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ECONOMIC TRENDS FAVORING THE USE OF ILLINOIS COAL FOR METALLURGICAL COKE

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ABSTRACT

Illinois coal is being used in increasing quantities in the manufacture of metallurgical coke. The expanded use is the result of trends in transportation costs and trends in productivity that are improving the economic and competitive position of Illinois coal. Better coal preparation resulting in a higher quality and more uniform product also is a factor.

Gradual depletion of coking coal reserves in the Appalachian coal fields and accompanying higher costs will further improve the position of Illinois coal in the years to come.

INTRODUCTION

A number of economic trends evident in recent years have been favoring the use of Illinois coal in the production of metallurgical coke. These have resulted in growing consumption of Illinois coal for this purpose and promise to become even more significant in the future.

Traditionally, most of the coal used in the manufacture of metallurgical coke has come from the coal fields of the Appalachian Region of the United States. Certain coals from these fields, particularly in Pennsylvania, eastern Kentucky, and West Virginia have proved especially suitable for manufacture of the high strength coke desired for blast-furnace use. In 1960, these three states still accounted for more than 88 percent of the coal consumed within the U. S. for this purpose. However, it has been proved that Illinois coal can be blended with eastern coals to provide a coke-oven charge that will produce satisfactory metallurgical coke (Jackman, et al., 1956, 1959). Increasing quantities of Illinois coal are being used for this purpose. The growing use of Illinois coal for coke manufacture can be attributed almost entirely to the fact that the use of Illinois coals offers an economic advantage that more than offsets any claims to better oven performance that other coals may make because of natural characteristics.

TRENDS IN COKING COAL CONSUMPTION

Figure 1 shows the trends in the sources of coal received by Illinois coke ovens since 1941. There has been a slight but steady decline in the total coal consumed over this period, amounting to about 20 percent. More significant, however, are the trends in the quantities supplied by the various coal-producing states. During the period shown on the chart, the consumption of West Virginia coking coal has declined to about 50 percent of its earlier level. In the period immediately following World War II, there was a gradual increase in the consumption of eastern Kentucky coking coal, but this too has shown a decline since 1947. Pennsylvania, which in 1944 provided more than a half million tons, now provides only a negligible quantity.

Prior to 1944 Illinois coal used in coke manufacture in Illinois was consumed principally in merchant oven plants producing coke for domestic heating and miscellaneous uses. In 1944 its use for the production of domestic coke ceased, but about 140 thousand tons of Illinois coal were used during that year in the production of metallurgical coke. By 1961 consumption had risen to about 4 times that level. With the recent expansion of coke oven capacity at Granite City, the consumption of Illinois coal for the manufacture of metallurgical coke within the state should approach 900 thousand tons.

Since 1941 there has been a slight upward trend in the consumption of coal for the production of coke in Indiana (fig. 2). Growth in the use of Kentucky coal has closely paralleled that of total consumption. The use of West Virginia coal rose somewhat more sharply than total use, but since 1955 it has trended downward. There has been a mild upward trend in the use of coal from Virginia.

Illinois coal used in Indiana prior to 1944 was consumed principally in the manufacture of domestic coke. For a period of about 5 years immediately following World War II, quantities ranging from about 150,000 to 350,000 tons were used in making blast furnace coke, but this use ended in 1950. From 1950 through 1953 no Illinois coal was reported shipped to Indiana coke ovens, but in 1954 a small quantity, less than 10,000 tons, was shipped. Since that time the use of Illinois coal in Indiana has increased to a present level of 175,000 to 200,000 tons a year.

COAL PREPARATION

One factor that has contributed to the suitability of Illinois coal and made it economically competitive has been the improved cleaning and preparation of the coal for market. Modern preparation has benefited the economic position of Illinois coal in two ways. First, preparation has made possible the cleaning of coals to the standards required for coke-oven use. Second and more recently, it has been shown that impurities can be removed from smaller sizes than earlier thought feasible (Jackman and Helfinstine, 1961). A larger range of sizes, and thus a greater portion of the total coal production, has been made suitable for coke oven use. This, in effect, increases the reserves of coal available for coking purposes within any given area.

In recent years the trend toward the mechanical cleaning of coal has been very pronounced. The need for such cleaning was greatly accentuated by the increased mechanical loading underground and the growth in surface mining. These do not permit the careful loading and sorting that previously could be done with hand-loading methods. The extent to which mechanical cleaning is being used is illustrated by the fact that in 1941 only 40.4 percent of the coal produced in Illinois was mechanically cleaned, whereas in 1960 it had increased to 90.7 percent. Carefully controlled mechanical preparation not only reduces the amount of impurity in the coal but also results in a product that is far more uniform in qualtiy and in size.

TRANSPORTATION

A principal advantage of Illinois coal is its proximity to the Illinois and Indiana steel centers. Figure 3 shows the freight rate on coal to Illinois and Indiana coke ovens and reveals the difference in costs between shipping coal from southern Illinois coal fields to Granite City, Illinois, and shipping coal to the same point from eastern Kentucky and West Virginia coal fields. The 1962 differential is $3.34 per ton in favor of Illinois coal.

A somewhat smaller differential exists in rail shipment of coal to the Chicago area. Here, the difference in rate is $1.52, in favor of the southern Illinois coal. This savings is reduced somewhat if the eastern coal moves to Chicago by way of Toledo and the Great Lakes; in this case the margin in favor of Illinois coal is $0.91 per ton.

