PENNSYLVANIA MINERALS

A Report

of the

JOINT STATE GOVERNMENT COMMISSION

to the

GENERAL ASSEMBLY

of the

COMMONWEALTH OF PENNSYLVANIA

SESSION OF 1955

The Joint State Government Commission was created by Act of 1937, July 1, P. L. 2460, as amended 1939, June 26, P. L. 1084; 1943, March 8, P. L. 13, as a continuing agency for the development of facts and recommendations on all phases of government for the use of the General Assembly.

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LETTER OF TRANSMITTAL

To the Members of the General Assembly of the Commonwealth of Pennsylvania:

Pursuant to the directive of the General Assembly contained in House Concurrent Resolution No. 79, Session of 1953, there is presented herewith a report on Pennsylvania's mineral deposits.

Under authority granted by the Act of 1943, March 8, P. L. 13, Section 1, the Commission created a subcommittee to facilitate the study of Pennsylvania's mineral deposits. On behalf of the Commission, the cooperation of the members of the subcommittee is gratefully acknowledged.

The Commission wishes also to express its appreciation to representatives of the U. S. Department of the Interior and to The Pennsylvania State University, the University of Pennsylvania, and the University of Pittsburgh, for cooperation in supplying the subcommittee with pertinent information and professional opinion.

BAKER ROYER, *Chairman*

Joint State Government Commission
Capitol Building
Harrisburg, Pennsylvania

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RECOMMENDATIONS

The Joint State Government Commission recommends that:

I. A Resource and Industrial Development Board be established for the purpose of co-ordinating geological survey, mineral research, and development work, the membership of such board to consist of representatives of management, labor, and the sciences.

II. The technical operation of the Pennsylvania geologic survey be transferred to State College, Pennsylvania, and the sum of $700,000 for the biennium 1955-57 be appropriated for purposes of the survey.

III. The appropriation to The Pennsylvania State University, School of Mineral Industries, be increased by $250,000 for the biennium 1955-57 for the purpose of developing better methods of mineral extraction and utilization.

IV. The mineral industries be contacted with a view of ascertaining the extent of possible private financial participation in research, survey, and developmental activities.

INTRODUCTION

On July 19, 1954, the Joint State Government Commission Subcommittee on Pennsylvania Mineral Deposits met at State College, Pennsylvania, with a panel of specialists from the United States Department of the Interior, The Pennyslvania State University, the University of Pennsylvania, and the University of Pittsburgh.[1]

The subcommittee reviewed with the specialists the facts relating to volume and value of mineral production in Pennsylvania, employment in the mineral industries, and means and ways of maximizing the Commonwealth's mineral potential.

The specialists pointed out that only one-third of the Commonwealth has been geologically mapped. They were of the opinion that an attempt should be made to prepare, within the shortest possible time, a detailed, comprehensive, and up-to-date geological map of the Commonwealth. It was the consensus of the specialists that the compilation of such a mineral deposit inventory was essential to the future welfare of Pennsylvania as a mineral producer and processor.

It was brought to the attention of the subcommittee that, from the standpoint of organizational pattern and performance, the geological surveying and mineral research program in Illinois is regarded as outstanding. The Illinois Geological Survey, located at the University of Illinois, has a staff of 115 technical employes and operates under the direction of a six-man Board of Natural Resources. Duties of the survey include locating underground resources, analysis of extraction processes, and development of improved methods of mineral utilization. Field surveys are conducted, topographic maps are prepared, and research is carried on in geology and mineral economics.

The annual budget of the Illinois Geological Survey is about $750,000. This represents about .15 percent of the total annual value of mineral production in Illinois.

For mineral research and geological survey work during the biennium 1953-55, the General Assembly of Pennsylvania appropriated the following amounts:

Department of Internal Affairs:	
Topographic and Geologic Survey	$250,000
The Pennsylvania State University:	
School of Mineral Industries ...	245,000
Total	$495,000

The total annual allocation for mineral research and geological survey work represents approximately .02 percent of the total annual value of mineral production in Pennsylvania.

Hence, relative to the value of mineral production, the state of Illinois is appropriating about seven times as much money for geological survey and mineral research as is the Commonwealth of Pennsylvania.

Concerning specific minerals, the specialists seemed to be in substantial agreement in many areas.

With respect to coal—bituminous and anthracite—it seemed to be the consensus that further mechanization of mining operations and the systematic development of mechanical devices specially adapted to Pennsylvania conditions would result in lowered costs and a strengthening of the competitive position of Pennsylvania mines. The specialists agreed that development of new coal derivatives might well improve the market posi-

[1] A list of the representatives of the Department of the Interior and the universities appears in the Appendix.

tion of coal. It was pointed out that relatively inconsequential quantities of coal are utilized directly in the manufacture of the newer coal derivatives, but that energy for the manufacturing process is often supplied by coal.

Pennsylvania bituminous coal, on the basis of an annual production of 92,000,000 tons, has a life expectancy of more than 300 years, and anthracite, on the basis of an annual production of 30,000,000 tons, has a life expectancy of about 200 years. The geologists on the panel, though cognizant of the immediate problems facing the coal industry, pointed out that coal accounts for 84 percent of the known energy reserves of existing mineral fuels in the United States (measured in British thermal units); oil shale (not yet commercially exploited) accounts for 12 percent; and natural gas and petroleum combined for but 4 percent.

The specialists explained that known recoverable reserves of petroleum in the Commonwealth amount to 111,000,000 barrels and annual production to 11,000,000 barrels. In other words, the life expectancy of Pennsylvania's oil industry is about one decade. However, it is possible that the life of Pennsylvania's oil wells can be extended. The subcommittee was reminded that in the early '30s production per acre was approximately 3,000 barrels, while today, with improved recovery techniques—the result of research financed partially with Commonwealth funds—the yield per acre is approximately 12,000 barrels.

Estimated proved recoverable reserves of native natural gas in Pennsylvania are 539,000,000,000 cubic feet. At the current production rate of approximately 100,000,000,000 cubic feet per year, these reserves would be exhausted in about five and one-half years.

Some of the specialists felt that prospecting for oil and other minerals might be encouraged if the General Assembly saw fit to enact legislation defining the rights of claimants and providing for orderly exploitation methods. Again, it seemed to be the consensus that exploration might be encouraged by the establishment of an adequately staffed, well-equipped testing laboratory for examination and preliminary evaluation of mineral samples.

With respect to clays, it was pointed out that currently all high grade China clays are imported from England or mined in Florida, Georgia, and North Carolina. However, exploratory research suggests that some of the clays found in central Pennsylvania can be inexpensively beneficiated into higher grade clays and may prove to be a commercially exploitable source of aluminum.

Concerning iron, the subcommittee was advised that it will be technically feasible and practicable within a few years to produce an additional 2,000,000 tons of iron ore per year. If this figure is realized, it will represent a 200 percent increase in Pennsylvania iron ore production.

Reviews of Pennsylvania's position as a mineral producer (from the standpoint of both current output and reserves) were presented to the subcommittee by representatives of the United States Department of the Interior. The presentations of Mr. T. W. Hunter, chief, Coal Branch, Bureau of Mines, and Mr. Ralph L. Miller, chief, Fuels Branch, Geological Survey, are reproduced in Section III of this report.

On July 20, 1954, the Joint State Government Commission Subcommittee on Pennsylvania Mineral Deposits met with representatives of management and labor of the mineral industries.[2] The testimony of these representatives dealt largely with measures which might be taken on the federal and state levels of government to improve the position of the industries concerned. The suggestions advanced by management and labor representatives for action on the state level are summarized in Section II of this report.

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[2] A list of the witnesses at the July 20 hearing is presented in the Appendix.

Section I

MINERAL PRODUCTION

This section deals with the location of known mineral deposits in Pennsylvania, the volume and value of different minerals produced, and the number of persons, and their wages, directly employed in the extraction industries.[1]

In 1952, the latest year for which comprehensive statistics are available, Pennsylvania's total mineral production was valued at $1,146,000,000. During the same year, the value of fuels—coal (bituminous and anthracite), petroleum, and natural gas—amounted to $930,000,000, which represents 81 percent of the value of all mineral production within Pennsylvania. Again in 1952, fuels accounted for approximately 93 percent of both the number of employes in the extractive industries and the total wages paid by these industries.

The Fuels

Bituminous Coal.—Among the Pennsylvania fuels, bituminous coal ranks first, historically and currently, with respect to value of product, number of employes, and amount of wages and salaries paid.

From Map I (page 9), which shows the location of known deposits of coal in Pennsylvania, it can be seen that bituminous coal mining operations are concentrated in the western counties.

Though bituminous coal is still the leading mineral product of the Commonwealth, its production has declined in recent years. Table 1 on the following page shows tons produced and number of employes, at both commercial and captive mines, for the years 1943 to 1953, inclusive.

Between 1943 and 1953, total production of bituminous coal in Pennsylvania decreased from 139,801,000 to 91,938,000 tons (column 2 of Table 1), a decrease of 34.2 percent. Over the same period, total number of employes (column 5) decreased from 105,900 to 69,100, a decrease of 34.8 percent. The decreases in tons produced and in number of employes were due, in the main, to decreases in commercial production. Commercial production decreased 45.6 percent, whereas captive production decreased but 2.8 percent. At the same time, employment at commercial mines decreased 46.8 percent, whereas employment at captive mines decreased but 1.8 percent.

[1] A table giving detailed production, employment, and reserve data for the major mineral industries of Pennsylvania is presented in the Appendix.

Table 1

PENNSYLVANIA BITUMINOUS COAL PRODUCTION AND EMPLOYMENT: 1943-1953

Year	Production (tons)			Number of Employes		
	Total	Commercial Mines	Captive Mines	Total	Commercial Mines	Captive Mines
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1943	139,801,000	102,716,000	37,085,000	105,900	77,600	28,300
1944	144,408,000	101,513,000	42,895,000	99,900	70,400	29,500
1945	130,697,000	92,197,000	38,500,000	98,800	69,700	29,100
1946	123,587,000	89,068,000	34,519,000	103,900	73,200	30,700
1947	144,762,000	102,521,000	42,241,000	109,200	77,700	31,500
1948	130,628,000	93,453,000	37,175,000	110,300	77,600	32,700
1949	87,352,000	59,310,000	28,042,000	100,100	66,300	33,800
1950	103,440,000	69,914,000	33,526,000	94,500	60,900	33,600
1951	106,680,000	70,496,000	36,184,000	86,400	55,000	31,400
1952	87,309,000	58,315,000	28,994,000	76,700	48,000	28,700
1953	91,938,000	55,897,000	36,041,000	69,100	41,300	27,800

SOURCE: Columns 2 and 5 from Pennsylvania Department of Mines. Division between captive and commercial mines furnished by the Central Pennsylvania Coal Producers' Association.

Chart I shows total production, deep-mine production, and strip mine production of bituminous coal in Pennsylvania for the years 1943 to 1953, and estimated total production for 1954.

Chart I indicates that though deep-mine output has exhibited a declining tendency since 1943, the output of strip operations continued to increase until 1947. However, since 1947, the output of both deep-mine and strip operations has declined.

