor	--	--	--	--	--	--	--	--	--	--	--	--	80,297	--	--	80,297	80,297	--	--	80,297
Total	16,285	53,487	8,891	78,663	73,097	129,492	6,127	208,716	77,935	21,031	--	98,966	422,931	3,426	--	426,357	590,248	207,436	15,018	812,702
MAHONING																				
Beaver	2,943	8,131	3,502	14,576	8,386	57,120	1,797	67,303	--	5,073	--	5,073	--	--	--	--	11,329	70,324	5,299	86,952
Berlin	--	--	--	--	--	--	--	--	--	7,525	--	7,525	--	3,494	--	3,494	--	11,019	--	11,019
Boardman	322	201	--	523	4,273	2,183	--	6,456	2,862	--	--	2,862	--	--	--	--	7,457	2,384	--	9,841
Canfield	1,491	739	1,566	3,796	4,475	12,700	3,041	20,216	1,834	8,567	--	10,401	--	--	--	--	7,800	22,006	4,607	34,413
Ellsworth	--	--	--	--	--	--	--	--	--	5,677	--	5,677	--	1,612	--	1,612	--	7,289	--	7,289
Goshen	1,128	2,587	--	3,715	6,431	42,940	921	50,292	--	28,560	691	29,251	--	--	--	--	7,559	74,087	1,612	83,258
Green	--	20,630	4,515	25,145	--	45,427	13,870	59,297	--	772	--	772	--	--	--	--	--	66,829	18,385	85,214
Poland	--	403	--	403	442	5,946	--	6,388	8,043	336	--	8,379	120	--	--	120	8,605	6,685	--	15,290
Smith	--	2,822	--	2,822	--	15,925	4,976	20,901	--	9,575	1,474	11,049	--	--	--	--	--	28,322	6,450	34,772
Springfield	1,471	11,558	--	13,029	15,966	54,801	--	70,767	6,068	436	--	6,504	--	--	--	--	23,505	66,795	--	90,300
Total	7,355	47,071	9,583	64,009	39,973	237,042	24,605	301,620	18,807	66,521	2,165	87,493	120	5,106	--	5,226	66,255	355,740	36,353	458,348

ESTIMATE OF THE RESERVES

Table 31 (continued)

ESTIMATED ORIGINAL RESERVES OF THE LOWER KITTANNING COAL BED IN OHIO

(In thousands of short tons. To obtain total tonnage add three zeros to end of each figure.)