Not only is the freight rate from southern Illinois considerably less than that from the eastern high-volatile coal fields, but the margin of savings per ton has shown a significant increase. This is shown by the following:

Year	Consuming area	Rate advantage of southern Illinois coal
1947	Granite City	$2.12 per ton
1962	Granite City	3.34 per ton
1952	Chicago	1.30 per ton
1962	Chicago	1.52 per ton

Figures 4 and 5 show the gradually widening spread of freight rates from southern Illinois and the eastern coal fields.

PRODUCTIVITY TRENDS

Another factor tending to improve the competitive position of Illinois coal is the trend toward greater productivity per worker. Productivity within the entire coal industry is being steadily advanced through improvement in and increased use of mechanical mining equipment.

The coal beds of Illinois are relatively level and quite thick compared to average bed thicknesses in most states. Such conditions are especially suitable for mechanical mining and Illinois underground mines are, on the average, the most productive of the nation.

The relation between coal bed thickness and productivity in underground mines is shown in figure 6. Although there is some variation in productivity for any given bed thickness, productivity tends to increase significantly with increasing thickness for both continuous mining machines and conventional loaders. The average productivity per worker in 6-foot coal, for example, is approximately twice that for men working in coal 42 inches thick.

Table 1 gives the average thickness of coal mined and the tons produced per manshift in underground mines in six coal-producing states in 1960. Not only is the productivity of Illinois mines higher than that of other areas providing coal for Illinois and Indiana coke ovens, but this spread has been steadily increasing (fig. 7). The curves on figure 7 represent the weighted average productivity of underground mines in counties producing coal for Illinois and Indiana coke ovens. The productivity figures in table 1 and figure 7 cover the production of all underground mines—the small and inefficient as well as the large and more modern mines. However, comparison of the most progressive mines also demonstrates the generally higher productivity of Illinois mines. Figures 8 and 9 show the productivity of individual mines and groups of mines. Each dot indicates a single Illinois mine; other symbols represent mines of other states. Horizontal lines show the average for groups of mines operating as single productive units. Only captive mines of steel companies and mines of major independent producers of coking coal are shown.

The influence of better mining conditions and highly efficient mechanization within Illinois mines is apparent. Another Illinois mine, too new to be shown in the 1959 data plotted on the figures, is estimated from figures published in the Annual Coal Report of the Illinois State Department of Mines and Minerals to have had an average of 45.5 tons per man day during 1961.

TABLE 1 —AVERAGE COAL THICKNESS AND TONS PER MAN PER DAY IN UNDERGROUND MINES FOR SELECTED STATES IN 1960

State	Average thickness of coal mined (feet)	Average output per man per day (tons)
Illinois	7.5	17.38
Pennsylvania	5.5	9.04
West Virginia	5.1	11.78
Ohio	4.9	10.95
Kentucky	4.3	10.61
Alabama	4.1	7.80

Source: U. S. Bureau of Mines Information Circular 8118.

COAL RESERVES AND AVAILABILITY

In addition to technological, transportation, and productivity trends that have been favoring Illinois coal, another factor that is only beginning to make itself felt will become more important as time goes by. This factor pertains to the availability of coal reserves.

In past years most of the coal used in the manufacture of metallurgical coke in Illinois and Indiana has come from a number of beds of high-grade coking coal in areas of eastern Kentucky and southern West Virginia. A number of years ago, the United States Bureau of Mines made reserve studies of the major beds of coals suitable for coking that occur within the Appalachian coal fields. Figures 10 through 13, showing the relation of reserves to the rate of production from major coking coals in eastern Kentucky and southern West Virginia, are from a study made at the Illinois State Geological Survey in 1958 (Risser, 1958).

In figure 10, the shaded area beneath the sloping line to the left of 1957 represents the coal mined from major coking coal beds prior to that date. The shaded areas to the right of 1957 represent the estimated remaining reserves as of January 1, 1957. If coal could be mined at a uniform rate, at the 1956 level as illustrated by the rectangular area, until the reserves were exhausted, the low-volatile reserves would last until about the year 2024, and the high- and medium-volatile coals until 2046 (fig. 10). If the output and consumption of coking coal from these beds were to grow as in the past, and production could follow the requirement curve upward until all the coal was gone, the life of the reserves would be reduced to about year 2004 for the low-volatile coal and 2020 for the medium- and high-volatile coals.

It is well known, however, that mineral production cannot follow an ever-increasing pattern until the resource is completely exhausted. Long before it is all extracted, mining becomes more difficult, production levels off and then gradually declines as illustrated in figure 11. This is true whether the reserves of a single mine, a coal field, or an entire nation are involved.

At the point where availability and increasing demand tend to diverge, it will become necessary to make up the deficit from other sources. Because of its proximity to market and its favorable mining conditions, Illinois coal will possess an economic advantage over most other suitable coking coals.

The information upon which any reserve estimate is based is, at best, incomplete and sketchy. In many instances large areas must be excluded from the estimate because of insufficient information. But if it were to be assumed that actual reserves are twice those estimated previously, little difference is shown. Figure 12 shows the result of such an assumption. The impending deficit is not eliminated; it merely is postponed a few years.

