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COAL IN KANSAS

prepared by

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Coal in Kansas*

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Geology

Coal-bearing areas of Kansas cover approximately 18,800 square miles or 23 percent of the state. Coal-bearing rocks are limited to two general areas: (1) the bituminous coal-bearing areas of eastern Kansas and (2) the marginal Cretaceous lignite region of central and north-central Kansas (Figure 1).

The bituminous region forms the western edge of the western region of the Interior Coal Province. At least 53 bituminous coals have been recognized in Kansas of which 7 are presently being mined and 16 have been mined in the past or are considered in reserve estimates. The coal-bearing rocks containing the major reserves are Lower and Middle Pennsylvanian in age, although two seams have been recognized in Lower Permian rocks in northeastern and east-central Kansas (Schoewe, 1951). Bituminous coal-bearing beds are not limited to the Cherokee and Forest City Basins as previously thought (Schoewe, 1958), but are known from electric logs to exist in the deeper subsurface over and west of the Nemaha Anticline.

The Pennsylvanian coal-bearing beds lie on the northwest flank of the Ozark Uplift and consequently the prevailing dip is to the northwest at 20 to 25 feet per mile. The regional strike is northeast. Kansas coals are predominantly flat-lying and relatively free of faulting. Deformation and faulting have been reported in coals of the lower Cherokee Group (Pierce, 1937), the Bevier (Hambleton, 1953), the Mulberry (Whitla, 1940), and the Nodaway coal (Whitla, 1940).

The structural features range from rolls 2 to 3 feet across and local fractures filled with clay and pyrite in the upper seams; to the northwest plunging Pittsburg anticline with structural relief of 70 feet, closed depressions 10 to 80 feet deep, and normal faults from less than one to 2.5 miles in length and 15 feet throw in the lower Cherokee seams.

Rank, Quality and Heating Value

Except for limited reserves of lignite and subbituminous coals in the central region, Kansas coals are mainly high volatile A bituminous in rank. In the commercially important coals of the Cherokee Group, the volatile matter decreases and fixed carbon progressively increases in coals successively lower stratigraphically in the group (Pierce, 1937).

On an as-received basis, moisture contents of Kansas bituminous coals range between 3 and 17%. The seven coals which are mined commercially have moisture contents ranging from 4 to 12% with a range of average moisture values between 5 and 10%. Kansas bituminous coals are moderate to high in ash and high in sulfur.

As-received ash values for all Pennsylvanian coals range between 5 and 34% and for commercially-mined coals, 17 and 30%.

Sulfur in Kansas bituminous coals ranges between 2 and 6% for commercially-mined coals and 2 to 12% for other Pennsylvanian coals. Average sulfur values for seven commercially-mined coals range between 2.6 and 5.0%. An

example of sulfur types for a commercial coal with 2.4% total sulfur is as follows: 0.05% sulfate sulfur; 1.21% organic sulfur; 1.11% pyritic sulfur.

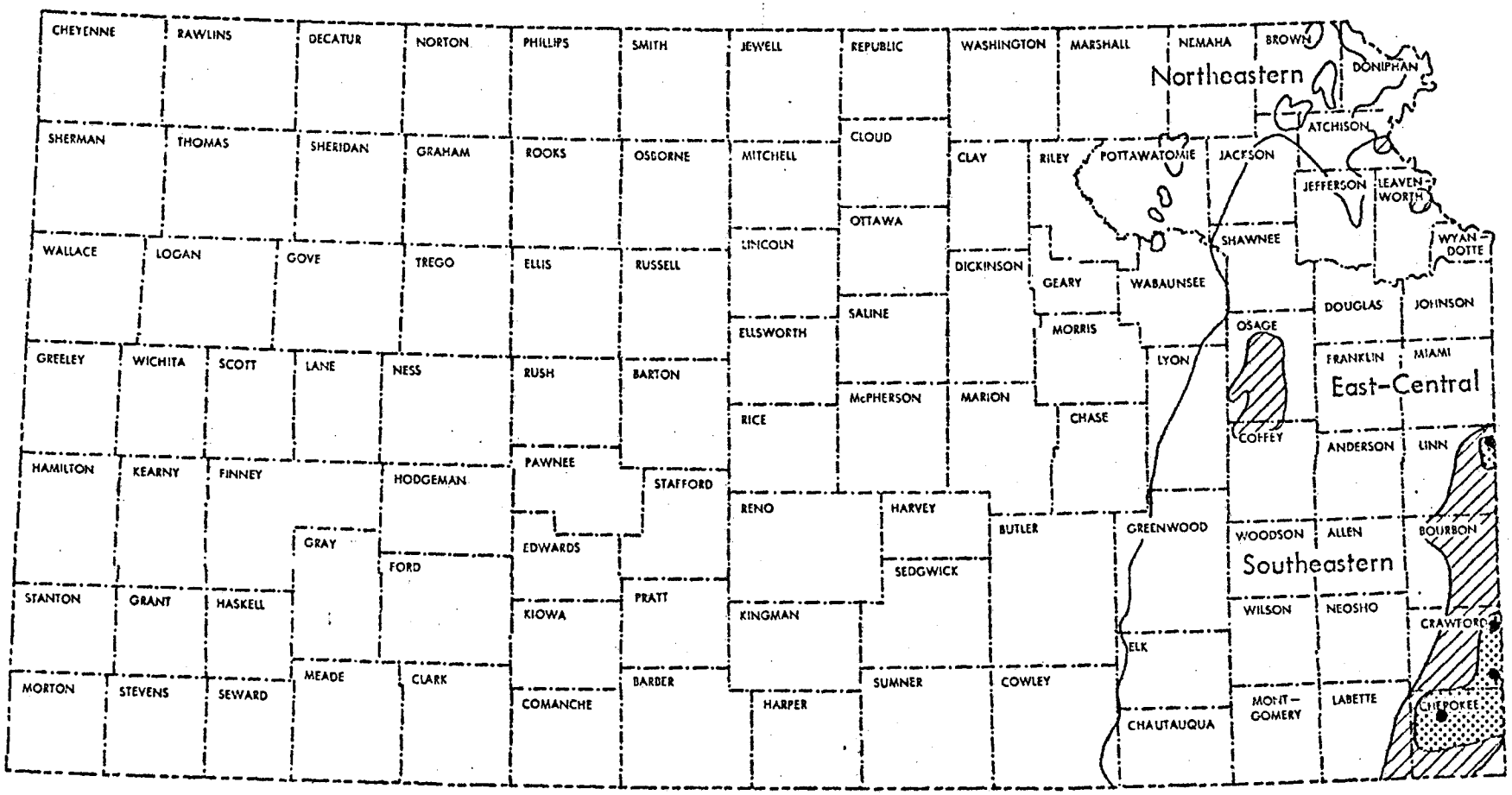
Heat values for Kansas bituminous coals on a dry, ash-free basis average between 13,750 and 15,120 BTU/lb. Washing of blends of various proportions of the Mineral, Fleming and Croweburg coals mined in Cherokee County produces a uniform product with approximately 6.5% moisture; 12.5% ash, 3.3% sulfur and 12,300 BTU/lb. with a seam loss of 10%.

