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Chapter 9

Pennsylvania Anthracite [1]

ANTHRACITE HAS been mined regularly in Pennsylvania since about 1820. It was one of the earliest branches of mineral production to resort to underground mining, and to face such basic problems as pumping, ventilation and roof support.[2] Yet some of the anthracite beds lie quite near the surface, and these have been worked by stripping within recent decades, thanks to the development of the power shovel. About 11 or 12 percent of total output is now obtained from open pit mines. Not all anthracite currently produced is freshly mined. In an earlier day substantial amounts were wasted through difficulties in washing or breaking. The waste was deposited in heaps called "culm banks," or in streams. As in the case of copper and several other branches of mining, improved technology has made it worth while to recover increasing amounts of material from these waste heaps. In 1939 some 5 percent of the total output of anthracite came from culm banks; nearly 2 percent was river coal, obtained chiefly by dredging.

In some areas, particularly in Southern Pennsylvania, coal lies near the surface. Here, because of the accessibility of the mineral, numerous small workings have been opened in the past two decades without the consent of the owners of the mineral rights. The practice has been facilitated by the use of motor trucks to ship the product to nearby towns. According to the Bureau of Mines such bootleg operations added in 1939 some 3½ to 4 million tons, or perhaps 8 percent, to legal output.[3] The figures given

[1] The production of anthracite coal in this country is not confined entirely to Pennsylvania, but because of the organization of the industry and the character of the available statistics this chapter will be limited to a discussion of anthracite production in that state.

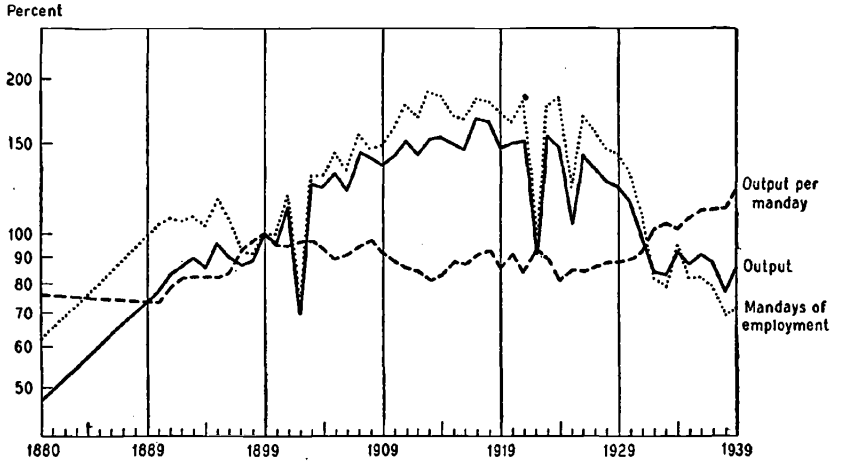
[2] See above, Chapters 5 and 6.

[3] Estimates of the importance of bootlegging are necessarily rough. Apparently in 1939 some 2,500 bootleg holes employed 9,000 men to produce, say, 3¾ million tons, or some 420 tons per man (*Minerals Yearbook, 1940,* p. 849). The 51 million tons produced by the legal industry employed about 93,000 men, and the output was therefore about 550 tons per man. However, only 183 days were worked on the average in the legal mines in 1939. Since days worked per year and hours worked per day are probably greater in the illicit than in the regular mines, the difference in productivity, if measured in terms of mandays or manhours, would probably be considerably larger than is suggested by the figures quoted.

for anthracite in this chapter and elsewhere in the volume relate exclusively to legal production.[4]

The output of anthracite is more homogeneous than that of bituminous coal, although it is marketed in many different forms and a trend toward smaller sizes has been encouraged through the use of automatic stoking equipment. Breaking is carried on near the mine and is an integral part of the industry.[5] Insofar as preparation has become more elaborate, changes in quality may have occurred, but we have no means of taking account of this development in our indexes. Output is measured by a single series on tonnage.

Chart 40
PENNSYLVANIA ANTHRACITE
Output, Employment and Productivity, 1880 – 1939
(1899 : 100)



THE RELATION BETWEEN OUTPUT AND EMPLOYMENT

The various series for the industry are shown in Charts 40 and 41. At the opening of the century output was rising fairly steadily—

[4] Scattered data on the bootleg industry will be found in various annual issues of *Minerals Yearbook*. For further information the reader is referred to the investigation by the Commonwealth of Pennsylvania, *Report of the Anthracite Coal Industry Commission* (Harrisburg, 1938).

[5] See Chapter 7 above.

except for the strike year 1902. After about 1907 a slackening in the rate of growth set in, and production reached a peak during the first World War. Since that time output has tended to decline, with several strikes again interrupting the trend. The demand for anthracite has been reduced by economy in its use and still more by the competition of other fuels. These factors in the situation were treated in Chapter 2 and will not be considered further here.