A further point of major significance is that long before the present reserves of coking coal are exhausted, diminishing bed thickness and accessibility will make themselves felt. In the free competitive type of economic system, it is only natural that the best, thickest, and most readily accessible coal is mined first. As time goes by, it becomes necessary to turn to thinner, deeper beds that are less accessible and more difficult to mine. Only about half of the coal reserves covered by figure 13 are in beds more than 42 inches thick, but 75 to 80 percent of the production comes from beds exceeding 42 inches. As the thicker coal is worked out, a larger and larger portion of the production will come from the thinner beds, with higher costs resulting. In Illinois more than 80% of the estimated reserve of coking coal is 5 feet or more in thickness, this also will have considerable beneficial effect on the economic position of Illinois coal in the manufacture of metallurgical coke.

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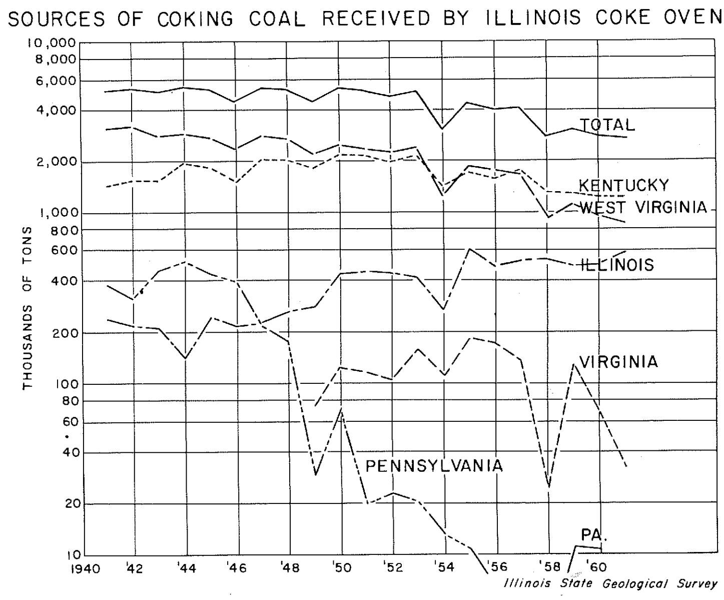

Fig. 1 - Trends in sources of coal consumed in Illinois coke ovens.

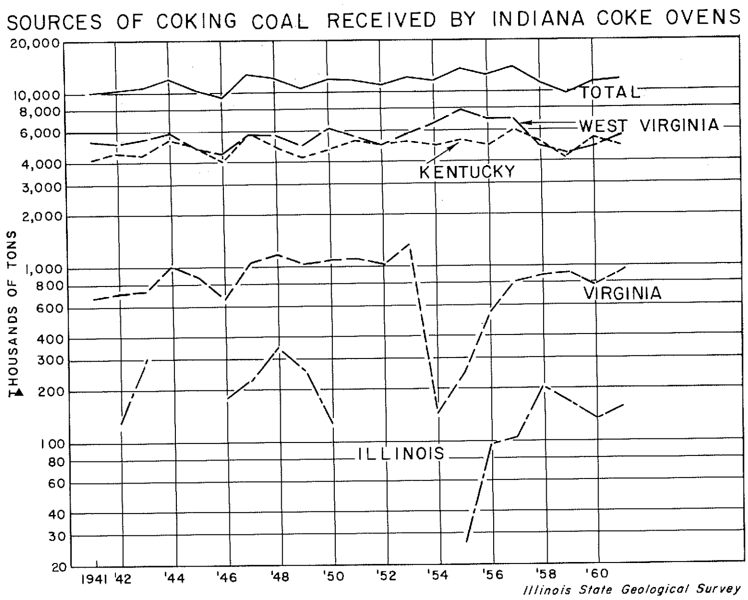

Fig. 2 - Trends in sources of coal consumed in Indiana coke ovens.