County and Township	Proven coal				Probable coal				Strongly inferred coal				Weakly inferred coal				Total			
	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total
MEIGS																				
Columbia	--	--	--	--	--	--	--	--	--	--	--	--	2,257	--	--	2,257	2,257	--	--	2,257
Rutland	--	--	--	--	--	--	--	--	--	--	--	--	89,288	--	--	89,288	89,288	--	--	89,288
Salem	--	--	--	--	--	--	--	--	10,301	--	--	10,301	75,660	--	--	75,660	85,961	--	--	85,961
Salisbury	--	--	--	--	--	--	--	--	--	--	--	--	42,214	--	--	42,214	42,214	--	--	42,214
Scipio	--	--	--	--	--	--	--	--	--	--	--	--	6,693	--	--	6,693	6,693	--	--	6,693
Total	--	--	--	--	--	--	--	--	10,301	--	--	10,301	216,112	--	--	216,112	226,413	--	--	226,413
MORGAN																				
Deerfield	--	--	--	--	--	--	--	--	--	--	--	--	5,362	--	--	5,362	5,362	--	--	5,362
Homer	--	--	--	--	--	--	--	--	--	--	--	--	73,704	--	--	73,704	73,704	--	--	73,704
Marion	--	--	--	--	--	--	--	--	--	--	--	--	4,011	--	--	4,011	4,011	--	--	4,011
Union	--	--	--	--	--	--	--	--	--	--	--	--	13,325	--	--	13,325	13,325	--	--	13,325
York	--	--	--	--	--	--	--	--	3,124	--	--	3,124	887	--	--	887	4,011	--	--	4,011
Total	--	--	--	--	--	--	--	--	3,124	--	--	3,124	97,289	--	--	97,289	100,413	--	--	100,413
MUSKINGUM																				
Brush Creek	1,168	--	--	1,168	2,560	--	--	2,560	1,088	--	--	1,088	--	--	--	--	--	--	--	4,816
Falls	--	--	--	--	--	--	--	--	443	--	--	443	--	--	--	--	--	--	--	443
Harrison	--	--	--	--	3,044	--	--	3,044	1,229	--	--	1,229	--	--	--	--	--	--	--	4,273
Highland	--	--	--	--	--	--	--	--	--	--	--	--	49,392	--	--	49,392	49,392	--	--	49,392
Meigs	--	--	--	--	--	--	--	--	--	--	--	--	7,318	--	--	7,318	7,318	--	--	7,318
Monroe	--	--	--	--	--	--	--	--	--	--	--	--	21,893	--	--	21,893	21,893	--	--	21,893
Newton	20	1,377	1,520	2,917	1,008	1,982	414	3,404	2,540	--	--	2,540	141	--	--	141	3,709	3,359	1,934	9,002
Perry	--	--	--	--	--	--	--	--	11,692	1,075	--	12,767	39,694	--	--	39,694	51,386	1,075	--	52,461
Rich Hill	--	--	--	--	--	--	--	--	--	--	--	--	76,204	--	--	76,204	76,204	--	--	76,204
Salem	--	--	--	--	--	--	--	--	--	--	--	--	13,003	--	--	13,003	13,003	--	--	13,003
Salt Creek	--	--	--	--	9,394	--	--	9,394	25,381	--	--	25,381	20,926	--	--	20,926	55,701	--	--	55,701
Springfield	--	--	--	--	161	--	--	161	--	--	--	--	--	--	--	--	161	--	--	161
Union	--	--	--	--	--	--	--	--	--	--	--	--	52,777	--	--	52,777	52,777	--	--	52,777
Washington	1,209	1,982	7,050	10,241	3,427	19,992	3,548	26,967	4,394	3,561	--	7,955	--	--	--	--	9,030	25,535	10,598	45,163
Wayne	2,439	672	2,718	5,829	7,902	21,873	7,833	37,608	6,935	15,120	--	22,055	--	--	--	--	17,276	37,665	10,551	65,492
Total	4,836	4,031	11,288	20,155	27,496	43,847	11,795	83,138	53,702	19,756	--	73,458	281,348	--	--	281,348	367,382	67,634	23,083	458,099
NOBLE																				
Brookfield	--	--	--	--	--	--	--	--	--	--	--	--	13,265	--	--	13,265	13,265	--	--	13,265
Buffalo	--	369	506	875	685	8,400	92	9,177	16,752	2,889	--	19,641	15,265	--	--	15,845	33,282	11,658	598	45,538
Noble	--	--	--	--	--	--	--	--	--	--	--	--	9,051	--	--	9,051	9,051	--	--	9,051
Wayne	--	--	--	--	--	--	--	--	--	--	--	--	2,620	--	--	2,620	2,620	--	--	2,620
Total	--	369	506	875	685	8,400	92	9,177	16,752	2,889	--	19,641	40,781	--	--	40,781	58,218	11,658	598	70,474

Table 31 (continued)

ESTIMATED ORIGINAL RESERVES OF THE LOWER KITTANNING COAL BED IN OHIO

(In thousands of short tons. To obtain total tonnage add three zeros to end of each figure.)

