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STATE GEOLOGICAL SURVEY
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# SOUTHERN ILLINOIS
## MINERAL RESOURCES AND INDUSTRIES

BY

MORRIS M. LEIGHTON AND WALTER H. VOSKUIL

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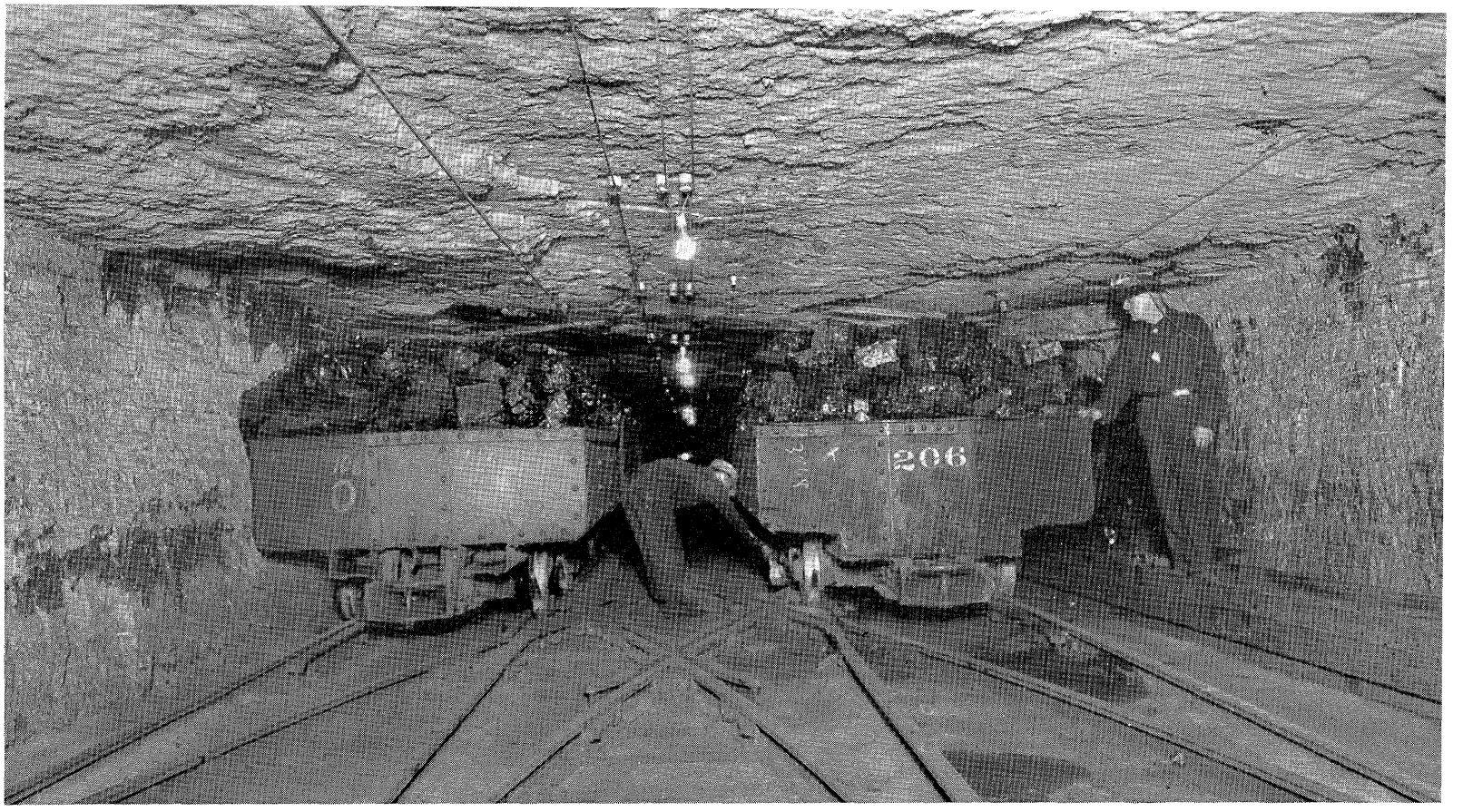


# Chapter VIII

# MINERAL RESOURCES AND INDUSTRIES

By Morris M. Leighton and Walter H. Voskuil*

The value of the minerals produced in the sixteen counties of Southern Illinois in 1946 was about $122 millions. The value of mineral production for Illinois as a whole in 1946 was approximately $375 millions. Thus these 16 counties account for nearly one-third of the total mineral production of the State. The State's output exceeds in value that of any other state in the Upper Mississippi Valley region. The production in the 16 counties alone was greater than the value of the mineral production of many of the western mining states such as Montana, Wyoming, Idaho, Washington, Oregon, Nevada, Colorado, and Arizona. It is therefore obvious that the mineral industries of these counties are of very great importance.

In their order of importance, the minerals produced in the sixteen southernmost counties of Illinois are: Coal, oil and gas, fluorspar, lead and zinc, limestone, silica, sand and gravel, fuller's earth, and clay and clay products. Table 25, which gives the value of mineral production by counties, shows that coal ranks far above all others combined — more than two-thirds of the total, or $86 millions. Oil and gas, a new industry since 1939, ranks second, amounting to $25 millions. Fluorspar is third with $7 millions. (See also Table 26.)

* With the assistance of the staff members of the State Geological Survey.

TABLE 25. PRODUCTION AND VALUE OF MINERALS IN SIXTEEN SOUTHERN ILLINOIS COUNTIES, 1946

| County | Coal | | Oil and Gas | | Limestone | | Sand and Gravel | |
|---|---|---|---|---|---|---|---|---|
| | Production (Net tons) | Value | Production (Barrels) | Value | Production (Net tons) | Value | Production (Net tons) | Value |
| Alexander | ..... | ..... | ..... | ..... | ..... | ..... | 239,355 | $139,761 |
| Franklin | 14,470,904 | $40,952,658 | 1,303,000 | $2,032,680 | ..... | ..... | ..... | ..... |
| Gallatin | 73,440 | 256,305 | 2,098,000 | 3,272,880 | ..... | ..... | ..... | ..... |
| Hamilton | ..... | ..... | 4,041,000 | 6,303,960 | ..... | ..... | ..... | ..... |
| Hardin | ..... | ..... | ..... | ..... | 72,390 | $ 92,372 | ..... | ..... |
| Jackson | 2,399,210 | 6,016,309 | 200 | 312 | ..... | ..... | ..... | ..... |
| Johnson | ..... | ..... | ..... | ..... | 139,103 | 166,925 | ..... | ..... |
| Massac | ..... | ..... | ..... | ..... | 26,347 | 29,772 | 16,613 | 11,543 |
| Perry | 3,759,892 | 9,286,933 | 2,000 | 3,120 | 14,705 | 22,057 | ..... | ..... |
| Pope | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Pulaski | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Randolph | 2,289,892 | 5,678,932 | ..... | ..... | 504,020 | 639,694 | ..... | ..... |
| Saline | 4,233,318 | 12,401,457 | 51,000 | 79,560 | ..... | ..... | ..... | ..... |
| Union | ..... | ..... | ..... | ..... | 272,777 | 308,557 | ..... | ..... |
| White | ..... | ..... | 8,519,000 | 13,289,640 | ..... | ..... | 256,030 | 167,700 |
| Williamson | 4,133,819 | 11,161,311 | ..... | ..... | ..... | ..... | ..... | ..... |
| *Total* | 31,360,475 | $85,753,905 | 16,014,200 | $24,982,152 | 1,029,342 | $1,259,377 | 511,998 | $319,004 |

| County | Fluorspar | | Lead and Zinc | | Clay and Clay Products | | Fuller's Earth | | Silica (Tripoli) | | Total Value of Mineral Production |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Production (Net tons) | Value | Production (Net tons) | Value | Production (Net tons) | Value | Production (Net tons) | Value | Production (Net tons) | Value | |
| Alexander | ..... | ..... | ..... | ..... | 281[a] | $1,182 | ..... | ..... | 15,631 | $321,600 | $ 462,543 |
| Franklin | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 42,985,338 |
| Gallatin | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 3,529,185 |
| Hamilton | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 6,303,960 |
| Hardin | 191,474 | $6,806,800 | 6,863[b] | $1,784,374[b] | ..... | ..... | ..... | ..... | ..... | ..... | 8,683,546[c] |
| Jackson | ..... | ..... | ..... | ..... | 11,124 | 116,828 | ..... | ..... | ..... | ..... | 6,133,449 |
| Johnson | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 166,925 |
| Massac | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 41,315 |
| Perry | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 9,312,110 |
| Pope | 1,312 | 46,640 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 46,640 |
| Pulaski | ..... | ..... | ..... | ..... | ..... | ..... | 33,134 | $296,637 | ..... | ..... | 295,637 |
| Randolph | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 6,318,626 |
| Saline | ..... | ..... | ..... | ..... | 11,386 | 74,246 | ..... | ..... | ..... | ..... | 12,555,265 |
| Union | ..... | ..... | ..... | ..... | 824[a] | 12,357 | ..... | ..... | ..... | ..... | 320,914 |
| White | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 13,457,340 |
| Williamson | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 11,161,311 |
| *Total* | 192,786 | $6,853,440 | 6,863[b] | $1,784,374[b] | 23,615 | $204,615 | 33,134 | $296,637 | 15,631 | $321,600 | $121,775,104[d] |

[a] Clay only — produced and sold. [b] 1947 figures. 1946 figures not available for Southern Illinois (only for State as a whole). [c] Total includes lead and zinc for 1947 instead of 1946. [d] Total for State as a whole — $374,364,674.

TABLE 26. PER CAPITA VALUE OF MINERALS PRODUCED BY COUNTY, 1946

| County | Total Value of Minerals, 1946 | Estimated Population, July 1, 1946[a] | Per Capita Value of Minerals, 1946 | Minerals Produced |
|---|---|---|---|---|
| Franklin | $42,985,338 | 47,797 | $899 | Coal, oil |
| White | 13,457,340 | 21,211 | 634 | Oil, sand and gravel |
| Saline | 12,555,265 | 33,483 | 375 | Coal, oil, clay and clay products |
| Williamson | 11,161,311 | 48,553 | 230 | Coal |
| Perry | 9,312,110 | 22,047 | 422 | Coal, oil, limestone |
| Hardin | 8,683,546 | 8,381 | 1,036 | Fluorspar, lead and zinc, limestone |
| Randolph | 6,318,626 | 31,788 | 199 | Coal, limestone |
| Hamilton | 6,303,960 | 13,406 | 470 | Oil |
| Jackson | 6,133,449 | 35,781 | 171 | Coal, clay and clay products, oil |
| Gallatin | 3,529,185 | 9,910 | 356 | Oil, coal |
| Alexander | 462,543 | 22,509 | 20 | Silica, sand and gravel, clay and clay products |
| Union | 320,914 | 20,343 | 16 | Limestone, clay and clay products |
| Pulaski | 296,637 | 14,064 | 21 | Fuller's earth |
| Johnson | 166,925 | 8,984 | 19 | Limestone |
| Pope | 46,640 | 6,309 | 7 | Fluorspar |
| Massac | 41,315 | 13,721 | 3 | Limestone, sand and gravel |

[a] Estimated by Illinois Department of Public Health, Division of Vital Statistics and Records.

## COAL

Statistics of coal production in Southern Illinois begin with 1882. The total amount of coal that has been produced from 1882 to 1947, inclusive, is 1,082,194,200 tons.

Because it is important to point out the significant features in the history of this coal production, Table 27 has been prepared to show production by decades beginning with 1888 and ending with 1947. The amount produced before 1888 is inconsequential for present consideration.

Figure 28 presents a map showing the shipping mines in 1947.

Of the 16 counties in Southern Illinois, coal production has been limited mainly to Franklin, Jackson, Perry, Randolph, Saline, and Williamson. Figure 29 graphically portrays their production by decades. To these may be added the less significant production of Gallatin, Hamilton, and White counties.

In the first decade, 1888-97, the principal producing county was Jackson; second and third decades, Williamson; fourth, fifth, and sixth decades, Franklin.

Williamson County production declined sharply during the decade 1928-37, and for the last 20 years its production has not exceeded 34 million tons per decade, whereas in the previous ten years, 1918-27, its greatest, it produced about 92 million tons. This sharp decline has had a depressing economic effect on that county and adjacent territory.

Perry County has gradually risen in its production from about five million tons in the first decade to nearly 40 million tons in the last decade shown. Strip mining has been important for 20 years.

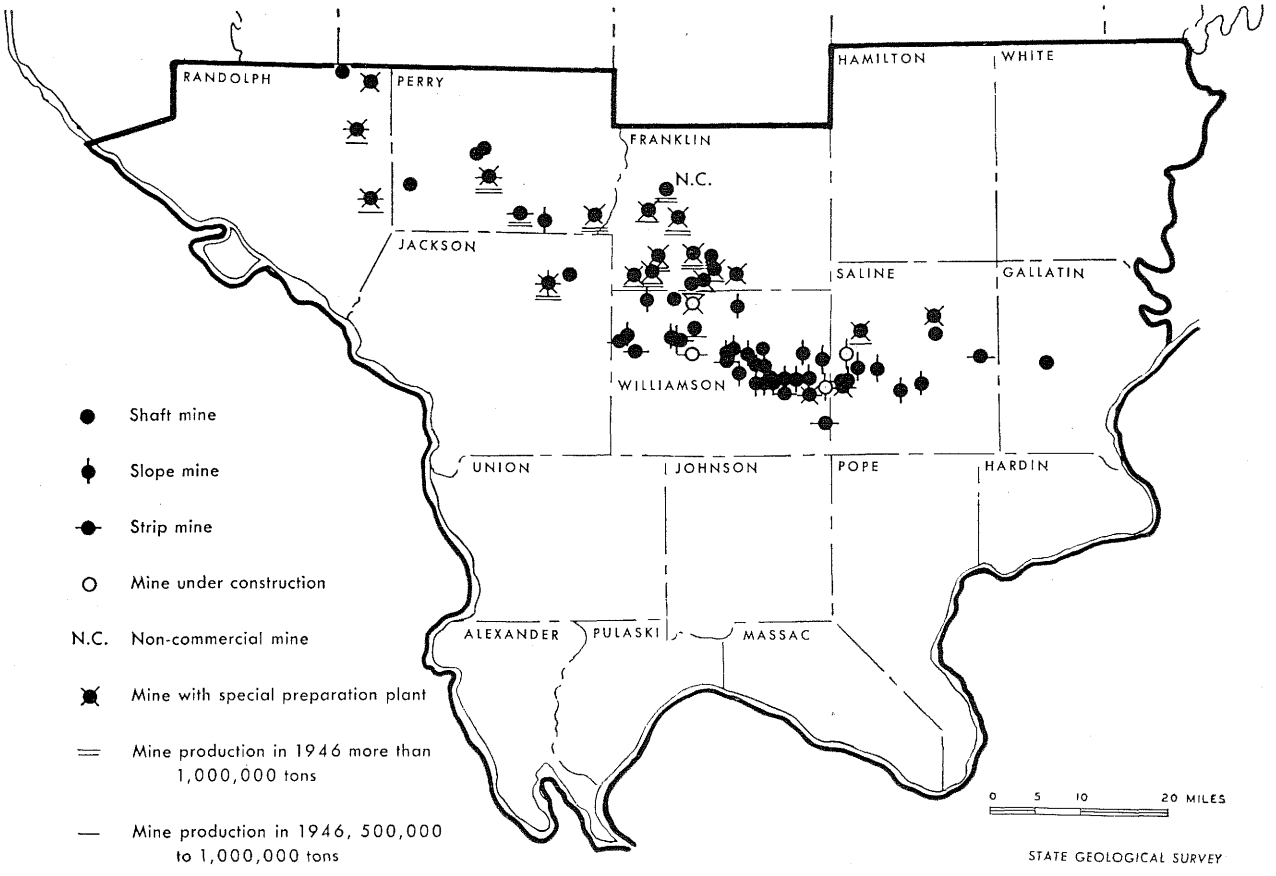



Fig. 28. Map of shipping mines in Southern Illinois, 1947.
(G. H. Cady, Coal Division, State Geological Survey.)

TABLE 27. COAL PRODUCTION BY DECADES AND COUNTIES[a]
(Thousands of tons)

| County | Decade | | | | | | Total, 1888-1947 |
|---|---|---|---|---|---|---|---|
| | 1888-1897 | 1898-1907 | 1908-1917 | 1918-1927 | 1928-1937 | 1938-1947[b] | |
| Franklin | 1.4 | 1,391.4 | 52,117.0 | 121,634.6 | 99,501.2 | 131,472.8 | 406,118.4 |
| Gallatin | 416.2 | 486.5 | 761.9 | 1,144.1 | 330.5 | 556.0 | 3,695.2 |
| Hamilton | 7.8 | 14.3 | ..... | ..... | ..... | ..... | 22.1 |
| Jackson | 6,933.9 | 8,536.9 | 7,064.4 | 12,043.2 | 15,523.9 | 22,230.4 | 72,332.7 |
| Perry | 5,645.0 | 10,587.8 | 18,250.7 | 22,885.8 | 30,840.6 | 39,343.1 | 127,553.0 |
| Randolph | 1,653.8 | 4,839.9 | 8,722.7 | 13,451.3 | 5,793.5 | 20,311.5 | 54,772.7 |
| Saline | 446.5 | 4,009.9 | 36,956.8 | 45,225.6 | 32,501.0 | 41,030.3 | 160,170.1 |
| White | ..... | 14.8 | 343.2 | 976.3 | 321.0 | 10.7 | 1,666.0 |
| Williamson | 3,489.1 | 25,506.7 | 69,683.7 | 92,247.1 | 31,597.6 | 33,339.8 | 255,864.0 |
| *Total* | 18,593.7 | 55,388.2 | 193,900.4 | 309,608.0 | 216,409.3 | 288,294.6 | 1,082,194.2 |

[a] Compiled from *Annual Coal Reports*, State Department of Mines and Minerals, Springfield, Ill.
[b] Preliminary figures from weekly reports were used for the year 1947.