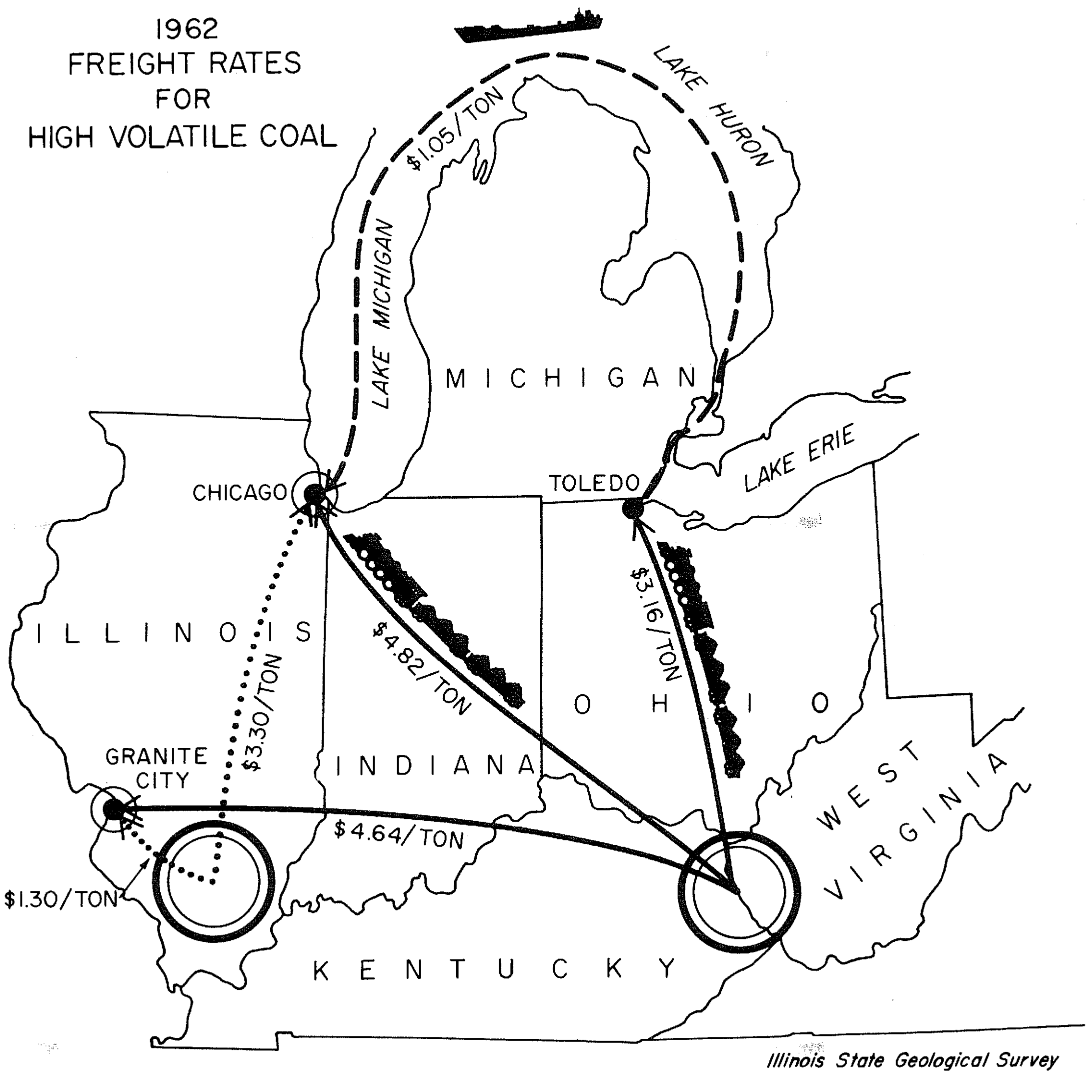

Fig. 3 - Coal freight rates to Granite City and Chicago.

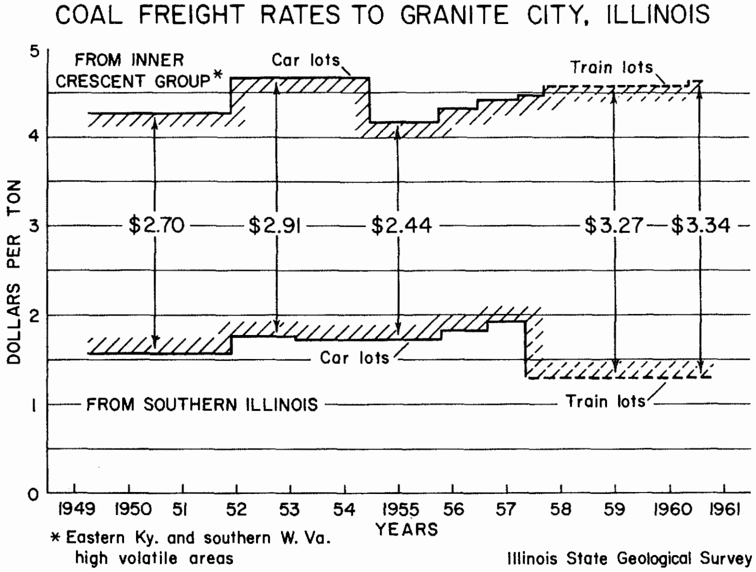

Fig. 4 - Trends in coal freight rates to Granite City.

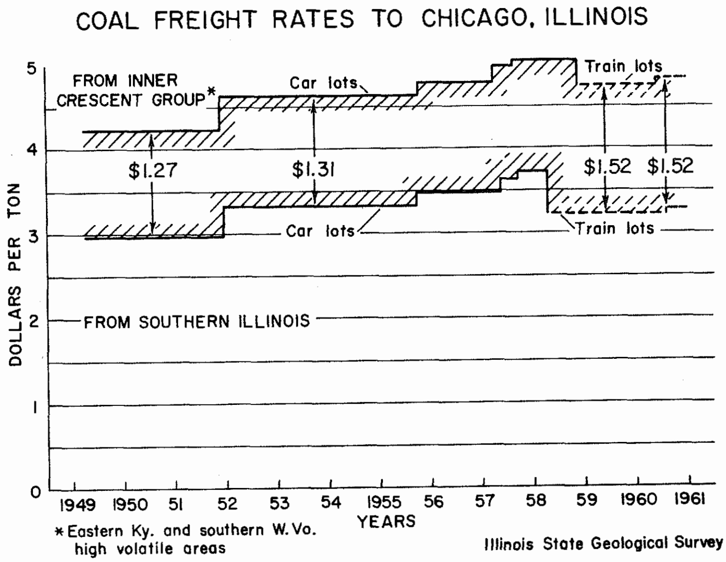

Fig. 5 - Trends in coal freight rates to Chicago.

