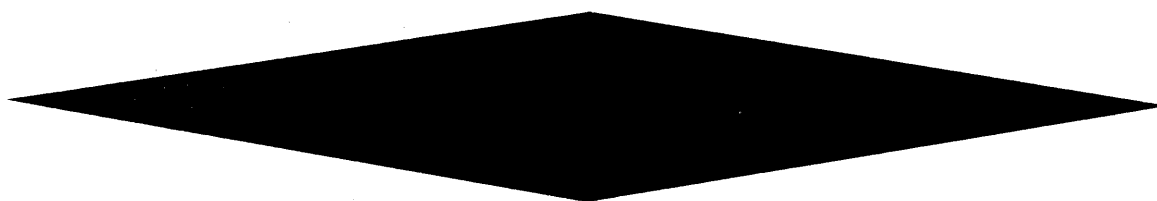


NUMBER 80



Atlas of Pennsylvania Coal  
and Coal Mining  
PART II  
Anthracite

George F. Deasy  
and  
Phyllis R. Griess

COLLEGE OF MINERAL INDUSTRIES  
THE PENNSYLVANIA STATE UNIVERSITY  
University Park • Pennsylvania



*Bulletin of the*

# MINERAL INDUSTRIES EXPERIMENT STATION

*Mineral Conservation Series*

Atlas of Pennsylvania Coal

and Coal Mining

Part II

Anthracite

George F. Deasy

and

Phyllis R. Griess

M. L. Keith, Editor  
Mineral Conservation Section  
of the Experiment Station

COLLEGE OF MINERAL INDUSTRIES  
THE PENNSYLVANIA STATE UNIVERSITY

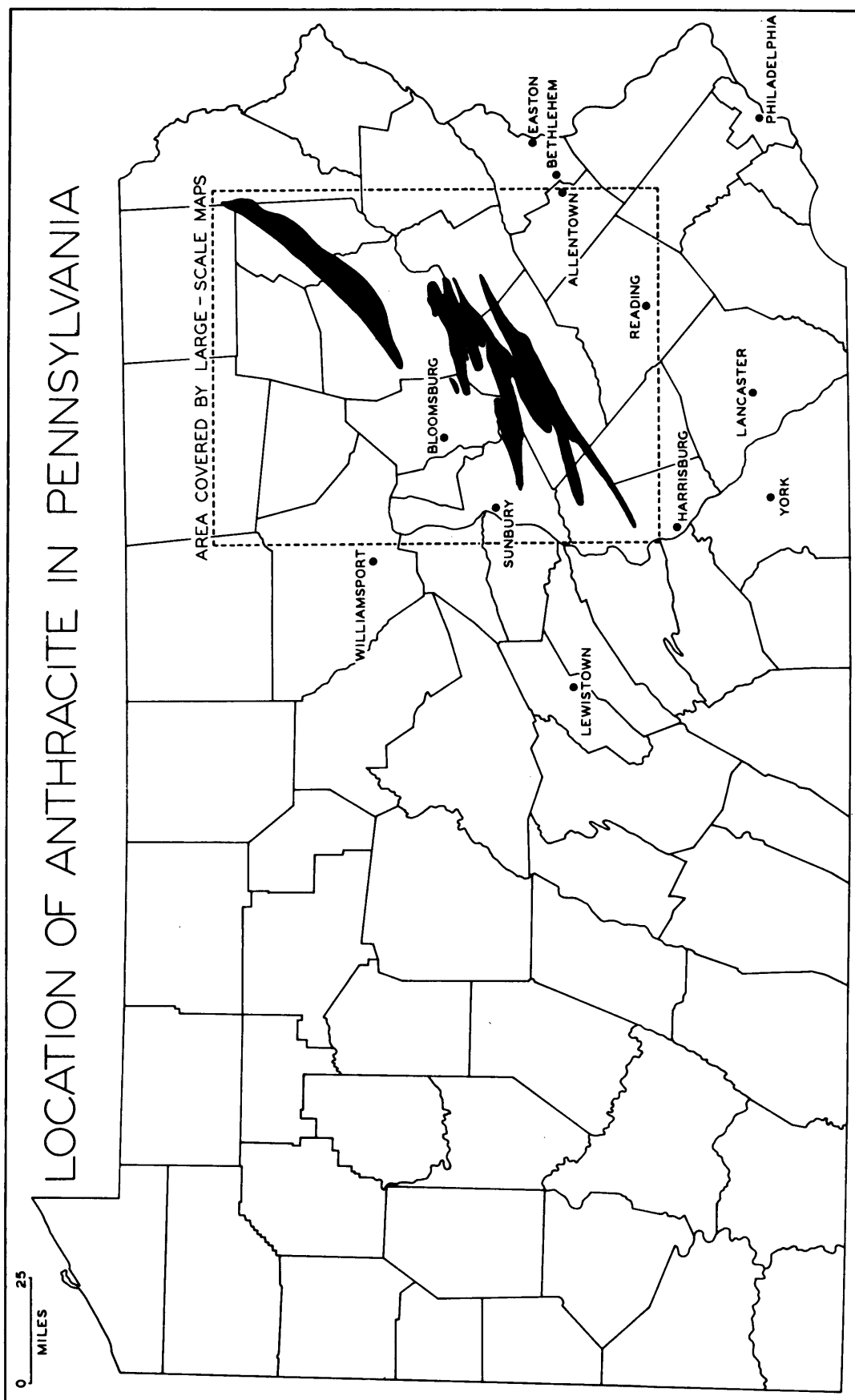
University Park, Pennsylvania

Price \$1.00

## TABLE OF CONTENTS

---

Preliminary Remarks . . . . .	v
Pennsylvania's Anthracite Industry in Its World, National, and Commonwealth Settings . . . . .	1
Pennsylvania's Anthracite Fields and Selected Aspects of Their Topography, Structure, and Stratigraphy . . . . .	5
Some Chemical and Physical Properties of Pennsylvania Anthracite . . . . .	17
Employment and Labor in Pennsylvania's Anthracite Mining Industry . . . . .	33
Mines and Preparation Plants, Mining Companies, and Accidents in Pennsylvania's Anthracite Mining Industry . . . . .	53
Production and Marketing of Pennsylvania Anthracite . . . . .	85
Appendix — Notes on Maps and Graphs . . . . .	119



## PRELIMINARY REMARKS

The Atlas of Pennsylvania Coal and Coal Mining brings together selected data on the Commonwealth's coal resources and coal mining industry and presents them in graphic form. Included are maps and graphs dealing with geological, historical, engineering, economic, production, employment, safety, transportation, and market facets of the subject. It is hoped that the Atlas will serve as a basic reference which will provide information regarding the coal industry of the Commonwealth to both layman and specialist. It should be of interest and use to educators, conservationists, coal mining companies, research and planning organizations, coal users and unions, and to federal, state, county, and local governmental agencies.

The Atlas is issued in two volumes. Part I, published in December, 1959, deals with bituminous coal and coal mining; Part II, the present volume, treats of anthracite. The approximately 135 maps and graphs in this volume are arranged in six groups. Introductory materials represent Pennsylvania's anthracite industry in its world, national, and Commonwealth settings. A second group of maps and graphs deals with selected aspects of the topography, structure, and stratigraphy of Pennsylvania's anthracite fields, and a third group analyzes the composition and various physical characteristics of the Commonwealth's anthracite resources. The fourth group of maps and graphs is devoted to employment and labor factors in the anthracite industry, and the fifth is concerned with mines, preparation plants, mining companies, and accidents. A final group represents the production and marketing of coal from the Commonwealth's anthracite fields.

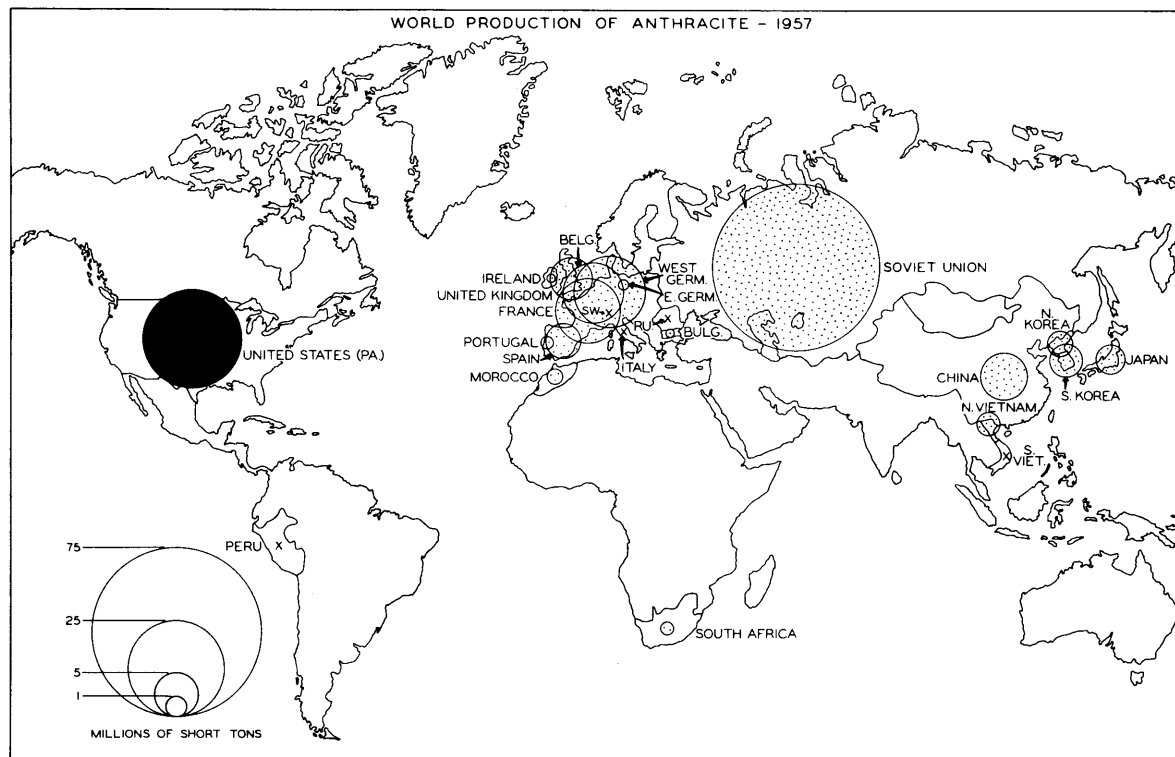
Sources of information that were of assistance in the preparation of this volume are many and varied. Special acknowledgment is due the Pennsylvania Department of Mines and Mineral Industries, and the Bureau of Mines of the United States Department of the Interior. Other important sources include such Federal agencies as the Department of Agriculture and the Geological Survey; such Commonwealth agencies as the Topographic and Geologic Survey, the Public Utility Commission, and the Department of Internal Affairs; and the Anthracite Institute. Both published and unpublished materials were obtained from these sources. Field work by the authors supplied additional information.

Interpretations of some of the maps included in the Atlas are contained in a number of publications written by the authors and issued by the College of Mineral Industries, The Pennsylvania State University, or they appear in the *Proceedings of the Pennsylvania Academy of Science*. The authors gratefully acknowledge the help of Mr. John Viletto, Jr., and Miss Grace Powell, graduate assistants in geography, in compiling data for some of the maps. The population maps on pages 50 to 52 were prepared by Professor Paul D. Simkins and by Mr. Harvey Heiges, graduate assistant in geography.

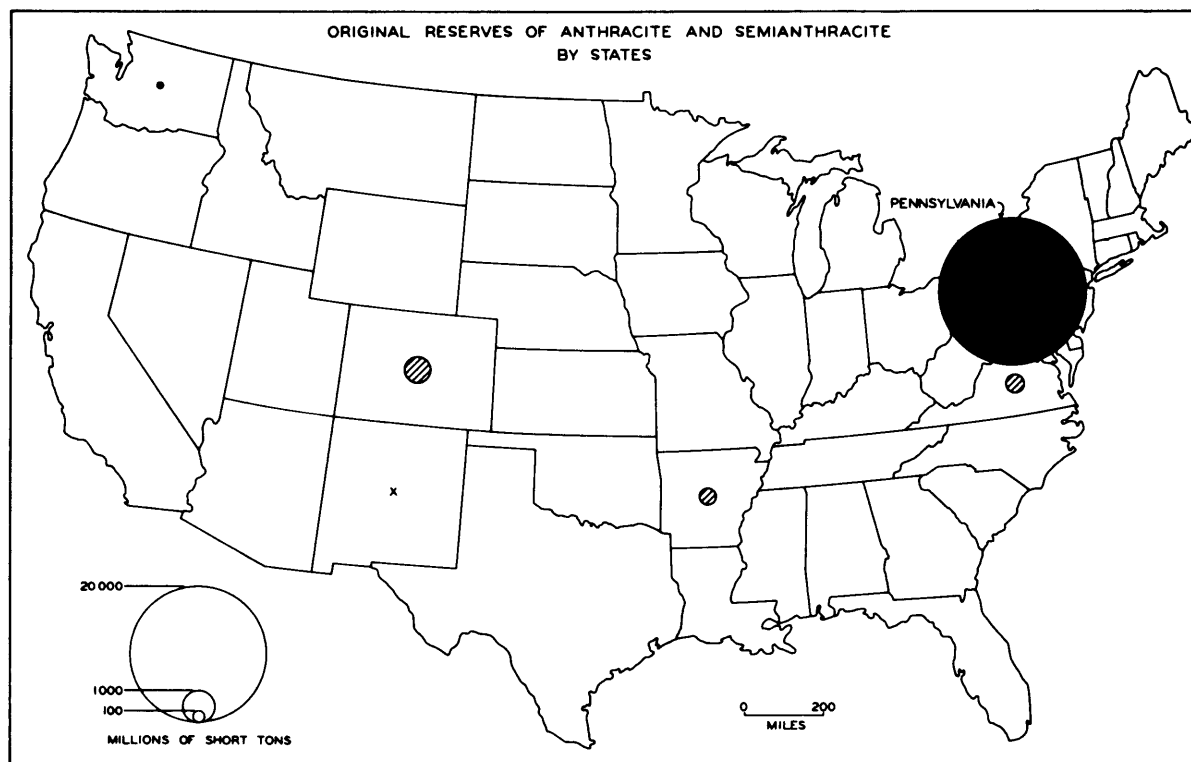
GEORGE F. DEASY  
PHYLLIS R. GRIESS

University Park, Pa.  
July, 1963

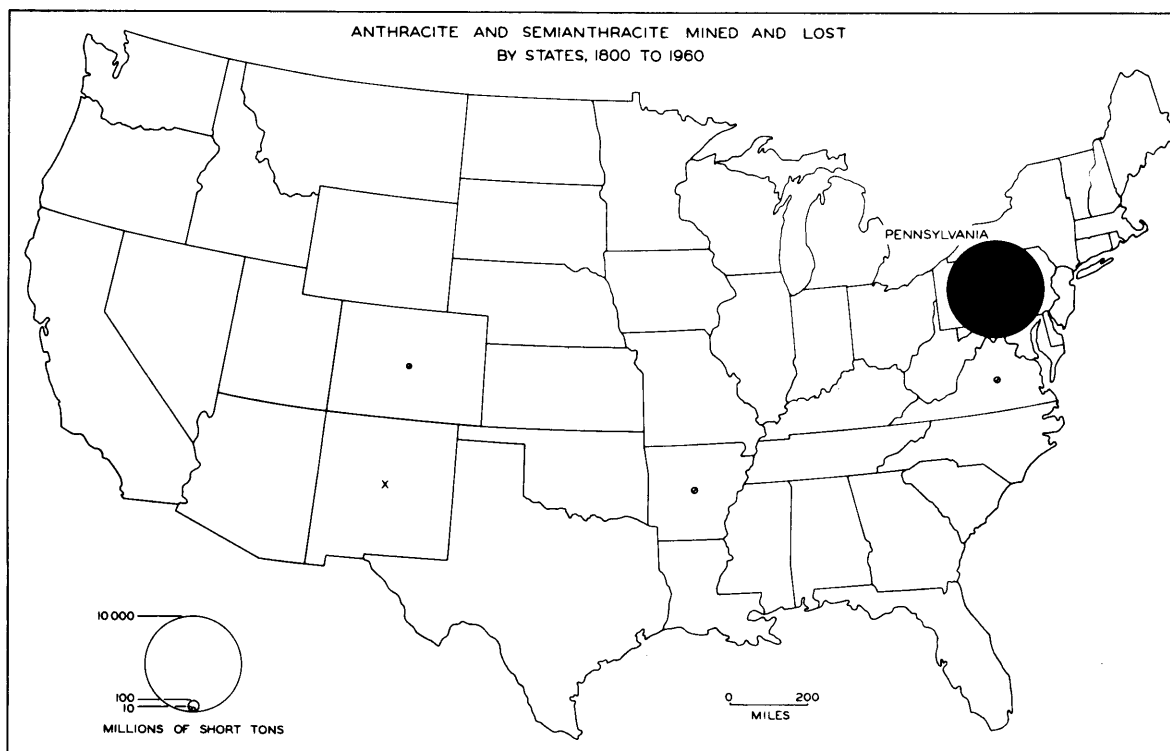
Pennsylvania's Anthracite Industry  
in Its World, National,  
and Commonwealth Settings



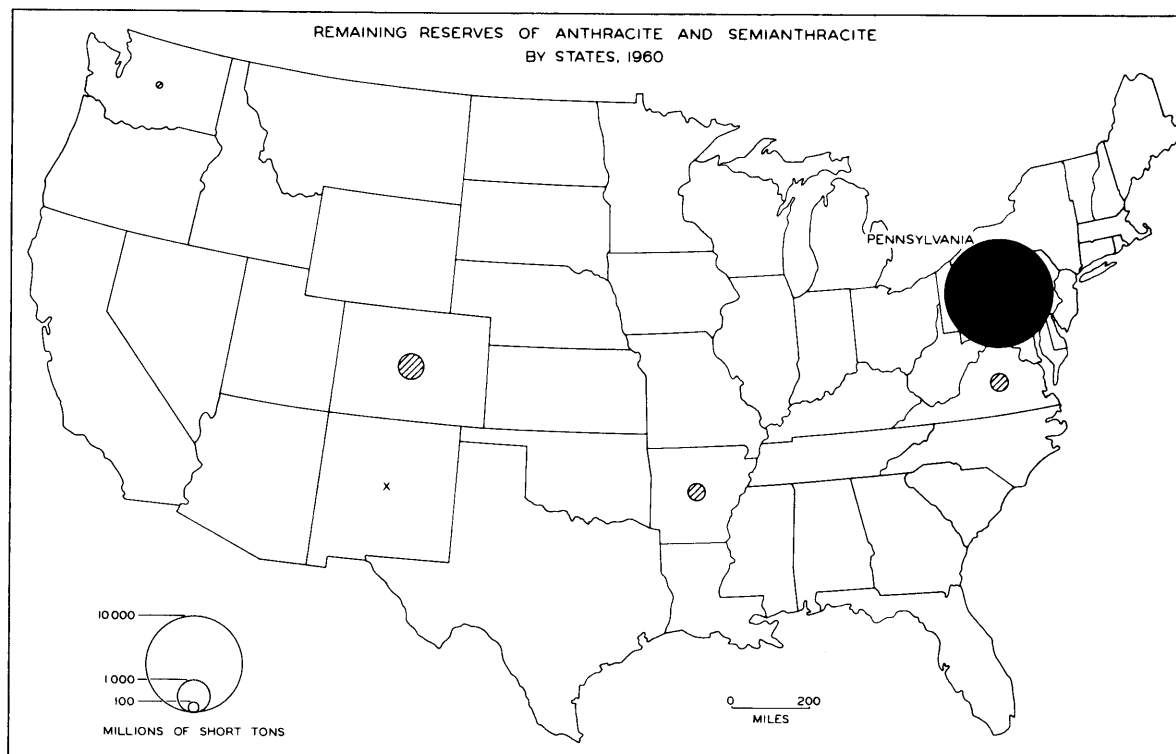
Appendix: Note 1.



Appendix: Note 2.

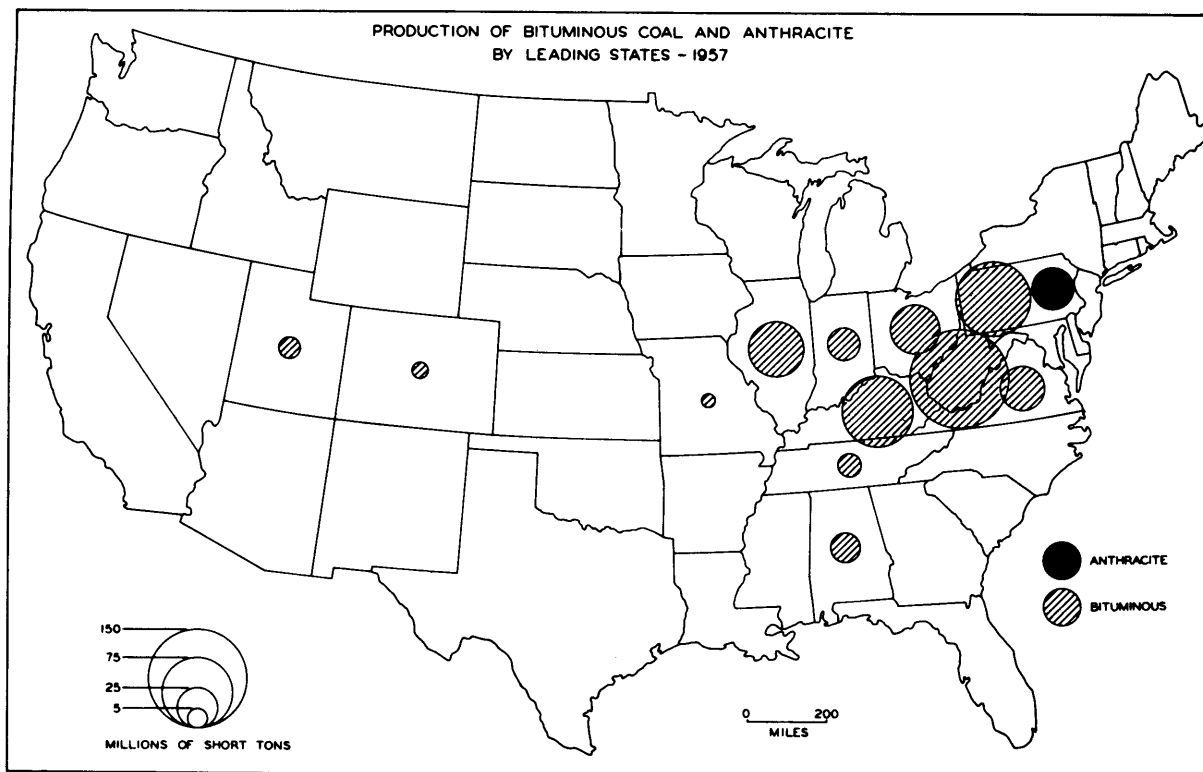


Appendix: Notes 2 and 3.

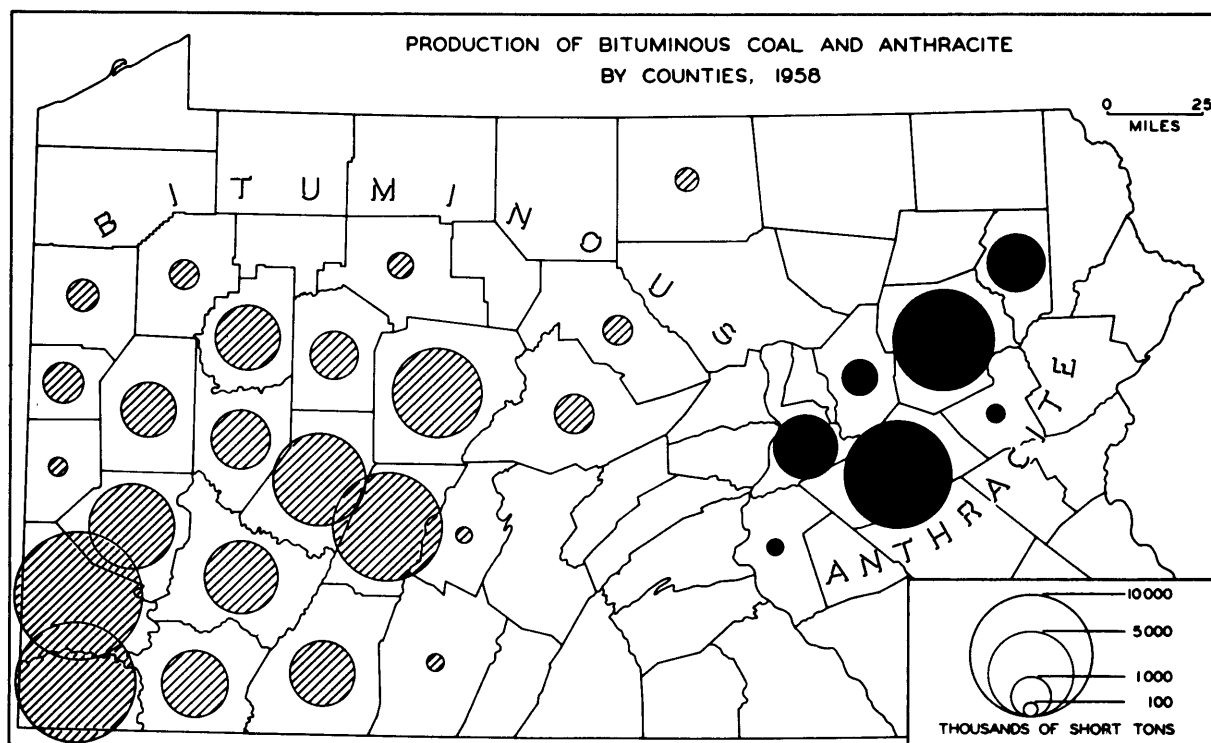


Appendix: Note 2.



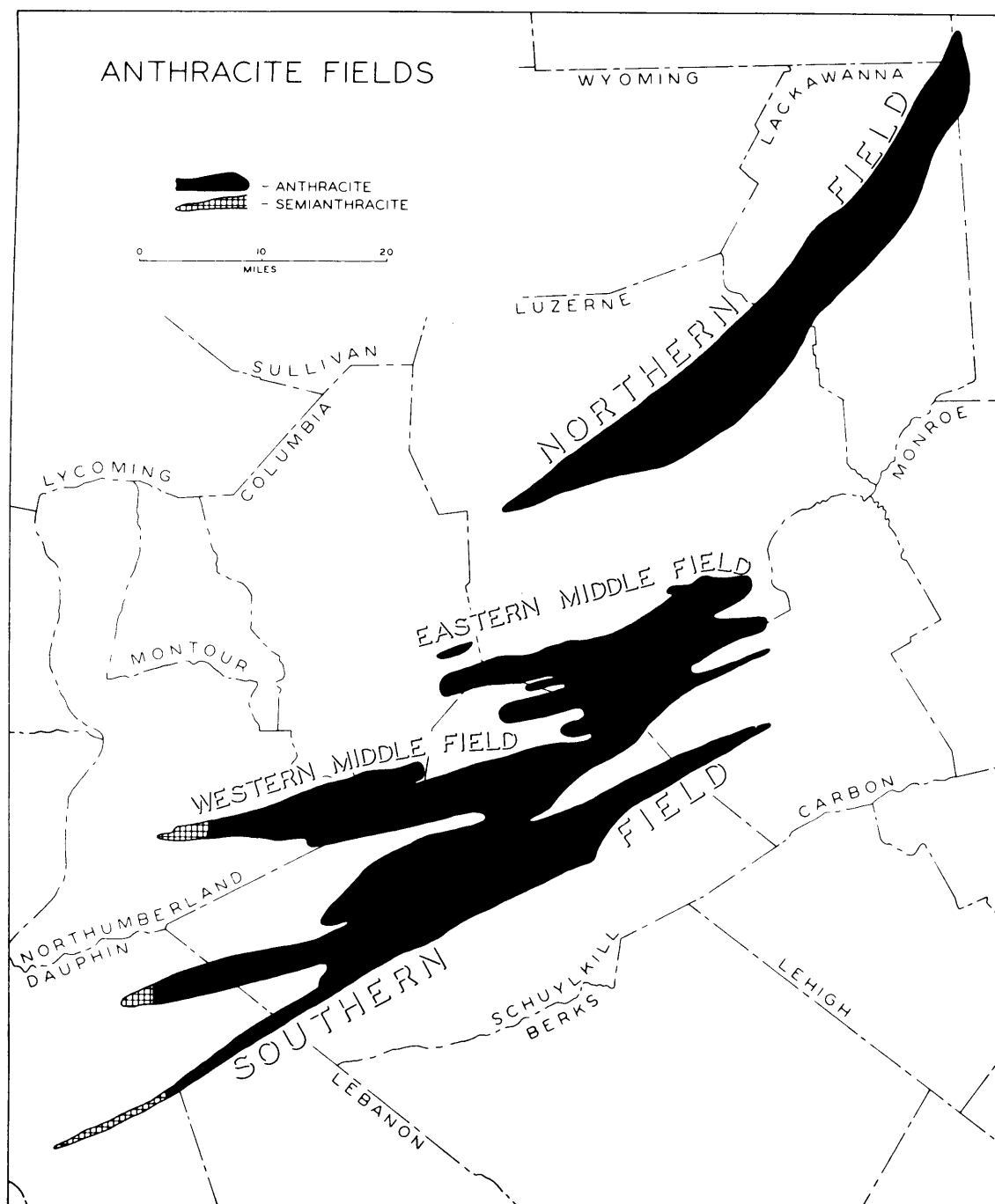


Appendix: Note 4.



Appendix: Note 5.

Pennsylvania's Anthracite Fields  
and Selected Aspects  
of Their Topography, Structure,  
and Stratigraphy

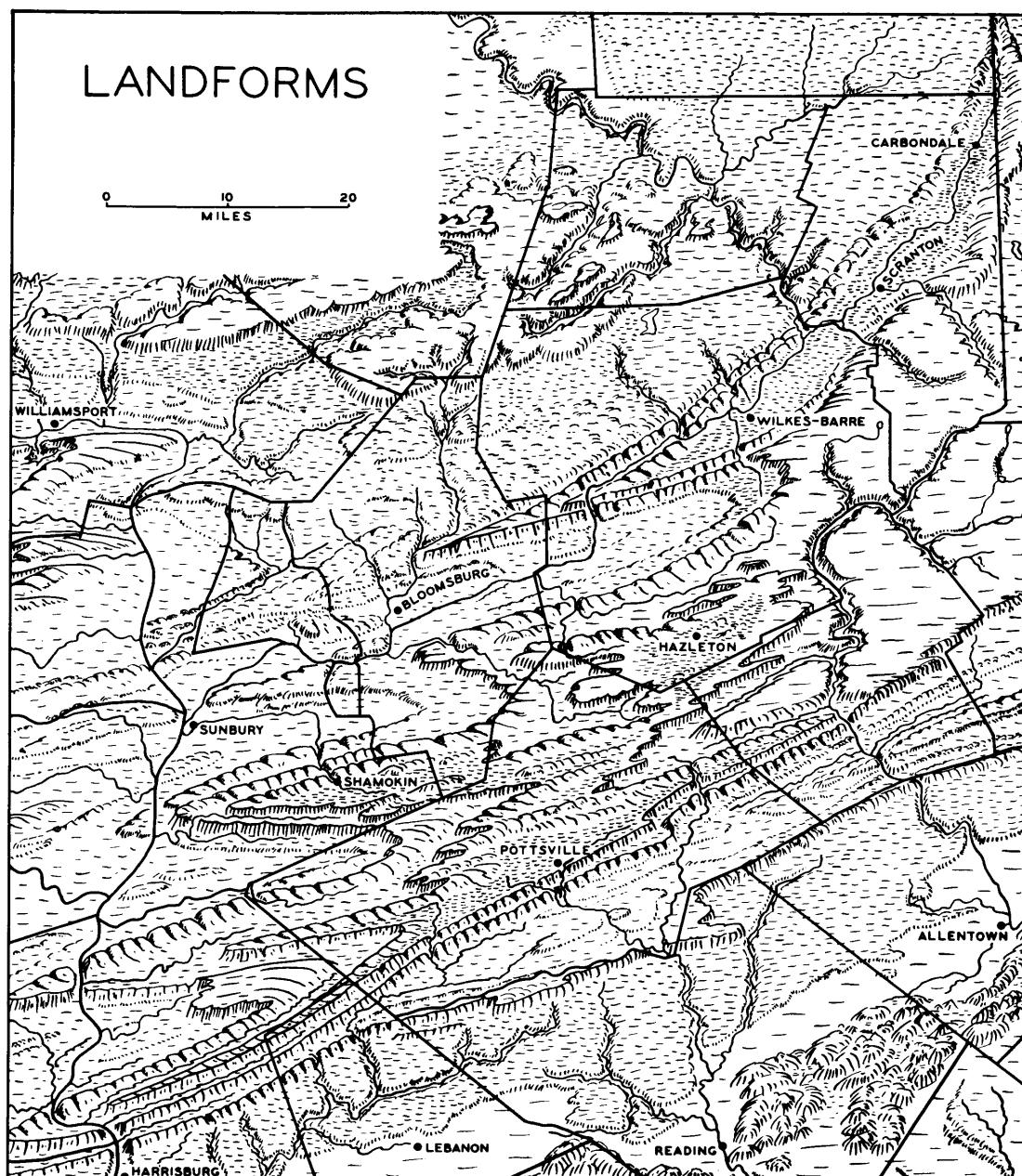


Appendix: Note 6.

### ANTHRACITE FIELDS

The four anthracite fields of Pennsylvania — Northern, Eastern Middle, Western Middle, and Southern — comprise a 484-square-mile area in a 10-county region in the east-central and north-eastern parts of the Commonwealth. County boundaries and names are shown for orientation purposes. Excluded from this and all subsequent

maps, except where specifically indicated, is the semianthracite Bernice Field in nearby Sullivan County. Boundaries of the anthracite fields on this and all following maps on which they are shown are generalized, and include small areas that are not underlain by anthracite.



Appendix: Note 7.

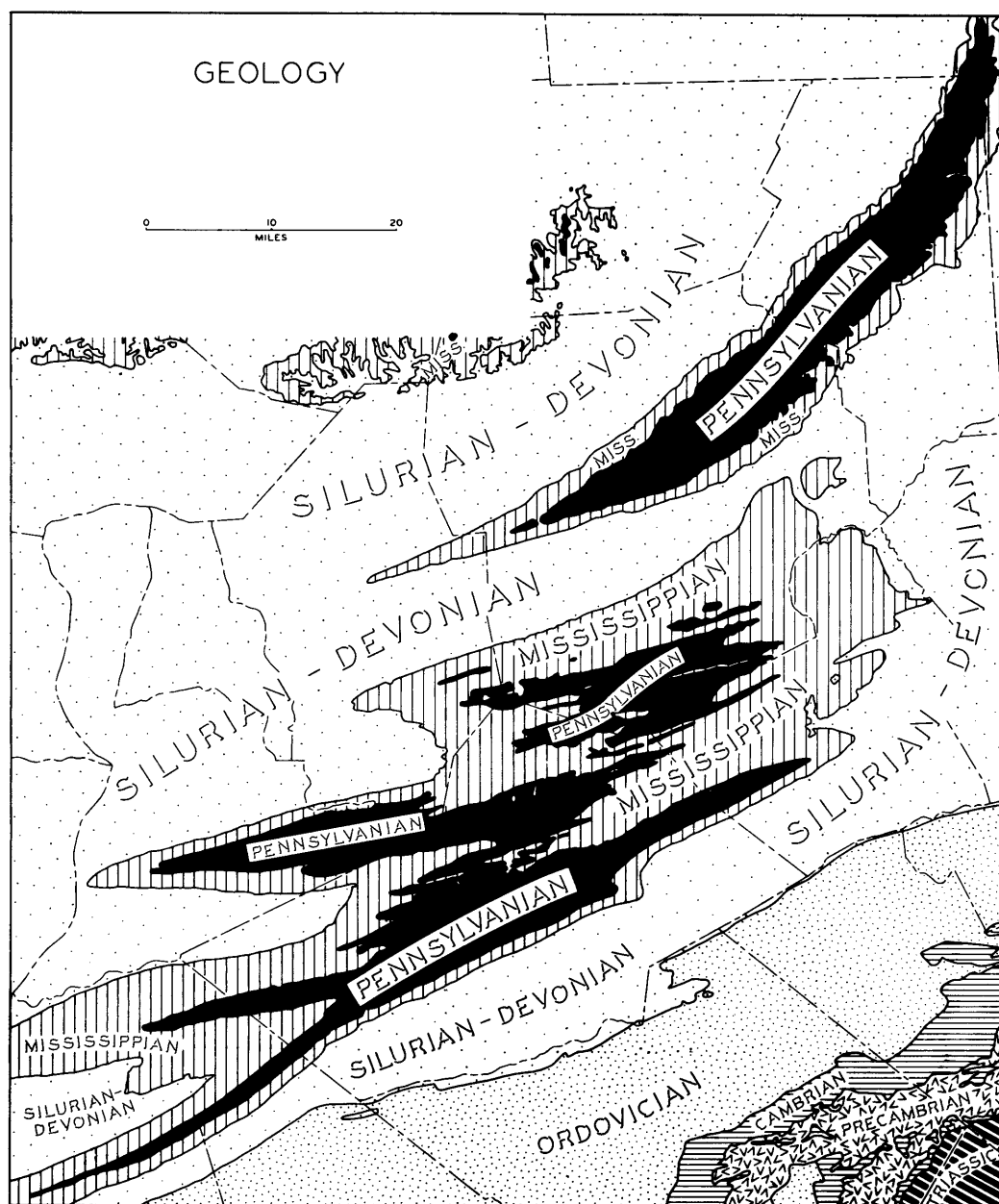
## LANDFORMS

A comparison of this landform map with the one on the facing page shows that the anthracite fields generally occupy topographic basins that are more or less continuously rimmed by one or several ridges.

The Northern Field, for example, underlies the well defined Wyoming Valley, a canoe-shaped and mountain-fringed basin measuring about 50 miles long and as much as five miles wide. Likewise, the Western Middle Field oc-

cupies a series of smaller interconnected valleys which are almost encompassed by rings of parallel ridges; and the Southern Field has a similar mountain-girded basin configuration. In contrast, the Eastern Middle Field has more the character of a high and fairly level tableland, whose edges drop off abruptly to surrounding lower lands.

Because of the rugged topography of much of the fringes of the anthracite region, it was early called St. Anthony's Wilderness.



Appendix: Note 8.

## GEOLOGY

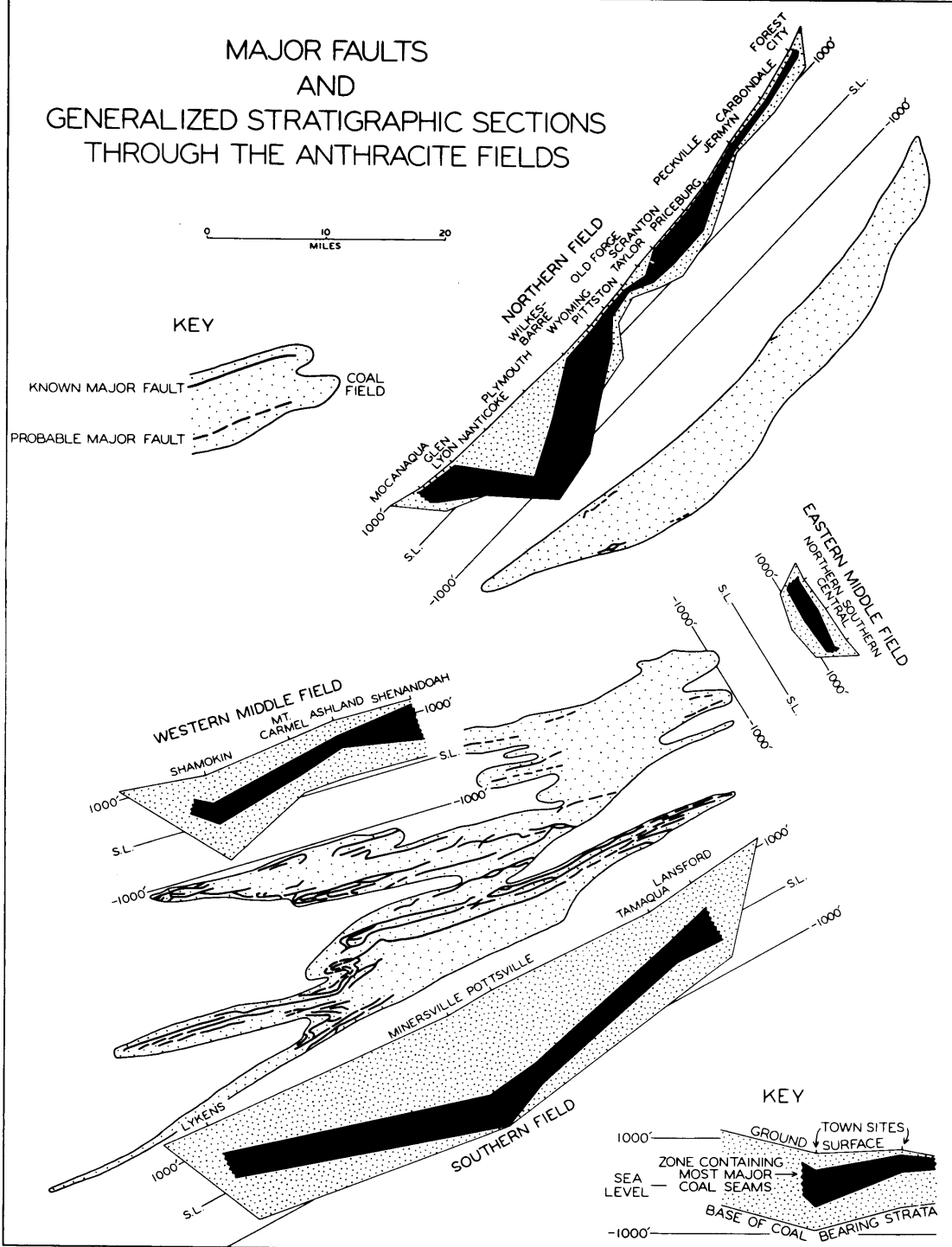
Almost all rocks underlying the anthracite region and neighboring territory, except surficial materials such as recent stream and glacial deposits, consist of sedimentary layers formed during the Paleozoic era on the geologic time scale.

The most recent of the subdivisions comprising that era, the Permian period, is missing, but successively older subdivisions are found. These include the Pennsylvanian period (from 270 to 310 million years ago), the Mississippian (from 310 to 350 million years ago), the Devon-

ian (from 350 to 400 million years ago), the Silurian (from 400 to 440 million years ago), the Ordovician (from 440 to 500 million years ago), and the Cambrian (from 500 to 600 million years ago).<sup>\*</sup> Precambrian age rocks, found in the southeastern corner of the map, are older than any of the rocks of Paleozoic age listed above; and Triassic age rocks, also in the southeast, are much younger.

<sup>\*</sup> Geologic ages are given on the revised scale of A. Holmes, Trans. Edin. Geol. Soc., 17 (1960) p. 183.

# MAJOR FAULTS AND GENERALIZED STRATIGRAPHIC SECTIONS THROUGH THE ANTHRACITE FIELDS



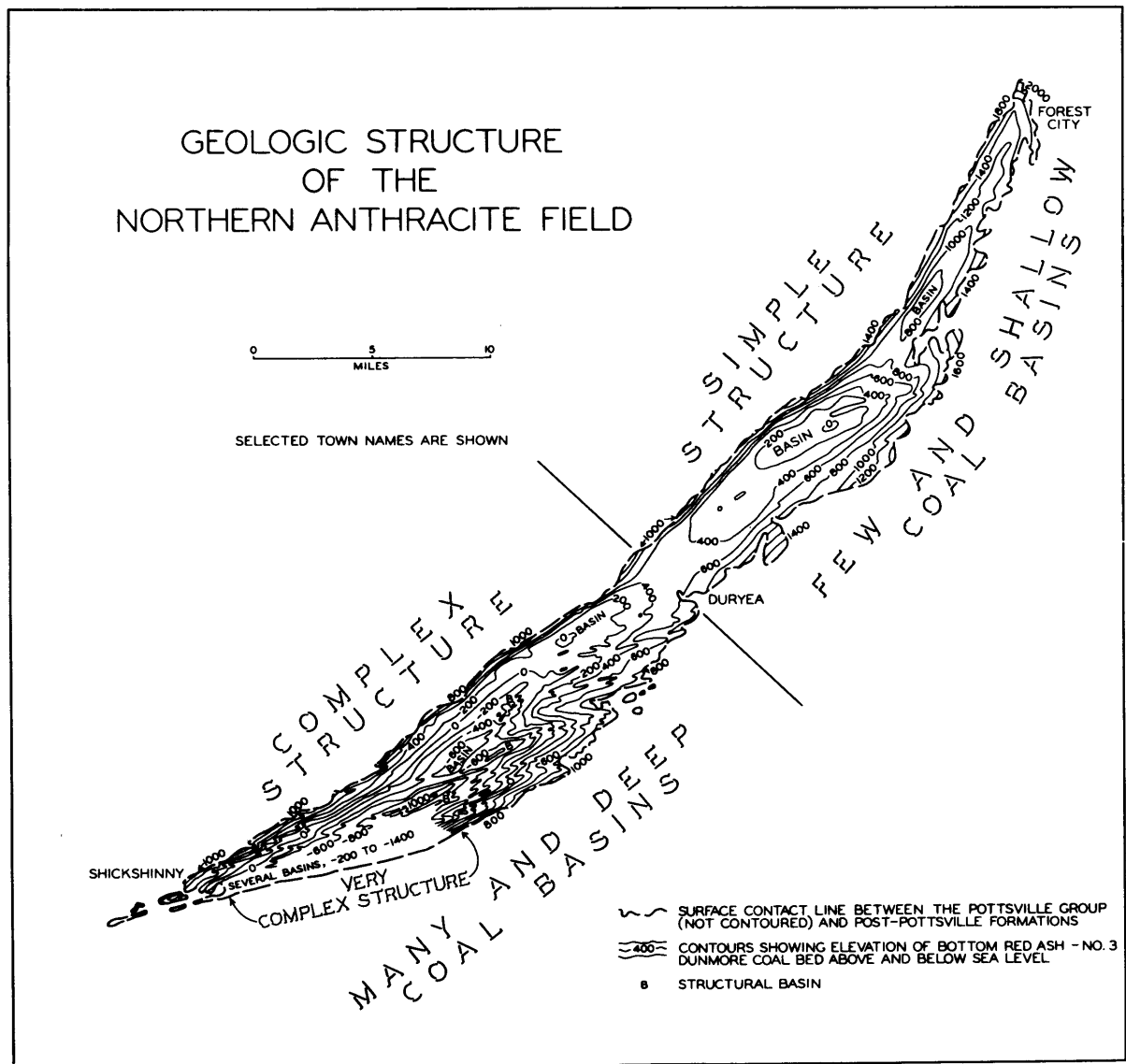
Appendix: Note 9.

## FAULTS AND STRATIGRAPHIC SECTIONS

Stratigraphic sections are highly generalized, represent average conditions, and are based on data relative only to the town sites indicated. Intervals between town sites are bridged by

straight lines. The term major coal seams indicates those measuring five feet or more in thickness at the town sites.

## GEOLOGIC STRUCTURE OF THE NORTHERN ANTHRACITE FIELD



Appendix: Note 10.