Saline County was prominent in the picture during the decade 1908-17 with a total ten-year tonnage of about 37 million tons. Since then its production has ranged from 32 million to 45 million tons for each decade.

Franklin County has been the outstanding producer for the past 30 years, becoming prominent in the decade 1908-17. For the past three decades it has averaged more than 115 million tons per decade.

Comparatively speaking, Jackson and Randolph counties are not large producers; their maxima were 22 million and 20 million tons, respectively, for 1938-47. But their tonnages are important and have substantially increased during the last decade.

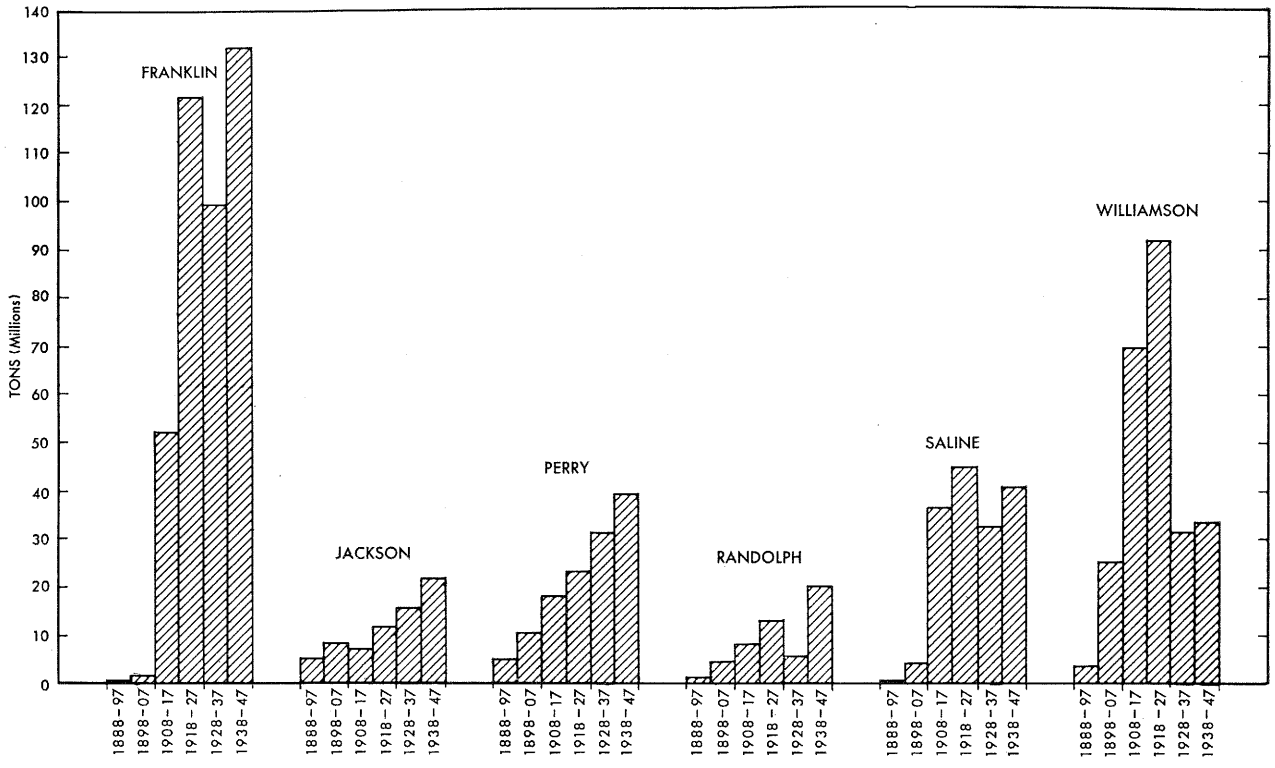



Fig. 29. Coal production of principal mining counties by decades, 1888-1947. (*Annual Coal Reports*, State Department of Mines and Minerals, Springfield, Ill.)

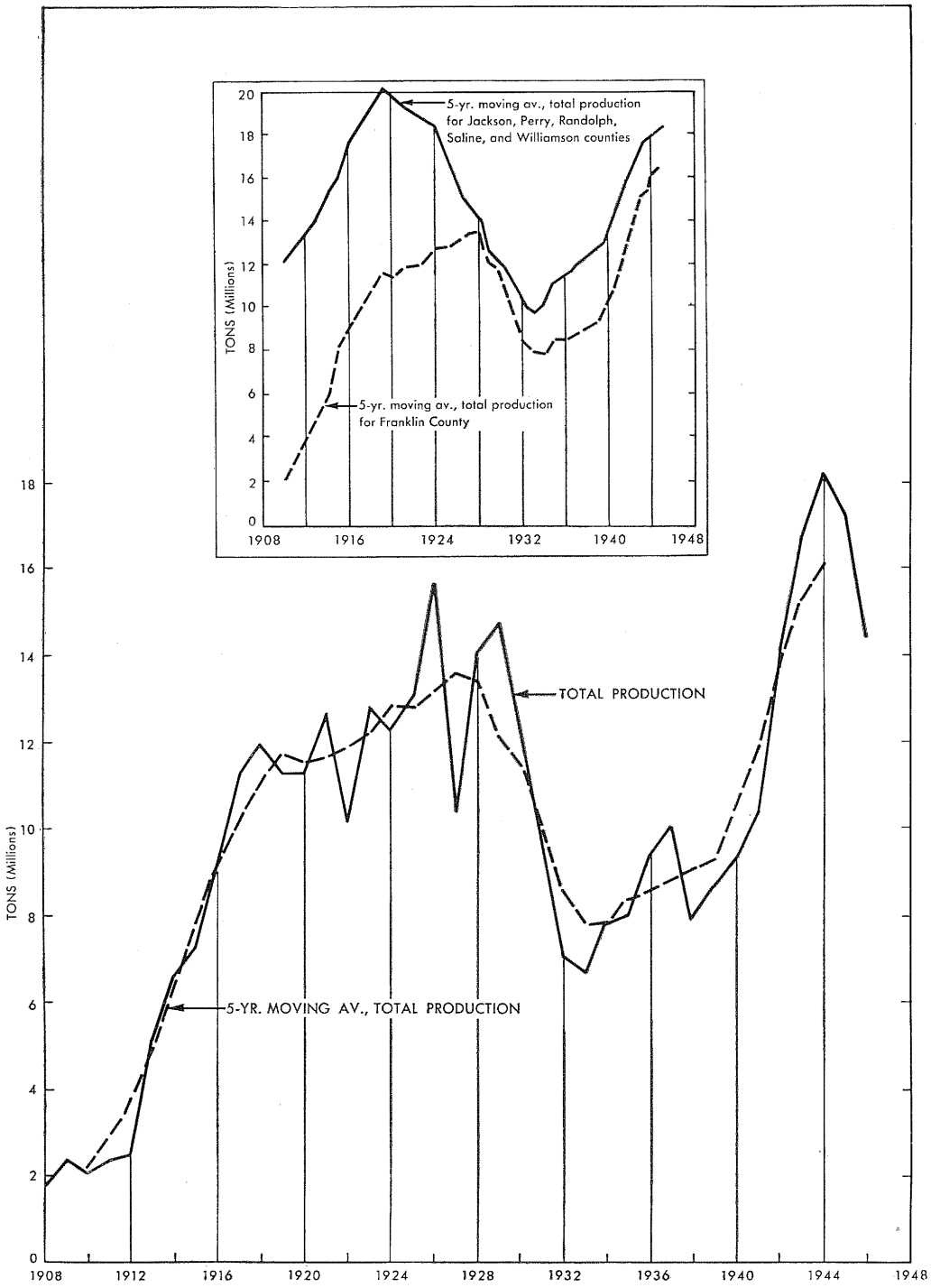



Fig. 30. Total production of shipping mines in Franklin County by years, 1908-1946, and by five-year moving average. The inset chart shows the five-year moving average for Franklin County and for the combined counties of Jackson, Perry, Randolph, Saline, and Williamson. (*Annual Coal Reports,* State Department of Mines and Minerals, Springfield, Ill.)

## EMPLOYMENT IN THE COAL INDUSTRY

Much has been said of the drop in employment in the coal industry of Southern Illinois. An appraisal of this matter is important in any consideration of the economic future of the area.

Because Franklin County is the largest producer and therefore has the largest influence in Southern Illinois, analysis of its shaft mining is made. The county has no strip mines.

### Franklin County

TONNAGE HISTORY. Figure 30 shows two curves: First, a detailed curve giving annual production; and second, a five-year moving average which is a series of averages in progression, dropping the oldest year for each successive series. The moving average smooths out the irregularities of the detailed curve and is easier to appraise, and therefore is used in the following discussion of averages.

Coal production in Franklin County increased steadily from 1908 until the latter part of the 20's; and it was very large from 1918 until 1930, averaging over 12 million tons per year. During the depression years production fell sharply to about the level of 1915; later, in 1939 it began a sharp rise to the greatest total in the county's history in 1944.

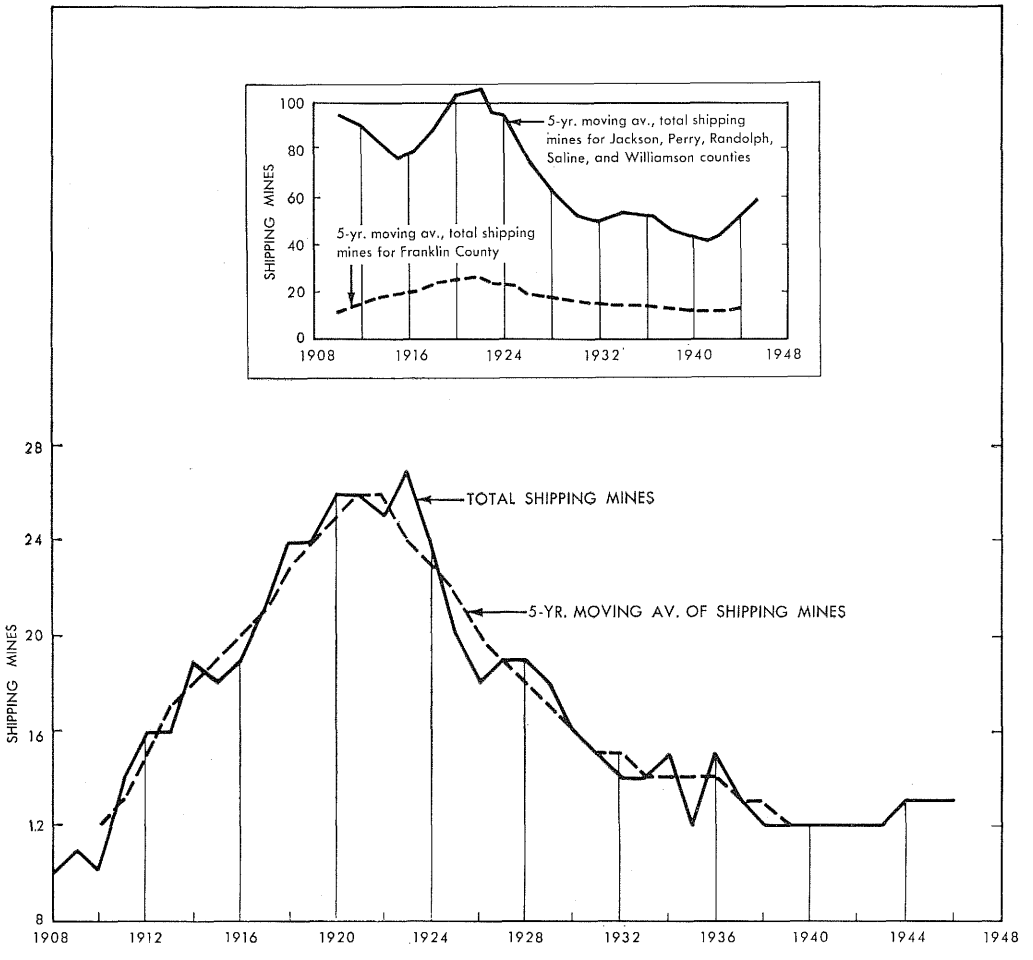



Fig. 31. Number of shipping mines in Franklin County, 1908-1946, and five-year moving average. The inset chart shows the five-year moving average for Franklin County and for the combined counties of Jackson, Perry, Randolph, Saline, and Williamson. (*Annual Coal Reports,* State Department of Mines and Minerals, Springfield, Ill.)

The small inset graph in Fig. 30 contains a five-year moving average curve showing the total production for Jackson, Perry, Randolph, Saline, and Williamson counties combined, for comparison with Franklin County. The group of counties produced much more coal than Franklin County until 1928. In 1920 their average annual production began to fall off rapidly and by 1928 had almost reached the level of Franklin County.

Shipping Mines. As shown in Fig. 31, shipping mines increased from 10 in 1910 to 27 in 1923. A succession of abandonments began in the 20's, well before the depression, until in 1939 there were less than half as many as in 1923 and less than there had been in 1911.

The inset graph shows that the combined number of shipping mines in Jackson, Perry, Randolph, Saline, and Williamson counties has been and is much larger than the number in Franklin County and that abandonment has been even more marked.

Days per Year Operated. According to Fig. 32, from 1910 until 1919 the mines were active on an

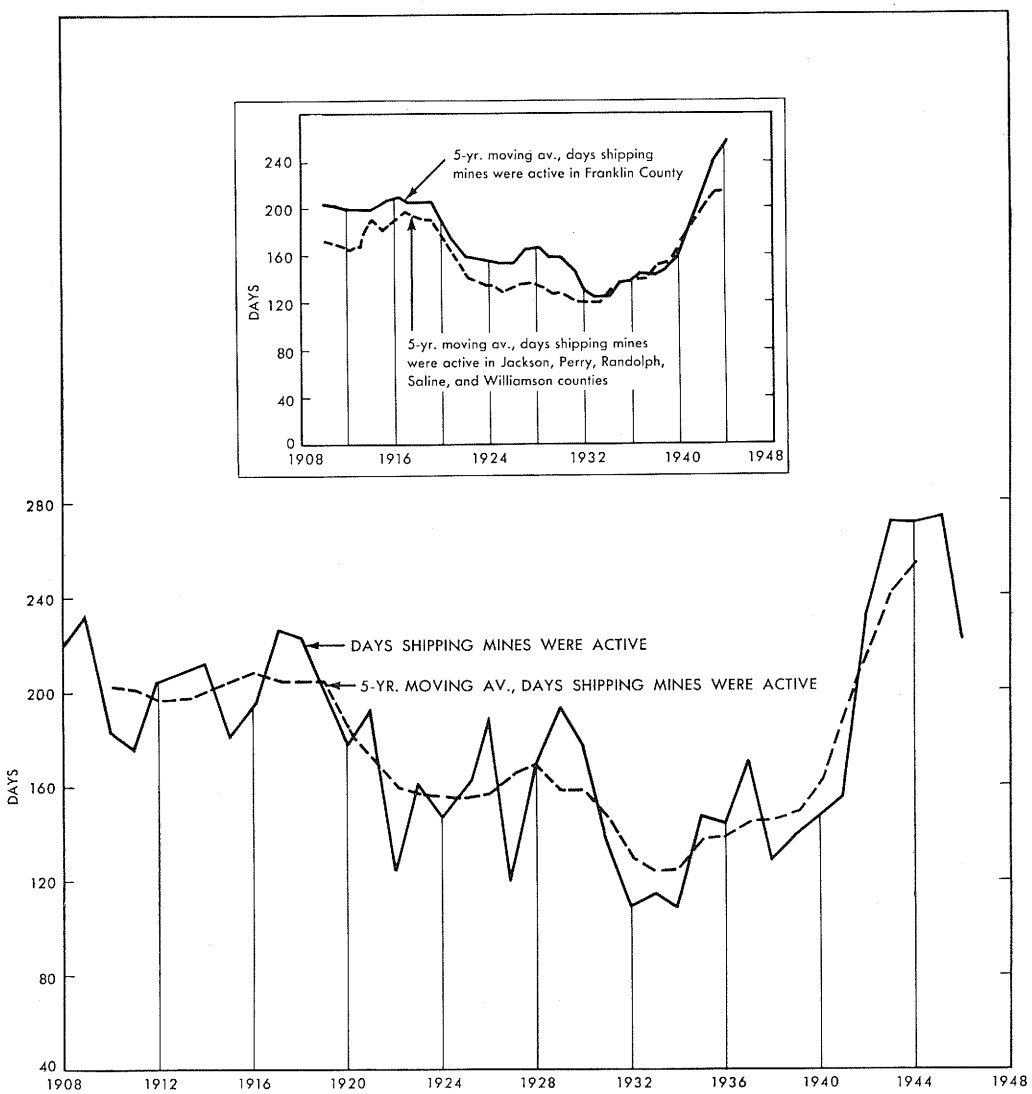



Fig. 32. Number of days that shipping mines were active in Franklin County, 1908-1946, and five-year moving average. The inset chart shows the five-year moving average for Franklin County and for the combined counties of Jackson, Perry, Randolph, Saline, and Williamson. (*Annual Coal Reports,* State Department of Mines and Minerals, Springfield, Ill.)