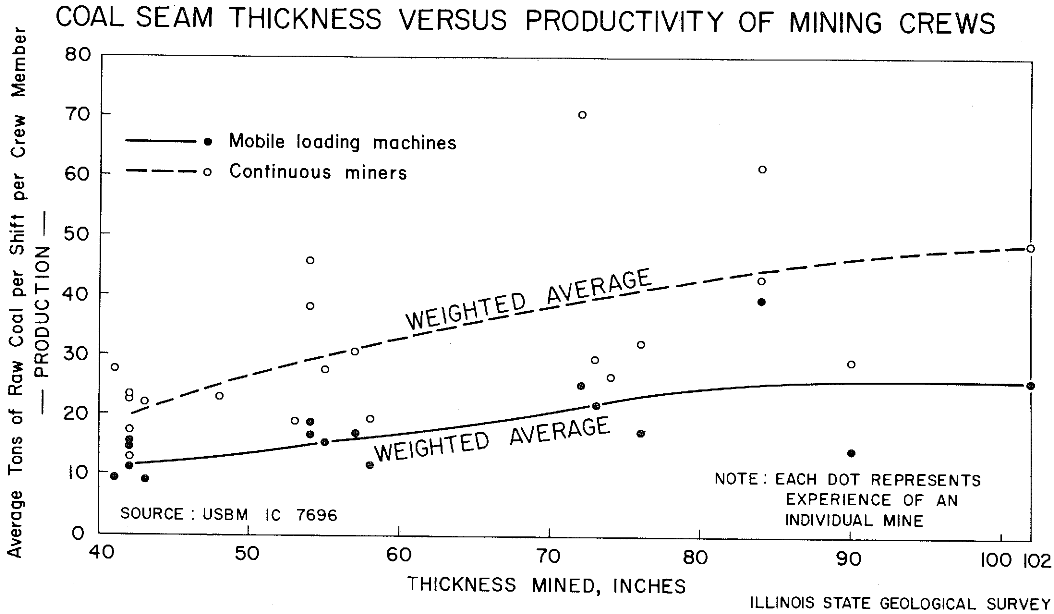

Fig. 6 - Relations of coal bed thickness to productivity of workmen.

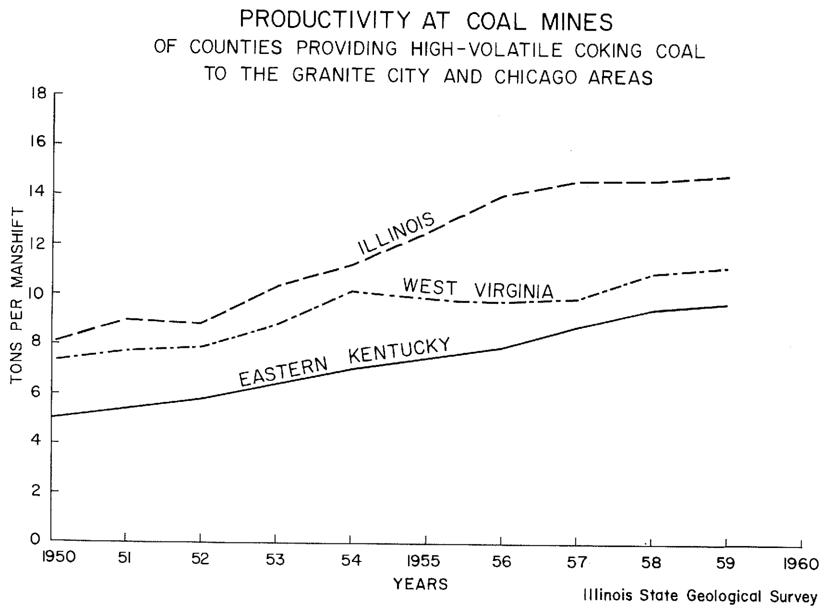

Fig. 7 - Trends in worker productivity in counties producing coking coal.

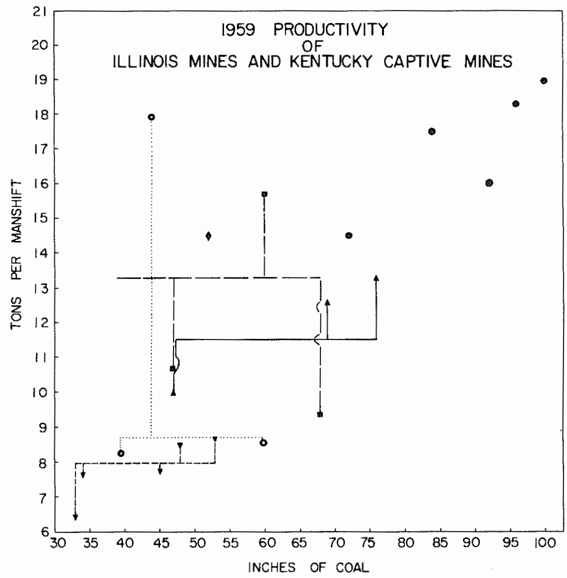

Fig. 8 - Coal bed thickness and productivity in selected mines and groups of mines in Illinois and Kentucky providing coal used in the production of metallurgical coke.

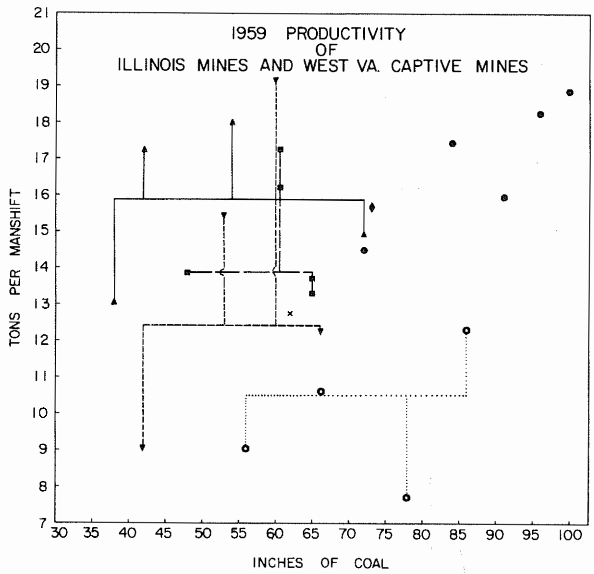

Fig. 9 - Coal bed thickness and productivity in selected mines and groups of mines in Illinois and West Virginia providing coal used in the production of metallurgical coke.