Generally speaking, bituminous production in Pennsylvania has declined more rapidly over the last few decades than has bituminous production in the nation. For example, "During World War I, Pennsylvania provided nearly one-third of the nation's soft coal; during World War II, less than one-fourth; and from 1948 to the present, about one-fifth of the total supply." [2]

[2] See T. W. Hunter, "Pennsylvania's Relative Position as a Mineral Producer," Section III, p. 28 of this report.

The decrease in bituminous output is due to such factors as the substitution of other fuels[3] (e.g., oil and natural gas) and increased efficiency in the utilization of fuels.[4] Fuel substitution, in turn, is in part due to cost differentials.

Cost differentials also obtain among producing regions of identical fuels. In the case of bituminous coal, these differentials emerge in connection with the actual production of the coal as well as in connection with its transportation from mine to market.

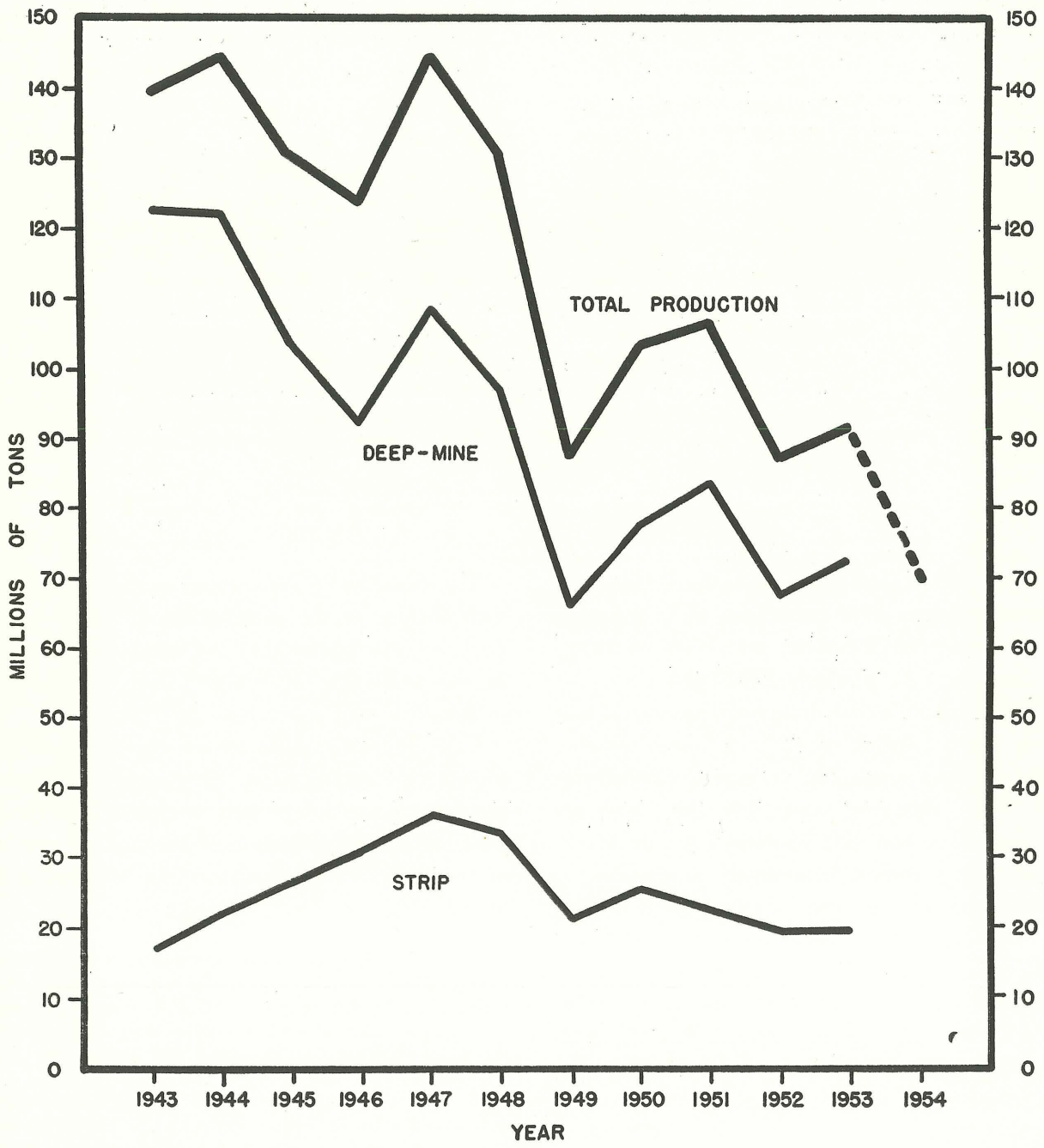
[3] It is estimated that between 1943 and 1953 the principal annual market losses by consumer groups were as follows: railroads, 103,000,000 tons; retail dealer deliveries, 62,000,000 tons; general industrial users, 48,000,000 tons; steel and rolling mills, 5,000,000 tons; estimated total annual sales loss, 218,000,000 tons. *Ibid.*, p. 30.

[4] In 1919, an average of 3.2 pounds of coal was consumed in producing a kilowatt-hour of electricity. By 1950, this average had fallen to 1.2 pounds of coal per kilowatt-hour, or an economy gain of 63 percent over 1919. See *Minerals Yearbook*, 1950, p. 327.

Chart I

BITUMINOUS COAL PRODUCTION IN PENNSYLVANIA

TOTAL, DEEP-MINE, AND STRIP PRODUCTION: 1943—1953
ESTIMATED TOTAL PRODUCTION: 1954



NOTE: Estimate for 1954 based on production for first six months.
SOURCE: Based on data furnished by the Pennsylvania Department of Mines.

Table 2 shows tons per man-day (deep mining) and seam thickness for the principal bituminous coal-producing states.

Examination of Table 2 shows, for example, that in Pennsylvania, which has an average seam thickness of 5.3 feet, a man produces, on the average, 5.07 tons of bituminous coal per day, whereas in neighboring West Virginia, which has an average seam thickness of 5.1 feet, a man produces, on the average, 6.07 tons per day.

In this connection, it may be noted that "Since 1947, the peak production year in the bituminous coal industry, the average f.o.b. mine price has increased more rapidly in Pennsylvania than in other coal producing areas. Nationally, the average f.o.b. coal price increased 18 percent from 1947 to 1953, while f.o.b. prices at Pennsylvania mines rose 27 percent." [5]

[5] See Hunter, *op. cit.*, p. 29.

Table 2

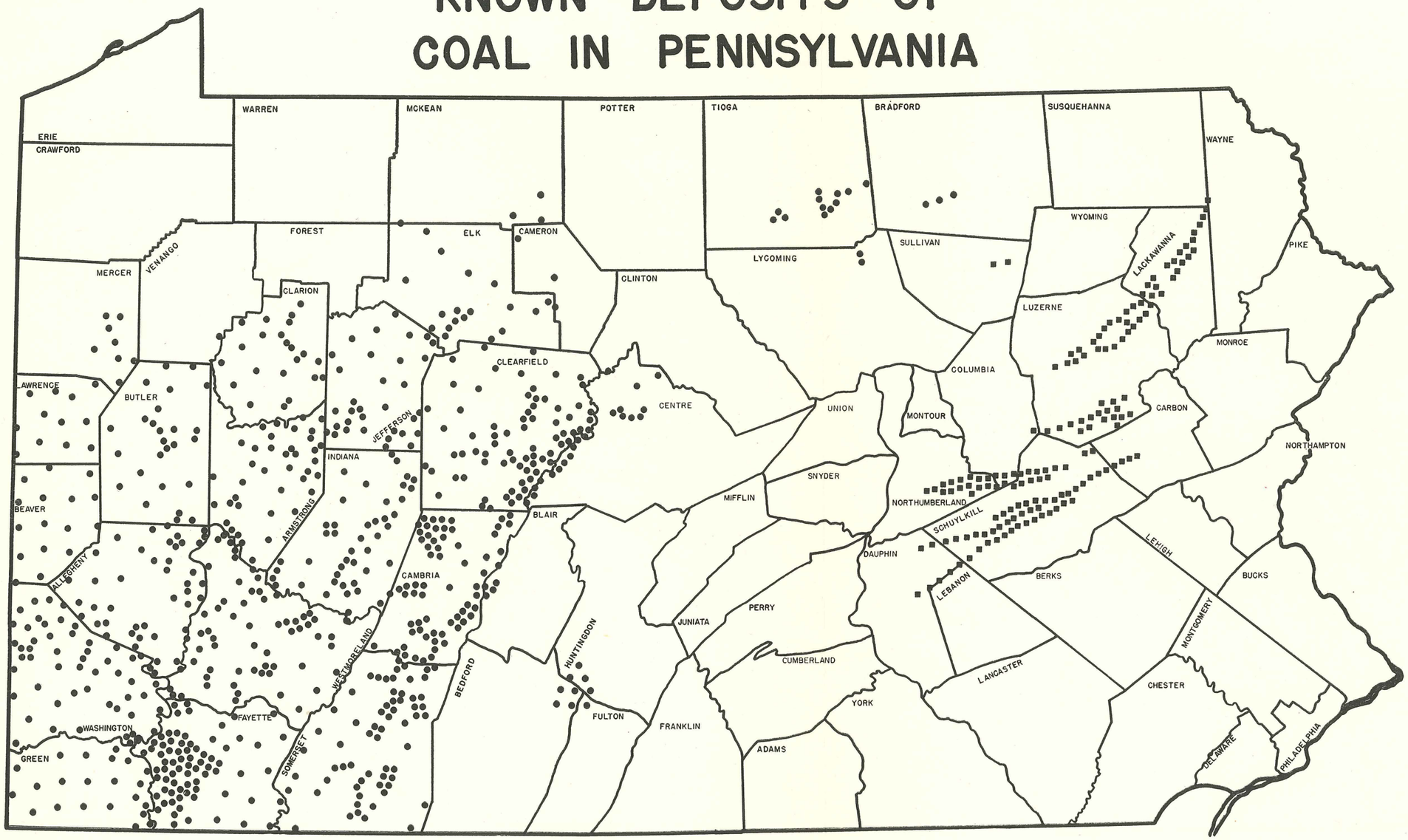
PRODUCTION PER MAN-DAY AND SEAM THICKNESS IN THE MAJOR BITUMINOUS COAL-PRODUCING STATES: 1950
(DEEP-MINE OPERATIONS)

State	*Tons per Man-day*	*Seam Thickness (feet)*
(1)	(2)	(3)
Illinois	8.00	7.1
Ohio	6.35	4.7
West Virginia	6.07	5.1
Northern West Virginia	7.59	6.5
Kentucky	5.59	4.1
Pennsylvania	5.07	5.3
Western Pennsylvania	5.31	6.2
Central Pennsylvania	4.68	3.8

SOURCE: U. S. Department of the Interior, Bureau of Mines.

Map I

KNOWN DEPOSITS OF COAL IN PENNSYLVANIA



LEGEND

● BITUMINOUS COAL ■ ANTHRACITE

SOURCE: Adapted from *The Pennsylvania State College Bulletin,* XLIV, No. 39 (September, 1950), 16-17.

