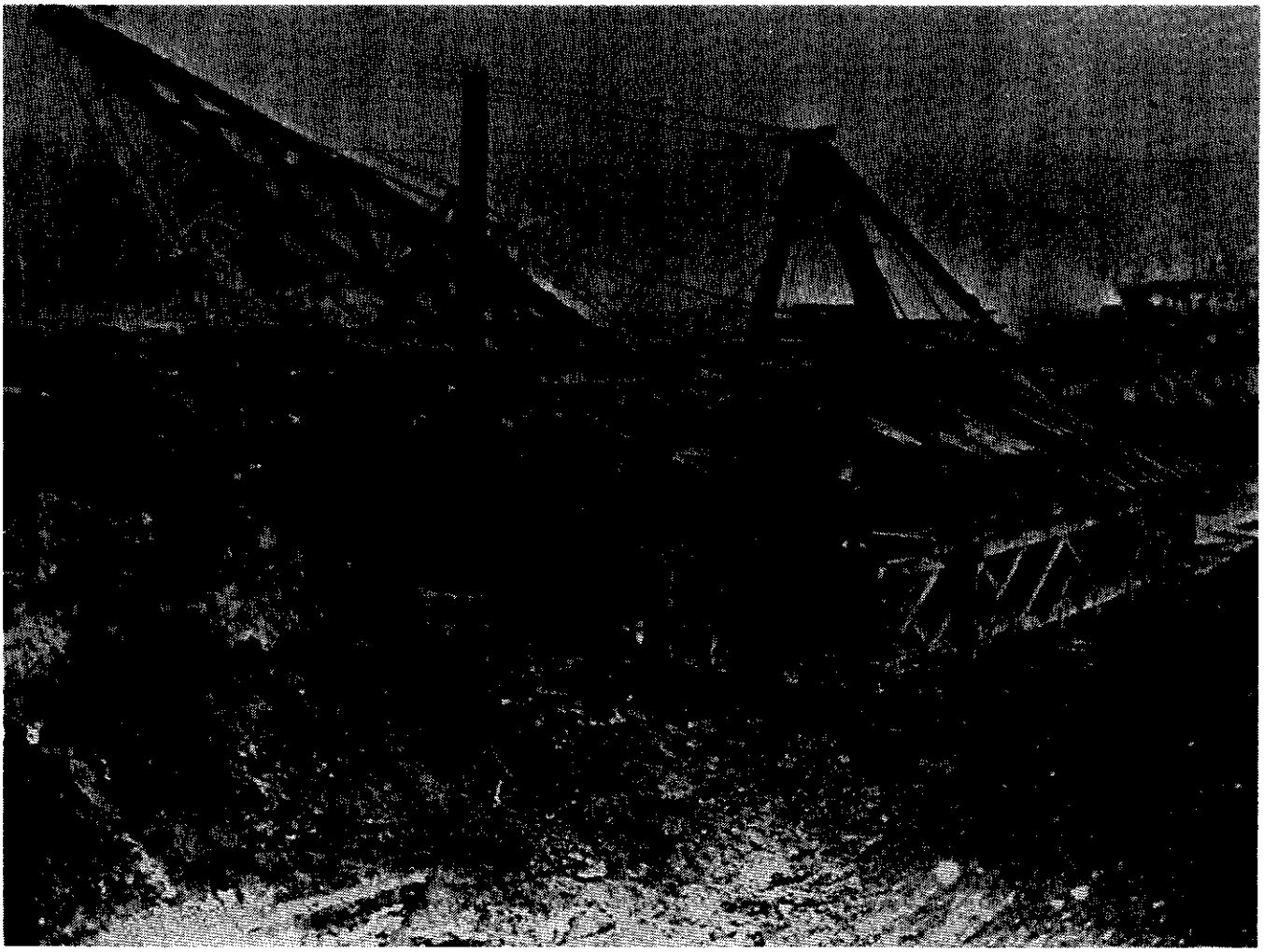
STRIPPABLE COAL RESOURCES OF ILLINOIS
Part 7—Vermilion and Edgar Counties

Russell J. Jacobson and Lawrence E. Bengal



Illinois Institute of Natural Resources
STATE GEOLOGICAL SURVEY DIVISION
Jack A. Simon, Chief

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COVER PHOTO: A "dry land dredge"—the second type of coal stripping machine to operate in the United States. Pictured at site in Missionfield, west of Danville, Illinois. For a short history of this machine, please turn to page ii.

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History of the "dry land dredge" (pictured on cover)

In 1885, Wright and Wallace, drainage contractors and dredgers from LaFayette, Indiana, contracted to strip coal for Consolidated Coal Company of St. Louis at a river bottom property known as Missionfield, near Danville, Illinois. The overburden at the site ranged from 0 to 35 feet in thickness, and the coal (now known as the Danville [No. 7] Coal Member) averaged 6 feet in thickness.

To remove the thick overburden, a machine with a long digging range was needed. Because the coal stripping machines available at that time were inadequate for such a task, Wright and Wallace decided to purchase a dipper dredge, which was used to dig in the deep waters of canals and drainage ditches. They purchased their first dredge in 1885 from the Marion Steam Shovel Company of Marion, Ohio, and purchased two more dredges over the next 3 years.

Each dredge was bought without its boat hull, and was installed on a wooden frame supported by fixed wheels. The machines were powered by block and tackle and could only move forward. The first dredge had a 50-foot-long boom with a ¾-yard dipper. The second dredge (pictured on the cover) was similar except that its dipper was 1¼ yards long. The third dredge had a 65-foot boom with a 1½-yard dipper.

The first two dredges used a single-cylinder vertical steam engine to hoist the dipper and swing the boom. The third dredge used two vertical steam engines. Because the dredges could only move forward, Wright and Wallace stripped the coal using a circular path of operation that resembled a flat coil spring. The machine would make an initial cut around the edges of a 30-acre area. This initial cut would usually take months to complete, as did each subsequent cut. As the machine was worked toward the center, the curves became sharper and it was harder to turn the machine. Eventually, jacks were used to skid the "land dredge" around sharp corners. The dredge could make cuts up to 20 feet in width, and on good days, up to 400 cubic yards of overburden were removed.

In 1888, financial problems caused by a miners' strike drove Wright and Wallace to sell the dredges and contract their work back to the Consolidated Coal Company. Consolidated operated the dredges for 2 more years, until financial difficulties and physical deterioration of the dredges caused them to look for newer and more efficient equipment.

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STRIPPABLE COAL RESOURCES OF ILLINOIS
Part 7—Vermilion and Edgar Counties

ABSTRACT

This report is part of a series of studies that describe strippable coal resources (defined as coal 18 in. or more thick and with overburden not exceeding 150 ft) in Illinois. This study contains estimates of resources of Danville (No. 7) and Herrin (No. 6) Coal Members of the Carbondale Formation, Kewanee Group, Pennsylvanian System, in Vermilion and northeastern Edgar Counties.

Another area of strippable coal of unknown extent identified in this report is in western Edgar County along the flanks of the La Salle Anticlinal Belt. Both the Danville (No. 7) and Herrin (No. 6) Coals occur at strippable depths near their subcrops along this structure; however, the data available are insufficient to calculate the amounts of these resources.

The maps in this report of the Danville (No. 7) and Herrin (No. 6) Coals are at a scale of ½-in. to the mile and show outcrops, coal thickness, overburden depths up to 150 ft, and mined-out areas. The stratigraphic relations of the coal deposits in the area are shown in a cross section; a discussion of the general stratigraphy of these coals and associated strata is found in the text. Also included are generalized structure maps of the Danville (No. 7) and Herrin (No. 6) Coals and a map showing the interval between these two coals. Tonnage estimates, based on the average thickness of coal in each category of overburden thickness, and reliability of estimates have been tabulated by township and county. A total of about 757 million tons of strippable coal resources are estimated to be present in the area of this report. About 70 percent of the total (approximately 540 million tons) is Danville (No. 7) Coal, and 30 percent (approximately 221 million tons) is Herrin (No. 6) Coal.

INTRODUCTION

This report is one of a series issued by the Illinois State Geological Survey (ISGS) summarizing the strippable coal resources of Illinois. A strippable coal resource is defined as having coal 150 ft or less deep, and 18 in. or more thick. Figure 1 indicates the location of the area covered by this report, which includes Vermilion and Edgar Counties. Almost 760 million tons of strippable coal resources have been mapped in this area. These resources are contained in the Danville (No. 7) and the Herrin (No. 6) Coal Members of the Carbondale Formation, Kewanee Group, Pennsylvanian System.

In all the reports on strippable coal resources, the resources are tabulated according to average coal thickness at depths of 0 to 50 ft, 50 to 100 ft, and 100 to 150 ft. The quantity of strippable coal (estimated according to coal thickness, overburden thickness, and reliability of estimate) is tabulated by township for each county (app. A). Over 20 billion tons of strippable coal resources remaining in the ground have been mapped in report areas 1 through 8 (fig. 1). These areas include the limits of the Illinois portion of the Illinois Basin Coal Field (fig. 2), where minable coals of the McCormick and Kewanee Groups crop out, and the central part of the state, where mapped strippable coal resources are mainly restricted to locally minable coals in the McLeansboro Group.

This report contains two maps (pl. 1-A and 1-B) that show the extent of strippable resources of Danville (No. 7) and Herrin (No. 6) Coal Members; the scale on the maps is approximately ½-in. to the mile. A north-south cross section (pl. 1-C) shows the succession of coals and associated strata. Generalized structural contours for the Danville (No. 7) and Herrin (No. 6) Coals are also shown on plates 1-A and 1-B. The interval between the Herrin (No. 6) and Danville (No. 7) Coals is shown in figure 3.

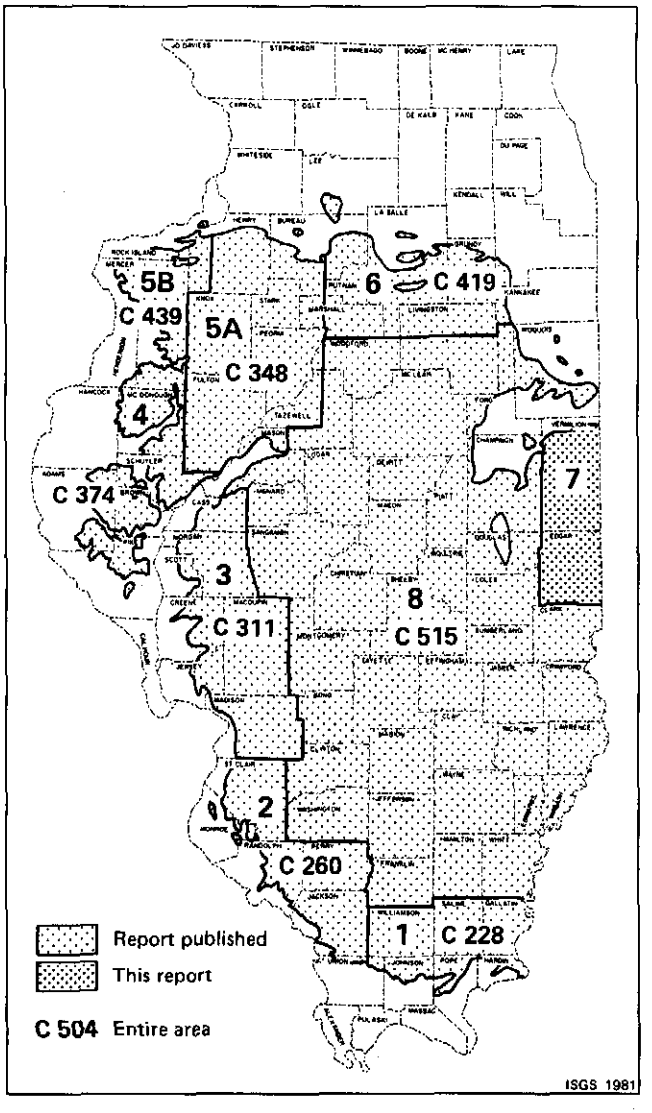

Figure 1. Report areas of strippable coal resources within the Pennsylvanian strata.