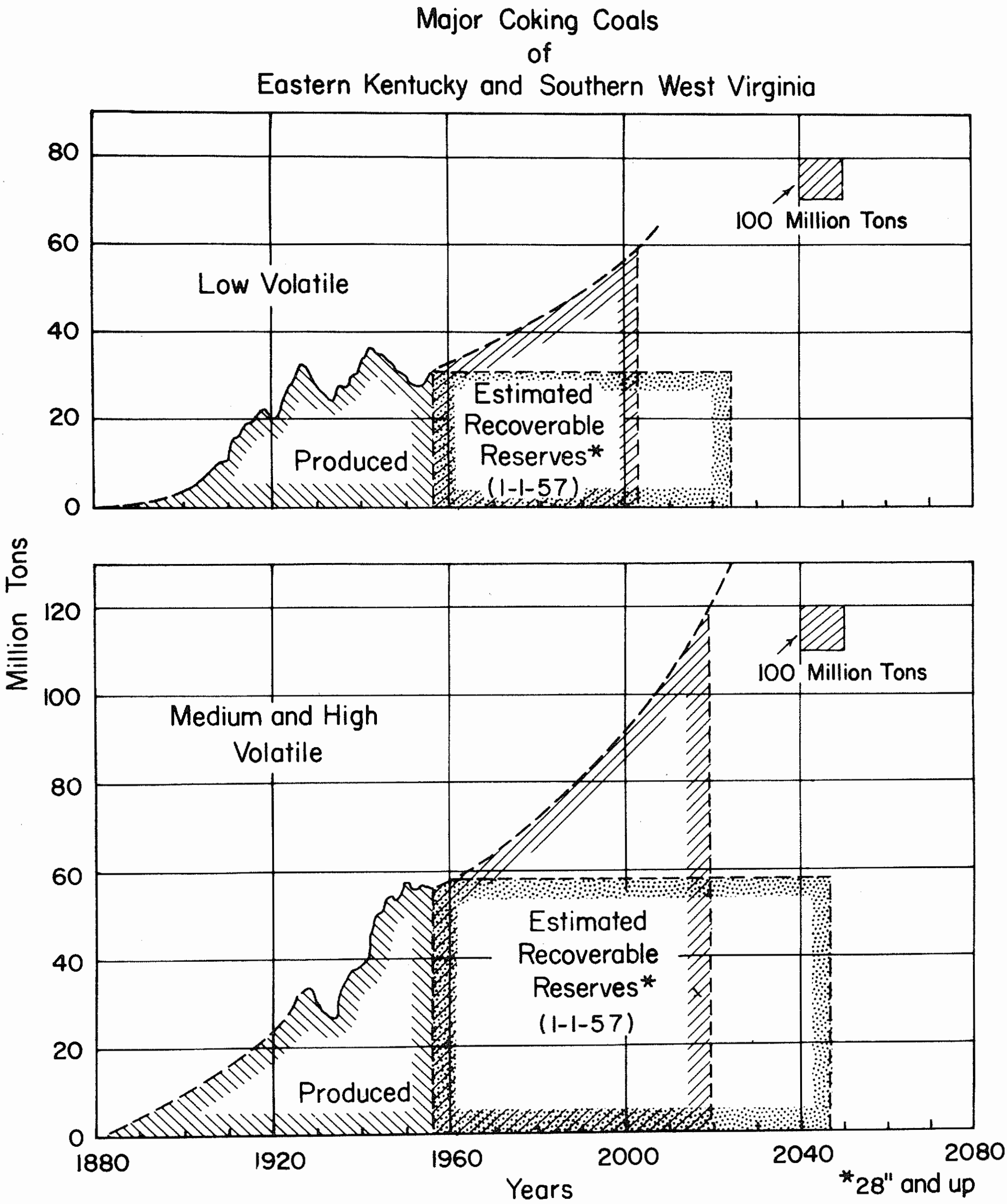

Fig. 10 - Known reserves and production of major coking coals.