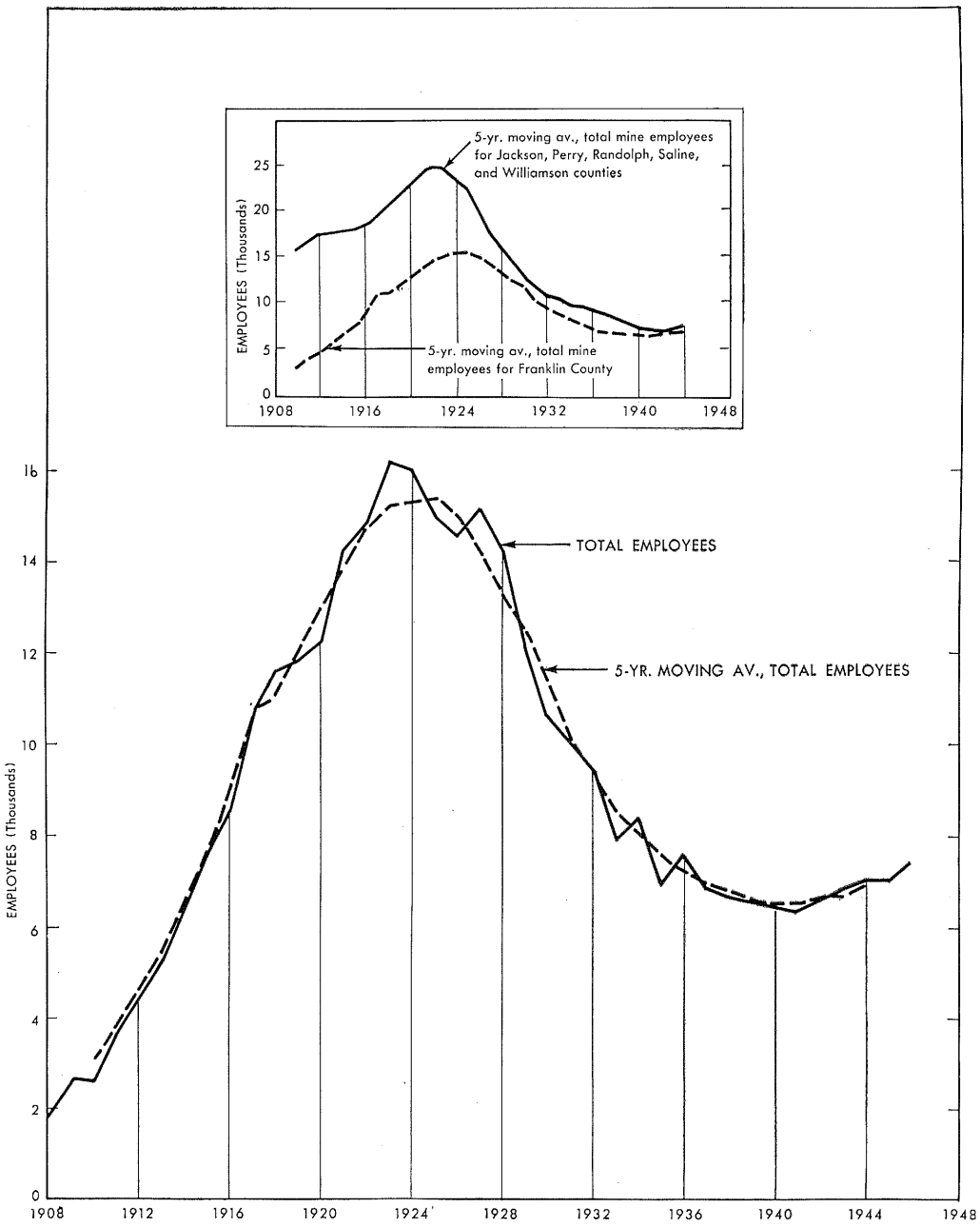



Fig. 33. Number of employees in Franklin County coal mines, 1908-1946, and five-year moving average. The inset chart shows the five-year moving average for Franklin County and for the combined counties of Jackson, Perry, Randolph, Saline, and Williamson. (*Annual Coal Reports*, State Department of Mines and Minerals, Springfield, Ill.)

average of about 200 days per year. This average declined to about 160 days by 1922 and persisted at about this level until 1930, when it dipped to slightly more than 120 days during the worst of the depression. Since then the annual average has risen to nearly 280 days, the highest ever. This rise steepened with the entrance of the United States into World War II.

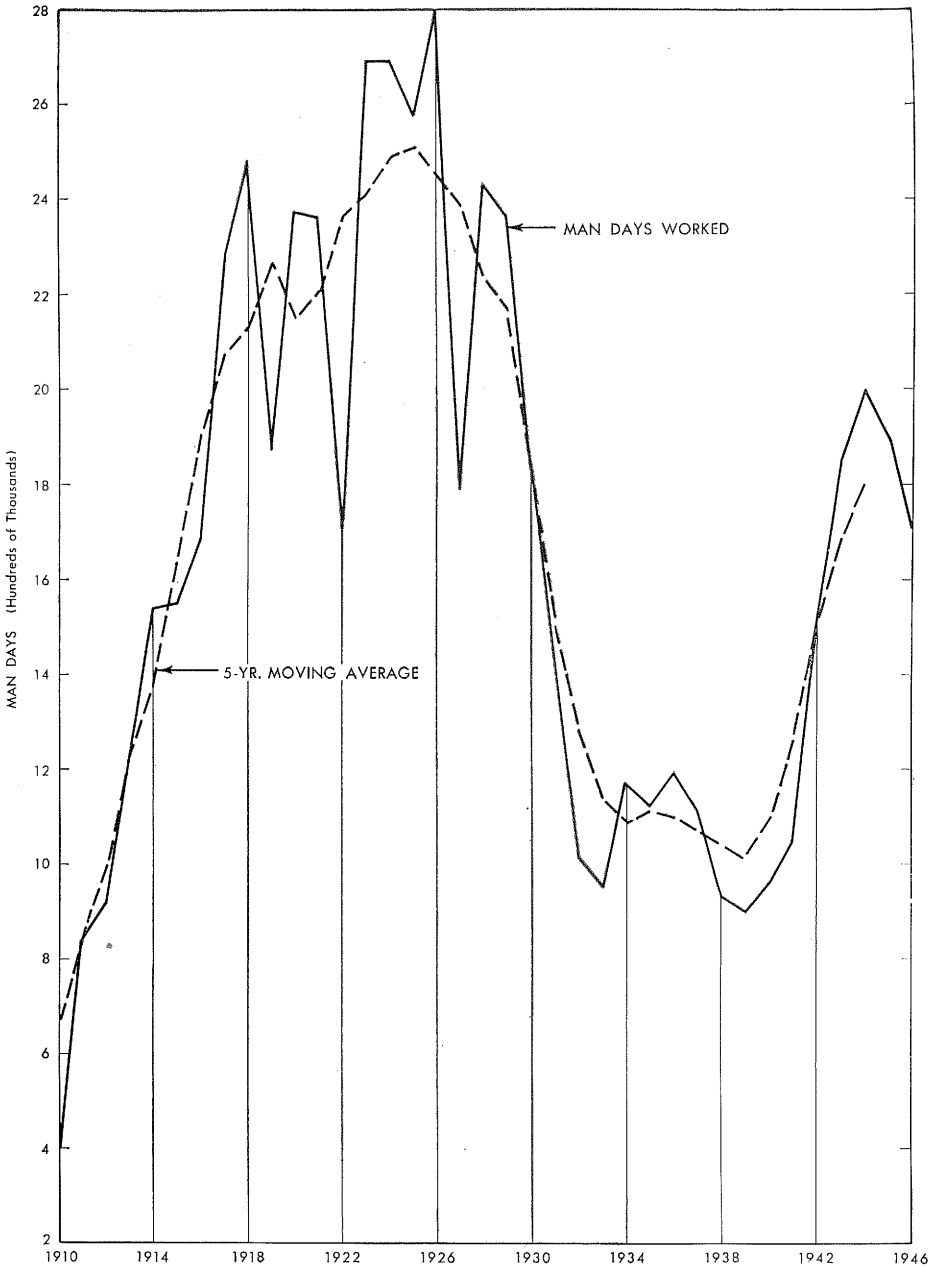



Fig. 34. Man days worked in Franklin County coal mines, 1910-1946. (*Minerals Yearbooks,* United States Bureau of Mines.)

The inset graph shows that the average number of days mines were active in the combined counties was less than in Franklin County except from 1934 to 1941, when they averaged about the same. Since that time they have again averaged less.

Total Employees in Mines. In view of the foregoing, it is interesting to note the history of employment in the mines of Franklin County (Fig. 33). Employment increased steadily from 2,000 in 1908 to an average of 15,000 or more from 1923 to

1926, then declined rapidly to an average of 6,500 in 1939 and 1940. Since then the number has increased to less than 7,500 in 1946 — fewer workers than in 1915.

The decline in number of mine employees was even greater in the other counties and began earlier than in Franklin County (see inset graph Fig. 33).

Man-Days Worked. From 1910 to the middle 20's the number of man-days worked per year rose from 380,000 to 2,800,000, and then fell to 950,000 in 1933 and as low as 900,000 in 1939 (Fig. 34). In 1940 a sharp increase began, reaching a peak of 2 million man-days in 1944 — half a million below the average for the middle 20's and 800,000 below the peak of 1926. In 1945 and 1946 there was a decline, the figure ultimately reaching 1,700,000.

Tons per Man-Day. In 1924 the United States Bureau of Mines began to present statistics by counties. The production per man-day in Franklin County rose from an average of 5.15 tons in 1924 to an average of about 9.5 tons during the last years of World War II (Fig. 35). The State average, which includes both shaft and strip mines, from 1933 to 1941 was nearly a ton per man-day below that of Franklin County, in spite of the fact that Franklin has only shaft mines. The State average, however, almost doubled between World War I and World War II, roughly from 4¼ to 8¾ tons. This rise was principally due to mechanization.

Mechanically Loaded Coal. Mechanical loading got well under way in the late 20's. Table 28 has been compiled from reports of the State De-

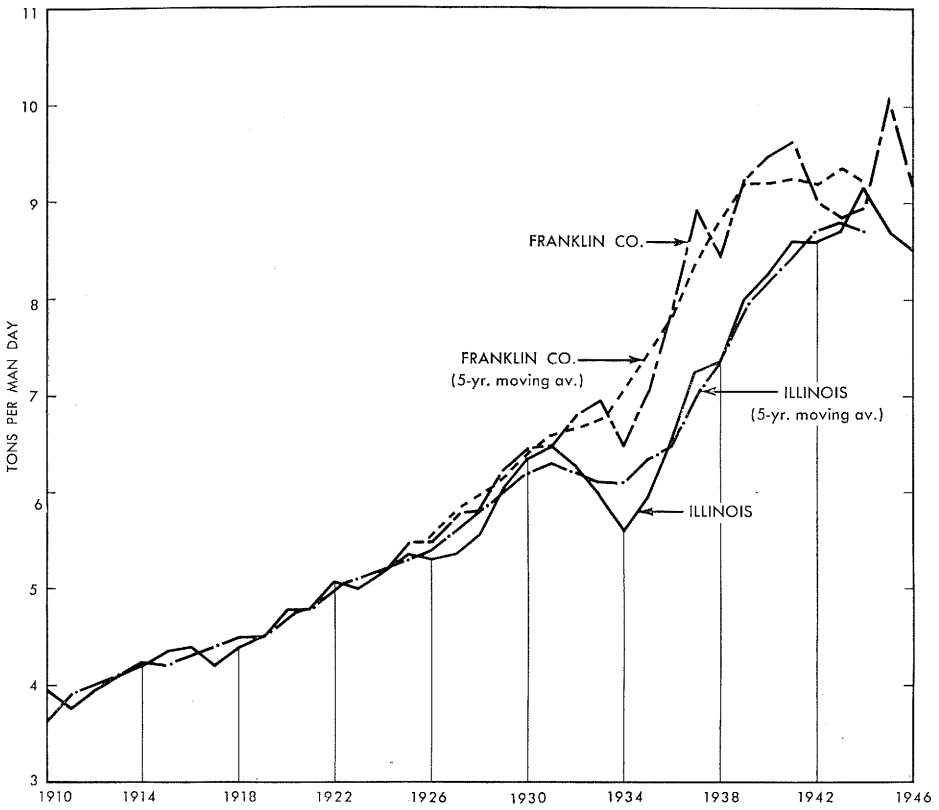



Fig. 35. Tons mined per man day in coal mines in Franklin County and in Illinois, 1908-1946, excluding mines producing less than 1,000 tons annually. (*Minerals Yearbooks*, United States Bureau of Mines.)

TABLE 28. TOTAL UNDERGROUND COAL MINED AND LOADED MECHANICALLY BY DISTRICTS, 1930-1946[a]
(In thousands of tons)

| Year | 9th District[b] | | | 10th District[b] | | | 11th District[b] | | | 12th District[b] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mined | Loaded Mechanically | | Mined | Loaded Mechanically | | Mined | Loaded Mechanically | | Mined | Loaded Mechanically | |
| 1930 | 3,282.3 | 1,927.1 | 59% | 11,997.3 | 7,574.6 | 63% | 3,531.6 | 648.7 | 18% | 3,928.3 | 1,929.8 | 49% |
| 1931 | 2,531.0 | 1,598.6 | 62% | 9,531.6 | 7,222.5 | 76% | 2,852.6 | 1,035.4 | 36% | 2,133.2 | 1,375.9 | 65% |
| 1932 | 1,667.0 | 914.4 | 55% | 7,064.4 | 5,312.1 | 75% | 2,204.5 | 819.7 | 37% | 1,908.4 | 1,639.0 | 86% |
| 1933 | 1,725.0 | 919.3 | 53% | 6,703.9 | 4,513.9 | 67% | 2,313.4 | 306.6 | 13% | 1,941.0 | 1,617.5 | 83% |
| 1934 | 2,400.1 | 1,216.8 | 50% | 7,780.2 | 5,365.6 | 69% | 2,543.8 | 323.1 | 13% | 1,958.3 | 1,236.0 | 63% |
| 1935 | 2,485.0 | 1,082.1 | 44% | 7,985.2 | 6,598.3 | 83% | 3,028.2 | 367.8 | 12% | 2,454.5 | 1,574.6 | 64% |
| 1936 | 3,034.0 | (553.3)[c] | (18%)[c] | 9,432.1 | 8,808.0 | 93% | 3,339.0 | 915.4 | 27% | 2,270.7 | 1,359.0 | 60% |
| 1937 | 3,090.0 | 2,068.9 | 67% | 10,108.3 | 9,955.0 | 99% | 2,775.5 | 1,325.0 | 48% | 2,212.9 | 1,452.5 | 65% |
| 1938 | 2,115.0 | 1,597.6 | 75% | 7,875.2 | 7,796.6 | 99% | 2,498.5 | 1,604.5 | 65% | 1,627.8 | 1,149.3 | 70% |
| 1939 | 2,662.2 | 2,134.5 | 80% | 8,774.0 | 8,562.6 | 98% | 2,978.9 | 2,408.3 | 81% | 1,767.8 | 1,146.5 | 65% |
| 1940 | 2,759.5 | 2,274.9 | 82% | 9,464.4 | 9,449.3 | 99% | 3,133.9 | 2,864.4 | 91% | 1,981.5 | 721.0 | 36% |
| 1941 | 3,094.0 | 2,758.1 | 89% | 10,746.7 | 10,731.9 | 100% | 3,432.0 | 3,230.9 | 94% | 1,965.0 | 1,099.7 | 56% |
| 1942 | 4,406.4 | 3,896.1 | 88% | 13,925.0 | 13,904.3 | 100% | 3,940.9 | (4,051.2)[c] | (100%)[c] | 2,634.9 | (350.0)[c] | (13%)[c] |
| 1943 | 5,248.0 | 4,754.8 | 91% | 16,684.4 | 16,663.6 | 100% | 3,805.6 | 3,713.6 | 97% | 3,261.7 | 2,667.3 | 82% |
| 1944 | 5,944.2 | 3,661.7 | 62% | 18,173.7 | 18,156.5 | 100% | 4,000.1 | 3,872.6 | 97% | 3,780.6 | 2,437.6 | 64% |
| 1945 | 5,570.0 | 4,877.7 | 88% | 17,247.4 | 17,233.1 | 100% | 3,952.3 | 3,853.6 | 98% | 3,641.6 | 2,316.9 | 64% |
| 1946 | 4,525.0 | 3,992.4 | 88% | 14,470.9 | 14,460.4 | 100% | 3,607.1 | 3,452.4 | 93% | 3,258.0 | 2,335.4 | 72% |

[a] Compiled from *Annual Coal Reports*, State Department of Mines and Minerals, Springfield, Ill.

[b] The coal producing counties included in the 9th and 10th districts varied from time to time and were as follows: 9th District, 1930-39: Jackson, Perry, Randolph, and Washington; 1940-46: Jackson, Perry, and Randolph. 10th District, 1930-33: Franklin; 1934-41: Franklin and Jefferson; 1942-46: Franklin. The 11th District includes Gallatin and Saline, and the 12th District, Williamson.

[c] Figures given in parentheses are not used in graph because of obvious error in available data.

partment of Mines and Minerals and gives the total tonnages of underground coal loaded mechanically, 1930-46, by mining districts.

Figure 36 is based on Table 28 and shows graphically the percentage of mechanically loaded coal in the several districts each year from 1930 to 1946 for which fairly adequate data are available.

All but the 12th District (Williamson County) show marked increases since the depression. Since 1941 the 10th District (Franklin County) has reached 100 per cent; the 11th District (Saline and Gallatin), the high 90's; the 9th District, approximately 90 per cent except for 1944; and since 1943 the 12th District has varied from 64 to 82 per cent.