Previous investigations

There are a number of works in the literature about the resources and geology of Vermilion and Edgar Counties. Worthen et al. (1870, 1882) presented the first description of the geology and coal resources of this area. Kay and White (1915) described the coal resources and mapped the coal structure in an area that included both counties. Cady (1920) included this area in his study on the structure of

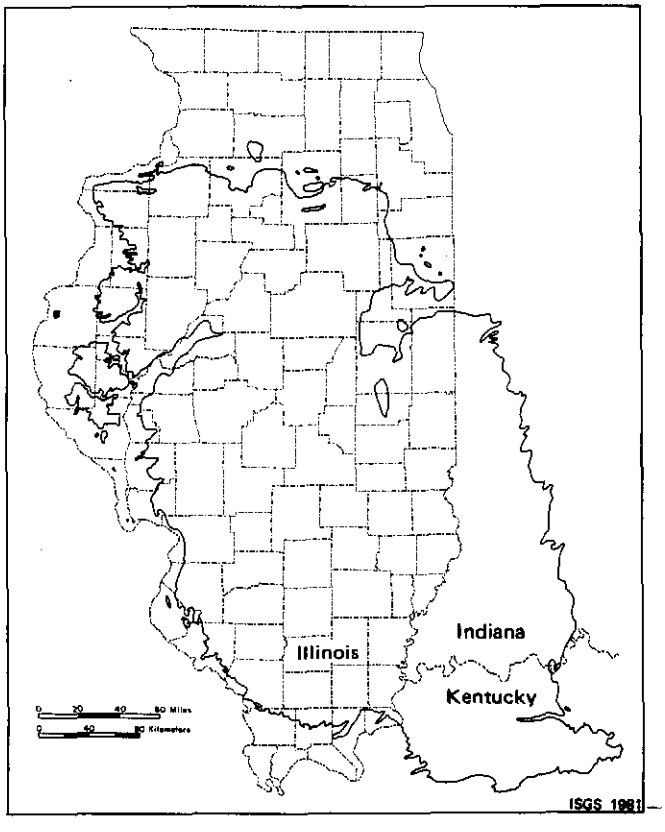

Figure 2. Illinois Basin Coal Field.

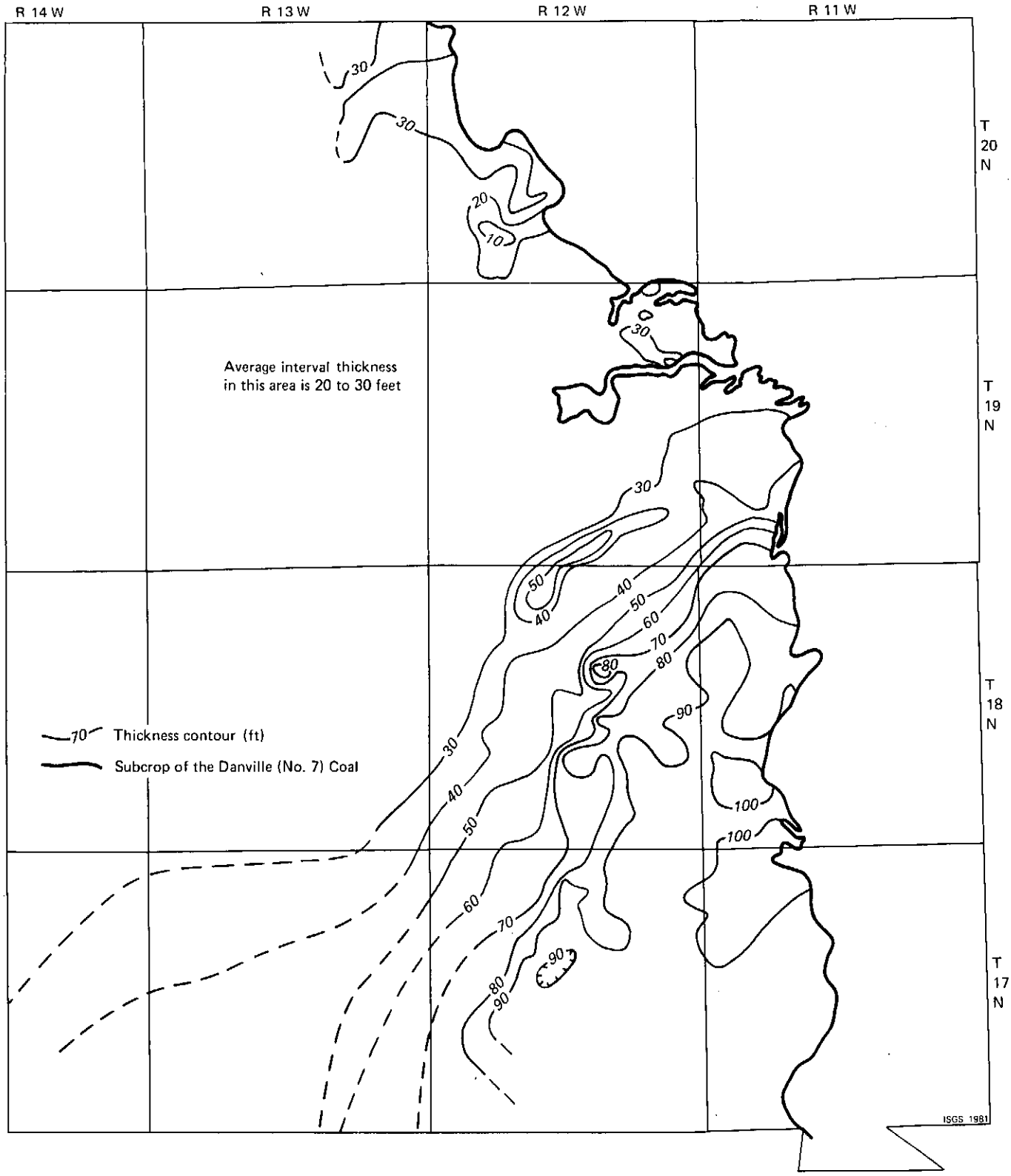

Figure 3. Thickness of the interval between the Herrin (No. 6) and Danville (No. 7) Coals in Vermilion County.

the La Salle Anticline (fig. 4), and Culver (1925) reported on the coal stripping possibilities for Edgar and Vermilion Counties. Mylius (1927) studied the oil and gas possibilities in an area that included Champaign, Clark, Coles, Cumberland, Douglas, Edgar, and Vermilion Counties, as well as part of Crawford and Jasper Counties. Alexander (1943) mentioned the key beds of Pennsylvanian strata found in eastern Vermilion County.

Cady (1952) published the first comprehensive report on the total coal resources of Illinois, but he did not differentiate strippable from underground resources in computing the total coal resources for each county. Clegg (1965) discussed the coal resources and the effect of the La Salle Anticline on the Pennsylvanian strata in Clark and Edgar Counties.

Smith and Stall (1975) considered the strippable resources for this area in their report on coal and water resources for coal conversion, but, as with the Cady study, the strippable resources were not differentiated from underground resources in computing the total coal resources.

METHOD USED TO ESTIMATE QUANTITY OF RESOURCES

Information sources

Coal thickness and elevation data used to compile the resource and structure maps were obtained from well logs of oil and water tests, diamond drill cores, surface exposures, and notes on abandoned mines, which are on file at the ISGS. Contour maps of the bedrock surface prepared by Horberg (1957), as well as preliminary coal structure maps, were used extensively in projecting the extent of coals concealed beneath glacial deposits. Data regarding the extent of mined-out coal as of January 1, 1979, were obtained from mined-out area maps numbers 16 and 17, compiled by the ISGS.

Selection of mapping areas

Illinois has been divided into eight areas for convenience in preparing reports and maps of strippable coal resources. This report, part 7, describes resources in Vermilion County and in the northeastern portion of Edgar County. The remainder of Edgar County consists largely of underground coal resources, which have been previously reported by Clegg (1965) and Treworgy (1981).

Another area of strippable coal of unknown extent occurs in western Edgar County along the flanks of the La Salle Anticlinal Belt. The Danville (No. 7) and Herrin (No. 6) Coals are known to lie at strippable depths near their subcrops along this structure (pl. 1-A and 1-B), but data are insufficient for any resource calculations. Areas 1 through 7 (fig. 1) incorporate the margins of the Illinois portion of the Illinois Basin Coal Field (fig. 2), where the minable coals of the McCormick and Kewanee Groups crop out within the state. Area 8 embraces a large part of the deeper portion of the Illinois Basin, where coals of the Kewanee Group generally lie at depths too great for strip mining. This area is mainly restricted to coals of the McLeansboro Group, which normally are less than 3 ft thick.

Definition of strippable coal

The criteria used to evaluate strippable resources is based principally upon the thickness of the coal and the overburden. The definition of strippable coal resources includes those coal seams that are 18 in. or more thick, and have an overburden not more than 150 ft thick (Smith, 1957).

Certain resources are not recoverable because they lie beneath cities, towns, or highways, or are otherwise limited; however, the scale on which the coal was mapped for this report does not permit the omission of such nonrecoverable coal from the estimate. A recent study by Treworgy, Bengal, and Dingwell (1978) evaluated strippable coal resources in Illinois according to their minability by current methods and economics.

In this report, as in the earlier reports (Cady, 1952; Smith, 1957, 1958, 1961, 1968; Smith and Stall, 1975), estimates of tonnages of coal are based on an assumption of 1,800 tons of in-place coal/acre/ft of coal. This conforms to the figure used by the U.S. Geological Survey (USGS) in estimating resources of high-volatile bituminous coal. Nevertheless, a figure of 1,770 tons/acre/ft probably better represents coals in Illinois (Smith, 1961). The estimates in this report are based on total coal in place; no estimate of recoverable coal is presented.

Mapping of coal subcrops

In this report, the term subcrop is used broadly to describe the border of a coal whether it is exposed at the surface or concealed beneath unconsolidated surface materials. The accuracy of mapping subcrop boundaries of coal seams depends on the number and distribution of visible outcrops and test holes, as well as the nature of the topography and the amount of unconsolidated material covering the area. Other problems that make it difficult to map the coal subcrop include faults and other structural features, erosional cutouts, and areas in which the coal is lenticular or lacks continuity.

In much of the report area, the bedrock is covered by less than 50 ft to more than 400 ft of glacial drift. Wherever sufficient data were available, a provisional line was drawn that represented the border of the coal beneath these unconsolidated deposits. These provisional subcrops were derived by interpolation from coal structure and the bedrock surface. Any new drill holes or other data will modify these provisional limits; however, the estimated limits of the coal are accurate enough to illustrate on the map and to discuss areas where coal may be found at strippable depths.

On the maps for this report, coal exposures along streams and in strip and shaft mines show areas of relatively close control. The remainder of the subcrop boundary indicates areas where projections of the subcrop are based on other data, such as drill holes.

Overburden categories

The thickness of overburden is shown on the map by thickness lines (isopachs) representing 50-ft intervals. These lines divide the overburden into three thickness categories: 0 to 50, 50 to 100, and 100 to 150 ft. Resources tabulated in appendix A show the amount and thickness of strippable coal in each of these categories. At present, 100 to 120 ft is the approximate maximum limit of overburden removal in Illinois strip mining.