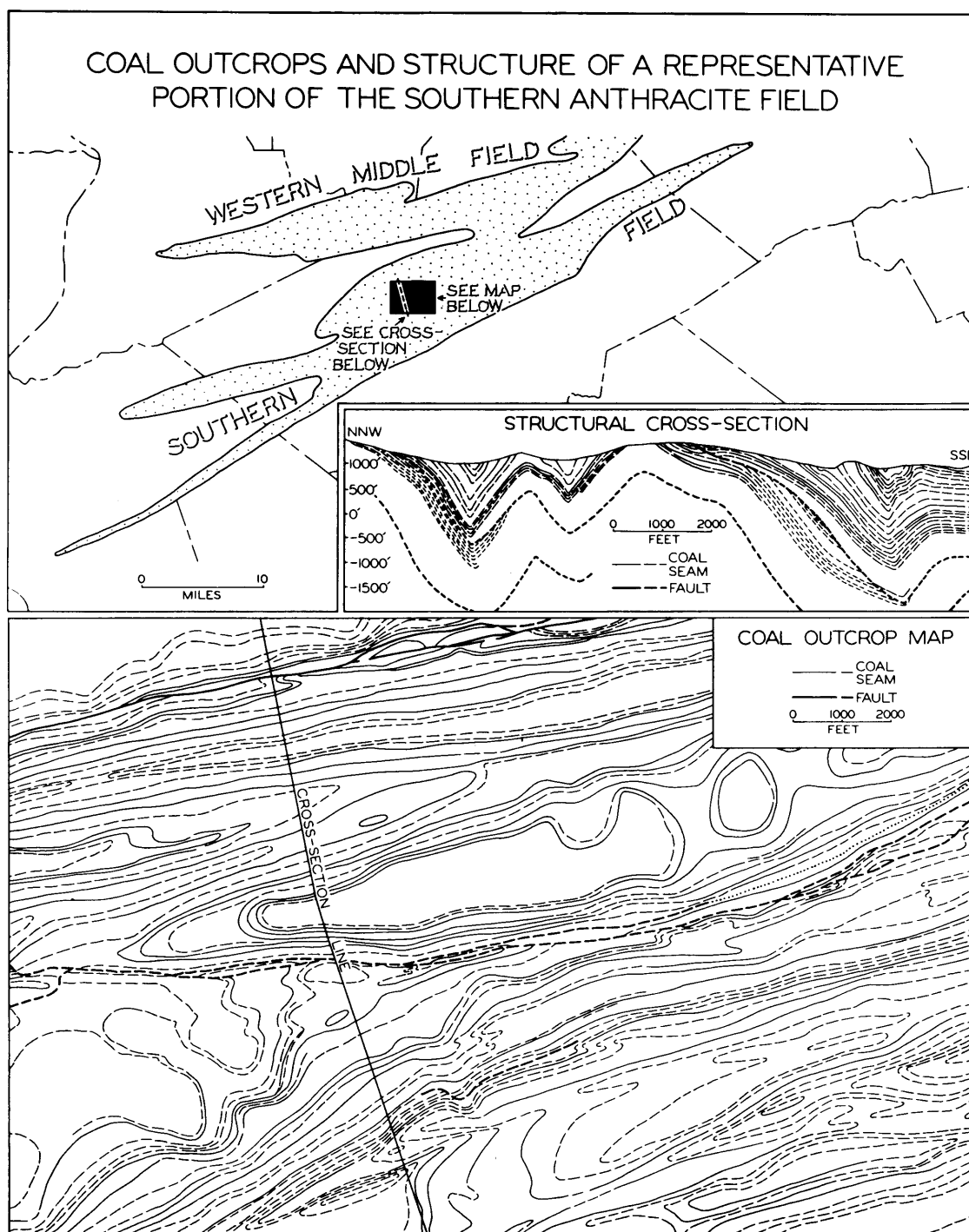
### STRUCTURE OF NORTHERN FIELD

The Bottom Red Ash — No. 3 Dunmore coal bed that is contoured on the above map is, in most places, the lowest important coal bed in the Northern Anthracite Field. The name Bottom Red Ash is employed to designate the coal bed in the southwestern portion of the field (see columnar sections on page 13), and the name No. 3 Dunmore is employed in the northeastern portion of the field (see columnar sections on page 12).

The contour interval on the map is 200 feet. For most places the contour lines were compiled from mine maps of various coal companies, but locally the lines were estimated from drill records

and surface data. Datum (sea) level differed slightly with different coal companies. The outcrop of the Bottom Red Ash — No. 3 Dunmore coal bed coincides with the surface contact line between the Pottsville Group (not contoured) and Post-Pottsville formations.

Because of limitations of map scale, contour lines are omitted from the area of most complex structure in a part of the southwestern portion of the field. The terms "complex structure" and "very complex structure" are applicable only to the Northern Anthracite Field; areas of far greater structural complexity are found elsewhere in the world.



Appendix: Note 11.

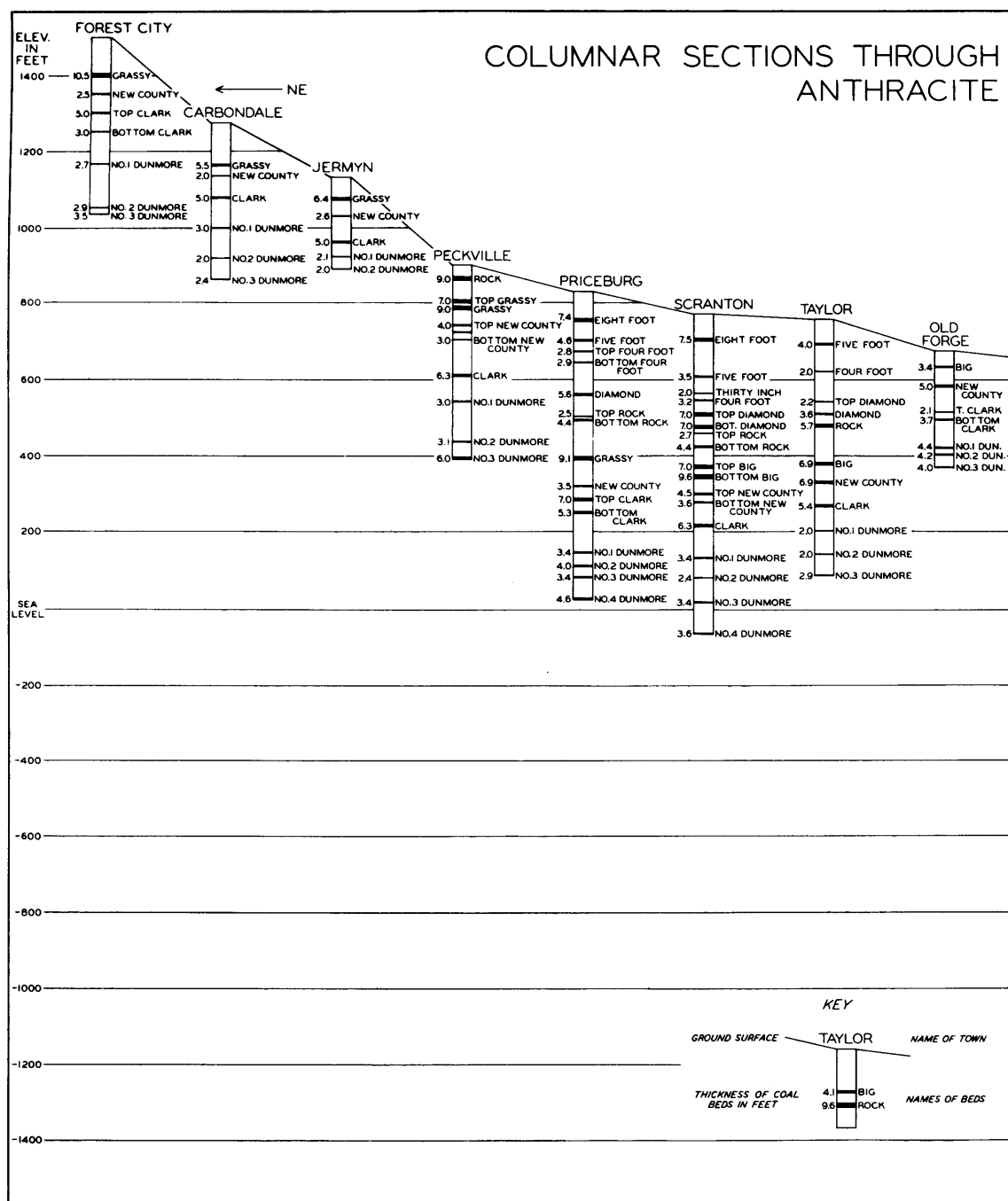
### COAL OUTCROPS AND STRUCTURE OF SOUTHERN FIELD

Note, on the structural cross-section, the number, steepness of pitch, and depth of the synclines; and, on the coal outcrop map, the resulting great number, close proximity, and intricate surface configuration of coal outcrops. Such complex structural and outcrop patterns are typical

of most portions of the Western Middle, Eastern Middle, and Southern Anthracite Fields.

On both cross-section and map, the more continuous the lines representing coal seams and faults, the greater the degree of certainty as to their existence and precise location.





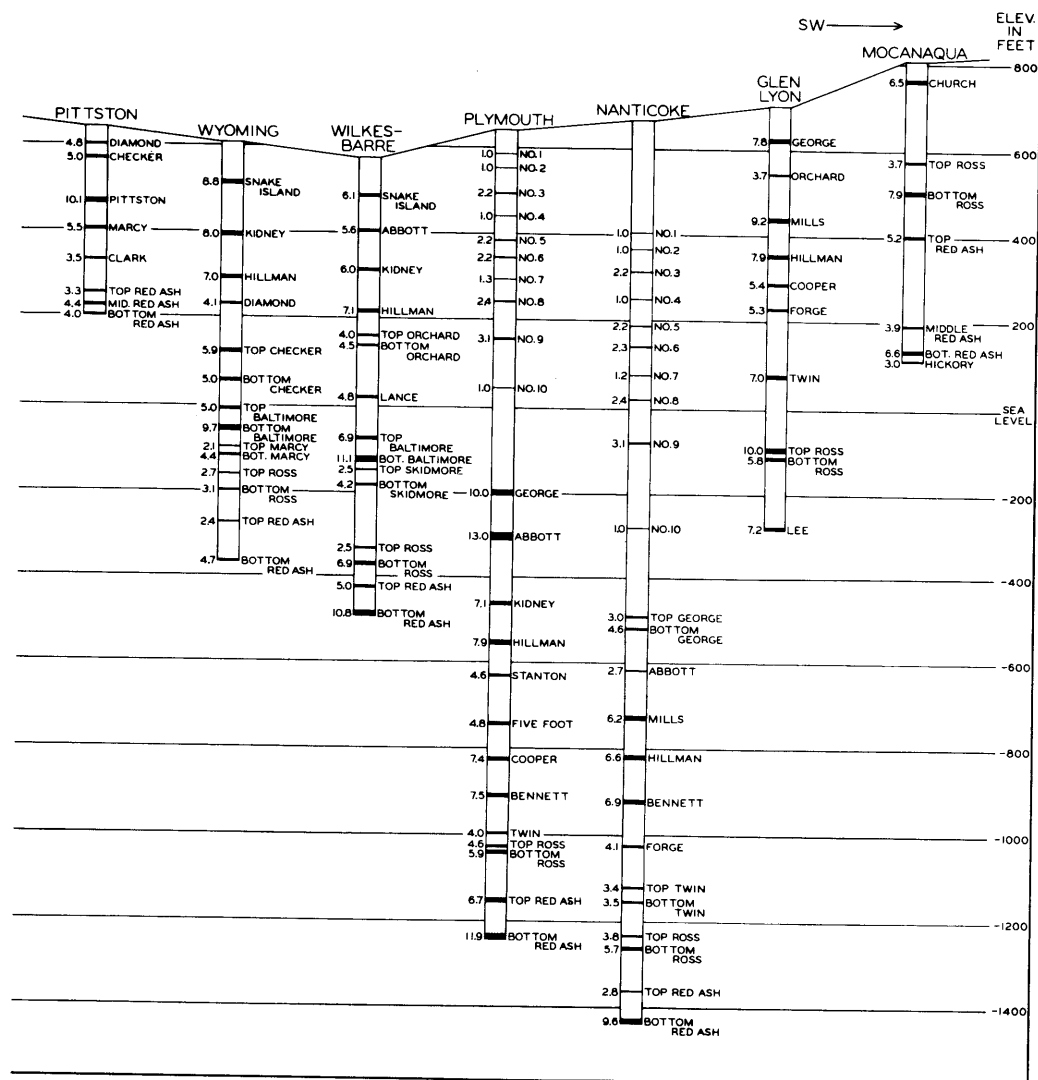
Appendix: Note 12.

## COLUMNAR SECTIONS — NORTHERN FIELD

Columnar sections indicate average elevation of land surface, average maximum depth of coal beds, average vertical interval between beds, average thickness of beds, and local names of beds. Selected town names indicate the approximate position of each columnar section in the anthracite region.

Identification and naming of coal beds at various localities in the anthracite region is inexact because of the complicated structure and stratigraphy of the area. Hence, identical names of coal beds in various of the columnar sections need not necessarily indicate correlations between the named beds. Conversely, different

# THE BEDS OF THE NORTHERN FIELD

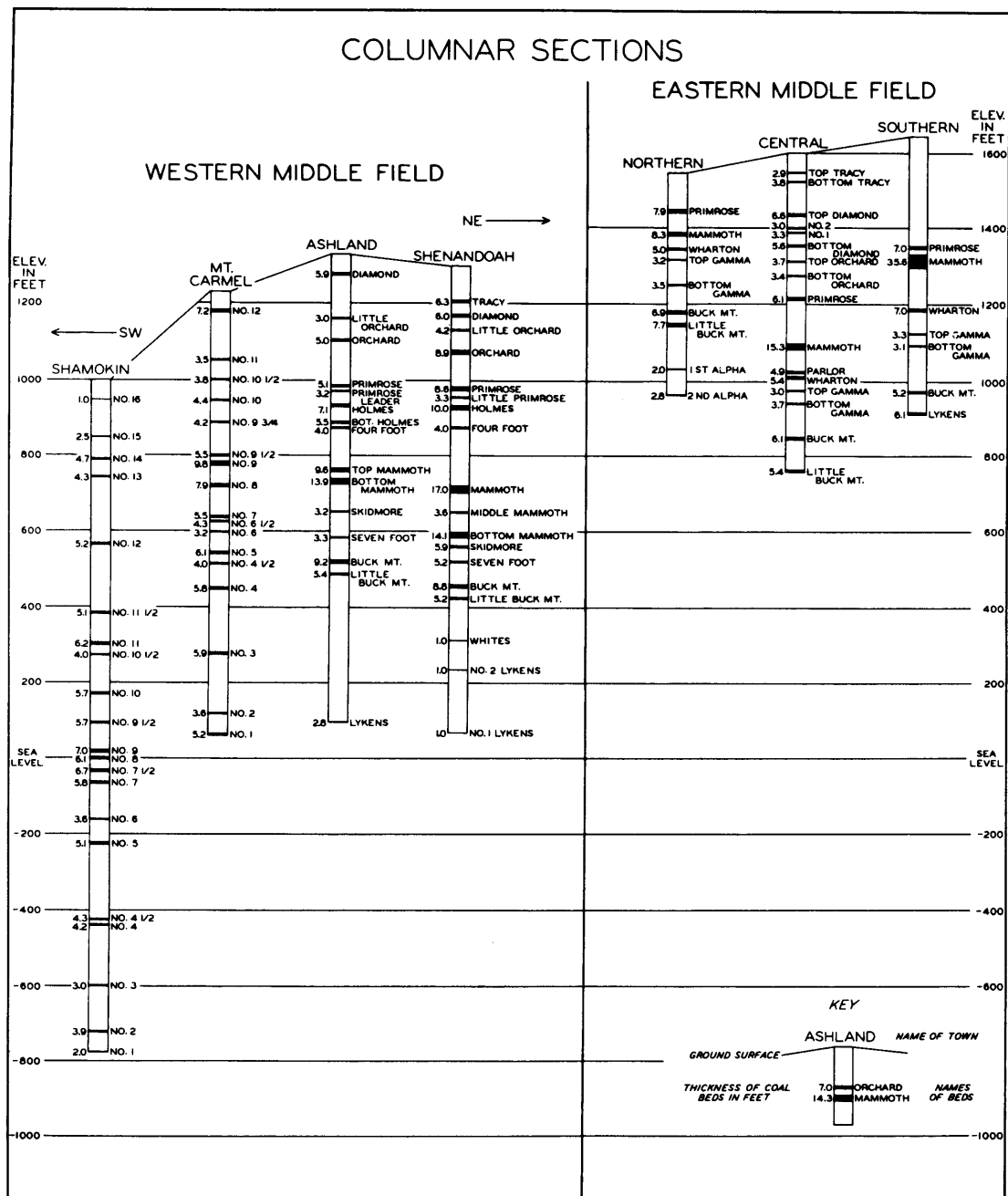


Appendix: Note 12.

names of coal beds in various of the columnar sections need not necessarily indicate lack of correlations between the named beds, since local nomenclature is frequently in disagreement with that used elsewhere. Note that differences in terminology are almost complete between the northeastern half of the Northern Field (from

Forest City to Old Forge) and the southwestern half (from Pittston to Mocanaqua).

The columnar sections indicate major differences in depths of coal beds beneath the surface, and in their vertical position above or below sea level, from one part of the Northern Field to another.



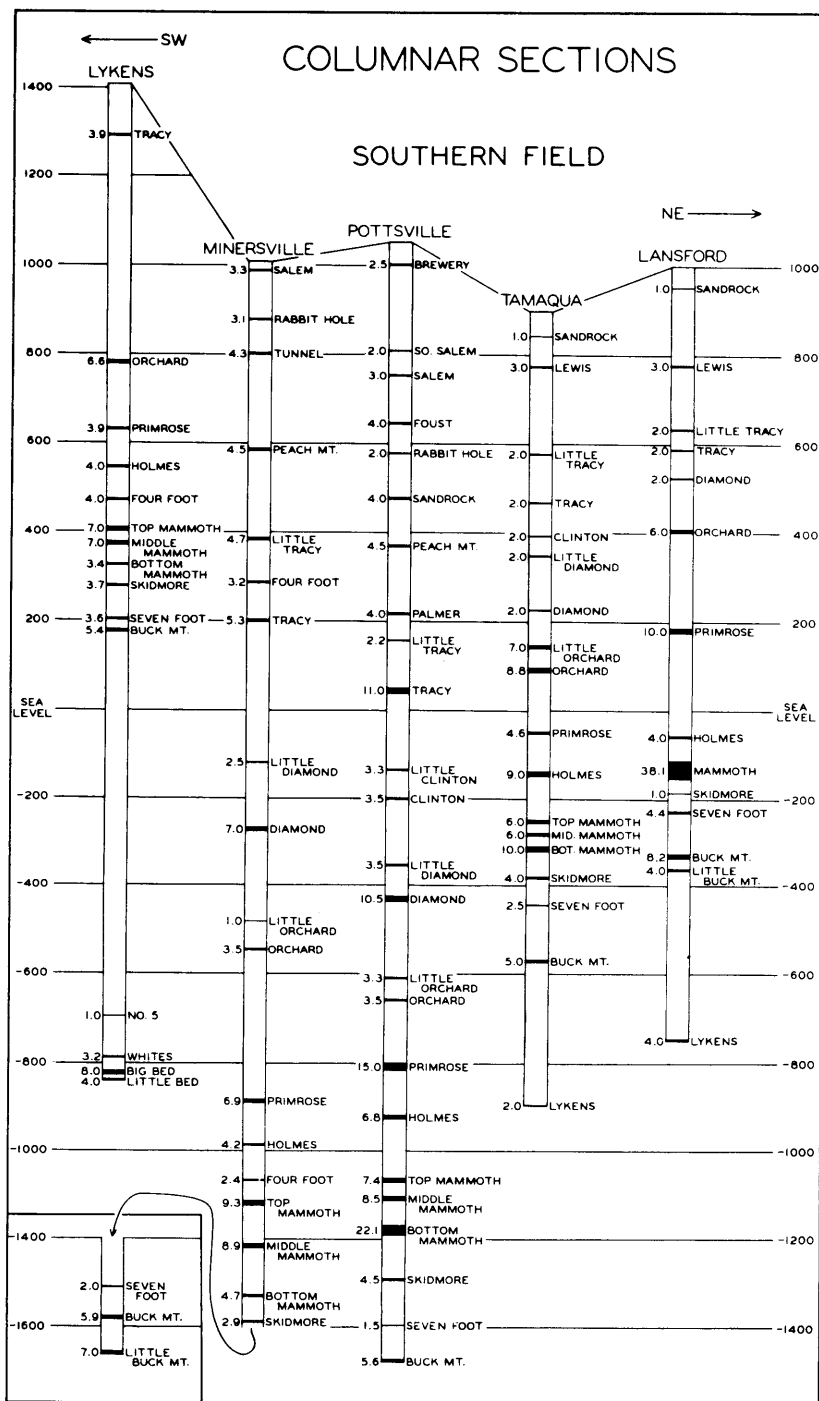
Appendix: Note 12.

### COLUMNAR SECTIONS WESTERN MIDDLE AND EASTERN MIDDLE FIELDS

See comments regarding coal bed terminology beneath the columnar sections of the Northern Field, on pages 12 and 13. In the Western Middle Field, coal bed terminology is completely different in the southwestern part (from Mt. Carmel to Shamokin) from that employed in the northeastern part (from Ashland to Shenandoah). In contrast, there is considerable similarity in the

coal bed names used in the northeastern part of the Western Middle Field and in the neighboring Eastern Middle Field.

Note the greater depths to which the coal beds extend beneath the surface in the Western Middle Field as compared with those in the Eastern Middle Field.



Appendix: Note 12.

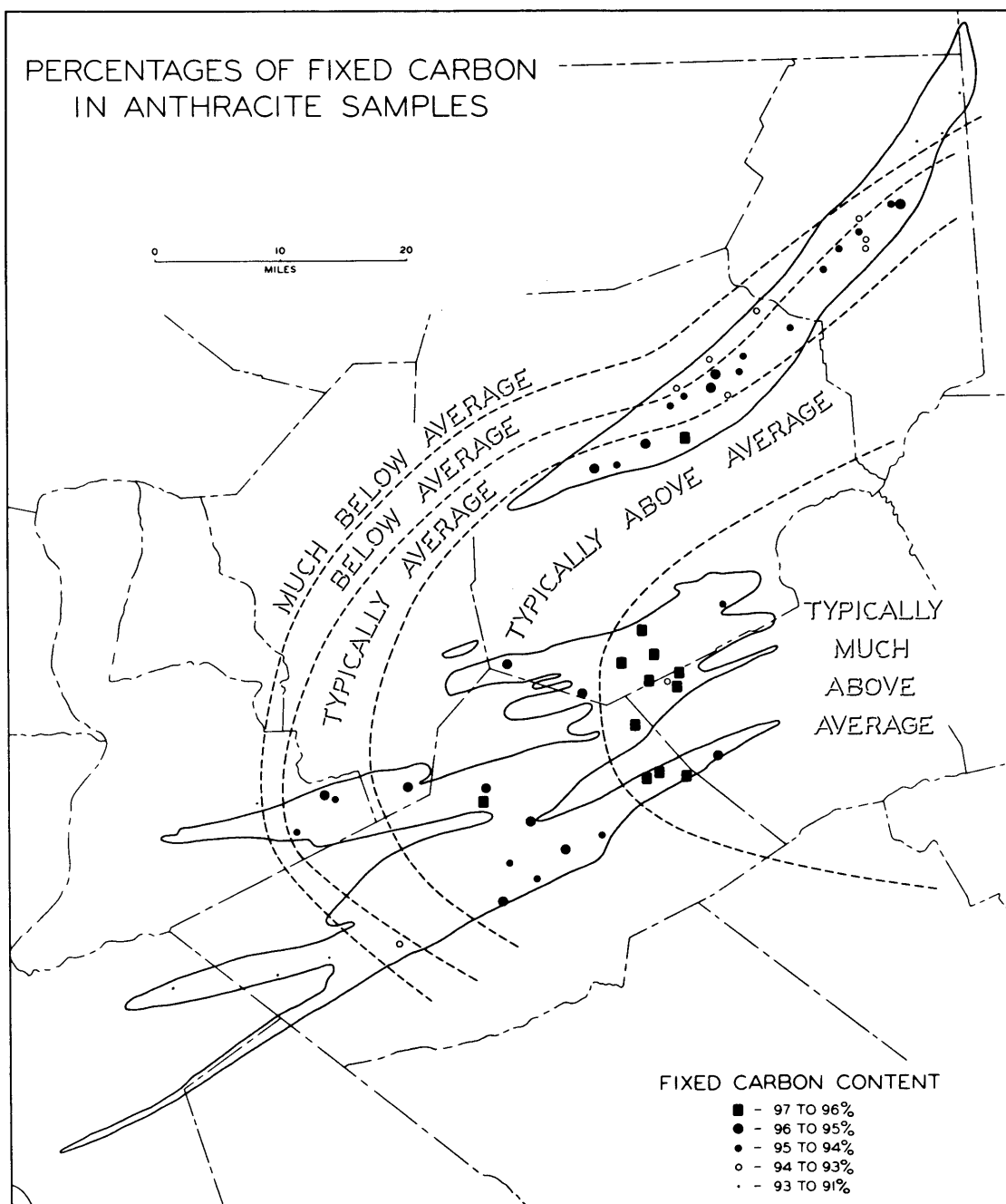
## COLUMNAR SECTIONS — SOUTHERN FIELD

See comments regarding coal bed terminology beneath the columnar sections of the Northern Field, on pages 12 and 13. Note the uniformity of terminology employed throughout the Southern Field, and the close correlation between these names and many of those used in the Eastern

Middle Field and in the northeastern part of the Western Middle Field.

The depths of many of the coal beds beneath the surface in the Southern Field are exceedingly great, and are approximated only in limited portions of the Northern Field.

Some Chemical and Physical  
Properties of  
Pennsylvania Anthracite



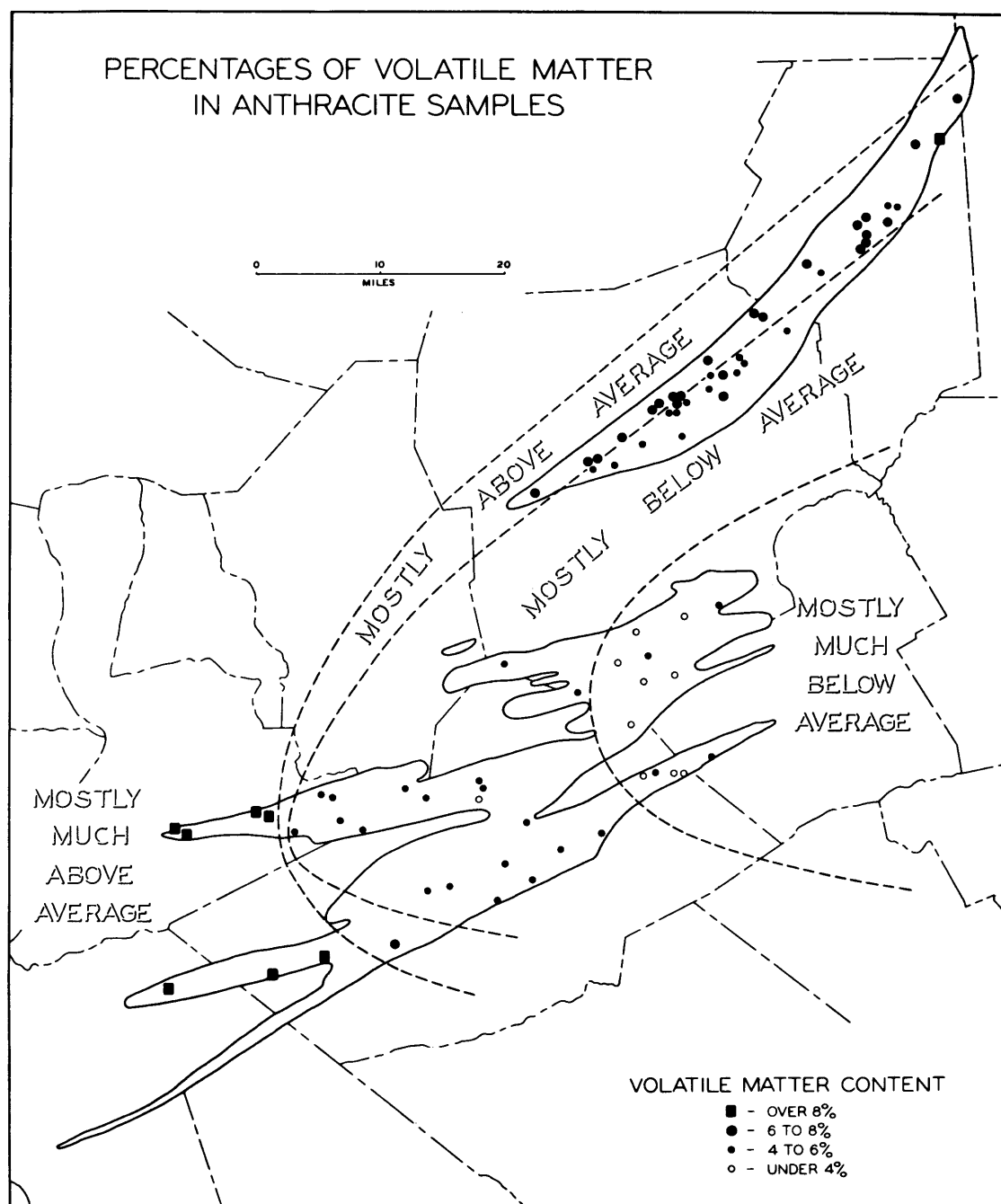
Appendix: Notes 13, 14, 15, 16, 17, 18, and 19.

## FIXED CARBON

The relative percentages of the four major components of coal — fixed carbon, volatile matter, moisture, and ash — differ from place to place in the Pennsylvania anthracite fields.

In general, fixed carbon percentages decrease from east to west and south to north, with highest values characterizing the eastern parts of the Southern and Eastern Middle Fields, and lowest

values occurring in the western portions of the Southern and Western Middle Fields and in the northern end of the Northern Field. This relationship holds true regardless of the individual coal seam considered, and appears to be related to regional differences in the intensity of heat and pressure to which the coal beds were subjected during earlier geologic time.



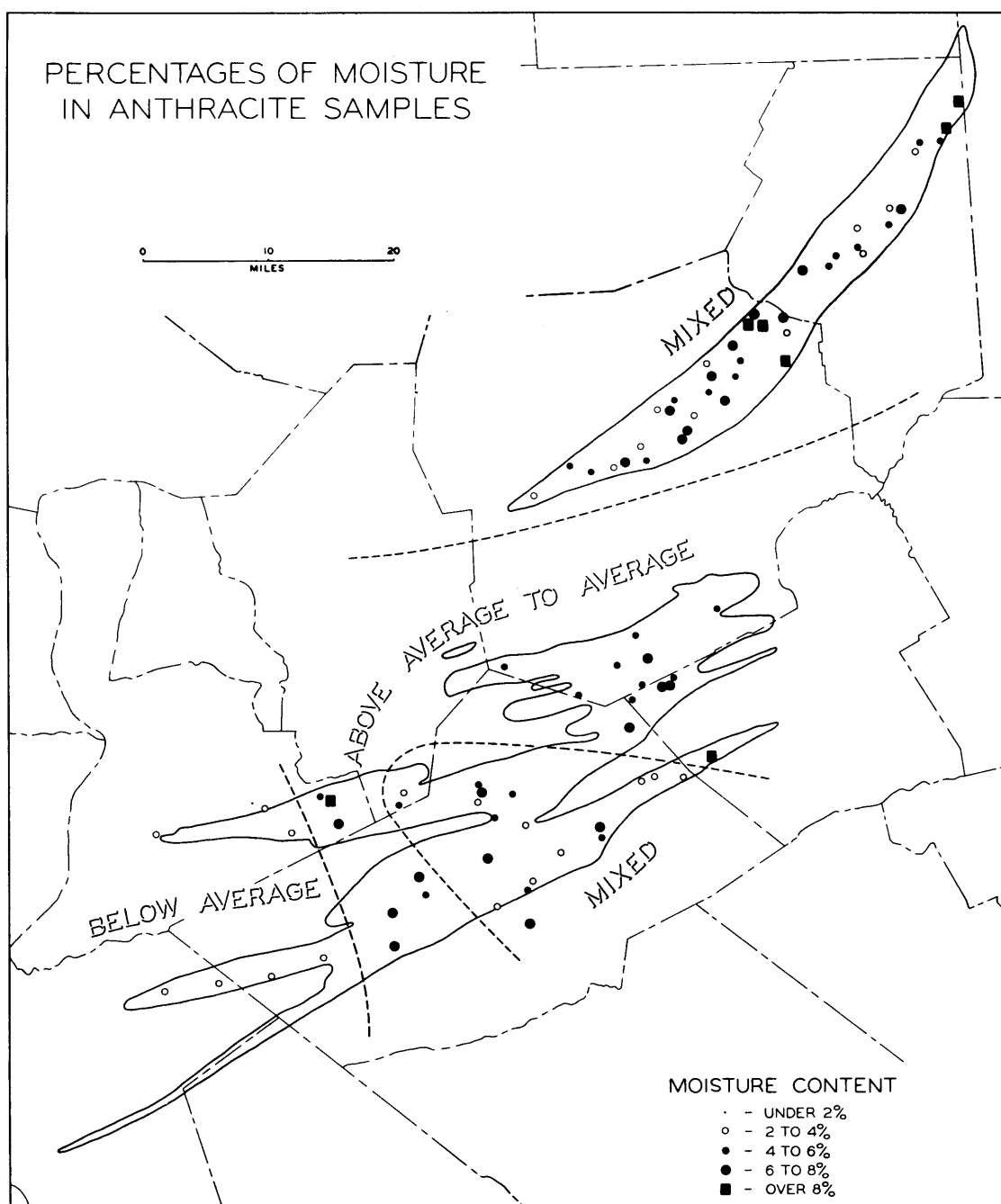
Appendix: Notes 13, 14, 15, 16, 17, 18, and 19.

## VOLATILE MATTER

Volatile matter in coal consists mainly of carbon, hydrogen and oxygen compounds that will burn if ignited. It also includes small amounts of non-combustible matter.

As in the case of fixed carbon percentages, volatile matter percentages change progressively from east to west and from south to north, and this progression is characteristic of all coal seams.

In the case of volatile matter, however, percentages *increase* westward and northward. Thus, as the above map illustrates, lowest values characterize the eastern parts of the Southern and Eastern Middle Fields, and highest values are found in the western portions of the Southern and Western Middle Fields and along the north-western side of the Northern Field.



Appendix: Notes 13, 14, 16, 17, 18, 19, and 20.

## MOISTURE

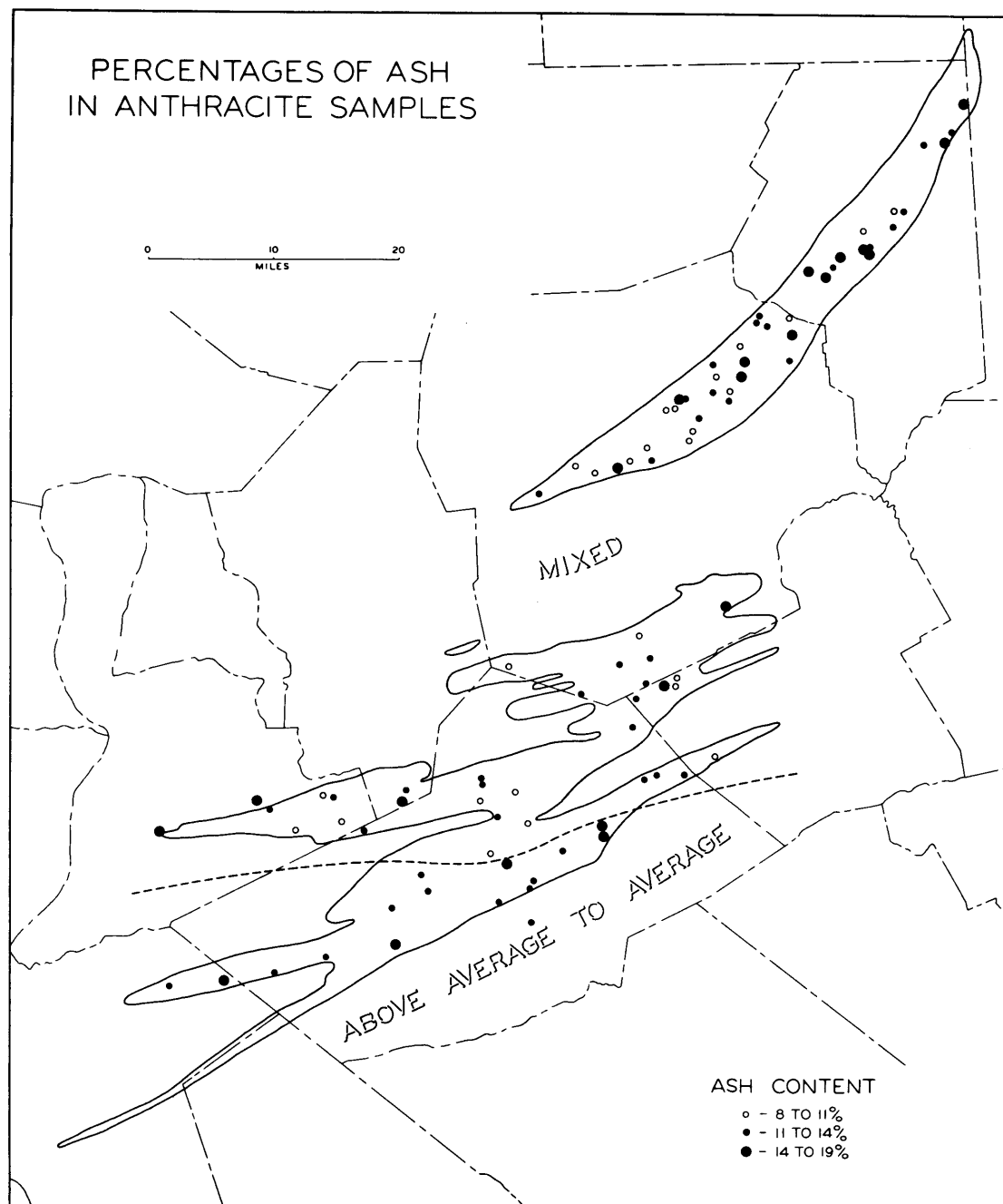
The moisture content of breaker samples of Pennsylvania anthracite ranges from approximately 0.5 to 14.6 per cent. Most rice size samples, however, have between 2 and 8 per cent moisture.

There is little in the way of systematic pattern to the distribution of coal moisture in the anthracite region, other than a tendency toward low percentages in the western parts of the Southern

and Western Middle Fields, and a tendency toward above average percentages in much of the remainder of these two fields as well as in the Eastern Middle Field.

Moisture, of course, is an undesirable constituent of coal. It does not contribute to the production of heat, and its transportation and storage entail expense.





Appendix: Notes 13, 14, 16, 17, 18, 19, and 20.

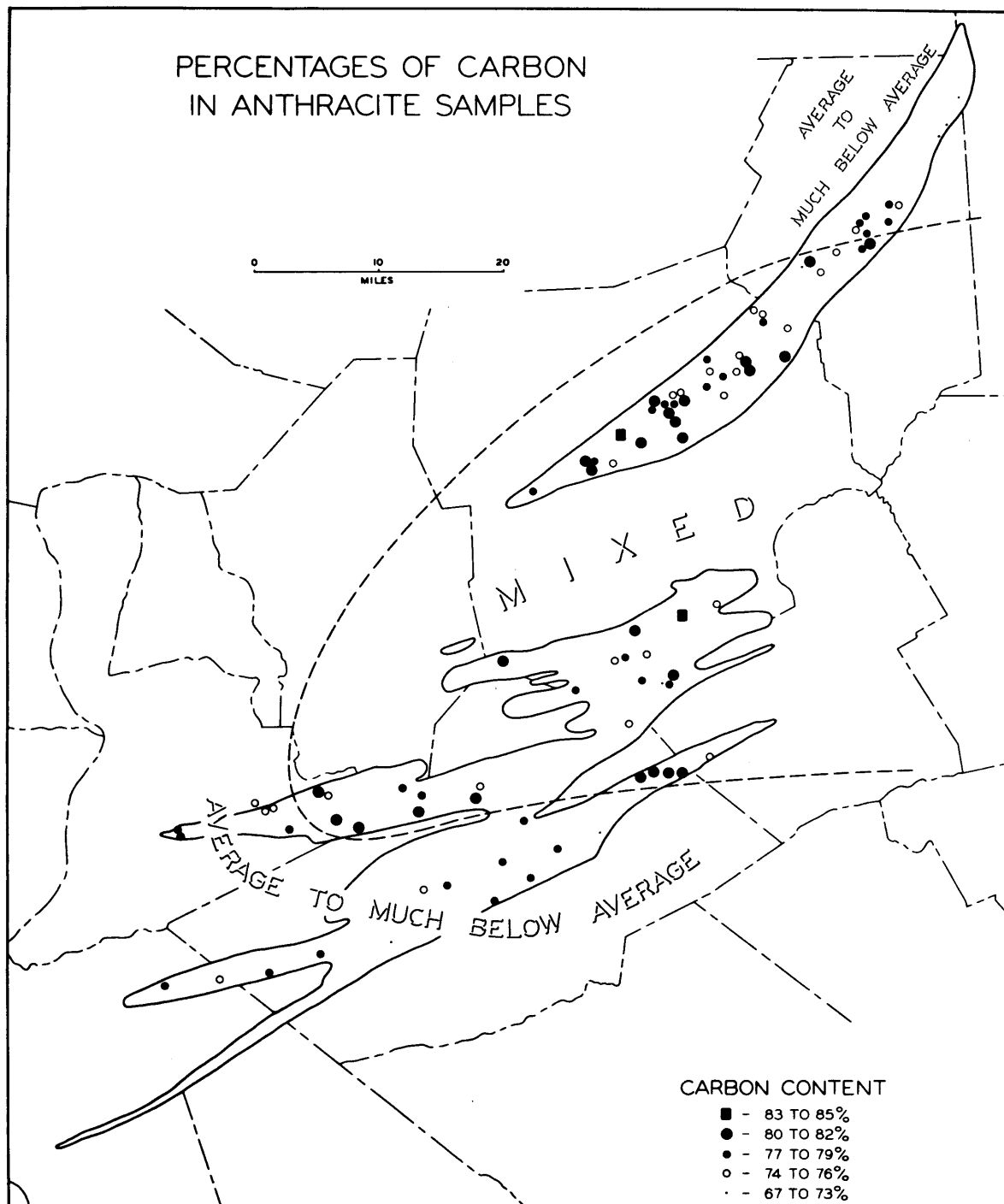
## ASH

Ash is the unconsumed solid material remaining after the combustion of coal, and is derived in part from inorganic constituents of the original coal swamp vegetation plus interlayered and intermixed rock materials.

The ash content of breaker samples of anthracite differs with the size of the samples. In general, the larger the coal size, the smaller the ash content. Other important factors influencing ash

content include the composition of the coal seam and the degree of thoroughness of breaker preparation.

As the above map indicates, there is no progressive geographical change in the ash content of rice size anthracite samples, other than a tendency toward higher ash content coals in much of the Southern Field.



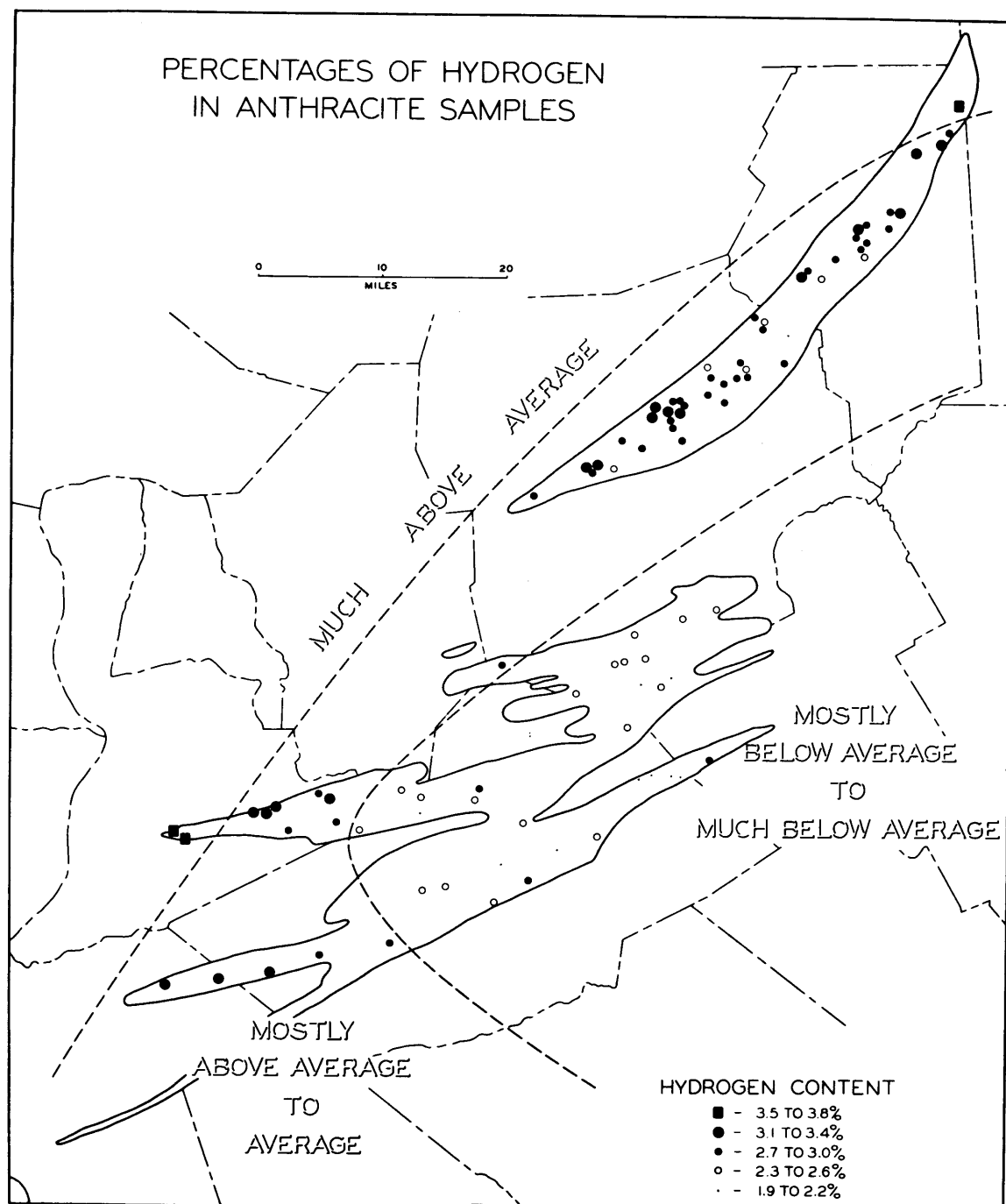
Appendix: Notes 13, 14, 16, 17, 18, 20, and 21.

## CARBON

Ultimate analysis of the carbon content of rice size anthracite as it comes from the breaker yields percentages ranging from 67 to 85, on an as-received basis. Most samples, however, range between 74 and 82 per cent.

As the above map shows, carbon percentages

of anthracite are relatively low in the northern third of the Northern Field, the western third of the Western Middle Field, and most of the Southern Field. Elsewhere, coal samples with all ranks of carbon content are geographically intermixed.