Anthracite Coal. — Unlike bituminous coal, which is used for both industrial and domestic purposes, anthracite coal is primarily used for domestic space heating. Again, unlike bituminous coal, which has to meet competition from bituminous coal mines in other regions (as well as from such other fuels as oil and gas), anthracite coal is produced in consequential amounts only in Pennsylvania among the forty-eight states. The production is concentrated in Lackawanna, Luzerne, Northumberland, and Schuylkill counties (see Map I).

Among Pennsylvania minerals, anthracite ranks second only to bituminous coal in value of product, number of employes, and amount of wages and salaries paid. In 1952, anthracite coal accounted for 33 percent of the value of all minerals produced in Pennsylvania, 41 percent of the production employes in all mineral industries, and 39 percent of total wages and salaries paid in these industries.

Between 1943 and 1953, production of anthracite coal declined 50 percent. The decline continued during 1954. Employment in the anthracite coal industry fell from 79,369 in 1943 to 56,952 in 1953, a decrease of 28.3 percent. Production and employment data for the Pennsylvania anthracite industry, 1943-1953, are given in Table 3.

Total anthracite production and deep-mine, strip, and bank production, for the years 1943 to 1953, and estimated total production for 1954 are shown on Chart II, page 12. The chart indicates that, though until the late '40s strip mining production of anthracite coal tended to increase, total production exhibited a declining tendency throughout the period under review.

Table 3

PENNSYLVANIA ANTHRACITE COAL PRODUCTION AND EMPLOYMENT: 1943-1953

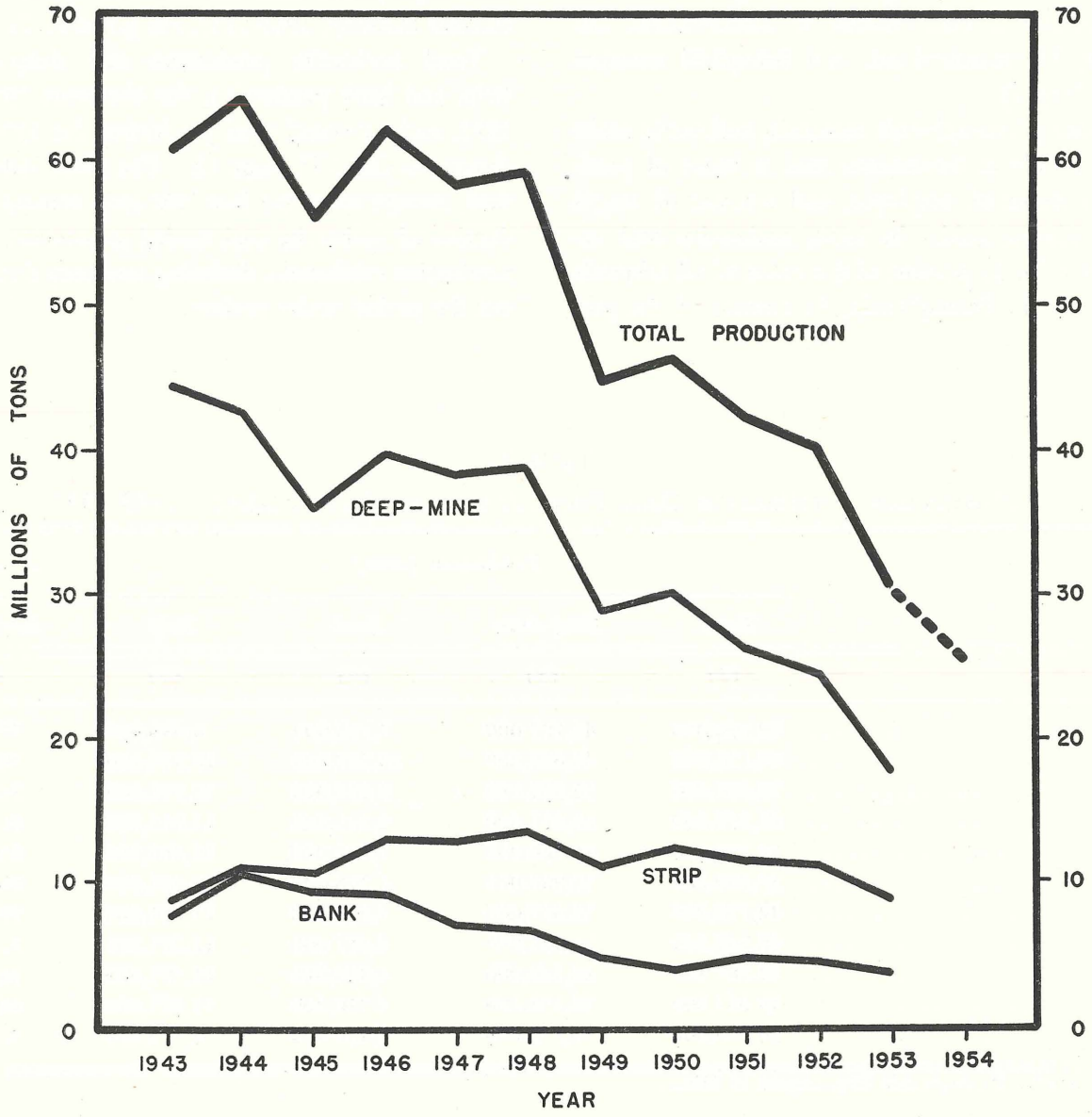
Year	*Production (tons)*				*Number of Employes*
	Total	*Deep-mine*	*Bank*	*Strip*	
(1)	(2)	(3)	(4)	(5)	(6)
1943	60,512,000	44,107,000	7,716,000	8,689,000	79,369
1944	64,113,000	42,660,000	10,527,000	10,926,000	78,145
1945	55,901,000	35,926,000	9,454,000	10,521,000	76,265
1946	61,979,000	39,851,000	9,215,000	12,913,000	80,556
1947	58,228,000	38,460,000	7,077,000	12,691,000	80,730
1948	59,109,000	38,887,000	6,736,000	13,486,000	80,390
1949	44,710,000	28,806,000	4,823,000	11,081,000	79,209
1950	46,339,000	30,021,000	4,027,000	12,291,000	75,231
1951	42,389,000	26,169,000	4,844,000	11,376,000	70,357
1952	40,067,000	24,338,000	4,710,000	11,019,000	66,438
1953	30,495,000	17,719,000	3,892,000	8,884,000	56,952

SOURCE: Pennsylvania Department of Mines.

Chart II

ANTHRACITE COAL PRODUCTION IN PENNSYLVANIA

TOTAL, DEEP-MINE, BANK, AND STRIP PRODUCTION: 1943-1953
ESTIMATED TOTAL PRODUCTION: 1954



NOTE: Estimate for 1954 based on production for first six months.
SOURCE: Based on data furnished by the Pennsylvania Department of Mines.

Petroleum and Natural Gas.—Petroleum and natural gas tend to occur together. Map II (page 15) shows that in Pennsylvania the concentrations of these fuels are in the western counties, particularly in McKean, Venango, Greene, Butler, and Washington.

In 1952, petroleum and natural gas production combined accounted for but 6.7 percent of the total value of mineral production in the Commonwealth, as contrasted with 74.4 percent for bituminous and anthracite coal combined.

Table 4 shows production of crude oil and number of employes engaged in crude oil production in Pennsylvania for the years 1943 to 1953. From 1943 to 1953, crude oil production in Pennsylvania declined from 15,757,000 to 10,669,000 barrels. Over the same period, employment in crude oil production declined from 6,098 to 4,107.

The occurrence of the petroleum known in the trade as Pennsylvania Grade Crude Oil is not confined to Pennsylvania. Pennsylvania Grade Crude Oil is also found in New York, West Virginia, and southeastern Ohio. In Pennsylvania, production is facilitated by so-called "secondary" recovery methods. The crude petroleum is forced to the surface by injecting water or gas under pressure into selected parts of the fields. Had it not been for the development of this method, "Pennsylvania would have ceased to be important in the production of oil." [6]

Though in 1953 Pennsylvania accounted for but approximately one-half of 1 percent of the nation's oil production, it nevertheless furnished about 10 percent of the lubricating oil produced in the United States.[7] In that year, 10,669,000

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[6] See Ralph L. Miller, "The Mineral Resources of Pennsylvania and Other States," Section III, page 33 of this report.

[7] In connection with petroleum, it should be noted that, specialties aside, it is the raw material from which fuel oil, Diesel oil, gasoline, and lubricating oil are derived. The proportions in which these are produced from a given volume of petroleum depends upon: (1) the chemical characteristics of the petroleum, and (2) the processing technique employed. Within given technological limits, the processing techniques can and are varied to take advantage of the prices which can be obtained for fuel oil, Diesel oil, gasoline, and lubricating oil. Generally speaking, fuel oil is a boiler fuel used for both domestic and industrial purposes and competes directly with coal.

Table 4

PENNSYLVANIA CRUDE PETROLEUM PRODUCTION AND EMPLOYMENT: 1943-1953

Year	*Production (bbls.)*	*Number of Employes*
(1)	(2)	(3)
1943	15,757,000	6,098
1944	14,118,000	5,822
1945	12,515,000	5,692
1946	12,996,000	5,931
1947	12,690,000	5,813
1948	12,667,000	5,771
1949	11,374,000	4,977
1950	11,859,000	4,732
1951	11,345,000	4,470
1952	11,233,000	4,413
1953	10,669,000	4,107

SOURCE: Column 2, *Minerals Yearbook,* 1945, 1948, and 1950, and correspondence with the U. S. Department of the Interior, Bureau of Mines; column 3, "Statistical Data Sheet" (unpublished issues, Pennsylvania Department of Labor and Industry, Bureau of Employment Security).

barrels of Pennsylvania Grade Crude were produced within the Commonwealth.

Table 5 shows the production of natural gas and the number of producing gas wells within the Commonwealth for the period 1943 through 1952. Although the number of producing wells decreased from 1943 to 1952, natural gas production in Pennsylvania increased from 93,543,000,000 to 108,684,000,000 cubic feet.

Currently, about 100,000,000,000 cubic feet of natural gas are produced each year in Pennsylvania. Consumption has been in excess of production since 1905. Today, imported gas (largely from the Southwest) supplies approximately two-thirds of the natural gas consumed (approximately 350,000,000,000 cubic feet annually) in Pennsylvania.

Natural gas is imported into Pennsylvania by means of five pipe lines. The most efficient utilization of pipe lines requires constant deliveries from day to day, and, since consumer demand for natural gas fluctuates widely with the seasons, natural gas is stored in large volume. As of December, 1953, approximately 213,000,000,000 cubic feet were stored underground in Pennsylvania. The stored gas is equivalent to approximately 40 percent of the estimated native natural gas reserve and represents an inventory investment of approximately $50,000,000.