The thickness lines that delineate the various categories of overburden thickness on the map were constructed by the interpolation of intervals between contours of surface topography and coal elevation on a scale of 1:62,500.

Coal thickness

Coal thickness is indicated on the maps (pl. 1-A and 1-B) by thickness lines (isopachs) and average thickness categories. Isopachs are drawn where datum points are closely spaced; however, in some areas it was not practical to construct isopachs because of the scarcity of datum points; therefore, only estimated average coal thickness values are shown. The average thickness values thus derived were used to calculate the coal tonnage within each of the overburden and reliability classes. The average thickness values and isopach intervals used in this study above the minimum 18 in. are at 1-ft increments of average thickness from 2 ft and above.

Mined-out coal

Mined-out coal areas shown on plates 1-A and 1-B are taken from maps compiled by the ISGS and include all mining to January 1, 1979. In some areas, much of the geologic information that relates to the distribution and thickness of the coal has come from observations at these mines.

STRIPPABLE COAL RESOURCES

Classification of resources

Coal resources are divided into two classes to designate the reliability of the estimate. In the maps and tables, resources are divided into class I and class II.

Class I resources. Class I resources include coal in areas where there are enough data to establish the presence and thickness of coal with reasonable certainty. Generally, this class includes all coal within 2 miles of any points for which there are reliable coal thickness data, such as: mines, outcrops, diamond drill holes, and churn drill coal-test holes. This is equivalent to the proven (class I-A) and probable (class I-B) categories for resources in the statewide inventory of coal resources compiled by Cady (1952), and is approximately equivalent to the measured and indicated category of the U.S. Bureau of Mines (USBM) and USGS (1976).

In some cases, when the available data suggest that the persistence of the coal is uncertain, or, that there are marked variations in its thickness, the limits of coal data reliability that are defined above have been reduced in making our appraisals.

Class II resources. Class II resources include coal 2 to 4 miles from all points of class I, and 0 to 4 miles from points for which there are less reliable data, such as test holes drilled for gas and oil, or water wells where data on thickness are not reliable enough for classifying the coal as class I resources. The class II resources of this report correspond to those classified by Cady (1952) as II-A (strongly indicated) and to a portion of the inferred category of the USGS (1976).

Resources classified as class II indicate areas where indirect evidence, plus geologic interpretation, strongly suggest that coal may be present at the thicknesses indicated on the maps. Exploration for strippable coal might be conducted advantageously in these places.

Quality of the coals

All Illinois coals fall into the category of high-volatile bituminous, as designated by the American Society for Testing and Materials (1980, standard D 388). Our coal analyses are summarized in appendixes B, C, and D. These tables list average values for the various parameters of the Danville (No. 7) and Herrin (No. 6) Coals, by mine average for each mine sampled and by an overall county average based on those samples.

The Danville Coal has an average sulfur value (moisture free) of 3.2 percent for the study area, which is fairly representative for this coal, although a few extremes of high and low sulfur are noted (app. B and C). The Herrin Coal has an average sulfur value of 3.0 percent, but in some mines it has been reported to have the relatively lower sulfur values of 1.4 to 2.5 percent where there is a thick nonmarine gray shale roof (app. D).

Structural setting of report area

The study area is situated just to the northeast of the La Salle Anticlinal Belt (fig. 4). This anticlinal structure forms a boundary between the Fairfield Basin and the study area; the study area is part of the eastern structural

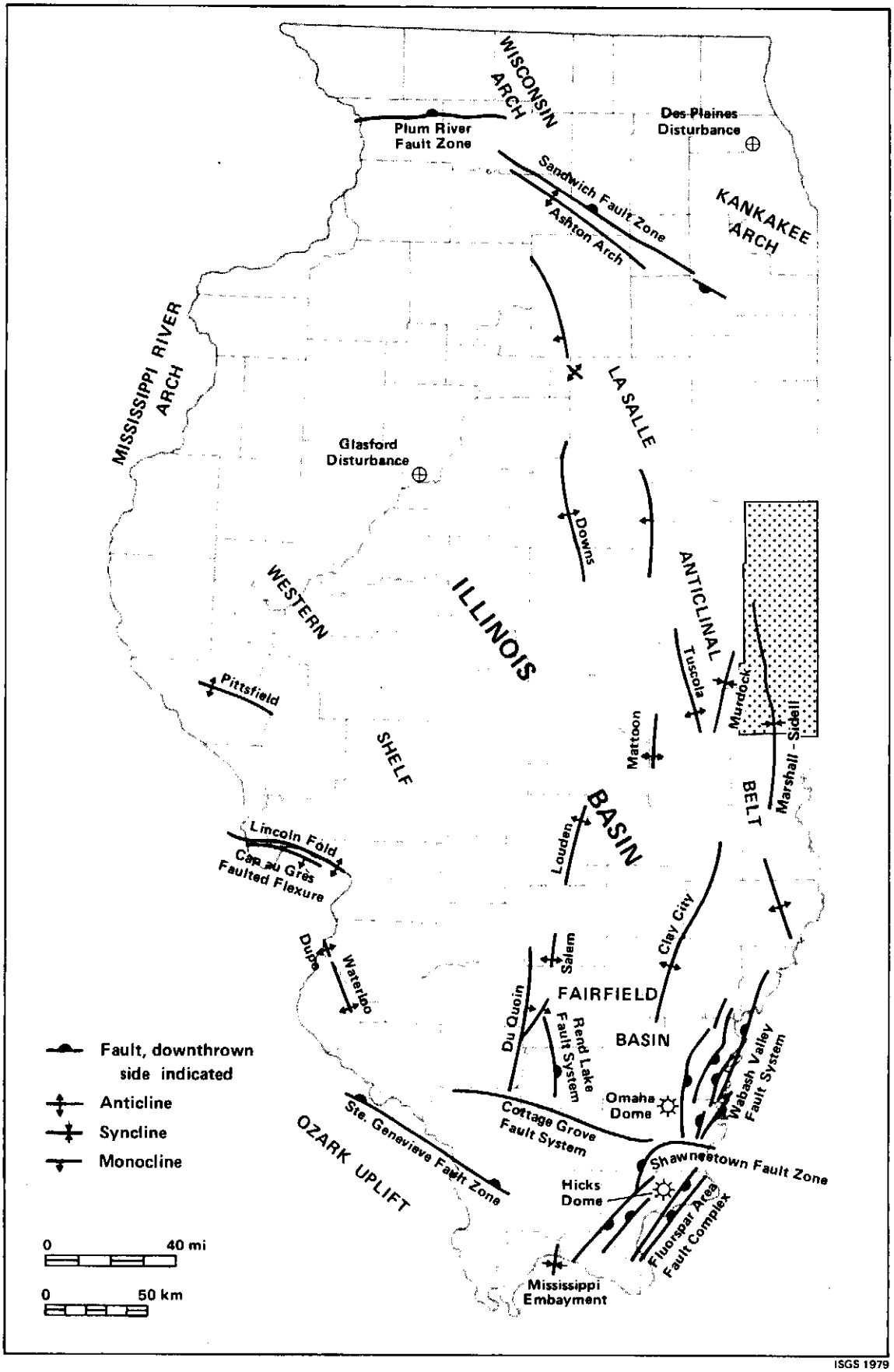

Figure 4. Principal geologic structures of Illinois and their relationship to the report area, compiled by Janis D. Treworgy, 1979.

shelf of the Illinois Basin (Clegg, 1965). Because this area was structurally higher than the deeper part of the Fairfield Basin to the southeast during the deposition of earliest Pennsylvanian sediments, deposition of these sediments was restricted (Clegg, 1965). The study area is situated astride the northern portion of the Marshall-Sidell Syncline. The mapped strippable coals occur along the eastern flank of the syncline, where the coals and associated strata gently dip less than one degree to the southwest. The structure on the top of the Danville (No. 7) and Herrin Coals in Vermilion and Edgar Counties is shown on plates 1-A and 1-B.

GEOLOGY AND STRATIGRAPHY OF THE COALS AND ASSOCIATED STRATA

Strata of the Pennsylvanian System in Illinois have been divided into three stratigraphic groups—McCormick, Kewanee, and McLeansboro—from oldest to youngest (Kosanke et al., 1960). Each stratigraphic group has been divided into formations, which are in turn divided into members. Only selected units will be discussed; the strippable coal resources classified in this report are for coals contained in the Carbondale Formation of the Kewanee Group. A generalized stratigraphic section (fig. 5) shows the classification of Pennsylvanian strata in east-central Illinois. A cross-section diagram (pl. 1-C) shows the correlation of key Pennsylvanian members in the area.

MCCORMICK GROUP

The McCormick Group is divided into the Caseyville and Abbott Formations (Kosanke et al., 1960). In Vermilion and Edgar Counties, no members of the Caseyville and Abbott Formations have been formally recognized. In the study area, the Caseyville and Abbott have a combined estimated maximum thickness of 150 ft, with the strata probably restricted to the Abbott and possibly the upper part of the Caseyville Formation.

KEWANEE GROUP

The Kewanee Group includes the Spoon and Carbondale Formations and is characterized by the widespread development of minable coals. Over 99 percent of the mapped coal resources of Illinois occur in the Kewanee Group (Kosanke et al., 1960).

Spoon Formation

Although many named members of this formation are recognized throughout the state and numerous coal seams in the formation have been or are presently being mined in Illinois, only one member, the Seelyville Coal, has been formally recognized in eastern Illinois.

The Spoon Formation is correlative with the uppermost part of the Brazil Formation, all of the Staunton Formation, and the basal part of the Linton Formation in Indiana (Kosanke et al., 1960; pl. 1-A). These formations contain several named coal seams that have been mined within counties adjacent to the study area in Indiana (Hutchinson, 1961).

Seelyville Coal Member. The Seelyville Coal Member (fig. 5) is named from mine exposures near the village of Seelyville, Vigo County, Indiana (Ashley, 1909). It is known in Indiana as the Seelyville Coal Member (III). The Seelyville Coal has been traced with geophysical logs in the subsurface throughout large areas of east-central Illinois (Treworgy, 1981). Treworgy's study shows the Seelyville to be fairly thick over the eastern half of Edgar County, where it ranges mostly from 3½ to 5½ ft, with a few areas in excess of 5½ ft. In the western half of Edgar County the coal is shown to be thin or absent. This study did not include Vermilion County.

The Snow Hill Coal Company mined the Seelyville Coal in their Green Valley mine northwest of Terre Haute, Indiana, where the seam averaged 7 ft in thickness and was approximately 30 ft below the No. 2 Coal. In the study area the Seelyville Coal generally lies 20 to 30 ft below the No. 2 Coal. A diamond drill core in Sec. 30, T. 14 N., R. 10 W., recorded 6 ft of Seelyville Coal at a depth of 553 ft. A diamond drill core further north in Sec. 8, T. 15 N., R. 10 W., shows this coal to be 4 ft 8 in. thick. Additional data from several drillers' logs and electric logs indicate an overall thinning, along with the development of prominent splits in the coal, northward into Vermilion County (pl. 1-C).

In 1882, Shaft No. 4 of the Ellsworth Coal Company at Tilton (Sec. 18, T. 19 N., R. 11 W.) in Vermilion County was sunk to a depth of 310 ft below the surface, where 4 ft of Seelyville Coal was encountered. Little mining of the Seelyville ensued and the mine was discontinued in 1885.

A diamond drill core in Sec. 28, T. 20 N., R. 12 W., Vermilion County, shows several coals occurring at the approximate stratigraphic position of the Seelyville Coal. The two upper seams are tentatively correlated as split Seelyville Coal.