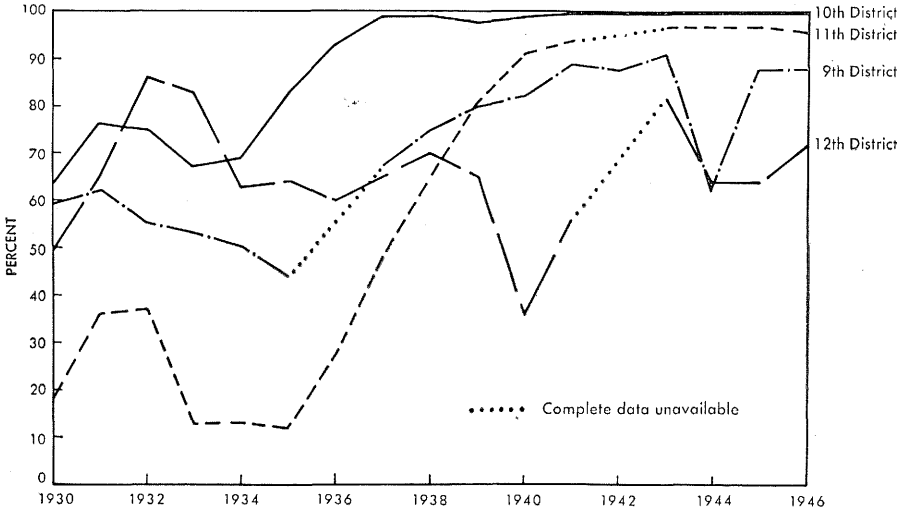



Fig. 36. Percentage of total coal mined underground and loaded mechanically, 1930-1946. (*Annual Coal Reports*, State Department of Mines and Minerals, Springfield, Ill.)

SIGNIFICANT FACTS. The following significant facts drawn from the foregoing data help to clarify the situation of unemployment which has beset the coal mines of Franklin County for more than 20 years and has affected other counties as well.

- The average of about 15,000 employees in Franklin County coal mines, in 1923 to 1925, was steadily reduced to 6,500 from 1939 to 1941. A slight upturn since then of about 800 has raised the average to about one-half that of the early and middle 20's.
- Unemployment of miners began before the depression. It accompanied and followed the abandonment of mines that began in 1923, the beginning of mechanization in the 20's, the decrease in number of days mines were operated after 1918, the decrease in the market for coal in 1929, the increase in efficiency of utilization of coal that has characterized most of this period, and the loss of market to oil and natural gas.
- The abandonment of mines was the result of over-expansion, mechanization, loss of market due to the depression, competition from oil and gas, increased efficiency in the utilization of coal, and increased costs due to rising wage scales and the cleaning and special preparation of stoker coals.
- Reduction in the number of days that the mines operated, which began at the close of World War I, resulted from more and more mines entering the competitive field, from loss of market, from increasing mechanization, and from decreased demand for coal during the depression. The recent increase in the number of operating days has been caused by the increased demand for coal at a time when mines were operating at capacity, from a larger summer market, and from shortages of labor and materials. This increase in operating days has been beneficial to the miners in increasing their annual income.
- Mechanization of mines was a natural result of the advancement in technology during the present century and of production problems within the industry.

## STRIP MINING

Total tonnage by all shipping mines in Southern Illinois, total tonnage by shipping strip mines, and percentage of strip coal to the entire shipping output are given in Table 29.

TABLE 29. NET TONS OF COAL PRODUCED IN SHAFT AND STRIP SHIPPING MINES, SOUTHERN ILLINOIS, 1928-1946[a]

| Year | From all Shipping Mines (1) | From Shipping Strip Mines (2) | Percentage of (2) to (1) |
|---|---|---|---|
| 1928 | 26,584,622 | 2,274,981 | 9 |
| 1929 | 29,178,690 | 3,058,886 | 10 |
| 1930 | 25,415,840 | 3,407,988 | 13 |
| 1931 | 21,878,730 | 3,436,787 | 16 |
| 1932 | 15,899,648 | 3,783,390 | 24 |
| 1933 | 15,218,253 | 3,126,437 | 20 |
| 1934 | 17,345,043 | 3,347,392 | 19 |
| 1935 | 19,046,570 | 3,923,754 | 20 |
| 1936 | 21,491,254 | 4,350,607 | 20 |
| 1937 | 22,768,095 | 5,541,406 | 24 |
| 1938 | 17,008,431 | 4,716,379 | 28 |
| 1939 | 20,241,944 | 5,145,896 | 25 |
| 1940 | 21,734,916 | 5,540,721 | 25 |
| 1941 | 23,927,460 | 5,949,125 | 25 |
| 1942 | 29,727,275 | 5,786,980 | 19 |
| 1943 | 33,628,742 | 5,576,329 | 17 |
| 1944 | 37,044,111 | 5,838,472 | 16 |
| 1945 | 35,584,642 | 5,968,847 | 17 |
| 1946 | 30,806,453 | 5,493,881 | 18 |

[a] Compiled from *Annual Coal Reports*, State Department of Mines and Minerals, Springfield, Ill.

Figure 37 shows production curves based on these data. It will be seen that the combined strip coal output has remained fairly uniform although the total coal production has varied. Thus there has been more uniform employment for those engaged in strip mining. However, the percentage of total coal to strip coal has increased markedly since the beginning of World War II, increasing the opportunity for employment, although not so much in number of employees as in greater number of working days and income per year (see Figs. 33, 34, and 38).

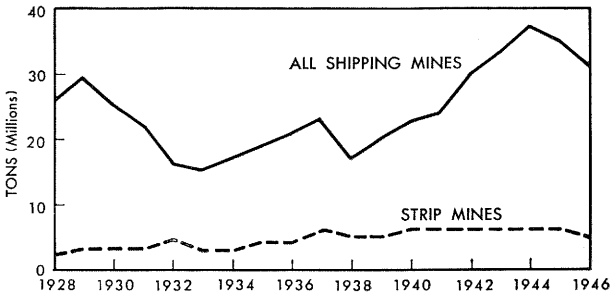



Fig. 37. Coal production from all shipping mines and from strip mines in Southern Illinois, 1928-1946. (*Annual Coal Reports*, State Department of Mines and Minerals, Springfield, Ill.)

TABLE 30. TONS PER MAN-DAY FROM ALL MINES PRODUCING MORE THAN 1,000 TONS, AND IN STRIP MINES FOR COUNTIES DESIGNATED, 1928-1945[a]

| Year | Counties | All Mines (Tons per man-day) | Strip Mines (Tons per man-day) |
|---|---|---|---|
| 1928 | Perry, Williamson | 6.62 | 17.41 |
| 1929 | Perry, Williamson | 6.89 | 20.67 |
| 1930 | Perry, Williamson | 7.01 | 18.82 |
| 1931 | Perry, Williamson | 7.71 | 14.88 |
| 1932 | Perry, Williamson | 7.57 | 14.48 |
| 1933 | Perry, Williamson | 7.63 | 13.60 |
| 1934 | Perry, Williamson | 6.66 | 12.72 |
| 1935 | Perry, Saline, Williamson | 6.65 | 12.90 |
| 1936 | Perry, Saline, Williamson | 7.09 | 17.39 |
| 1937 | Perry, Saline, Williamson | 8.42 | 20.74 |
| 1938 | Perry, Saline, Williamson | 8.54 | ....[b] |
| 1939 | Perry, Saline, Williamson | 8.93 | 18.81 |
| 1940 | Perry, Saline, Williamson | 9.12 | 16.75 |
| 1941 | Perry | 9.39 | 17.35 |
| 1942 | Jackson, Perry, Randolph, Williamson | 8.87 | 20.58 |
| 1943 | Perry, Randolph, Saline, Williamson | 8.37 | 23.85 |
| 1944 | Perry, Randolph, Williamson | 8.71 | 25.16 |
| 1945 | Jackson, Perry, Randolph, Saline, Williamson | 9.08 | 19.73 |

[a] *Minerals Yearbooks*, U. S. Bureau of Mines.
[b] No data for strip mines in 1938.

Table 30 and Fig. 38 show that there is less opportunity for employment in the production of a given amount of coal by strip mining than by shaft mining. From two to three times as much coal is produced per man-day by the former as by the latter. In referring to Table 30 and Fig. 38 it should be borne in mind that both shaft mines and strip mines are included in the first column and the lower curve.

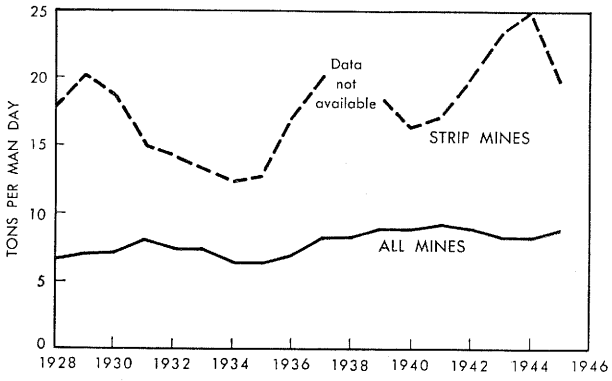



Fig. 38. Tons produced per man day in all mines producing more than 1,000 tons annually and in strip mines in Southern Illinois, 1928-1945. See Table 30. (*Minerals Yearbooks*, United States Bureau of Mines.)

TABLE 31. NUMBER OF EMPLOYEES IN SHIPPING MINES AND SHIPPING STRIP MINES IN SIXTEEN SOUTHERN ILLINOIS COUNTIES, 1928-1946[a]

| Year | Number of Employees | |
|---|---|---|
| | All Shipping Mines | Shipping Strip Mines |
| 1928 | 28,486 | 678 |
| 1929 | 26,660 | 697 |
| 1930 | 23,410 | 1,223 |
| 1931 | 22,712 | 1,680 |
| 1932 | 19,539 | 1,046 |
| 1933 | 18,104 | 955 |
| 1934 | 18,409 | 1,133 |
| 1935 | 17,167 | 1,280 |
| 1936 | 16,874 | 1,196 |
| 1937 | 15,987 | 1,321 |
| 1938 | 15,401 | 1,273 |
| 1939 | 14,765 | 1,275 |
| 1940 | 13,378 | 1,288 |
| 1941 | 13,354 | 1,149 |
| 1942 | 13,520 | 1,404 |
| 1943 | 13,845 | 1,475 |
| 1944 | 14,475 | 1,423 |
| 1945 | 14,403 | 1,341 |
| 1946 | 15,211 | 1,343 |

[a] Compiled from *Annual Coal Reports*, State Department of Mines and Minerals, Springfield, Ill.

As to number of employees, Table 31 and Fig. 39 are enlightening. While shaft mines have always provided the bulk of employment, they have offered less uniform employment. From 1928 to 1940 there was a reduction of about 15,700 men in shaft mines, as compared with an increase of more than 600 in strip mines. From 1940 to 1946, there occurred an increase of nearly 1,800 positions in shaft mines, as compared with 55 in strip mines.

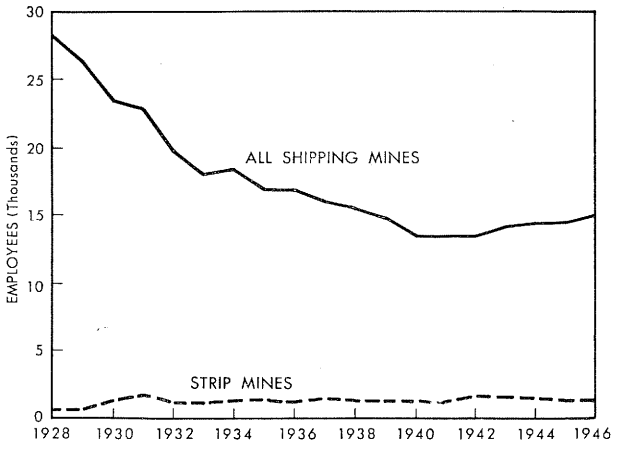



Fig. 39. Number of employees in all shipping mines and in strip mines in Southern Illinois, 1928-1946. (*Annual Coal Reports*, State Department of Mines and Minerals, Springfield, Ill.)

## THE PRESENT SITUATION

It appears that the Illinois coal industry, for the present, has experienced its greatest change due to mechanization, but another cycle appears to be in the making, the effects of which cannot be predicted; that the market for coal will be less affected in the immediate future by further progress in efficient utilization than in the past; that the competition of petroleum products will increase somewhat in railroad fuel and decrease in domestic heating and in manufacturing; and that some new markets for Illinois coal are developing.

Research by the State Geological Survey on the production of metallurgical coke for the steel industries of the Chicago and St. Louis areas, using a blend of Illinois coal and eastern coal, is already yielding results. Illinois coal is now being used for this purpose to the extent of about one million tons a year. It is estimated that there is a potential market for five million tons when the capacity of the mines becomes such that delivery over a substantial period of time can be assured.

Further research is being planned to ascertain whether or not the low-volatile coking coal of the East can be partly replaced by using Illinois coal to produce what is called char, and blending this with high-volatile Illinois coal for the production of metallurgical coke. At the present time Illinois coal can be only partially substituted for high-volatile eastern coal.

More attention is being given to the briquetting of "fines" containing sufficient fusain to produce a "smokeless" domestic fuel.

There are also developments toward the conversion of coal into liquid and gaseous fuels, which will be discussed further.

The time is probably not at hand for the much-discussed underground gasification of coal. It is a problem which has many ramifications. Much more additional information — scientific, technologic, and economic — is needed.

Consideration should be given to the possibility of increasing the dock facilities on the Mississippi River and constructing more efficient docks in Chicago to transfer coal to lake vessels, so that more Illinois coal could reach the Great Lakes markets.

As progress is made in the development of other industries in Southern Illinois, the coal industry will gain an additional market which, in turn, will promote additional employment opportunity. Table 32 and Fig. 40 show, for six counties, the amount of coal that was loaded on railroads in 1945 for markets elsewhere, the amount sold to railroads, and the amount sold locally. Assuming that the outside markets can be retained, the quantity sold locally can be increased as industrial development progresses. Large resources of cheap fuel should attract industries.

The future of coal stripping is admittedly limited. Table 29 and Fig. 37 show the tonnage

TABLE 32. DISPOSITION OF COAL, 1945[a]
(In net tons)

| | |
|---|---|
| Jackson County: | |
| Loaded on railroads | 2,160,695 |
| Sold to railroads | 542,573 |
| Sold locally | 150,756 |
| Other disposition | 66,184 |
| *Total* | 2,920,208 |
| Perry County: | |
| Loaded on railroads | 3,144,592 |
| Sold to railroads | 1,103,997 |
| Sold locally | 77,787 |
| Other disposition | 47,994 |
| *Total* | 4,374,370 |
| Randolph County: | |
| Loaded on railroads | 1,613,940 |
| Sold to railroads | 987,772 |
| Sold locally | 134,854 |
| Other disposition | 71,957 |
| *Total* | 2,808,523 |
| Franklin County: | |
| Loaded on railroads | 12,397,278 |
| Sold to railroads | 3,895,975 |
| Sold locally | 472,129 |
| Other disposition | 482,064 |
| *Total* | 17,247,446 |
| Saline County: | |
| Loaded on railroads | 3,331,285 |
| Sold to railroads | 1,050,501 |
| Sold locally | 88,409 |
| Other disposition | 87,286 |
| *Total* | 4,557,481 |
| Williamson County: | |
| Loaded on railroads | 2,022,912 |
| Sold to railroads | 1,624,117 |
| Sold locally | 711,973 |
| Other disposition | 34,360 |
| *Total* | 4,393,362 |

[a] Compiled from *Annual Coal Report for 1945*, State Department of Mines and Minerals, Springfield, Ill.

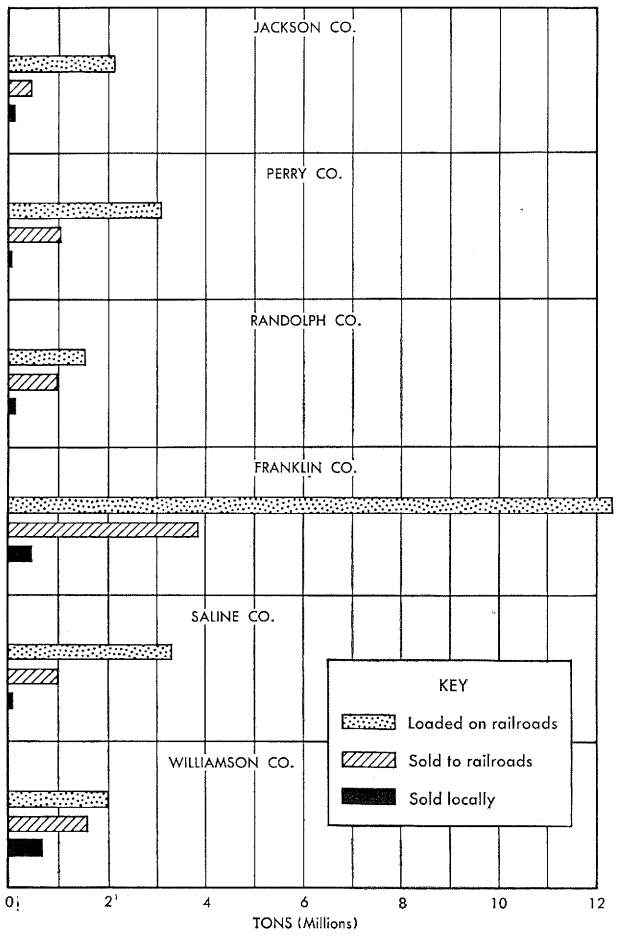



Fig. 40. Disposition of coal mines by counties in Southern Illinois, 1945. (*Annual Coal Reports*, State Department of Mines and Minerals, Springfield, Ill.)

of Southern Illinois coal mined by stripping, from 1928 to 1946.