Table 5

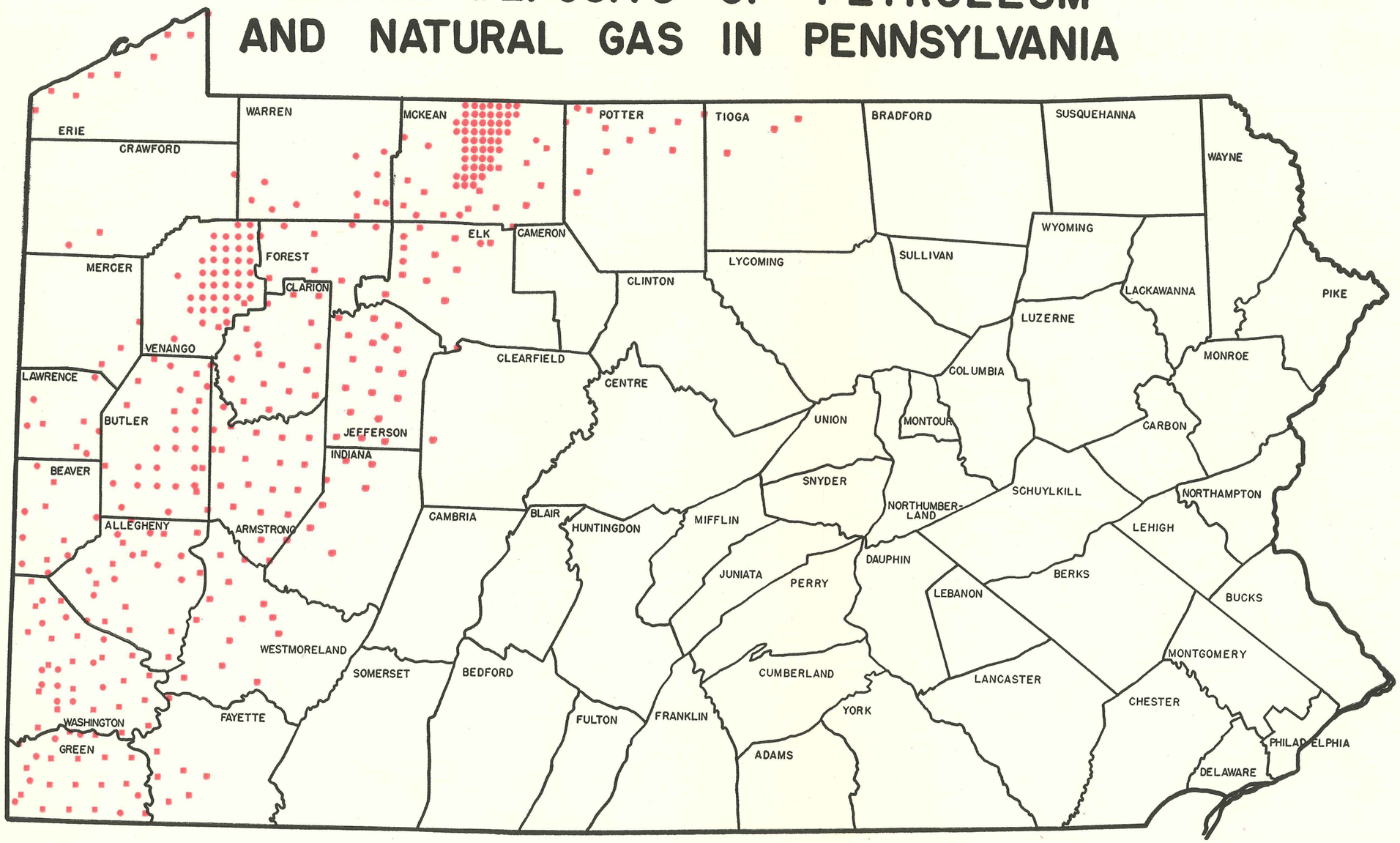
PENNSYLVANIA NATURAL GAS PRODUCTION AND NUMBER OF PRODUCING WELLS: 1943-1952

Year	*Production (Millions of Cubic Feet)*	*Number of Producing Gas Wells*
(1)	(2)	(3)
1943	93,543	18,600
1944	92,987	19,000
1945	82,000	19,300
1946	92,443	19,500
1947	91,971	19,100
1948	87,578	18,800
1949	84,739	18,400
1950	91,137	18,500
1951	128,715	17,700
1952	108,684	16,700

SOURCE: Column 3 and production data for 1951 and 1952 from correspondence with American Gas Association; other data from *Minerals Yearbook*, various years.

Map II

KNOWN DEPOSITS OF PETROLEUM AND NATURAL GAS IN PENNSYLVANIA



LEGEND
- PETROLEUM
- NATURAL GAS

SOURCE: Adapted from *The Pennsylvania State College Bulletin*, XLIV, No. 39 (September, 1950), 16-17.

Other Minerals

The location of known deposits of the principal minerals produced in Pennsylvania is shown on Map III, page 19.

In the aggregate, minerals other than fuels accounted for 19 percent of the total value of Pennsylvania mineral production in 1952. Among the minerals of this group and their percentage contributions to the total value of Pennsylvania mineral production in 1952 are: cement, 8.99 percent; stone, 3.93 percent; sand and gravel, 1.75 percent; and clay 1.05 percent.[8]

Other minerals which individually contributed less than 1 percent to the total value of mineral production but which were produced in significant amounts (value of production exceeding $1,000,000) include: slate, iron ore, lime, slag, and cobalt.

For the principal Pennsylvania minerals other than fuels, Table 6 shows production for 1943 and production, value of product, and number of employes for 1952.

The value of production for 1952 for the four minerals listed in Table 6 was $180,000,000, or about 16 percent of the total value of Pennsylvania mineral production. In contrast to the decline in production of all fuel minerals in Pennsylvania, the four principal non-fuel minerals registered substantial increases in production over the decade 1943-1952. Cement output more than doubled, while clay output increased threefold. Stone production increased 28 percent, and sand and gravel, 58 percent.

[8] Such portions of the basic raw materials—limestone, clay, and shale—as enter into the production of cement are collectively reported.

"Stone" excepts limestone for cement, and lime.

Table 6

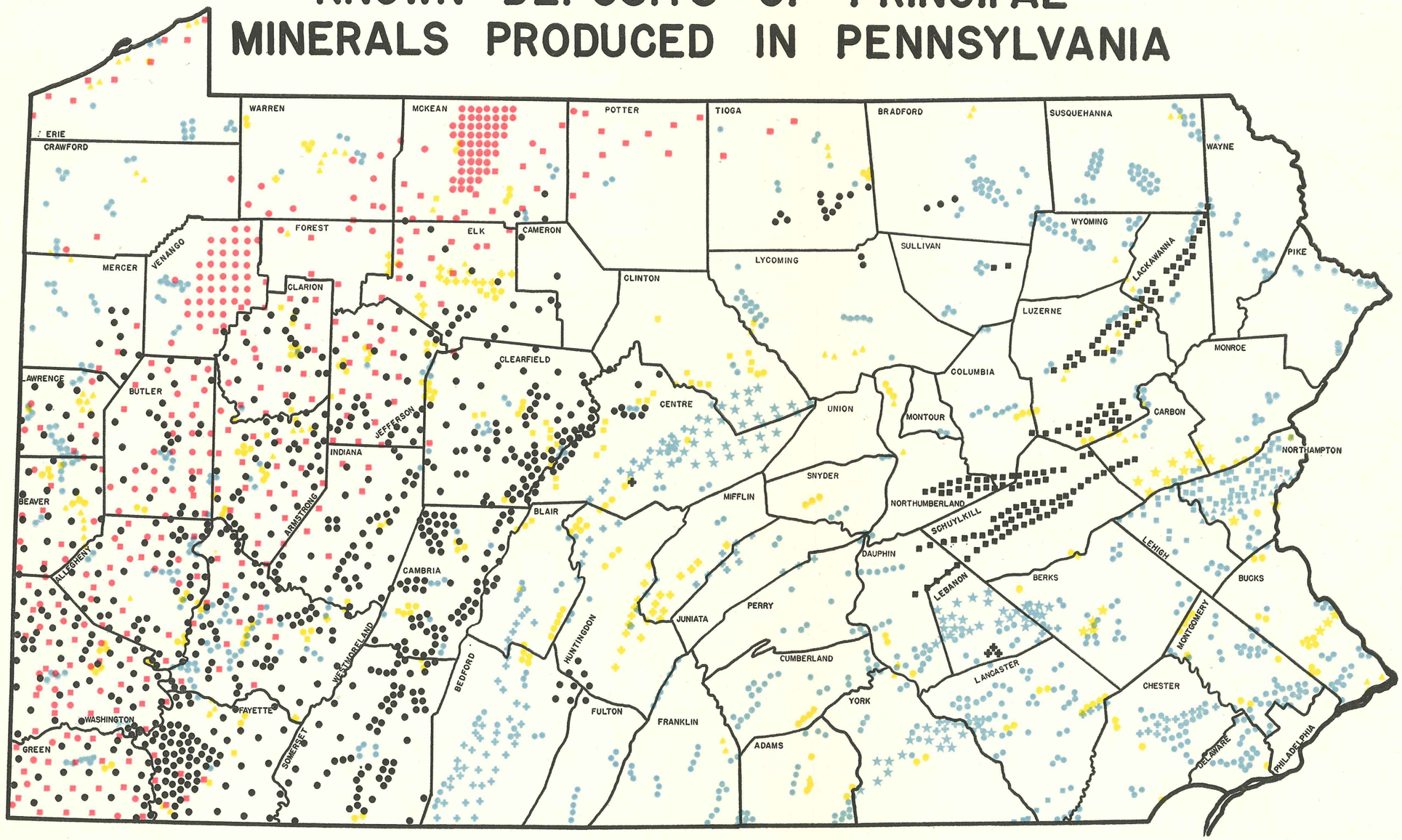
Principal Pennsylvania Minerals Other Than Fuels: Production (1943) and Production, Value of Product, and Number of Employes (1952)

Mineral	*1943 Production*	*1952*		
		Production	*Value of Product (millions)*	*Number of Employes*
(1)	(2)	(3)	(4)	(5)
Cement (bbls.)	19,551,000	40,037,000	$103	7,837
Stone (tons)	20,000,000	25,610,000	45	507
Sand and gravel (tons) ...	9,279,000	14,696,000	20	1,228
Clay (tons)	1,251,000	3,528,000	12	690

Source: *Minerals Yearbook,* 1945 and 1950, and unpublished data from the Bureau of Mines, U. S. Department of the Interior; column 5 from Bureau of Employment Security, Pennsylvania Department of Labor and Industry.

Map III

KNOWN DEPOSITS OF PRINCIPAL MINERALS PRODUCED IN PENNSYLVANIA



LEGEND

- BITUMINOUS COAL
- ANTHRACITE
- IRON ORE
- PETROLEUM
- NATURAL GAS
- BUILDING STONE
- SLATE
- GANISTER
- CHEMICAL LIMESTONE AND DOLOMITE
- CEMENT ROCK
- CERAMIC ROCK
- FIRE CLAY
- GLASS SAND
- MINERAL PIGMENTS
- SAND AND GRAVEL

SOURCE: Adapted from *The Pennsylvania State College Bulletin,* XLIV, No. 39 (September, 1950), 16-17.

Section II

MINERAL PROBLEMS AND MINERAL POLICIES

Though the basic problem of a mineral industry is the improvement of its economic position, mineral industries differ in the emphasis which they place upon the technological and economic aspects of the problem.