We saw in Chapter 4 that the rise in output per manday between 1902 and 1939 was smaller for anthracite than for any other mining industry for which we have collected data. From

Chart 41
PENNSYLVANIA ANTHRACITE
Productivity, 1902–39
(1902 : 100)

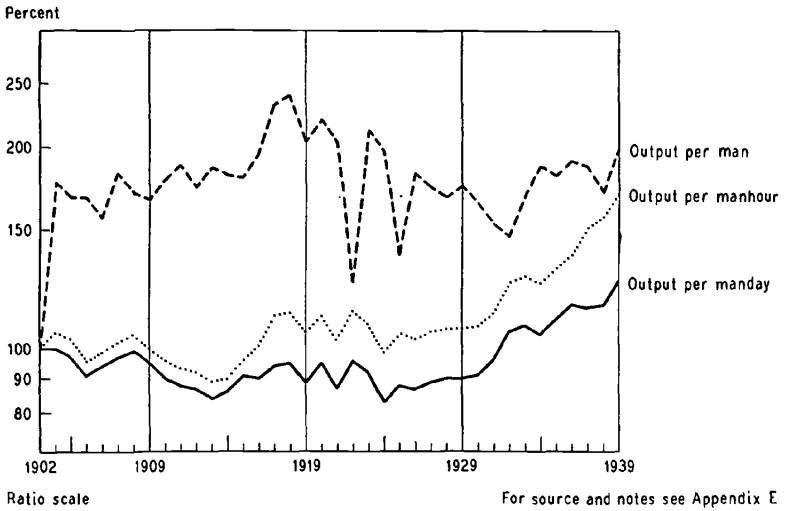


Chart 40 it is clear that for much of our period the trend in productivity was horizontal or even downward, and that any rise that has occurred in output per manday is confined entirely to the most recent decade. Because of curtailment of the work day, output per manhour makes a somewhat more favorable showing (Chart 41). On the other hand, output per man exhibits practically no upward trend at all, for increases in manday or manhour productivity are absorbed by a reduction in the average number of days or hours worked per year. Intermittent operation was respon-

sible for fluctuations in output per man, and these in turn were aggravated by several major labor disputes.

As in other branches of mining, the change—or absence of change—in productivity must be ascribed to technology, to resource conditions, and to reactions between them. Anthracite contrasts sharply with bituminous mining, where, as we have seen, depletion has had slight effect upon productivity. In the anthracite industry adverse resource conditions clearly have played an important role in keeping the rise in output per manday within

TABLE 16

PENNSYLVANIA ANTHRACITE: THICKNESS OF BEDS MINED AND DEPTH OF WORKINGS, 1872–1922

Year	*Average Thickness (inches)*	*Average Depth (feet)*
1872	158	235
1882	130	310
1892	108	360
1902	93	390
1912	84	400
1922	80	415

Source: R. A. Walter and C. E. Lesher, "Capacity for Production of Domestic Anthracite," *Report of the United States Coal Commission* (1925), Part II, p. 661.

moderate proportions. This restraint upon rising productivity appears to have been effected in two more or less distinct ways: directly through the depletion of the most easily worked mineral, and indirectly through increased difficulty of mechanization, designed to overcome the effects of this depletion.

The mining of anthracite is a relatively old industry, as we noted in Chapter 1. For the most part the deposits now being worked were discovered long ago, and mining is carried on in much the same localities. Depletion has not been counteracted as it has in so many other mineral industries, by discovery of newer, richer or more accessible deposits. The results of this situation are illustrated in Table 16. It will be seen that over the half century for which we have data the average width of seam worked declined steadily, and the average depth to which it was necessary to carry the workings increased equally steadily. Both these factors operated to reduce the effectiveness of labor in the industry.

Meanwhile numerous reports indicate that the anthracite industry has been peculiarly difficult to mechanize. We learn, for example, that in 1901 machinery, except for drilling, had not been adopted in the industry (although it was already in use in many bituminous coal mines) because of the pitch or slope of

TABLE 17

PENNSYLVANIA ANTHRACITE: PRODUCTION, BY MINING METHOD, 1927–40[a]

Million short tons

Year	From Mines			From Culm Banks	From River Dredging	Total[b]	Percent of Underground Production Mechanically Loaded
	Underground		Strip Pits				
	Mechanically Loaded	Hand Loaded					
1927	2.2	71.4	2.2	3.3	1.0	80.1	3.0
1928	2.4	67.4	2.4	2.3	.9	75.3	3.4
1929	3.5	66.5	1.9	1.2	.7	73.8	5.0
1930	4.5	60.5	2.5	1.3	.6	69.4	6.9
1931	4.4	49.1	3.8	1.9	.5	59.6	8.2
1932	5.4	38.4	4.0	1.6	.5	49.9	12.4
1933	6.6	34.5	4.9	3.0	.5	49.5	16.0
1934	9.3	39.3	5.8	2.1	.7	57.2	19.1
1935	9.3	34.4	5.2	2.7	.6	52.2	21.2
1936	10.8	33.9	6.2	3.2	.5	54.6	24.2
1937	10.7	31.9	5.7	2.7	.8	51.9	25.1
1938	10.2	28.0	5.1	2.3	.6	46.1	26.6
1939	11.8	30.8	5.5	2.6	.7	51.5	27.7
1940	12.3	29.2	6.4	2.8	.9	51.5	29.7