**Coal Reserves**

Many old mines in Illinois are approaching their property limits and new blocks of coal at other places in the State will be sought. The State Geological Survey has a continuing program of collecting drill records, well-cutting samples, and diamond-drill cores to aid the coal industry in solving problems of selecting acreages of coal of the desired thickness, depth, quality, and mining conditions.

The original coal resources as estimated by the State Geological Survey for counties of Southern Illinois and the estimated depletion are shown in Table 33.

Formerly it was believed that the coal left in mine pillars, in the roof, and between mining properties amounted to 50 per cent of the original coal. Recent study of mine maps indicates that about 60 per cent of the coal is unmined. Notwithstanding the large reserve of coal, a more complete recovery of the coal is important to the future of Southern Illinois. Full information on what is happening to our exhaustible resources is imperative, and it is suggested that the State Geological Survey be provided annually by the coal industry with revised maps of mined-out areas for study and for public record.

## RECOMMENDATIONS

The following recommendations are made with a view of providing a broad basis for industrial development:

1. Make a complete inventory of the coal resources that can be mined under present conditions.
2. Develop full information on the physical and chemical nature of all commercial coals.
3. Ascertain the practical potentialities of Southern Illinois coal in the fields of combustion, coking, gas making, and for use as a chemical raw material.
4. Maintain an up-to-date appraisal of the marketing possibilities for Southern Illinois coal.

*1. Inventory*

This is important in selecting new blocks of coal for mining which will compete successfully with other coal fields. The inventory must include the thickness of the coal, depth, ash content, sulphur content, B.t.u. value, roof and floor conditions, coal splits, coal cut-outs, areas affected by faulting and warping, areas suitable for coal stripping, and other characteristics.

The State Geological Survey has advanced far in its inventory of Southern Illinois coal, but the work is prodigious and will require the constant collection of new information from current oil well drillings and from other sources.

*2. Characteristics*

Great progress has been made in the study of the physical and chemical characteristics of coal. But basic knowledge must yet be obtained as to the

molecular structure of the coal substance and its chemical behavior in order that the use of coal, including its use as a chemical raw material, may be more fully developed.

It is quite obvious that a great resource like that of Southern Illinois coal, vast in quantity and potentiality, needs and deserves the comprehensive employment of modern science.

*3. Potentialities*

Stoker manufacturers and research engineers have done much experimental work on stoker devices for the efficient and smokeless combustion of coal, but there has been little systematic investigation of what constitutes a good stoker coal and what specifications should guide its preparation. This is a study to which the State Geological Survey is giving attention.

In the work on metallurgical coke the Survey has designed, constructed, and put into use an experimental oven that matches in coking tests the results obtained by commercial ovens. From this experimental oven there has been a steady demonstration of the extent to which some of the Southern Illinois coal can be blended with certain eastern coal for the making of metallurgical coke required by the great steel industries. A larger market for Southern Illinois coal is thereby opened. This market will be increased by experimentation.

TABLE 33. ESTIMATED PRESENT RESERVES OF COAL FOR MAJOR PRODUCING COUNTIES[a]
(In millions of tons)

| County | Original Reserve | Production, 1882-1945 | Estimated Depletion[b] | Percentage Depletion |
|---|---|---|---|---|
| Franklin | 3,718 | 385.3 | 963 | 26 |
| Gallatin | 1,970 | 3.8 | 10 | 0.5 |
| Hamilton | 2,000 | ..... | ... | .. |
| Jackson | 713 | 70.0 | 175 | 24 |
| Perry | 4,932 | 122.0 | 305 | 6 |
| Randolph | 759 | 50.9 | 127 | 17 |
| Saline | 2,712 | 155.7 | 389 | 14 |
| White | 2,000 | ..... | ... | .. |
| Williamson | 1,489 | 254.5 | 636 | 43 |

[a] Gilbert H. Cady, "Content, Conduct and Results of Illinois Coal Resources Inventories, 1946" (unpublished paper).

[b] In the production of coal at least an equal amount of coal has been left as unminable; probably, taking into consideration all the coal left between abandoned underground mines, the amount reported produced is only about 40 per cent of the total subtracted.

*4. Markets*

A valuable contribution to the expansion of markets for Illinois coal is now being made by providing an up-to-date appraisal of the natural geographic market area for Illinois coal, including both domestic and industrial fuels. This appraisal also considers the competition of oil and natural gas, the shift from steam locomotives to Diesel engines, the full use of the Illinois Waterway, and other favorable and unfavorable factors that influence the marketing of Illinois coal.

Maintaining the summer market for Illinois coal is of great importance to steady employment in Illinois mines. A potential market for summer production exists in the industrial cities in eastern Wisconsin, in the cities along the Upper Mississippi Valley, and in the Canadian railway docks on upper Lake Superior. These markets must be reached during the season of river and lake navigation. Two steps are essential in opening these markets to Illinois coal producing districts:

a. Establishment of mechanized coal loading docks on the Mississippi River. Thus far this has been done at Alton, Illinois, but more facilities for unloading at some points along the Upper Mississippi are needed.

b. Construction of a modern, large capacity rail-to-vessel transfer, through which coal can be moved quickly and at low cost, is needed at Chicago. Such a facility is necessary in order to compete with the large transfer docks along Lake Erie through which coal is shipped from the Appalachian fields to upper lake markets.

## LIQUID FUELS FROM COAL*

Because the present Secretary of the Department of the Interior recommended to Congress the adoption of a program for the establishment of a synthetic fuels industry in this country, a summary of this matter is here given.

Natural petroleum is the cheapest source of liquid fuels. Proved reserves of natural petroleum have been mounting year by year in spite of the increased consumption of oil, and the geological picture is still bright for the discovery of much more oil in this country. Gasoline shortages, such as occurred during the last war, might, however, hasten the production of gasoline from coal.

The term "hydrogenation of coal" originates from the fact that hydrogen must be added to and oxygen must be removed from coal in order to con-

* For a more complete statement, see *Opinion and Comment*, Bureau of Economic and Business Research, University of Illinois, May 17, 1948, p. 31.

vert it into oil. Two methods for the liquefaction of coal were developed in Germany before the second World War — a direct method (Bergius Process) using high temperatures and pressures, and an indirect method (Fischer-Tropsch Synthesis) which first converts coal into gas and then into oil.

Considerable research has been carried on by the United States Bureau of Mines and much information has been acquired from Germany since the close of the war. The Bureau of Mines acquired a former ordnance plant at Louisiana, Missouri, for use as a coal-to-oil demonstration plant. A demonstration plant costing an estimated $7 millions is being constructed there, which will have a capacity of 200 barrels of gasoline a day by the direct hydrogenation of coal. Another plant costing an estimated $4.4 millions is under contract for construction, which will use the indirect method and which will have a daily capacity of 80 barrels. From these low capacities, it is obvious that the two plants are not commercial plants but demonstration-research plants.

The program of the Secretary of the Interior covered four major lines of development: (1) direct hydrogenation of coal; (2) indirect hydrogenation of coal; (3) conversion of natural gas into oil; and (4) extraction of oil from oil shales. Each of these methods in commercial plants would eventually produce 500,000 barrels of oil a day. The total for the four would equal approximately 40 per cent of the average daily production of natural petroleum in 1947.

This enormous program cannot be put into effect all at once. The Secretary of the Interior proposed an initial appropriation of $350 millions for the construction of three 10,000-barrel commercial units — one to produce oil from coal by direct hydrogenation, one to use the indirect method, and the third to process oil shale.

In a 10,000-barrel direct hydrogenation plant the number of men working would be approximately 1,600; 15 per cent of them would be supervisory and technical personnel.

Half of the coal mined would be used as boiler fuel and in the manufacture of hydrogen, and the other half would be used in the liquefaction process. Coal for the latter use should not have more than 3 per cent ash. A cleaning plant is a necessity. The high-ash portion will be used as boiler fuel.

Each ton of coal used for conversion yields four barrels of liquid fuels. Since only one half of the coal used is processed, the net yield is two barrels of liquid fuel for each ton of coal. Thus a 10,000-barrel-a-day plant would require 5,000 tons of coal a day, or 1,825,000 tons a year. To meet these requirements for 20 years would call for 36 million tons of coal. A plant, using the indirect method, would require as much coal as the plant using the direct method, or a little more.

Great quantities of clean water free from suspended solids are absolutely necessary. In a direct-method plant producing 10,000 barrels of oil a day, 6,600 gallons of water will have to be added each minute to maintain a circulation of 120,000 gallons of water each minute, due to loss by evaporation, use of water in the cooling system, sanitary waste, and miscellaneous losses; 2,000 to 2,300 gallons each minute would be discharged as plant effluent. Whether or not the effluent would require treatment before discharge from the plant would be a local problem. If the water supply were plentiful, an additional 3,000 gallons each minute might be used; thus the effluent would be increased proportionately. The water required for a 10,000-barrel plant using the indirect method would be one-third more.

It is estimated by authorities that 100,000 tons of steel would be required for a 10,000-barrel-per-day plant using the direct method. This does not include steel for the production of raw materials; nor do these figures distinguish among kinds of steel. The direct hydrogenation of coal takes place in reactors operating under 10,000 pounds pressure per square inch and at a temperature of 480° C., whereas the indirect method operates at a maximum pressure of 150 pounds per square inch and at a temperature of 180° to 200° C.

According to experts of the Bureau of Mines, if and when the full program of the Secretary of the Interior for 500,000 barrels a day by direct hydrogenation is put into effect, it would require seventeen plants of 30,000-barrel capacity. A 30,000-barrel-per-day plant would require 15,000 tons of coal a day, or 5.5 million tons a year. The life of such a plant is estimated at 15 to 20 years; therefore, the amount of coal that would be required for 20 years would be 110 million tons which is equivalent to a bed of coal five and one-half feet thick covering twenty square miles.

The amount of make-up water required to maintain the circulation of water for a 30,000-barrel plant would be 20,000 gallons per minute or about 30 million gallons per day. Since the indirect method requires 50 per cent more make-up water than the direct method, it seems obvious that the seventeen 30,000-barrel plants using the direct method and the seventeen using the indirect method would have to be located at many different places where cheap coal and large supplies of water would be available.

From the information at hand it appears that the production of gasoline and other liquid fuels from coal will cost appreciably more than presently indicated costs of the same fuels from petroleum. It seems clear, however, that Southern Illinois can meet all the requirements for the operation of one or more of the initial 10,000-barrel plants for the beginning step in the proposed program.

## OIL AND GAS

The map in Fig. 41 shows the geographic distribution of oil and gas pools in the sixteen Southern Illinois counties. They represent a southward extension of discoveries that began further north in the Illinois basin in 1937 and which reached Southern Illinois in 1939.

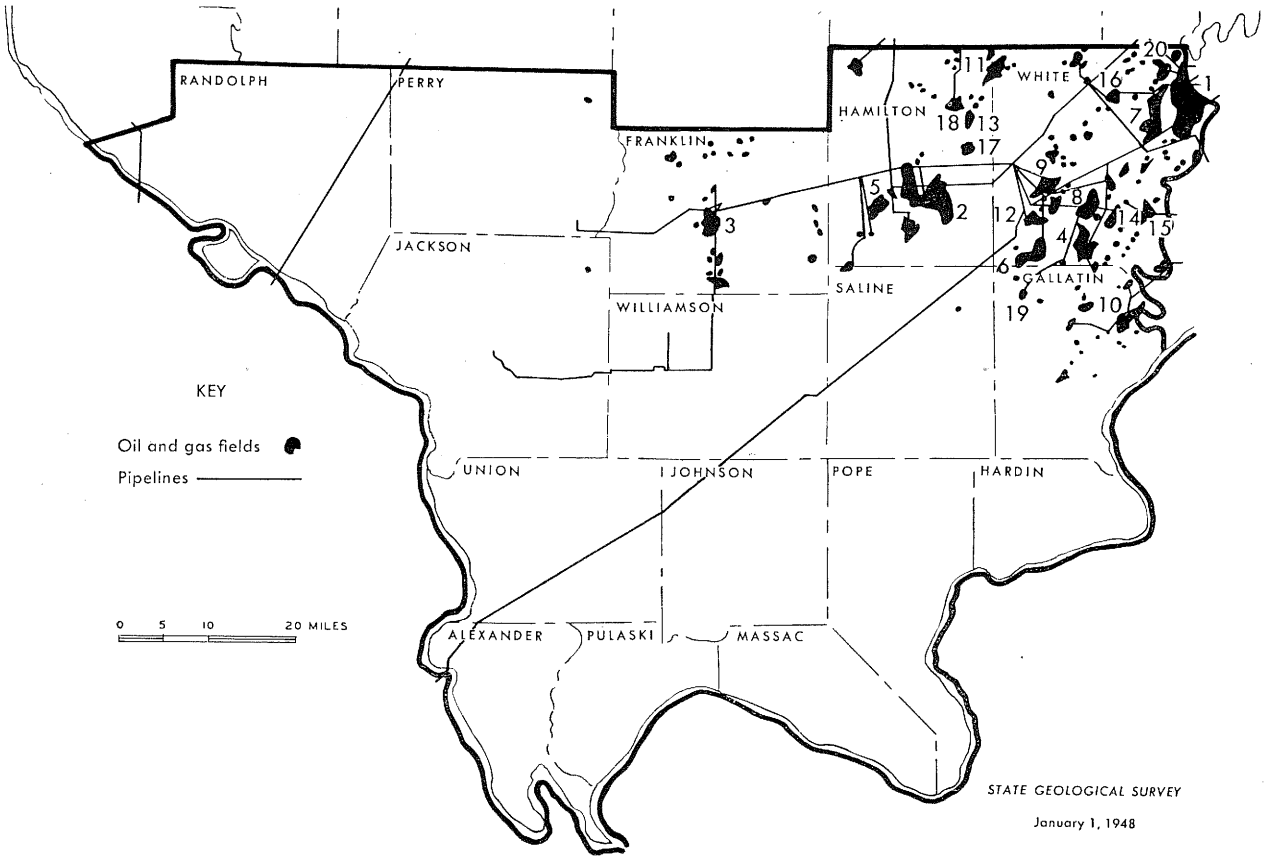
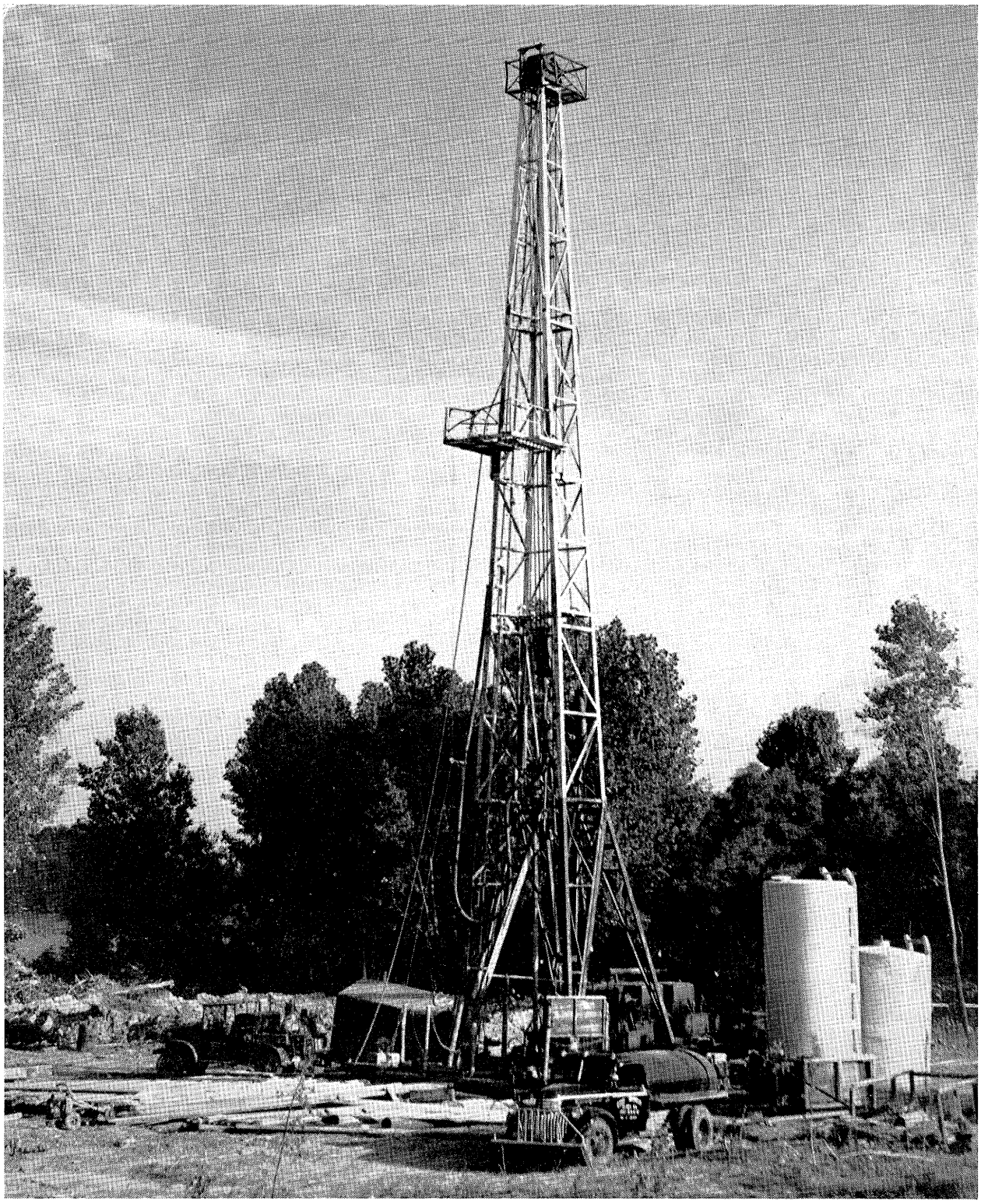



Fig. 41. Map of oil and gas fields of Southern Illinois. The pipe line that enters Illinois in Alexander County is the "Big Inch" and carries natural gas from Texas to the eastern states. Most other pipe lines shown carry crude oil. Numbers indicate large producing pools, see Fig. 42.
(A. H. Bell and others, Oil and Gas Division, State Geological Survey.)