The coal industry, the oil producers, the producers of sand and gravel, the ceramic industries, the slate producers, and the Pennsylvania CIO Council have made specific suggestions for governmental action at the *state level.*

Bituminous Coal

As has been pointed out, during the recent past the bituminous coal industry has been characterized by shrinking production and contracting employment.

The industry in Pennsylvania attributes its decline to the following: (1) increasing competition from other fuels, particularly natural gas and imported residual fuel oil; (2) a freight rate structure which impedes the flow of Pennsylvania bituminous to important markets; (3) a tax structure within Pennsylvania which imposes disproportionate burdens upon the industry; (4) the enactment, by local units of government, of smoke abatement ordinances which impose restrictions upon the use of specified fuels; and (5) the development of federally financed hydroelectric plants.

The industry recognizes that the jurisdiction of the Commonwealth does not extend to interstate and foreign commerce, and has urged the federal authorities to strengthen the position of bituminous coal in both interstate and foreign commerce.

The industry suggests the following action on the state level:

1. Continuous quantitative and qualitative appraisal of reserves
2. A continuing and expanded program of research to develop better methods of extraction and utilization
3. Legislation making it mandatory upon all establishments fully or partially financed by state funds to afford coal producers a competitive opportunity to supply space heating and energy requirements
4. An evaluation of the tax structure with a view of determining the tax burden carried by coal and other industries
5. Resumption of the acid water control survey formerly conducted by the industry and the Sanitary Water Board in the Pennsylvania Department of Health.

Anthracite Coal

The problem of the anthracite coal industry is similar to that of the bituminous coal industry. The industry attributes its plight to competitive fuels, particularly residual oil.

The anthracite industry endorses suggestions 2 and 3 of the bituminous industry for action on the state level and in addition proposes that, if the federal government fails to appropriate sufficient funds for the building of ditches and flumes, backfilling of stripping pits and cropfalls, improvements to stream beds, driving of underground

drainage tunnels and gangways, and construction of underground dams, the Pennsylvania legislature appropriate enough funds to cover the deficiency.

Petroleum

Unlike the coal industry, which, though faced with shrinking markets, has ample reserves, Pennsylvania crude oil producers are faced with both contracting markets and rapidly dwindling reserves.

As has been pointed out, given present recovery techniques, Pennsylvania's oil reserves are estimated at 111,000,000 barrels, which means that at current rates of output the industry has a life expectancy of about ten years. However, it is estimated by the industry that about a billion barrels of crude will remain underground unless new recovery techniques are developed.

The industry attributes its recent reverses to the following: (1) the extensive adoption of selective-solvent processing of lubricating oil stocks by Mid-Continent and other refineries; (2) the assistance given by the federal government to foreign countries in connection with the establishment of refineries, including lubricating oil plants; (3) the widespread adoption of the Diesel engine by American railroads, which has reduced the demand for steam cylinder oil; and (4) the trend toward production of multi-graded motor oils, which has reduced the use of bright stock.

The industry proposes the following action at the state level:

1. An accelerated program of geological mapping of the Commonwealth of Pennsylvania
2. An expanded program of research aimed at the development of superior recovery techniques
3. Consideration of conservation laws which will encourage risk capital into exploratory work.

Sand and Gravel

The principal producers of aggregate (sand and gravel) point out that readily available reserves of sand and gravel are being depleted. To assure the future of the industry, they suggest:

1. An accelerated program of geological mapping of the Commonwealth
2. Resistance of any attempts to impose either a ton-mile tax on truck transportation or a severance tax on mineral production
3. Memorializing Congress in opposition to the proposed federal tax on inland waterway transportation.

Clay

The ceramics industry suggests:

1. An accelerated program of geological mapping of the Commonwealth
2. Intensive basic research into the mineral composition of Pennsylvania deposits
3. An information service for mineral producers similar to the information services furnished by agricultural experiment stations.

Slate

The slate industry takes the position that expansion of its operations presupposes the development of improved mining techniques, improved methods of utilization of by-products, and extensive market research coupled with effective advertising.

The industry suggests that the General Assembly appropriate funds (approximately $100,000 annually) to The Pennsylvania State University, specifically earmarked for the following research projects:

1. Development of chain-sawing techniques
2. Study of the penetrating sheave
3. Design of a new rotary saw
4. Improvements in wire-sawing methods
5. Design and development of a mechanical splitter
6. Study of new mining and quarrying systems
7. Study of new roofing systems
8. Development of crushed slate products
9. A market and economic survey
10. Erection of a lightweight aggregate pilot plant.

Tourist Trade

With a view of attracting more tourists to the state, the Pennsylvania CIO Council suggests that Pennsylvania statutes relating to spoil banks be revised to accelerate the rate at which strip-mined areas are replanted.

Section III

PENNSYLVANIA'S MINERAL POSITION

At the request of the Joint State Government Commission Subcommittee on Pennsylvania Mineral Deposits, representatives of the United States Department of the Interior presented the subcommittee with reviews of Pennsylvania's position in mineral production and mineral resources. The statements of the representatives of the Department of the Interior—Mr. T. W. Hunter, chief of the Coal Branch of the Bureau of Mines, and Mr. Ralph L. Miller, chief of the Fuels Branch of the Geological Survey—are reproduced in this section.

Pennsylvania's Relative Position as a Mineral Producer

by

T. W. Hunter, Chief, Coal Branch,
Bureau of Mines, United States Department of the Interior

Our highly integrated national economy involves the interdependence and interplay of many complex forces, and the attainment of Pennsylvania's objectives with respect to maximal utilization of the mineral resources within her boundaries depends, in part, on the relative position of the Commonwealth among the states with respect to the quantities and qualities of minerals produced and production costs, processing, transportation, marketing, consumption, and reserves of these minerals.

It should be emphasized at the outset that in our highly integrated economy there is considerable competition between and among some of the minerals and fuels produced in the respective states. Foreign competition, too, has presented a number of problems in some areas of interest.

In value of minerals produced, Pennsylvania ranks as the third largest state in the nation. It is preceded only by Texas and California, both of which have attained their dominance through the production of petroleum, natural gas, and natural gas liquids. Pennsylvania has attained her high ranking mineral position principally through the production of coal, cement, petroleum, and stone. In 1952, the value of minerals produced in Pennsylvania was about $1,150,000,000. Of this total, coal accounted for $853,000,000, or 74 percent, of which $473,000,000 represented bituminous production and $380,000,000, anthracite. The five next highest minerals in value were cement ($103,000,000), petroleum ($47,000,000), stone ($45,000,000), natural gas ($30,000,000), and sand and gravel ($20,000,000). These minerals, together with coal, accounted for over 95 percent of the total value of minerals produced in Pennsylvania in 1952.

In the mineral fuels group, Pennsylvania also produces natural gas liquids, which include natural gasoline and liquefied petroleum gases. In the field of nonmetallic minerals, it produces lime, clays, slate, ground sand and sandstone, pyrites, peat, mica, and tripoli. In the metals groups, it producers iron ore, copper, cobalt, gold, and silver.

Pennsylvania is virtually the sole U. S. producer of anthracite and ranks second only to West Virginia in bituminous coal output. On the basis of value of all coal produced (bituminous and anthracite), Pennsylvania ranks first. In value of production of petroleum and natural gas combined, it ranks twelfth.

In nonmetallics production, Pennsylvania ranks first in cement, stone, and slate; second in lime and clays; third in tripoli; fifth in mica (scrap) and ground sand and sandstone; sixth in pyrites; ninth in sand and gravel; and tenth in peat.

In metals production, Pennsylvania ranks first in cobalt; eighth in iron ore; eleventh in copper; twelfth in gold; and fifteenth in silver.

Before discussing in more detail the principal minerals produced in Pennsylvania, let us briefly consider the potentials of the other minerals produced in the state.

The iron ore mines at Cornwall, active since 1742, in recent years have produced an average of about a million tons per year. By geophysical prospecting, a new underground iron ore deposit was recently discovered near Morgantown. It is well along in development work and is expected to produce about 6,000 tons of concentrates per day. By-product production at Cornwall has made Pennsylvania the leading United States producer of cobalt, accounting for almost one-third of our entire cobalt production.

Other minerals produced in Pennsylvania, though of minor economic significance at present, are tripoli, an abrasive; secondary selenium, a semiconductor; and germanium, a semiconductor used in transistors and rectifiers which is presently recovered from flue dust at metallurgical plants but which may some day come from Pennsylvania coal beds. The large reserves of graphite which occur near Chester Springs probably could provide the nation with a self-sufficiency in most strategic grades if economical milling methods could be developed. Manganese from open-hearth slags could provide much of the nation's annual requirements if economical extractive processes could be developed. A process to recover manganese from slags has been developed at Pittsburgh by the Bureau of Mines in cooperation with the American Iron and Steel Institute, and the federal government, through the General Services Administration, is assisting in the development of a semicommercial plant at Pittston.

Although Pennsylvania has been an important producer of slab zinc for many years, it is not currently a source of zinc ores. However, the New Jersey Zinc Company has recently completed the sinking, at Friedensville in Lehigh County, of a seven-compartment vertical shaft of 1,261 feet designed for hoisting 2,500 tons a day. The problems involved in sinking the shaft were somewhat unusual and have been described in Bureau of Mines publications.

The rare metals, gallium, thallium, and indium, may someday be produced from the zinc ores that are smelted at three plants in Pennsylvania.

Pennsylvania ranks second to Ohio in the production of lime, for which chemical uses are growing. It also ranks second to Ohio in the production of raw clay, the future production of which may be depressed by competition from other materials, such as metals and plastics. The flint clays of central Pennsylvania, on the other hand, represent a potential source of aluminum. These are now selectively mined to provide high-alumina material for refractories. Techniques for recovering alumina from Pennsylvania clays have been studied by the Bureau of Mines and successfully tested on a pilot-plant scale.

Although Pennsylvania continues to occupy a leading position among the states in the slate industry, there are no significant current trends in the industry that would indicate a potential increase in the future. If the slate industry is to increase its output, measures must be taken to reduce the tremendous waste of rock at quarries and mills. Research conducted at State College has demonstrated that waste slate could be used successfully to make slate-lime brick and lightweight aggregate.

Pennsylvania ranks high (fourth in value of production in 1952) in the production of sand and gravel, and it leads the United States in the production of stone. Stone is encountering increasing

competition from the newer building materials, such as glass blocks and architectural concrete. Aluminum and other metals also are being used to some extent in fields formerly served by stone.

Foremost of the nonmetallic minerals produced in Pennsylvania is cement; Pennsylvania leads the states by a wide margin in both tonnage produced and value. The development of prestressed concrete and of lightweight concrete as a replacement or partial substitute for structural steel in certain types of construction augurs well for a continued high level of activity in cement production. Otherwise the potentials of cement, as of stone, slate, and gravel, are tied closely to the general trend of business and industrial activity, particularly in the field of construction, and to public construction programs.

Pennsylvania is the oldest oil producing state in the country and has been taking oil from the earth for almost one hundred years. It is probable that reserves of oil in addition to those presently known will be proved through the application of improved exploration methods, deeper drilling, and secondary recovery techniques.