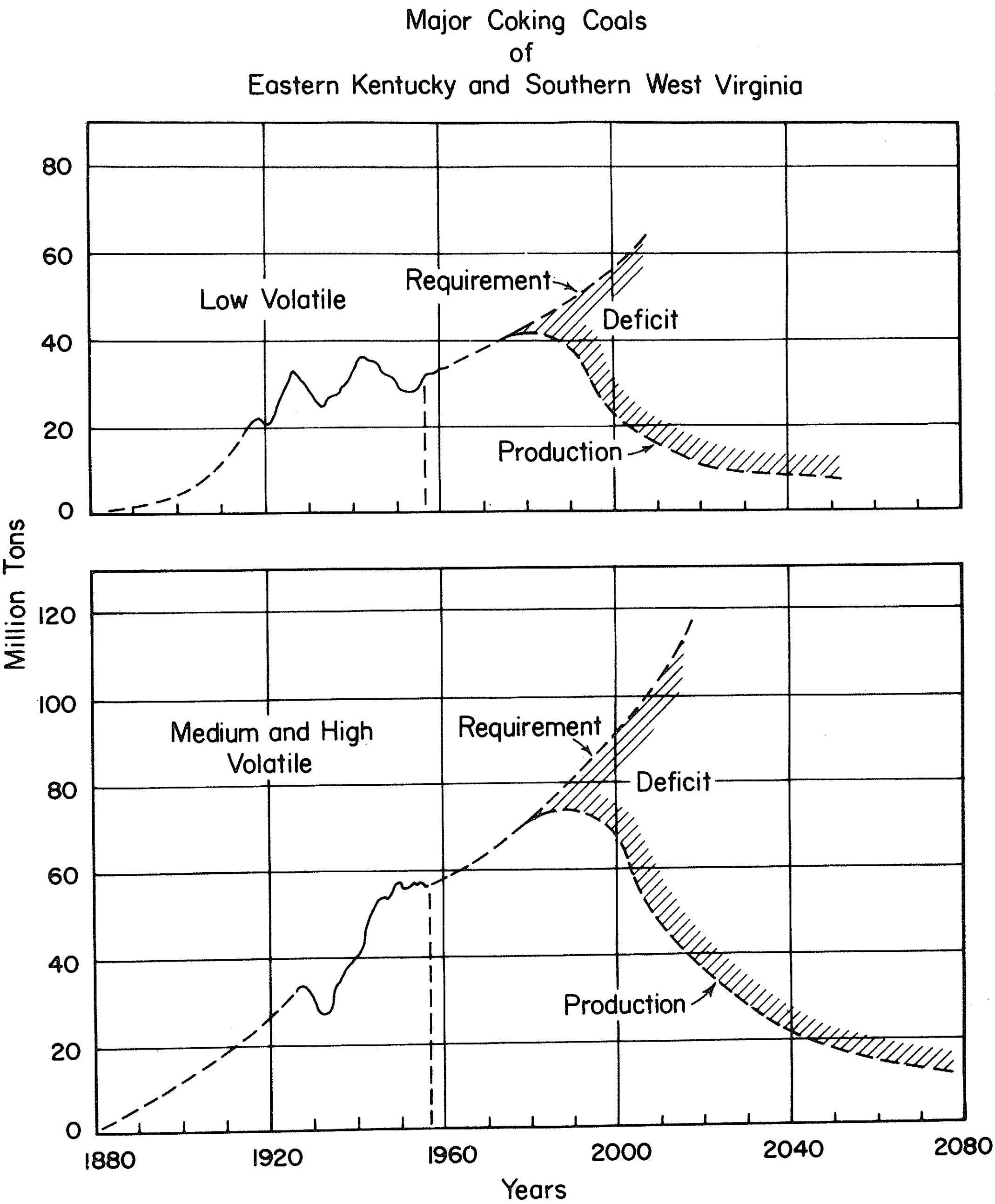

Fig. 11 - Effect of diverging requirement for and availability of coking coal.