Oil well being drilled by rotary rig

TABLE 34. POOLS WHICH HAVE PRODUCED 1,000,000 BARRELS OR MORE OF OIL TO END OF 1947

| Pools | Barrels | Pools | Barrels | Pools | Barrels |
|---|---|---|---|---|---|
| New Harmony-Griffin Consol.[a] (exclusive of Wabash County) | 35,000,000 | Phillipstown Consol. | 5,564,000 | Maunie South | 2,244,000 |
| Dale-Hoodville Consol. | 24,099,000 | Storms | 5,474,000 | Centerville East | 1,718,000 |
| Benton | 19,089,000 | Stokes-Brownsville | 5,155,000 | Thackeray | 1,580,000 |
| Herald | 17,100,000 | Inman East | 3,906,000 | Blairsville | 1,497,000 |
| Rural Hill | 10,034,000 | Mill Shoals[a] | 3,625,000 | Omaha | 1,362,000 |
| Roland | 7,290,000 | Iron | 3,363,000 | Calvin North | 1,131,000 |
| | | Bungay Consol. | 2,438,000 | | |
| | | Concord | 2,357,000 | *Total* | 154,026,000 |

[a] Includes only production in southernmost 16 counties. Total production in the case of the following 2 pools which extend northward is as follows: New Harmony-Griffin Consol., 42,519,000; Mill Shoals, 4,524,000.

Figure 42 shows the cumulative production of oil in 20 pools of one million barrels or more in the sixteen counties for the period 1939-1947, inclusive. Table 34 gives the detailed production figures for these pools.

The annual production of Southern Illinois oil is shown in Table 35 and Fig. 43. It will be observed that the greatest production was in 1941, when it reached approximately 33 million barrels. There was a marked decline to about 22 million barrels in 1943, since which time the decline has been less marked, to 14,264,000 barrels in 1947.

From 1939 to the end of 1947 Illinois as a whole produced nearly 858 million barrels of oil; about 159 million barrels came from Southern Illinois.

New water-flooding projects to increase oil recovery were started in White County in 1947. More secondary recovery projects are expected, and as a result considerably more oil will be recovered than could be produced by ordinary pumping. With an active drilling program in progress and with secondary recovery methods making strides, it seems clear that Southern Illinois will have an oil industry for many decades to come.

As in the case of coal, the State Geological Survey has carried on active geological research to aid in the discovery of oil pools and petroleum engineering research to prolong the life of the pools, increasing the ultimate amount of oil that can be recovered. In 1930 the State Geological Survey prepared a classification map of the oil possibilities in Illinois, as shown in Fig. 44. This map was a great incentive to the oil industry to investigate further the oil and gas possibilities of Illinois. It is to be noted that only a small fraction of the new oil that

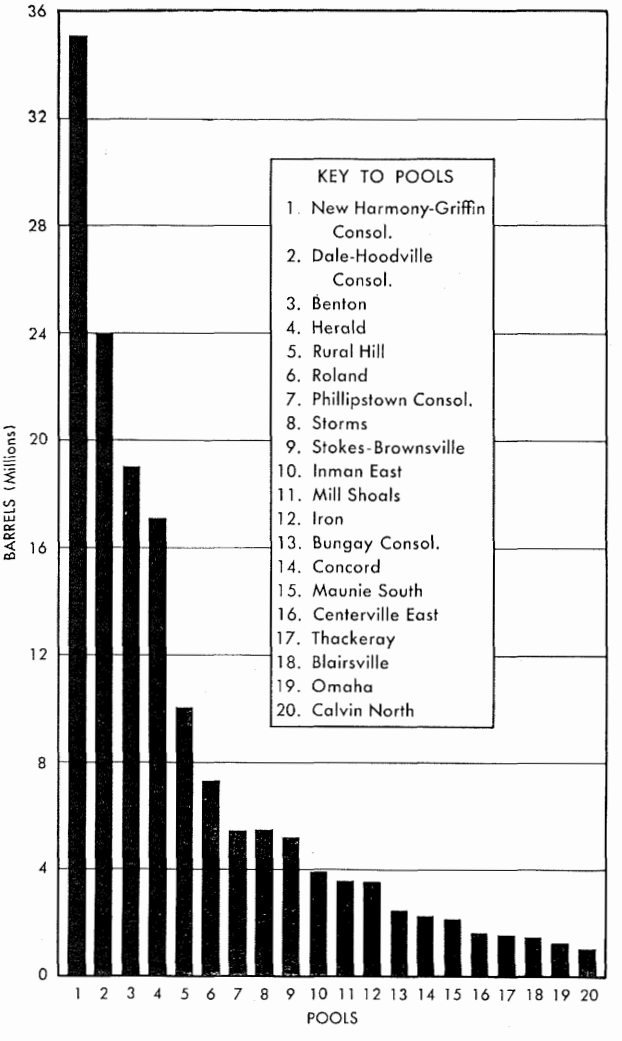



Fig. 42. Cumulative production of oil in twenty pools producing 1 million barrels or more in Southern Illinois, 1939-1947. For location of pools, see Fig. 41. (Oil and Gas Division, State Geological Survey.)

TABLE 35. ANNUAL PRODUCTION OF SOUTHERN ILLINOIS OIL FIELDS[a]

| Year | Thousands of Barrels |
|---|---|
| 1939 | 411 |
| 1940 | 6,578 |
| 1941 | 33,085 |
| 1942 | 30,688 |
| 1943 | 22,060 |
| 1944 | 19,504 |
| 1945 | 16,882 |
| 1946 | 15,426 |
| 1947 | 14,264 |
| *Total, Southern Illinois* | 158,898 |
| Total, State | 857,982 |

[a] State Geological Survey, Oil and Gas Division.

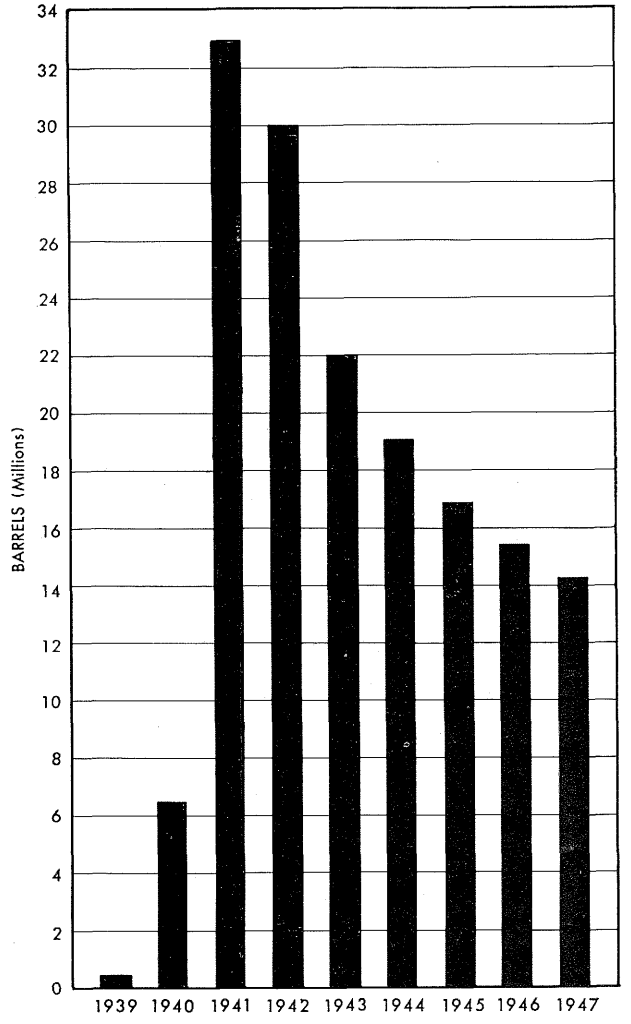



Fig. 43. Southern Illinois oil production, 1939-1947. (Oil and Gas Division, State Geological Survey.)

has been found lies outside of the area designated as having the best possibilities.

The following is a list of the geological formations in Southern Illinois, with approximate upper and lower limits of depths to top of pay zone in existing pools.

| | *Depth (feet)* |
|---|---|
| CENOZOIC* | |
| Pleistocene and recent systems | |
| Tertiary | |
| Pliocene system | |
| Eocene system | |
| MESOZOIC* | |
| Cretaceous system | |
| PALEOZOIC | |
| Pennsylvanian system | |
| Tradewater group† } Caseyville group† } | 780–1,900 |
| Mississippian system | |
| Chester series | |
| Kinkaid limestone† | 1,700 |
| Degonia sandstone† | 1,690–1,975 |
| Clore limestone† | 1,725–2,100 |
| Palestine sandstone† | 1,700–2,085 |
| Menard limestone | |
| Waltersburg sandstone† | 1,770–2,290 |
| Vienna limestone | |
| Tar Springs sandstone† | 2,080–2,575 |
| Glen Dean limestone | |
| Hardinsburg sandstone† | 2,135–2,630 |
| Golconda limestone | |
| Cypress sandstone† | 780–2,930 |
| Paint Creek formation† | 2,595–3,040 |
| Bethel sandstone† | 2,600–2,990 |
| Renault limestone† | 2,690–2,735 |
| Aux Vases sandstone† | 2,650–3,360 |
| Iowa series | |
| St. Genevieve formation | |
| Levias limestone† | 2,735–3,440 |
| Rosiclare sandstone† | 2,800–3,365 |
| Fredonia limestone (includes McClosky)† | 2,800–3,505 |
| St. Louis limestone† | 3,080 |

* Present only in southern parts of Alexander, Massac, Pope, Pulaski, and Union counties.

† Produces oil in sixteen-county area.

## RECOMMENDATIONS

To promote further discoveries of oil, which is now so vital to the nation, and to advance secondary recovery methods for securing the greatest ultimate amount of oil, the following recommendations are made:

1. That a geological library of all drillings and samples be created by the State Geological Survey.
2. That research in petroleum geology and petroleum engineering be more amply supported.

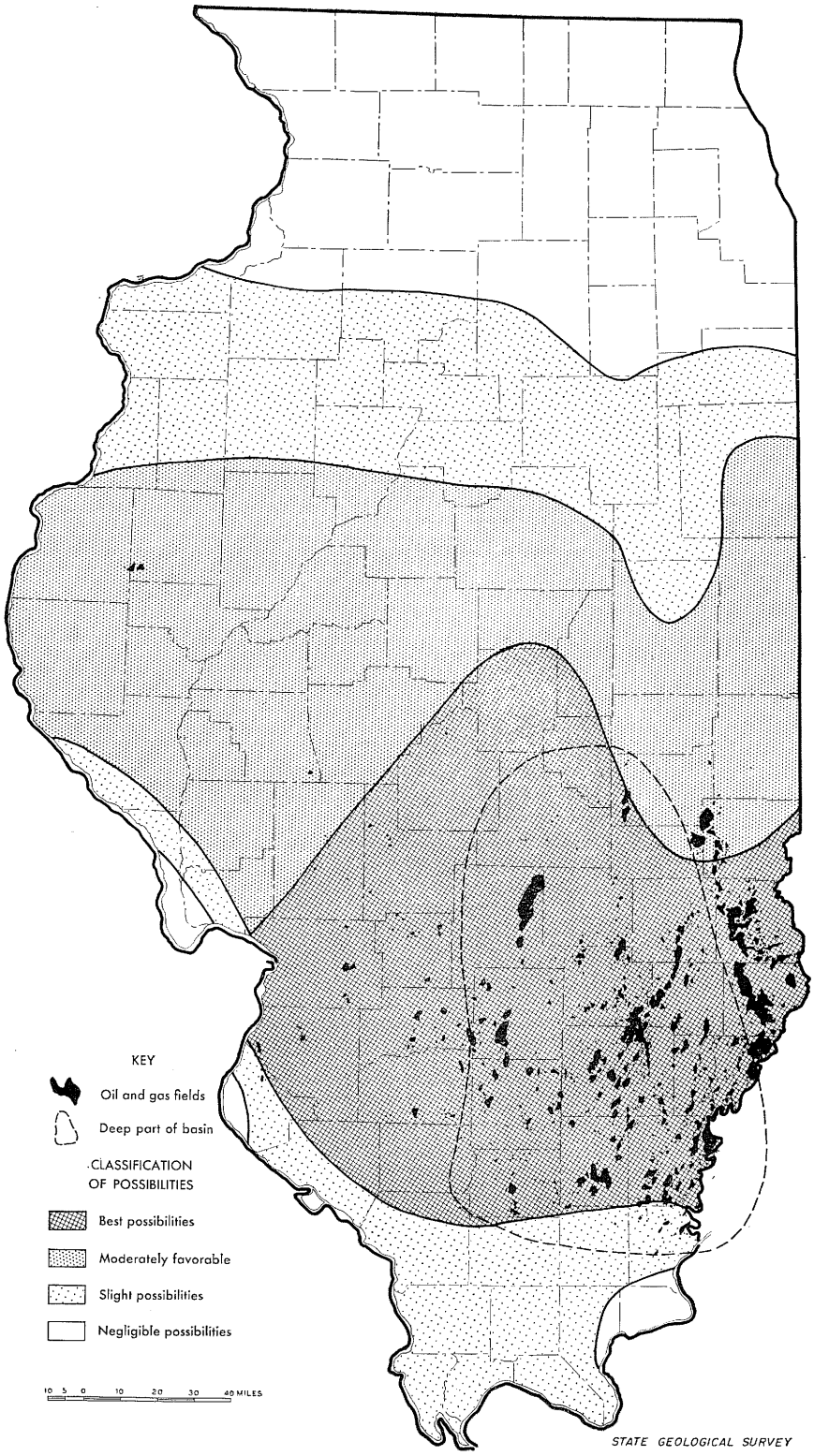



Fig. 44. Map classifying oil and gas possibilities in Illinois and showing producing areas as of January 1, 1947. (Classification of areas was made in 1930 by A. H. Bell, State Geological Survey.)

3. That the information gained be made available to all interested persons.
4. That oil operators give complete consideration at the earliest favorable time to exploring the oil and gas possibilities of the deeper geological formations.

*1. Library*

A library of well logs and samples is of great importance in resource development of all subsurface minerals. All well logs, drill-cutting samples, diamond-drill cores and samples of rock outcrops must be indexed and filed, as the books of a library are indexed and filed, and made accessible for study and ready reference. They are the source material for finding underground deposits and conditions affecting recovery. This is especially true beneath the prairies of Illinois where most of the mineral deposits are deeply buried. Much of the information to promote and guide the future industrial development of Illinois will depend upon this library.

*2. Research*

Research is a necessity until the petroleum resources of the State are known. Research will aid new discoveries and will guide secondary recovery methods, such as water-flooding and gas injection, in securing the greatest ultimate recovery of petroleum.

*3. Availability of information*

The importance of the availability of information scarcely needs comment, except to emphasize that competent personnel is required for the preparation of reports and maps and for conducting conferences with interested persons. Adequate funds will also be needed for printing and distribution of maps and reports.

*4. Exploration*

Oil companies maintain exploratory programs in areas throughout the United States selected on the basis of the best possibilities and according to costs. The deeper formations of Illinois which have not yet been explored are worthy of consideration whenever economic conditions will warrant such testing.

## OTHER MINERALS

Southern Illinois possesses a wide variety of resources including fluorspar, high calcium limestone, silica, fuller's earth, ganister, novaculite, and molding sand for the chemical, metallurgical, and processing industries; and stone, ceramic clays and shales, and sand and gravel for construction. A considerable mineral industry is engaged in the production of these resources.

If Southern Illinois were located close to a large industrial city, its mineral resources, by reason of their magnitude and variety, would be a great boon to such a city and the city a great boon to the production of these minerals. The size of the mineral industry would be greatly increased and its character more diversified. This illustrates the important fact that some of the non-fuel resources of Southern Illinois are "place minerals," minerals which are relatively common and whose successful development usually depends on proximity to consuming centers. Further industrial utilization of these "place resources" will therefore go hand in hand with the growing industrial development of Southern Illinois and adjacent areas. Utilization will also be aided by the current systematic program of research revealing the occurrence and character of all potential mineral deposits, their uses, and how their products can be improved and extended. Fluorspar, for example, has many direct uses, but in addition to these a wider market is being established in the chemical industry by research in fluorine chemistry.

The variety of resources in Southern Illinois is of course related to its geology (Figs. 45 and 46). Because of the dissected nature of the Ozark Hills, and because earth movements have displaced and tilted the rocks, gently in some places, more steeply in others, there is a wide variety of rock formations exposed. Figure 45 shows diagrammatically how the tilting of the bedrock strata and the ruggedness of the Ozark Hills are responsible for the outcropping of numerous formations which would not be exposed were they lying in a normal horizontal position. By this same token the readily accessible mineral resources have been increased.