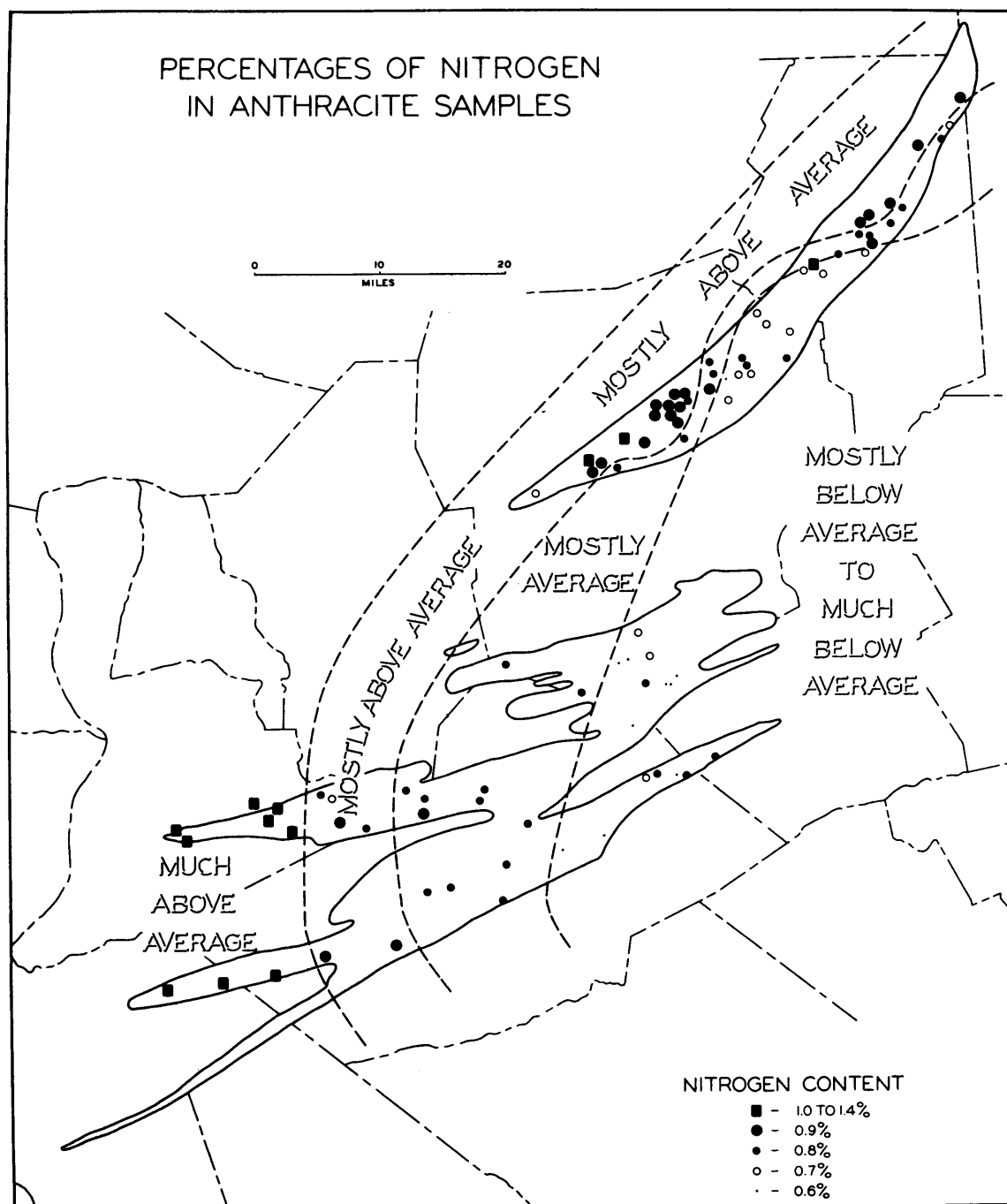
Appendix: Notes 13, 14, 16, 17, 18, 20, and 21.

## HYDROGEN

Ultimate analysis of the hydrogen content of rice size anthracite as it comes from the breaker yields percentages ranging from 1.9 to 3.8, on an as-received basis. Most samples, however, range between 2.5 and 3.1 per cent.

As the above map indicates, there is progressive increase in hydrogen content of Pennsylvania anthracite from east to west and from south

to north. Thus, lowest values characterize the Eastern Middle Field, the eastern half of the Western Middle Field, and the central and eastern portions of the Southern Field. Highest values are found at the western end of the Western Middle Field and the northern end of the Northern Field.



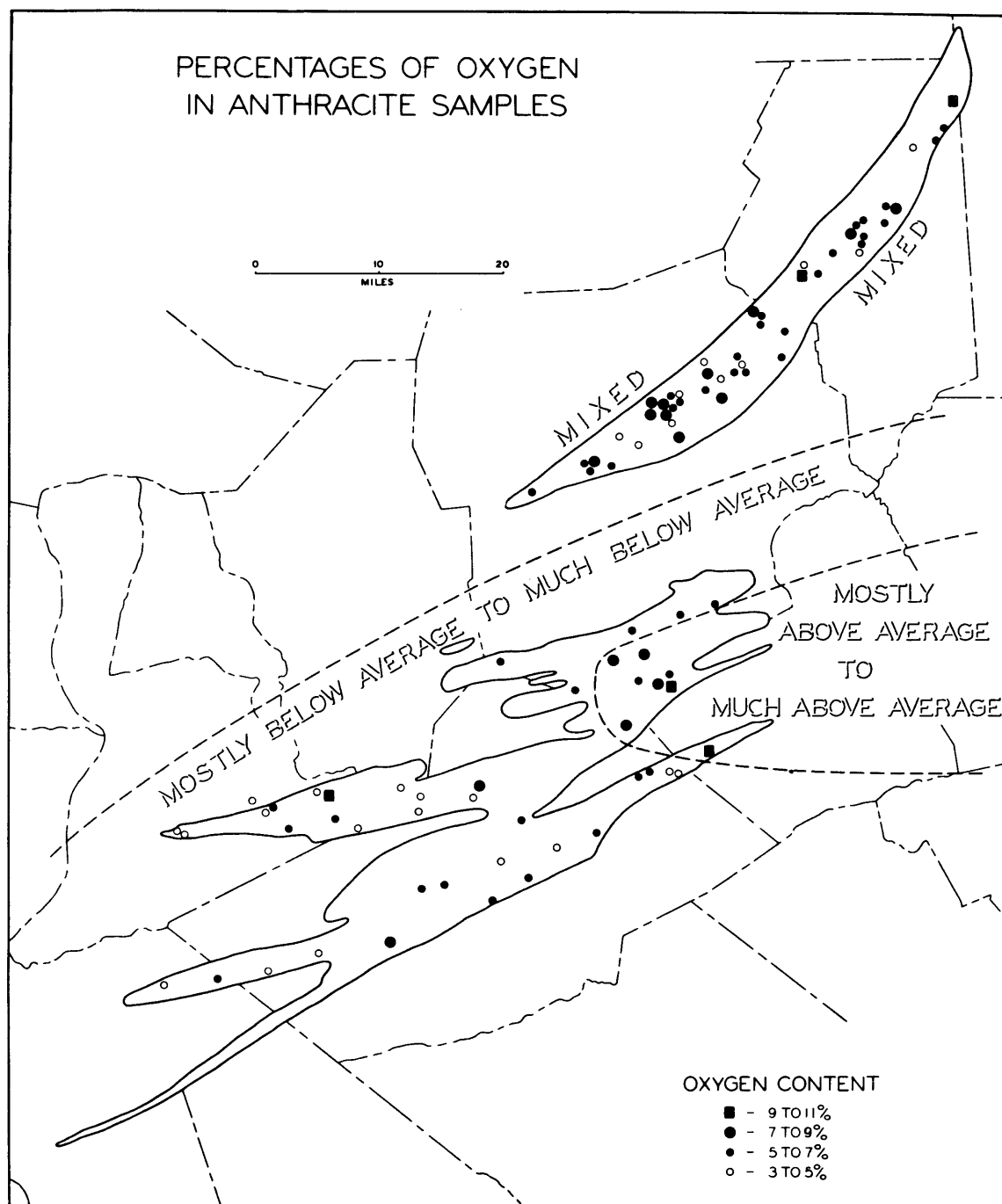
Appendix: Notes 13, 14, 16, 17, 18, 20, and 21.

## NITROGEN

Ultimate analysis of the nitrogen content of rice size anthracite as it comes from the breaker yields percentages ranging from 0.6 to 1.4, on an as-received basis. Most samples, however, range between 0.7 and 0.9 per cent.

As the above map indicates, the nitrogen content of Pennsylvania anthracite is generally low-

est in the southeast and gradually increases westward and northwestward. Lowest percentages characterize the central portion of the Northern Field and the eastern parts of the Eastern Middle and Southern Fields. Highest percentages of nitrogen are found in the western parts of the Western Middle and Southern Fields.



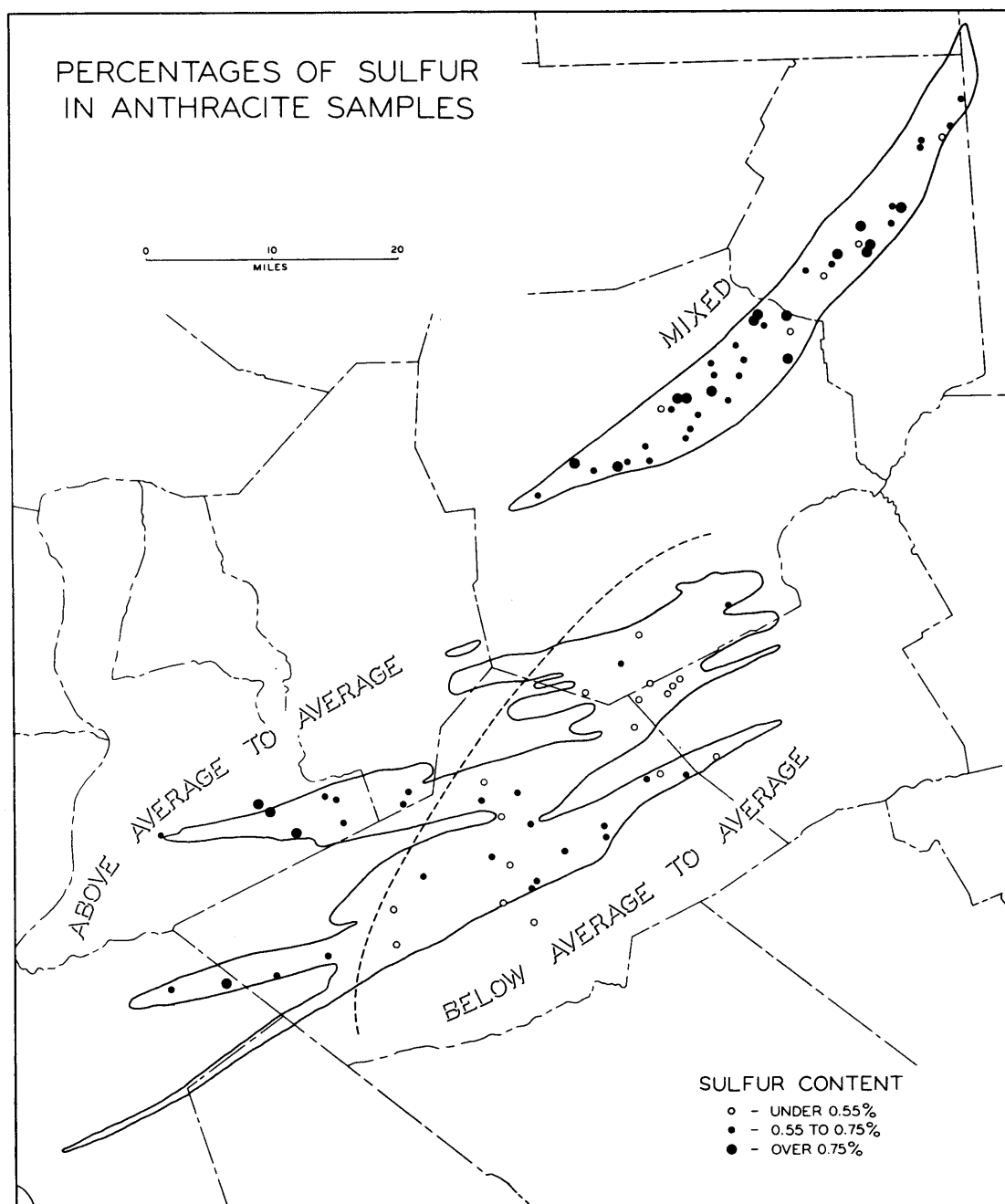
Appendix: Notes 13, 14, 16, 17, 18, 20, and 21.

## OXYGEN

Ultimate analysis of the oxygen content of rice size anthracite as it comes from the breaker yields percentages ranging from 3 to 11, on an as-received basis. Most samples, however, range between 3 and 7 per cent.

As is indicated on the above map, oxygen percentages tend to be highest in eastern portions of the Eastern Middle and Southern Fields.

Elsewhere in these two fields, and in the Western Middle Field, percentages of oxygen in most samples are below average to much below average. In the Northern Field, values range from much below to much above average, with no significant tendency toward regional differentiation.



Appendix: Notes 13, 14, 16, 17, 18, 20, and 21.

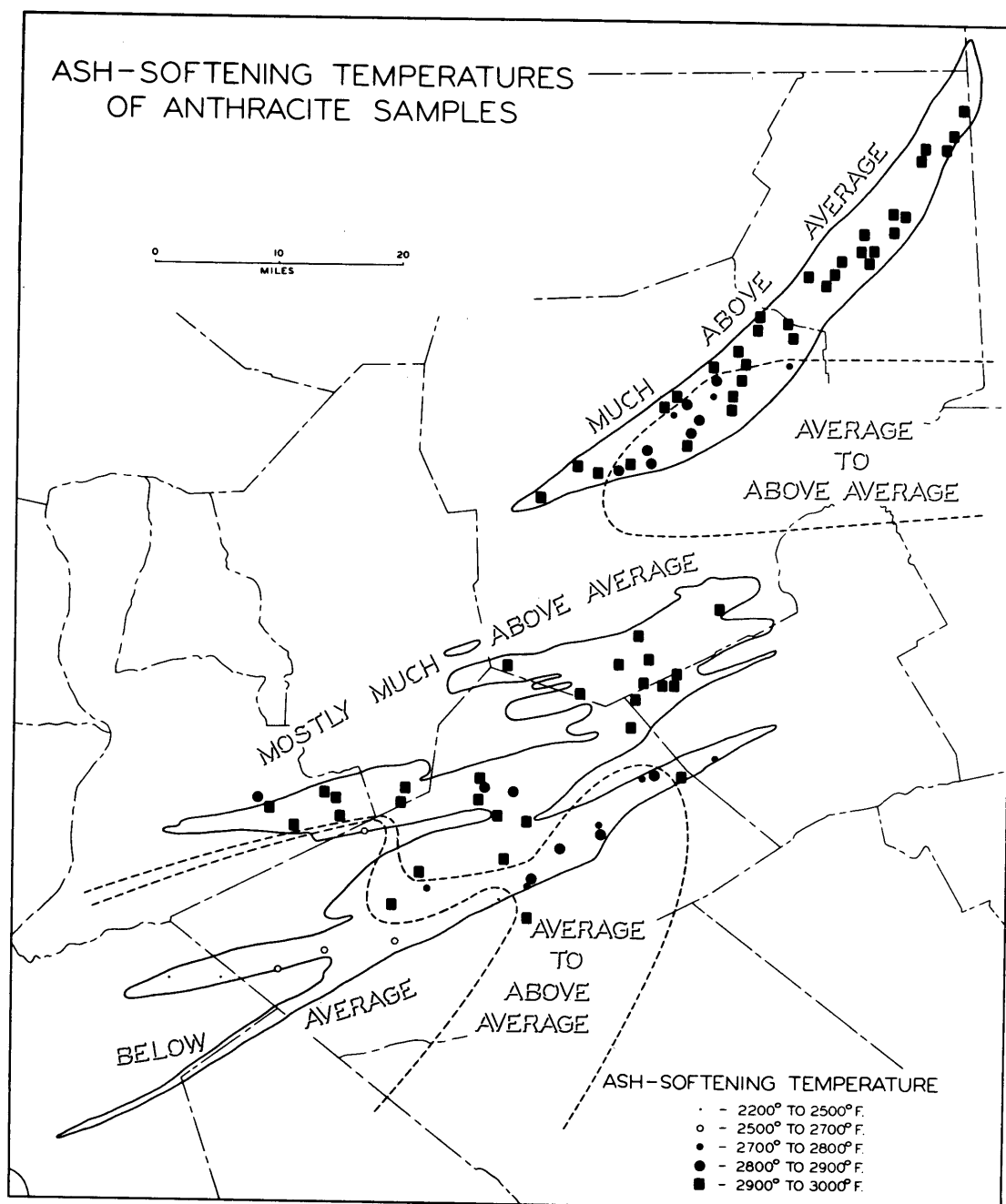
## SULFUR

Most sulfur associated with coal exists as sulfides, sulfates, and organic compounds of free sulfur. The sulfides occur either in the coal bed or in the roof rock, as solid partings, irregular crevice fillings, nodules, and microscopic particles.

The sulfur content of Pennsylvania anthracite as it comes from the breaker generally ranges from 0.3 to 1.2 per cent, on an as-received basis.

In a few instances, however, amounts exceed 2 and even 3 per cent.

As illustrated above, sulfur content tends to be lower in the southeastern portion of the combined Southern and Middle Fields than elsewhere in those fields. In the Northern Field, samples having the full range of sulfur values are geographically intermixed.



Appendix: Notes 13, 14, 16, 17, 18, and 20.

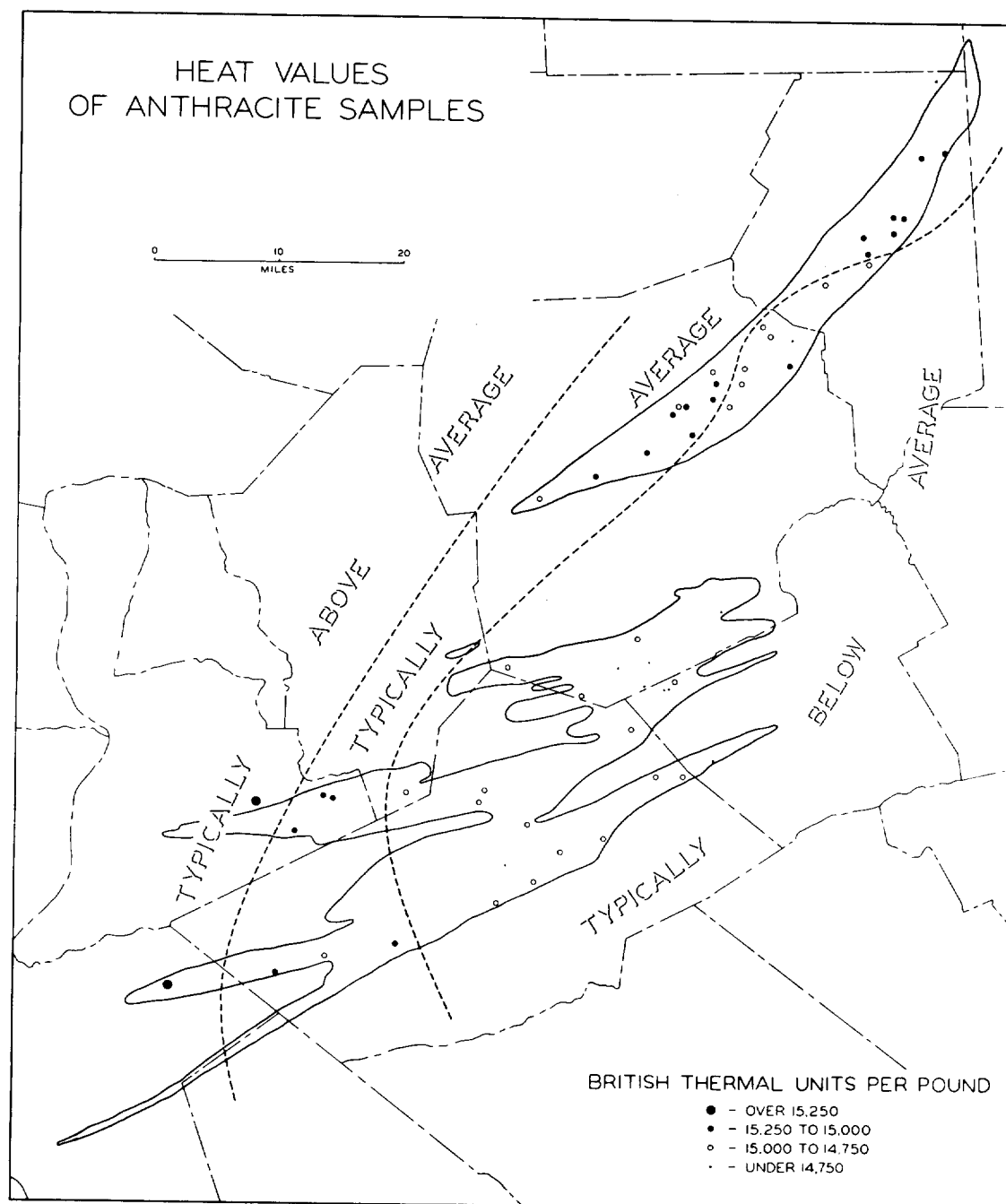
## ASH-SOFTENING TEMPERATURES

The softening temperature of coal ash, sometimes erroneously called the ash fusion temperature, is that temperature at which a cone of ash, when heated in a test furnace under prescribed conditions, fuses down to a spherical lump. This softening temperature is an important factor in determining the clinkering properties of coal. Ash with a softening temperature above 2,600° F is classified as refractory.

The ash-softening temperature of breaker samples of Pennsylvania anthracite ranges from approximately 2,200° to 3,000° F. As the above map represents, ash-softening temperatures increase progressively from southwest to northeast in the combined Southern and Middle Fields, and are much above average in all but a small portion of the Northern Field.







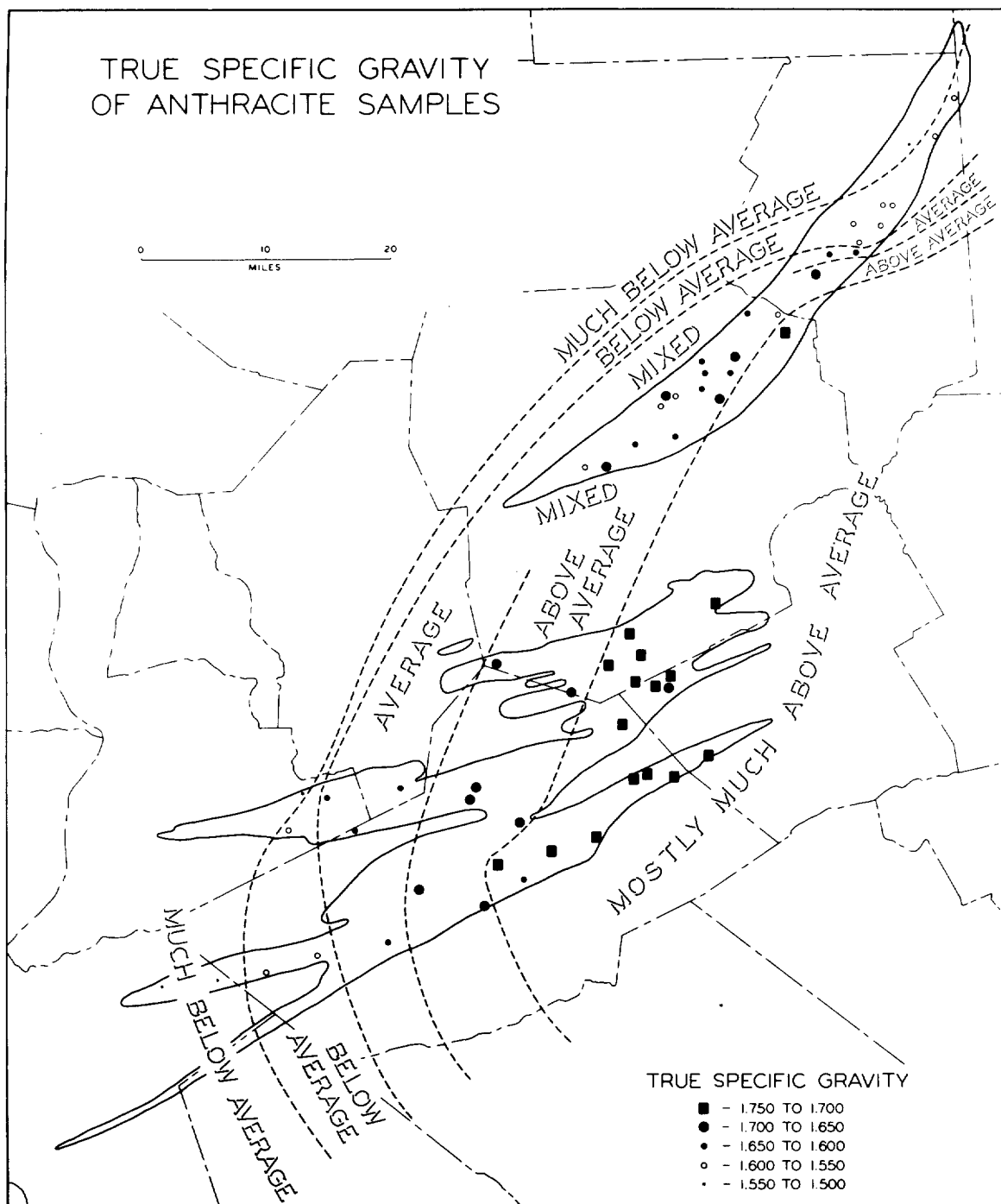
Appendix: Notes 13, 14, 15, 16, 17, and 18.

## HEAT VALUES

There is a close relationship between the percentage of volatile matter (see map on page 19) and the heat value of Pennsylvania anthracite. In general, the higher the volatile matter the higher the B.T.U. content, which is the reverse of the relationship in most bituminous coals of the Commonwealth. There is a difference of approximately 1,000 B.T.U.'s per pound between Pennsylvania anthracite of lowest and highest

rank, with values ranging from 14,430 to 15,450 on a dry ash-free basis.

The map above indicates a generally progressive increase in heat values from southeast to the west and northwest in the anthracite region. Coal with highest heat values is limited to the western ends of the Southern and Western Middle Fields.

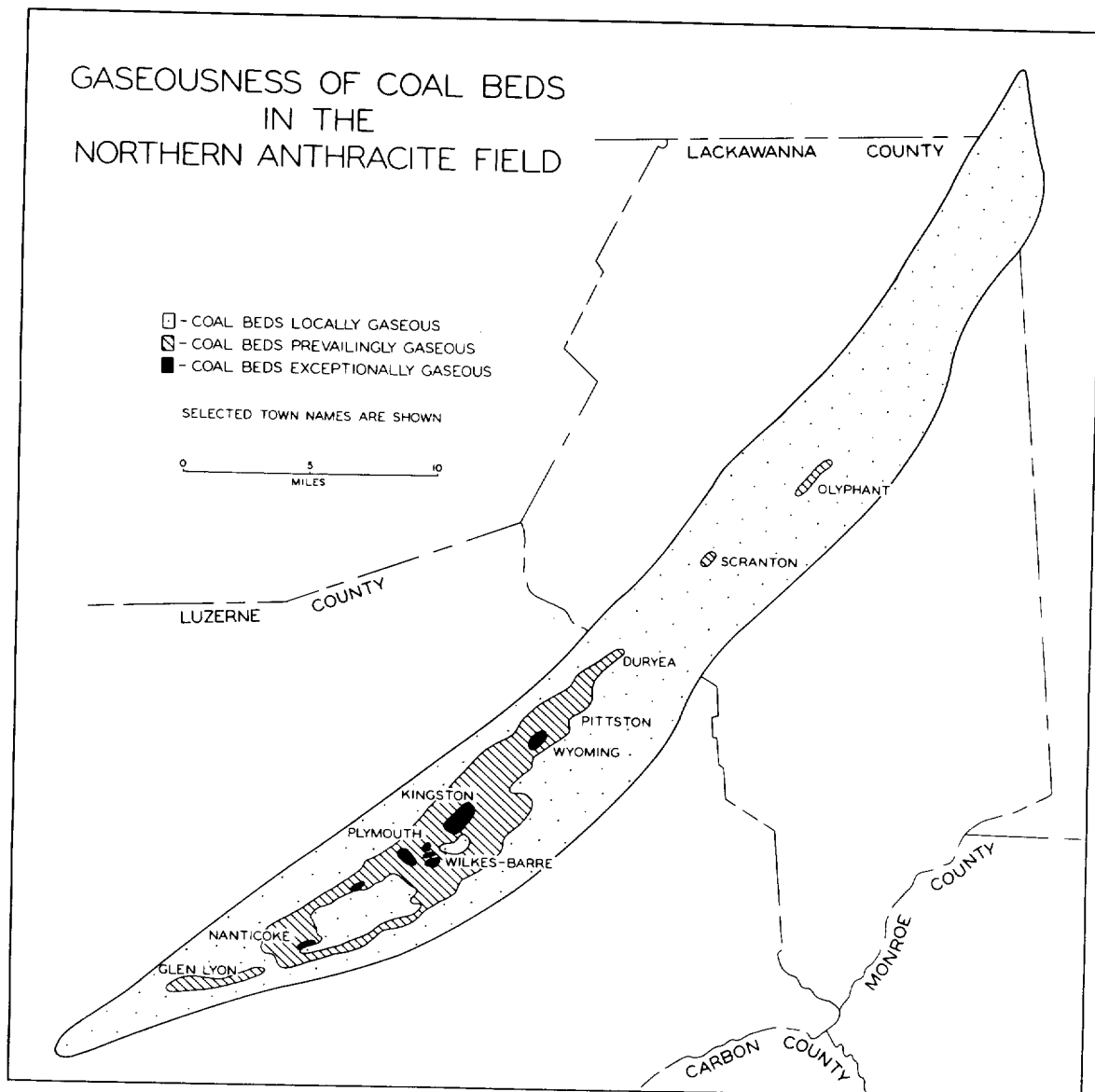


### TRUE SPECIFIC GRAVITY

The true specific gravity of rice size samples of Pennsylvania anthracite ranges from approximately 1.500 to 1.750.

In general, specific gravity values decrease in a smoothly progressive fashion from east to west and south to north. Highest values characterize the eastern parts of the Southern and Eastern

Middle Fields, and the east-central margin of the Northern Field. Lowest values are found at the western ends of the Southern and Western Middle Fields, and at the northern end of the Northern Field. Only in the southwestern portion of the Northern Field are widely divergent sample values geographically intermixed.



Appendix: Note 28.

### GASEOUSNESS — NORTHERN FIELD

Coal beds differ markedly in gaseousness from one geographical locality to another, and the changes frequently are of major proportions within short distances. The above map illustrates such variations as they occur within the Northern Anthracite Field. Note the lack of pronounced gaseousness in the Lackawanna County section of the field, except for local areas near Olyphant and Scranton, and the extensive expanse of prevalingly or exceptionally gaseous conditions in the interior portions of the Luzerne County section of the field.

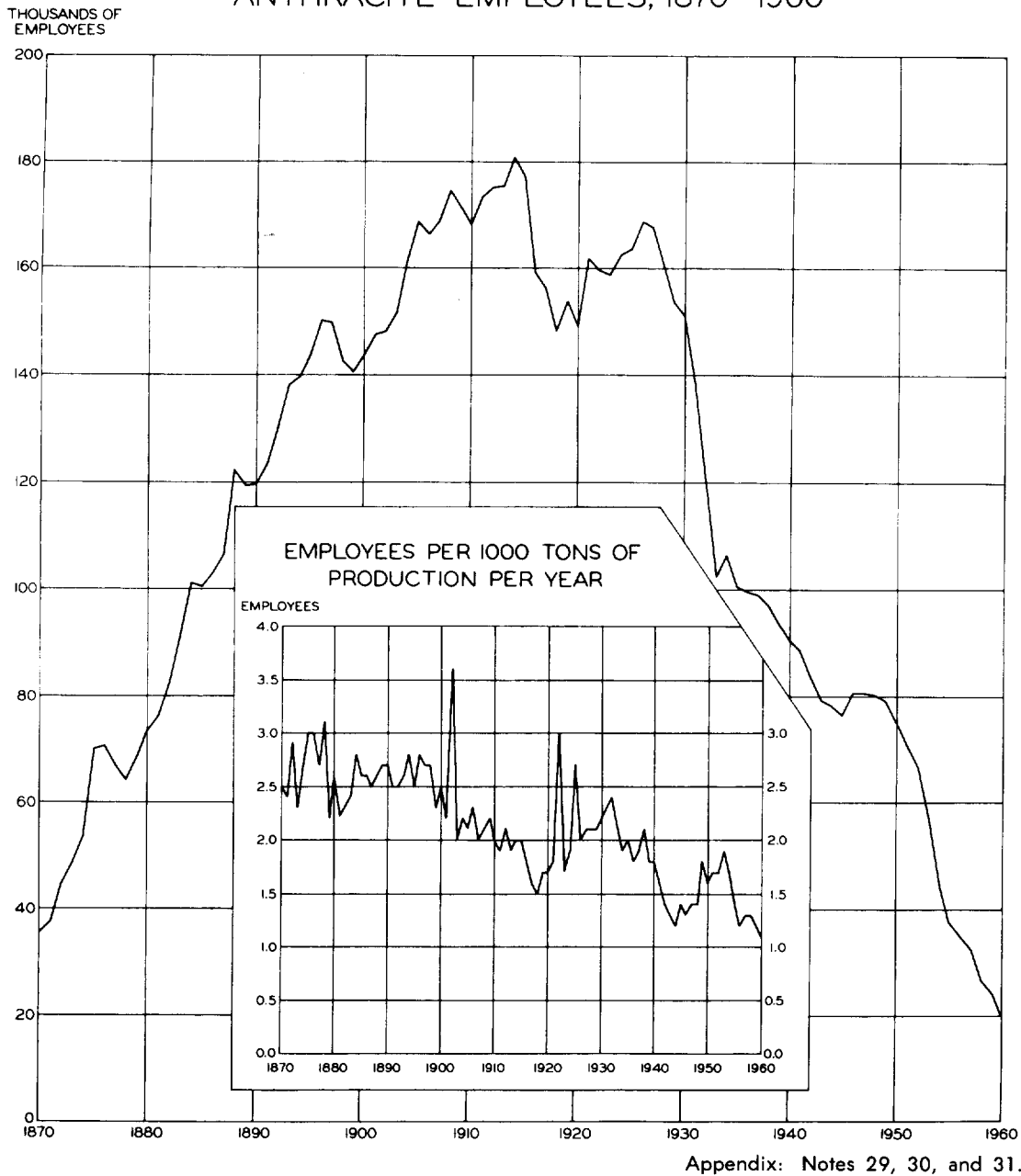
Depth of burial of coal seams beneath the surface is believed to be one of the major causes

of gaseousness, since thick overburden is thought to retard upward escape of coal-associated gases. The validity of this hypothesis can be partially evaluated by comparing the geographical pattern of gaseousness on the above map with the longitudinal stratigraphic cross-section of the Northern Field on page 9, and with the structural map of that field on page 10.

The human effects of local variations in the degree of gaseousness can be observed by comparing conditions on the above map with those shown on the map on page 81, representing the distribution of major gas explosion accidents in the Northern Field between 1847 and 1959.

Employment and Labor  
in Pennsylvania's Anthracite  
Mining Industry

## ANTHRACITE EMPLOYEES, 1870-1960

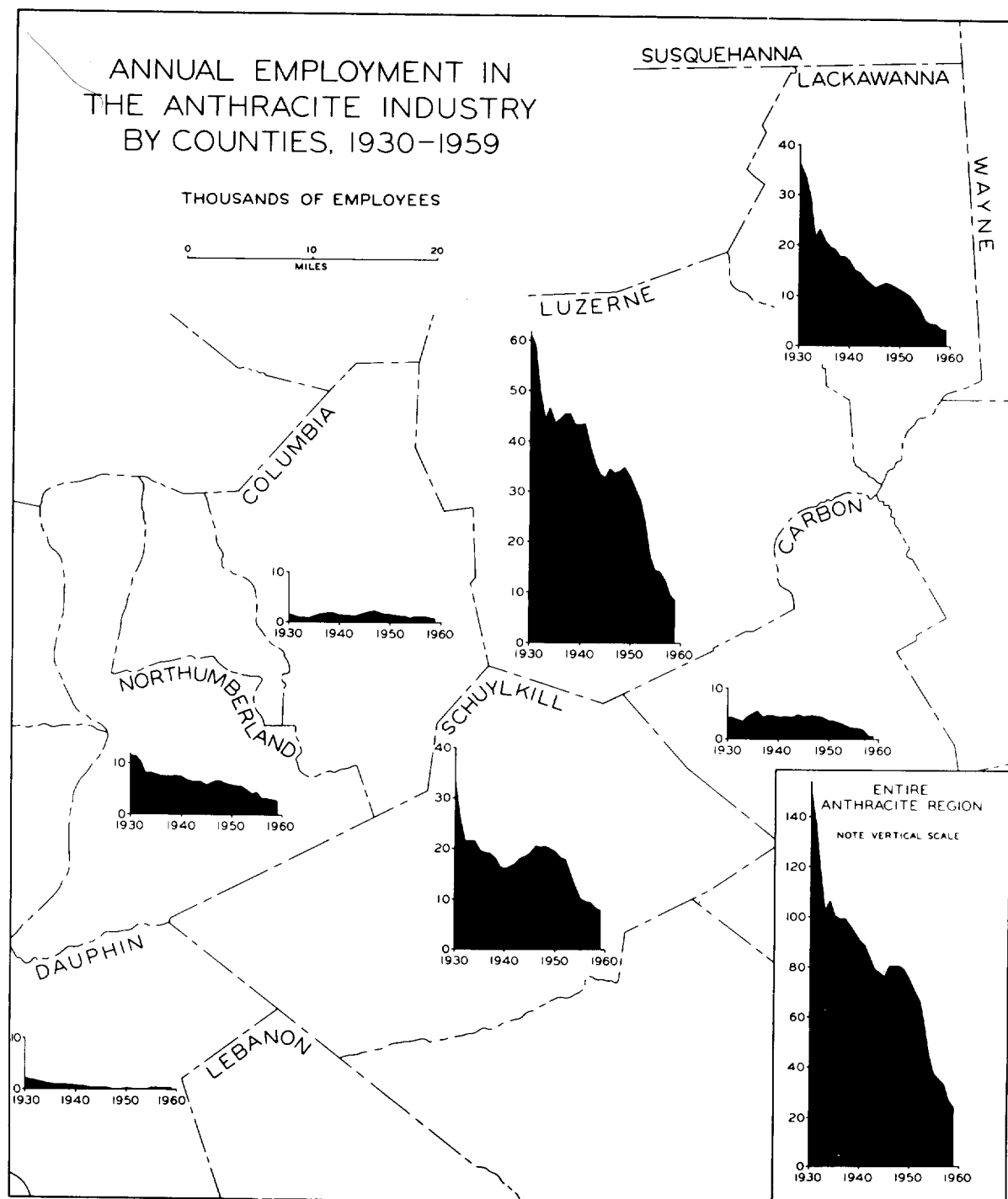


### TOTAL EMPLOYEES, 1870 - 1960

The main graph depicts the rise and decline of employment in Pennsylvania's anthracite mining industry during a 90-year period. No accurate record of the number of anthracite employees was maintained prior to 1870, but from that year until 1914, the year of peak employment, the number of workers increased five-fold, from some 36,000 to over 180,000. The following 46 years, however, witnessed an equivalently precipitous decline in employment, to some 20,-

000 in 1960. Today, there are probably fewer anthracite employees than there were a century ago.

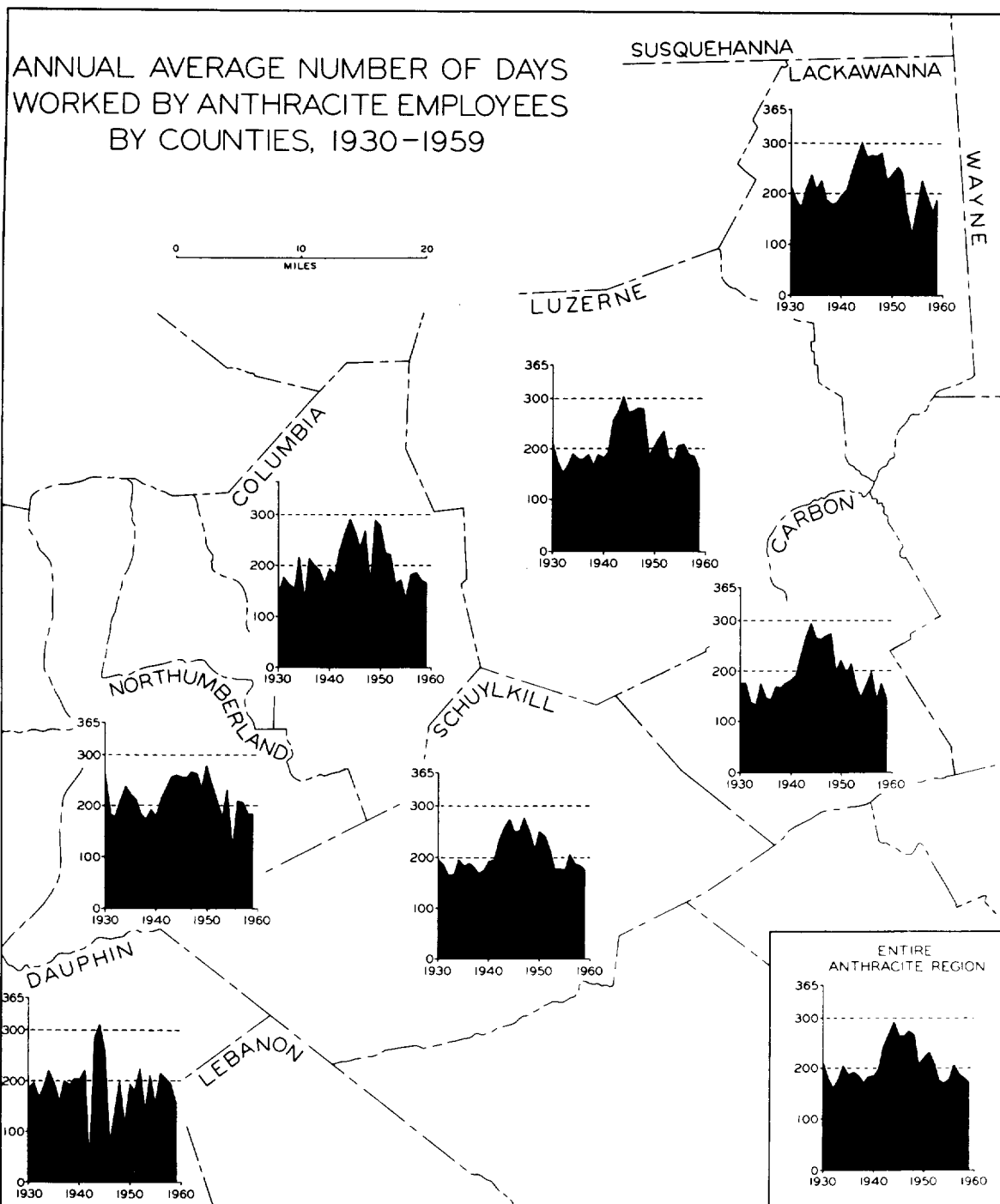
The number of employees would probably have risen to even greater heights by 1914, and the subsequent decline would have been less drastic, if there had not occurred the gradual increase in productivity per employee recorded on the inset graph, above.



### EMPLOYMENT BY COUNTIES, 1930 - 1959

Significant differences are apparent in the 1930-1959 employment graphs for the anthracite industry in individual Pennsylvania counties. In general, percentile declines in employment during the past two decades have been less drastic in Columbia, Northumberland, and Schuylkill

counties than in others; but only one of these, Schuylkill, is a major producer of anthracite. Note the increase in number of employees in most counties during the World War II years of the 1940's, when demand for anthracite was temporarily strong.

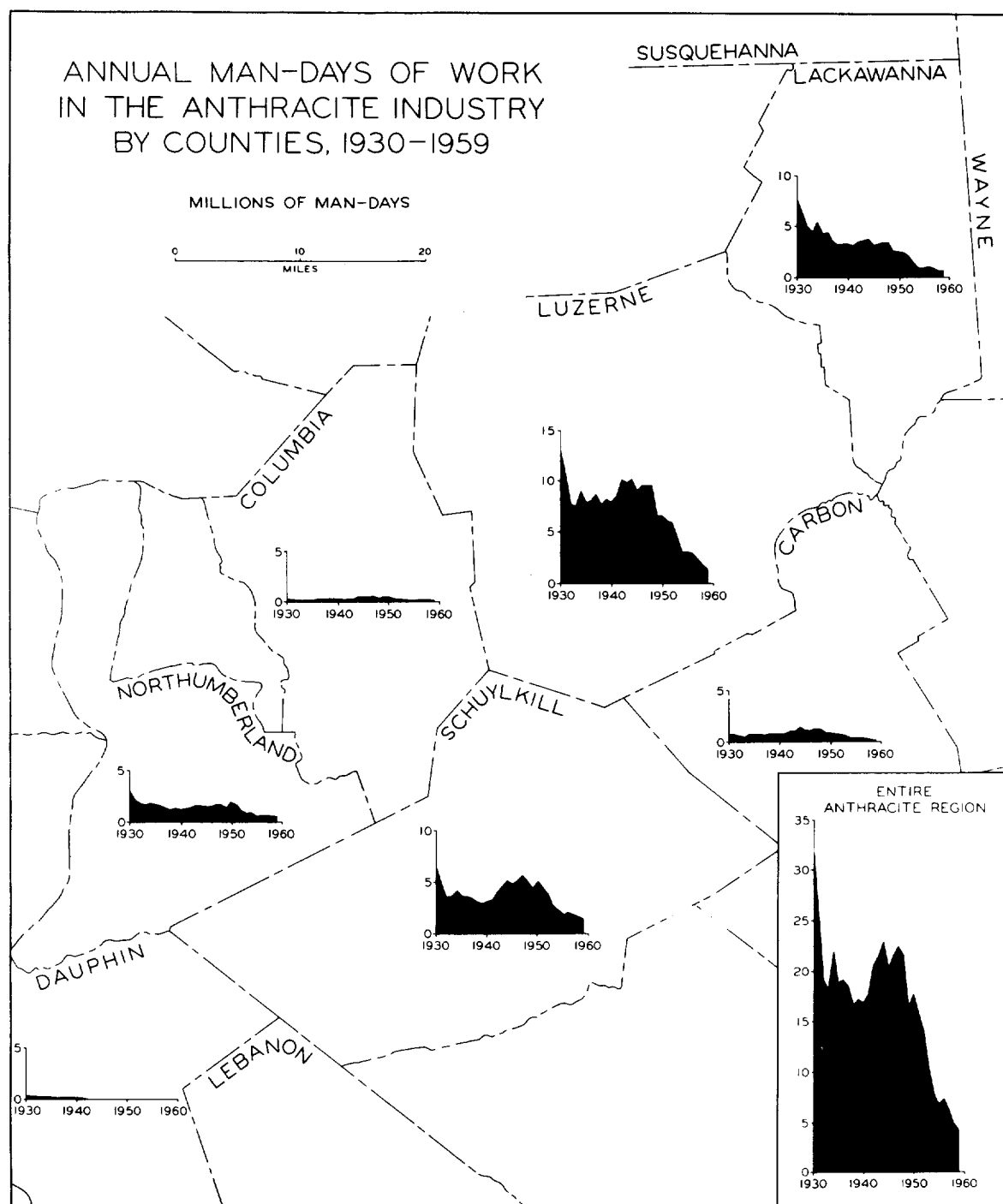


Appendix: Notes 29, 30, 32, and 33.

### DAYS WORKED BY EMPLOYEES, 1930 - 1959

In most of Pennsylvania's anthracite counties, as well as in the anthracite region as a whole, the annual period of employment among workers in the anthracite industry averaged mostly below 200 days from 1930 until the early 1940's, between 200 and 300 days from the early 1940's

to the early 1950's, and below 200 days since then. These data reflect the varying fortunes of the industry during the pre-World War II national depression period, the wartime boom, and the post-war private depression of the anthracite industry.