Production

Kansas bituminous coal production has been centered in three regions: (1) the Southeastern Coal Field; (2) the East-Central Coal Field; and (3) the Northeastern Coal Field (Figure 1). However, since 1950, the Southeastern field, in particular Crawford, Cherokee and Linn counties, has produced 99.5% of the coal mined in the state. Since 1969, when the last mine closed in the East-Central Coal Field, 100% of recorded production has come from these 3 counties. Intermittent production in the East-Central field has been restricted to local trade. Total production from the 1860's through 1972 is 375,471,000 tons. Production by counties since 1869 is represented in Figure 2.

Peak Kansas coal production (7,250,000 tons) was recorded in 1917 and 1918 and with the exceptions of the years of World War II and 1962, to the present, has shown a declining trend (Figure 3). In 1970, coal production recorded a

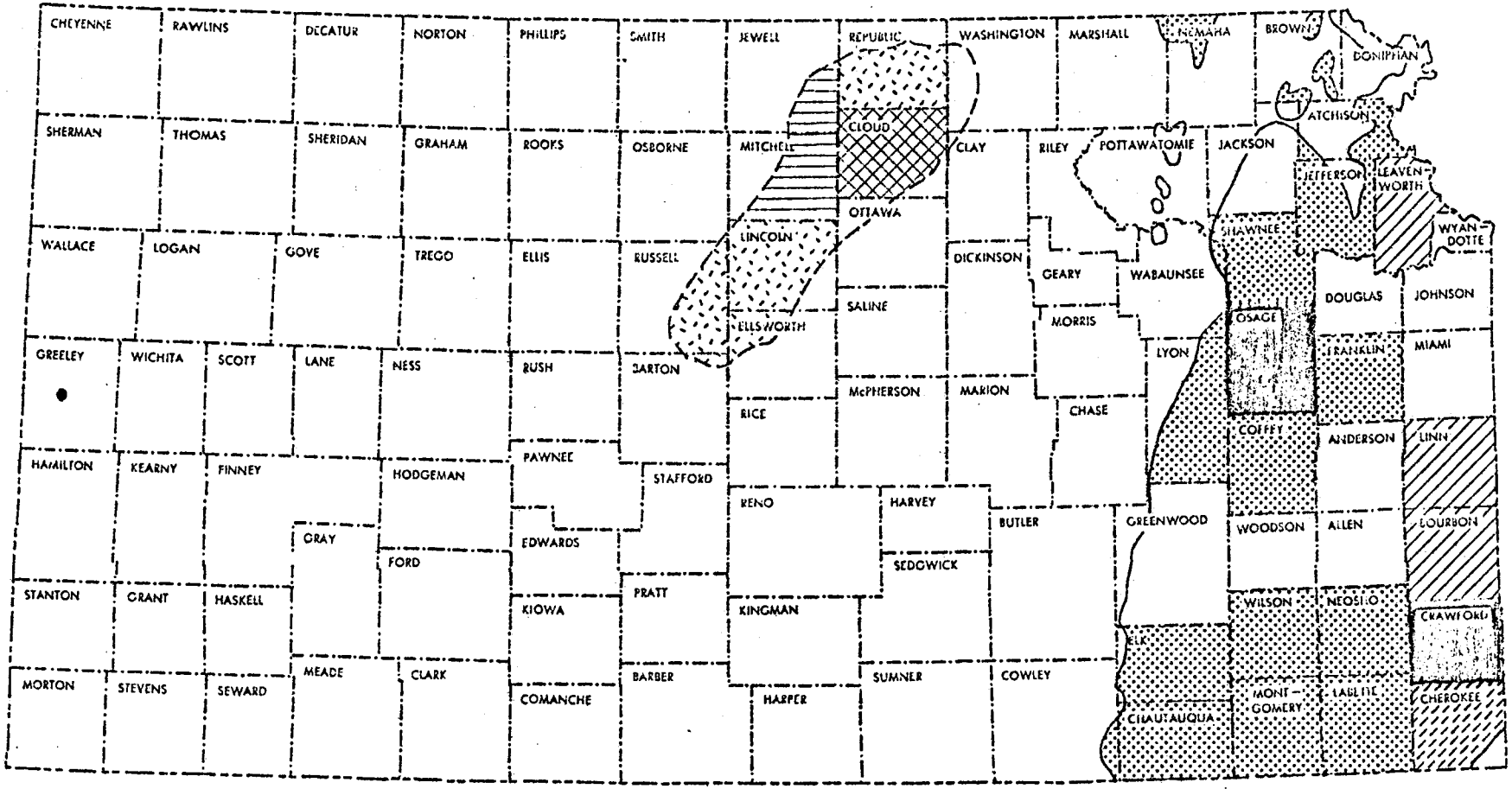
Location of Kansas Mines and Coal Fields



EXPLANATION

- Inactive coal fields
- Active coal fields
- Location of major mines
- Limit of Pennsylvanion Outcrop