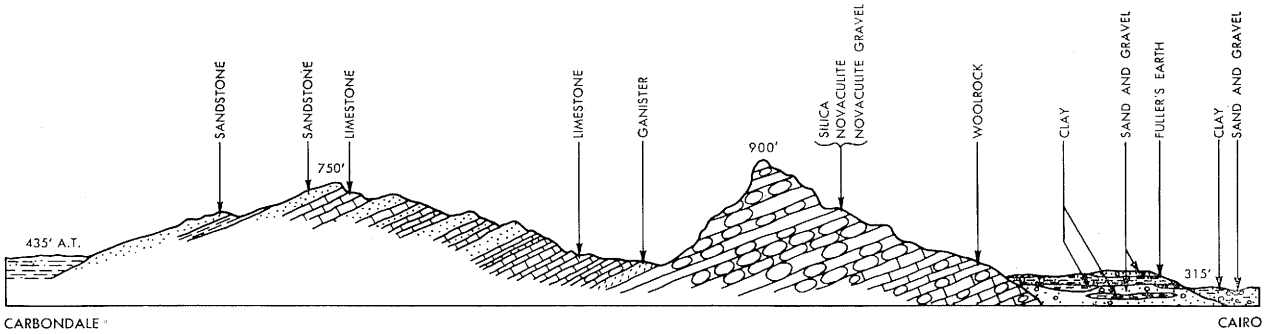



Fig. 45. Cross section of Southern Illinois showing geological formations exposed and their relation to mineral resources. The vertical scale of the drawing is greatly exaggerated. For map of mineral resources, see Fig. 46. (J. E. Lamar, Industrial Minerals Division, State Geological Survey.)

Figure 46 is a map showing the source areas of different mineral deposits. Because of the number of resources occurring together in closely related areas, this map is of necessity generalized. It is intended to show the general distribution and character of resources rather than specific deposits or sites for development.

## CHEMICAL, METALLURGICAL, AND PROCESSING MINERALS

### Fluorspar

Fluorspar is one of the most rare and important minerals of the nation, and Southern Illinois is the nation's largest producer of this resource. The spar occurs in Hardin County and the adjacent part of Pope County, with production centered at Rosiclare and Cave in Rock. In 1946 the fluorspar output had a value of $6,853,440 (Table 25).

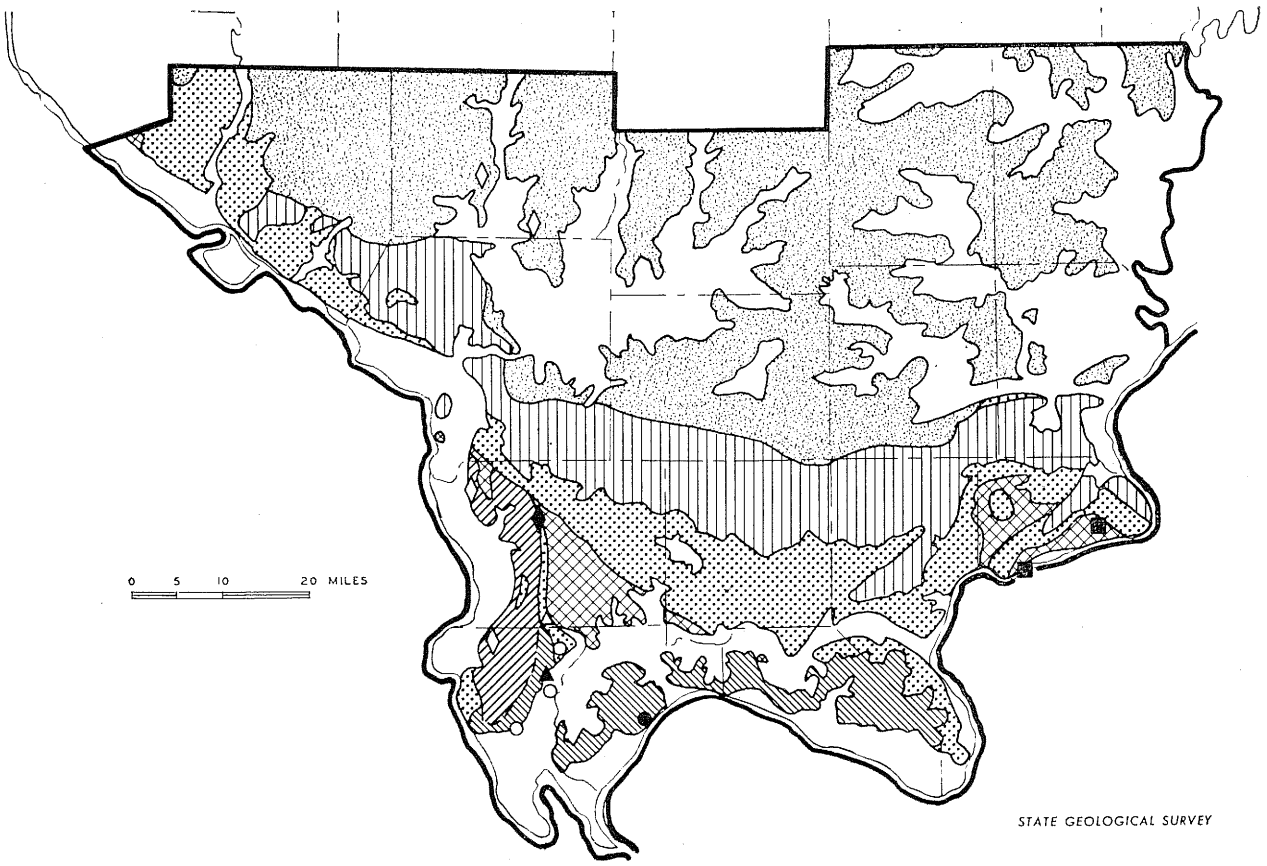
In the vicinity of Rosiclare the fluorspar occurs as vertical or nearly vertical veins, but in the Cave in Rock district it is found in essentially flat-lying deposits. Some fluorspar is directly salable as it comes from the ground, but most of it requires processing to eliminate objectionable materials and to recover valuable metallic ores.

Fluorspar has three principal uses: In metallurgy where its major use is as a flux in steel-making; in chemistry in the making of hydrofluoric acid, from which a great variety of industrially important chemicals is made; and in ceramics where it is used in making glass and enamels.

Figures 47 and 48 show curves of fluorspar production and value for a ten-year period. Illinois shipments amount to nearly one-half of the total United States production. It is of interest that before 1942 the chief product of the Illinois fluorspar industry was metallurgical spar, and the operations of the industry were largely determined by the activity of the steel industry which used the spar. But 1942 saw the beginning of a marked increase in the production of acid spar, to such an extent that in 1944 it outstripped metallurgical fluorspar in amount and value. Since 1944, production of these two grades of spar has been about the same (Fig. 47). This situation offers a better future for fluorspar production during periods when and if slack conditions exist in the steel industry.

The fluorspar district has the advantage of geological maps and reports prepared from field studies. During World War II, Survey geologists conducted extensive geological studies to aid in the search for new ore deposits. They are also investigating the processes and conditions which controlled the deposition of the fluorspar. Such information will assist further in the discovery of hidden deposits.

During 1942-43 the Office of Scientific Research and Development of the United States Government contributed funds to extend the Survey's research on the preparation and determination of physical and chemical properties of organic fluorine compounds, and since September, 1946, the Office of Naval Research has cooperated.




■ FLUORSPAR, ZINC, and LEAD. Principal producing centers. Deposits occur throughout much of Hardin and in eastern Pope counties.

1 Areas wherein occur deposits of:
LIMESTONE, thick, many of them of high purity. Crushed and pulverized stone, chemical stone, building stone, in places marble.

2 Areas wherein occur deposits of:
LIMESTONE, thin to moderately thick, impure to moderately pure. Crushed stone, pulverized stone, building stone, and locally marble and woolrock.
SHALE. Possibly suited for structural clay products, especially in the area west of Jonesboro and Mill Creek.
SANDSTONE, thick to thin. Building stone.

3 Areas wherein occur deposits of:
LIMESTONE, usually less than 15 feet thick, impure to moderately pure, scattered deposits. Crushed stone, in places pulverized stone, possibly building stone in some places.
SHALE. Structural clay products.
SANDSTONE, thin to moderately thick in scattered deposits. Possibly building stone in some places.

6 Areas wherein occur deposits of:
CLAYS. Structural clay products, stoneware, terra cotta, refractory wares and sanitary ware. (The southern half of the area of pattern 2 in western Alexander Co. also contains similar clays.)
BROWN CHERT GRAVEL and SAND. Road material, concrete aggregate; in places molding sand.

4 Areas wherein occur deposits of:
CHERTY LIMESTONE and CHERT. Roadstone and in places woolrock. (Also underlie area of pattern 6 in Alexander Co.)
SILICA, GANISTER, and NOVACULITE. Best-known deposits are near producing centers. (Also underlie area of pattern 6 in Alexander Co.)

○ SILICA. Producing centers obtaining their raw materials from deposits in the general vicinity. Abrasive, filler, and other uses.

△ GANISTER. Refractory products.

▲ NOVACULITE. Refractory products, chemicals.

▲ NOVACULITE GRAVEL. Other deposits occur in the uplands of Alexander and western Union counties. Road material, refractory products.

◊ WOOLROCK. Other deposits occur in the vicinity of the sites shown.

5 Areas wherein occur deposits of:
SHALE. Structural clay products.
SANDSTONE, thick. Building stone.

● FULLER'S EARTH.

♦ KAOLIN.

7 Areas wherein occur deposits of:
ALLUVIAL CLAY, silty. Suitable for structural clay products in some places.
SURFACE CLAYS, scattered deposits over all areas; common structural clay products.
SAND, deposits are known or may occur at scattered places.
SAND AND GRAVEL or SAND occur in places in the channels of Mississippi, Ohio, and Wabash rivers.

Fig. 46. Generalized map of Southern Illinois non-fuel mineral resources.
(J. E. Lamar, Industrial Minerals Division, State Geological Survey.)

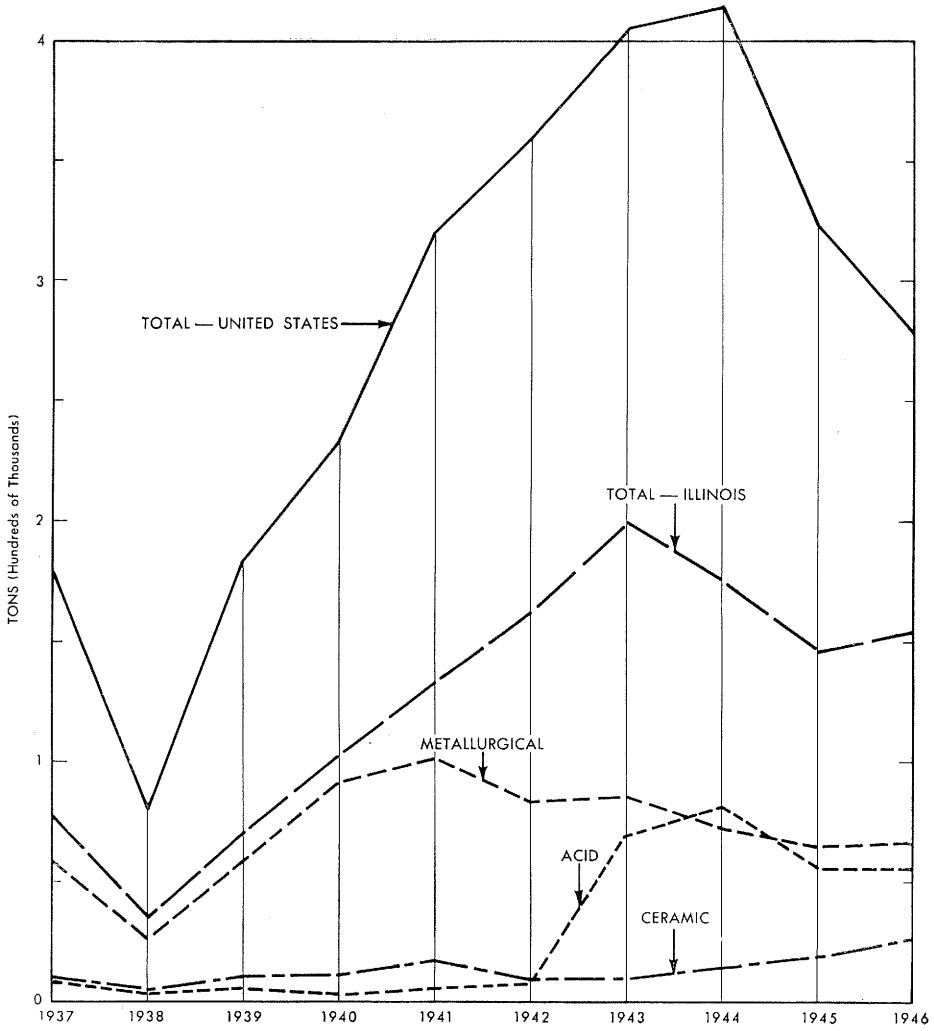



Fig. 47. Amount of fluorspar shipped by mines in the United States and Illinois. The Illinois total is broken down into three major industrial uses. (*Minerals Yearbooks,* United States Bureau of Mines.)

### Silica

Silica, also known as tripoli and variously described as "soft," "amorphous," or "microcrystalline," occurs locally in the uplands of Alexander County and the west half of Union County (Fig. 49). The silica is mined underground from nearly flat-lying beds up to about 25 feet thick. Only the whitest silica is mined. Preparation for use involves pulverizing to a flour and sizing to different size grades. Uses include mineral filler, fine abrasive, glass polishing, concrete admix, and other purposes.

Processing plants are located at Elco, Tamms, and Olive Branch and obtain their raw material from near by. In 1946, the silica produced in Southern Illinois had a value of $321,600 (Table 25).

### Fuller's Earth

Fuller's earth is a variety of clay which has the property of decolorizing oil. It is being mined by open-pit at Olmsted by a single company. In addition to sale for decolorizing oils, the product is used in insecticides, as an oil absorbent, in foundries, and for other purposes. In 1946 $296,637 worth was produced. Fuller's earth is restricted to the Porters Creek formation of Pulaski County and is shown in Fig. 46.

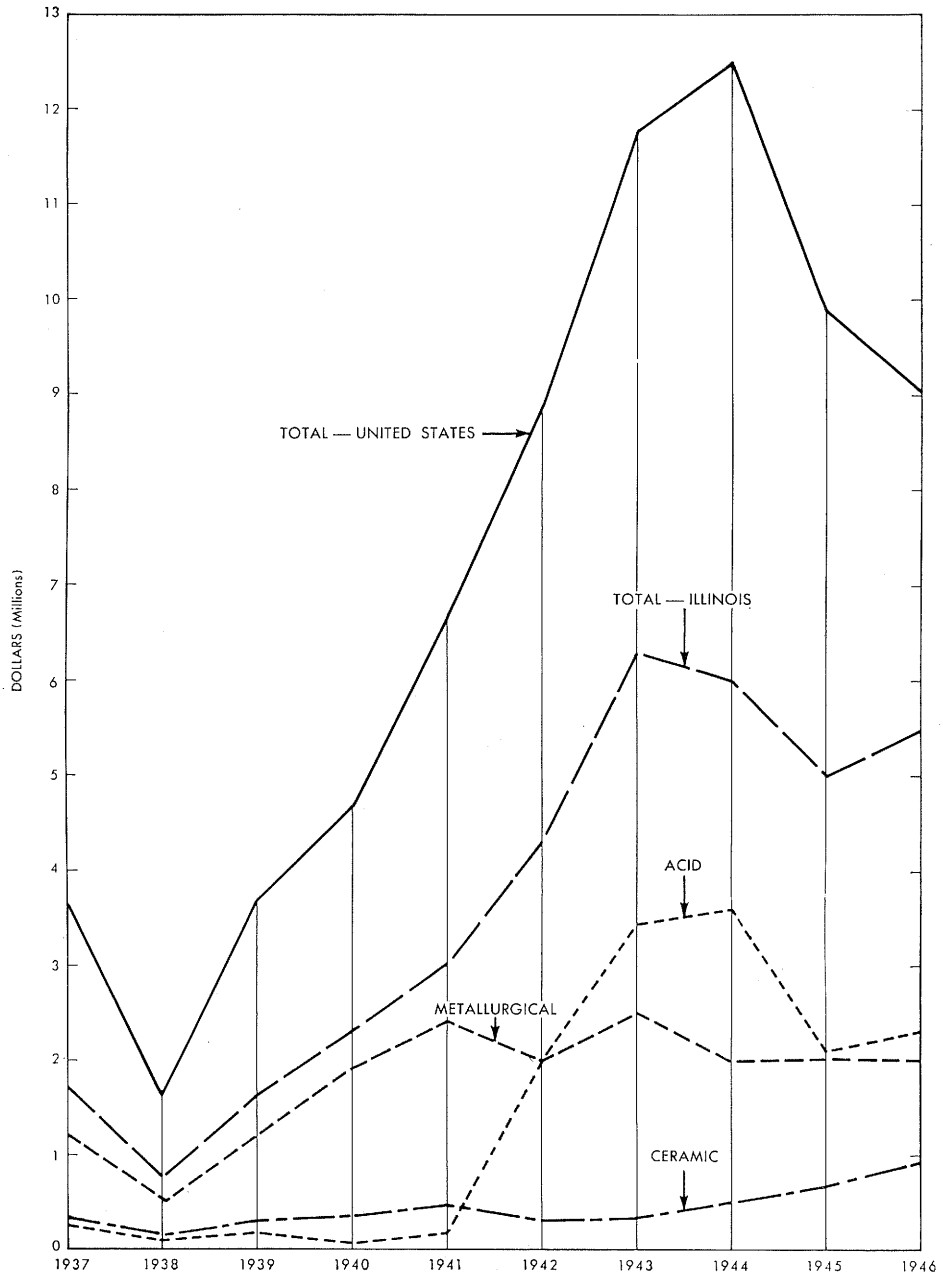



Fig. 48. Value of fluorspar shipped by mines in the United States and Illinois. The Illinois total is broken down into three major industrial uses. (*Minerals Yearbooks,* United States Bureau of Mines.)

Another source of bleaching clays for certain purposes is the kaolin deposits lying northwest of Anna (Fig. 46). These clays, if suitably processed, also have possibilities for the decolorizing of oils.