County and Township	Proven coal				Probable coal				Strongly inferred coal				Weakly inferred coal				Total			
	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total
PERRY																				
Bearfield	--	--	--	--	685	7,593	--	8,278	13,527	4,670	--	18,197	31,933	--	--	31,933	46,145	12,263	--	58,408
Clayton	1,128	14,481	4,331	19,940	4,697	22,108	3,686	30,491	927	403	--	1,330	--	--	--	--	6,752	36,992	8,017	51,761
Coal	--	--	--	--	362	--	--	362	--	--	--	--	--	--	--	--	362	--	--	362
Harrison	--	1,041	1,981	3,022	6,753	6,820	7,557	21,130	887	--	--	887	--	--	--	--	7,640	7,861	9,538	25,039
Hopewell	--	--	--	--	--	268	--	268	342	33	--	375	--	--	--	--	342	301	--	643
Jackson	40	--	--	40	4,818	100	138	5,056	2,056	--	--	2,056	--	--	--	--	6,914	100	138	7,152
Madison	451	1,915	1,382	3,748	1,249	3,124	--	4,373	1,915	--	--	1,915	--	--	--	--	3,615	5,039	1,382	10,036
Monday Creek	2,661	--	--	2,661	5,785	--	--	5,785	80	--	--	80	--	--	--	--	8,526	--	--	8,526
Monroe	--	--	--	--	--	--	--	--	--	--	--	--	6,229	--	--	6,229	6,229	--	--	6,229
Pike	1,733	6,652	921	9,306	20,502	22,176	--	42,678	7,822	--	--	7,822	--	--	--	--	30,057	28,828	921	59,806
Pleasant	--	--	--	--	1,088	3,292	--	4,380	15,099	33	--	15,132	12,297	--	--	12,297	28,484	3,325	--	31,809
Reading	--	--	4,469	4,469	423	1,612	6,819	8,854	2,237	2,822	--	5,059	483	--	--	483	3,143	4,434	11,288	18,865
Salt Lick	1,592	873	--	2,465	14,011	168	--	14,179	604	--	--	604	--	--	--	--	16,207	1,041	--	17,248
Total	7,605	24,962	13,084	45,651	60,373	67,261	18,200	145,834	45,496	7,961	--	53,457	50,942	--	--	50,942	164,416	100,184	31,284	295,884
SCIOTO																				
Bloom	120	--	--	120	524	--	--	524	40	--	--	40	--	--	--	--	684	--	--	684
Green	--	974	--	974	342	638	--	980	--	--	--	--	--	--	--	--	342	1,612	--	1,954
Vernon	--	--	--	--	1,411	537	--	1,948	322	--	--	322	--	--	--	--	1,733	537	--	2,270
Total	120	974	--	1,094	2,277	1,175	--	3,452	362	--	--	362	--	--	--	--	2,759	2,149	--	4,908
STARK																				
Bethlehem	262	--	--	262	1,249	672	--	1,921	705	33	--	738	--	--	--	--	2,216	705	--	2,921
Canton	282	537	--	819	2,620	4,200	--	6,820	282	--	--	282	--	--	--	--	3,184	4,737	--	7,921
Lexington	--	1,747	6,128	7,875	--	6,283	7,557	13,840	--	4,569	--	4,569	--	--	--	--	--	12,599	13,685	26,284
Marlboro	--	--	--	--	--	--	--	--	141	2,688	--	2,829	120	302	--	422	261	2,990	--	3,251
Nimishillen	--	1,948	--	1,948	5,443	13,675	--	19,118	15,644	10,348	--	25,992	5,886	--	--	5,886	26,973	25,971	--	52,944
Osnaburg	3,124	2,284	--	5,408	19,877	10,483	--	30,360	12,378	840	--	13,218	--	--	--	--	35,379	13,607	--	48,986
Paris	--	268	--	268	1,512	13,944	--	15,456	25,804	11,592	--	37,396	19,071	--	--	19,071	46,387	25,804	--	72,191
Perry	--	--	--	--	100	--	--	100	161	--	--	161	--	--	--	--	261	--	--	261
Pike	2,096	1,243	2,304	5,643	5,785	8,736	645	15,166	1,411	--	--	1,411	--	--	--	--	9,292	9,979	2,949	22,220
Sandy	1,330	2,822	1,797	5,949	8,386	9,307	1,290	18,983	705	33	--	738	--	--	--	--	10,421	12,162	3,087	25,670
Sugar Creek	161	--	--	161	907	--	--	907	463	--	--	463	--	--	--	--	1,531	--	--	1,531
Tuscarawas	--	--	--	--	--	--	--	--	--	--	--	--	383	--	--	383	383	--	--	383
Washington	--	33	--	33	282	21,974	--	22,256	6,088	53,424	--	59,512	9,636	6,216	--	15,852	16,006	81,647	--	97,653
Total	7,255	10,882	10,229	28,366	46,161	89,274	9,492	144,927	63,782	83,527	--	147,309	35,096	6,518	--	41,614	152,294	190,201	19,721	362,216
TUSCARAWAS																				
Auburn	2,882	--	--	2,882	8,668	2,587	--	11,255	4,798	6,115	--	10,913	--	--	--	--	16,348	8,702	--	25,050
Bucks	2,217	3,561	--	5,778	14,936	12,936	--	27,894	20	--	--	20	--	--	--	--	17,195	16,497	--	33,692
Clay	60	1,108	--	1,168	2,661	16,833	--	19,494	2,439	25,704	--	28,143	--	3,292	--	3,292	5,160	46,937	--	52,097