Appendix: Notes 29, 30, 32, 33, and 34.

### MAN-DAYS OF WORK, 1930 - 1959

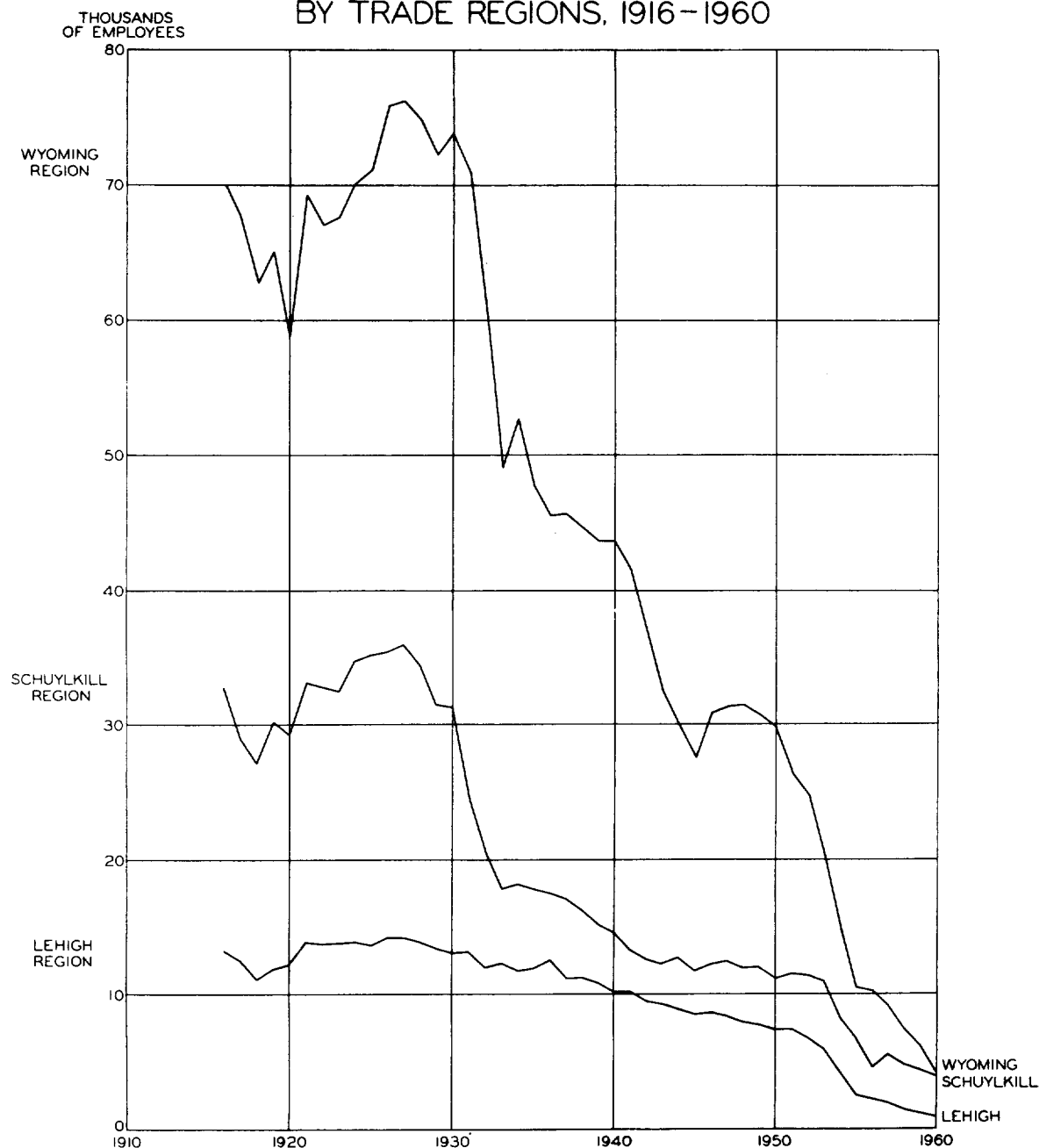
The graphs on this page combine data on number of employees and average length of the work-year, given on the two preceding pages, and represent therefore total employment-time opportunities afforded by the coal mining industry in each of the anthracite producing counties of Pennsylvania as well as in the anthracite re-

gion as a whole during the past three decades.

As is apparent on the above graphs, the major decline in coal-mining employment-time opportunities did not occur, as one might suppose, during the depression years of the 1930's, but instead was concentrated in the 1950's.



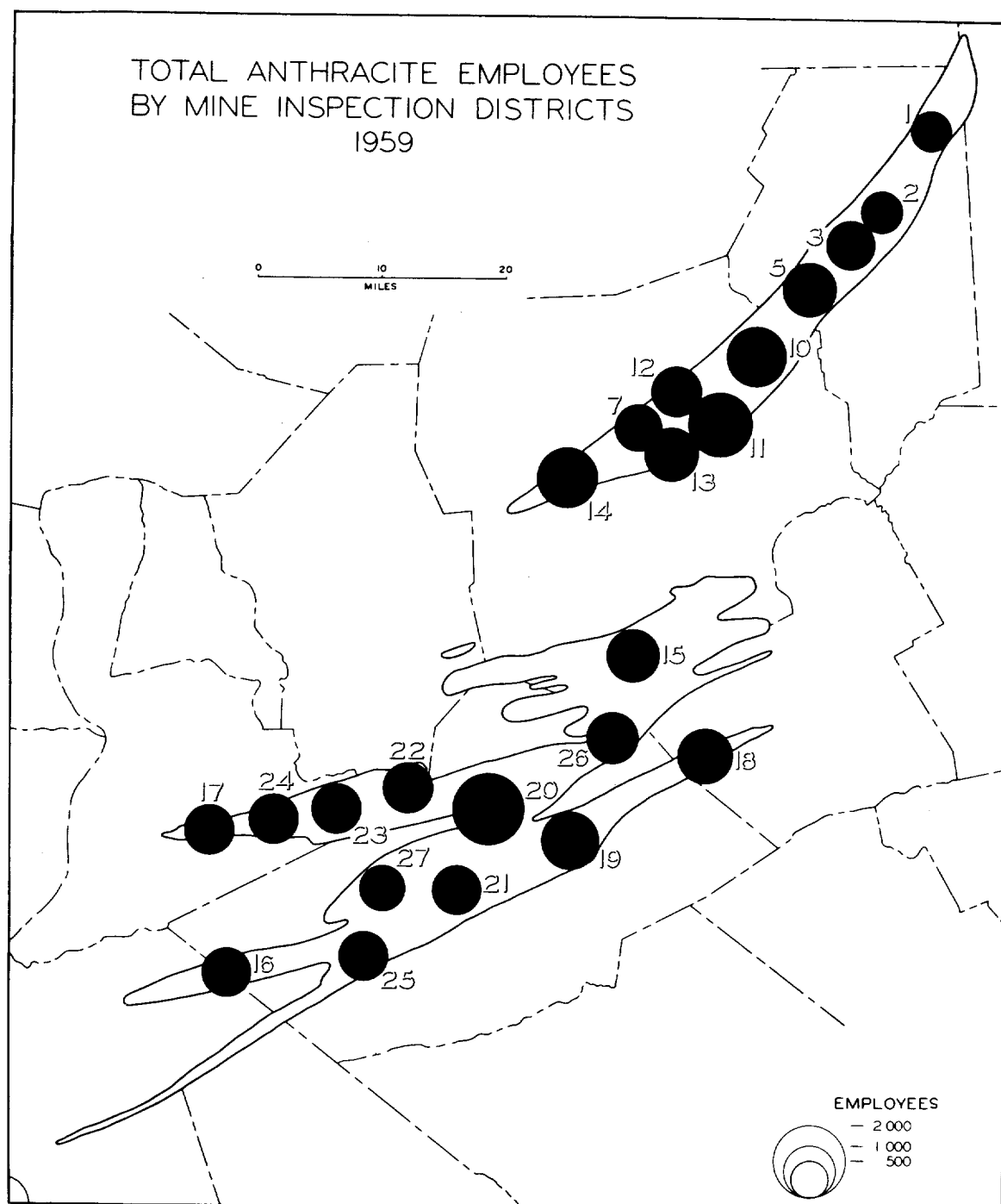
## ANTHRACITE UNDERGROUND EMPLOYEES BY TRADE REGIONS, 1916-1960



### UNDERGROUND EMPLOYEES, 1916 - 1960

The dominant position of the Wyoming trade region in underground mining has been a characteristic of the anthracite industry of Pennsylvania for many decades. As the above graph indicates, the Wyoming area accounted for some 60 per cent or more of total underground employees from 1916 until the early 1950's, and this proportion remained remarkably constant

despite the sharply declining total number of underground workers that has characterized the anthracite industry ever since the late 1920's. By 1960, however, less than one-half of all underground employees were found in the Wyoming region, and the Schuylkill region had become relatively almost as important.



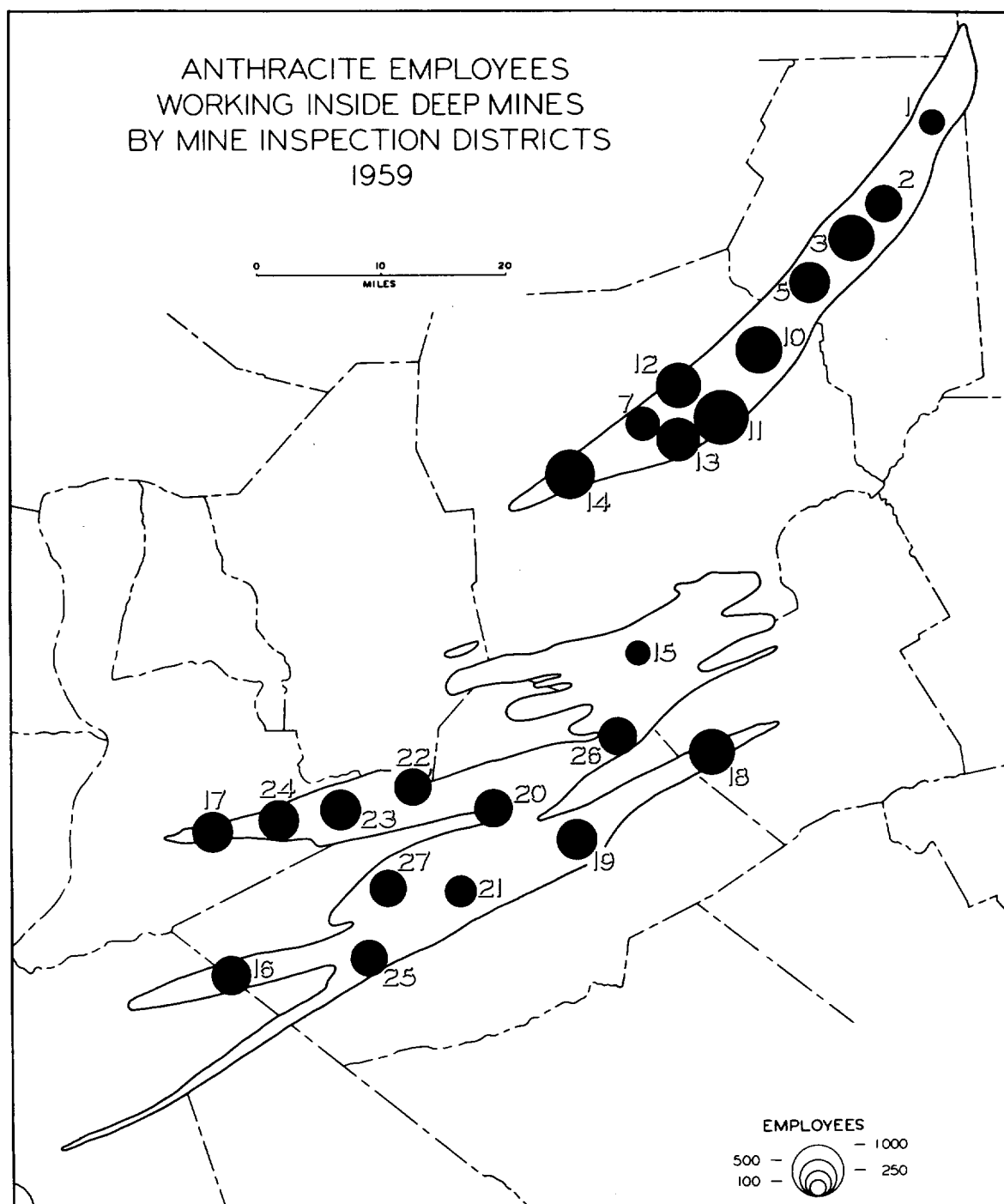
Appendix: Notes 29, 39, 40, and 41.

### TOTAL EMPLOYEES, BY INSPECTION DISTRICTS

The total number of anthracite mine employees per mine inspection district in Pennsylvania ranged in 1959 from a minimum of 620 in District 1 to a maximum of 1,972 in District 20.

Since individual districts differ greatly in areal dimensions (see page 83), it is evident from the

above map that district boundaries are established, in part at least, so as to allocate roughly equivalent numbers of mine employees to the jurisdiction of each of the anthracite region's mine inspectors and thus tend to even out their work loads.



Appendix: Notes 29, 39, 40, 41, and 46.

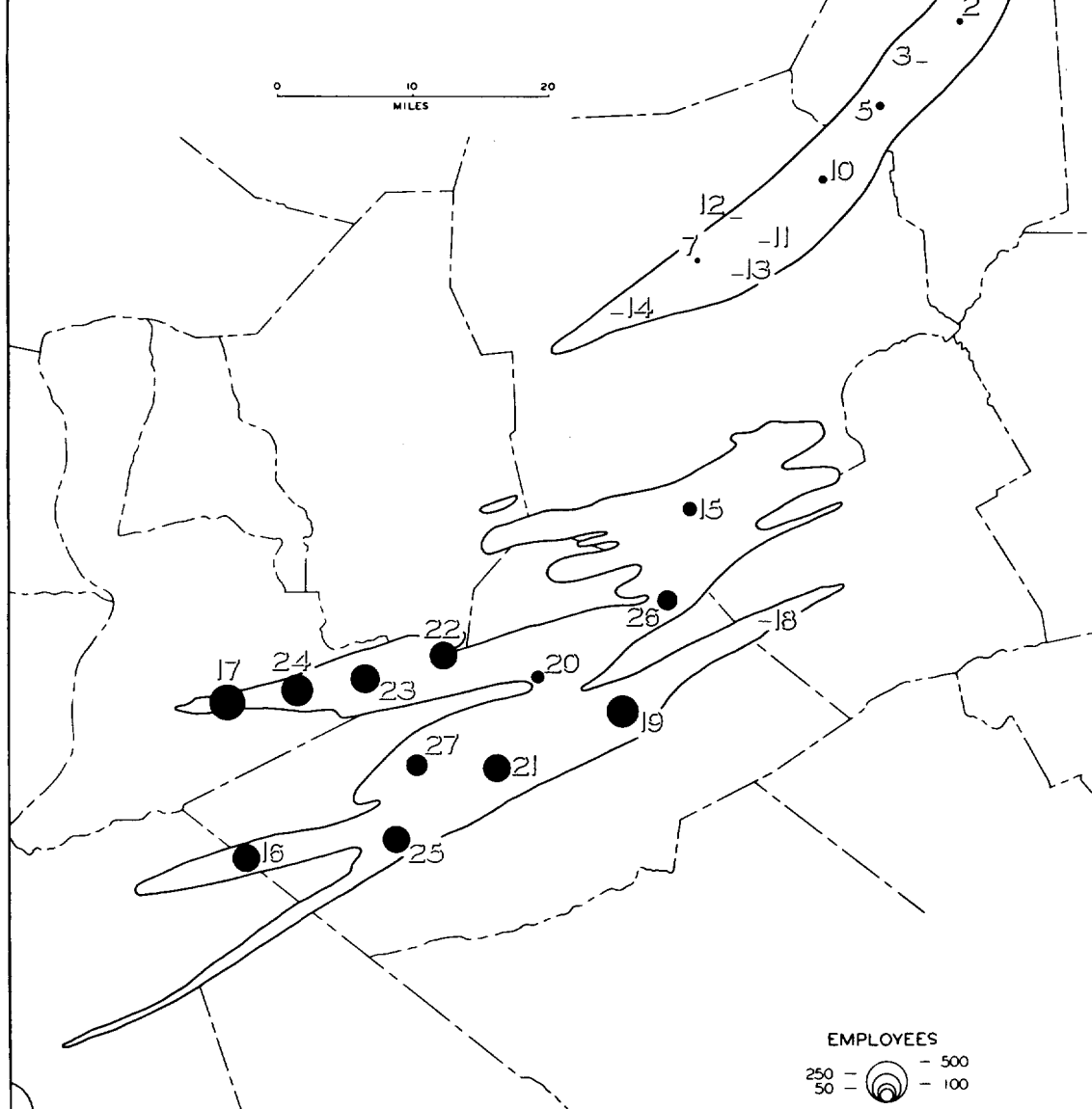
### DEEP MINE EMPLOYEES, BY INSPECTION DISTRICTS

The total number of employees working inside deep coal mines in Pennsylvania's anthracite region was 13,024 in 1959. This represented about 54 per cent of all employees in the anthracite industry.

District 11 had the largest number of under-

ground workers, 1,108; and District 15 the fewest, 184. Although some such employees are found in all districts, most of them work in the Northern Field and particularly in its southwestern portion.

# ANTHRACITE EMPLOYEES AT DEEP MINES EMPLOYING FEWER THAN FIVE MEN UNDERGROUND BY MINE INSPECTION DISTRICTS 1959



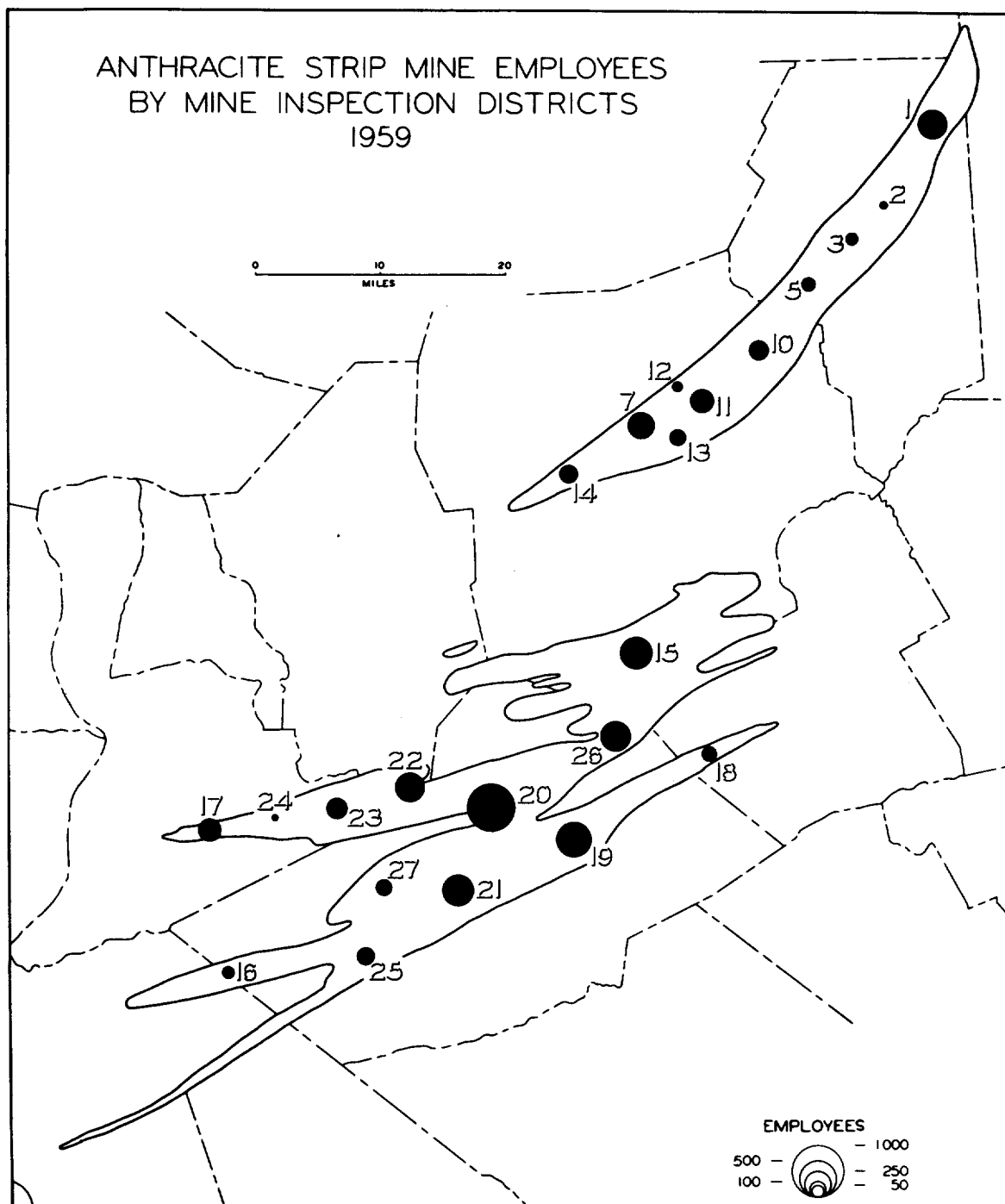
Appendix: Notes 29, 39, 41, and 46.

## SMALL DEEP MINE EMPLOYEES, BY INSPECTION DISTRICTS

In contrast to the map on the preceding page, which represents employees working inside both large and small deep mines, the above map indicates only those men working in deep mines employing fewer than five men underground. Many of these mines are so-called "bootleg" operations.

It is evident that small-sized deep mines are almost non-existent in the Northern Field, are

few in number in the Eastern Middle Field, and are confined largely to parts of the Western Middle and Southern Fields. The total number of underground employees in small deep mines was 2,371 in 1959, which represented only about 10 per cent of all employees in the Commonwealth's anthracite industry.



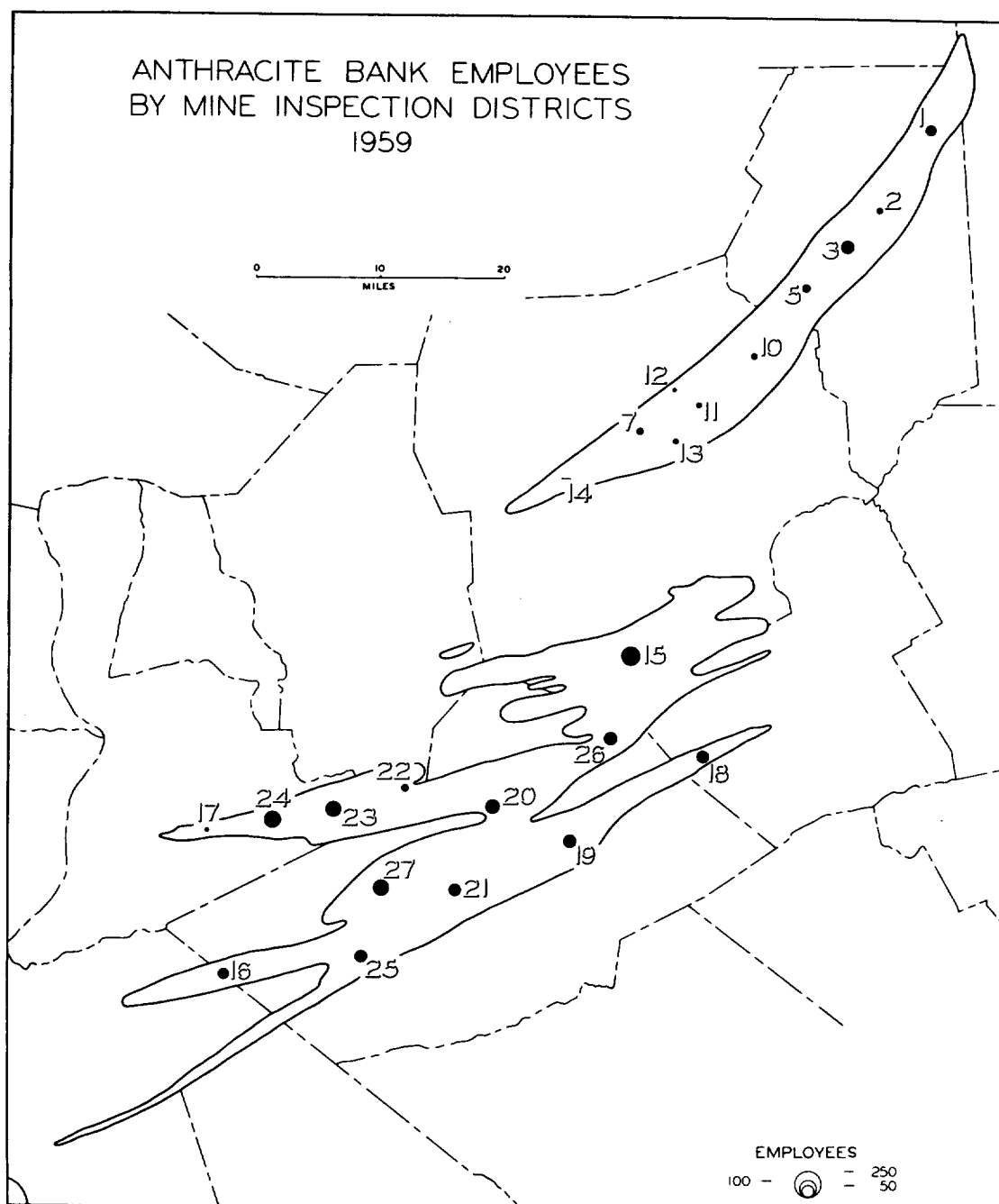
Appendix: Notes 29, 39, and 41.

### STRIP MINE EMPLOYEES, BY INSPECTION DISTRICTS

The total number of strip mine employees in Pennsylvania's anthracite region was 4,194 in 1959. This represented about 17 per cent of all employees in the anthracite industry.

The largest number of strip mine workers

(823) were located in District 20; the smallest number (16) were in District 24. Although there are strip mine employees in every district, most are found in districts at or near the junction of the Western Middle and Southern Fields.



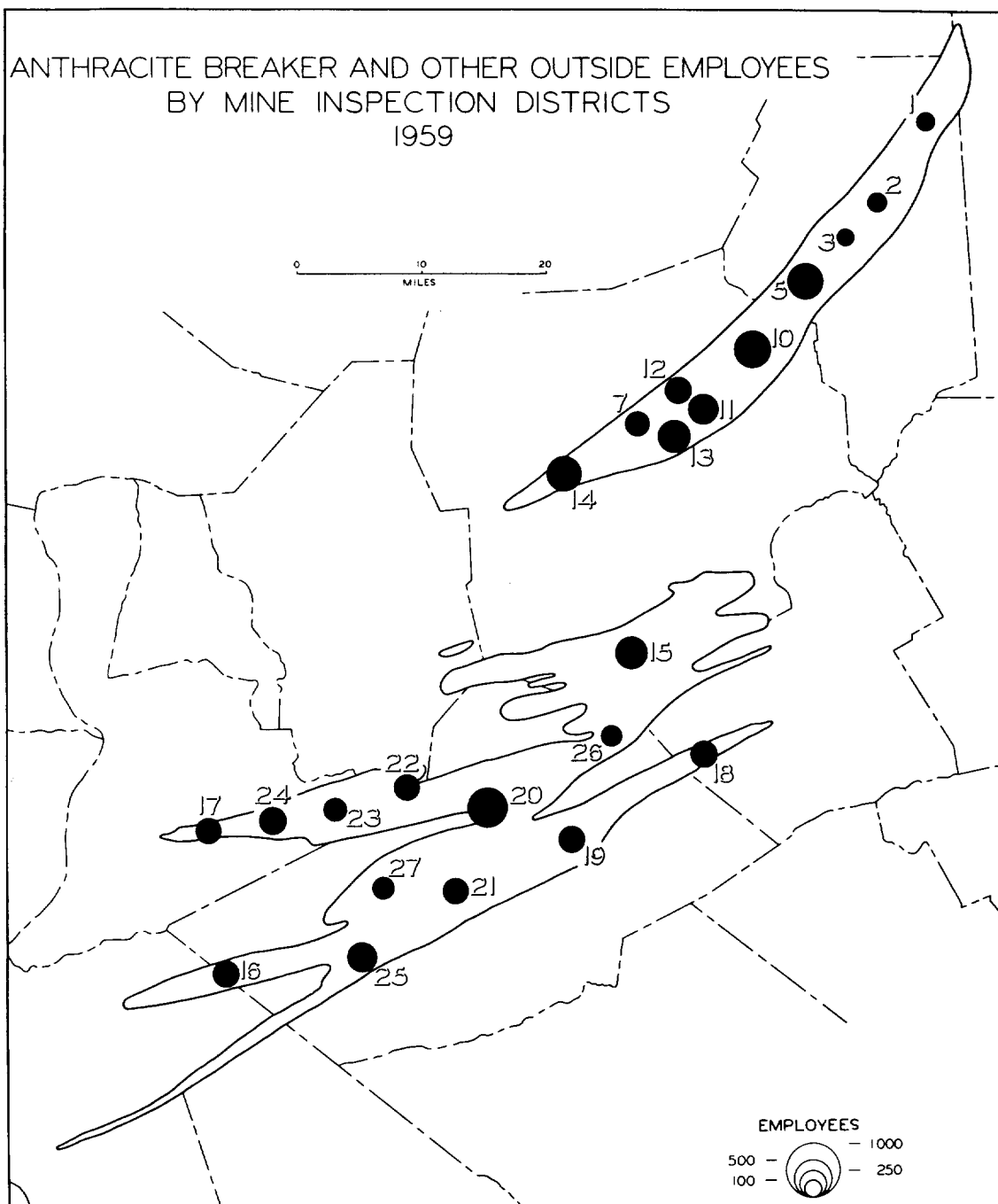
Appendix: Notes 29, 39, and 41.

### BANK EMPLOYEES, BY INSPECTION DISTRICTS

A bank, in the terminology of the anthracite region, is an accumulation of mixed rock and coal fragments that was deposited as waste material after processing of raw anthracite in a breaker. The coal content of many of the older banks, once considered to have no commercial value, was subsequently found to be saleable, and many banks have been and are still being

reprocessed to recover their useable coal.

Employees working at banks (830) represented about 4 per cent of all workers in the Pennsylvania anthracite industry in 1959. Most bank employees were found in the Southern and the two Middle Fields; there were very few in the Northern Field.



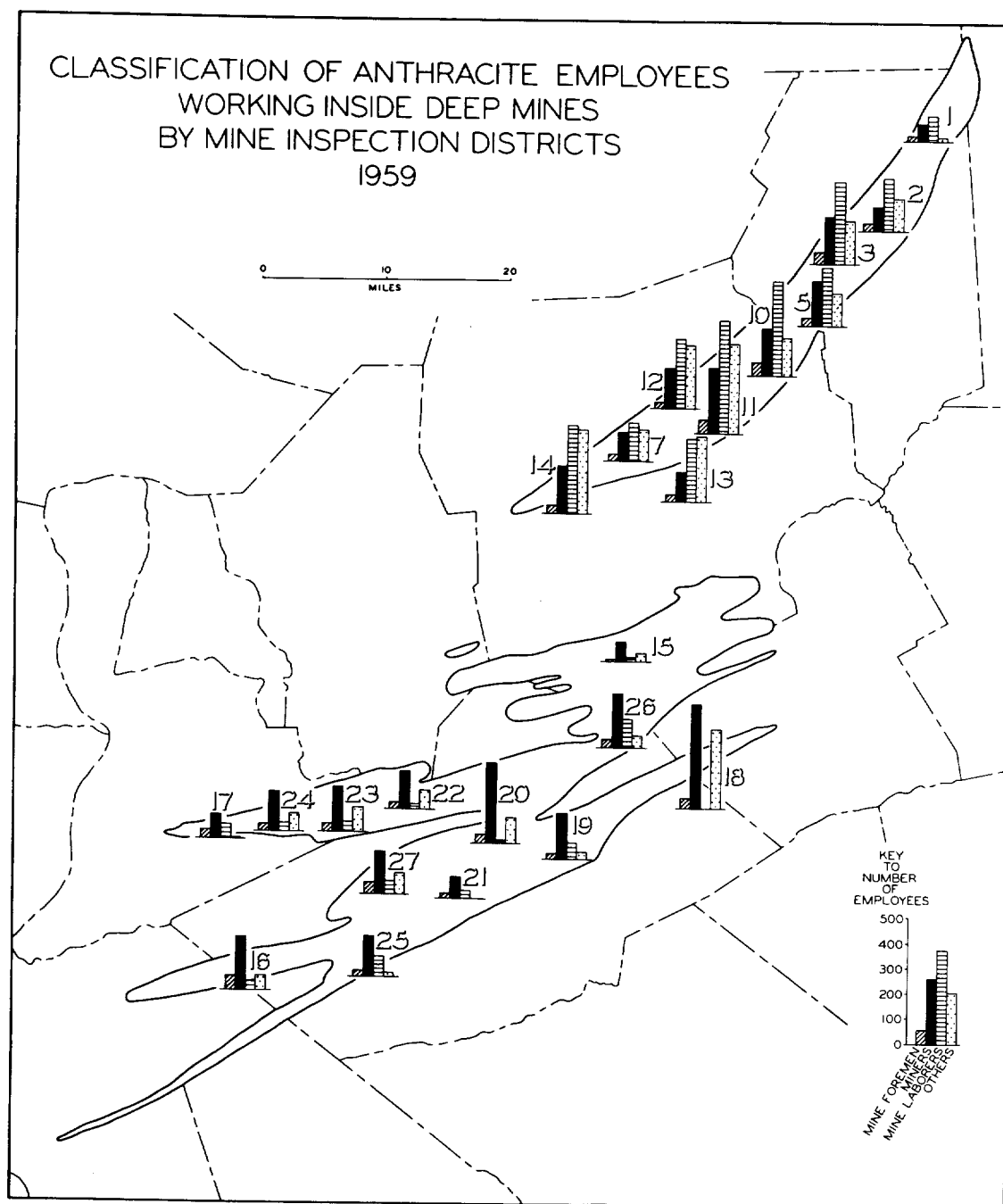
Appendix: Notes 29, 39, 40, and 41.

### BREAKER AND OTHER OUTSIDE EMPLOYEES, BY INSPECTION DISTRICTS

Breaker employees, and those engaged in outside activities other than actually working at strip mines and banks, numbered 6,064 in 1959 and represented about 25 per cent of all workers in the Pennsylvania anthracite industry. Included in this category were such employees as superintendents, engineers, office workers, truck

drivers, and so forth.

Obviously, some such workers will be found in every mine inspection district of the anthracite region. As the above map shows, however, the greatest concentration of such employees exists in the middle and southwestern portions of the Northern Field.



Appendix: Notes 29, 39, 42, and 46.

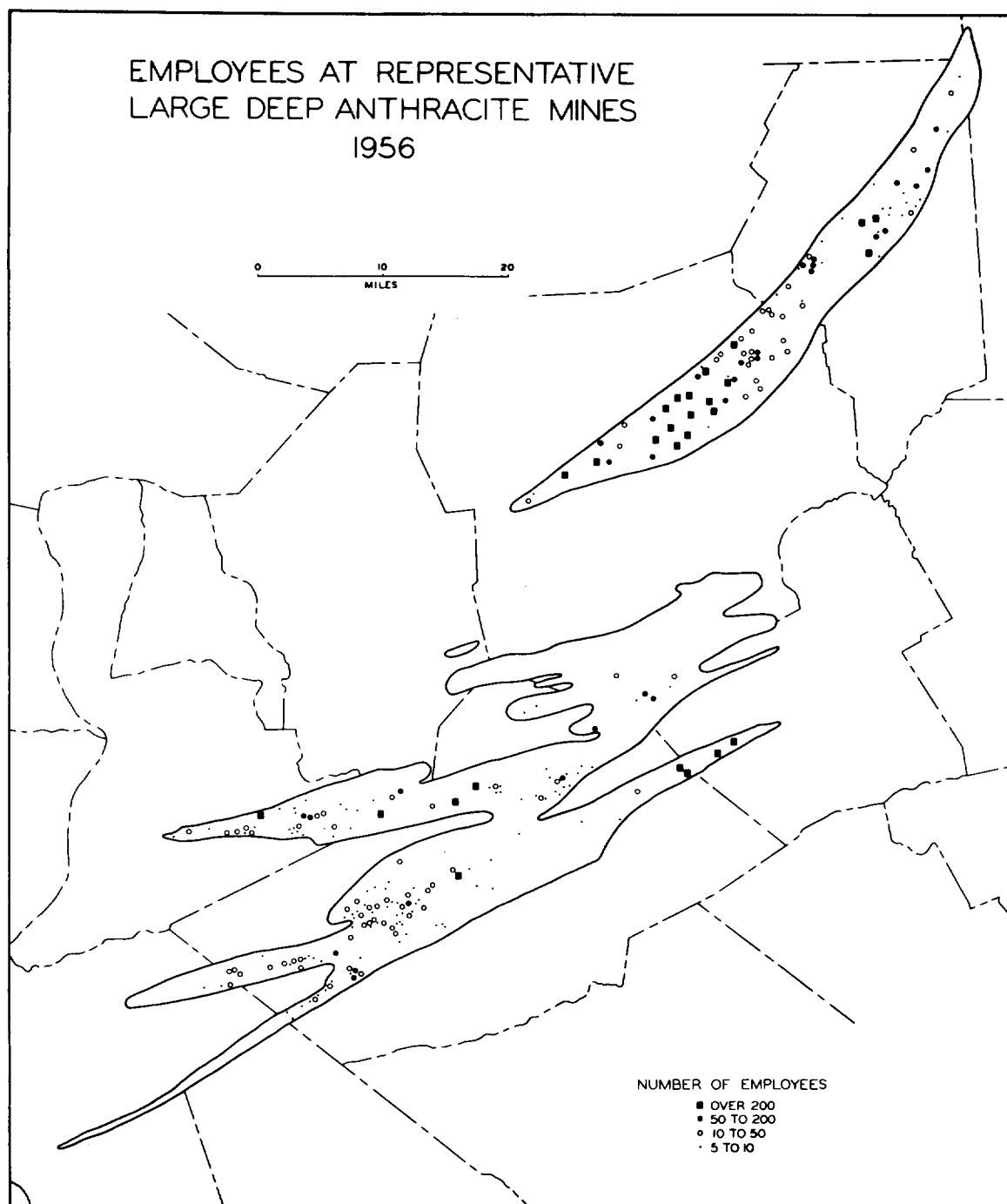
### TYPES OF DEEP MINE EMPLOYEES, BY INSPECTION DISTRICTS

In the deep mine phase of Pennsylvania's anthracite industry there were employed, in 1959, 707 mine foremen, 3,926 miners, 3,218 mine laborers, and 2,798 other underground employees, making a total of 10,649.

Note that in the Northern Field, where deep mines are most numerous, there is the greatest number of underground employees. Observe, further, that in the Northern Field, where coal

seams are generally flat-lying and relatively little faulted, and hence where mining operations are least complicated, that there are proportionally large numbers of relatively unskilled mine laborers and "other" employees as compared with skilled miners and foremen. Just the opposite relationship holds in the intensively folded and faulted seams of the Middle and Southern Fields.



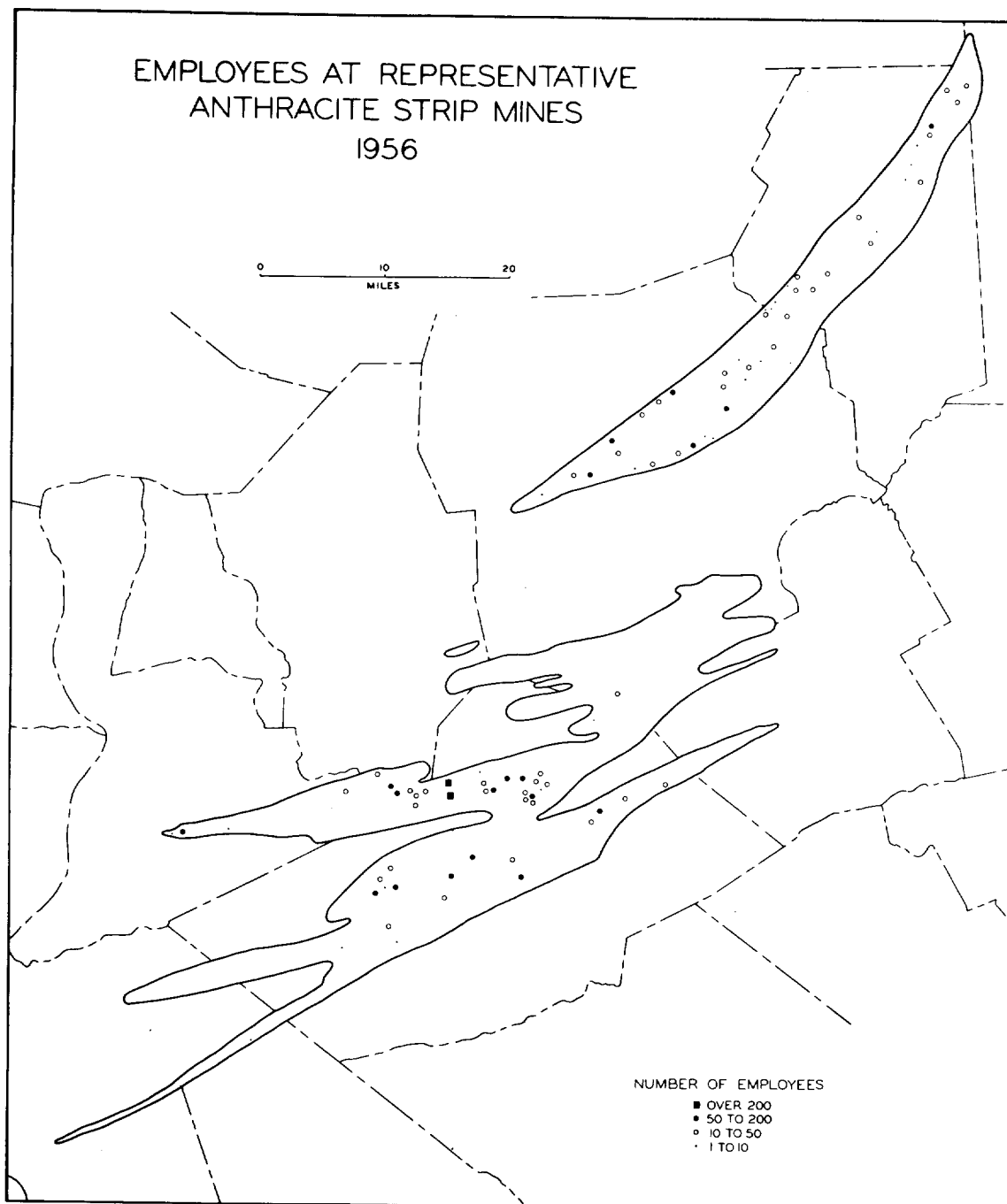


Appendix: Notes 29, 42, 43, 45, 46, 54, and 55.

### NUMBER OF EMPLOYEES PER LARGE DEEP MINE

The number of employees per individual underground anthracite operation in Pennsylvania, excluding small mines with fewer than five employees underground, ranged from five to a maximum of 1,517 in 1956. Almost one-half of the so-called large mines had between five and 10

employees each, and approximately another one-third had only between 10 and 50 each. Most of the mines with more than 50 employees were located in the Northern Field, long the focus of truly large-scale anthracite operations.

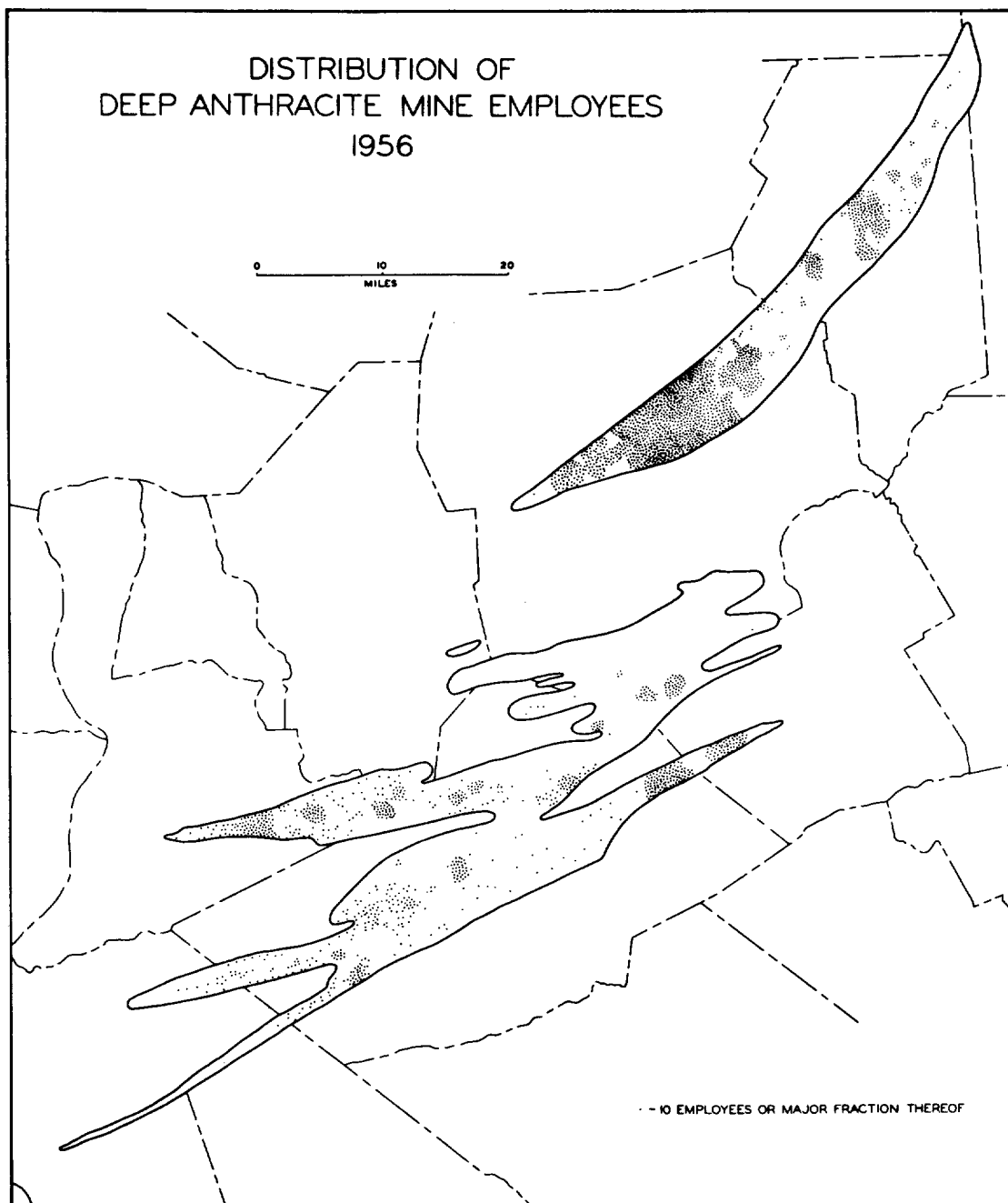


Appendix: Notes 29, 43, 45, 54, and 55.

### NUMBER OF EMPLOYEES PER STRIP MINE

The number of employees per individual anthracite stripping operation in Pennsylvania ranged from one to a maximum of 443 in 1956. Approximately one-half of the strip mines had between 10 and 50 employees, and about one-quarter had fewer than 10. Only a few employed more than 200 workers.

Most of the large-scale stripping operations were concentrated in the eastern portion of the Western Middle Field, and in the adjacent middle section of the Southern Field. Very little stripping on any scale was conducted in the Eastern Middle Field, and in the western parts of the Western Middle and Southern Fields.