Coal and Lignite Production Since 1869



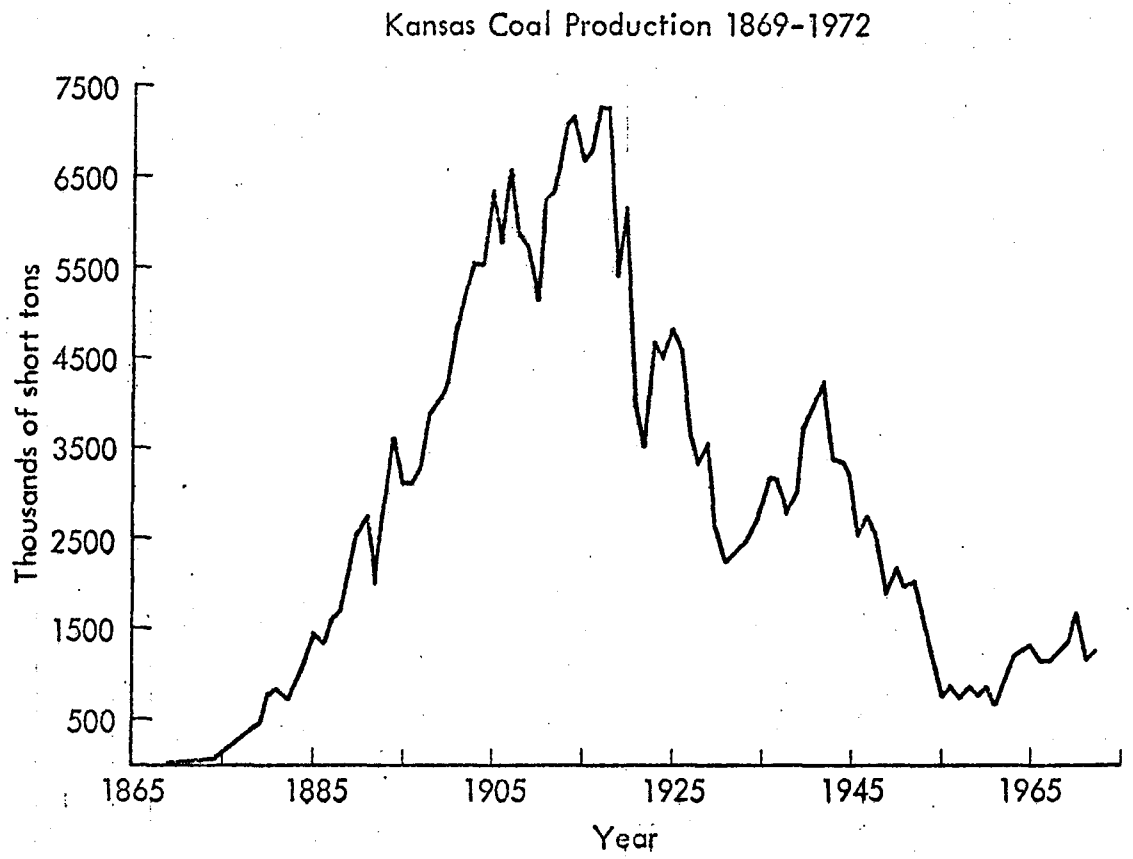
EXPLANATION

Bituminous (millions of tons)

- 100–160
- 50–100
- 1–25
- Less than 1

Lignite and Subbituminous (thousands of tons)

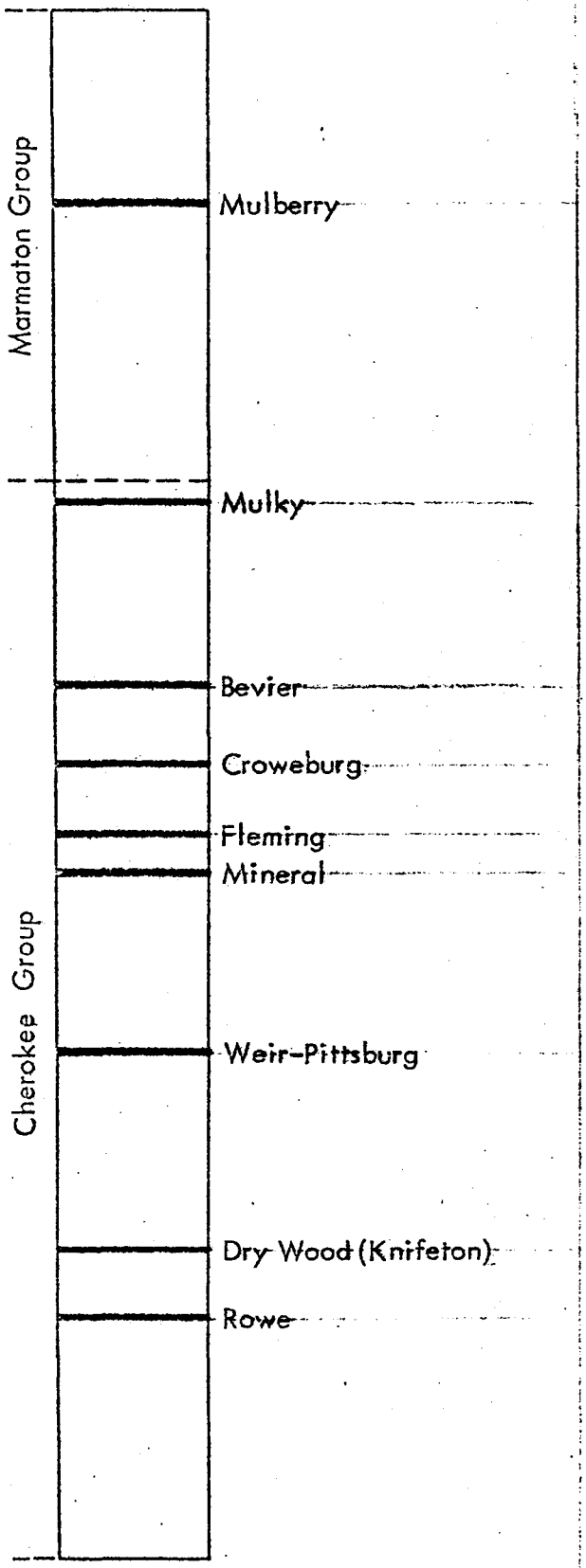
- 100–150
- 10–100
- Less than 10
- ——— Limit of Pennsylvanian Outcrop
- – – – Cretaceous Lignite Area


Kansas Coal Production 1869-1972
Thousands of short tons
7500
6500
5500
4500
3500
2500
1500
500
1865
1885
1905
1925
1945
1965
Year

17-year-high of 1.6 million tons which ranked Kansas 17th in bituminous coal production in the United States and 8th among states mining coal west of the Mississippi. In 1971, production dropped to 1.1 million tons due to a strike and then rose slightly in 1972 to 1.2 million tons valued at $6.6 million.