In T. 17 and 18 N., R. 7 W., northwest of Cayuga, Vermillion County, Indiana, two coals have been mined at numerous locations; the average interval between the coals is 5 ft. The upper seam in this area has been correlated with the Colchester (No. 2) Coal in Illinois and averages 2½ ft in thickness. The lower seam varies in thickness from 2 to 3½ ft and has been correlated with the Seelyville Coal (Hutchinson, 1961).

Resources of the Seelyville Coal in Vermilion County Illinois, have been estimated to be 44,521,000 tons (Cady, 1952). Total resources in Edgar County have been estimated at 878,904,000 tons (Cady, 1952).

In most of the area of this report the Seelyville Coal appears to be at depths greater than the 150-ft strippable

coal limit; however, in the northeastern part of T. 19 N., R. 10 W. and part of T. 20 N., R. 10 and 11 W. of Vermilion County, this coal may occur at strippable depths. The basis for this inference is a projection of the inferred subcrop of the Colchester (No. 2) Coal from Indiana into Vermilion County, Illinois (Hutchinson, 1961), and the inferred subcrop of the Colchester for Vermilion County as shown on the geologic map of Illinois (Willman et al., 1967).

These data, combined with the estimated bedrock surface elevations in the above townships, suggest that both the Seelyville and Colchester Coals may lie at strippable depths in part of this area. Without the presence of reliable drill hole data, however, the extent of the area cannot be determined because of the presence of a bedrock valley that probably cuts out most of these coals.

Carbondale Formation

The Carbondale Formation (Kosanke et al., 1960) includes strata from the base of the Colchester (No. 2) Coal to the top of the Danville (No. 7) Coal. In the southern part of the study area the formation averages 275 to 300 ft in thickness, thinning northward to 180 to 190 ft in central Vermilion County.

The Carbondale Formation is dominantly composed of gray shales, but sandstones occurring in elongate channel facies up to a maximum of 100 ft thick and thinner sheet sandstones are common. Limestones are normally argillaceous and average 1 to 5 ft in thickness. Black fissile shales are usually well developed over most of the coals, and claystones are normally present beneath most coals. Cyclic sequences also have a wider variety of lithologic units than in lower formations. The principal economic coals of Illinois are contained in this formation, including the two seams studied in this report, the Danville (No. 7) and the Herrin (No. 6) Coals.

Colchester (No. 2) Coal Member. The Colchester (No. 2) Coal (figs. 5 and 6), named for the town of Colchester in McDonough County, Illinois, is the lowest member of the Carbondale Formation in Illinois, and is known as the Colchester Coal Member (IIIa) in Indiana. In the study area, the Colchester Coal is generally overlain by the black Mecca Quarry Shale (fig. 6). The Colchester Coal occurs about 75 to 80 ft below the Summum Coal in northeastern Edgar County, and thins northward with an average interval of less than 50 ft between the two coals in the northern part of the study area. The Colchester generally averages 18 in. or less in thickness but thickens eastward into Indiana, where it was mined several miles northeast of Cayuga, Vermillion County, Indiana, at a reported thickness of 2 to 3 ft and at a depth of 15 to 40 ft (Hutchinson, 1961).

As reported earlier, this coal may occur at or near strippable depths in T. 19 N., R. 10 W., and T. 20 N., R. 10 and 11 W. of Vermilion County, but no reliable data are available to show its thickness or actual depth.

Shawneetown Coal Member. The Shawneetown Coal (fig. 6) is named for Shawneetown, Gallatin County, Illinois. The coal is persistent in southern and eastern Illinois and is correlated with the Survant Coal Member (IV) of Indiana (Willman et al., 1975). A coal possibly correlative with the Shawneetown Coal lies 25 to 50 ft below the Summum (No. 4) Coal Member in this area. This coal is usually thin, and is often split into two benches. In localized areas of eastern Edgar County, where the two benches have merged and thickened, this coal has been reported to be up to 6 ft thick. A coal test in Sec. 17, T. 15 N., R. 10 W., Edgar County, shows this coal to be 5 ft 4 in. thick; however, in most of the study area the coal is very thin.

Summum (No. 4) Coal Member. The Summum (No. 4) Coal or the recognized horizon of the coal (fig. 6) is one of the most widespread stratigraphic markers in the state (Willman et al., 1975). The Summum Coal in Edgar County may be as little as 15 ft to as much as 85 to 90 ft below the Springfield (No. 5) Coal, with the thinner interval prevailing in the western part of the county (Clegg, 1965). In most of eastern Vermilion County, the Summum Coal lies 60 to 80 ft below the Springfield (No. 5) Coal. Available data indicate the Summum Coal is fairly thin in Edgar County and its position is recognized only by the presence of the associated thick black shale in eastern Vermilion County.

Springfield (No. 5) Coal Member. Earlier reports of the study area called the Springfield (No. 5) Coal the Harrisburg Coal; however, a recent study by Trask et al. (in preparation) has dropped the name Harrisburg from this coal in eastern and southern Illinois. The name given this coal in the remainder of the state—Springfield—was used to name the coal in eastern and southern Illinois. The Springfield (No. 5) Coal (fig. 6) is economically the second most important coal seam in Illinois. At present, the Springfield Coal accounts for 30 percent of the state's total production.

In the study area, the Springfield Coal occurs approximately 25 ft below the Herrin (No. 6) Coal. In Vermilion County, the Springfield Coal horizon is locally recognized by the presence of a black, carbonaceous shale with a thin overlying limestone (fig. 6). Occasionally a thin, lenticular, poorly developed coal is present. Southward into Edgar County, the Springfield Coal thickens; in Sec. 8, T. 15 N., R. 10 W., a coal test penetrated 4 ft 2 in. of this coal. This trend continues further south, where the coal averages 4 to 5 ft throughout much of east-central Illinois, and into adjacent counties in Indiana, where it has been mined extensively by both stripping and underground methods (Cady, 1952). Resources in the ground in Edgar County, totaling 441,330,000 tons, surface and deep minable, were originally mapped by Cady (1952). A recent study (Smith and Stahl, 1975) estimated there are 427,640,000 tons of Springfield Coal with a seam thickness greater than 42 in.

Herrin (No. 6) Coal Member. The Herrin (No. 6) Coal is named for Herrin, in Williamson County, Illinois, where

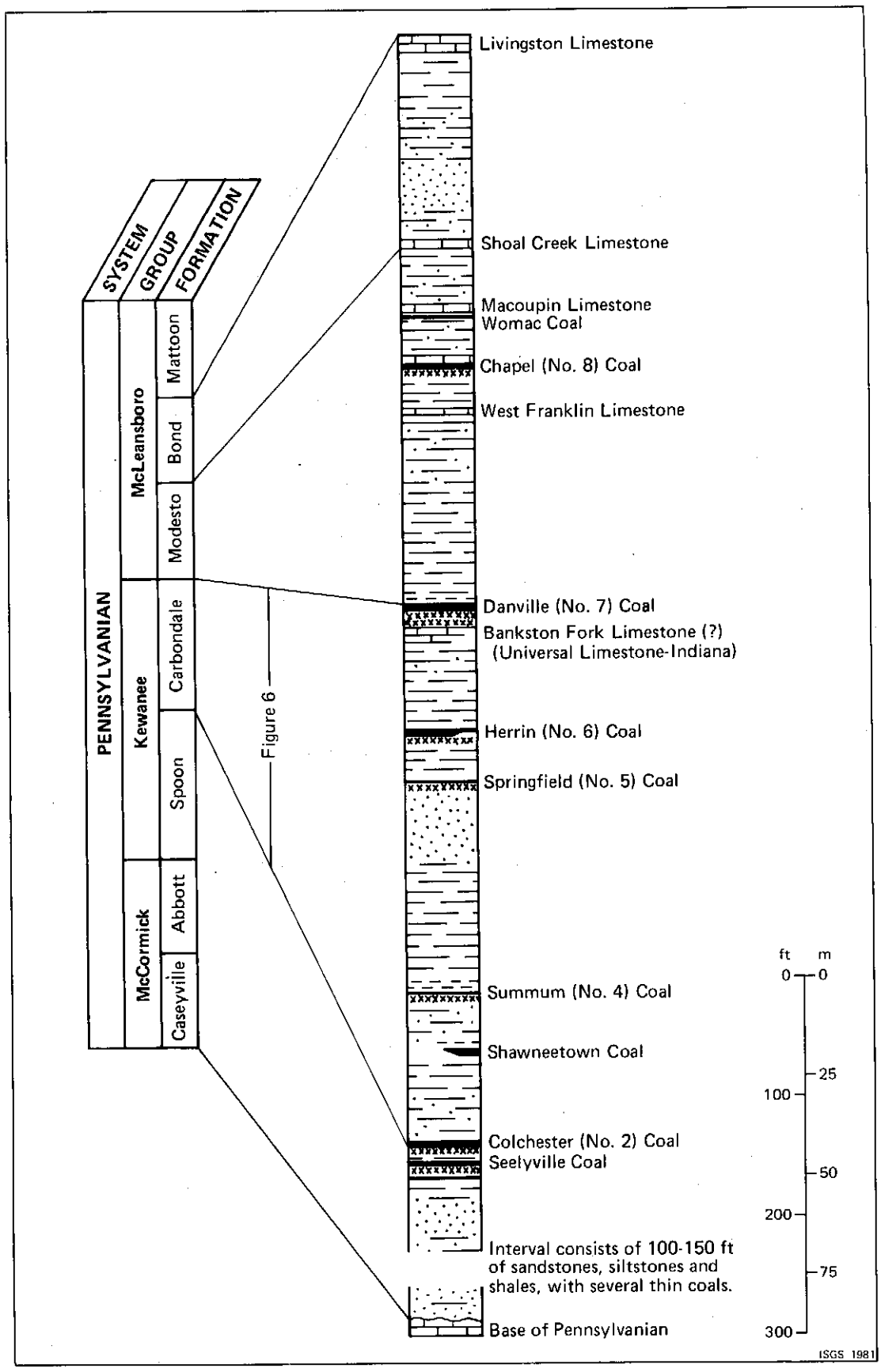

Figure 5. Composite stratigraphic section of the report area and nomenclature of the Pennsylvanian System in Illinois.

the coal was extensively mined (fig. 6). In Vermilion County the Herrin Coal was formerly referred to as the "Grape Creek Coal." Clegg (1965) made detailed physical correlations that demonstrated that the Grape Creek and Herrin Coals were the same. Palynological studies at the ISGS have confirmed this correlation. The Herrin in this area is correlative with a coal in Vigo and Vermillion Counties, Indiana, called the Bucktown Coal Member (Vb) by the Indiana Geological Survey (Shaver et al., 1970).

The Herrin Coal is present in both Vermilion and Edgar Counties and ranges in thickness from several inches to more than 6½ ft; locally, it attains a thickness of more than 9 ft. The Herrin Coal in the study area lies from 12 ft or less below the Danville (No. 7) Coal northwest of Danville to as much as 110 ft below the Danville Coal in the southern part of the report area.

In most areas of the state the Herrin Coal is normally overlain by the Anna Shale Member and/or the Brereton Limestone Member (fig. 6); occasionally, however, the coal is overlain by a gray silty shale that is stratigraphically below the Anna Shale and may attain thicknesses of more than 100 ft. This shale unit has been named the Energy Shale Member (Allgaier and Hopkins, 1975) from exposures near the town of Energy, Williamson County, Illinois. Where the Energy Shale (fig. 6) exceeds 20 ft in thickness, the Herrin Coal is generally lower in sulfur content (about 2.5 percent or less) than the state average of 3 to 5 percent (Gluskoter and Simon, 1968).