[a] *Minerals Yearbook.*

[b] Total coal produced, including that used for colliery fuel. In some years there is difficulty in segregating from culm bank coal the coal coming from underground mines. On this account the sum of the items in the breakdown does not always agree exactly with total reported production. The latter is the series we use in constructing output indexes: see Appendix Table A-1.

the beds, which often attained an angle of 60 degrees to the horizontal.[6] In addition, faults and other geological irregularities are encountered. These circumstances probably explain why, even today, less than 5 percent of the output from underground mines is cut by machine.[7] Even mechanical loading is a relatively recent development (Table 17).

These facts—deterioration of resource conditions and inability to mechanize—explain why output per manday was lower at the

[6] *Report of the Industrial Commission,* Vol. XII (1901), pp. 150, 651.

[7] In 1939, 4.4 percent of anthracite from underground mines was cut by machine; the comparable figure for bituminous coal was 87.9 percent.

end of the 1920's than it had been at the opening of the century.[8] There remains the question why, after many decades of stagnation, productivity rose during the 1930's, with the result that manday output was 40 percent higher in 1939 than it had been in 1929.[9]

The most notable change of the past ten or fifteen years is the introduction of mechanical loading. For this purpose the commonest type of equipment used is the conveyor. Even where conveyors must be loaded by hand, they are considered a form of mechanical loading equipment and yield a notable increase in efficiency. There are, moreover, some fully automatic loading devices. Mechanically loaded anthracite accounted for but 3 percent of the product of all underground mines in 1927 (the first year for which we have data) and for as much as 28 percent in 1939 and 30 percent in 1940 (Table 17). While it may have prevented, and may still prevent, other forms of mechanization, irregularity of geological formation has certainly not hindered the introduction of mechanical loading devices into a substantial number of the anthracite mines of Pennsylvania. The question therefore arises, why were such devices not introduced earlier? We have been unable to collect any real evidence on this point. Perhaps peculiar problems of adaptation had to be solved to meet the irregularity of anthracite workings. It is possible, too, that competition of other fuels and the shrinking market for the product provided a spur to modernization that previously had been lacking.[10]

The introduction of mechanical loading into an important

[8] It should be remembered that the length of the work day was about 9½ hours in 1902, 8 hours in 1929 (Table 10 above). Output per manhour increased slightly between the two dates (Chart 41).

[9] Output per manhour rose 59 percent between the two dates, the length of the work day having been reduced during the decade from 8 to 7 hours.

[10] Adverse economic conditions have been cited as the prime reason for mechanization in many British coal mines, as the following quotation shows: "The argument that natural conditions make impossible the employment of machine mining on a large scale is not a new one in the British coal industry. . . . But when in the thinner seams of Scotland it became a question of survival, means were soon found which made the machine practicable. . . . Likewise in the older districts, Durham for example, natural difficulties were quickly overcome under the spur of economic necessity" (Isador Lubin and Helen Everett, *The British Coal Dilemma*, Macmillan, 1927, pp. 149-50). Equally, the profitability of anthracite mining during the 1920's has been cited as a factor that postponed mechanization and reinforced conservatism in industrial practice: see U. S. Coal Commission, *Report*, Part III (1925), p. 1884.

segment of the anthracite industry must certainly have contributed to the sharp rise in productivity in recent years. Several other factors may have been operating as well. One is the installation of larger and more efficient washing and breaking equipment. Another is the increasing relative importance of open cut mining: 2.6 percent of total output came from stripping operations in 1929, 10.7 percent in 1939 (Table 17). Productivity at such operations is higher than at underground mines.[11] Finally, the output of the industry has fallen sharply in recent years (Chart 40). It is likely that production has been concentrated, to some extent at least, in the more efficient mines or workings. Yet, in terms of tons per manday, the level of productivity in anthracite is still much below that which obtains in the bituminous coal industry. The burden which adverse resource conditions have imposed upon the industry can be overcome only through wider use of mechanized loading, or perhaps through the eventual development of a satisfactory method of cutting by machine.

[11] If surface employees are excluded, output per manday in 1939 was 3.3 tons at underground mines; at stripping operations the corresponding figure was 7.4 tons. (*Minerals Yearbook, Review of 1940,* p. 846; "Coal-Mine Accidents in the United States, 1939," U. S. Bureau of Mines, p. 69.)