Seam Data

The nine coals of economic importance in southeastern Kansas (Figure 4) and the Nodaway coal with significant reserves in the East-Central Coal Field are characterized in Table 1.


Marmaton Group
Mulberry
Mulky
Bevier
Croweburg
Fleming
Mineral
Cherokee Group
Weir-Pittsburg
Dry Wood (Knifeton)
Rowe

Softening Temperature of Ash °F	Reserves (millions of tons)	Comments
	36.25 - Osage County 1 or less - Coffey, Elk, Jefferson Cos.	Total production to date 12 million tons localized hardening and thickening: one of 12 seams in Wabaunsee Group
2,100	129 - Linn County 10 - Bourbon County	2-3 foot rolls; clay tilled fractures; thin pyrite band near base
	7 - Bourbon County 2.5 - Crawford County	Fort Scott coal, not currently mined
2,300	10 - Bourbon County 17 - Cherokee County 21 - Crawford County	Currently mined in Crawford and Cherokee counties; previously mined at 750 ft. depths in Atchison and Leavenworth counties
2,200	1 - (approx.) each in Crawford and Cherokee counties	Mined in Cherokee County with the Fleming and Mineral Seams; 1972 production of 130,000T
2,100	2.5 - Crawford County 21 - Cherokee County	
2,050	48.5 - Cherokee County 126.5 Crawford County	Currently supplies greatest production (Cherokee and Crawford counties)

2,000-2,040	103.6 - Cherokee County 100.5 - Crawford County	Easily accessible reserves depleted
2,300		Mined in Crawford County with Rowe seam
2,300		Blocky with thin clay parting

Resources vs. Reserves[1]

Kansas has estimated bituminous coal resources of 18.7[2] billion tons (Averitt, 1969). However, only a small portion of this resource can be considered a mineable reserve under current technologic conditions.

When resources are considered, Kansas has approximately 2% of the total estimated remaining coal resources for states west of the Mississippi (excluding Alaska). In total coal resources, Kansas is exceeded in order of increasing tonnages by Missouri, Utah, New Mexico, Colorado, Wyoming, Montana and North Dakota. When bituminous coals alone are considered, Kansas is exceeded in tonnages by Missouri, Utah and Colorado.

Kansas' remaining coal reserves are estimated to be 895[3] million tons. The location and amounts of these reserves

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[1]The term resources refers to identified coal deposits which may or may not be recoverable under present technologic and economic conditions; while the term reserves refers to coal deposits which are workable or probably workable and which meet certain stated geologic and economic limits.

[2]Resources in the ground including bituminous coal 10 inches or more thick; maximum overburden thickness 60 feet or an overburden to coal ratio not exceeding 35:1 for strippable coal. For underground mining methods the following criteria based on Abernathy, Jewett and Schoewe (1947) were used--

Max. depth to coal (ft.)	Min. thickness of coal (inches)
100	16
150	18
200	22
600	32
1200	36

[3]1973 Kansas Geological Survey Estimate; proven reserves; all economic limits have not been considered.

are shown on a county basis in Figure 5. Stripping-coal reserves (Figure 6) are estimated to be 226[4] million tons from original resources of 500 million short tons stripping coal generally less than 100 feet below the surface (Averitt, 1970). According to Pittsburg and Midway Coal Mining Company estimates, Crawford, Cherokee, Linn and Bourbon counties have strippable coal reserves of 165 million tons. U.S. Bureau of Mines estimates (1969, 1971) of recoverable reserves are 831[5] million tons with recoverable stripping coal estimates ranging from 215[6] to 375[7] million tons. These stripping coal estimates include reserves which are contractually committed including approximately 30 million tons of Mulberry coal in Linn County and 14 to 15 million tons committed for mining in Cherokee and Crawford counties into the middle 80's.

The greatest reserves from a single Kansas seam are present in the Weir-Pittsburg coal. In 1925, these reserves were estimated to be 233,383,000 tons from original total reserves of 295,622,000 tons (Young, 1925). This seam is the thickest in Kansas (34 to 60 inches) and has supplied more

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[4]1973 Kansas Geological Survey Estimate; bituminous coal of 12 inches minimum thickness and 100 feet maximum overburden thickness.

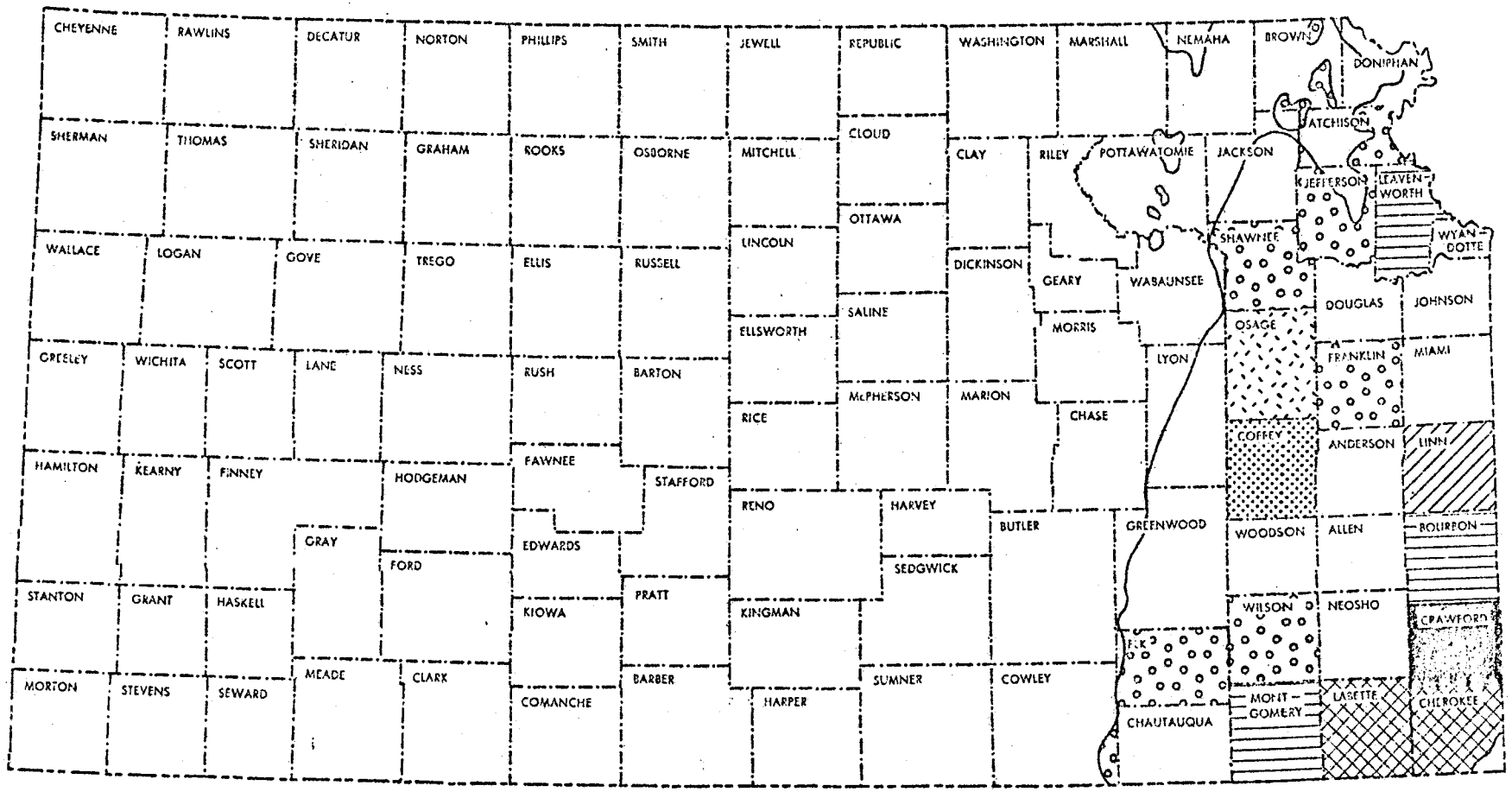
[5]Conditions used to evaluate strippable and underground reserves not precisely stated.