While the rate of crude oil production has been declining gradually for many years, in 1953 over $77,000,000 worth of oil, natural gas, and natural gas liquids was produced, equivalent to 6.6 percent of the total value of mineral production in the Commonwealth. Production alone—apart from transportation, processing, and distribution —provided employment for 6,700 persons spread over 25 counties.

Of far more importance to Pennsylvania is the petroleum refining industry, in which the Commonwealth ranks fourth among the states (based on crude oil input capacity of refineries) and accounts for 7 percent of the national total. It is notable that the Philadelphia harbor area—which includes some facilities in New Jersey—is the fastest growing refining center in the country and will, upon completion of construction work now in progress, surpass Los Angeles and rank second only to the Houston-Port Arthur area of Texas. In addition to the large capacity refineries in eastern Pennsylvania, there are the relatively small but highly important Pennsylvania Grade refineries in the western part of the state that contribute a proportionately heavy share to the state's income because of the large quantities of high-valued lubricating oils that they produce.

The transportation and distribution of crude petroleum and its products also make a very substantial contribution to the economy of Pennsylvania. Some idea of the magnitude of these functions may be gathered from the fact that almost 10,000 miles of oil pipelines are buried under the surface of the state. Further evidence of the importance of petroleum in the state's economy is the fact that over three-quarters of the total tonnage moving in the Port of Philadelphia consists of petroleum and its products.

Pennsylvania is much closer to self-sufficiency in natural gas than in oil. The 108,700,000,000 cubic feet of gas produced in the state during 1952 represented just about one-third of the state's consumption. In actual practice, however, as a matter of convenience most of the Pennsylvania gas was shipped to New York State and replaced with gas from West Virginia, Mississippi, and the Southwest. As with oil, the transmission and distribution of natural gas (with some 29,000 miles of pipeline in Pennsylvania) also represents a substantial segment of the state's economy.

According to the 1950 Census, 819,000 dwelling units in Pennsylvania—about 40 percent of all dwelling units in the state—were served by natural gas. Inasmuch as residential use of natural gas in 1952 was 27 percent greater than in 1950, it seems reasonable to assume that more homes are using natural gas and that its use for heating, in addition to cooking and water heating, is increasing.

Looking now to coal, the leading mineral product of Pennsylvania, upon which a substantial part of the economy of the Commonwealth has for

many years been based, we know that some serious changes have been taking place. Coal production throughout the country has been dropping substantially during the past year. In view of the steadily increasing demand for energy during recent years, this seems to be a paradox. The reasons for the decline, of course, are the shifts to competing forms of energy, particularly oil and natural gas. The primary reasons for these shifts, in turn, are convenience and comparative costs.

Because of differing characteristics, the bituminous coal and anthracite industries of Pennsylvania will be discussed separately.

Since the inception of soft coal mining in Pennsylvania, total output has amounted to nearly 8,000,000,000 tons. During World War I, Pennsylvania provided nearly one-third of the nation's soft coal; during World War II, less than one-fourth; and from 1948 to the present, about one-fifth of the total supply. Pennsylvania bituminous production in 1953 was 94,000,000 tons. During the first half of 1954, Pennsylvania's rate of production was 25 percent below the first half of 1953, as compared to an 18 percent decrease for the country as a whole.

The decline in coal mine employment has been greater, relatively, than the drop in production. Although nearly 175,000 men were employed in the peak-output year (1918), employment dropped from the 1948 high of recent years (approximately 106,000) to only 76,000 in 1952. Present employment is somewhat less.

The average number of days worked annually in the mines also has declined. Because of increased coal demand and labor shortages during World War II, the average time worked per year rose to 257 days from the 178-day average of the '30s, but by 1952 the average was only 188 days.

To comprehend some of the major changes that have taken place in the soft coal regions, let us turn to the matter of coal mine mechanization. Coal output during World War I was almost entirely from deep mines. During World War II, however, strip mines were responsible for 15 percent of the total production. Since then deep-mine production has accounted for about 75 percent and strip mines about 25 percent of total production. In Pennsylvania, strip output as a fraction of total output has been ahead of the national average by a slight margin. Mechanical undercutting and mechanized underground loading in Pennsylvania are in the same proportion as the rest of the country—95 percent and 75 percent, respectively, of total deep-mine production. Nearly one-half of all coal produced in the United States is mechanically cleaned; Pennsylvania mechanically cleans about 46 percent.

The net tons of coal produced per man-day of labor has much to do with the competitive position of the various coal producing states and regions. During World War I, Pennsylvania mines had the advantage of an output per man per day higher than the national average for all mines. However, that has not been the case for some years since. World War II and the early postwar years found the output per man-day at Pennsylvania mines at a level 7 percent below the national average. Each year since then this disadvantage has grown, until in 1952 the differential had risen to 16 percent. In other words, in 1952 the average output per man-day at Pennsylvania bituminous mines amounted to 6¼ tons, compared to 7½ tons for all mines in the United States. In 1953, the national average was up to 8 tons per man per day. West Virginia mines, with only 7 percent of output produced at strip pits, averaged 7 tons per man-day at all mines, or 12 percent more than Pennsylvania mines. Deep-mine output per man per day in West Virginia averages 23 percent more than output at deep mines in Pennsylvania.

In coal used for the manufacture of oven coke —of great significance to Pennsylvania—the Commonwealth has a substantial margin of total production over total consumption. Of 30,000,000 tons of coking coal produced in the state in 1952, approximately 12,000,000 tons were shipped to

other states. However, 4,000,000 tons of coking coal came into Pennsylvania from other states, making a net "export" balance of 8,000,000 tons.

The principal coking coal fields of Pennsylvania, in order of shipments to oven coke plants in 1952, were as follows:

Field	*Net tons*
Pittsburgh	11,189,000
Connellsville	9,172,000
Central Pennsylvania	6,060,000
Freeport	2,804,000
Westmoreland	374,000
Somerset	361,000
Anthracite	151,000

Pennsylvania's principal "competitors" in coal produced for oven coke manufacture are West Virginia, with a net "exportable" production of over 27,000,000 tons (of a total production of 32,500,000 tons), and Kentucky, with over 12,000,000 tons.

Since 1947, the peak production year in the bituminous coal industry, the average f.o.b. mine price has increased more rapidly in Pennsylvania than in other coal producing areas. Nationally, the average f.o.b. coal price increased 18 percent from 1947 to 1953, while f.o.b. prices at Pennsylvania mines rose 27 percent.

The significant accomplishments of the mines of Pennsylvania and the nation in mechanizing and otherwise improving production methods to reduce costs, increase productivity, and improve the quality of coal are evidence of the real efforts of the coal industry to meet competition. The coal industry generally is alert to changes that will assist in more economical methods of production and is participating, as is the government, in continuing research programs designed to bring greater stability to the industry.

In anthracite production, Pennsylvania has a virtual monopoly. However, the anthracite industry has for quite some time suffered drastic reverses. From a peak of 100,000,000 tons in 1917, production dropped to an average of 80,000,000 tons during the '20s, and 54,000,000 tons during the '30s. During the war years of 1941 through 1945 it increased to an average of 59,000,000 tons per year, from which it dropped more or less steadily to a level of 31,000,000 tons in 1953, the lowest in nearly three-quarters of a century. Production to date in 1954 is behind last year's by 11 percent.

Mine employment has been decreasing continually. From World War I to World War II, employment in anthracite mines was cut in half. By 1952 it was down to 66,000, and at present is about two-thirds of that, or about 45,000.

The average number of days worked per year also has been on the decline. During World War II, increased demand for anthacite and a general shortage of manpower were responsible for an increase to 255 days per year from the 186-day level of the '30s. By 1952, however, days worked per year had dropped to 201, and the current rate is below that.

Labor productivity has increased at a slower rate at anthracite mines than at bituminous coal mines. From an average of 2.2 tons per man per day in the '20s, average productivity has increased to only 3 tons per man-day so far in the '50s. It is recognized that anthracite mines are not so susceptible to mechanization as are bituminous mines. Nevertheless, increased output per man-day represents one of the greatest potentials of the anthracite industry for reducing unit costs and enhancing its competitive position. Increased efficiency in this respect also would enable the industry to make adjustments in its sizing practices to take greater advantage of the industrial market and offset to a considerable extent its heavy losses in the space-heating markets of New England and the Middle Atlantic states.

In addition to the contribution of coal mining activities per se to Pennsylvania's economy, coal production contributes heavily to many other economic activities in the state, principally trans-

portation. It provides hundreds of millions of dollars in railroad freight revenue alone and is a real factor in the employment of many thousands of workers in the various transportation industries throughout the Commonwealth. Substantial declines in coal production naturally cause reductions of many millions of dollars in these related economic activities. Hence, anything that can be done to maintain or increase coal production within the state will automatically bolster the economy by millions of dollars worth of related economic activity.

Having examined trends in the coal industries of Pennsylvania and noted the importance of coal in the over-all economy of the Commonwealth, let us review the position of coal in the energy markets, the types of markets which it serves, and the broad changes that have occurred over the years.

The total demand for energy throughout the nation has been increasing at a rapid rate—approximately 106 percent in the last twenty years. Since 1940, energy demand for all mineral fuels and water power has increased on an average of 4 percent per year.

Using 1940 as a base point and comparing with 1953 demonstrates that the contributions of the various minerals fuels and water power have undergone tremendous changes. Bituminous coal and Pennsylvania anthracite together in 1953 contributed 6 percent less than in 1940. Anthracite dropped 42 percent; bituminous coal alone declined 2 percent. Among the mineral fuels, only solid fuels have been declining. Petroleum from all sources has nearly doubled in supply, increasing 97 percent over the thirteen-year period. From domestic sources, the supply of petroleum increased 74 percent, while the supply of foreign petroleum, on a Btu equivalence, increased 804 percent. Natural gas supply was 217 percent higher in 1953 than in 1940. Water power was up 73 percent. All mineral fuel and water power energy combined increased 55 percent.

The importation of petroleum and petroleum products from abroad has been a matter of interest or concern to those engaged in producing and transporting fuels and to some fuel consumers. A comparison of British thermal units contributed to the total energy supply by imported petroleum and by domestic coal during recent years indicates that, in 1940, 54 Btu of coal were produced for each Btu of petroleum imported. By 1953, the ratio had dropped to only 6 to 1. With respect to Pennsylvania anthracite, the ratio reversed from 5 to 1 in favor of anthracite in 1940 to 3 to 1 for imported petroleum in 1953. For bituminous coal, the ratio fell from 49 to 1 in 1940 to 5 to 1 in 1953.

Consumption of bituminous coal by the major consuming groups in the United States has undergone great changes. The largest quantity of bituminous coal consumed in the United States in any one year was 594,000,000 tons (1943). Using that year as a bench mark, the significance of subsequent changes is outlined below.

By 1953, total bituminous consumption had dropped to 426,000,000 tons, a net decline during the decade of 168,000,000 tons. In contrast to this decline, the over-all energy market increased by the equivalent of 318,000,000 tons of coal. To put it another way, bituminous coal not only failed to share in the increased energy market but actually lost ground to an extent equal to more than half of the total expansion of the energy market. The principal losses, by consumer groups, were as follows: railroads, 103,000,000 tons; retail dealer deliveries, 62,000,000 tons; general industrial users, 48,000,000 tons; steel and rolling mills, 5,000,000 tons; total loss in these consumer groups, 218,000,000 tons. However, over the past decade bituminous coal consumption increased in three of the principal consuming groups. They are the electric power utilities, which increased consumption by 38,000,000 tons; coke plants, which were higher by 10,000,000 tons; and cement mills, which increased consumption by about 2,000,000 tons.