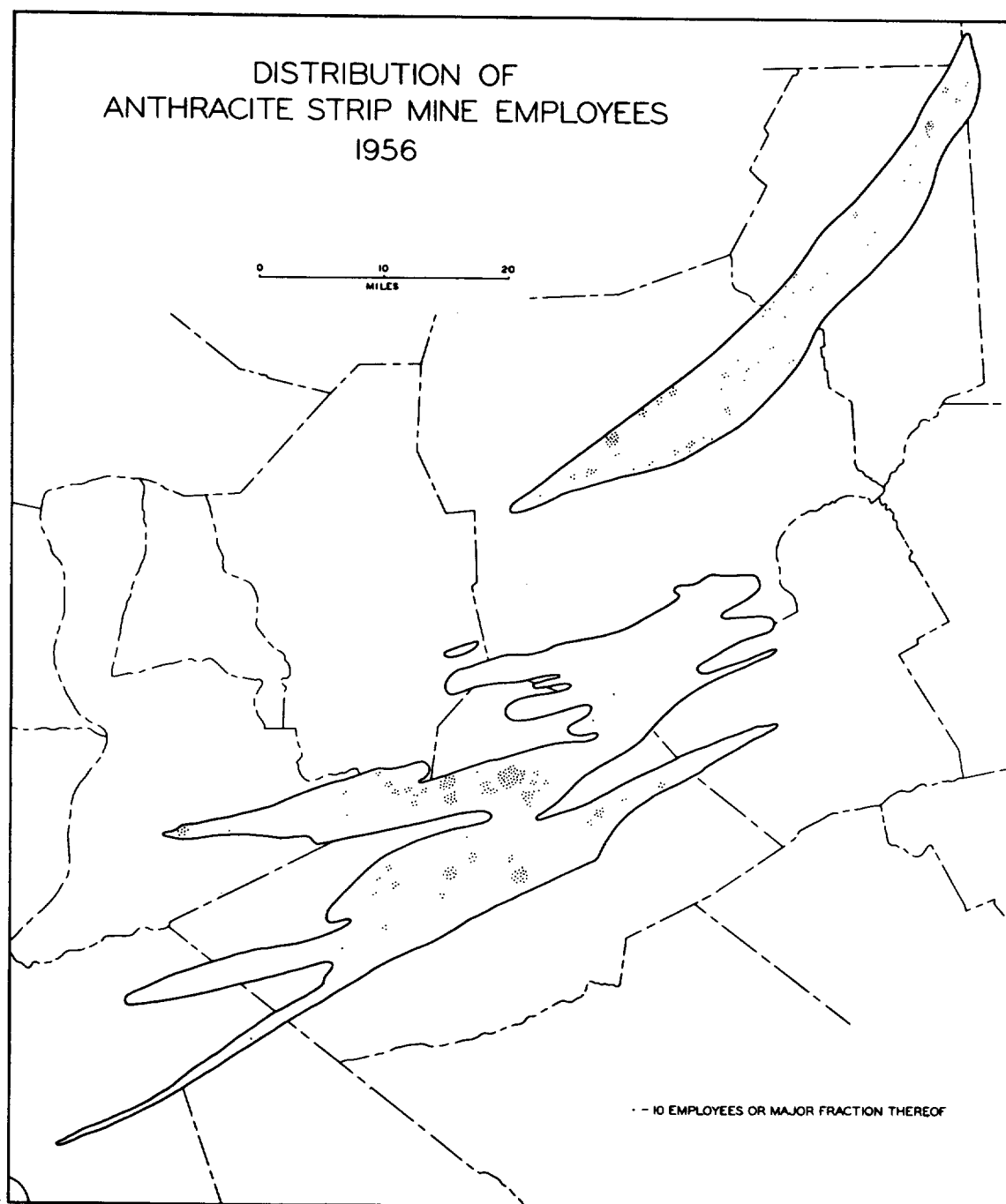
Appendix: Notes 29, 40, 43, 45, 46, 49, 50, and 54.

### DEEP MINE EMPLOYEES

Although the number of deep anthracite mine employees in Pennsylvania has declined drastically in recent decades (see graph on page 38), there nevertheless were some 19,000 such employees in the Commonwealth in 1956 and their contributions to the economy of the anthracite region remained of considerable significance.

By far the greatest concentration of deep mine

employees was found in the southwestern half of the Northern Field. Other more local, but nevertheless important, foci of such workers, as the above map indicates, were found in the middle segment of the northeastern portion of the Northern Field, at the western end of the Western Middle Field, and at the eastern end of the Southern Field.

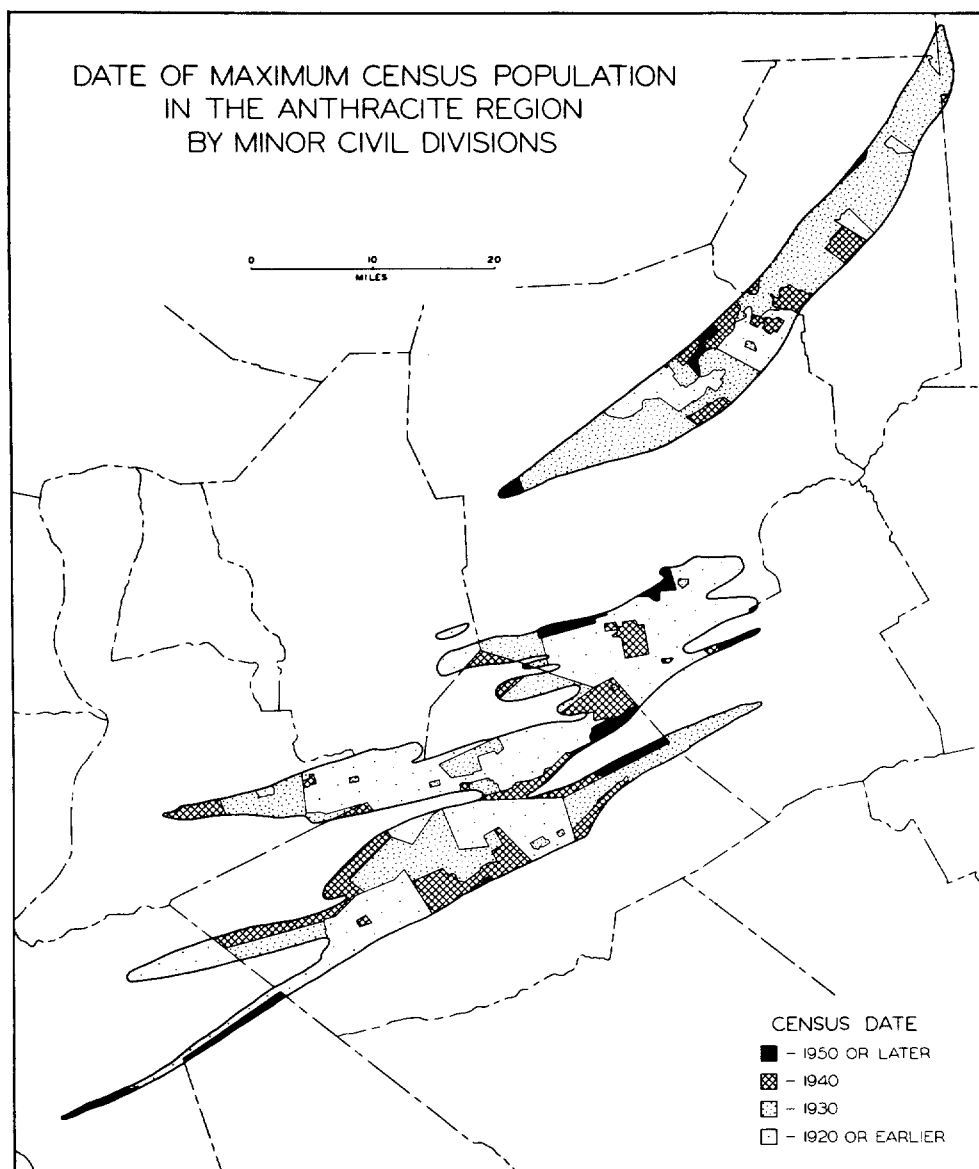


Appendix: Notes 29, 43, 45, 49, 50, and 54.

### STRIP MINE EMPLOYEES

Strip mine employees were only about one-quarter as numerous as deep mine employees in Pennsylvania's anthracite industry during 1956, and their impact on the economy of the anthracite region was proportionally smaller. Nevertheless, some 5,000 such employees played a significant economic role locally, because of their

concentration largely within limited segments of the anthracite area. By far the greatest concentration of strip mine workers was that found in the eastern part of the Western Middle Field, and in adjacent middle portions of the Southern Field.



Appendix: Note 105.

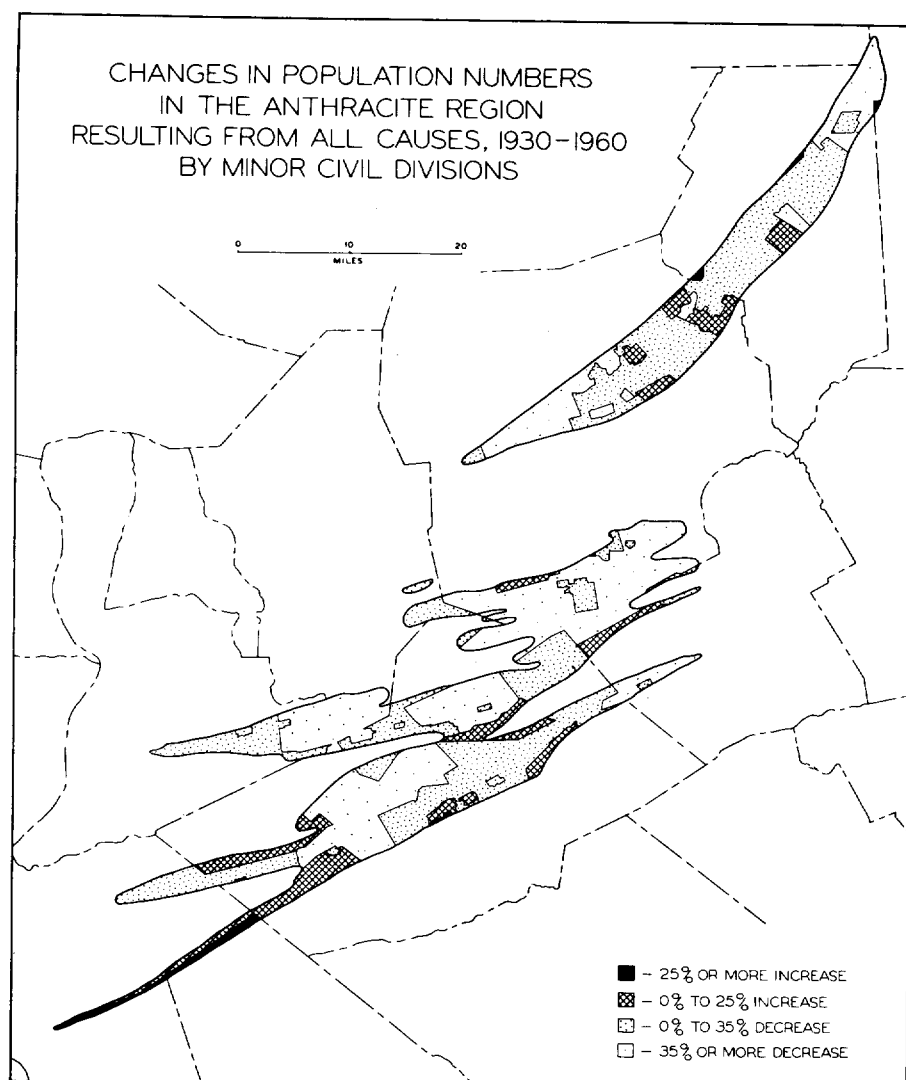
### DATE OF MAXIMUM CENSUS POPULATION

The drastic decline of the anthracite mining industry during recent decades has blighted the economy of the anthracite region and reduced its population significantly. Each of the five main coal producing counties reached its maximum census population in 1930. There is, however, considerable variation in dates of maximum population among the constituent minor civil divisions of the anthracite region.

Within the Northern Field most of the divisions, and especially those in the northern and southern portions of the field, reached their maximum census populations in 1930. In con-

trast, the divisions of the middle section more commonly attained their greatest populations earlier. Few divisions reached their peak populations after 1930, and these are either peripheral to the field or to its major cities.

In the remainder of the anthracite area, the pattern of peak population years is different. For example, major proportions of the Middle and Southern Fields attained their greatest populations in 1920 or earlier, or else in 1940. Moreover, the largest cities, Hazleton and Pottsville, acquired maximum populations later than did their counterparts in the Northern Field.



Appendix: Note 105.

### CHANGES IN POPULATION NUMBERS RESULTING FROM ALL CAUSES, 1930 - 1960

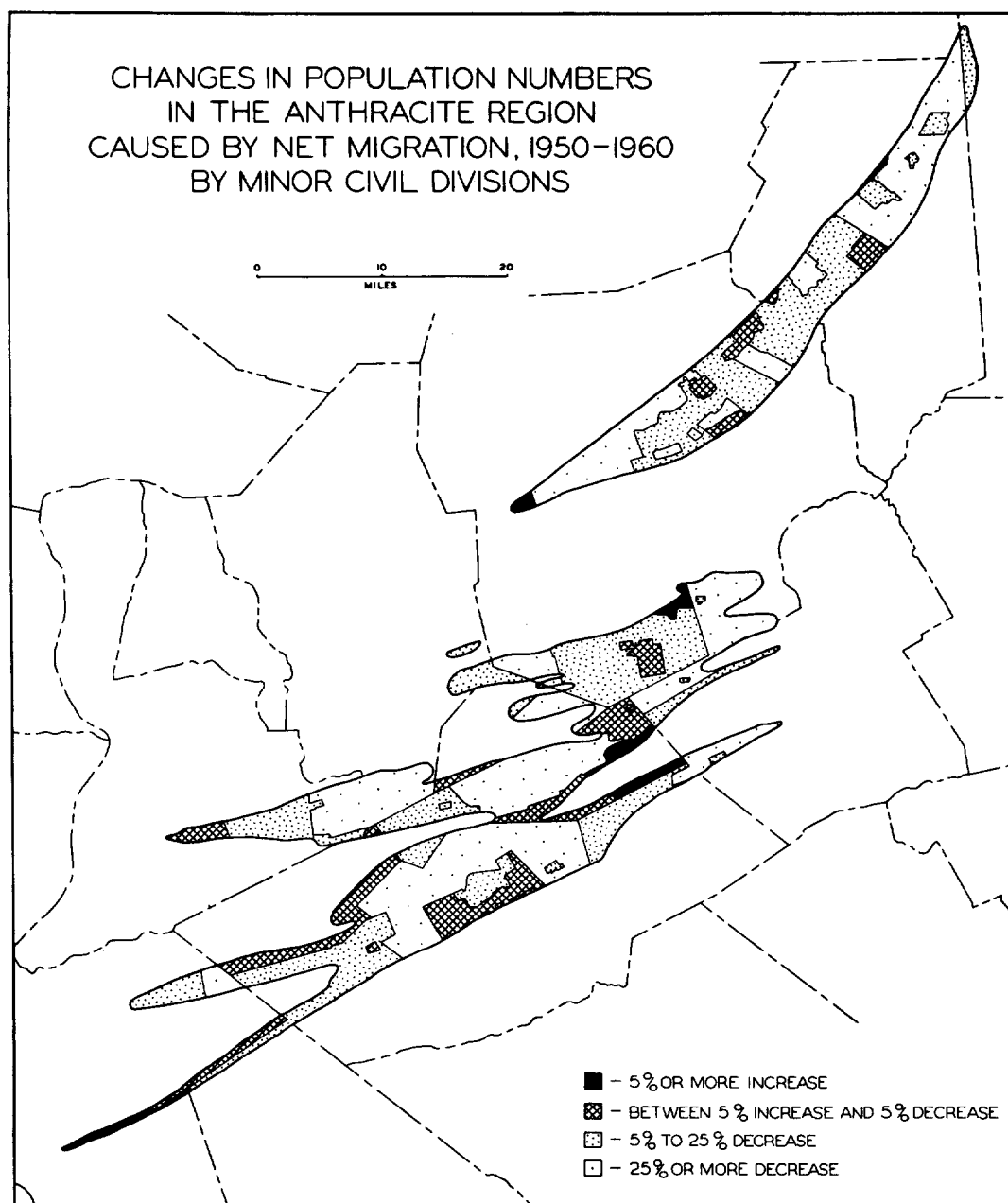
Changes in population numbers in any region are a net product of four relevant factors: births, deaths, in-migration, and out-migration. The interaction of these factors in the declining economy of the anthracite region has produced a progressive decrease in population numbers, since 1930 or earlier, in most of the minor civil divisions of the area. Of the 117 divisions included wholly or largely within the region, 99 had a smaller population in 1960 than in 1930.

Greatest population losses (35 per cent or more) occurred chiefly in the terminal portions of the Northern Field, in most parts of the Middle Fields, and in the central part of the Southern Field. Losses in many of these areas were

particularly heavy during the 1950 to 1960 decade.

Minor civil divisions with moderate population losses (less than 35 per cent) were most common in the central portion of the Northern Field, and in the extremities of the Western Middle and Southern Fields. In many of these divisions the tempo of decline slowed appreciably after 1950.

The few minor civil divisions that gained in population numbers during the 1930-1960 period were either marginal to the coal producing areas or were adjacent to some of the larger cities of the anthracite region.



Appendix: Note 106.

### CHANGES IN POPULATION NUMBERS CAUSED BY NET MIGRATION, 1950 - 1960

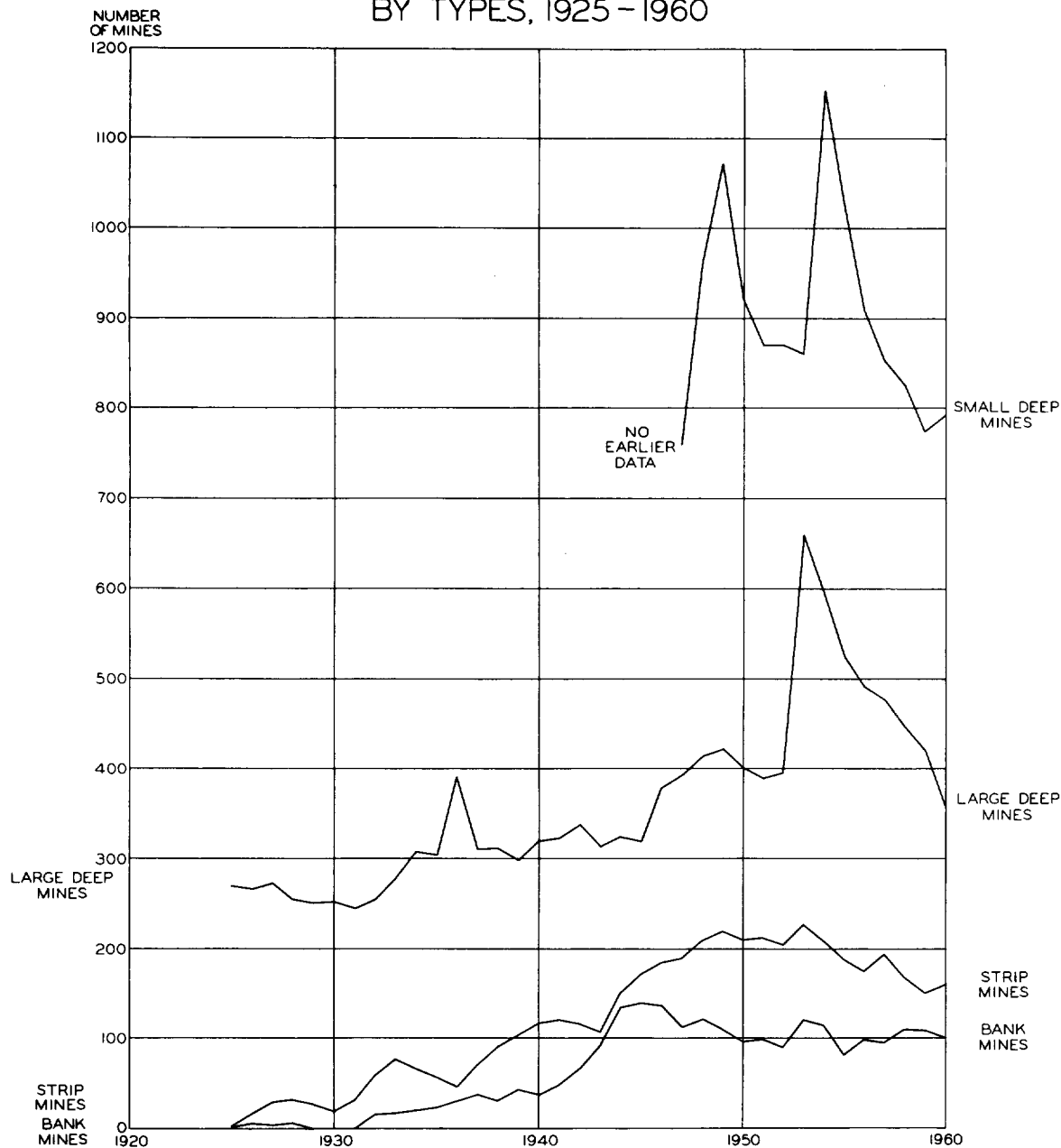
Heavy population losses due to out-migration persisted throughout the decade, 1950-1960, for many of the minor civil divisions of the anthracite region. Within the five leading anthracite producing counties, 54 divisions lost by net migration a number equivalent to 25 per cent or more of their 1950 populations. Of these divisions, 53 were in anthracite producing areas. In contrast, nearly all of the divisions shown on the

above map which gained numbers by net migration (the solid black pattern), or experienced essentially no change in population numbers due to migration (the cross-hatched pattern), were marginal to, or only partially included within, the anthracite region. Most of the migrants from the anthracite region were young adults, thereby raising the median age of the remaining population considerably above the state average.

Mines and Preparation Plants,  
Mining Companies, and Accidents  
in Pennsylvania's  
Anthracite Mining Industry



## NUMBER OF ANTHRACITE MINES BY TYPES, 1925 - 1960



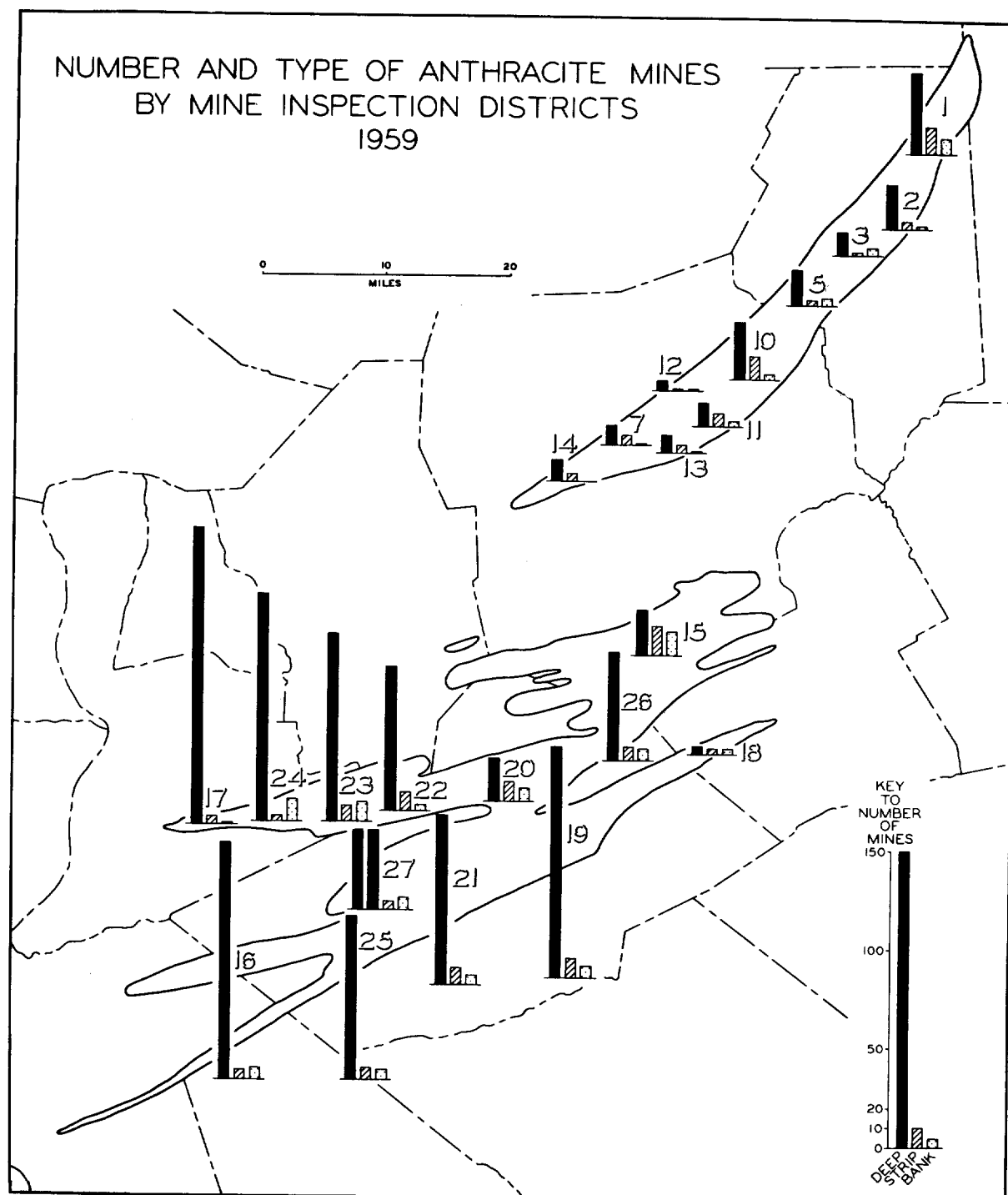
Appendix: Notes 29, 46, and 51.

### NUMBER OF MINES, 1925 - 1960

Over the decades, by far the most common type of mine in the anthracite industry of Pennsylvania has been the deep, or underground, mine; and, since perhaps the early 1930's, most of these have been small one- to four-men operations engaged in by individuals or a few partners. Strip and bank mines both have consistently formed only a small percentage of total

mines.

It is an anomalous situation that, while anthracite production and employment were declining drastically over the past one-third of a century (see graphs on pages 34 and 86), the broad trend in the number of all types of mines has been upward.



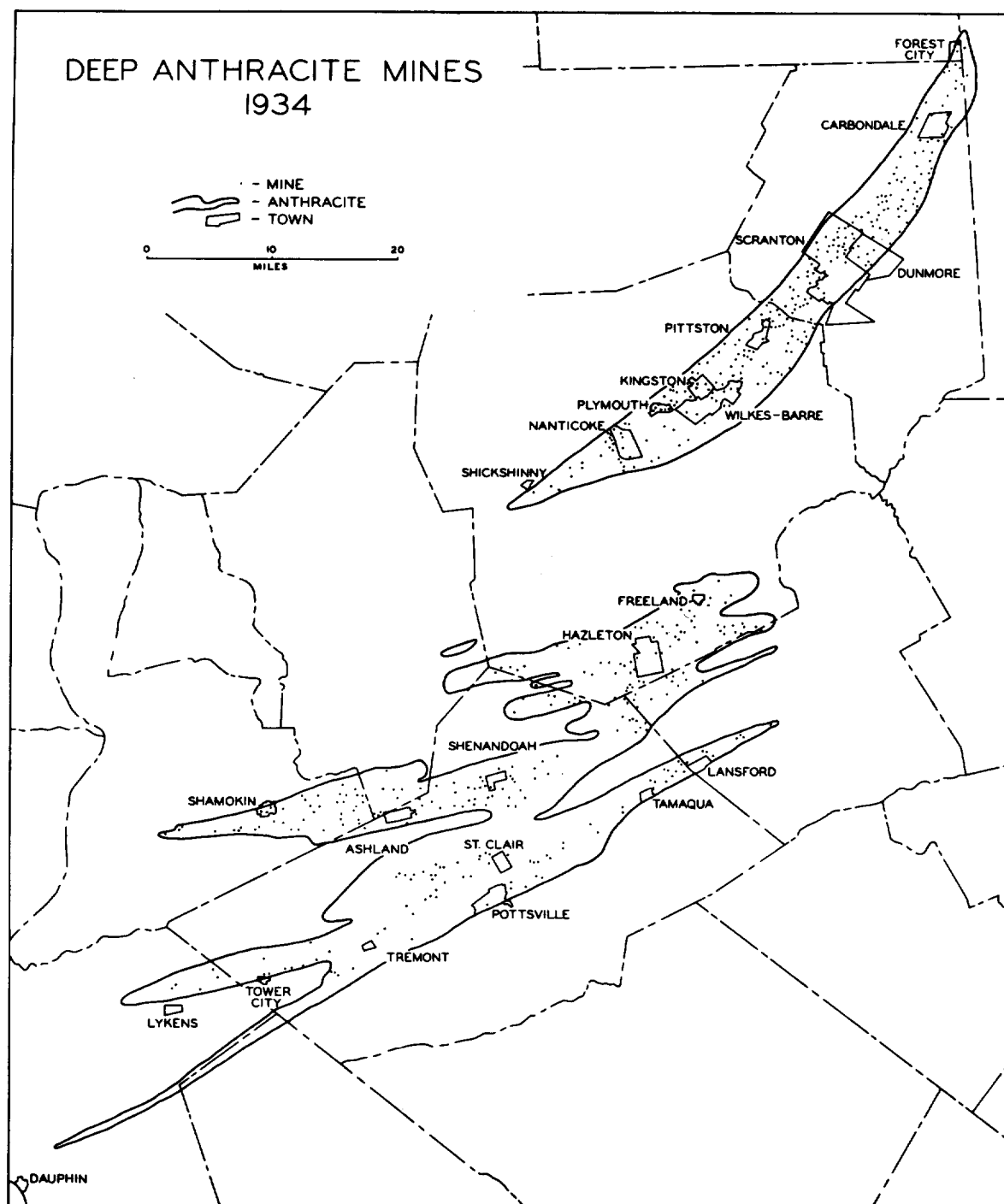
Appendix: Notes 29, 39, 40, 46, and 56.

### NUMBER AND TYPE OF MINES, BY INSPECTION DISTRICTS

There were 1,449 anthracite mines of all types operating in Pennsylvania's anthracite region in 1959. Of these, 1,192 were deep mines; 149, strip mines; and 108, bank mines.

The number of mines per district was small in

the Northern Field, most of the Eastern Middle Field, and at the eastern ends of the Western Middle and Southern Fields. Elsewhere, there were many more mines per district, with deep mines being especially numerous.



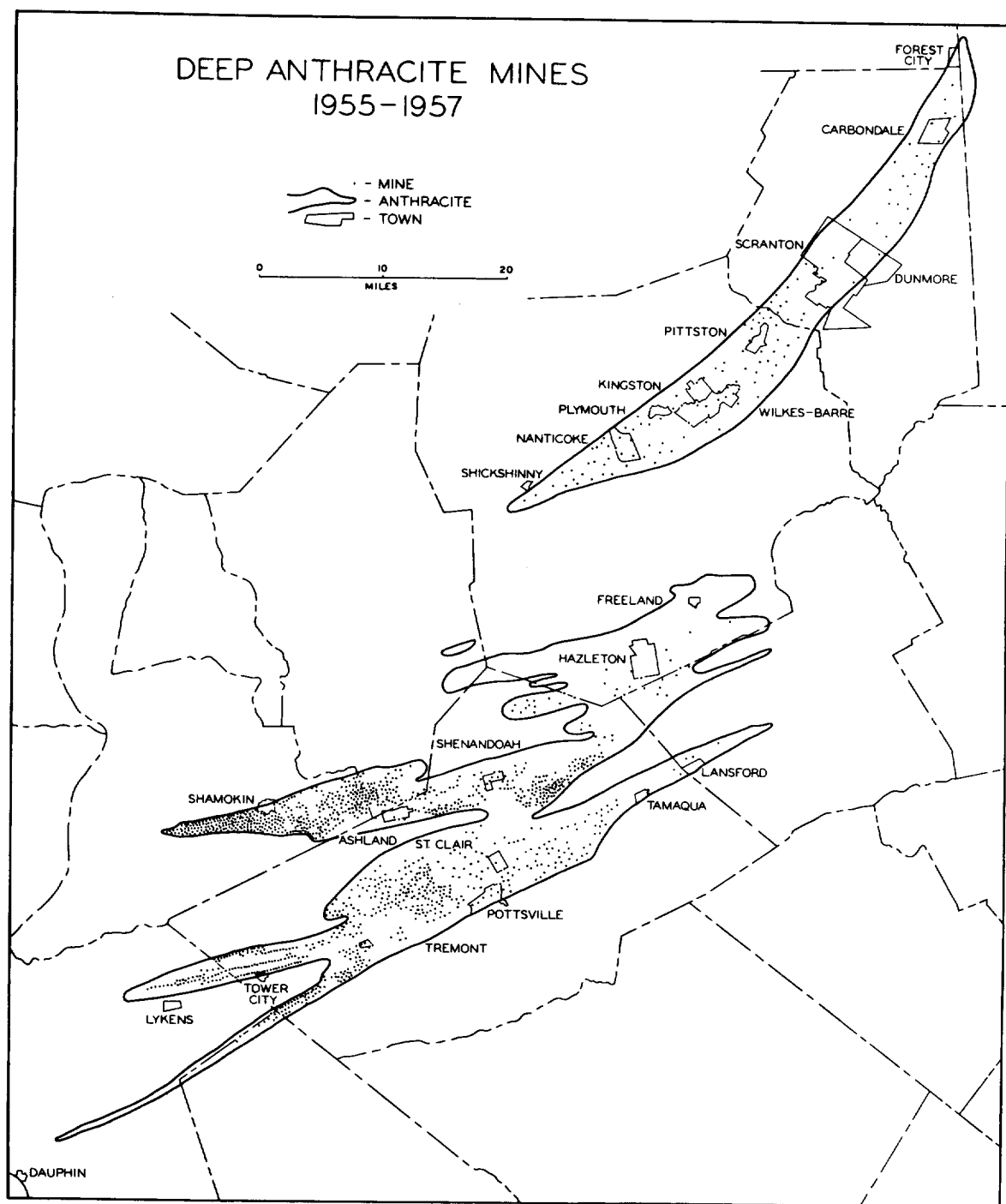
Appendix: Notes 40, 46, 52, 53, and 54.

### INDIVIDUAL DEEP MINES, 1934

The above map represents the distribution of deep anthracite mines that were in operation in 1934. Earlier mines, that had been closed down prior to that date, are not shown.

Note the relatively uniform distribution of mines throughout most parts of the anthracite

fields. Comparison of the above map with the one following indicates changes in the number and distribution of Pennsylvania's mines that have taken place during slightly more than two decades.

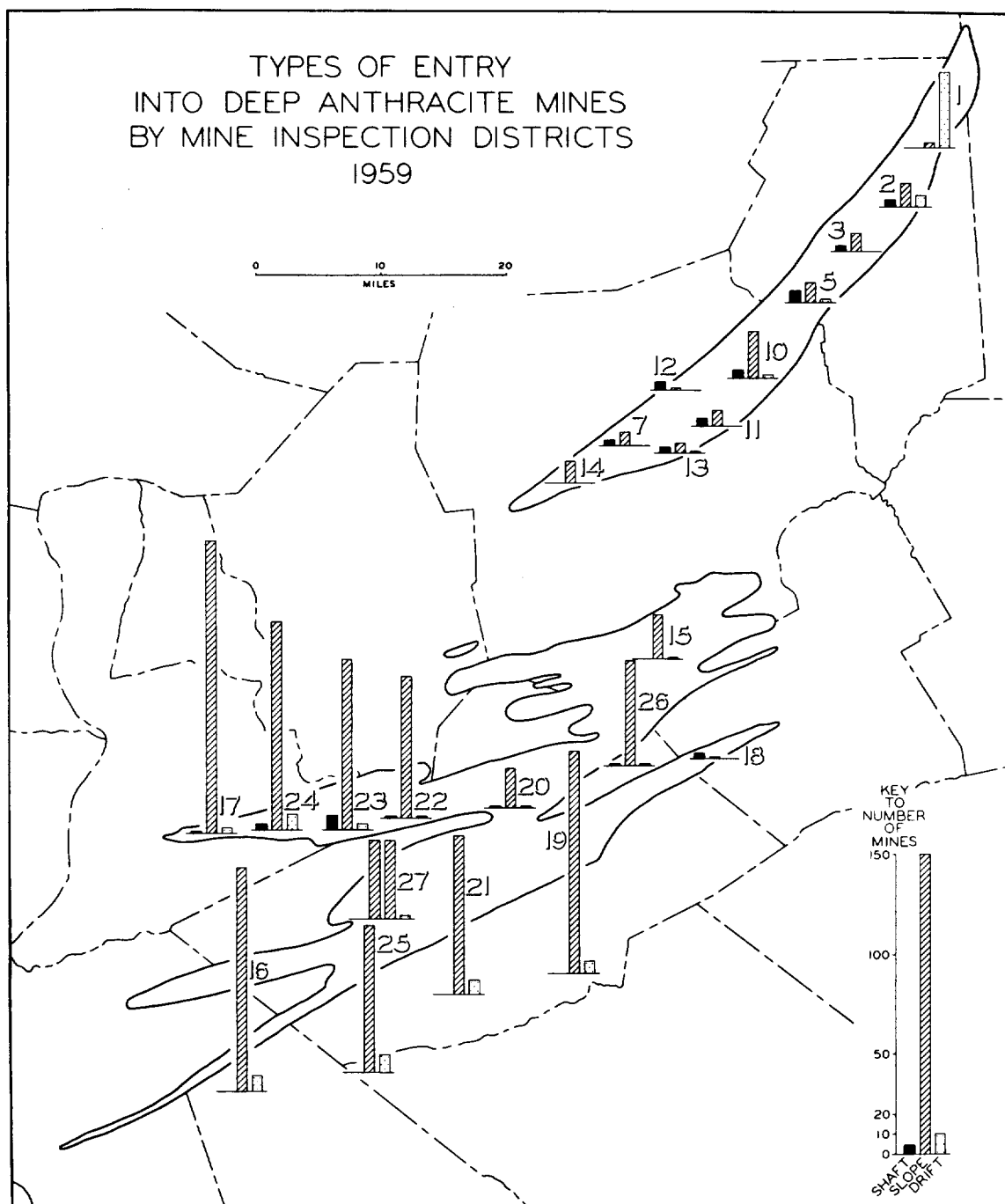


Appendix: Notes 40, 43, 44, 46, 48, 52, 54, and 55.

### INDIVIDUAL DEEP MINES, 1955 - 1957

The deep anthracite mines shown on the above map obviously are far more numerous than those of 1934 which are represented on the immediately preceding map. Moreover, the 1955-1957 pattern of distribution of deep mines is radically different from that in 1934, for in recent years there has occurred a marked reduction in the

number of such mines in most parts of the Northern and Eastern Middle Fields, and a dramatic increase in their numbers in most portions of the Western Middle and Southern Fields. Much of this increase is due to the tremendous proliferation of small deep mines since the depression years of the 1930's (see graph on page 54).

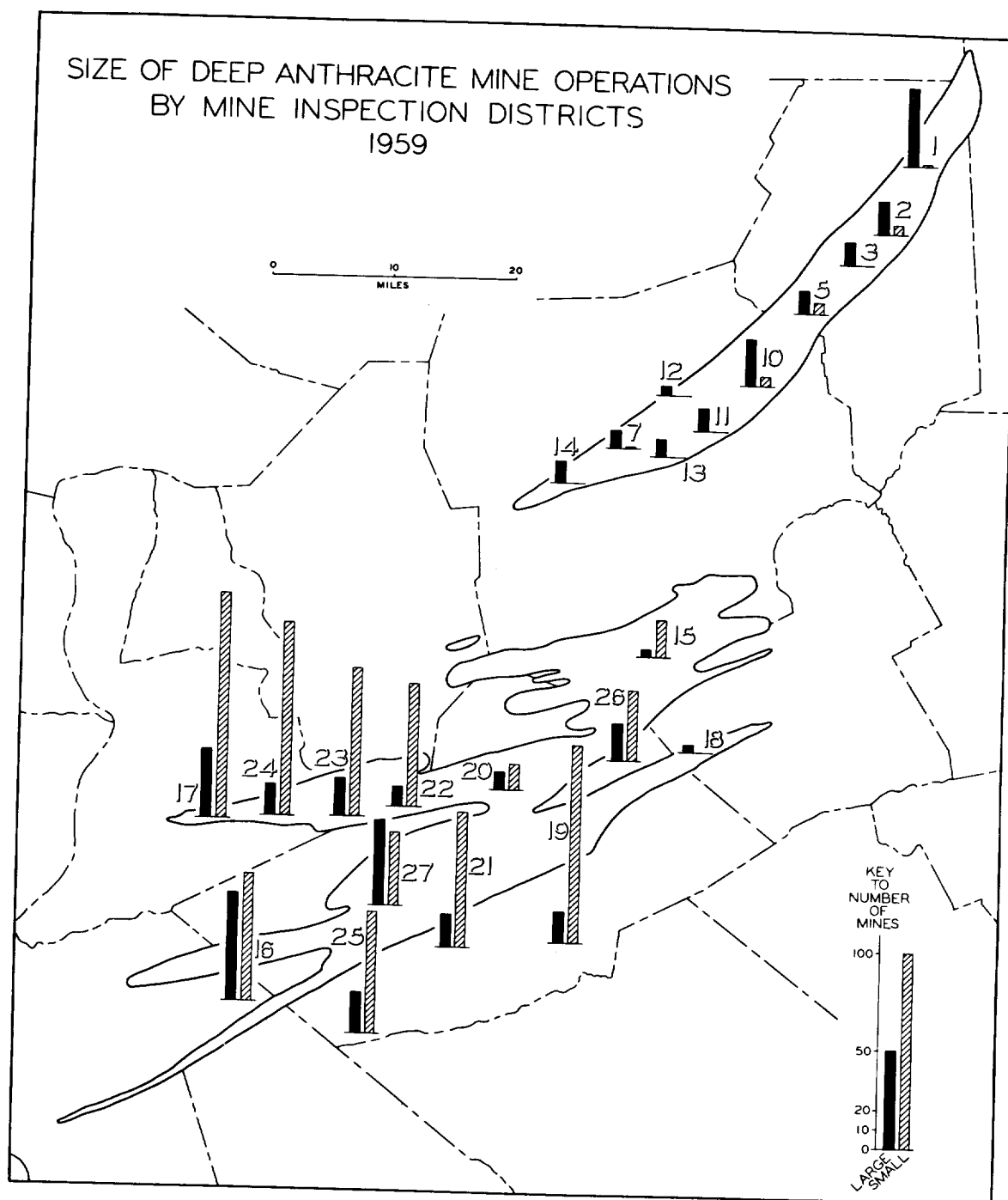


Appendix: Notes 29, 39, 40, 46, and 56.

### TYPES OF ENTRY INTO DEEP MINES

Of the 1,192 deep anthracite mines operating in 1959, 1,045 employed slope (inclined) entries, 99 used drift (horizontal) entries, and 48 had shaft (vertical) entries. The ubiquitous slope entries predominated, generally to an overwhelming extent, in every mine inspection district except three. Almost all of the shaft entries

were found in the Northern Field, the western half of the Western Middle Field, and the north-eastern end of the Southern Field. Drift entries were confined principally to the northeastern end of the Northern Field, the western portion of the Western Middle Field, and the central and western parts of the Southern Field.



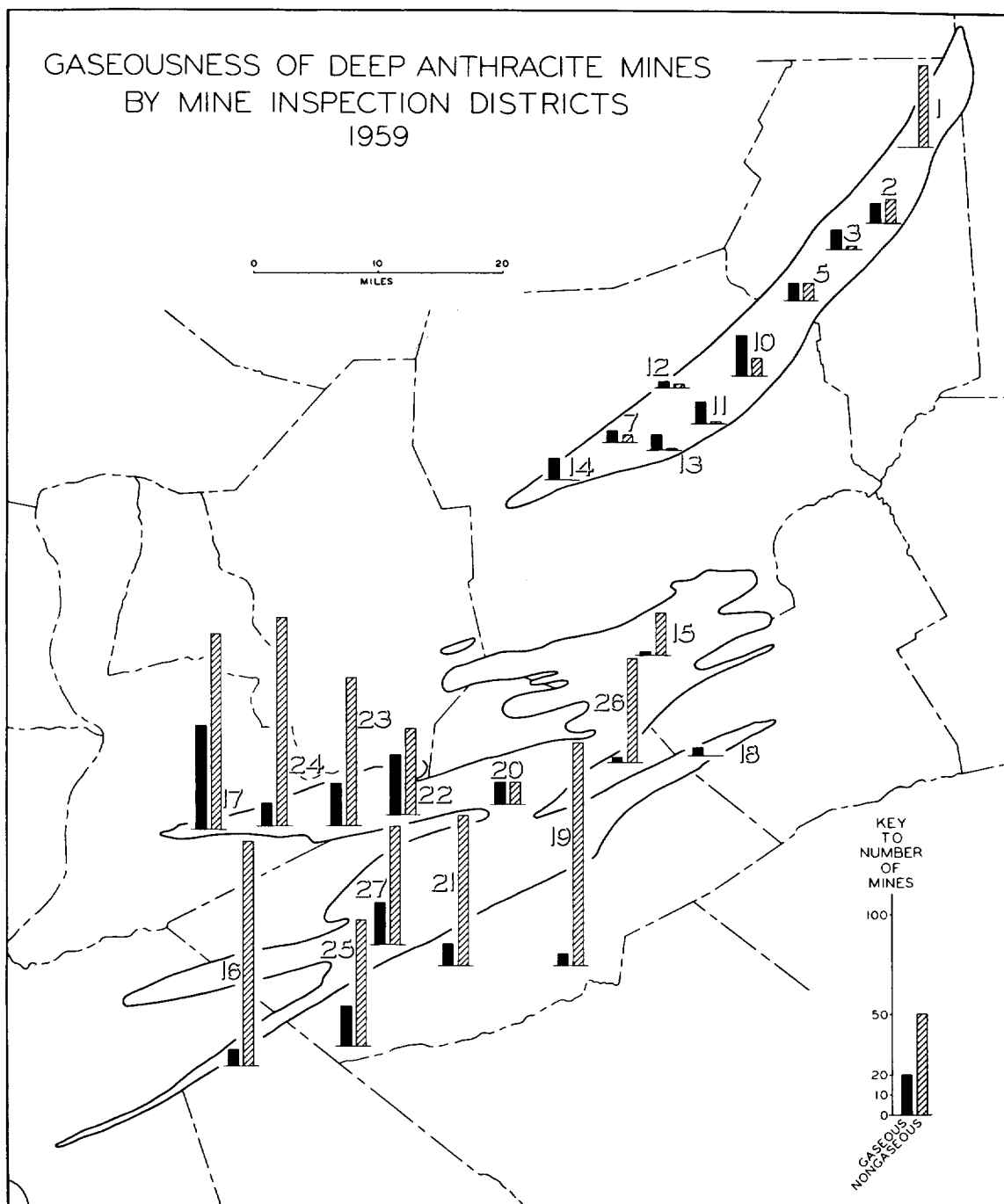
Appendix. Notes 29, 39, 40, 46, and 56.

### SIZE OF DEEP MINE OPERATIONS

Of the 1,192 deep anthracite mines operating in Pennsylvania during 1959, 419 were so-called large mines employing five or more persons underground and 773 were so-called small mines with fewer than five persons working underground. Many of the latter type were "bootleg" operations, i.e., they were conducted by indi-

viduals or partners on land for which mineral rights were owned by someone other than the coal operator.