[6]Same as 4.

[7]Strippable reserves of 12 inches minimum thickness, 120 feet maximum overburden; economic stripping ratio 15:1 (feet to feet) or less; with deletion of reserves known to be unminable because of cultural or topographic features, steep dips or oxidation at the outcrop, previous mining, unacceptable quality and because of coal which may never be leased or sold.

Estimated Recoverable Bituminous Coal Reserves

(millions of tons)



EXPLANATION

200–270

150–200

100–150

35–40

25–30

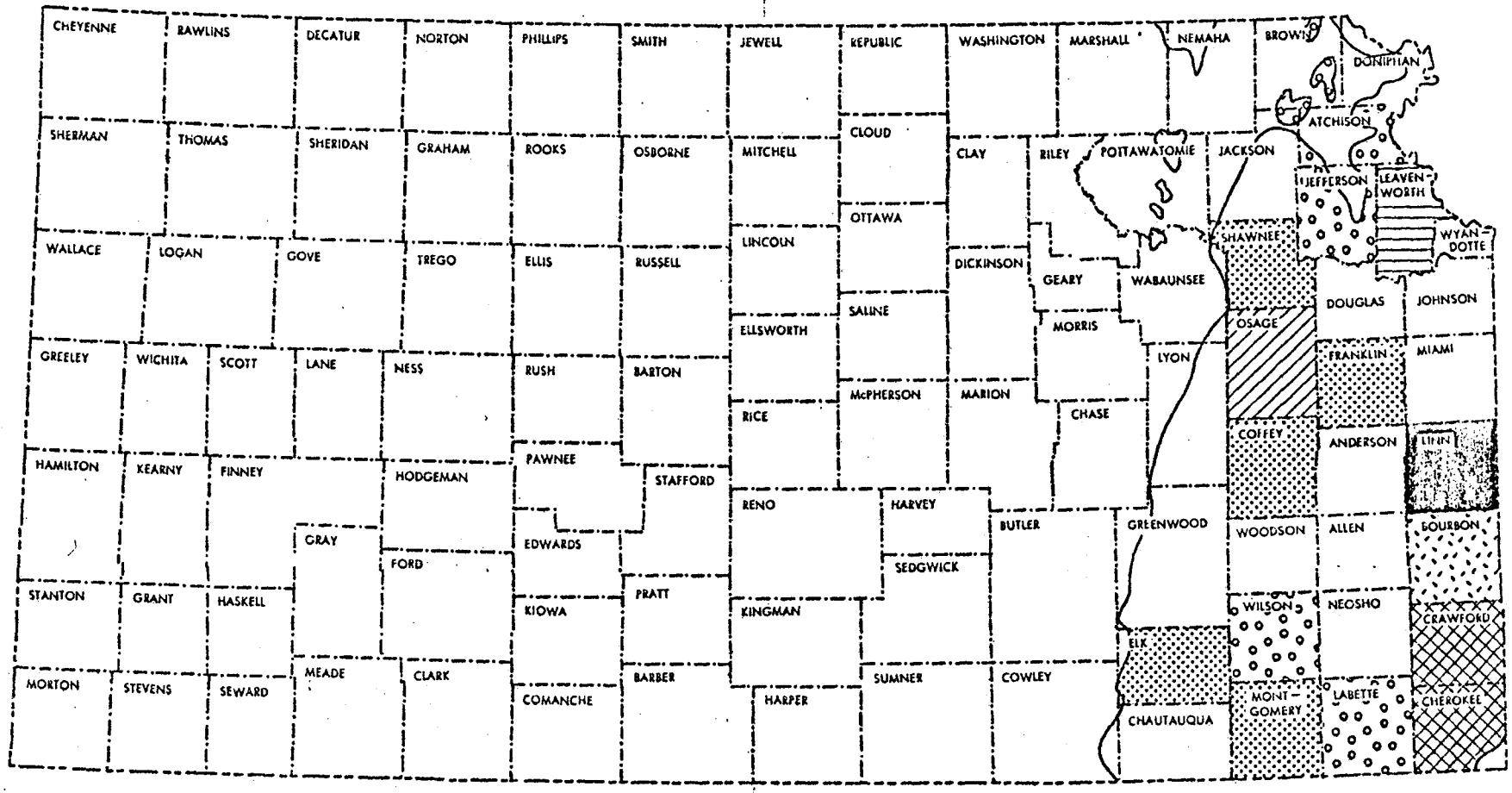
1–5

Less than 1

Limit of Pennsylvanian Outcrop

Estimated Bituminous Stripping-Coal Reserves

(millions of tons)



EXPLANATION

75-90

45-50

20-25

15-20

5-10

1-5

Less than 1

Limit of Pennsylvanian Outcrop

coal, both by open-pit and underground mining methods, than any other coal bed in the state. More than 100 square miles of 42 inch or thinner Weir-Pittsburg coal were intensively mined until post-World War II in the Southeastern Coal Field by underground methods. The readily accessible Weir-Pittsburg coal is depleted but substantial deep reserves are present in Labette County at depths of 500 feet along the Kansas-Oklahoma border; in Cherokee County; and possibly Montgomery County, and in the Northeastern Coal Field in Leavenworth County. All remaining reserves are high sulfur coals.