Table 31 (continued)

ESTIMATED ORIGINAL RESERVES OF THE LOWER KITTANNING COAL BED IN OHIO

(In thousands of short tons. To obtain total tonnage add three zeros to end of each figure.)

County and Township	Proven coal				Probable coal				Strongly inferred coal				Weakly inferred coal				Total			
	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total	14"-28"	28"-42"	42" & over	Total
Dover	1,390	9,172	1,105	11,667	1,834	19,151	4,423	25,408	--	--	--	--	--	--	--	--	3,224	28,323	5,528	37,075
Fairfield	403	--	--	403	9,414	739	--	10,153	12,539	--	--	12,539	--	--	--	--	22,356	739	--	23,095
Franklin	20	3,124	967	4,111	40	4,704	414	5,158	100	--	--	100	--	--	--	--	160	7,828	1,381	9,369
Goshen	1,108	--	--	1,108	1,833	--	--	1,833	1,894	--	--	1,894	--	--	--	--	4,835	--	--	4,835
Jefferson	2,036	1,512	--	3,548	26,127	6,417	--	32,544	4,173	--	--	4,173	--	--	--	--	32,336	7,929	--	40,265
Lawrence	423	3,225	2,304	5,952	2,903	6,686	4,469	14,058	524	--	--	524	--	--	--	--	3,850	9,911	6,773	20,534
Mill	4,193	1,848	276	6,317	22,720	2,184	--	24,904	9,616	--	--	9,616	--	--	--	--	36,529	4,032	276	40,837
Oxford	20	--	--	20	6,592	638	--	7,230	6,834	18,547	--	25,381	--	--	--	--	13,446	19,185	--	32,631
Perry	--	--	--	--	--	--	--	--	--	--	--	--	51,871	3,360	--	55,231	51,871	3,360	--	55,231
Rush	20	--	--	20	11,007	--	--	11,007	38,767	--	--	38,767	8,930	537	--	9,467	58,724	537	--	59,261
Salem	5,523	5,275	--	10,798	19,172	19,790	--	38,962	--	638	--	638	--	--	--	--	24,695	25,703	--	50,398
Sandy	483	10,483	6,727	17,693	1,653	9,004	7,464	18,121	--	--	--	--	--	--	--	--	2,136	19,487	14,191	35,814
Sugarcreek	--	2,318	--	2,318	161	9,911	--	10,072	846	1,343	--	2,189	--	--	--	--	1,007	13,572	--	14,579
Union	342	1,982	967	3,291	10,846	1,478	--	12,324	5,040	--	--	5,040	--	--	--	--	16,228	3,460	967	20,655
Warren	--	2,352	--	2,352	8,426	23,586	--	32,012	11,349	2,788	--	14,137	--	--	--	--	19,775	28,726	--	48,501
Warwick	2,479	--	--	2,479	19,232	--	--	19,232	1,391	--	--	1,391	--	--	--	--	23,102	--	--	23,102
Washington	--	--	--	--	--	974	--	974	--	24,528	--	24,528	6,048	47,107	--	53,155	6,048	72,609	--	78,657
Wayne	987	5,342	--	6,329	2,338	3,595	--	5,933	--	--	--	--	--	--	--	--	3,325	8,937	--	12,262
York	887	2,755	--	3,642	7,902	16,699	--	24,601	403	3,057	--	3,460	--	--	--	--	9,192	22,511	--	31,703
Total	25,473	54,057	12,346	91,876	178,487	157,912	16,770	353,169	100,733	82,720	--	183,453	66,849	54,296	--	121,145	371,542	348,985	29,116	749,643
VINTON																				
Brown	3,568	2,251	--	5,819	16,833	7,392	--	24,225	342	--	--	342	--	--	--	--	20,743	9,643	--	30,386
Clinton	2,116	7,123	138	9,377	4,677	7,963	--	12,640	--	--	--	--	--	--	--	--	6,793	15,086	138	22,017
Elk	60	3,393	--	3,453	3,528	3,931	--	7,459	403	--	--	403	--	--	--	--	3,991	7,324	--	11,315
Knox	524	--	--	524	2,197	--	--	2,197	--	--	--	--	--	--	--	--	2,721	--	--	2,721
Madison	3,427	100	--	3,527	19,111	1,008	--	20,119	705	--	--	705	--	--	--	--	23,243	1,108	--	24,351
Swan	221	940	--	1,161	947	67	--	1,014	141	--	--	141	--	--	--	--	1,309	1,007	--	2,316
Vinton	3,386	1,747	--	5,133	24,393	10,987	--	35,380	2,701	--	--	2,701	--	--	--	--	30,480	12,734	--	43,214
Wilkesville	4,536	9,172	967	14,675	28,062	6,182	--	34,244	17,841	--	--	17,841	887	--	--	887	51,326	15,354	967	67,647
Total	17,838	24,726	1,105	43,669	99,748	37,530	--	137,278	22,133	--	--	22,133	887	--	--	887	140,606	62,256	1,105	203,967
WAYNE																				
Franklin	--	33	875	908	40	235	92	367	--	--	--	--	--	--	--	--	40	268	967	1,275
Paint	1,733	1,444	--	3,177	504	2,385	--	2,889	--	1,176	--	1,176	--	--	--	--	2,237	5,005	--	7,242
Salt Creek	--	--	--	--	--	--	--	--	262	1,579	--	1,841	282	1,612	--	1,894	544	3,191	--	3,735
Sugar Creek	--	--	--	--	--	--	--	--	141	--	--	141	181	--	181	322	--	--	--	322
Total	1,733	1,477	875	4,085	544	2,620	92	3,256	403	2,755	--	3,158	463	1,612	--	2,075	3,143	8,464	967	12,574
State Total	171,234	381,749	105,266	658,249	955,713	1,470,017	197,338	2,623,068	1,189,035	793,631	18,520	2,001,186	4,381,986	249,500	--	4,631,486	6,697,968	2,894,897	321,124	9,913,989