The remaining portion of the coal market—exports—has had wide fluctuations, dependent upon requirements by foreign countries and their ability to meet supply. During 1940, soft coal exports were 16,000,000 tons, almost all of which went to Canada. From then until 1947 there was a vast increase in demand for United States coal throughout most of the world. Each year exports increased, until they reached a peak of nearly 69,000,000 tons in 1947. From that point they declined to only 25,000,000 tons in 1950. With the outbreak of the Korean War, in 1951 demand increased and exports rose to more than double the 1950 level, reaching 57,000,000 tons. The expansion of foreign coal production facilities and the decline of requirements abroad, particularly in Europe, resulted in reduction in exports of United States bituminous coal to 48,000,000 tons in 1952 and 34,000,000 tons in 1953. So far in 1954, exports are under last year's by 22 percent; if the current trend continues throughout the year, the export market will have leveled to something around 27,000,000 tons.

Prior to World War II, practically all anthracite exports were to Canada. With increased overseas demands for coal following the war, exports increased to a peak of 8,500,000 tons, 4,500,000 of which went to Canada and 4,000,000 overseas. By 1953, total exports had dropped to 2,700,000 tons, of which all but about 100,000 tons went to Canada. It is not expected that the overseas market will be resumed in substantial amount in the foreseeable future. In addition, there is some concern that British shipments of anthracite to Canada, combined with the transmission of natural gas from Alberta to the provinces of Ontario and Quebec, might seriously affect exports of anthracite from Pennsylvania to Canada.

The recent losses of anthracite markets have been principally to natural gas and to oil, and are due to factors of convenience as well as of price.

With regard to the future potential of coal in Pennsylvania, as well as throughout the country, let us consider again that the demand for energy throughout the nation has increased approximately 106 percent in the last twenty years, including a 23 percent increase since the end of World War II. Over the past forty years the demand for electric power alone has doubled every ten years, and the rate of increase is accelerating. Anticipating that for some years ahead the great preponderance of our rapidly increasing energy demand must be supplied by coal, petroleum, and natural gas, many industry leaders and experts in energy have predicted that the total energy demand in this country will be so great that within the next twenty to thirty years coal output alone will approximate one billion tons annually. At the same time, they expect that the demand for petroleum products and natural gas will be at least double that of today. Supporting these predictions are estimates that within the next twenty-five years our national population will be around 200,000,000 persons. Certainly such increases in population and demand for electric energy will create strong pressures for the development and production of many new goods and services throughout the entire economy. These prospects are a challenge to all of us, particularly in the fields of both fundamental and applied research, and in the often neglected field of market research.

Among other prospects for fuels is a greater degree of interchangeability. The leading potential in this respect, of course, is the conversion of coal into liquid or gaseous fuels. Because the basic structure of coal contains the elemental substances present in petroleum and gaseous fuels, we have, in our tremendous resources of coal alone, the potential for meeting the heaviest of energy demands for many years to come.

The economic forces that have brought about changes in the use of energy from various sources are being studied widely. We are in a period of transition in which many forces are at work. It is hoped that, from within our system of American free enterprise, there will soon emerge an eco-

nomic pattern in which all energy sources, and other minerals, will share favorably in assuring the great advancements that have been predicted for our future.

The greatest hope for the mineral industries of Pennsylvania and of the nation lies in their continuing to work aggressively in all these areas toward the ultimate of efficiency in mineral production, processing, transportation, marketing, consumption, and utilization.

The Mineral Resources of Pennsylvania and Other States

by

Ralph L. Miller, Chief, Fuels Branch,
Geological Survey, United States Department of the Interior

The general subject of amounts of mineral resources is difficult of treatment, for minerals range in concentrations all the way from the magnificent Pittsburgh coal bed to invisible traces of substances present only to the extent of a few parts per million. Somewhere between these extremes lie most of our mineral resources, but whether or not they are economically recoverable is a continually shifting matter controlled by many factors. To have some definite markers in this shifting area, we should establish a few simple subdivisions of the over-all term *resources*.

Ore is mineral from which a metal or nonmetal can be extracted at profit.

Reserves are the ore masses exploitable under present economic and technologic conditions or under specified other conditions.

Potential resources are the mineral masses that, for exploitation, demand new technology or more favorable economic conditions than those of today.

Resources are the sum of reserves and potential resources.

The importance of Pennsylvania's fuel and mineral deposits and industries is a well established fact, but I believe it would be in order to discuss briefly each of the more important mineral commodities, with especial emphasis on the relationships between the Commonwealth and other states and the nation as a whole.

Let us first consider bituminous coal, of which Pennsylvania in 1953 supplied 21 percent of the nation's total production.

The best available figures on the bituminous coal reserves of Pennsylvania were published by the Pennsylvania Topographic and Geologic Survey in 1928. The figures are based on a minimum bed-thickness of 18 inches and a somewhat low assumed specific gravity, which tends to make them rather conservative. They are not so detailed as the type of estimates now being compiled, and much exploration has been done since, but when adjusted for production and mining losses to the start of 1953, they indicate that the total amount of bituminous coal still in the ground in Pennsylvania is about 60,000,000,000 tons. That is 5.7 percent of the estimated amount of bituminous coal remaining in the entire nation, and it places the Commonwealth ninth among the states with respect to bituminous reserves. Illinois leads with 13 percent of the national total, followed in order by Kentucky, West Virginia, Colorado, Utah, Ohio, Missouri, Alabama, and Pennsylvania. Reappraisals by the U. S. Geological Survey and state organizations now in progress may change the positions of some of the states.

To date, spectographic analyses for the determination of the germanium content in the ash of

eleven columnar samples of Pennsylvania bituminous coal and one sample of Pennsylvania anthracite have been made available. The germanium content of the anthracite was negligible, but three samples of the Lower Kittanning bituminous coal bed ash contained about one one-hundredth of 1 percent germanium. Analyses of samples of the same bed in Ohio show a much greater concentration there—about two-tenths of 1 percent of the ash, or twenty times as much. No germanium is yet produced from coal ash in this country, but this is a factor that might possibly have some future effect on bituminous coal mining in the Commonwealth.

The U. S. Bureau of Mines has in recent years been working on estimates of minable reserves of coking coal in several of the eastern states. Thus far, results of this work have been published for eight Pennsylvania counties. On July 1, 1955, this work, by mutual agreement, will be transferred to the U. S. Geological Survey. The studies will be continued, however, and in course of time a complete, new, highly detailed estimate of the amount of bituminous coal in the Commonwealth will have been made by these agencies.

Turning to anthracite, it should be noted that the estimated 13,000,000,000 tons remaining underground in Pennsylvania represent over 90 percent of the nation's supply. Other states with anthracite or semianthracite reserves, and their approximate percentages of the national total, are as follows: Colorado, 5 percent; Virginia, 2.5 percent; Arkansas, 1.5 percent; and the states of Washington and New Mexico, which together contain less than 1 percent. It is estimated that the original distribution of reserves among the several Pennsylvania anthracite fields was as follows: southern field, 48 percent; northern field, 27 percent; western middle field, 22 percent; and eastern middle field, 3 percent.

One of the most active programs of basic geologic investigations now being conducted by the U. S. Geological Survey in the sphere of mineral fuels has been underway for some time in the Pennsylvania anthracite fields. There we have undertaken a complete investigation of the exact location, thickness, character, extent, correlations, and structure of the coal beds and intervening rocks and are collecting the most complete information possible on past and present mining. The maps that have been published are accompanied by sections, figures, tables, and short texts.

The figures on coal reserves just mentioned are taken in large part from the publication "Coal Resources of the United States—A Progress Report, October 1, 1953."

Oil and gas, on the basis of present information, are relatively less abundant in Pennsylvania than in many other states. In recent years nearly all of the high-quality oil production in the Commonwealth has been made possible by injecting water or gas under pressure into selected parts of the fields, forcing the oil to move toward other wells. Had it not been for this technologic improvement, Pennsylvania would have ceased to be important in the production of oil. Even with these so-called "secondary recovery" techniques, petroleum engineers estimate that about half of the original oil will be left in the ground, and extensive research is being conducted in the hope of finding ways to obtain higher recoveries. If such a method is found—and there is real hope—Pennsylvania's production of oil will be extended many years.

Last year, Pennsylvania produced about 10,500,000 barrels of oil, which is about a half of 1 percent of the total U. S. production. However, this yielded about 10 percent of the lubricating oil in the nation. Total oil reserves in Pennsylvania recoverable by present methods are estimated at about 110,000,000 barrels, a little less than one-half of 1 percent of the U. S. total.

Gas is obtained in Pennsylvania from beds of several ages and, like oil, has been exploited for many decades. Pennsylvania's known reserves, recoverable by present methods, are estimated at

about 750,000,000,000 cubic feet, about a third of 1 percent of the national total. Recent consumption of natural gas in Pennsylvania has been about two and one-half to three times production in the Commonwealth.

The outlook for future oil and gas production in Pennsylvania is uncertain. The known oil-bearing beds, which are relatively shallow, have been so intensively drilled that it is probable that few pools of appreciable size have escaped discovery.

Several important gas fields, however, have been found in the deeper Oriskany sandstone, most of them east of the early, shallow sources of oil and gas. Although no commercial oil has yet been found in the Oriskany in Pennsylvania, there is good reason to hope that further drilling will yield oil, besides the additional gas that is almost certain to be found. This sandstone is untested in vast areas of the Commonwealth, and the testing will be expensive and financially hazardous. The locations of the oil and gas fields are clearly shown on a map recently prepared by the Pennsylvania Topographic and Geologic Survey.

Still older and deeper beds are present in much of Pennsylvania, and it is entirely reasonable to hope that some of them will eventually yield oil and gas. On the basis of present knowledge, an intensive drilling program cannot be justified, but these rocks will certainly be tested in the future, since they remain one of the large unprospected zones in the East. Even today, a few wells have tested these pre-Oriskany rocks. However, many of them are in the eastern part of the area of possibility, where the beds are closer to the surface but where the prospects do not at present appear very encouraging. Farther west, at even greater depths, they may well contain oil and gas in unpredictable quantities.

The U. S. Geological Survey has recently studied some of the oil- and gas-producing beds of western Pennsylvania and parts of several adjoining states. These studies have shown why some areas are not productive and have indicated other areas that may produce.

Let us consider now some of the chief non-fuel mineral resources of Pennsylvania.

Refractory clays—that is, clays that can be used to make heat-resistant products—occur chiefly as underclays beneath bituminous coal beds in the western and central parts of the Commonwealth. These clays are widespread and reasonably flat lying. They are recovered by both strip and underground mining methods, depending largely upon the thickness and nature of overburden. As strip mining is commonly less expensive, an increasing quantity of these clays is produced by this method. Reserves of clay which can be stripped are rapidly decreasing, and most of the remaining clay is beneath so much overburden as to preclude the possibility of its ever being stripped. Higher prices, however, and larger stripping equipment now permit the removal of somewhat greater thicknesses of overburden than have been removed in the past.