Mining Methods Utilized in Kansas

Strip mining exceeded deep mine production for the first time in 1931 and continued to increase until, in 1964, the last deep mine closed and open-pit mining accounted for 100% of Kansas' production.

In the Southeastern Kansas Coal Field, the Weir-Pittsburg coal seam was extensively mined by room and pillar methods. In Osage County, the Nodaway coal seam and in Leavenworth County the Cherokee Group coals were extensively mined using both room and pillar and longwall methods. Thickness of seams, coal quality, and economics of mining the remaining reserves have been instrumental in discontinuance of underground mining in Kansas.

In 1877, power equipment for strip-mining was first introduced to the industry in southeast Kansas. From this early start, the modern strip-mining of thin coals utilizing large electric shovels and draglines has evolved.

At two of the three major coal mines in Cherokee and Crawford counties, multiple coal seams are worked. This multiple seam mining is necessary because the seams mined are generally less than 20 inches in thickness. Overburden to coal thickness ratios up to 35:1, the greatest recorded in the nation, are presently being mined in the state. This is possible because most of the strata overlying the coals consist of shale with only a few thin limestone beds.

Profiles of Kansas' Two Leading Coal Mining Companies

The Pittsburg and Midway Coal Mining Company, a wholly-owned subsidiary of the Gulf Oil Corporation is the major coal producer in Kansas. P&M ranks as the 13th largest coal producing company in the United States and currently operates nine mines in five states from Kentucky to Colorado and New Mexico. In 1972, P&M produced more than 800 thousand tons of coal in Kansas. At P&M Mine #19 in Cherokee County, a Bucyrus-Erie 90-yard 1850-B shovel and a 35-yard 1250-B dragline are utilized in mining two or more thin coals. The most important seam that is mined is the Mineral seam, with mining of the Fleming and Croweburg coals in areas where their thickness justifies mining. Coal production from Mine #19 is hauled ten miles by truck to the company's preparation plant at Hallowell, Kansas. The washed coal is shipped subsequently via the MK&T Railroad to Lawrence, Topeka and Kansas City, Kansas and Omaha, Nebraska.

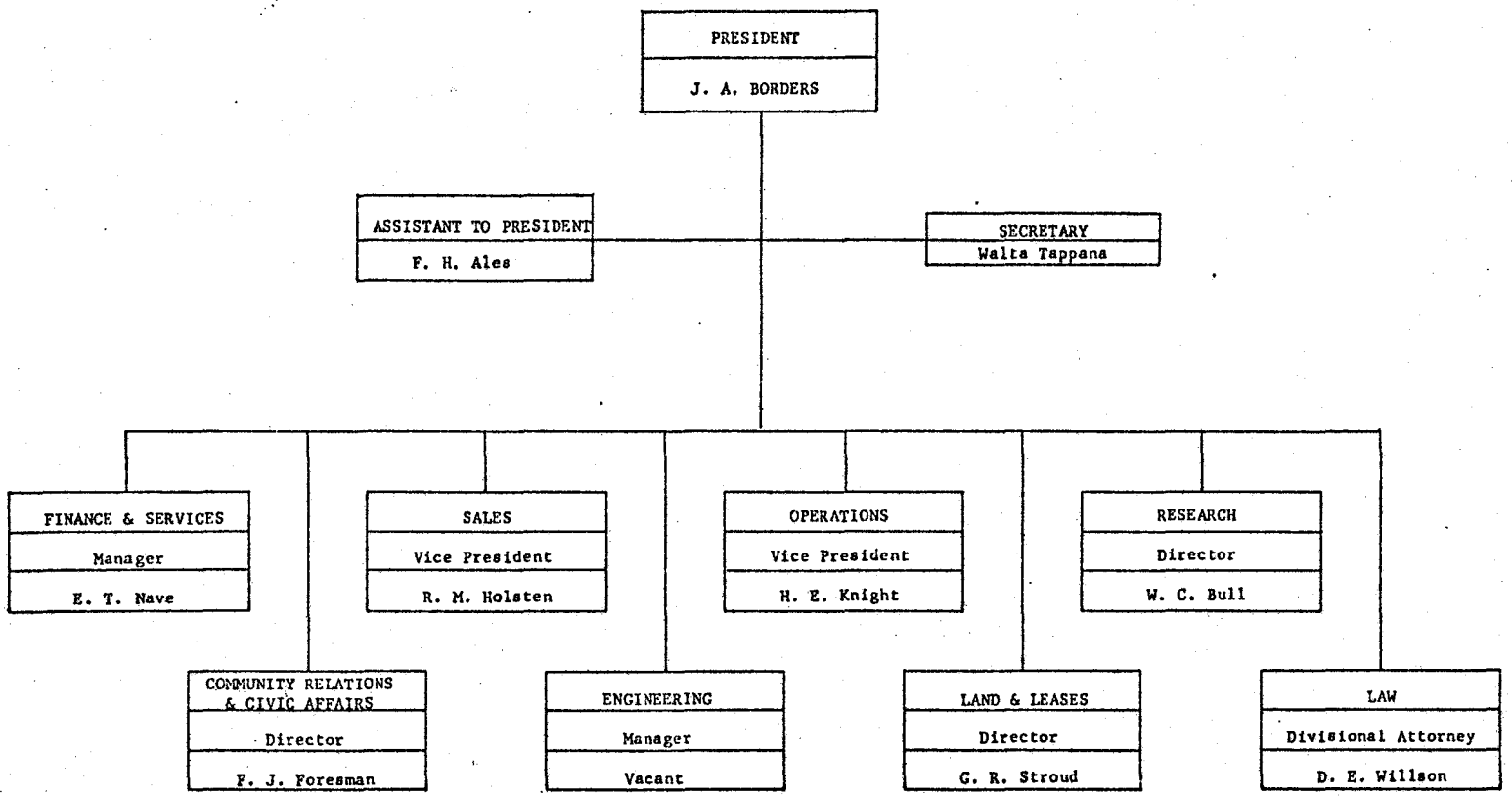
In September of 1972, P&M produced the first coal from the company's Midway Mine in Linn County, Kansas and Bates