In the northwestern two-thirds of the study area, the Herrin Coal lies an average of 25 ft below the Danville Coal (fig. 3). Here the Herrin is overlain by several feet of dark-gray to black shale of the Anna Shale Member. A gray, argillaceous, marine limestone—the Brereton Limestone Member—overlies the Anna. The Brereton Limestone is discontinuous in its extent, is lenticular, and ranges from 0 to 7 ft in thickness. Where the interval between the Danville and Herrin Coals exceeds 25 ft (fig. 3), as in the southern part of Vermilion County, the Herrin Coal is overlain by the gray, silty Energy Shale Member. This shale first appears as a thin gray wedge between the Anna Shale and the Herrin Coal just south of Danville.

The wedge of Energy Shale in southern Vermilion County is part of a large clastic wedge that has been mapped by Treworgy and Jacobson (in preparation). This clastic wedge of Energy Shale covers more than 3,900 sq km (1,500 sq mi) in east-central Illinois, and has been traced into west-central Indiana. Treworgy and Jacobson have interpreted this deposit to be a lacustrine delta that filled a low area in the Herrin swamp.

Immediately north of the main body of Energy Shale in Vermilion County are found isolated lenses of dark gray Energy Shale overlying the Herrin Coal. These lenses correspond to areas where the Herrin Coal is thickest. Apparently these lenses were deposited in the most actively subsiding portions of the coal swamp, which first received thick accumulations of peat, and then became ponds of open water (Nelson and Danner, unpublished data).

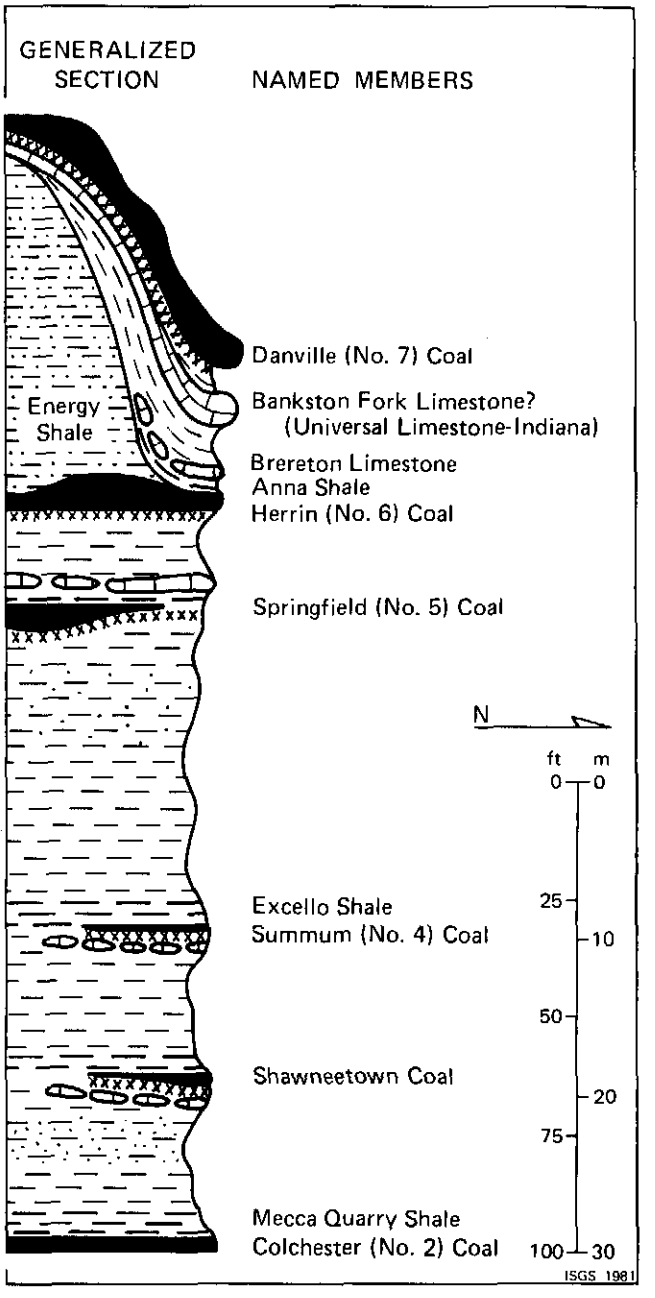

Figure 6. Diagrammatic section of the Carbondale Formation in Vermilion and northeastern Edgar Counties.

Because of the nature of available data, a map showing the 20-ft thickness lines of the Energy Shale was not prepared; however, this line corresponds approximately to the 40-ft interval between the Herrin and Danville Coals (fig. 3). Mines in the general area, where the gray shale is greater than 20 ft thick, have reported sulfur values of 1.2 to 2.5 percent.

Bankston Fork Limestone Member (Universal Limestone Member, Indiana). The Universal Limestone Member of Indiana (Shaver et al., 1970) has been tentatively correlated with the Bankston Fork Limestone (Willman et al., 1975). At the type locality of the Universal Limestone, which is located in the SW¼ of Sec. 31, T. 14 N., R. 9 W., Ver-

million County, Indiana (which is close to the study area), the Universal Limestone has been described as a mottled gray and brown, fine-grained, argillaceous and fossiliferous limestone. It has a reported thickness of 0.1 to 11.9 ft in Indiana (Shaver et al., 1970), but seldom exceeds 6 ft in Illinois (Willman et al., 1975).

In the study area, a limestone correlative with the Universal Limestone Member occurs from 5 to 20 ft below the Danville (No. 7) Coal Member (pl. 1-C). A typical exposure of this unit occurs south of Danville at the abandoned V-Day mine (Sec. 30, T. 19 N., R. 11 W.), where it has been found 8 to 10 ft below the Danville, with a maximum thickness of 5 ft. At this locality it was described as a medium-gray, mottled greenish-gray, irregularly bedded, and argillaceous limestone. In much of the study area, the limestone is lenticular and pinches out or is nodular. In many areas of Vermilion County this limestone contains no marine fossils and represents the underclay limestone of the Danville Coal. In parts of southern Vermilion and Edgar Counties, the limestone does contain marine fossils, which become abundant near the eastern edge of Edgar County.

Since this unit in the study area is equivalent to the Universal Limestone and is probably correlative with the Bankston Fork Limestone, the name Bankston Fork will be used only tentatively.

Danville (No. 7) Coal Member. The Danville (No. 7) Coal Member, an important coal that has been mined since the middle part of the 19th century, is the uppermost member of the Carbondale Formation. It is named for the city of Danville, Vermilion County, near the type section in Sec. 7, T. 19 N., R. 11 W. (Wanless, 1956), where it is 6 ft thick and 20 ft above the Herrin (No. 6) Coal Member. The Danville Coal is quite extensive in Vermilion and Edgar Counties, but most mining has occurred in the area immediately west and south of the city of Danville. The coal is eroded in most of the northern third of Vermilion County; it averages 5 to 6 ft in thickness throughout the middle third, and gradually thins southward and eastward. The coal averages 3 ft in thickness in southeastern Vermilion and northeastern Edgar Counties, locally thickening to 4 or 5 ft near Brouilletts Creek and the Illinois-Indiana border. Locally, a split of the Danville Coal, called the "Blacksmith's Seam" or "Sump Vein" by local miners in the past (Worthen et al., 1870), occurs about 6 in. below the main seam and attains a maximum thickness of 2 ft.

The Danville Coal extends throughout much of the rest of Illinois and has also been mined in Livingston, McLean, La Salle, and Marshall Counties. In the rest of the state it is thin, usually only a few inches to less than 3 ft thick. The Danville (No. 7) Coal correlates with the Danville Coal Member (VII) of Indiana (Willman et al., 1975).

Where the Danville Coal is present in most of Illinois, it is generally overlain by the Farmington Shale Member of the Modesto Formation, but in our study area the immediate roof is locally overlain by 1 or 2 ft of black fissile shale. The seam is underlain by a well-developed claystone underclay.

MCLEANSBORO GROUP

The McLeansboro Group includes all younger Pennsylvanian strata above the Danville Coal in the study area (fig. 5). The group is divided into three formations: the Modesto, the Bond, and the Mattoon, in ascending stratigraphic order. Lithologically, the McLeansboro Group is similar to the Carbondale Formation, but it contains a few limestones that are thicker and less argillaceous than those of the Carbondale Formation. In Vermilion County, the Mattoon Formation is not present and the Bond and Modesto Formations are generally present only in the west-central and southwestern parts of the county.

Modesto Formation

The Modesto Formation includes all strata from the top of the Danville (No. 7) Coal Member to the base of the Shoal Creek Limestone Member (fig. 5). The coals within this formation are usually thin, and extend over a large area. Gray shales and sandstones that may be as much as 100 ft thick make up the greater part of this formation.

In the study area the formation is present in the west-central and southwestern half of Vermilion County and in all but extreme eastern and western Edgar County. The Modesto Formation in this area attains a maximum thickness of about 150 ft. Some of its recognized members in the report area include: the West Franklin Limestone, the Chapel (No. 8) Coal, the Womac Coal, and the Macoupin Limestone (fig. 5).

West Franklin Limestone Member. The West Franklin Limestone Member (fig. 5) is named for West Franklin, Posey County, Indiana. In Vermilion County, the West Franklin is present as one or two poorly developed, nodular, and argillaceous limestone beds associated with variegated claystone or shale. Near the northern limit of McLeansboro strata in Vermilion County, the West Franklin lies about 75 ft below the Shoal Creek Limestone Member. This interval thickens to 90 ft near the southern boundary of Vermilion County.

Chapel (No. 8) Coal Member. The Chapel (No. 8) Coal Member (fig. 5) of the Modesto Formation (Kosanke et al., 1960) is named for Graham Chapel, Peoria County. This coal is correlated with the Ditney Coal Member of southwestern Indiana (Willman et al., 1975). In Vermilion County the Chapel (No. 8) Coal is present as a thin, bony coal streak that seems to be fairly persistent throughout the area of McLeansboro strata. It lies about 75 ft below the Shoal Creek Limestone in southern Vermilion County, and the interval thins northward to about 60 ft at the northern limit of McLeansboro strata.

Womac Coal Member. The Womac Coal Member (fig. 5) of the Modesto Formation (Kosanke et al., 1960) is named for Womac, Macoupin County. This thin coal is widely traced in the Illinois Basin along with the overlying Macoupin Limestone, from which it is separated by 1 to 2 ft of black fissile shale (Willman et al., 1975). It is present in Vermilion County as a thin, shaly, coal horizon beneath the Macoupin Limestone Member.

Macoupin Limestone Member. The Macoupin Limestone Member of the Modesto Formation (Wanless, 1931) is named for Macoupin Creek in Macoupin County, where the type section is exposed (fig. 5). It is a widespread unit found throughout much of the Illinois basin. In Vermilion County the Macoupin Limestone is 1 to 2 ft thick and consists of an argillaceous, silty, gray to dark-gray, fossiliferous, sometimes nodular limestone, generally occurring about 30 ft below the Shoal Creek Limestone. Generally, the Macoupin Limestone is not as well developed as the Shoal Creek and in certain areas it may be absent; therefore, it is seldom reported in drill hole records (Clegg, 1965).

Bond Formation

The Bond Formation of the McLeansboro Group (Kosanke et al., 1960) is named for Bond County, Illinois, where exposures of it are prominent. The formation includes all the strata from the top of the Livingston Limestone Member to the base of the Shoal Creek Limestone Member. It is characterized by a high percentage of limestone and calcareous claystones and shales (Willman et al., 1975).

In Vermilion County the Bond Formation generally averages 90 to 100 ft in thickness and is overlain by Pleistocene deposits. The Bond Formation has been removed by erosion in much of the area. It is present in the southern quarter of Vermilion County, and in Edgar County as a north-south band running through about the middle half. Some of the prominent members of the Bond Formation in the study area are the Livingston Limestone Member and the Shoal Creek Limestone Member (fig. 5).