Most of the deep mines in the Northern Field were large-sized operations, but almost everywhere else the small type of deep mine predominated, sometimes to an overwhelming degree.



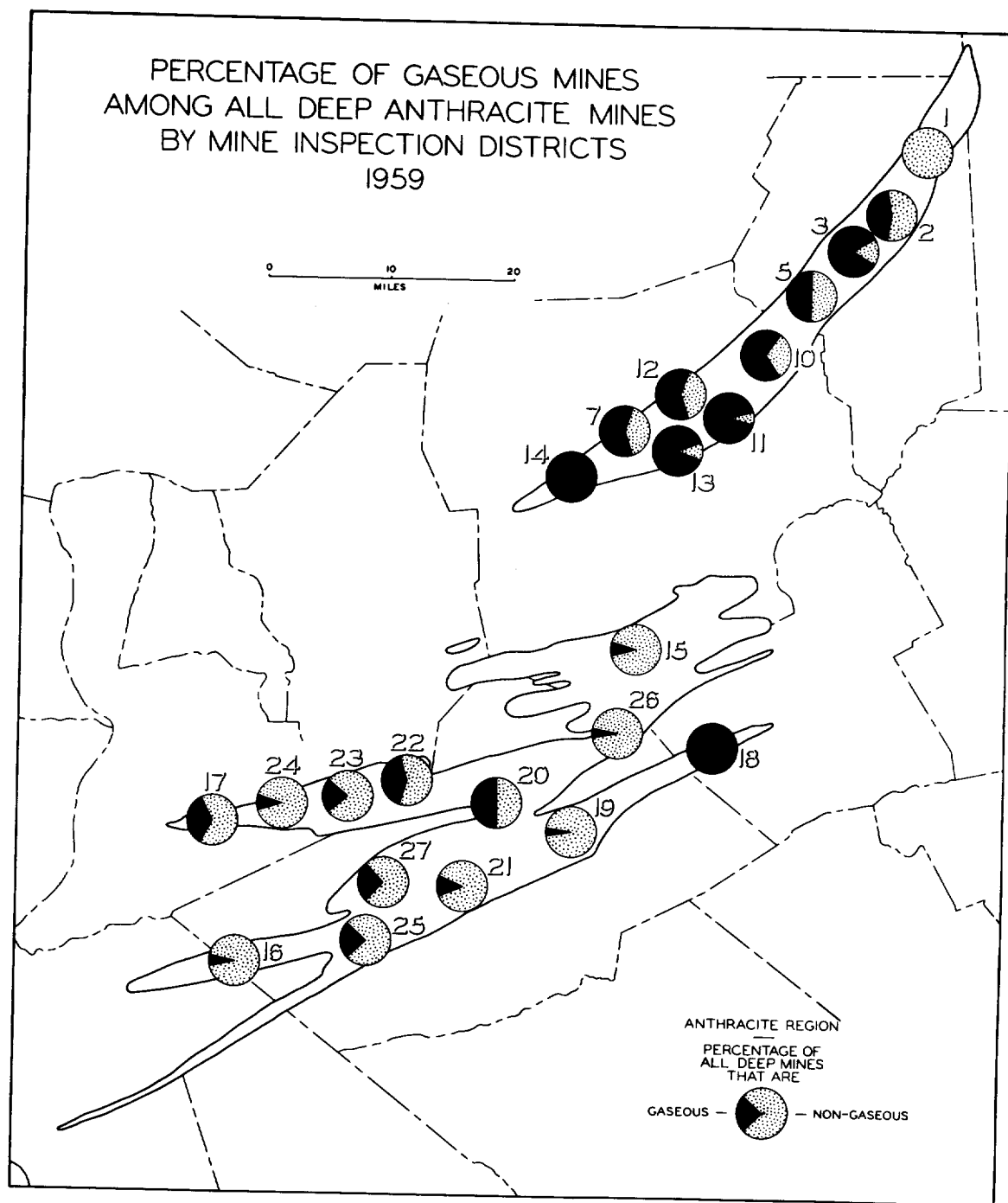
Appendix: Notes 29, 39, 40, 46, and 56.

### GASEOUSNESS OF DEEP MINES

The Pennsylvania Department of Mines and Mineral Industries classified as gaseous 288 of the 1,192 deep anthracite mines operating in the Commonwealth in 1959. The remaining 904 were designated as nongaseous.

Most of the gaseous mines of that year were found in the Western Middle Field, the south-

western half of the Southern Field, and in all but the northeastern end of the Northern Field. Nongaseous mines were common everywhere in the anthracite region except in the southwestern part of the Northern Field and the northeastern end of the Southern Field.



Appendix: Notes 29, 39, 40, 46, and 56.

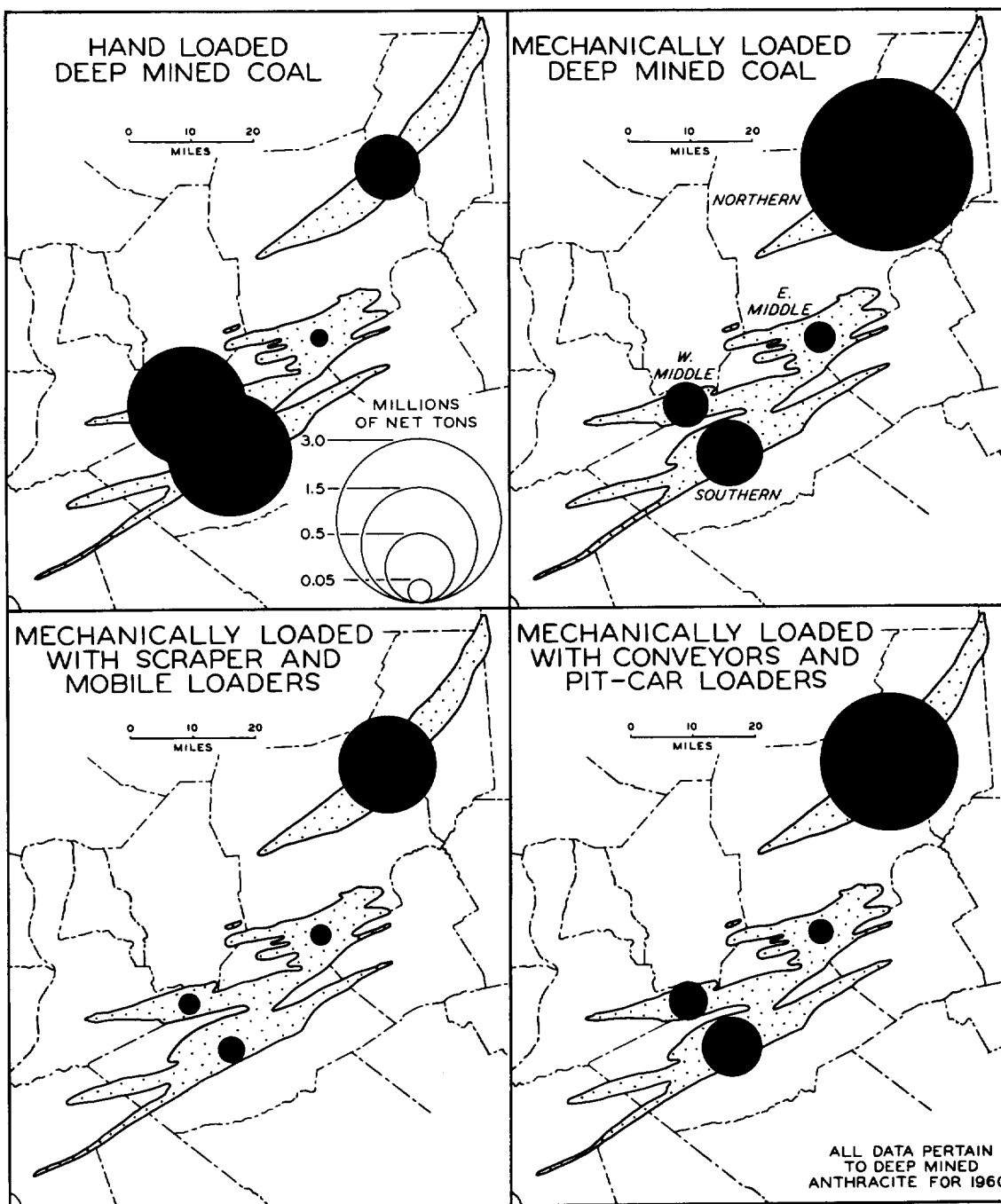
### PERCENTAGE OF GASEOUS MINES AMONG DEEP MINES

The symbols on the above map express, on a percentage basis, the absolute data represented on the immediately preceding map.

Deep mines in the Northern Field, except at the northeastern end, were predominantly gaseous, as were those in the northeastern part of the Southern Field. Elsewhere in the Pennsyl-

vania anthracite region, during 1959, nongaseous mines predominated, in many places to an overwhelming degree. For the anthracite region as a whole, some 24 per cent of all deep mines were classified as gaseous, and 76 per cent as non-gaseous.





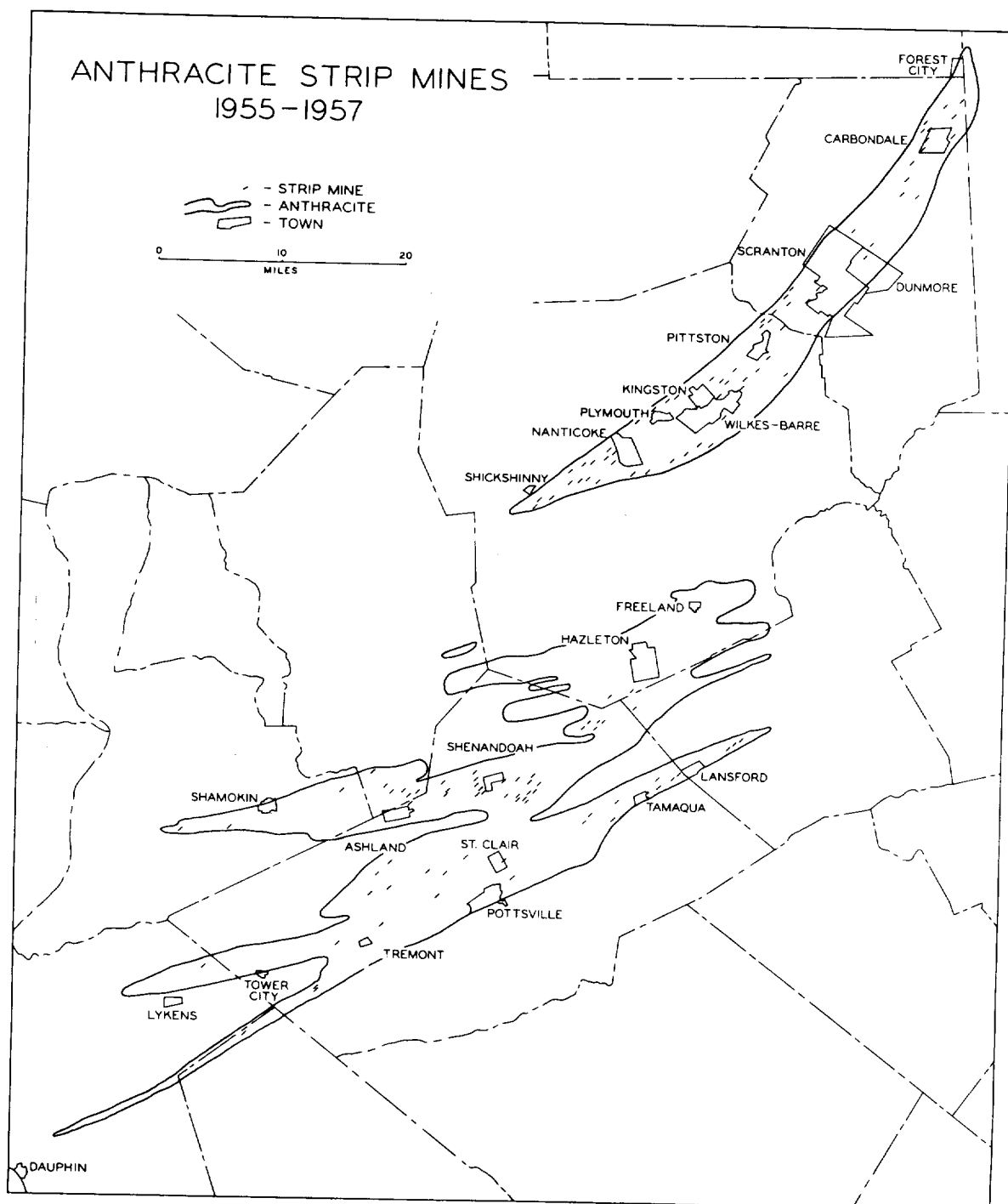
Appendix: Notes 35, 40, and 46.

## METHODS AND EQUIPMENT USED IN LOADING DEEP MINED COAL

Most deep mined coal is hand loaded onto underground transport devices in the Western Middle and Southern Fields (upper left map), where as most such coal is mechanically loaded in the Northern and Eastern Middle Fields (upper right map). Of the total coal loaded mechanically in 1960, some 81 per cent came from the

Northern Field.

In 1960, there were 114 scraper loader units and 45 mobile loaders in operation in the anthracite region, and 754 pit-car loaders and conveyors. Most of this loading equipment was employed in the Northern Field (the two lower maps).



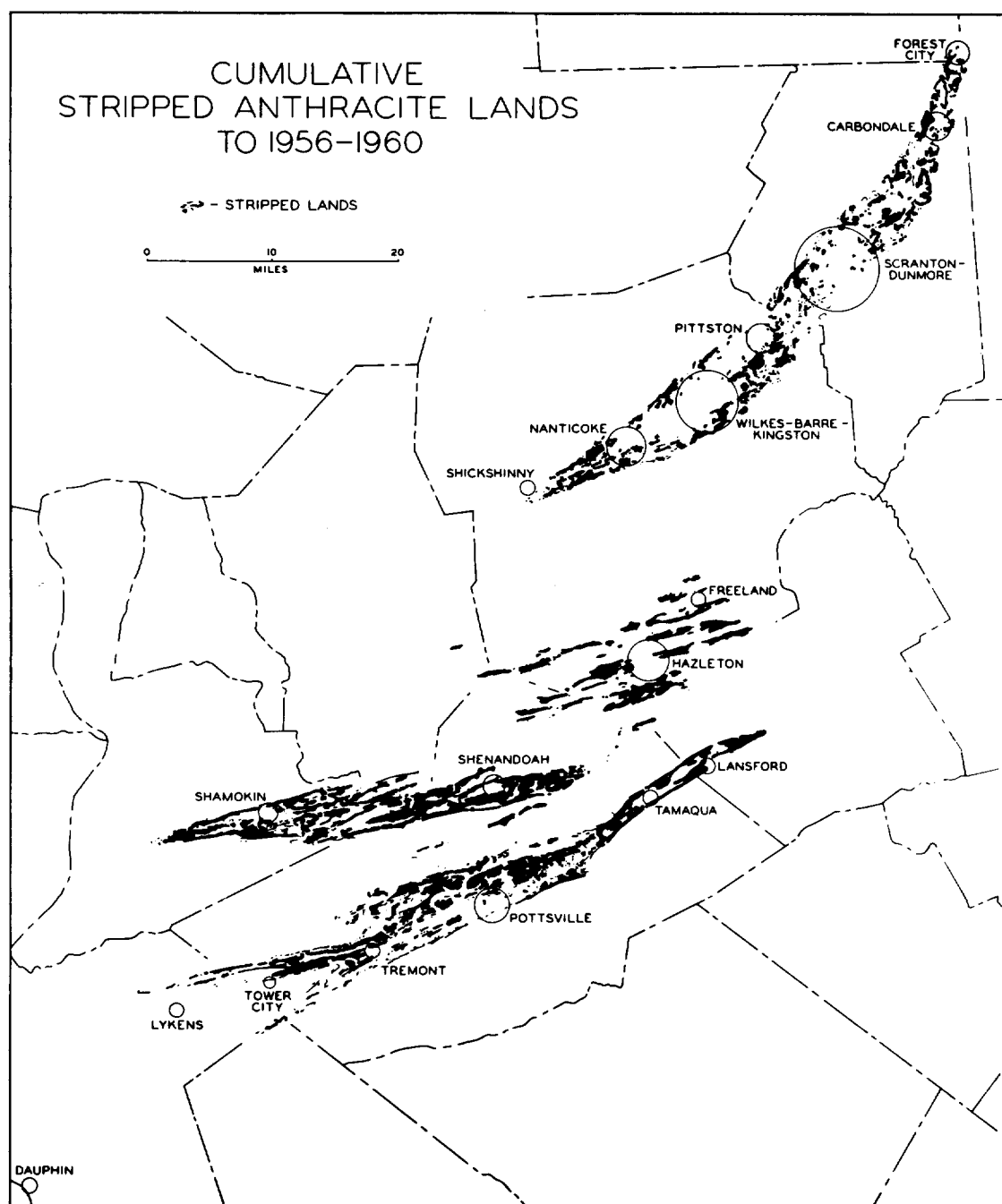
Appendix: Notes 43, 47, 52, 55, and 57.

## INDIVIDUAL STRIP MINES

Strip mines were much less numerous than deep mines in Pennsylvania's anthracite fields during 1955-1957 (compare the above map with that on page 57).

Approximately one-half of the strip mines in operation during those years were located in the

Northern Field. Other areas with relatively numerous strip mines included the eastern part of the Western Middle Field, the southwestern corner of the Eastern Middle Field, and the middle and northeastern portions of the Southern Field.



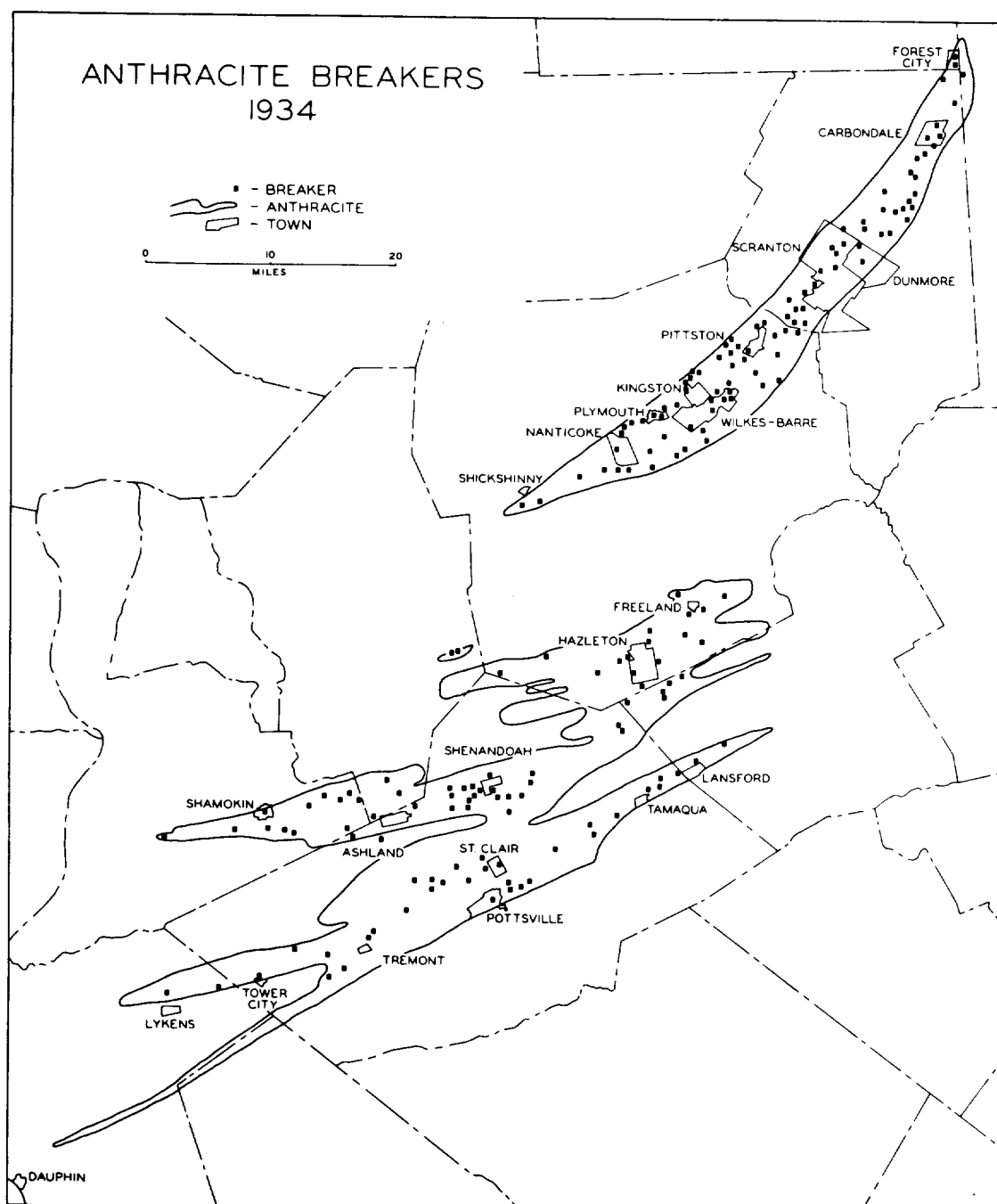
Appendix: Notes 58, 59, and 60.

### CUMULATIVE STRIPPED ANTHRACITE LANDS

The above map represents the accumulation of territories within the anthracite region of Pennsylvania that have been subject to the effects of open-pit, or strip, coal mining from the beginning of such operations many decades ago until 1956-1960.

Greatest continuity of stripping operations is found in the Western Middle Field; in large seg-

ments of this field, more than half the area has been affected by stripping. Progressively more diffused patterns of stripping characterize the Southern Field, the Eastern Middle Field, and the Northern Field. A total of some 51,000 acres, approximately 80 square miles, had been affected by stripping by 1956-1960.



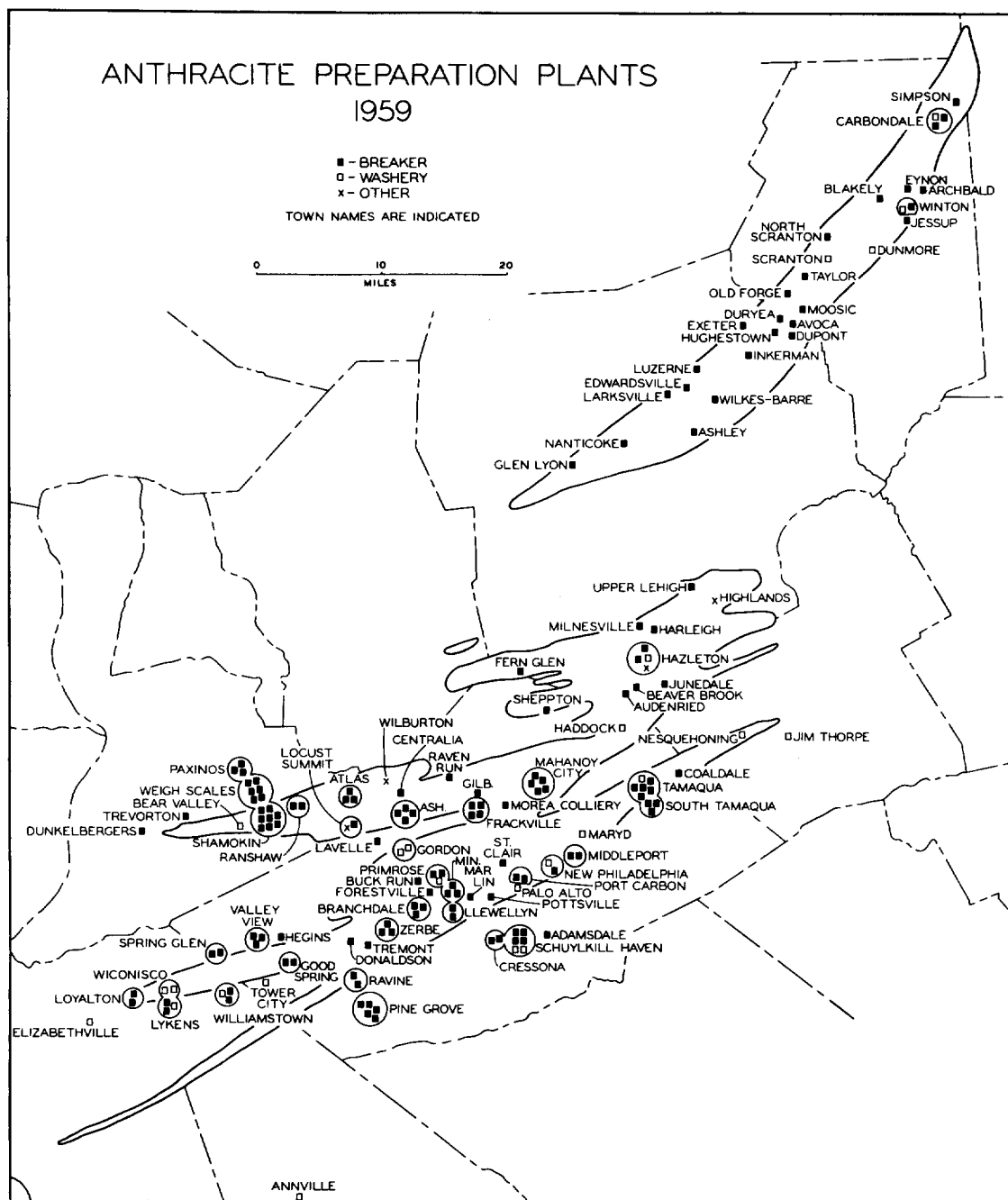
Appendix: Notes 52, 53, and 61.

### BREAKERS, 1934

Raw anthracite has long been processed in large preparation plants, termed breakers, before being placed on the market. Processing includes the removal of impurities to certain prescribed limits of tolerance, and the sorting of the final anthracite product into a wide range of sizes.

Since significant percentages of impurities characterize all freshly mined anthracite, it is

necessary to have breakers distributed at closely spaced intervals in those portions of the anthracite fields being mined in order to avoid unnecessarily long and expensive transport of impurities. Comparison of the above breaker map with the map on page 56 representing deep anthracite mines in 1934 shows the close correspondence in their distributional patterns.



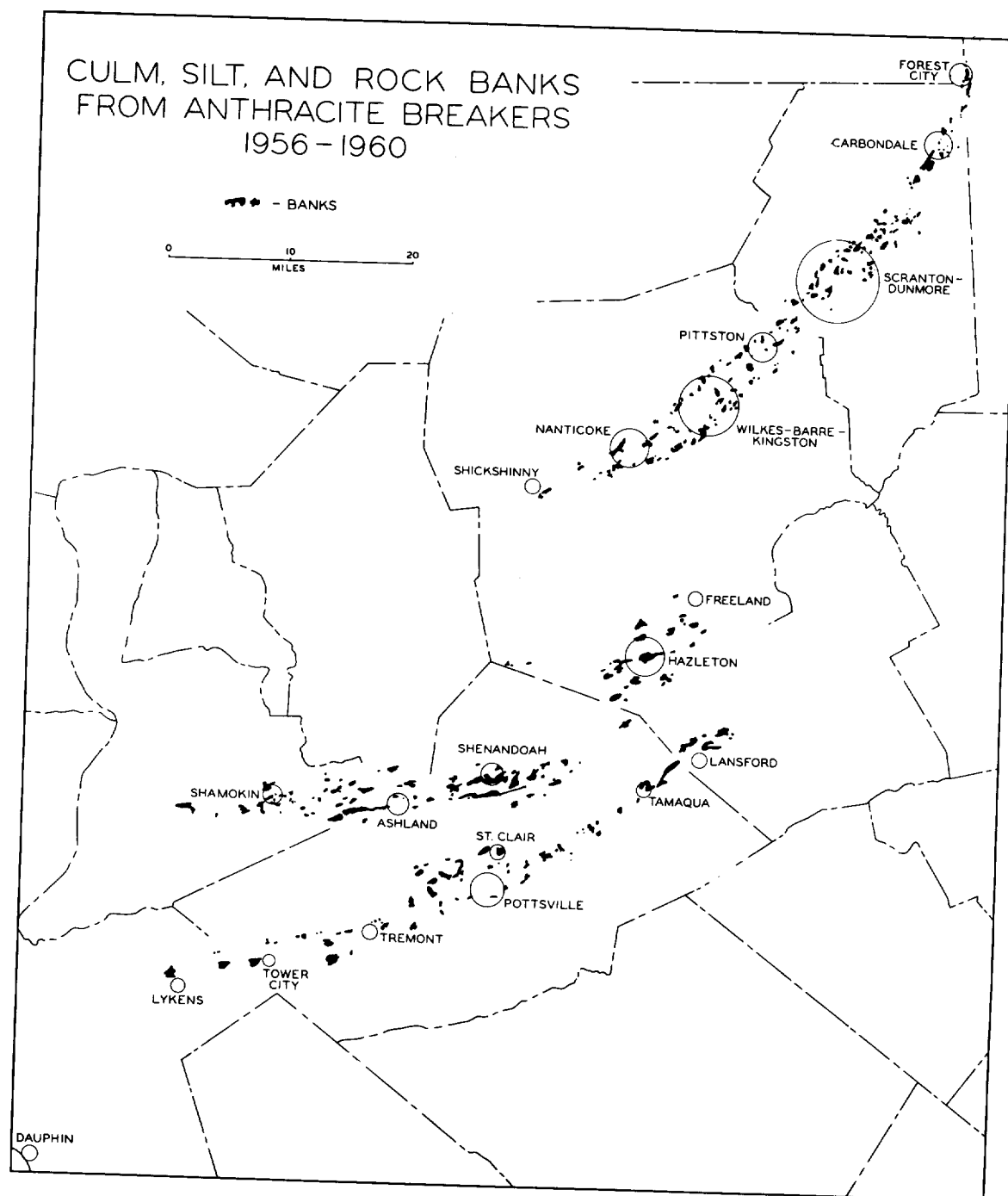
Appendix: Notes 29, 54, 61, and 62.

### PREPARATION PLANTS, 1959

There were 169 anthracite preparation plants in operation in Pennsylvania during 1959. These included 140 breakers, 25 washeries, and four other types of plants, the latter consisting of two fine coal plants, one silt plant, and one flotation plant.

The distributional pattern of anthracite preparation plants in 1959 was considerably different

from that for 1934 shown on the immediately preceding map. A drastic decline in the number of such plants had occurred in the Northern Field, and a drop of lesser proportions in the Eastern Middle Field. In contrast, there had been significant increases in number of preparation plants in the remaining two fields.



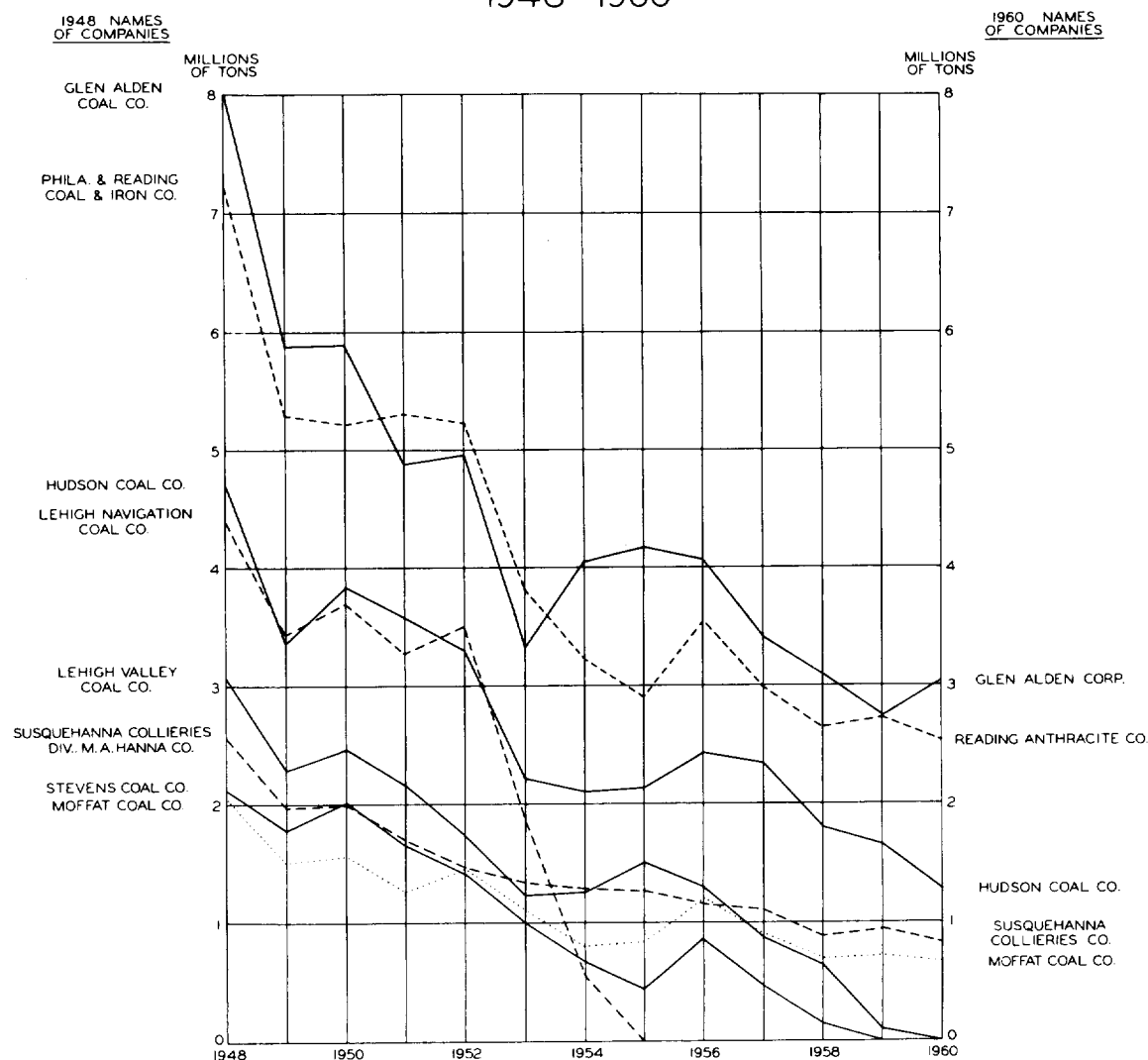
Appendix: Notes 58 and 60.

### CULM, SILT, AND ROCK BANKS

The solid waste materials discharged from anthracite preparation plants over the years have been accumulated in great mounds termed culm, silt, and rock banks. The first of these types contains not only coarse rock fragments but also a significant percentage of recoverable coal, whereas a rock bank has only a very limited coal con-

tent (generally one to five per cent). A silt bank is an accumulation of very fine-sized coal particles, with associated lesser quantities of rock dust, that has settled out of waste water piped from a breaker to a settling basin. All three types of banks form prominent and ubiquitous features of the anthracite landscape.

## ANTHRACITE PRODUCTION FROM LEADING OPERATORS 1948-1960

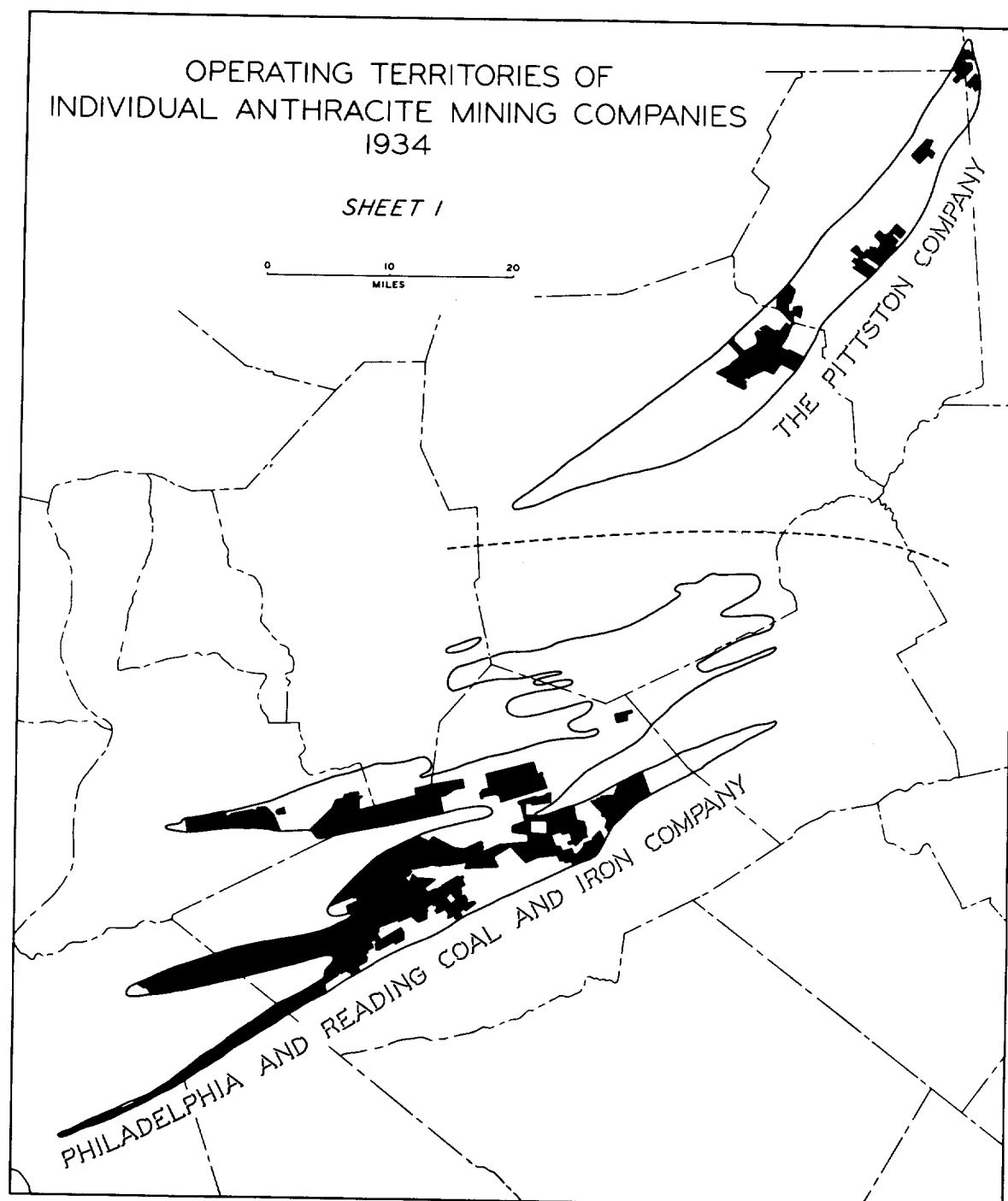


### PRODUCTION FROM LEADING OPERATORS, 1948 - 1960

The above graph represents the annual anthracite production from the eight most important producers of 1948 and the five leading operators of 1960, together with name changes of the companies involved.

A number of significant facts are evident from the graph. First, the three leading producers in 1948 continued in that position in 1960; i.e., there was no replacement of top producers over the 12-year period. Second, one by one over the years some of the leading operators of 1948 were

forced to cease production because of the depressed conditions of the anthracite industry. Thus, the Lehigh Navigation Coal Company discontinued mining in 1954, the Stevens Coal Company in 1958, and the Lehigh Valley Coal Company in 1959. Third, the drastically declining output from *all* leading producers over the years indicates that the problem was not a matter of inefficient individual producers, but rather one that was common to all operators — efficient and inefficient alike.



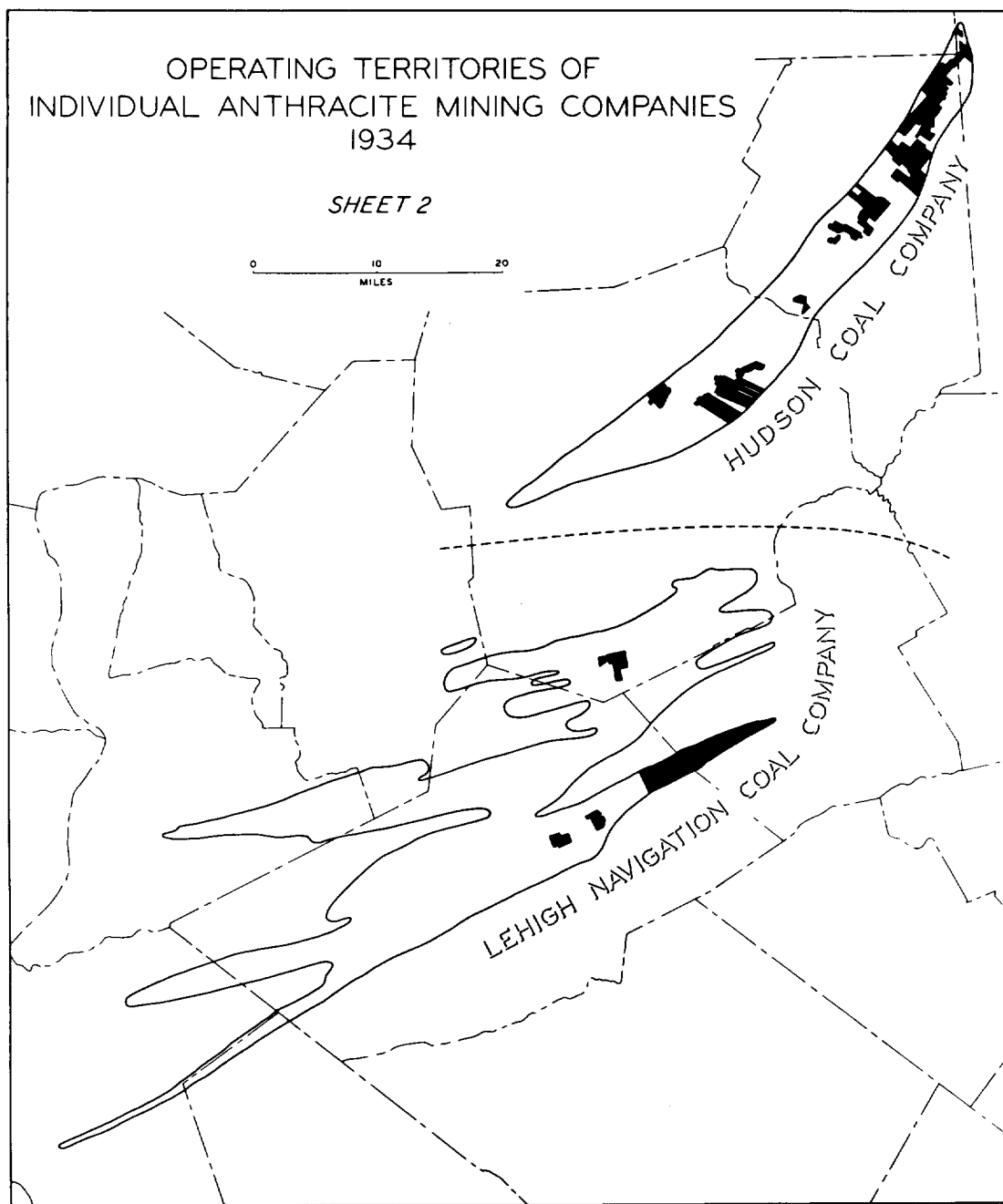
Appendix: Note 53.

### OPERATING TERRITORIES OF THE PITTSTON COMPANY AND THE PHILADELPHIA AND READING COAL AND IRON COMPANY, 1934

Areas in black represent territory in which the indicated anthracite mining companies had either subsurface mineral rights, or both surface and subsurface rights of ownership, in 1934. Note the concentration of Pittston Company lands in

the middle and northeastern parts of the Northern Field, and of Philadelphia and Reading lands in the Western Middle and Southern Fields. The latter company had the most extensive operating territory of any anthracite operator in 1934.



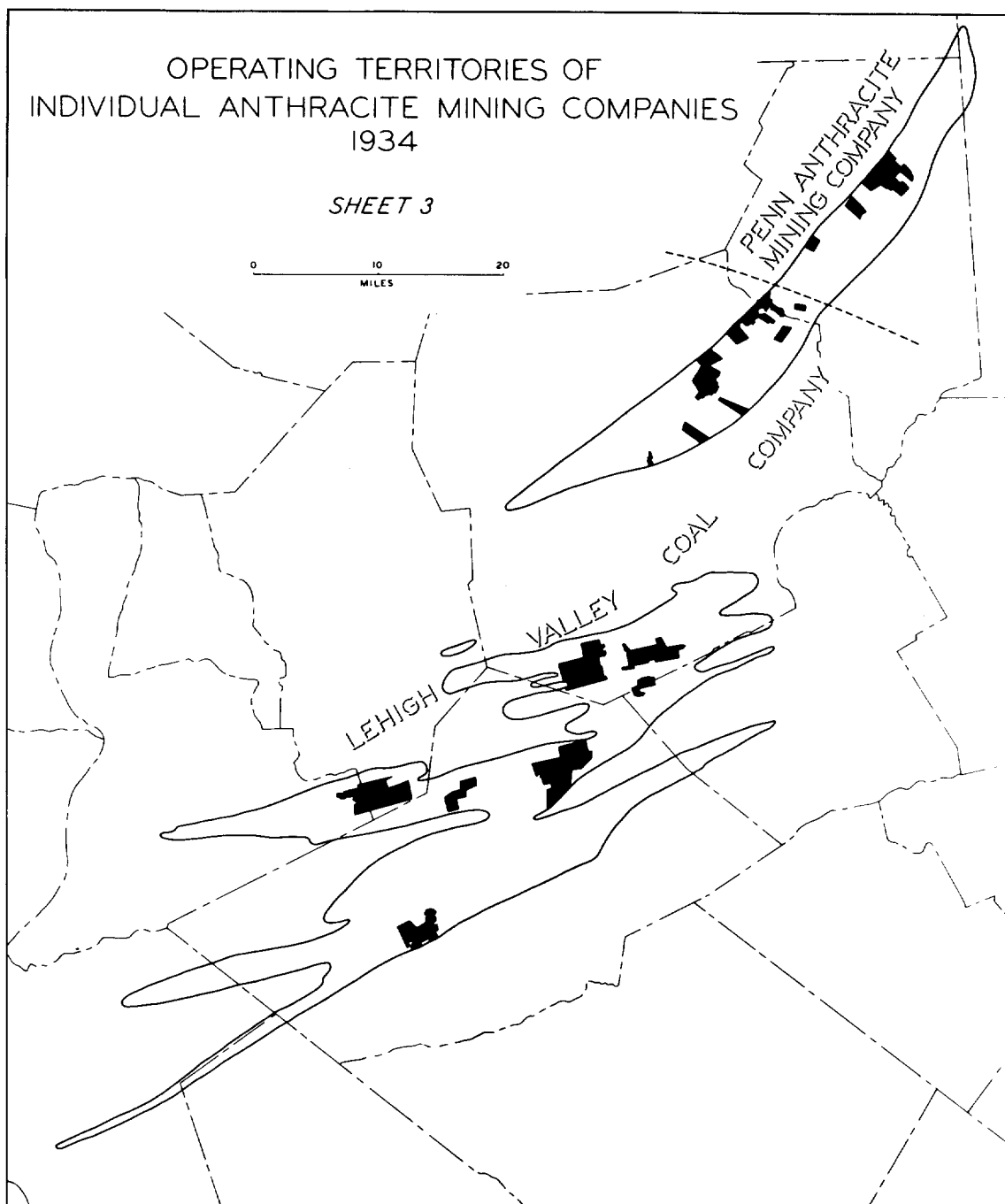


Appendix: Note 53.

### OPERATING TERRITORIES OF THE HUDSON COAL COMPANY AND THE LEHIGH NAVIGATION COAL COMPANY, 1934

Areas in black represent territory in which the indicated anthracite mining companies had either subsurface mineral rights, or both surface and subsurface rights of ownership, in 1934. Note the concentration of Hudson Coal Company lands in the middle and northeastern parts of the Northern Field, and of most Lehigh Navigation

Coal Company lands in the northeastern part of the Southern Field. Reference to the graph on page 68 shows that the Lehigh Navigation Coal Company ceased production in 1954, but that the Hudson Coal Company continues as one of the leading anthracite producers.