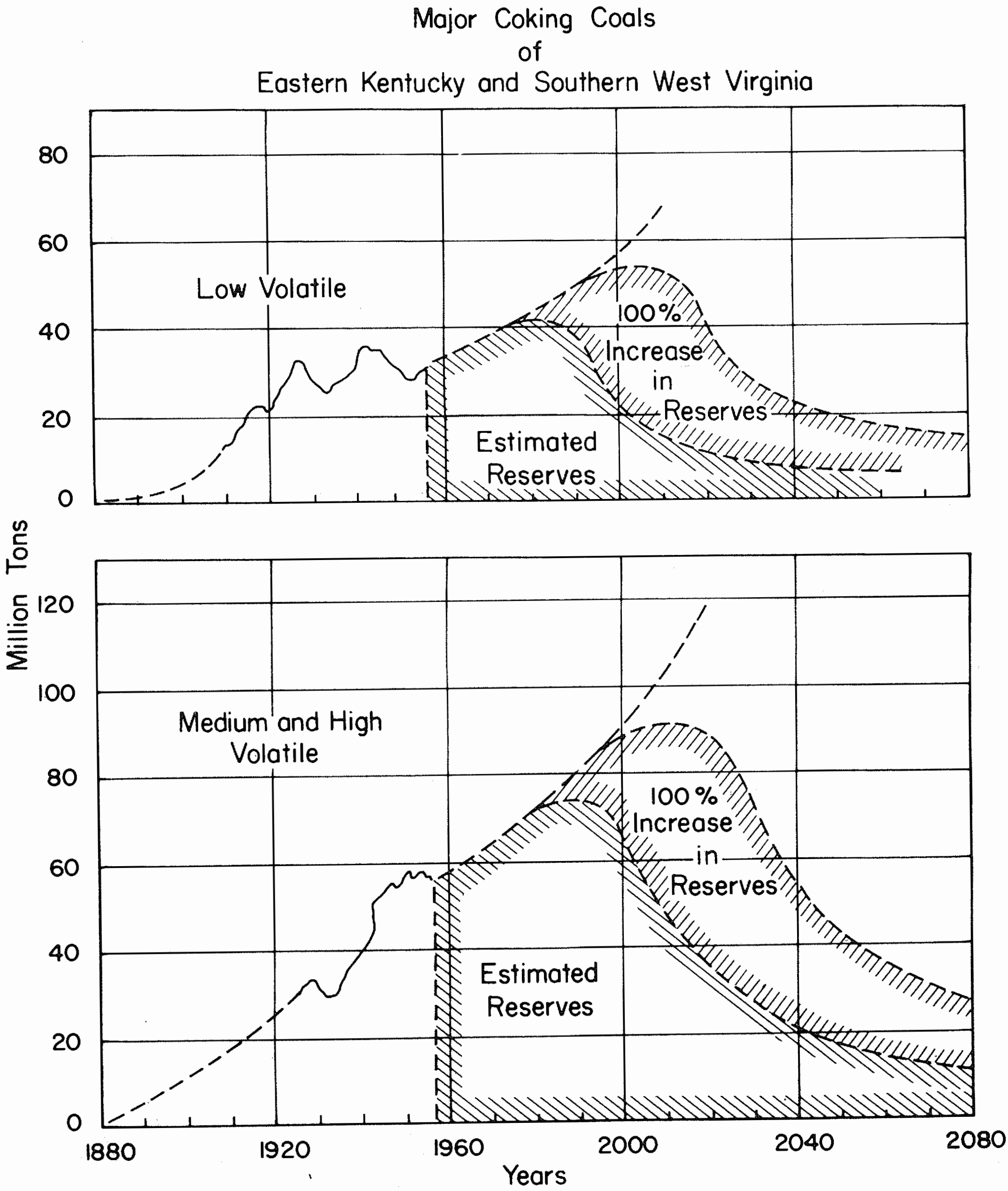

Fig. 12 - Effect of increased reserves upon projected deficit.

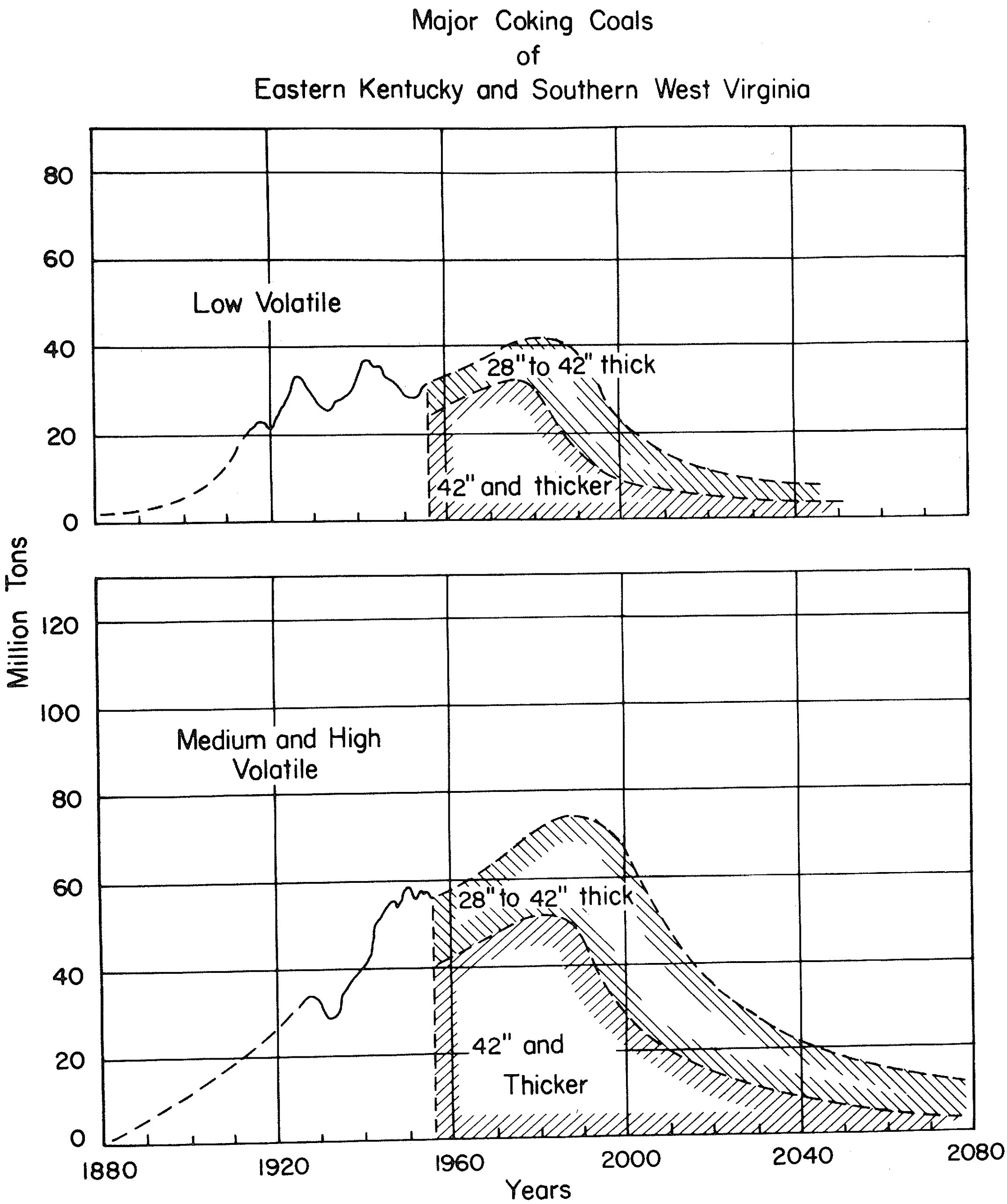

Fig. 13 - Projected production of major coking coals by thickness of beds.

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