Shoal Creek Limestone Member. The Shoal Creek Limestone Member (Engelmann, 1868) is the basal unit of the Bond Formation and is named for exposures along Shoal Creek in Clinton County (fig. 5). In Vermilion County the Shoal Creek Limestone generally lies about 100 ft below the Livingston Limestone. Locally, the Shoal Creek Limestone is a gray, argillaceous, dense limestone 1 to 4 ft thick, which sometimes is nodular in its upper part and which contains an abundance of small, black, rounded phosphatic pebbles or nodules scattered throughout its extent. It is also associated with a variegated red and green claystone or shale that occurs above the limestone and assists in its identification. The Shoal Creek Limestone is also called the Shoal Creek Limestone Member in Indiana (Willman et al., 1975).

Livingston Limestone Member. The Livingston Limestone Member (fig. 5) is named for the town of Livingston in Clark County (Worthen, 1875; Willman et al., 1975). Apparently the Livingston Limestone is present in Vermilion County in only one known outlier, which is located beyond the northern limits of its subcrop in central Edgar County (Clegg, 1965). This outlier is south of the town of Fairmont, where a quarrying operation has been active for many years in limestone 16 to 20 ft thick. At this quarry the Livingston Limestone is bluish gray to light gray, fine grained, dense, very fossiliferous in beds from 1 to 20 in. thick, and contains numerous small masses of crystalline calcite. The beds of limestone are usually separated by shale partings less than ½-in. thick.

STRIPPABLE RESOURCES OF HERRIN (NO. 6) COAL

The Herrin (No. 6) Coal has been extensively mined in Vermilion County since the latter part of the 19th century. The first recorded strip mine in the United States opened in 1866 in the Herrin Coal near the town of Grape Creek. The overburden in this mine was removed by horse-drawn plows and scrapers and hauled away in wheelbarrows and carts. Most mines in the study area have used underground methods to extract Herrin Coal. Most of these mines, all of which are located south of Danville, suspended operations during the 1940s and only limited production from relatively small mines has occurred since that time. At present, only one mine, an underground operation of the Lee Coal Company southwest of Danville, operates in the Herrin Coal in the study area.

Strippable resources in Vermilion and Edgar Counties that total more than 218 million tons and lie at depths of 150 ft or less are summarized in table 1. Approximately 60 percent of the strippable resources are at depths greater than 100 ft, which currently is the maximum mining depth for most strip mines in Illinois. A more detailed summary of the resources by county, township, and seam thickness is given in appendix A.

As we discussed earlier, the immediate roof of the Herrin Coal in the northwestern two-thirds of the study area is a black shale (Anna Shale Member), which is sometimes overlain by an argillaceous, gray, marine limestone (Brereton Limestone Member). In the southern third of the study area (fig. 3), however, a gray silty shale—the Energy Shale Member—overlies the coal. The change from Anna Shale roof to Energy Shale roof is marked by an increase in a southeastward direction in the average thickness of the interval between the Herrin and Danville Coals. This change in interval is caused by the increasing thickness of the Energy Shale Member. A maximum interval of 110 ft between the two coals is attained in southeastern Vermilion County; this interval remains fairly constant southward throughout eastern Edgar County.

Most mines in the Herrin Coal in Vermilion County operated in the area of gray, silty Energy Shale roof, and

TABLE 1. Strippable resources of Herrin (No. 6) Coal (in thousands of tons)

County	Class I resources at overburden thickness 0-50 (ft)	50-100 (ft)	100-150 (ft)	Total	Class II resources at overburden thickness 0-50 (ft)	50-100 (ft)	100-150 (ft)	Total	Total of I and II	Mined-out coal (sq mi)
Vermilion	18,125	64,846	106,752	189,723	1,520	5,878	20,568	27,966	217,689	8.08
Edgar			3,129	3,129					3,129	
Total	18,125	64,846	109,881	192,852	1,520	5,878	20,568	27,966	220,819	8.08

usually produced coal with relatively low sulfur content in the range of 1.2 to 2.5 percent. Some mines, however, yielded high-sulfur coal when the Energy Shale thinned to less than 20 ft. North of the 20-ft thickness limit, the Energy Shale thins and a poorly bedded, lenticular, weak, medium-dark-gray shale is present locally. In most of the region north of the gray shale area and further northward, the relatively thin, dark-gray to black, moderately well bedded, and more competent Anna Shale Member directly overlies the coal. This unit generally becomes more continuous and thicker to the north. Approximately 75 percent of the mapped strippable resources of Herrin Coal in Vermilion and Edgar Counties occur in the area where the interval between the Herrin and Danville Coals is 40 ft or more in thickness. Where the interval is 40 ft thick, there is a corresponding 20-ft thickness of the Energy Shale Member (fig. 3). Consequently, potentially low-sulfur resources (less than 2.5 percent) of coal lie within the area where this interval is 40 ft or more thick. The remainder of the resources north of this limit are expected to average 3 to 5 percent sulfur.

Vermilion County

Vermilion County has an estimated 217,689,000 tons of strippable resources (table 1). The Herrin Coal ranges in thickness from a few inches to greater than 9 ft and has an average thickness of 6 ft in the intensively mined area southwest of Danville (pl. 1-B). The coal generally contains a 1- to 2-in. claystone parting called the "blue band," which occurs 1½ to 3½ ft above the base of the coal (Kay and White, 1915).

Northward in a line from Catlin to Tilton, the Herrin Coal begins to thin, averaging between 2½ to 3½ ft; locally, however, it is quite variable in thickness, ranging from a few inches to as much as 7 ft (pl. 1-B). Further north, near the town of Collison in T. 21 N., R. 13 W., the Herrin Coal lies at depths greater than 150 ft and thickens locally from 3½ to more than 9 ft. The thick Danville and Herrin Coals in this area may be caused by thicker peat accumulation in a small localized basin present at the time of the deposition of both coals. In this area (T. 21 N. and the northern part of T. 20 N., R. 13 W., and 14 W.), the Gifford and Newtown Moraines trend east-west across the county, which results in glacial drift more than 100 ft thick. This may negatively affect the strip mining potential of both the Danville and Herrin Coals. North of this area the accurate limit and distribution of the Herrin Coal is not known because of a lack of data; the coal may not be present north of T. 21 N. because of a bedrock valley that extends below the elevation of the coal.

In southeastern Vermilion County, the Herrin Coal thins southward from over 6 ft in the area in which it was mined to less than 3 ft, with continued thinning to less than 2 ft in eastern Edgar County.

Edgar County

Cady (1952) originally mapped the resources of Herrin Coal with a seam thickness of 28 in. or more in Edgar County. Smith and Stall (1975) estimated there to be 751,184,000 tons of Herrin Coal with a seam thickness greater than 42 in. in Edgar County; however, all these resources occur in the western part of the county.

A total of 3,129,000 tons of strippable resources has been mapped for Edgar County in this study (table 1). All the mapped strippable resources are in the eastern part of T. 15 N., R. 10 W., and occur at a depth of 100 to 150 ft. Available data indicate the Herrin Coal is deeper than 150 ft over the rest of eastern Edgar and that it averages 2 ft or less in thickness.

In western Edgar County an undelineated area of strippable Herrin Coal occurs along the margins of the La Salle Anticlinal Belt before it crops out (pl. 1-B). In several holes, the Herrin Coal occurs at strippable depths, but the data were insufficient to delineate the area of strippable coal, or to calculate any resources.

STRIPPABLE RESOURCES OF DANVILLE (NO. 7) COAL

The Danville (No. 7) Coal has been mined extensively in Vermilion County since the last half of the 19th century. Most of the mining occurred south and west of the city of Danville. The Danville Coal was mined by both strip and underground methods until production declined in the 1940s; only a few underground and strip mines continued to operate through the early 1970s. In southern Vermilion and northern Edgar Counties, several small mines operated

a number of years ago; however, at present, only one small strip mine of the Lee Coal Company operates southwest of Danville in the Danville Coal.

The Danville Coal averages 5 to 6 ft thick in the area where it was extensively mined, with local thickening to more than 7 ft. The Danville Coal in some places contains several partings that generally do not persist. Pyrite occurs as lenses, bands, stringers, and plates along bedding planes and cleat faces. Detailed chemical analyses of the Danville Coal in Vermilion and Edgar Counties can be found in appendixes B and C.

In the study area, the Danville Coal is locally overlain by a black shale of variable thickness, but normally it is overlain by a gray shale, the Farmington Shale Member (Savage, 1927), which averages 50 ft in thickness. In some parts of the study area the gray shale, which contains numerous ironstone concretions, was used for the manufacture of brick and tile.

The roof of the Danville Coal contains some "rolls" that may affect mining operations. The floor is a 6- to 8-in. bed of claystone, which tended to heave during mining in the past. The Danville Coal generally thins southward and averages 3½ ft in thickness throughout the southern part of Vermilion and northeastern part of Edgar Counties. Further south, near the intersection of the Illinois-Indiana border and Brouilletts Creek, the coal thickens to locally more than 6 ft (pl. 1-A).

Strippable resources totaling over 537 million tons have been mapped for the Danville Coal in Vermilion and Edgar Counties (table 2). Detailed summaries of these resources are listed by county, township, and seam thickness in appendix A.

Vermilion County

Cady (1952) mapped a total of 1,712,155,000 tons of Danville (No. 7) Coal. The total resources of Danville Coal in Vermilion County have been reevaluated by the ISGS (Coal Section staff, 1980) to be 1,725,964,000 tons. In our study 386,647,000 tons of coal were identified as strippable in Vermilion County (table 3).

Strippable Danville Coal lies in an approximately 3- to 7-mile-wide band that begins at the town of Collison (Sec. 34, T. 21 N., R. 13 W.), and roughly trends south and east into northeastern Edgar County (pl. 1-A). From just north of Kickapoo State Park to east of Georgetown, the Danville Coal is visible in a few places in surface exposures along the Vermilion River and its tributaries; however, because of a lack of data and the considerable thickness of glacial drift, the location of the subcrop of the coal north of Collison is not accurately known. Nevertheless, a map of the bedrock surface in Illinois (Horberg, 1957) shows a major bedrock valley in northern Vermilion County with bedrock surface elevations well below the estimated elevations of the top of the Danville and Herrin Coals, indicating that the coal has been removed by erosion. Interpolation from this map indicates the northern limit of both coals to be near the north lines of T. 21 N., R. 13 W. and R. 14 W. (pl. 1-A and 1-B).

The Danville Coal averages 5 to 6 ft in the area southwest of Danville, but varies in thickness from less than 3 ft to over 8 ft. The coal generally thins to the south from the region southwest of Danville to an average thickness of 3½ ft (pl. 1-A), and this trend continues into northeastern Edgar County. Northwest of Danville the Danville Coal averages 4 to 5 ft. Further northwest, near the town of Collison, the coal lies at depths greater than 200 ft; however, the coal thickens locally and is more than 9 ft thick in this area.

In Vermilion County, strip mining was largely done at the base of the river bluffs and on the bottomlands of the Vermilion River and its tributaries, where it could be easily stripped without the removal of much overburden. In some areas the Herrin Coal was also mined. Most underground mining was also done along the Vermilion River, but higher up on the bluffs. Today, many of these areas adjacent to underground mines contain coal that is economical to strip mine.

Edgar County

Resources of Danville Coal in Edgar County were originally mapped by Cady (1952), who estimated them to be 1,423,169,000 tons. In this study, a total of 150,392,000 tons of strippable resources have been mapped for Edgar County (table 2).