Appendix: Note 53.

### OPERATING TERRITORIES OF THE PENN ANTHRACITE MINING COMPANY AND THE LEHIGH VALLEY COAL COMPANY, 1934

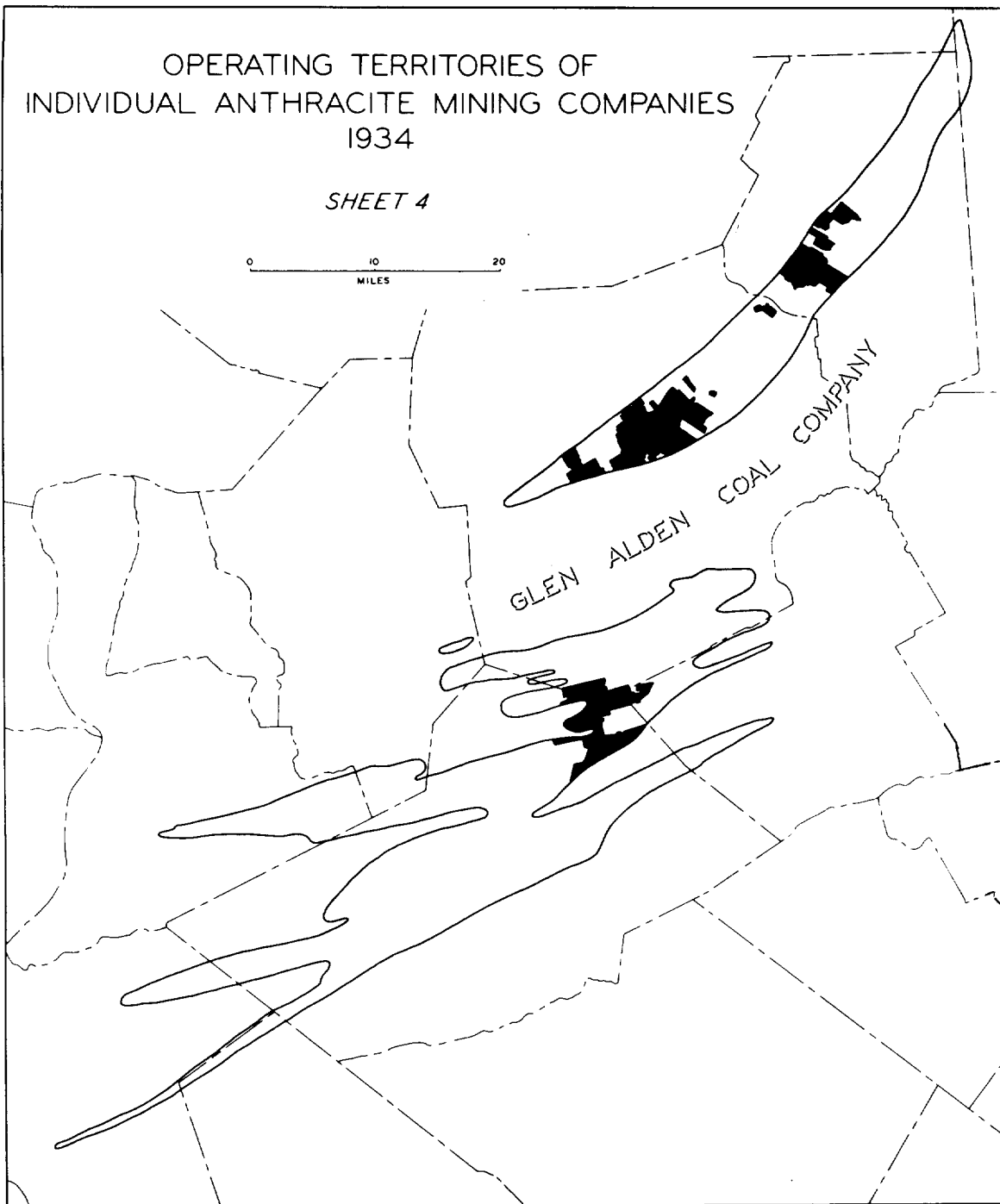
Areas in black represent territory in which the indicated anthracite mining companies had either subsurface mineral rights, or both surface and subsurface rights of ownership, in 1934. The Lehigh Valley Coal Company was the only major producer in that year that had lands located in

all four of the anthracite fields. Operating territory of the Penn Anthracite Mining Company, in contrast, was restricted to the northeastern half of the Northern Field. Note, on the graph on page 68, that the Lehigh Valley Coal Company ceased production in 1959.

OPERATING TERRITORIES OF  
INDIVIDUAL ANTHRACITE MINING COMPANIES  
1934

SHEET 4

0 10 20  
MILES



Appendix: Note 53.

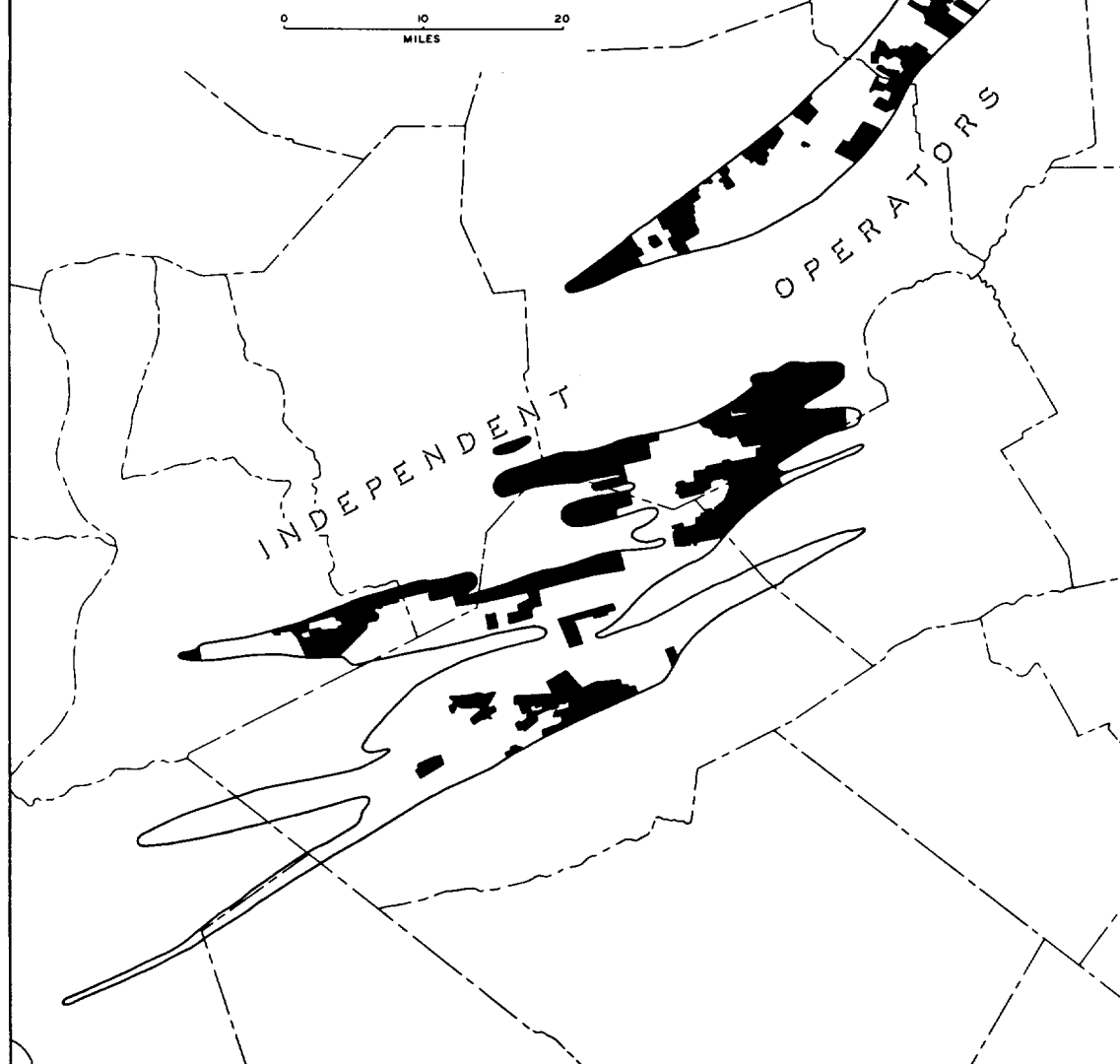
**OPERATING TERRITORY OF THE GLEN ALDEN COAL COMPANY, 1934**

Areas in black represent territory in which the Glen Alden Coal Company had either subsurface mineral rights, or both surface and subsurface rights of ownership, in 1934. The company's lands were located mostly in the middle and southern parts of the Northern Field; lesser areas

were found in the southern part of the Eastern Middle Field and the extreme eastern end of the Western Middle Field. As is shown on the graph on page 68, the Glen Alden Coal Company has typically ranked as the leading producer of anthracite in Pennsylvania.

# OPERATING TERRITORIES OF INDIVIDUAL ANTHRACITE MINING COMPANIES 1934

*SHEET 5*

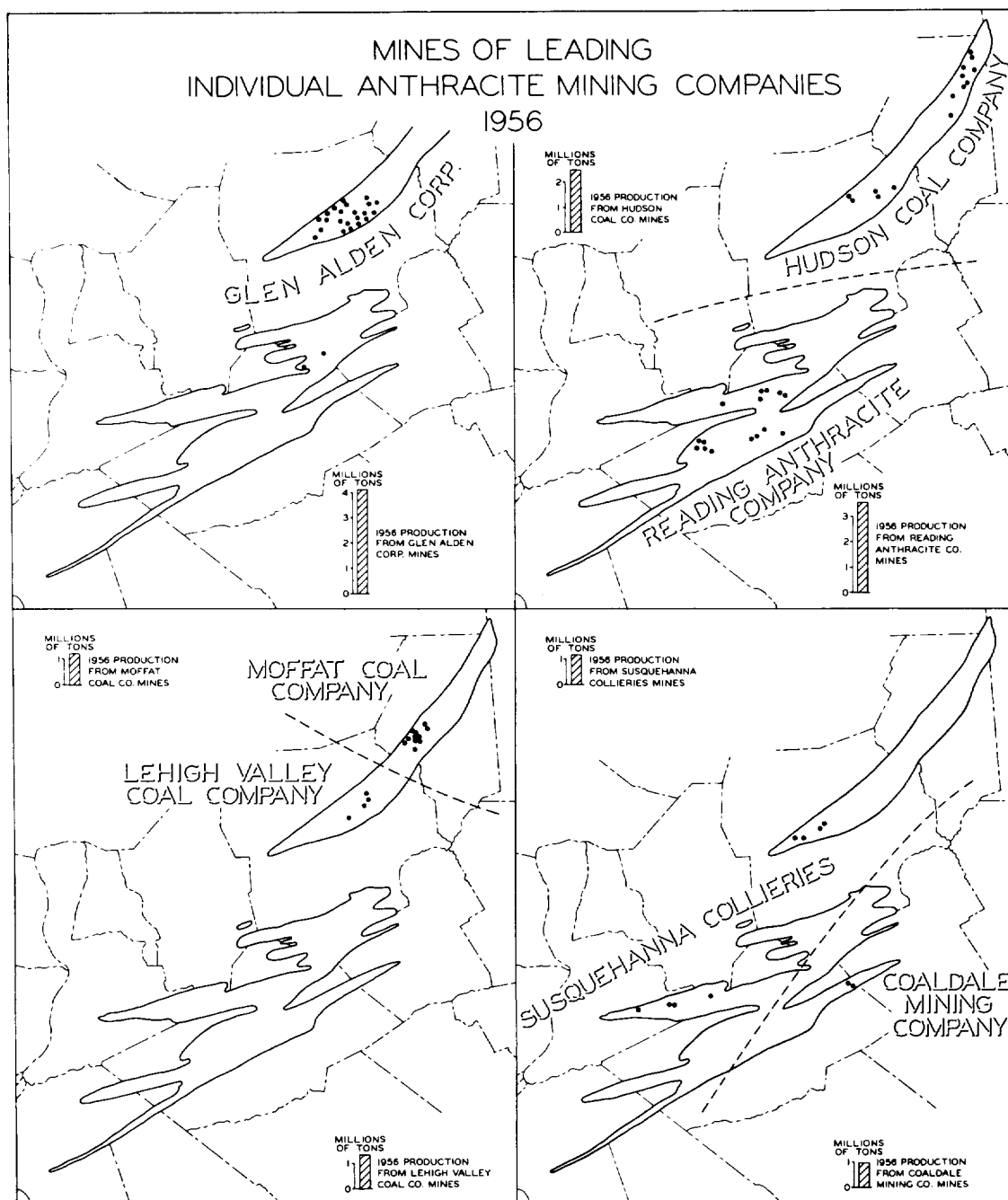


Appendix: Note 53.

## **OPERATING TERRITORIES OF THE INDEPENDENT ANTHRACITE COMPANIES, 1934**

The independent operators included all of the more than 100 anthracite mining companies of 1934 except the seven "railroad" companies represented on the previous maps of this series. The latter companies were so called because of their long and close connections with the railroads

that served the anthracite region. Operating territories of the independents were widely distributed throughout all four of the anthracite fields in 1934, being least extensive in the Southern Field, and most widespread in the Eastern Middle Field.



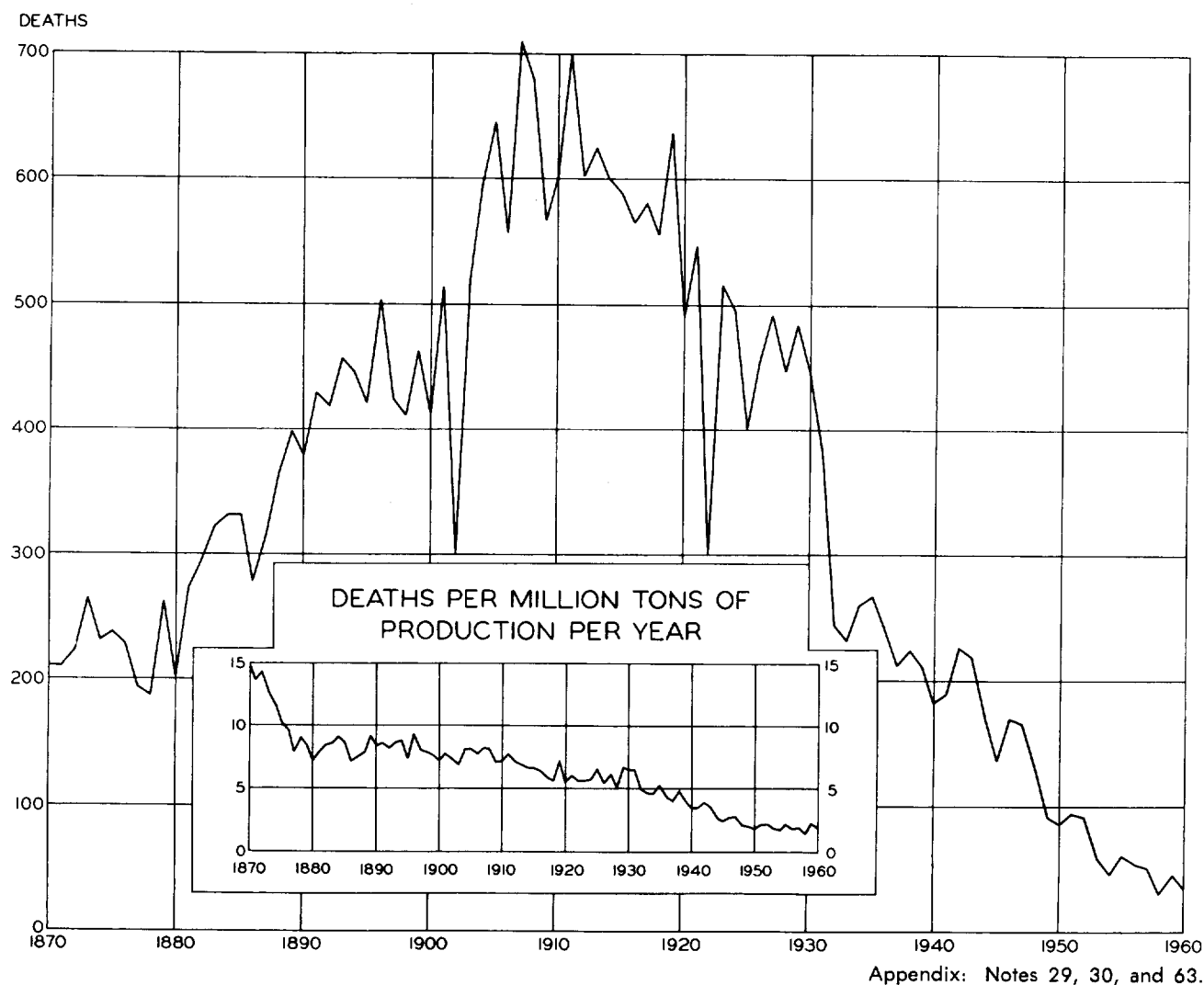
Appendix: Notes 29, 43, 45, and 54.

### MINES OF LEADING INDIVIDUAL ANTHRACITE MINING COMPANIES, 1956

The above maps show the distribution of mines operated by the seven leading anthracite companies of 1956, together with the total production of each company during that year. Each dot represents an active mine. Note the close correspondence between the operating territories

of several of the leading companies in 1956, with the operating territories of those same companies in 1934 as represented on the immediately preceding series of maps. See the graph on page 68 for name changes of certain companies.

## DEATHS FROM ALL TYPES OF ANTHRACITE MINE ACCIDENTS 1870-1960

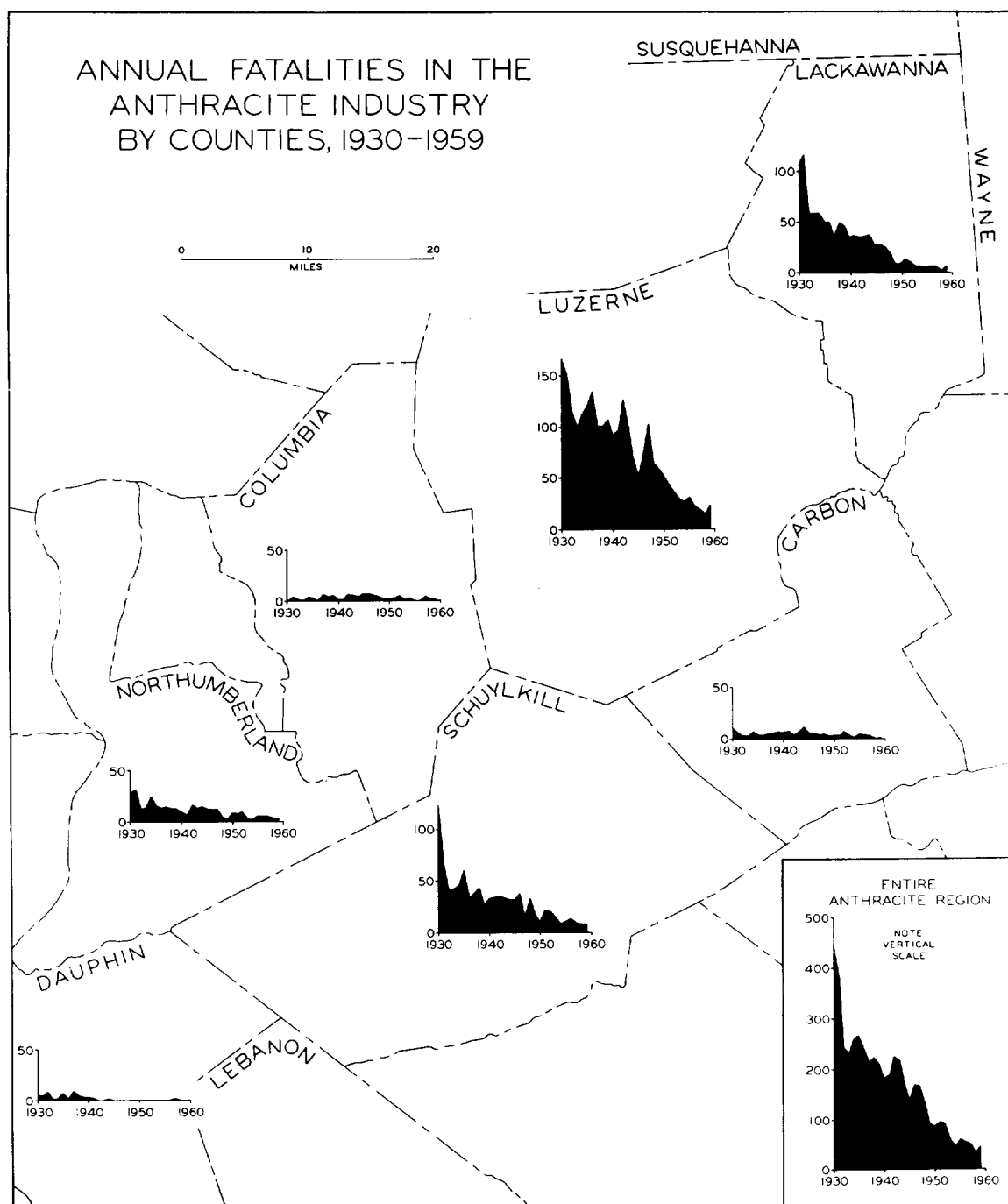


### ACCIDENTAL DEATHS, 1870 - 1960

Accidental deaths at anthracite mining operations in Pennsylvania numbered slightly over 200 in 1870, reached an apex of more than 700 in 1907, and declined to 35 in 1960. The over-all rise and decline in the death curve was primarily in response to equivalent changes in the number of anthracite employees (see graph on page 34), for the greater the number of workers exposed to the hazards of mining the greater the likelihood of accidental death. However, pronounced fluctuations in the number of accidental deaths from year to year, as during the periods 1901-1903 and 1921-1923, reflect marked changes in

the annual rate of production (see graph on page 86) rather than in number of employees.

As illustrated on the inset graph, above, the long-term secular trend in the accidental death rate of the anthracite industry has been downward during the past century. Part of the decline has been due to the development of more effective safety measures and their more rigid enforcement, but an additional factor has been the increasing significance of inherently safer bank and strip operations as contrasted with more dangerous underground operations.

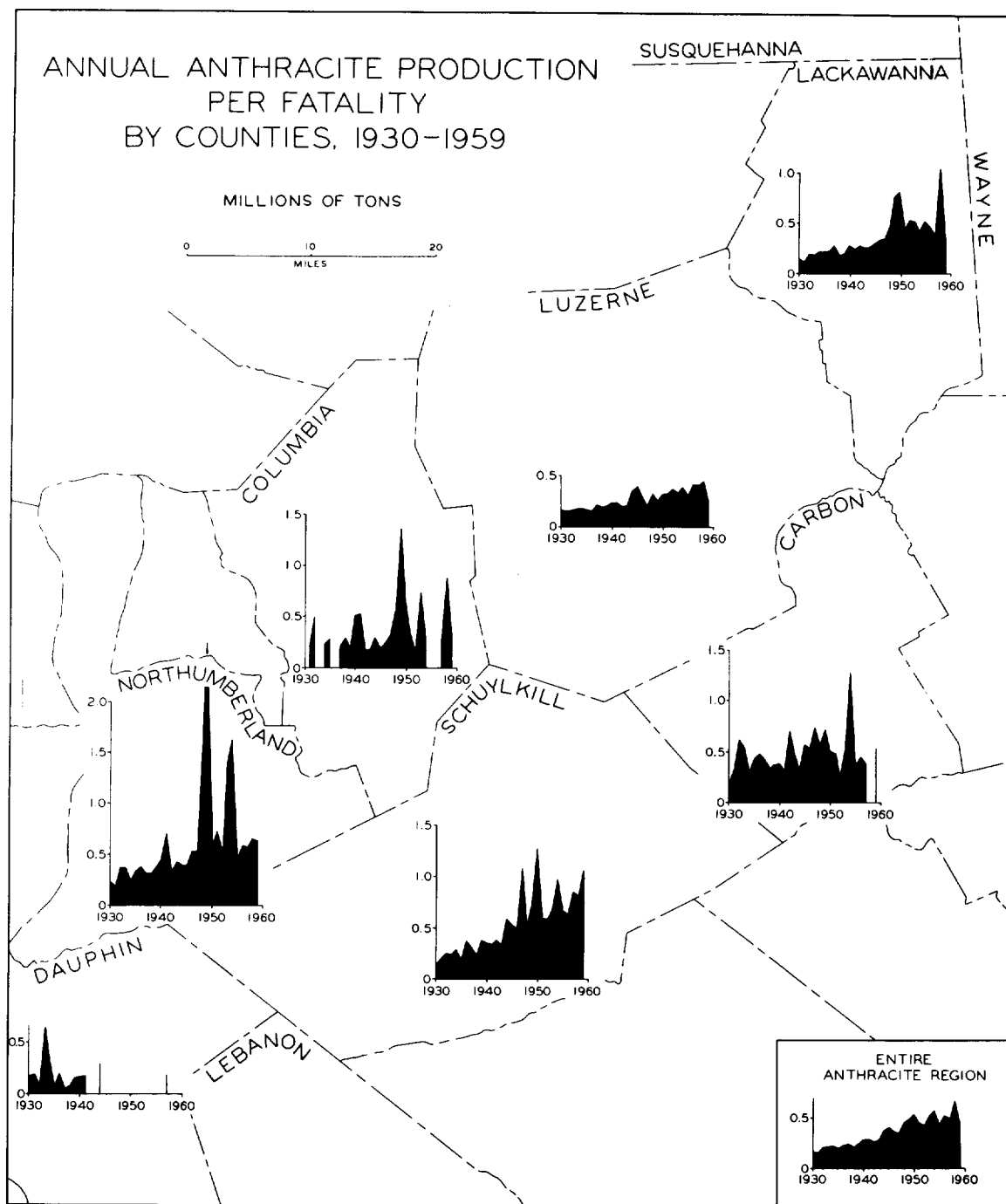


Appendix: Notes 29, 30, and 64.

### FATALITIES, BY COUNTIES, 1930 - 1959

In accordance with the trend in the anthracite industry as a whole (see inset), the number of mining-associated accidental deaths in each individual county has tended to decline during the past three decades. The percentile decrease, however, has differed from county to county, being greatest in those such as Schuylkill where

the substitution of inherently safer strip and bank mining for more dangerous underground mining has progressed furthest (see graph on page 89), and in other counties such as Lackawanna where the anthracite industry as a whole has declined most drastically (see graph on page 88).



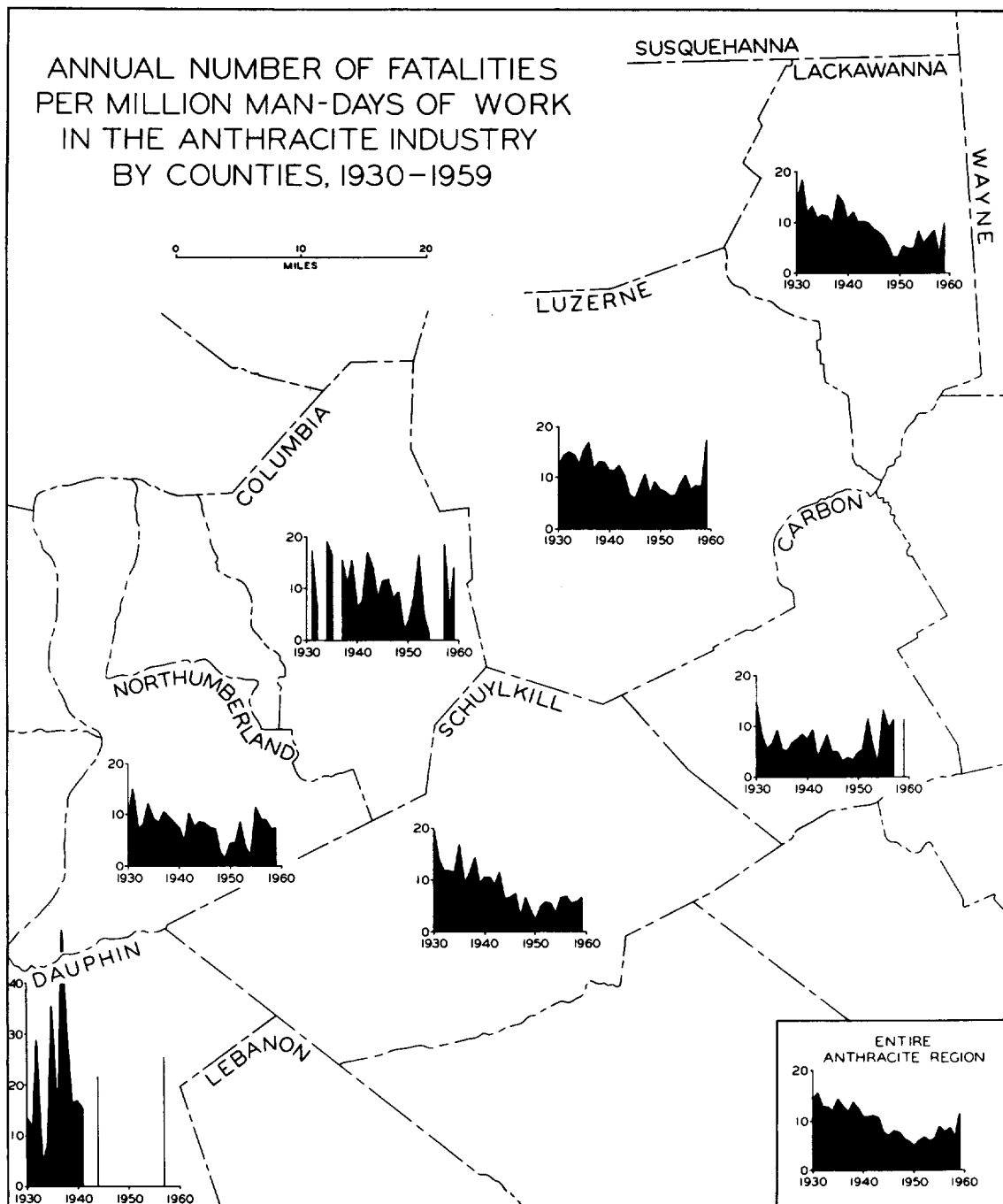
Appendix: Notes 29, 30, 64, and 65.

### PRODUCTION PER FATALITY, BY COUNTIES, 1930 - 1959

The greatest long-term increase in production of coal per fatality is recorded in Schuylkill County; there has been little or no long-term improvement in Carbon and Dauphin counties. Curves for counties in which annual production is small, e.g., Carbon, Columbia, Dauphin, and Northumberland (see production graphs on page

88), tend to be highly erratic, since slight variations in the number of fatalities per year result in great differences in production per fatality. Likewise, as annual production has declined during recent years in some of the major producing counties, e.g., Lackawanna and Schuylkill, their curves have become more erratic.





Appendix: Notes 29, 30, 64, and 65.

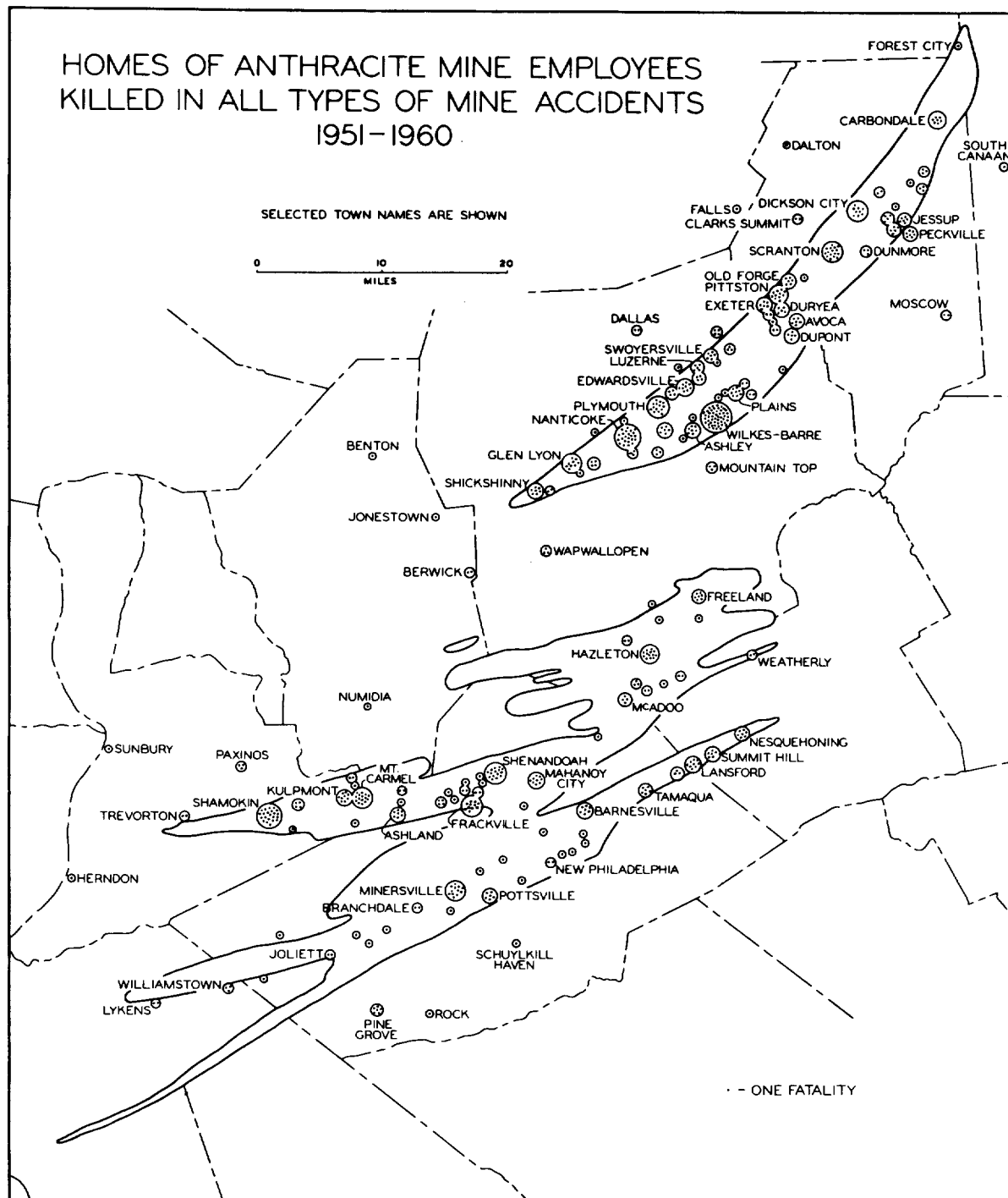
### FATALITIES PER MAN-DAYS OF WORK, BY COUNTIES, 1930 - 1959

Between 1930 and 1950 there was a gradual decrease in the number of fatalities per million man-days of work in Pennsylvania's anthracite industry as a whole, but from 1950 to 1960 this trend was reversed (see inset graph, above).

The death-ratio curves for the more important producing counties reflect these changes. Great-

est long-term improvement has occurred in Schuylkill County. Significant, but less pronounced, progress also has been recorded in Lackawanna and Luzerne counties. Other counties, however, have experienced little or no long-term change in the annual number of deaths per million man-days of exposure.

# HOMES OF ANTHRACITE MINE EMPLOYEES KILLED IN ALL TYPES OF MINE ACCIDENTS 1951-1960

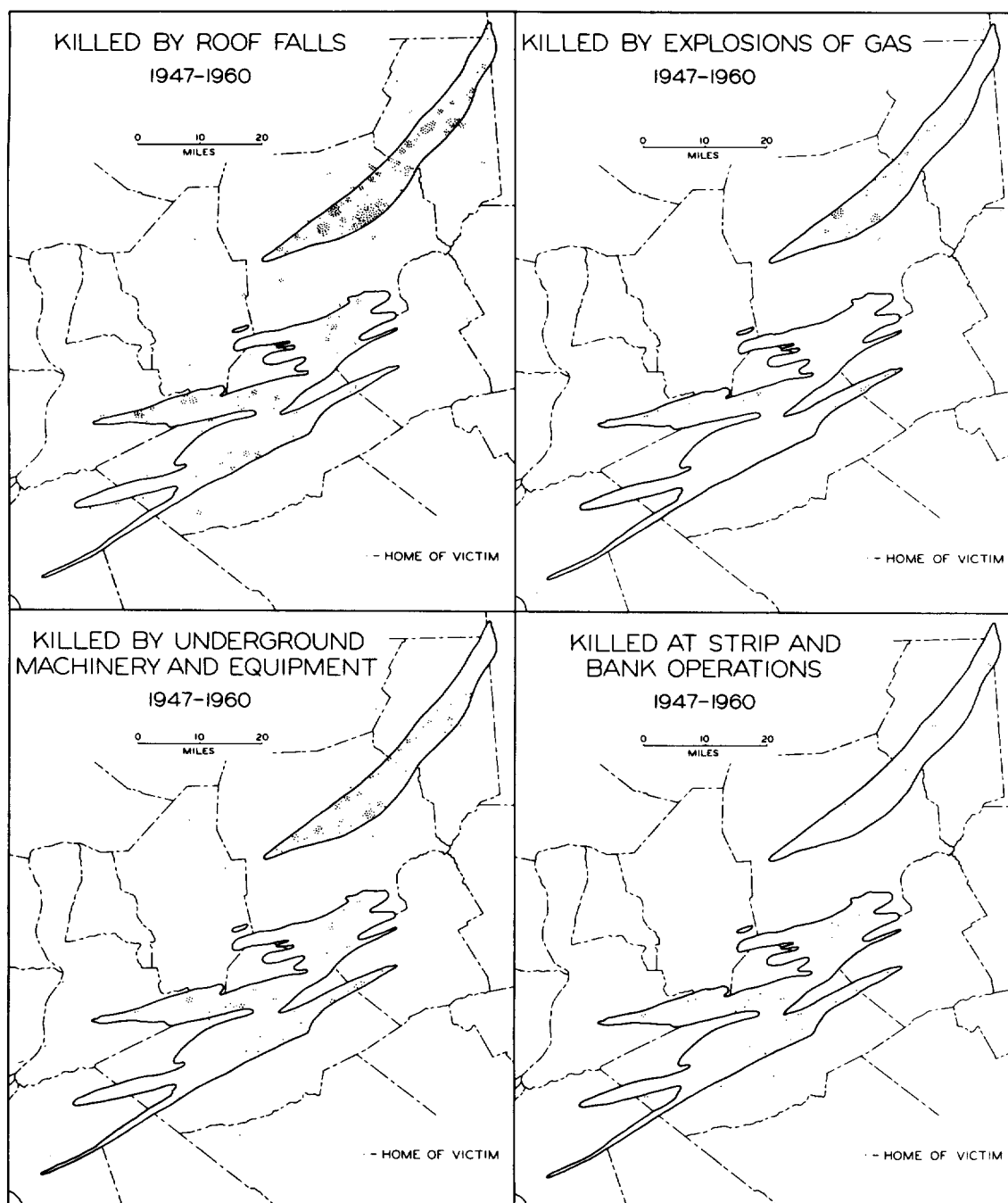


Appendix: Notes 29, 30, 54, and 66.

## HOMES OF MINE DISASTER VICTIMS, 1951 - 1960

A total of 567 fatal accidents occurred in Pennsylvania's anthracite industry during the decade, 1951-1960. By far the greatest number of these involved employees living in or near the Northern Field. Progressively fewer casualties affected residents in or near the Western Middle,

Southern, and Eastern Middle Fields. Wilkes-Barre had the greatest number of victims. Other towns with large numbers included Nanticoke, Shamokin, Scranton, Shenandoah, and Mt. Carmel. Note the distance of some of the victims' homes from the anthracite fields.



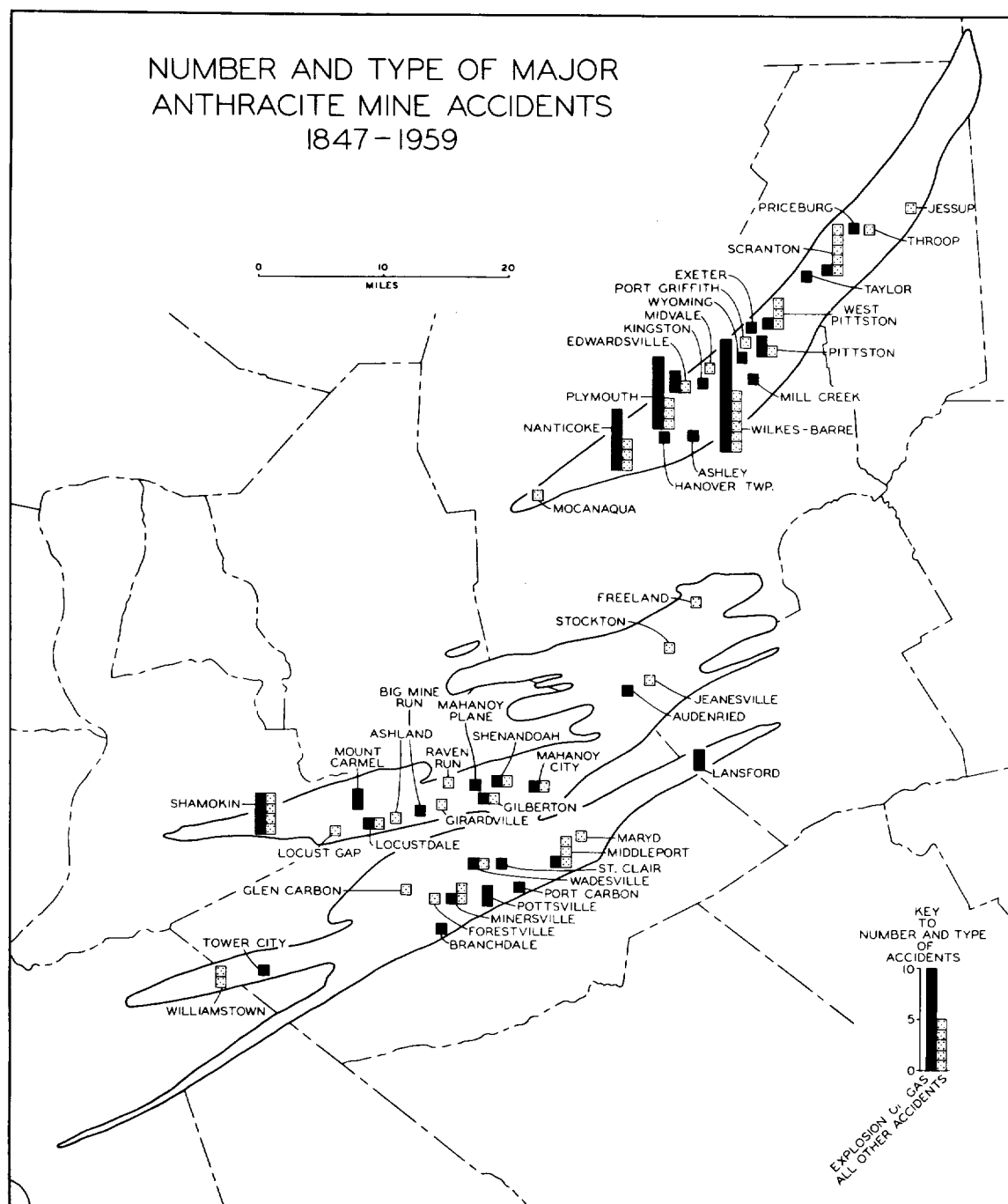
Appendix: Notes 29, 30, 54, and 67.

### SPECIFIC CAUSES OF FATAL ACCIDENTS, 1947 - 1960

The above maps show cumulative deaths from the three most important categories of underground accidents, and from all surface-mining accidents, for the period 1947 to 1960, inclusive. Each dot represents the home of a victim, not the site at which the fatality took place.

As the maps indicate, a majority of all three types of underground fatalities — those caused

by roof fall, explosion of gas, and underground machinery and equipment — are associated with the Northern Field, where deep mining of anthracite is emphasized. Most deaths at strip and bank operations occurred in the Middle and Southern Fields, where surface mining operations are relatively most important.

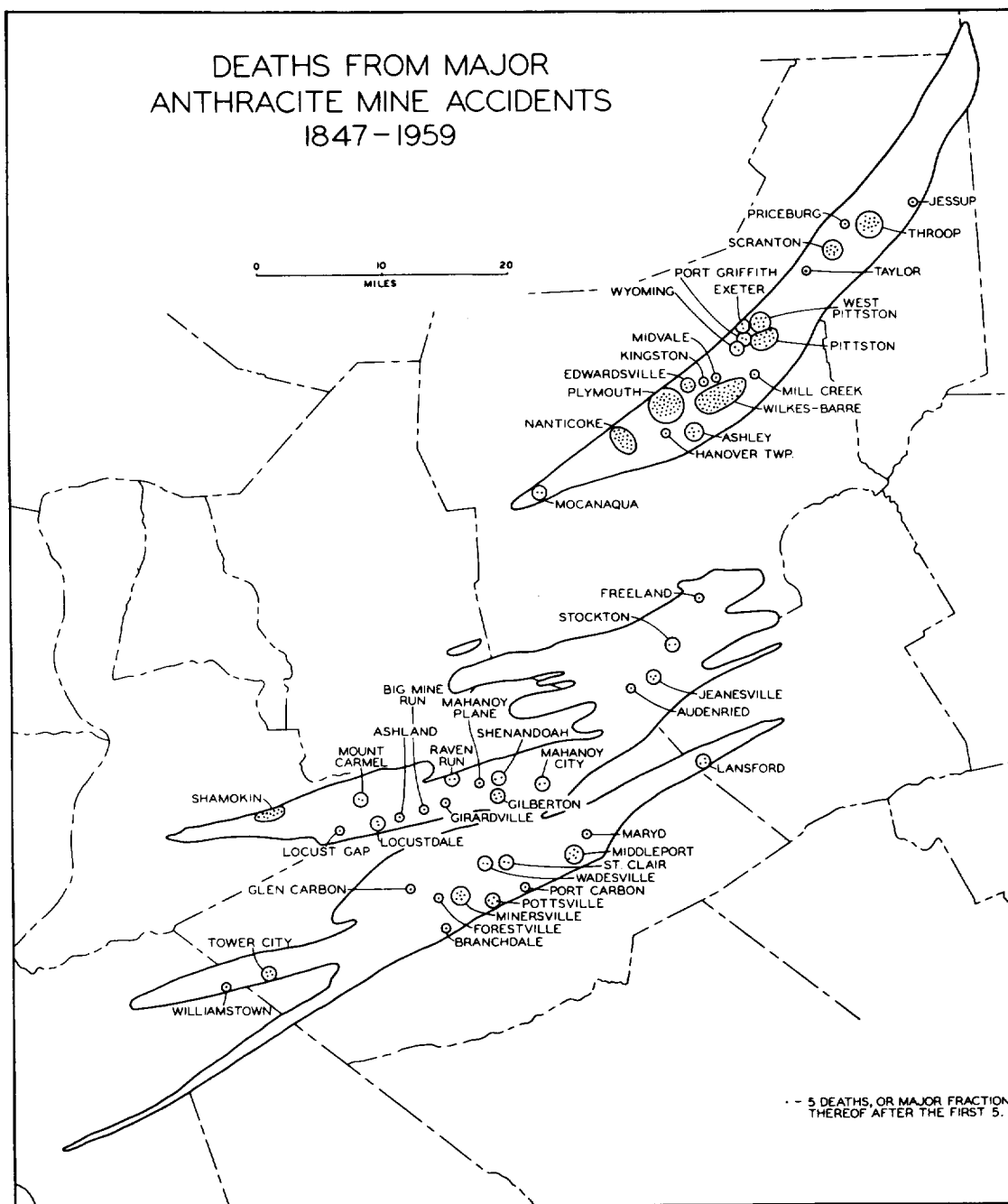


Appendix: Notes 29, 42, 54, 68, and 69.