Reserves of underclays for underground mining are very large, and the potential resources even greater. Strip mining reserves are much less—are, in fact, small compared to those available for underground recovery. In the future, underground clay mining is almost certain to increase. Pennsylvania ranks among the first three states in the country in reserves and potential resources of refractory clays.

Of other types of clay, white and buff-burning clays, some of which are refractory, occur in other geologic formations in the central and eastern parts of the Commonwealth. They tend to be lenslike bodies of limited extent and, although important, do not rank with the underclays on a statewide or national basis, and resources are small.

Brick and tile clays or shales are more common, occurring in all counties. Resources of these clays and shales are large and present no problem, considering the state as a whole.

High-iron, high-alumina clays that could be a source of aluminum are present in Clearfield County and, according to the Pennsylvania Topographic and Geologic Survey, total more than 5,000,000 tons. These flint and diaspore-bearing flint clays, which are currently unsuited for refractory purposes because of their iron content, are associated chiefly with the Mercer shale member of the Pottsville formation, which is mined for refractory clay. The figure of 5,000,000 tons of potential aluminum ore is believed to be an absolutely minimum estimate; the actual resources of these clays may be many times that amount, because the enclosing Mercer shale member extends over a wide area.

Pennsylvania has, until now, ranked first among the states in cobalt production and resources. Until recently, the principal source has been Bethlehem Steel's Cornwall mine in Lebanon County, where the magnetite ore contains about five one-hundredths of 1 percent cobalt, or one pound of cobalt per ton of ore. Idaho has recently begun supplying a considerable amount of cobalt.

Resources of cobalt are estimated at possibly 30,000,000 pounds at Cornwall and at roughly 20,000,000 pounds in other deposits in eastern Pennsylvania, a total of approximately 50,000,000 pounds. In addition, Bethlehem Steel's deposit in southern Berks County, discovered a few years ago, may have a cobalt content similar to that of the Cornwall ores. The United States today supplies only about 8 percent of its consumption of this metal; most of its supply comes from the Belgian Congo.

Graphite has been mined in Berks, Bucks, Lehigh, and Chester counties. The principal deposits, however, are west of Phoenixville in Chester County. Evaluation of graphite deposits must be based to a large degree upon physical characteristics, and these have never been adequately tested to determine whether the flake is equal in quality to imported graphite now being used for the manufacture of crucibles. Reserves are large enough to warrant this testing.

The Bethlehem Steel Company's Cornwall deposit in Lebanon County is the principal source of iron ore in the Commonwealth. The ore is magnetite; it contains 40 to 42 percent iron and requires beneficiation. Copper, cobalt, and sulphur are recovered as by-products.

Pennsylvania ranks approximately eighth among the states in iron ore reserves, having an estimated reserve of somewhat over 200,000,000 long tons. Of this estimate, less than half is represented by the common iron ore minerals—magnetite, hematite, and brown ore. The reserves of magnetite at Cornwall have been reported as 40,000,000 to 60,000,000 long tons, which is about half of this nation's annual production of iron ore.

A few of the other mineral deposits of the Commonwealth should be mentioned briefly.

Limestone and dolomite, some of high purity, are widely distributed. The important cement industry is based on the limestone deposits, some of which are virtually inexhaustible. Reserves of high-purity limestone suitable for chemical lime and of dolomite from which magnesium might be extracted are more limited.

Silica of high purity suitable for the manufacture of silica brick is obtained from the Tuscarora quartzite, and the reserves are huge. Locally the rocks must be beneficiated to meet the rigid specifications. Other quartzites and sandstones in the southeastern and western parts of the Commonwealth supply raw materials for various silica refractories. The Oriskany sandstone is acceptable locally for glass sand, but reserves of high-purity sand are not great. Other sandstones are used as engine sands and molding sands.

Pennsylvania has long been the most important source of black slate for roofing shingles and granules and for structural purposes. The Lehigh-Northampton district is of greatest importance, furnishing the bulk of the black slate used in the United States for purposes other than granules and electrical switchboards. The Peach Bottom slate, on the Pennsylvania-Maryland line, is of excellent weathering quality but has not been

exploited for shingles since World War II. It is, however, the only slate used for roofing granules in the Commonwealth and also furnishes a considerable tonnage of slate flour for use as mineral filler. While reserves of high-quality black slate are not large, they are believed adequate for many years.

The only known major deposit of zinc ore in Pennsylvania is at Friedensville. Accurate reserve figures are not available, but it is known that reserves exceed 100,000 tons of recoverable zinc metal. This is less than 1 percent of the total recoverable zinc metal reserves in the United States, which are estimated at about 16,000,000 tons.

Pennsylvania has been an outstanding producer of mineral products throughout the history of our country. But because Pennsylvania has been a pioneer in mineral production, some of the better and more accessible deposits have been depleted. By contrast, some of the states that have started to exploit their mineral wealth more recently still have their high-grade ores. This factor tends, of course, to put Pennsylvania in a somewhat less favorable position, but the momentum the mineral industries within the Commonwealth have developed constitutes an important factor which, at least for a long time, will tend to offset the advantages associated with virgin deposits in other states.

APPENDIX

Lists of Specialists Who Participated in Panel Discussion July 19, 1954, and Witnesses Who Presented Testimony July 20, 1954

Specialists—July 19, 1954

From the United States Department of the Interior:

T. W. Hunter, Chief
Coal Branch
United States Bureau of Mines

Ralph L. Miller, Chief
Fuels Branch
United States Geological Survey

David M. Larrabee
Mineral Deposits Branch
United States Geological Survey

From The Pennsylvania State University:

E. F. Osborn, Dean
College of Mineral Industries

A. W. Asman, Head
Department of Mining

J. C. Calhoun, Head
Department of Petroleum and Natural Gas

H. B. Charmbury, Head
Department of Mineral Preparation

J. D. Clendenin
Department of Fuel Technology

J. A. Hipple, Assistant Dean for Research
Director, Mineral Industries Experiment Station

B. F. Howell, Head
Department of Geophysics and Geochemistry

F. A. Hummel, Acting Head
Department of Ceramics

P. D. Krynine, Head
Department of Mineralogy

E. W. Miller, Head
Department of Geography

D. R. Mitchell, Chairman
Division of Mineral Technology

H. A. Panofsky, Acting Head
Department of Meteorology

J. J. Schantz, Acting Head
Department of Mineral Economics

A. J. Shaler, Head
Department of Metallurgy

T. S. Spicer
Department of Fuel Technology

F. M. Swartz, Head
Department of Geology

O. F. Tuttle, Chairman
Division of Earth Sciences

W. A. Weyl, Chairman
Division of Mineral Engineering

From the University of Pennsylvania:

Knut A. Krieger
Professor of Chemistry

From the University of Pittsburgh:

H. G. Botset, Head
Petroleum and Geological Engineering Departments

Witnesses—July 20, 1954

H. Hershey Miller, Executive Secretary
Pennsylvaina Sand and Gravel Producers' Association

J. P. Jones, Director of Production
F. I. L. Lawrence, Technical Advisory Committee
Pennsylvania Grade Crude Oil Association

F. W. Earnest, Jr., President
Anthracite Institute

Walter F. Schulten, Director
Western Pennsylvania Coal Operators Association

Robert T. Laing, Executive Director
Central Pennsylvania Coal Producers' Association

E. W. Bauman, Managing Director
National Slag Association

W. T. Mullin
Pennsylvania Slate Producers Guild

George W. Ahl, Jr., Vice President
Summit Mining Corporation

J. S. McDowell
The Refractories Institute

James R. Coxey, Chairman
Engineering and Technology Committee
Mid-Atlantic Region
Structural Clay Products Institute

James J. Thomas, Vice President
United Steel Workers

Harry Boyer, President
Pennsylvania CIO Council

(In addition, written statements were filed by the Natural Gas Men's Association and by F. H. Mohney, Executive Secretary, Mineral Producers Association.)

PRODUCTION, VALUE OF PRODUCT, NUMBER OF EMPLOYES, AND WAGES AND SALARIES PAID, FOR MAJOR MINERAL INDUSTRIES IN PENNSYLVANIA (SELECTED YEARS) AND MINERAL RESERVES [1]

(All dollar figures in millions)

Product	*1925*		*1940*				*1952*				*Estimated Reserves* [4]
	Production	*Value of Product*	*Production*	*Value of Product*	*Number of Employes* [2]	*Wages and Salaries Paid* [2]	*Production*	*Value of Product*	*Number of Employes* [3]	*Wages and Salaries Paid* [3]	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Anthracite coal (short tons) ..	61,817,149	$328	51,484,640	$205	81,434	$107	40,067,000	$380	66,438	$224	6,360,000,000 [5]
Bituminous coal (short tons) .	136,928,019	288	116,602,999	237	111,418	146	87,309,000	473	76,700	290	29,829,000,000 [5]
Crude petroleum (bbls.)	8,097,000	29	17,353,000	40	[6]	[6]	11,233,000	47	4,413	14	111,000,000 [7]
Natural gas (M cu. ft.)	101,632,000	47	90,725,000	42	[6]	[6]	108,684,000	30	679	2	752,000,000 [8]
Iron ore (long tons)	919,548	2	2,900,499 [9]	8 [9]	660	.96	992,000	[6]	777	3	26,154,000 [2]
Cement (bbls.)	41,899,787	73	27,499,786	38	6,920	17	40,037,000	103	7,837	31	Limestone used in cement available in almost unlimited quantity. However, high-grade raw materials are limited.[2]
Sand and gravel (short tons) ..	12,604,000	11	8,432,000	8	1,765	3	14,696,000	20	1,228	5	Many sands unlimited in quantity. Deposits for special uses limited.[2]
Raw clay (short tons)	759,345	2	899,173	2	298	.27	3,528,000	12	690	2	Clay for most purposes abundant throughout the state.[2]
Slate (short tons)	[6]	6	201,670	3	1,608	2	215,000	4	507	2	Abundant.[2]
Stone, except limestone for cement and lime (short tons)	16,124,590	19	19,277,690	20	5,024	6	25,610,000	45			
Total value of mineral production [10]		867		618				1,146			

[1] Unless otherwise designated, all data are from *Mineral Resources of U. S.*, 1925, *Minerals Yearbook*, 1941 and 1950, and correspondence with the Bureau of Mines, United States Department of the Interior.

[2] *Pennsylvania's Mineral Heritage* (Harrisburg: Pennsylvania Department of Internal Affairs, 1944).

[3] "Statistical Data Sheet" (unpublished issues, Pennsylvania Department of Labor and Industry, Bureau of Employment Security).

[4] Recoverable by known methods under present economic conditions.

[5] *Coal Resources of the United States* (United States Department of the Interior, Geological Survey Circular 293 [Washington, D. C.: 1953]).

[6] Not available.

[7] American Petroleum Institute.

[8] American Gas Association. Includes stored reserves of 213,000,000,000 feet.

[9] New York figures are included.

[10] Includes value of minerals not shown separately.

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