TABLE 2. Strippable resources of Danville (No. 7) Coal (in thousands of tons)

	Class I resources at overburden thickness				Class II resources at overburden thickness					
County	0-50 (ft)	50-100 (ft)	100-150 (ft)	Total	0-50 (ft)	50-100 (ft)	100-150 (ft)	Total	Total of I and II	Mined-out coal (sq mi)
Vermilion	19,733	152,017	198,999	370,749		7,258	8,640	15,898	386,647	15.26
Edgar	13,087	49,801	55,093	117,981		18,801	13,610	32,411	150,392	
Total	32,820	201,818	254,092	488,730		26,059	22,250	48,309	537,039	15.26

TABLE 3. Strippable coal resources by county, coal bed, and reliability of classification (in thousands of tons)

Coal	Class I resources at overburden thickness				Class II resources at overburden thickness				Total of I and II	Mined-out coal (sq mi)
	0-50 (ft)	50-100 (ft)	100-150 (ft)	Total (ft)	0-50 (ft)	50-100 (ft)	100-150 (ft)	Total		
				Edgar County						
No. 7 Coal	13,087	49,801	55,093	117,981		18,801	13,610	32,411	150,392	
No. 6 Coal			3,129	3,129					3,129	
Total	13,087	49,801	58,222	121,110		18,801	13,610	32,411	153,521	
				Vermilion County						
No. 7 Coal	19,733	152,017	198,999	370,749		7,258	8,640	15,898	386,647	15.26
No. 6 Coal	18,125	64,846	106,752	189,723	1,520	5,878	20,568	27,966	217,689	8.08
Total	37,858	216,863	305,751	560,472	1,520	13,136	29,208	43,864	604,336	23.34
Grand total	50,945	266,664	363,973	681,582	1,520	31,937	42,818	76,275	757,857	23.34

The Danville Coal was mined in Edgar County in a few local mines that operated many years ago for local trade only. The Danville Coal averages 3½ ft in thickness throughout the northeastern part of the county, then thickens to the south to an average of 4 ft. Near Brouilletts Creek in Sec. 29 and 32, T. 15 N., R. 10 W., the Danville Coal is locally more than 6 ft thick (pl. 1-A). In the western part of the county along the margin of the Danville subcrop (pl. 1-A), which occurs on the edge of the La Salle Anticlinal Belt, a potential area of strippable coal may be found. Several drill holes indicate the Danville is less than 150 ft deep here, but data were insufficient to delineate the area of strippable coal, or to calculate any resources.

SUMMARY

Based on the data presented here, about 757 million tons of strippable coal resources, defined as coal 18 in. or more thick with overburden not exceeding 150 ft, have been mapped in the study area. The estimated strippable resources of the two principal coal seams in this area are: Danville (No. 7) Coal, 537,039,000 tons; and Herrin (No. 6) Coal, 220,819,000 tons. A little over 384 million tons or 72 percent of the Danville Coal and about 158 million tons or 72 percent of the Herrin Coal resources occur in seams more than 4 ft thick. The remaining percentages of the resources from both seams average 2 to 3 ft thick. Over 260 million tons, approximately 49 percent of the Danville Coal resources, and about 90 million tons or about 40 percent of the Herrin Coal resources have an estimated overburden thickness of 100 ft or less, which is generally the current maximum depth of strip mining in Illinois. Table 3 summarizes the distribution of the resources by county and coal seam. Appendix A presents a tabulated summary of the resources by county, township, and thickness of the overburden in two reliability categories that are shown in the maps (pl. 1-A and 1-B). Of the tabulated resources, 682 million tons are in the class I category, and about 74 million tons are in the class II category.

Another potential area of strippable coal has been identified by this report in western Edgar County along the flank of the La Salle Anticlinal Belt. Several drill holes in this area indicate that both the Herrin and Danville Coals occur at depths of less than 150 ft. Data were insufficient to delineate the area of strippable coal or to calculate its resources; however, data from the four drill holes available indicated that further exploration may yield another large block of strippable coal resources.

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APPENDIX A. Strippable coal resources according to thickness of overburden, thickness of coal, and reliability classification, by county and township (in thousand tons)

Coal, location, thickness (in.)	Class I resources at overburden thickness 0-50 (ft)	50-100 (ft)	100-150 (ft)	Total	Class II resources at overburden thickness 0-50 (ft)	50-100 (ft)	100-150 (ft)	Total	Total of I and II	Mined-out coal (sq mi)
EDGAR COUNTY										
No. 7 Coal										
14N-10W										
36			1,002	1,002					1,002	
48			922	922					922	
60	576	1,152	7,546	9,274					9,274	
72	2,004	1,037	691	3,732					3,732	
Total	2,580	2,189	10,161	14,930					14,930	
14N-11W										
60			461	461					461	
Total			461	461					461	
15N-10W										
48	1,567	12,718	4,943	19,228					19,228	
60	1,152	4,205	5,587	10,944					10,944	
72	3,318	7,050	1,037	11,405					11,405	
84	1,210	3,629		4,839					4,839	
Total	7,247	27,602	11,567	46,416					46,416	
15N-11W										
48	922	4,931	13,409	19,262					19,262	
60			1,382	1,382					1,382	
Total	922	4,931	14,791	20,644					20,644	
15N-12W										
48			922	922					922	
Total			922	922					922	
16N-10W										
36			2,004	2,004					2,004	
Total			2,004	2,004					2,004	
16N-11W										
36	1,002	4,808	335	6,145	18,801	13,610	32,411		38,556	
48	1,336	10,271	14,852	26,459					26,459	
Total	2,338	15,079	15,187	32,604	18,801	13,610	32,411		65,015	
Coal seam	13,087	49,801	55,093	117,981	18,801	13,610	32,411		150,392	
No. 6 Coal										
16N-10W										
24			3,129	3,129					3,129	
Total			3,129	3,129					3,129	
Coal seam			3,129	3,129					3,129	
County	13,087	49,801	58,222	121,110	18,801	13,610	32,411		153,521	
VERMILION COUNTY										
No.7 Coal										
17N-11W										
36	1,002	9,573	9,815	20,390	7,258	8,640	15,898		36,288	
48		2,673	6,728	9,401					9,401	
Total	1,002	12,246	16,543	29,791	7,258	8,640	15,898		45,689	

APPENDIX A. *Continued.*

Coal, location, thickness (in.)	Class I resources at overburden thickness 0-50 (ft)	50-100 (ft)	100-150 (ft)	Total	Class II resources at overburden thickness 0-50 (ft)	50-100 (ft)	100-150 (ft)	Total	Total of I and II	Mined-out coal (sq mi)
17N-12W										
24		230	2,580	2,810					2,810	
36		2,177	9,297	11,474					11,474	
48		691	2,028	2,719					2,719	
Total		3,098	13,905	17,003					17,003	
18N-11W										
24		3,133		3,133					3,133	
36		15,587		15,587					15,587	
48		19,691	2,167	21,858					21,858	
60	1,382	2,765	1,152	5,299					5,299	
Total	1,382	41,176	3,319	45,877					45,877	
18N-12W										
24			668	668					668	
36		6,532	13,409	19,941					19,941	
48		9,815	18,985	28,800					28,800	
60			4,205	4,205					4,205	
Total		16,347	37,267	53,614					53,614	
19N-11W										
36	415	414		829					829	
48	1,106	1,105		2,211					2,211	
60	2,534	6,163		8,697					8,697	
72	5,737	22,533		28,270					28,270	
84	1,935	3,871		5,806					5,806	
Total	11,727	34,086		45,813					45,813	2.76
19N-12W										
48			461	461					461	
60		6,163	18,432	24,595					24,595	
72	5,046	25,782	63,660	94,488					94,488	
84			2,339	2,339					2,339	
Total	5,046	31,945	84,892	121,883					121,883	11.46
19N-13W										
60		516	5,299	5,815					5,815	
72		4,147	12,096	16,243					16,243	
Total		4,663	17,395	22,058					22,058	0.50
20N-12W										
36		345		345					345	
48		460		460					460	
60	576	1,382	5,875	7,833					7,833	
72		4,656	15,068	19,724					18,724	
84		1,613	3,871	5,484					5,484	
Total	576	8,456	24,814	33,846					33,846	0.54
20N-13W										
60			864	864					864	
Total			864	864					864	
Coal seam	19,733	152,017	198,999	370,749		7,258	8,640	15,898	386,647	15.26

APPENDIX A. *Continued.*

Coal, location, thickness (in.)	Class I resources at overburden thickness 0-50 (ft)	50-100 (ft)	100-150 (ft)	Total	Class II resources at overburden thickness 0-50 (ft)	50-100 (ft)	100-150 (ft)	Total	Total of I and II	Mined-out coal (sq mi)
No. 6 Coal										
17N-11W										
24		849	2,123	2,972		313	2,369	2,682	5,654	
36	201	1,341	1,766	3,308					3,308	
48	7,196	9,968	2,056	19,220					19,220	
60		1,229	9,331	10,560					10,560	
72			670	670					670	
Total	7,397	13,387	15,946	36,730		313	2,369	2,682	39,412	.20
18N-11W										
48	760	894	819	2,473					2,473	
60	838	3,743	1,095	5,676					5,676	
72	939	6,504	21,321	28,764					28,764	
84		2,503	3,285	5,788					5,788	
Total	2,537	13,644	26,520	42,701					42,701	5.00
19N-11W										
24	1,252	916		2,168					2,168	
36	302	670		972					972	
48	223	6,705	3,442	10,370					10,370	
60	503	1,676	1,732	3,911					3,911	
72	3,956	8,113	12,739	24,808					24,808	
84		2,112	156	2,268					2,268	
Total	6,236	20,192	18,069	44,497					44,497	2.75
19N-12W										
24	1,140	2,637	6,425	10,202	1,520	5,185	16,545	23,250	33,452	
36	184	1,291	2,179	3,654					3,654	
48	89	3,017	10,682	13,788					13,788	
60	140	1,229	5,419	6,788					6,788	
72	402	805	5,699	6,906					6,906	
84			3,911	3,911					3,911	
Total	1,955	8,979	34,315	45,249	1,520	5,185	16,545	23,250	68,499	0.13
19N-13W										
24						380	1,654	2,034	2,034	
Total						380	1,654	2,034	2,034	0
20N-12W										
24		2,749	3,062	5,811					5,811	
36		1,341	1,559	2,900					2,900	
48		4,470	2,883	7,353					7,353	
60		84	1,090	1,174					1,174	
72			1,542	1,542					1,542	
84			1,486	1,486					1,486	
96			179	179					179	
108			101	101					101	
Total		8,644	11,902	20,546					20,546	
Coal seam	18,125	64,846	106,752	189,723	1,520	5,878	20,568	27,966	217,689	8.08
County	37,858	216,863	305,751	560,472	1,520	13,136	29,208	43,864	604,336	23.34
Grand total	50,945	266,664	363,973	681,582	1,520	31,937	42,818	76,275	757,857	23.34

APPENDIX B. Vermilion County—Danville (No. 7) Coal, mine and county averages of proximate and ultimate analyses