**High-Calcium Limestone**

Southern Illinois contains a number of high-calcium limestone deposits within the area of pattern 1 (Fig. 46), some of which are being used

commercially. Other deposits are available, many of which will involve selective quarrying or underground mining. The area of pattern 2 contains high-calcium limestone only in western Alexander County.

The term high-calcium limestone is variously used; here it is employed to describe limestones containing more than 97 per cent calcium carbonate. Usually specifications regarding minor constituents, such as silica, magnesium carbonate, or iron oxide, importantly affect the acceptability of stone for specific uses. High-calcium limestones are employed for making lime, for metallurgical flux, in the glass industry, in mineral feeds for stock, for poultry grit, and in various chemical industries. If limestone yields a powder of high whiteness, the powder may find use for a multiplicity of purposes as an ingredient of or filler for manufactured products.

### Ganister

Ganister, a material comprised of silica ($SiO_2$) and having a texture resembling cornmeal, is produced in the general vicinity of Mill Creek, Union County, and in Elco, Alexander County. It is used in the manufacture of refractory products.

### Novaculite

Novaculite, a blocky chert of high chemical purity, has been produced near Tamms in Alexander County and sold for chemical purposes. This material and the novaculite gravel with which it is often associated are suitable for making silica brick. It is a potential substitute for crushed

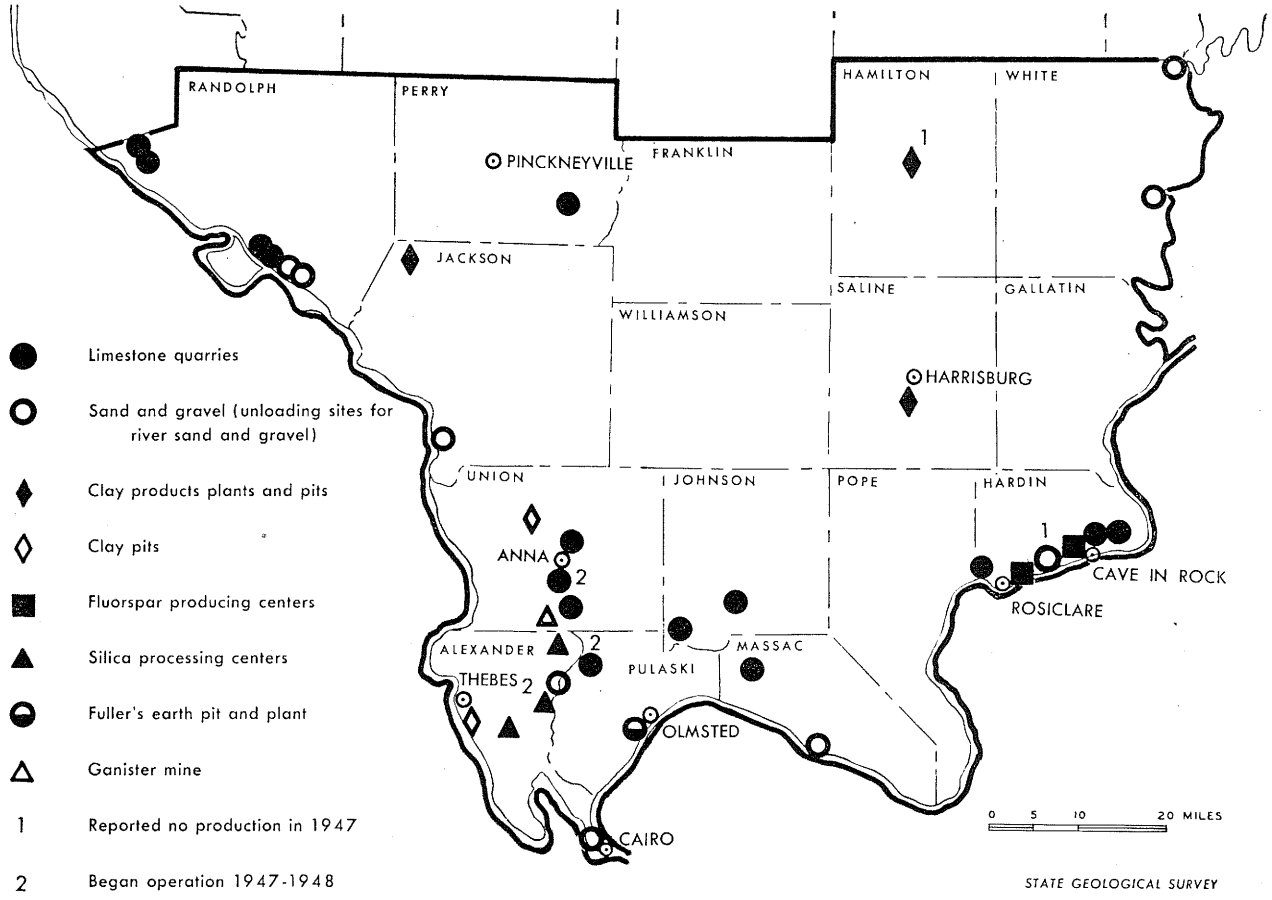



Fig. 49. Mineral industries of Southern Illinois exclusive of coal and petroleum. (Industrial Minerals Division, State Geological Survey.)

quartzite, a material which is shipped into the State.

### Molding Sand

Natural-bonded molding sands, used for iron molding, are not produced in Southern Illinois, but potential deposits occur at many places, especially in the area of pattern 6 (Fig. 46). All the sands of this area contain some clay bond but many will require additional bonding material. The sands are non-calcareous and high in silica, and some deposits can supply fine- or medium-grained sands which, if washed and bound with fire clay or bentonite, might be suitable for casting steel.

Some sands having possibilities as natural-bonded molding sand occur in White, Pope, Gallatin, and Jackson counties. (See Fig. 46, pattern 7.) If adequately processed, some might prove suitable for brass, aluminum, and magnesium castings.

### Feldspar Bearing Sands

Feldspar is a mineral widely used in making glass, enamels, and other ceramic products. The fact that certain sands occurring in Southern Illinois and elsewhere in the State contain a considerable amount of feldspar was brought to light by Geological Survey research and is significant in that Illinois imports its feldspar from distant states. Separation of the feldspar from the sands is believed to be technically feasible.

Sands from the banks and bars of the Mississippi River have the highest feldspar content, about 25 per cent. Wind-laid sand deposits in or adjacent to the flats of the Mississippi River should have similar feldspar content. Ohio and Wabash river sands contain between 10 and 20 per cent feldspar. The sands of the areas of pattern 6 (Fig. 46) are generally low in feldspar.

## CONSTRUCTION AND OTHER PURPOSES

### Stone

Limestone. The limestone industry of Southern Illinois produces a variety of stone products including concrete aggregate, road material, railroad ballast, agricultural limestone, riprap, filler, and high-calcium limestone for physical and chemical uses. The locations of quarries are shown in Fig. 49. In 1946 the limestone produced had a value of $1,259,377 (Table 25).

The geographic distribution of limestone resources is shown in Fig. 46. In general, the deposits in the areas indicated by pattern 1 are without bedrock overburden and therefore more favorable for open-pit quarrying than those in the area of pattern 2 where many deposits have bedrock cover. The latter may be worked by underground mining. No dolomite deposits are known in Southern Illinois but relatively thin deposits of dolomitic limestone are present in some places.

Sandstone. Enormous resources of sandstone occur in Southern Illinois, especially in the areas of pattern 5 (Fig. 46) and to a lesser but important extent in the areas of pattern 2. The sandstone varies from highly impure to relatively pure. The full use of this resource awaits the future industrial development of Southern Illinois. In the past important amounts of flagstone, curbing, riprap, and building stone have been produced from these deposits.

Building Stone and Marble. The sandstones of Southern Illinois occur in a variety of textures and attractive colors and are capable of providing large quantities of building stone. A beginning has been made in recent years in the use of these resources in the erection of homes, filling stations, and other structures. These resources merit further development. In the construction of motels and other facilities to serve the tourist trade, the use of these sandstones offers attractive building possibilities.

A great diversity of limestones also is found which exhibit many different textures and shades of white, cream, and gray. These resources also justify much greater use.

Limestones which take a polish, have attractive colors and textures, and are used commercially for interior decoration are often called marbles. Suitable Southern Illinois limestones include almost black, spotted gray and buff, and variegated cream and white stones. In general the stone is suitable for paneling in corridors, foyers, and some of it for floor tile. The State Geological Survey has polished specimens available for inspection.

Lime. In the early days of Southern Illinois, lime was made locally from convenient limestone deposits but this practice has long since been discontinued. The production of lime from limestones of high purity is presently favored because of the

greater variety of uses for such limes in the chemical and building industries. Limestones of high purity believed to be suitable for lime-making occur in the areas of pattern 1 (Fig. 46).

Sand and Gravel. Southern Illinois has five principal sources of sand and gravel for construction purposes including road gravel, concrete aggregate, mortar sand, plastering sand, and the like. These sources are the sand bars in the Mississippi, Ohio, and Wabash rivers, brown chert gravel found commonly throughout the areas of pattern 6, novaculite gravel, Elco gravel, and creek gravel. The river gravel and sand is produced by dredging and is the most common commercial source of these products in Southern Illinois. Figure 49 shows the unloading points of dredging operations. Sand is the principal product obtained from the Mississippi River; sand and gravel composed mainly of brown chert pebbles is obtained from the Ohio River; and sand and gravel made up of limestone and igneous rock pebbles is obtained from the Wabash River. The value of the production in 1946 was $319,004 (Table 25).

The brown chert gravel in the area of pattern 6, Fig. 46, occurs in deposits up to about 40 feet thick, and most of it contains a relatively small amount of red or yellow clay. The gravel has been dug at many places from roadside pits and has been used for road surfacing.

Novaculite gravel, composed of angular light-colored chert fragments and red or brown clay and silica in lesser amounts, also occurs in deposits up to about 150 feet thick. It is produced commercially for road material from an extensive deposit near Tamms in Alexander County and has been worked at a number of other places. This gravel also has possibilities for the making of silica refractories. The area of patterns 2, 4, and 6, Fig. 46, in Alexander County contain novaculite gravel or deposits of similar character.

Elco gravel is a light-colored chert gravel found in the vicinity of Elco. The pebbles are angular to rounded. It is used chiefly as road material.

Agricultural Limestone. Agricultural limestone is used principally for correcting soil acidity and is of great importance to Southern Illinois. It is prepared by crushing limestone to such a size that most of it passes an 8-mesh sieve. The higher the purity of the limestone the better. All of the quarries shown in Fig. 49 produce agricultural limestone.

The areas of pattern 1, Fig. 46, afford numerous additional quarry sites; in general, the deposits are thick and without bedrock overburden. In the areas of pattern 2, Fig. 46, workable deposits are present but are likely to be less pure than the better deposits in the area of pattern 1 and in many cases have bedrock overburden. Scattered thin limestone deposits occur in the areas of pattern 3, Fig. 46, and include especially the caprock limestones of coals. Some of the latter have a satisfactory neutralizing value but more testing of the caprock limestones of coal is required.

Woolrock. Slag is the most commonly used raw material for the making of rock wool, but in those areas remote from such sources, impure limestones called "woolrock" can be similarly used. The caprock of No. 6 coal where it is 15 feet or more thick, as in some places in the vicinity of Pinckneyville, and the cherty impure limestone in the Mississippi River bluffs near Aldridge, Reynoldsville, and McClure, have or approach the proper chemical composition for making rock wool. Other deposits doubtless occur in the vicinity of those mentioned and at places in the area of pattern 2, Fig. 46. The areas of pattern 1 may contain woolrock but are generally less favorable than those of pattern 2, Fig. 46. Sites affording opportunity for obtaining limestone and sandstone or shale for combination to yield mixtures of suitable chemical composition for rock wool are likewise present, especially in the areas of pattern 2, Fig. 46. Future industrialization may well involve the use of these resources.

## CLAY AND SHALE

Industries dependent on the clay and shale resources of Southern Illinois (Fig. 49) include plants manufacturing structural clay products at Harrisburg and Campbell Hill, a plant producing fuller's earth at Olmsted, and clay producing operations near Thebes and Anna. Clay has also been produced as a coproduct with silica from a deposit near Olive Branch. In 1946, the value of the output was $204,615 (Table 25).

In addition to the structural clay products plants mentioned, there were other operations in 1930 at Murphysboro, McLeansboro, Enfield, and Carmi.

There formerly were two fuller's earth plants at Olmsted. During World War I the kaolin of the Anna district was produced in large quantities. Before the war clays for pottery and other uses were produced in the area of pattern 6, especially in the vicinity of Round Knob in Massac County and Raum in Pope County.

The clay resources of Southern Illinois are extensive and varied. They may be divided into three general categories — red-burning clay, light-burning clay, and plastic refractory clay.

#### Red-burning Clay and Shale

Red-burning clay and shale find their major use in the manufacture of structural clay products such as common and face brick, drain tile, structural tile and blocks, fireproofing, and similar products.

The uplands of Southern Illinois are mantled by brown clayey silt, which varies from non-calcareous to calcareous and from a few feet to about 40 feet in thickness, the thickest deposits being along the major river valleys. The upper five-to-ten feet especially can be used for making common structural clay products such as brick and drain tile. North of the Ozark Hills the material just mentioned is commonly underlain in the upland tracts by a pebbly, glacial clay. The upper portion which contains no limestone pebbles can also be used.

The silty non-calcareous clay in the valley-flat areas at Ullin (pattern 7, Fig. 46), was at one time used for structural clay products.

Bedrock clays and shales are often preferred to surface clays because they can usually be used for manufacturing a greater variety of structural clay products. Such shales in thick deposits are exposed in places in the area of pattern 3 and to a lesser extent in the area of pattern 5. At some points they are relatively shallow in the area of pattern 7 in the northern half of Southern Illinois and have been exposed by coal stripping and other excavations. In the area of pattern 2, deposits are likewise present but many of them are calcareous.

The bedrock clays of the area in pattern 3 usually lie below coals and are sometimes referred to as "fire clays," implying that they are refractory. This is generally not true. Some of the clays may be useful for making structural clay products.

Within the area of pattern 6 some deposits of Cretaceous-Tertiary clays which burn red are known. They usually have a moderate to heavy overburden. The Porters Creek clay formation, which is the source of fuller's earth at Olmsted, ranges up to 100 feet in thickness. By suitable processing it can probably be used for making common structural clay products. The clay is naturally lightweight and this characteristic may make possible the production of lightweight, burned-clay products from the clay.

#### Light-burning Clay and Shale

Light-burning clays are those which when fired yield light-colored products in shades of buff, cream, tan, gray, or white. Many of them can be used commercially for making a wide variety of structural clay products, and some are also suitable for the making of terra cotta, stoneware, pottery, sanitary ware, and similar products.

In the area of pattern 5, there occur in a few places bedrock clays which burn buff. The known deposits have a bedrock overburden and must be mined.

Throughout the area of pattern 6 deposits of light-burning clays occur at many places and with a maximum thickness of about 20 feet. Outcrops are generally limited to stream valleys and bluffs, where the deposits are commonly disturbed by slumping. Overburden, consisting of sand and gravel plus surface clays, is commonly heavy. It is believed, however, that prospecting of selected portions of the upland flats may reveal the presence of essentially flat-lying, workable deposits. Lesser amounts of the clays are available from natural outcrops, but the overburden prohibits open-pit mining back of the outcrops.

Some of the kaolin of the Anna district in Union County, discussed subsequently, is suited for making sanitary ware, stoneware, terra cotta, and similar products.

#### Plastic Refractory Clay

Clays for making dense-burning refractories such as crucibles and glass pots, or for admixture with other clays for this purpose, are found in the kaolin producing district near Anna. At a few other places within the area of pattern 6, clays of approximately similar character are known.

The clays of the kaolin district occur in deposits in or near stream flats, on the slopes of ridges and

on the ridges. Production has come principally from deposits of the first two types. The deposits range up to about 85 feet in thickness, although 25-35 feet has been the more common thickness worked. The tract wherein the deposits occur near Anna has an area of about four square miles. There is some mixing of varieties of clays within the deposits.

### Clay for Non-Ceramic Use

Potential resources of bonding clays, used to give cohesiveness to molding sand, are the Porters Creek clay, the Anna kaolin, some of the clays in the area of pattern 6, some of the red residual clays of the limestone bedrock in the areas of pattern 1, some of the silty clays of the area in pattern 7, and some deposits of gumbotil in Perry County. Some of the kaolin clays of the Anna district and possibly some clays in the area of pattern 6 may, if processed, be used by the rubber and paper industries for filler.

## METALS

### Lead and Zinc

The present fluorspar producing area of Southern Illinois was an important source of lead for the early settlers who considered the fluorspar a waste product. Later, when uses developed for the spar, the lead ore became less important. For many years the principal production of lead ore came from the vein deposits of the Rosiclare area.

In 1938 newly discovered deposits in the Cave in Rock fluorspar area began to be developed. They were not only rich in fluorspar but also in lead and zinc. These ores are now being mined commercially in considerable amounts. In 1947 the value of the recovered lead and zinc amounted to $1,784,374 (Table 25). Separating the spar, zinc, and lead involves a relatively complex ore dressing procedure which includes froth flotation. A small amount of silver occurs in the lead ore of the fluorspar area and is recovered during the smelting of the ore.

Small deposits of lead ore or zinc ore have been found or reported at a number of places in the Ozark Hills. None of these deposits is known to be of commercial size.

### Iron Ore

Deposits of limonitic iron ore in Hardin County near Elizabethtown have been known since its settlement. In the early days the ore was smelted by two furnaces located at the deposits. The deposits are pockety, small, and of no commercial significance.