County, Missouri. At anticipated peak production in 1974, approximately 2.4 million tons of raw Mulberry coal will be hauled by truck to the mine-mouth power plant at LaCygne, Kansas which is equipped with a Babcock & Wilcox environmental control system for both particulate and gaseous emissions. The coal is mined using a Bucyrus-Erie 2570-W 110-yard dragline. In the near future a Marion 8200 70-yard dragline also will be put into service at the mine. P&M initiated reclamation efforts in Kansas in 1938. With the more extensive reclamation required in recent years, P&M is making major studies to develop new equipment for better movement of the mine spoil in reshaping mined-land by reclaiming acreage strip-mined prior to enactment of the Kansas reclamation law.

Key personnel at corporate offices in Kansas City, Missouri are shown in Figure 7.

THE PITTSBURG & MIDWAY COAL MINING CO.

A WHOLLY OWNED SUBSIDIARY OF GULF OIL CORPORATION



January 1, 1973

The Clemens Coal Company with offices in Pittsburg, Kansas, is the second-largest coal mining company in the State. In 1972, Clemens Coal Company mined in excess of 400 thousand tons of coal at two mines in Crawford County. By utilizing a smaller shovel and dragline at each mine, Clemens has worked multiple coal seams and maintained a continuing reclamation effort. At the Clemens Mine #22, a 23-yard Marion 5560 shovel and a 11-yard Marion 7400 dragline are utilized in mining the Mineral and also the Bevier coal seams. At the Clemens Mine #25, a 15-yard Marion 5322 shovel and a 11-yard Marion 7400 dragline are used to mine the Rowe and Dry Wood seams. By operating the shovel and dragline in tandum much of the soil is separated from shale for replacement in the reclamation effort.

Coal production from Clemens' mines is hauled to the company's preparation plant north of Mulberry, Kansas by both truck and rail. Mine #22 coal requires a 4 mile truck haul. Rowe and Dry Wood coal are transported approximately 18 miles on the St.L. & S.F. Railroad, washed, and then returned to the same cars for further shipment.

In addition to reclamation of current mining acreage, the Clemens Coal Company is reclaiming acreage strip-mined prior to enactment of the Kansas reclamation law. Officers in the company are:

Chairman of the Board:	George K. Mackie, Jr.
President:	John W. Mackie, Jr.
Vice President:	Jess M. Lee
Treasurer:	Flora DeVoss

Exploration and Manpower Base in Kansas

Since most land in Kansas is under private ownership, exploration for future mine development is limited to the standard permit, lease, or contract arrangements with the landowner. No filing of coal exploration logs with the State is required, and coal exploration in Kansas is basically a contractual matter between the landowner and coal company, arranged primarily by a good land-man.

Manpower in Kansas is more than adequate to supply any mining activity in the State. Persons with mining experience and skilled in the use of heavy equipment provide a ready work force in areas of potential mine development. The work staff of the recently opened P&M Midway Mine were mainly residents of the surrounding communities. James Borders, P&M President, has said these people have provided the new mine with a very capable work force.

Reclamation Requirements in Kansas

With approximately 45 thousand acres of mined-land in Kansas attributed to previous stip-mining activities, a law covering surface mining of coal was enacted in 1968 to restore future mined-land to productive agricultural use. Reclamation efforts in Kansas are governed by the Kansas Mined-Land Conservation and Reclamation Board. All surface coal mining activities in the state require a one-year permit from the Board and the posting of a performance bond to insure an

adequate reclamation effort. The bond may not exceed $500 per acre.

Reclamation work must be conducted concurrently with the mining operation. The land must be shaped essentially to a rolling-type terrain with appropriate slopes to provide drainage for all portions of the permit area. Grading specifications for the land are as follows:

(1) Maximum slope - 25 percent

(2)

Average Slope (%)	Maximum Slope Length (ft.)
0-4	No Limit
4-8	300
8-15	150
15-25	75

(3) All exposed rocks that will not disintegrate in less than 3 years and larger than six inches in diameter are to be removed or buried with a minimum of six inches of soil.

Revegetation of the land is required following grading in order to minimize soil erosion and put the land into beneficial agricultural use. Reseeding at the present time is normally to legumes and/or grasses. However, the Board will consider the landowners' desires, expected future use of the land, and the physical and chemical properties of the soil. Inquiries about all State requirements on reclamation should be addressed to the chairman of the Kansas Mined-Land Conservation and Reclamation Board, Kansas Department of Labor, Topeka, Kansas.

Objections to Kansas reclamation requirements from the present coal producers have been concerned primarily with the grading of box cut spoil to meet the slope angle and length

requirements stated above. The companies feel that the grading regulations should be modified for box cut spoils.

A favorable factor in Kansas strip-mining is the general absence of acid water problems. Where areas of low pH exist that could lead to an acid water drainage condition, corrective measures can be made simply.

A Look At Kansas' Coal Future By Its Major Producer

James Borders, President of the Pittsburg and Midway Coal Mining Company, is not optimistic about the future of coal mining in Kansas. According to Mr. Borders, future coal production in Kansas is limited by two major factors: (1) the presence of only thin coal seams, and (2) the high sulfur content of the coals. Sulfur content of Kansas coals restrict their use to major utility companies that can afford the necessary pollution control equipment required for their use.

Mr. Borders foresees only limited coal production in Cherokee County in particular and southeast Kansas in general, after 1985, and an end to P&M's major mining activities in Kansas near the end of this century. These dates are defined by the major contractual commitments of P&M with major area utility companies. With the opening of the new Midway Mine in Linn County, Kansas and Bates County, Missouri in September, 1972, P&M will supply, at full production 2.4 million tons of raw coal annually to a mine-mouth power station at LaCygne, Kansas. According to Mr. Borders,

P&M has a commitment with the Kansas Gas and Electric Company and Kansas City Power and Light Company to supply the coal to the power plant until 2002. Approximately 30 to 35 million tons of an estimated 65 to 70 million tons of coal for the plant will be mined in Kansas. This will result in approximately 10,000 acres of Kansas land being mined. The remaining 30 to 35 million tons of coal necessary for the plant will be mined in Missouri.