LOWER KITTANNING COAL

LIST OF QUADRANGLES COVERING LOWER KITTANNING COAL-BEARING COUNTIES

Outcrop maps, in photostat form, of the Lower Kittanning coal are available on topographic quadrangle base from the Division of Geological Survey. The following list shows the quadrangles according to county coverage:

Athens County	Holmes County	Perry County
Athens	Brinkhaven	Logan
New Lexington	Coshocton	New Lexington
Zaleski	Loudonville	Thornville
	Millersburg	Zanesville
Carroll County	Navarre	
Carrollton	Newcomerstown	Scioto County
Dover		Ironton
	Jackson County	Greenup
Columbiana County	Bidwell	Oak Hill
Alliance	Jackson	
Columbiana	Oak Hill	Stark County
Lisbon	Wilkesville	Alliance
Wellsville		Canton
	Jefferson County	Carrollton
Coshocton County	Steubenville	Dover
Brinkhaven	Wellsville	Navarre
Cambridge		
Conesville	Lawrence County	Tuscarawas County
Coshocton	Ceredo	Cambridge
Frazeysburg	Ironton	Dover
Newcomerstown	Greenup	Navarre
	Oak Hill	Newcomerstown
		Uhrichsville
Gallia County	Mahoning County	
Bidwell	Alliance	Vinton County
Oak Hill	Columbiana	Wilkesville
Wilkesville	Lisbon	Zaleski
	Warren	
Guernsey County	Youngstown	Wayne County
Cambridge		Massillon
	Muskingum County	Millersburg
Hocking County	Conesville	Navarre
Athens	Frazeysburg	
Logan	Philo	
New Lexington	Zanesville	
Zaleski		

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