Mine name, location	Mine index no.	No. of analyses averaged, laboratory no., date	Condition[a]	Proximate				Ultimate					Heat values			
				Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Cal/g*	Btu/lb*	Rank	Unit index
Electric C.C.	94	8	1	13.2	38.0	39.3	9.5	3.2	5.8	61.7	1.2	18.6	6,213	11,180		
Electric Mine		BM 13497 (composite of	2		43.8	45.2	11.0	3.7	5.0	71.7	1.3	7.9	7,156	12,880		
10-19N-12W		6), BM 84229	3		49.2	50.8		4.1	5.6	79.9	1.5	8.9	8,039	14,470		
		(composite of 3),	4	15.0	40.0	44.1							6,964	12,540	125	
		4711-13-14-16-22-24	5		48.1	51.9							8,191	14,740		147
		1912, 1922, 1912[b]														
Fairmount C.C.	97	4	1	13.4	37.2	39.3	10.1	2.5	5.7	60.6	1.1	20.0	6,177	11,120		
Fairmount Mine		4727-34-36, BM 13551	2		42.9	45.4	11.7	2.9	4.8	70.0	1.3	9.3	7,133	12,840		
34-19N-13W		(composite of 3)	3		48.6	51.4		3.3	5.4	79.3	1.5	10.5	8,077	14,540		
			4	15.3	40.3	44.4							6,963	12,530	125	
			5		47.6	52.4							8,221	14,800		148
M & B C.C. Mine	603	1	1	13.3	38.3	38.8	9.6	2.8	6.0	61.4	1.0	19.2	6,244	11,240		
10-19N-12W		BM A90630 (composite	2		44.1	44.8	11.1	3.2	5.2	70.8	1.1	8.6	7,200	12,960		
		of 3)	3		49.7	50.3		3.7	5.9	79.6	1.3	9.5	8,100	14,580		
		1933[b]	4	15.1	41.3	43.6							7,000	12,600	126	
			5		48.6	51.4							8,245	14,840		148
Grape Creek M.C.	656	1	1	17.1	33.5	37.2	12.2	2.7	6.0	55.5	1.0	22.6	5,622	10,120		
Grape Creek Mine		BM B55491 (composite	2		40.4	44.9	14.7	3.3	5.0	67.0	1.2	8.8	6,778	12,200		
5-18N-11W		of 3)	3		47.4	52.6		3.9	5.8	78.5	1.4	10.4	7,950	14,310		
		1940[b]	4	20.0	36.8	43.2							6,500	11,700	117	
			5		46.1	53.9							8,122	14,620		146
Fairview Collieries	673	18	1	11.6	40.2	40.2	8.6	2.9	5.7	62.3	1.2	18.5	6,413	10,885		
Corp.		C-7567, C-7951, C-8359,	2		44.6	45.5	9.8	3.0	4.9	70.5	1.3	8.9	7,259	13,036		
Harmattan		C-13773-74-75,	3		49.5	50.5		3.7	5.5	78.3	1.5	9.9	8,013	14,415		
2-19N-12W		C-15031-32-33-34,	4	13.4	42.2	44.4							7,053	12,676	127	
		C-15275-76-77-78,	5		48.8	47.1							8,143	14,643		146
		C-12570, C-6103,														
		C-6474, C-6533														
		1952, 1953, 1952, 1965,														
		1968, 1968, 1962,														
		1949, 1950, 1950[c]														
Blue Lake C.C.	811	9	1	12.4	37.8	38.0	11.7	3.6	5.95	61.7	1.1	18.8	6,038	10,868		
27-19N-12W		C-1008, C-11496-97-98-	2		42.9	43.4	13.3	4.1	5.15	71.5	1.3	7.9	6,898	12,280		
		99, C-10100-01-02,	3		49.9	50.1		4.7	5.78	79.9	1.4	8.9	7,958	14,324		
		C-12520	4	15.3	42.0	42.6							6,900	12,420	124	
		1957, 1960, 1957, 1962[c]	5		49.6	50.4							8,012	14,421		144

APPENDIX B. *Continued.*

Mine name, location	Mine index no.	No. of analyses averaged, laboratory no., date	Condition[a]	Proximate				Ultimate					Heat values			
				Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Cal/g*	Btu/lb*	Rank	Unit index
Black Hawk C.C.	852	1	1	9.2	38.1	43.1	9.6	2.1	5.8	65.2	1.2	16.1	6,574	11,834		
Black Hawk Mine		C-2451	2		42.0	47.4	10.6	2.3	5.3	71.8	1.3	8.7	7,240	13,033		
9-19N-12W		1941[c]	3		46.9	53.1		2.6	5.9	80.3	1.5	9.7	8,096	14,574		
			4	10.4	41.2	48.4							7,364	13,256	⊕	
			5		46.2	53.8							8,222	14,800		⊕
Pierce Mining Co.	853	1	1	11.6	44.5	40.6	3.3	2.6	6.2	68.3	1.3	18.3	6,862	12,352		
10-19N-12W		C-2297	2		50.3	46.0	3.7	3.0	5.6	77.3	1.4	9.0	7,761	13,970		
		1940[c]	3		52.3	47.7		3.1	5.8	80.3	1.5	9.4	8,013	14,514		
			4	12.2	45.5	42.3							7,147	12,865	⊕	
			5		51.7	48.3							8,137	14,646		⊕
Deep Valley C.C.	916	1	1	12.8	40.5	37.1	9.7	3.3	5.8	62.0	1.2	18.1		11,207		
Deep Valley Mine		C-17053 (composite of 3)	2		46.4	42.5	11.1	3.8	5.1	71.1	1.3	7.7		12,850		
22-19N-12W		1971[c]	3		52.3	47.8		4.2	5.7	79.9	1.5	8.7		14,451		
			4	14.6	43.8	41.7								12,584	126	
			5		51.2	48.8								14,729		147
		Average of 9 mine averages (County Ave)	1	12.8	38.4	39.2	9.5	2.9	5.8	61.8	1.1	19.0	6,266	11,269		
			2		44.0	45.0	10.0	3.2	5.1	66.8	1.2	8.5	7,178	12,877		
			3		49.4	50.6		3.7	5.7	79.5	1.4	9.3	8,030	14,463	126	147
			4	14.7	41.4	43.8							6,987	12,555		
			5		48.6	46.7							8,162	14,699		

[a] Basis of analysis is denoted as follows: (1) sample as received at laboratory; (2) moisture-free; (3) moisture- and ash-free; (4) moist mineral-matter free; and (5) dry mineral-matter free (unit coal).
[b] Data from Cady (1948).
[c] Data from additional unpublished analyses in ISGS files.
* Conversion from calories to Btu's used conversion factor of 1.8.
⊕ Due to abnormally low moisture content no unit coal values calculated

APPENDIX C. Edgar County—Danville (No. 7) Coal, mine and county averages of proximate and ultimate analyses

Mine name, location	Mine index no.	No. of analyses averaged, laboratory no., date	Condition[a]	Proximate				Ultimate					Heat values			
				Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Cal/g*	Btu/lb*	Rank	Unit index
Edgar County C.C.	614	1	1	12.5	37.1	40.6	9.8	3.1	5.7	62.2	1.2	18.0	6,242	11,240		
Mine #1		C-682 (composite of 3)	2		42.4	46.4	11.2	3.5	5.0	71.1	1.3	7.9	7,133	12,840		
20-14N-10W		1934[b]	4	14.3	40.0	45.7							7,021	12,640	126	
			5		46.6	53.4							8,189	14,740		147

[a] Type of analysis is denoted as follows: (1) sample as received at laboratory; (2) moisture-free; (3) moisture- and ash-free; (4) moist mineral-matter free; and (5) dry mineral-matter free (unit coal).
[b] Data from unpublished analyses in ISGS files.
* Conversion from calories to Btu's used conversion factor of 1.8.

APPENDIX D. Vermilion County—Herrin (No. 6) Coal, mine and county averages of proximate and ultimate analyses

Mine name, location	Mine index no.	No. of analyses averaged, laboratory no., date	Condition[a]	Proximate				Ultimate					Heat values			
				Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Cal/g*	Btu/lb*	Rank	Unit index
Peabody C.C.	91	7	1	14.7	34.5	41.4	9.4	2.2	5.8	60.6	1.3	20.7	6,079	10,940		
#24		4741-42-43-44-45-46,	2		40.5	48.4	11.1	2.6	4.8	71.1	1.5	8.9	7,125	12,830		
15-18N-12W		BM 13570 (composite	3		45.5	54.5		3.0	5.4	79.9	1.7	10.0	8,012	14,420		
		of 3)	4	16.6	37.1	46.3							6,792	12,230	122	
		1912[b]	5		44.5	55.5							8,143	14,660		147
Sharon C.C.	92	4	1	15.5	32.9	40.7	10.9	2.3	5.5	59.5	1.3	20.5	5,856	10,540		
Sharon Mine		4702-03-04, BM 13471	2		38.9	48.2	12.9	2.7	4.5	70.5	1.5	7.9	6,928	12,470		
7-17N-11W		1912[b]	3		44.6	55.4		3.1	5.2	80.9	1.7	9.1	7,952	14,310		
			4	17.8	35.7	46.5							6,658	11,980	120	
			5		43.5	56.5							8,099	14,580		146
Bunsen C.C.	93	7	1	15.2	34.7	41.8	8.3	2.1	5.9	61.2	1.2	21.3	6,092	10,970		
Little Vermilion		4670-71-74-76-78-79,	2		41.0	49.2	9.8	2.5	4.9	72.2	1.4	9.2	7,183	12,930		
19-18N-11W		BM 13449	3		45.4	54.6		2.7	5.4	80.0	1.6	10.2	7,963	14,330		
		(composite of 6)	4	16.9	37.0	46.1							6,713	12,080	121	
		1912[b]	5		44.5	55.5							8,079	14,540		145
W. C. Shafer Mine	95	3	1	12.6	39.6	38.8	9.0	3.6	5.7	61.5	1.2	19.0	6,234	11,220		
7-19N-11W		4706-07, BM 13452	2		45.3	44.4	10.3	4.1	4.8	70.4	1.4	9.0	7,136	12,840		
		(composite of 2)	3		50.5	49.5		4.6	5.4	78.5	1.5	10.0	7,951	14,310		
		1912[b]	4	14.3	42.4	43.4							6,943	12,500	125	
			5		49.4	50.6							8,103	14,590		146
Taylor English C.C.	212	1	1	14.1	34.1	42.8	9.0	2.3	5.8	61.7	1.2	20.0	6,133	11,040		
#2 Mine		BM 84225	2		39.7	49.8	10.5	2.7	4.9	71.9	1.4	8.6	7,144	12,860		
3-18N-12W		(composite of 3)	3		44.4	55.6		3.0	5.4	80.3	1.5	9.8	7,983	14,370		
		1922[b]	4	15.8	36.5	47.7							6,818	12,270	123	
			5		43.3	56.7							8,109	14,600		146
U.S. Fuel C.C.	401	1	1	16.9	31.9	42.6	8.6	1.5	6.1	59.3	1.3	23.2	6,000	10,800		
Bunsenville Mine		BM A90661	2		38.4	51.2	10.4	1.8	5.0	71.4	1.5	9.9	7,222	13,000		
26-18N-12W		(composite of 3)	3		42.8	57.2		2.0	5.6	79.6	1.7	11.1	8,061	14,510		
		1933[b]	4	18.8	34.1	47.1							6,629	11,930	119	
			5		42.0	58.0							8,171	14,710		147
		Average of 6 mine	1	14.8	34.6	41.4	9.2	2.3	5.8	60.6	1.3	20.8	6,065	10,920		
		averages[b]	2		40.6	48.6	10.8	2.7	4.9	71.2	1.5	8.9	7,119	12,810		
			3		45.5	54.5		3.0	5.5	79.8	1.7	10.0	7,981	14,370		
			4	16.7	37.1	46.2							6,759	12,170	122	
			5		44.5	55.5							8,110	14,600		146

[a] Type of analysis is denoted as follows: (1) sample as received at laboratory; (2) moisture-free; (3) moisture- and ash-free; (4) moist mineral-matter free; and (5) dry mineral-matter free (unit coal).
[b] Data from Cady (1935).
* Conversion from calories to Btu's used conversion factor of 1.8.