Kansas' Changing Role as a Coal Producing State

The role of Kansas as a coal supplier has been favored in the past by its geographic position in the Midwest in conjunction with large supplies of readily accessible coal. Until the steam locomotive market was eliminated, eastern Kansas provided a convenient refueling stop for the railroads of the area. However, changing economic conditions have forced the closing of underground mines and the adoption of preparation plants to make strip-mined coal from thin seams suitable for powerplant use. Within the near future the delivered cost of imported low sulfur western coals will approach the price of coal from southeastern Kansas, and at that time, the market for Kansas coal will be very limited.

It is expected that coal production for the next five to six years will remain at approximately the present production of 1.2 to 1.5 million tons per year. In approximately 1978, the P&M Midway Mine will move most of its mining operations from Missouri into Kansas and Kansas coal production should

rise to approximately 2.6 to 3 million tons a year. Probably in the mid-80's a decline in Kansas coal production will begin. Markets for Kansas coals in the near future will continue to be the electric utility companies in Kansas and portions of adjoining states.

Reserves in Southeast Kansas coal fields are still the important areas for future coal development. However, it is expected that future mining operations in Kansas will be smaller than at present with new mines working generally smaller reserve areas than those mines presently operating in the State. These smaller producers would supply small industrial and commercial operations and municipal electric plants.

Future Mining Methods

Strip-mining operations will probably continue to be the only economical way of coal mining in Kansas. Thickness of the coal seams limits the introduction of underground mining methods at the present market value of Kansas coal. The best potential strip-mine areas are in southeastern Kansas. Areas having the best potential for future underground mining are in the western and southern portion of the Southeastern Kansas coal field where the Weir-Pittsburg coal seam can be mined.

Bibliography

Abernathy, G.E., Jewett, J.M., and Schoewe, W.H., 1947, Coal reserves in Kansas: Kansas Geol. Surv. Bull. 70, pt. 1, 1-20 p.

Averitt, Paul, 1969, Coal resources of the United States, January 1, 1967: U.S. Geol. Surv. Bull. 1275, 116 p.

_____, 1970, Stripping coal resources of the United States, January 1, 1970. Geol. Surv. Bull. 1252-C, 20 p.

Bowsher, A.L., and Jewett, J.M., 1943, Coal resources of the Douglas Group in east-central Kansas: Kansas Geol. Surv. Bull. 46, 94 p.

Davis, J.P., et al. 1944, Carbonizing properties of Western Region Interior Province Coals and certain blends of these coals: U.S. BuMines TP667, 138 p.

Hambleton, W.W., 1953, Petrographic study of southeastern Kansas coals: Kansas Geol. Surv. Bull. 102, pt. 1, 76 p.

Odell, W.W., 1942, Carbonization of Bevier-bed coal from Kansas and production of blue gas from the resulting coke: U.S. BuMines R.I. 3671, 21 p.

Pierce, W.G., and Courtier, W.H., 1937, Geology and coal resources of the southeastern Kansas coal field: Kansas Geol. Surv. Bull. 24, 122 p.

Schleicher, J.A., and Hambleton, W.W., 1954, Preliminary spectographic investigation of germanium in Kansas coal: Kansas Geol. Surv. Bull. 109, pt. 8, 113-124 p.

Schoewe, W.H., 1944, Coal resources of the Kansas City Group, Thayer bed; in eastern Kansas: Kansas Geol. Surv. Bull. 52, pt. 3, 81-136 p.

_____, 1951, Coal resources of the Permian system in Kansas: Kansas Geol. Surv. Bull. 90, pt. 3, 53-68 p.

_____, 1955, Coal resources of the Marmaton group in eastern Kansas: Kansas Geol. Surv. Bull. 114, pt. 2, 112 p.

_____, 1958, The geography of Kansas: pt. IV, Economic geography: mineral resources: Trans. Kansas Acad. Sci., v. 61, 367-391 p.

Stroup, R.K., and Falvey, A.E., 1969, Coal reserves for steam-electric generation in Kansas and Missouri areas of Missouri River Basin: U.S. BuMines Prel. Rept. 174, 37 p.

U.S. Bureau of Mines, 1929, Analyses of Kansas Coals: U.S. BuMines TP 455, 52 p.

_____, 1971, Strippable reserves of bituminous coal and lignite in the United States: U.S. BuMines Inf. Circ. 8531, 148 p.

Whittla, R.E., 1940, Coal resources of Kansas: Post-Cherokee deposits: Kansas Geol. Surv. Bull. 32, 64 p.

Young, C.M. and Allen, H.C., 1925, Kansas Coal: Kansas Univ. Eng. Bull. 13, 201 p.

Table 1

Characterization and Reserves of Major Kansas Coals**

Seam	Seam Thickness	(Av) or Range of Seam Thickness Mined	Range and (Av)% Moisture**	Range and (Av)% Ash**	Range and (Av)% Sulfur**	Range and (Av)% BTU/lb.**
Nodaway	1-36	16-20 (18)	7.4-15.3 (10.2)	6.7-15.7 (10.0)	5.1-9.9 (7.6)	8,728-12,170 (11,093)
Mulberry	12-48	(27)	8-12 (10)	19-30 (23)	4-6 (5)	8,500-10,500 (9,600)
Mulky	8-22	12-14	(2.8)	(9.3)	(3.9)	(13,286)
Bevier	14-24	(15)	6-9 (6.5)	18-30 (24)	2.3-3.1 (2.6)	(10,100)
Croweburg	8-15	8-12	(6)	(26)	(2.5)	(9,800)
Fleming	1-26	(15)	(5)	(24)	(5)	(10,100)
Mineral	5-24	15-19	4-8 (5)	17-26 (21)	(4)	(10,500)

Table 1 (con't.)

Weir-Pittsburg	34-60	(42)	3.8-7.4 (6.1)	6.5-13.1 (9.9)	2.2-5.3 (3.7)	12,110-13,210
Dry Wood (Knifeton)	3-20	10-12	(6)	(22)	(4)	(10,400)
Rowe	10-20	14-17	(6.5)	(26)	(4.7)	(10,100)

*Data compiled from Kansas State Geological Survey estimates, U.S. BuMines references, and the Pittsburg and Midway Coal Mining Co.; reserves refer to proven reserves without consideration of all economic limits.

**As-received basis.