### NUMBER AND TYPE OF MAJOR MINE ACCIDENTS, 1847 - 1959

A major mine accident is defined here as one in which five or more persons are killed. A total of 117 such catastrophes occurred in the Pennsylvania anthracite industry during the 113-year period from 1847 to 1959. Explosion of gas was the cause of over 50 per cent of the accidents; among the more important additional causes

were mine fires, roof falls, explosion of powder and dynamite, falling down mine shafts, suffocation by gas, and drowning. Note the heavy concentration of major mine accidents in the middle and southern parts of the Northern Field, throughout the Western Middle Field, and in the south-central portion of the Southern Field.

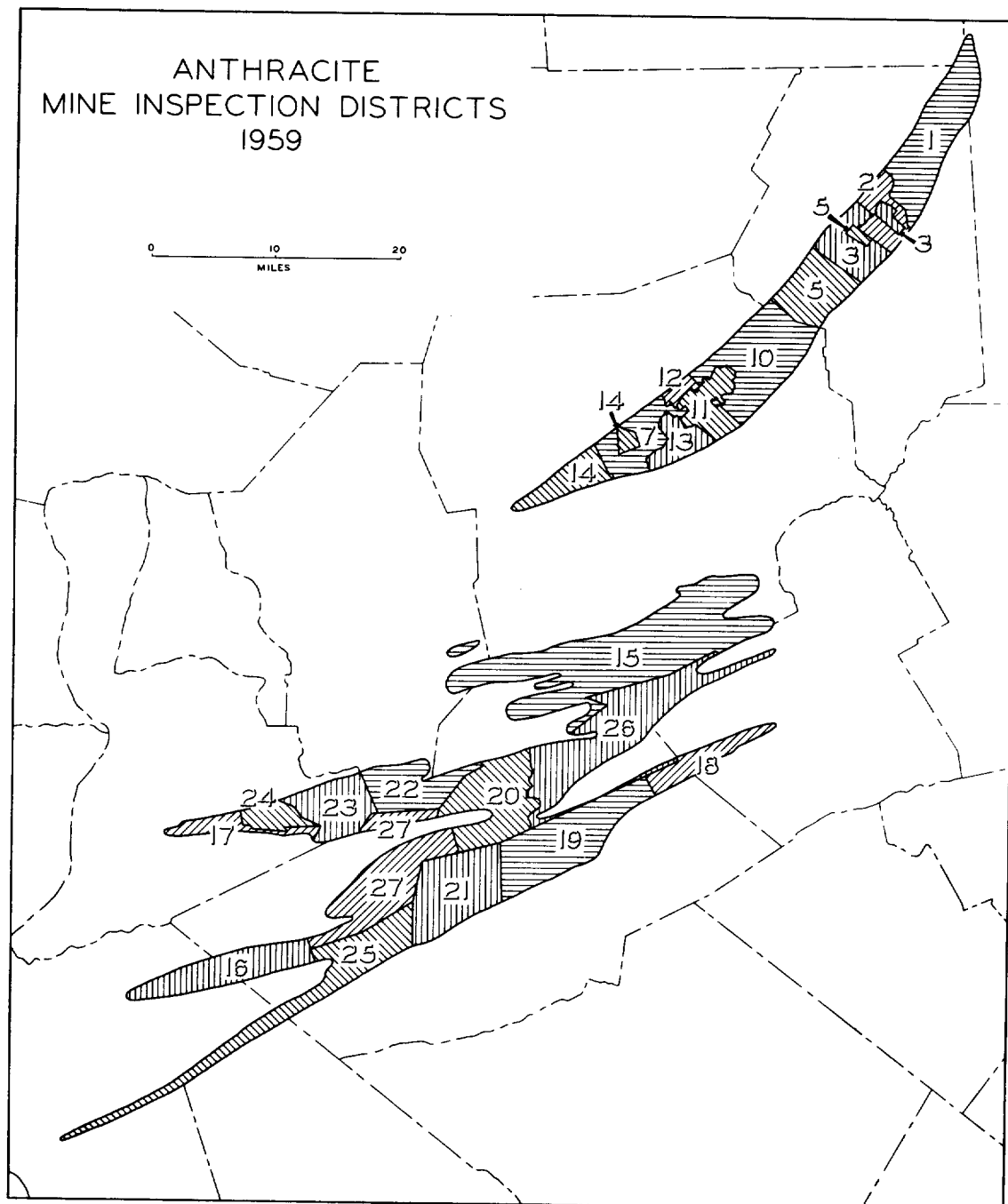


Appendix: Notes 29, 42, 54, 68, and 70.

### DEATHS FROM MAJOR MINE ACCIDENTS, 1847 - 1959

The above map is related to the one immediately preceding, but indicates the number of deaths caused by major mine accidents rather than the number of accidents that occurred. A total of 1,240 deaths are reported to have resulted from major accidents in the Pennsylvania anthracite industry during the 113-year period from 1847 to 1959. Such deaths have been par-

ticularly concentrated in and near the towns of Wilkes-Barre, Plymouth, Nanticoke, Pittston, West Pittston, Scranton, and Throop — all in the Northern Field; and in or near Shamokin in the Western Middle Field. Elsewhere in the anthracite fields the distribution of such deaths was more widely dispersed.



Appendix: Note 71.

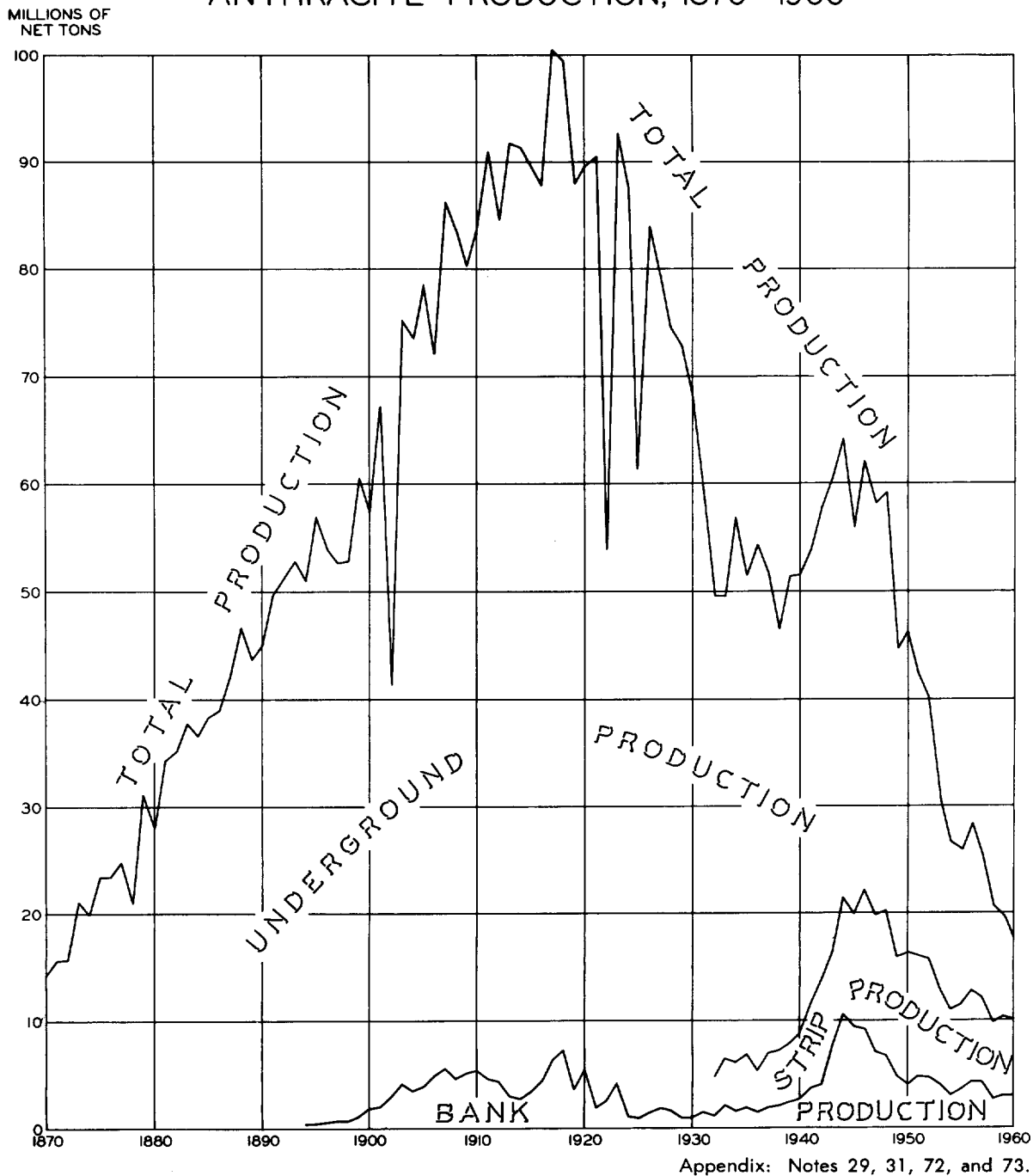
### ANTHRACITE MINE INSPECTION DISTRICTS

The Anthracite Division of the Pennsylvania Department of Mines and Mineral Industries is charged with supervising laws relating to the promotion of health and safety among employees of the anthracite industry. Day to day field activities of the Division are carried on by State Mine Inspectors, each of whom is assigned to a specific inspection district. The number, size, or

boundaries of these districts change, in at least some respect, on almost a yearly basis. In the map above, which represents conditions in 1959, there were 23 inspection districts. The designations of these, however, were not wholly in numerical sequence, for there were no districts numbered 4, 6, 8, and 9.

Production and Marketing  
of Pennsylvania Anthracite

## ANTHRACITE PRODUCTION, 1870-1960



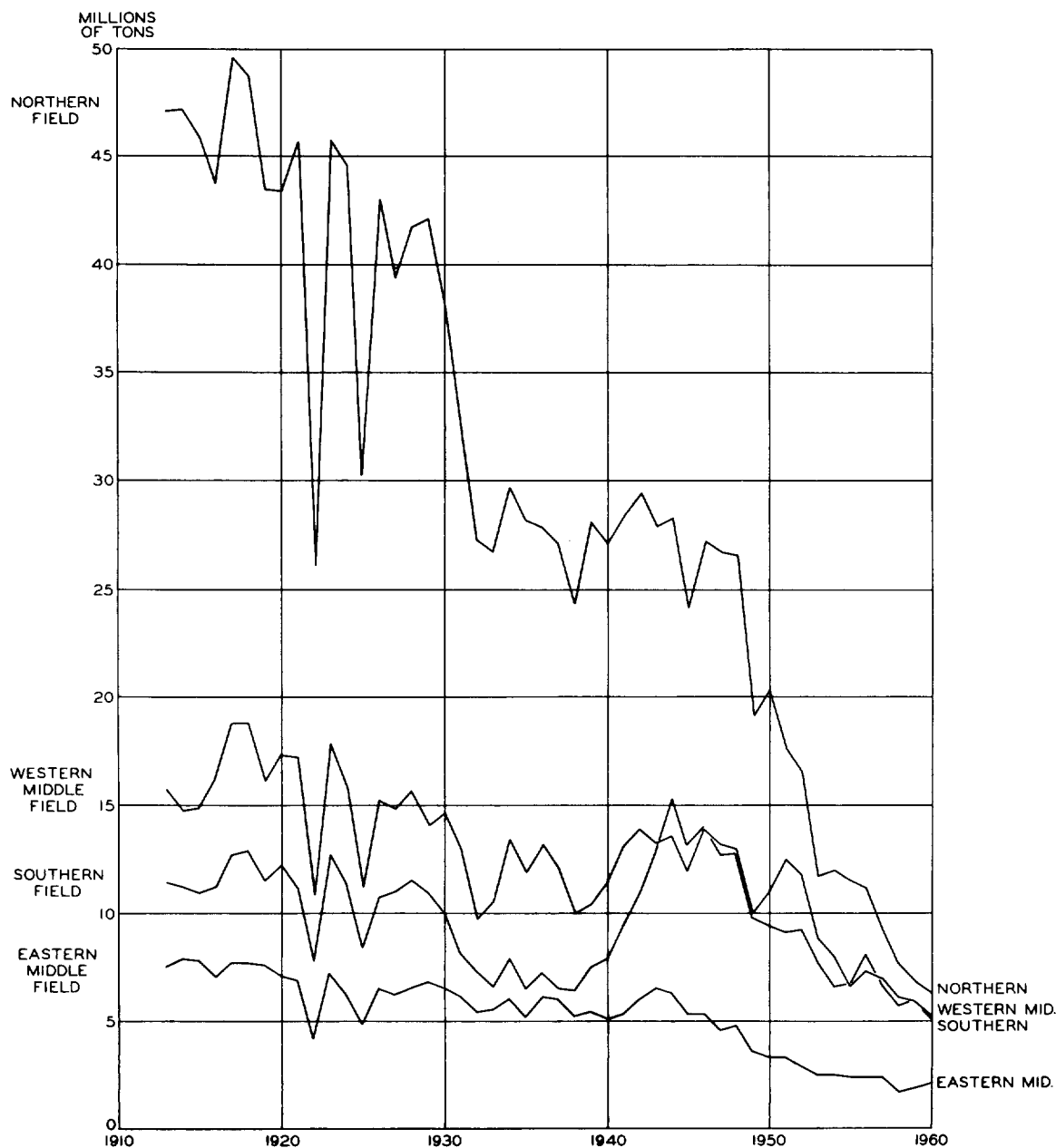
### PRODUCTION, 1870 - 1960

The above graph represents the exuberant growth and severe retrenchment of a great industry. From its youthful stage in 1870, to its peak of maturity in 1917, the Pennsylvania anthracite industry increased its annual output more than seven-fold, to 100 million tons a year. The following four decades, however, witnessed

an equally drastic decline which was only temporarily interrupted by the rise in output during World War II years. Today, the industry is operating at a production level essentially the same as that of the 1870's. The increasing relative, if not always absolute, significance of bank and strip mining during recent decades is apparent.



## ANTHRACITE PRODUCTION, BY FIELDS, 1913 - 1960

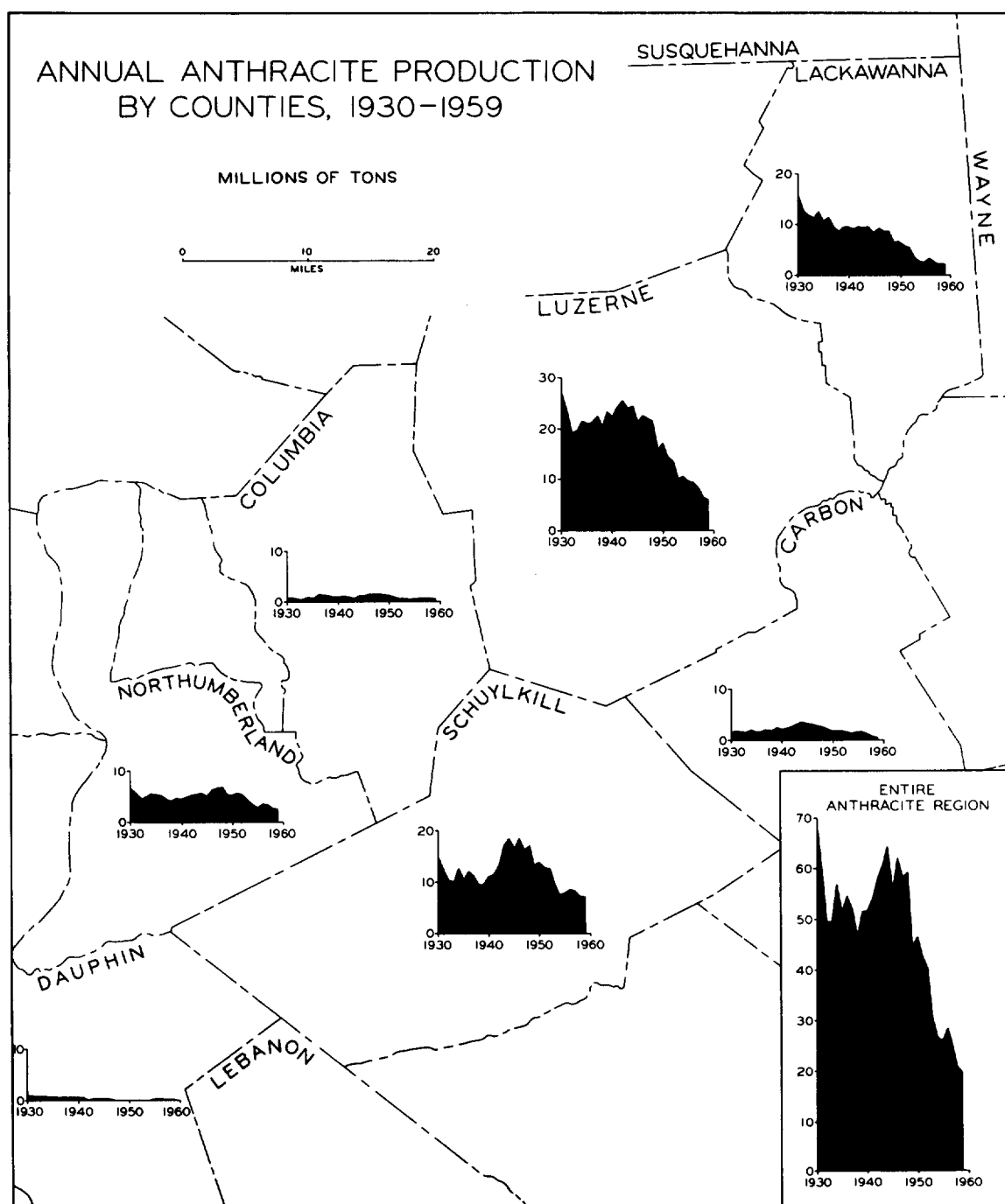


Appendix: Notes 35, 40, 74, and 75.

### PRODUCTION, BY FIELDS, 1913 - 1960

The relative decline in production over the decades has differed greatly among the several anthracite fields of Pennsylvania. Most drastic retrenchment has occurred in the Northern Field, which once so dominated the anthracite industry that other areas were considered to be of only minor significance. Today, the greatly diminished annual output from the Northern Field

barely exceeds that from several of its competitors. Most successful among the several regions in maintaining production over the decades has been the Southern Field; in fact, its World War II output actually exceeded the former peak production, and its present output is only slightly less than one-half that of 1913.

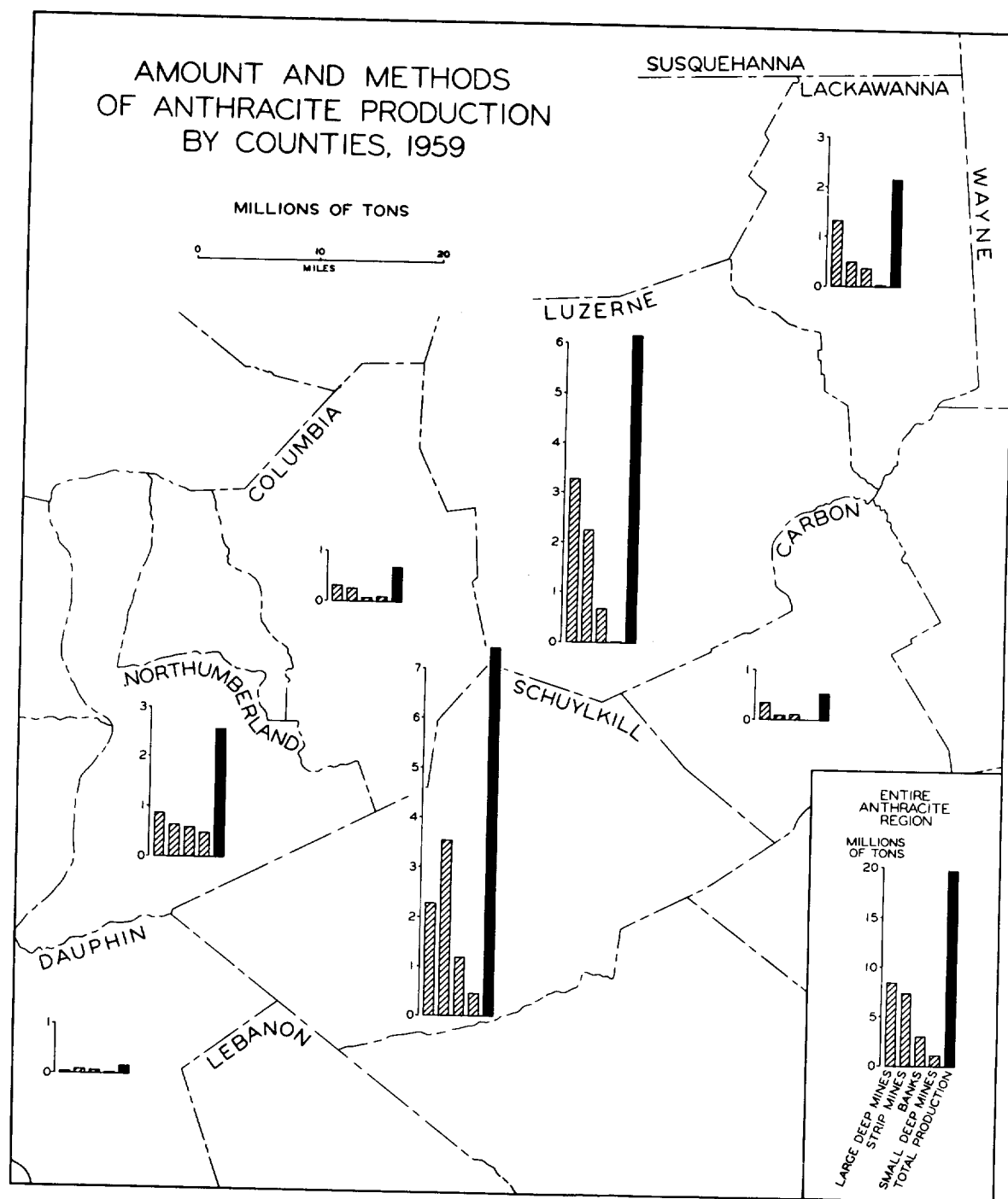


Appendix: Notes 29, 32, 33, and 72.

### PRODUCTION, BY COUNTIES, 1930 - 1959

Significant differences are apparent in the 1930-1959 anthracite production graphs for individual Pennsylvania counties. Most of the producing counties—including Luzerne, Schuylkill, Northumberland, Carbon, and Columbia — had a relatively stable output during the 1930's, a sharp increase in production during the war

years of the 1940's, and a decline during the 1950's. Lackawanna and Dauphin counties, however, experienced almost continuous decline in output during the entire three decades, with at best only a reduction in the rate of decline during the war years.

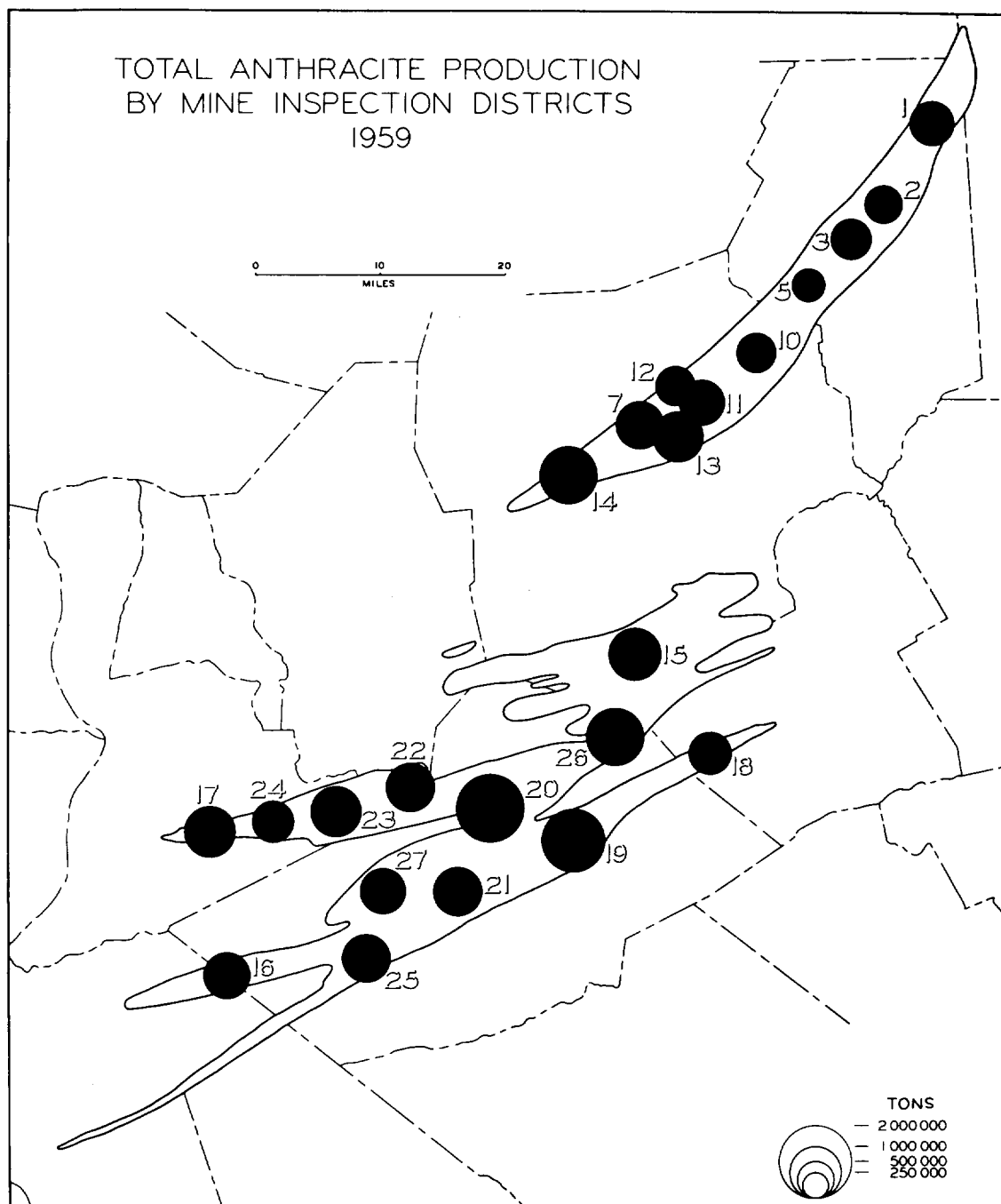


Appendix: Notes 29, 40, 46, and 64.

### AMOUNT AND METHODS OF PRODUCTION, BY COUNTIES

As is evident on the map, above, the production of anthracite from large deep mines predominated during 1959 in all but two of the significant producing counties of Pennsylvania. In Schuylkill and Dauphin counties, strip mine production was most important; but this type of mining also played a major role in Luzerne,

Northumberland, and Columbia counties. Production from banks was relatively most important in Northumberland County, but tonnages were greater in several other counties. Production from small deep mines was appreciable only in Northumberland and Schuylkill counties.



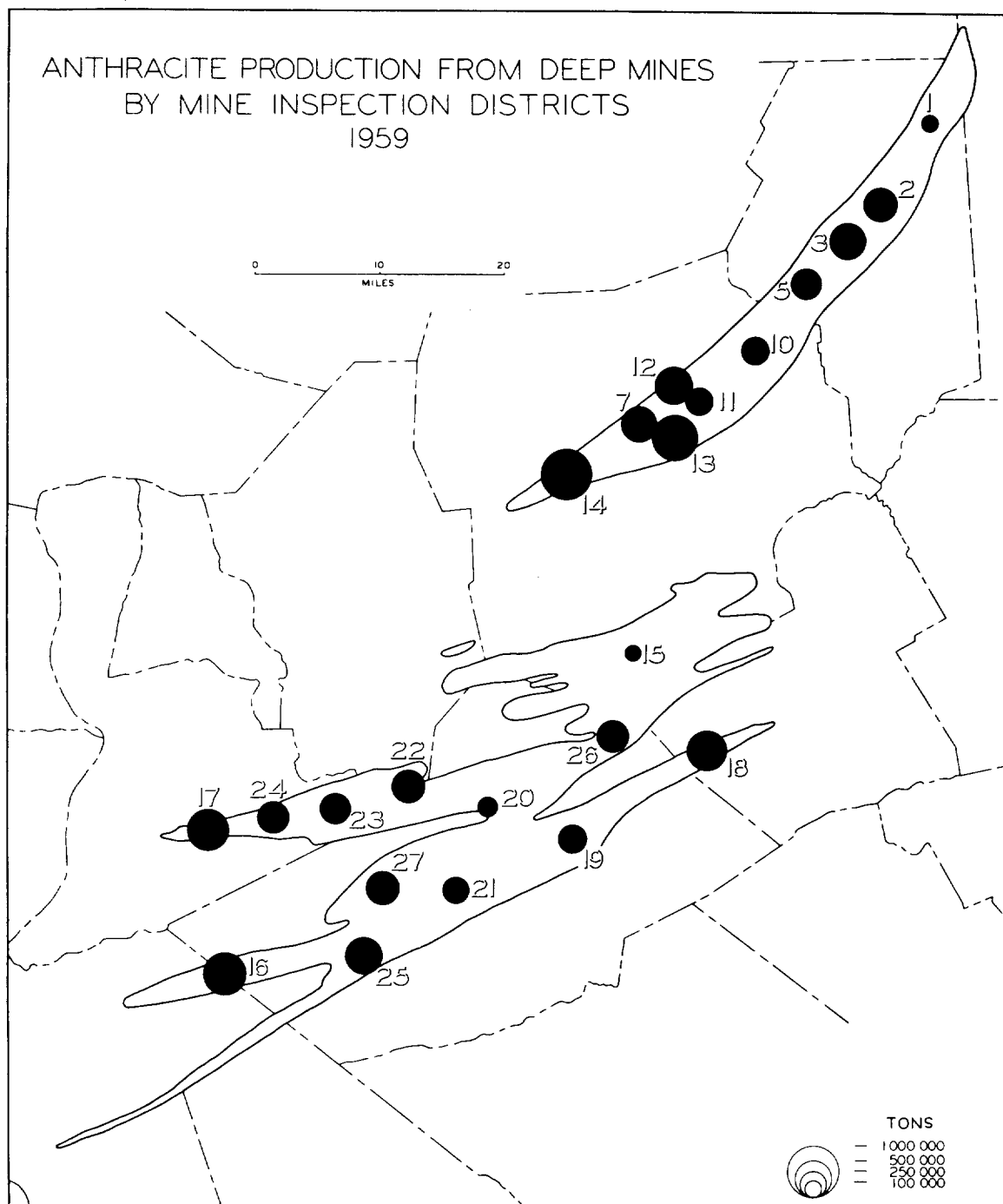
Appendix: Notes 29, 39, 40, and 76.

### PRODUCTION, BY INSPECTION DISTRICTS

Total production of Pennsylvania anthracite in 1959 was 19,670,615 tons. Output in excess of one million tons came from five districts — 14, 15, 19, 20, and 26. Minimum production, approximately 400,000 tons, came from district 5.

Since individual districts differ greatly in areal dimensions (see page 83), it is evident from the

above map that district boundaries are established, in part at least, so as to allocate roughly equivalent tonnages of production to the jurisdiction of each of the anthracite region's mine inspectors and thus tend to even out their work loads.

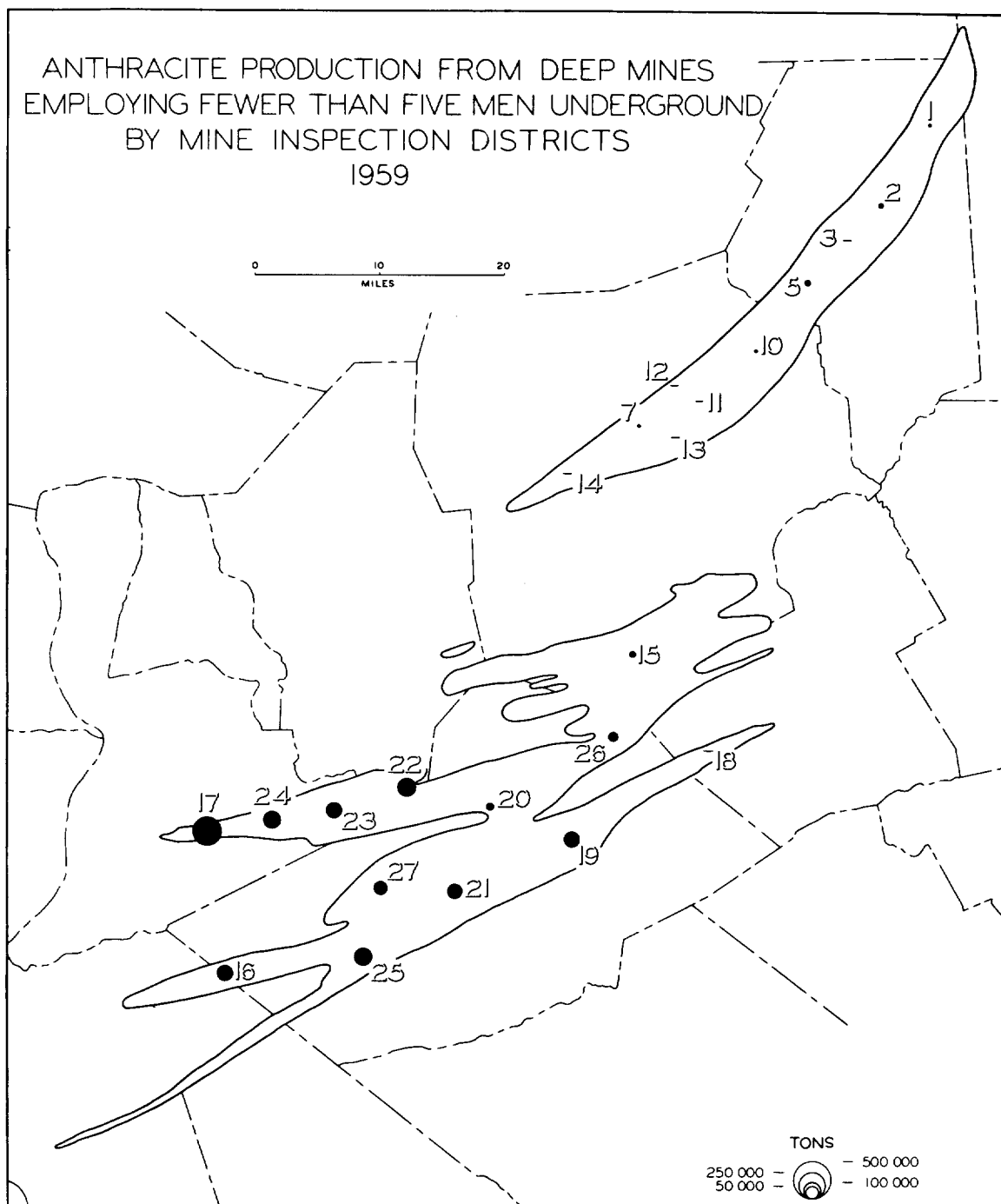


Appendix: Notes 29, 39, 40, 46, and 76.

### DEEP MINE PRODUCTION, BY INSPECTION DISTRICTS

The production of deep mined anthracite in Pennsylvania during 1959 totalled 9,416,258 tons, and represented about 48 per cent of the total production. Some coal was deep mined in every anthracite mine inspection district of the state. However, most such coal came from districts in

the Northern Field, and particularly from its southwestern portion. District 14 had the largest output of deep mined coal — almost one million tons. Least production came from district 15, with some 80,000 tons.

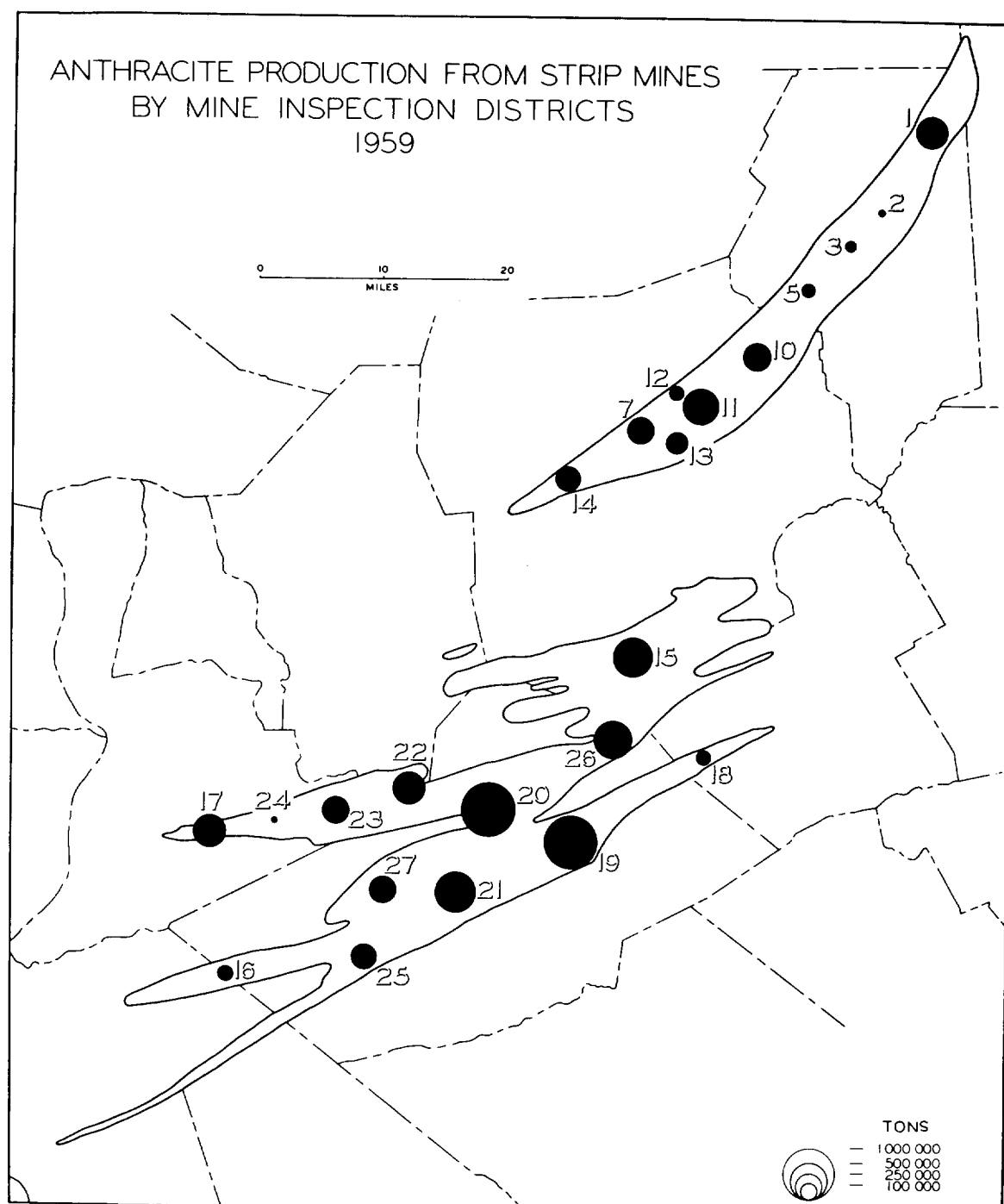


Appendix: Notes 29, 39, 46, and 76.

### SMALL DEEP MINE PRODUCTION, BY INSPECTION DISTRICTS

In contrast to the map on the preceding page, which represents production from both large and small deep mines, the above map indicates only production from small deep mines. Many of these are so-called "bootleg" operations. Most production from such mines came from the

Western Middle Field, and from the western and central parts of the Southern Field, in 1959. Some 1,000,000 tons of anthracite were produced at small deep mines during that year, which represented about five per cent of total production.

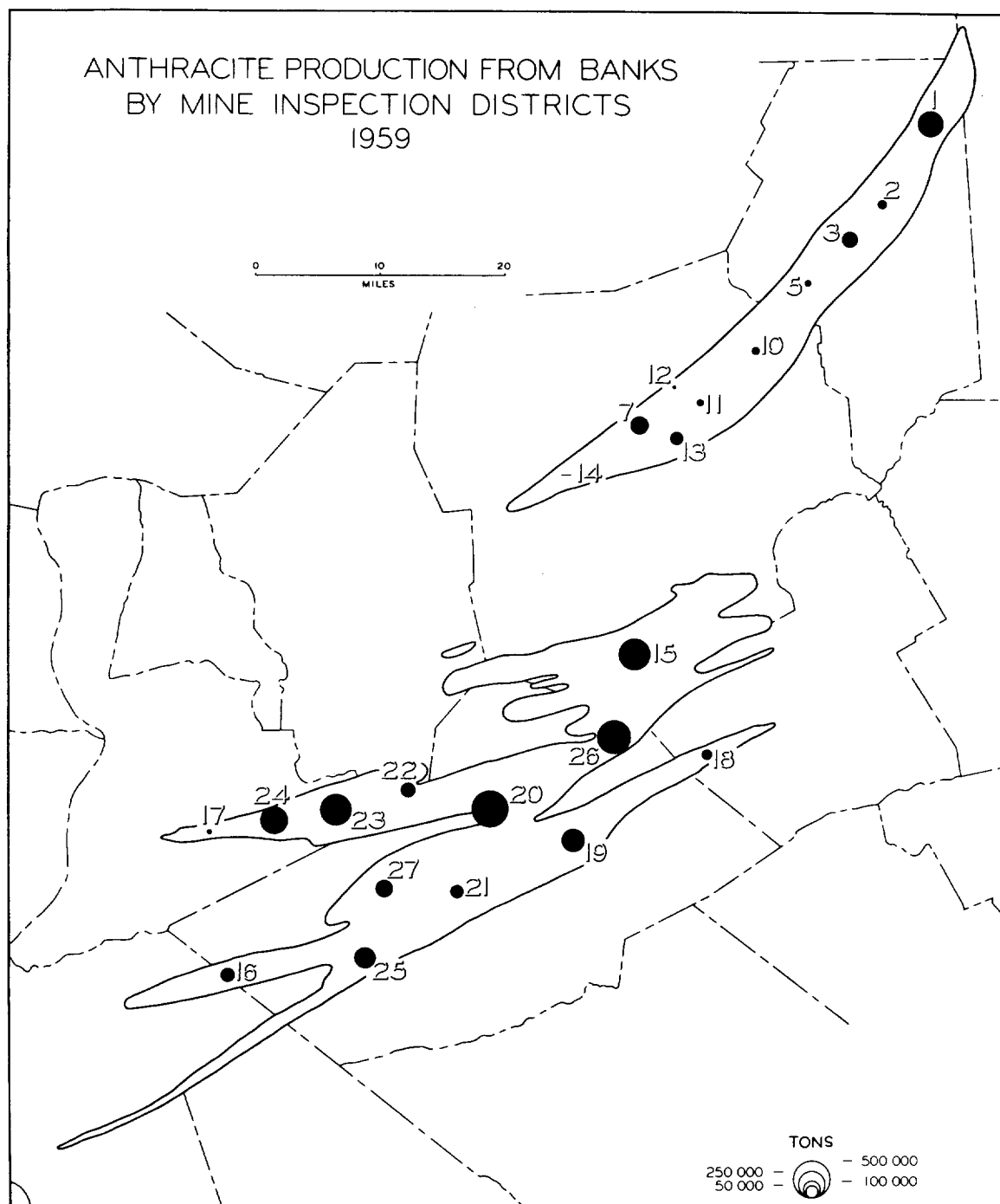


Appendix: Notes 29, 39, and 76.

### STRIP MINE PRODUCTION, BY INSPECTION DISTRICTS

In 1959, some 7,273,000 tons of coal were produced at Pennsylvania's anthracite strip mines, representing about 37 per cent of total production. Every inspection district produced some stripped coal, but particularly large amounts came from districts 19 and 20, both of which

yielded over a million tons. The smallest amount, some 12,000 tons, was produced in district 24. Strip mining was least significant in much of the northern half of the Northern Field, and in the northeastern and southwestern portions of the Southern Field.



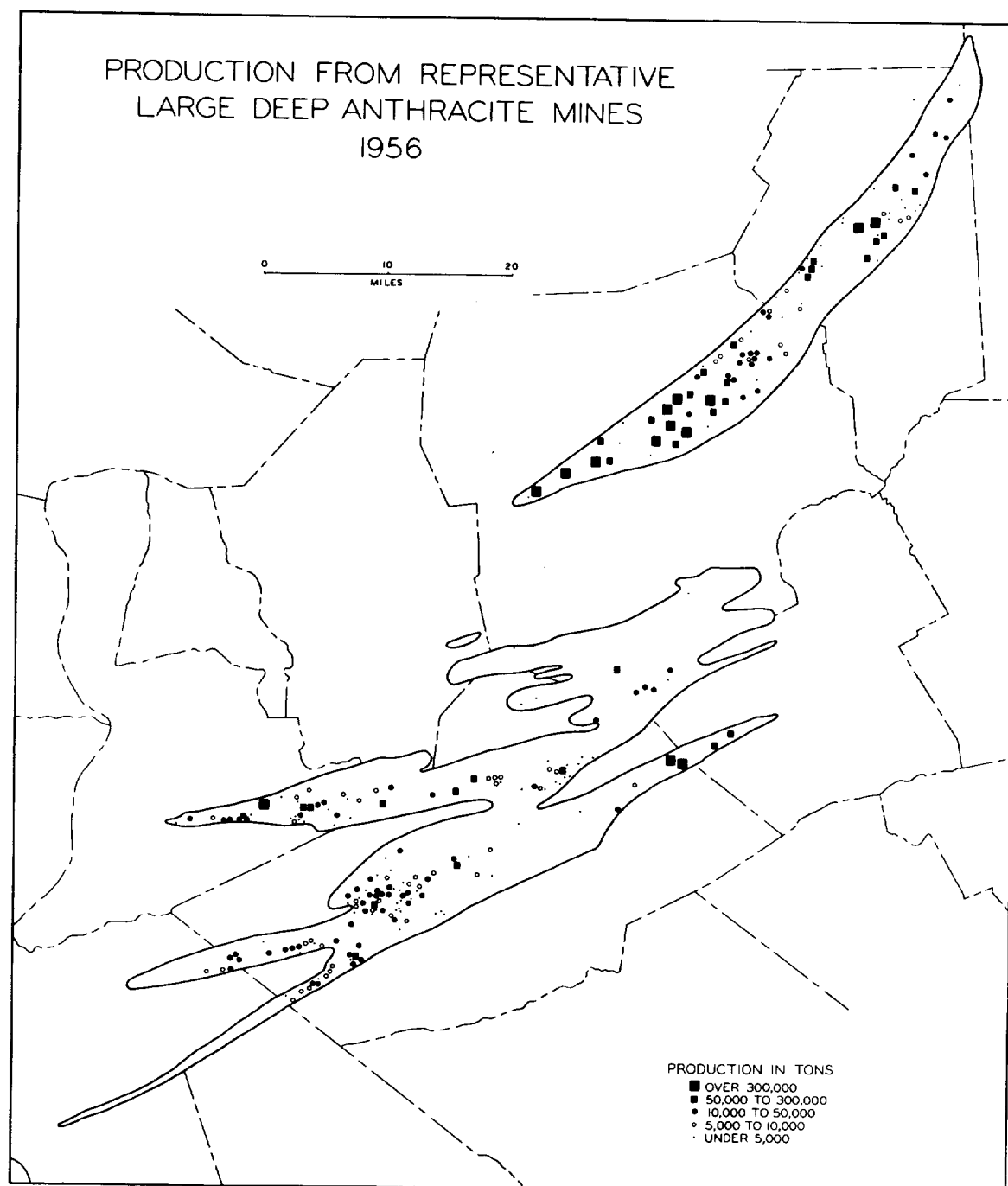
Appendix: Notes 29, 39, and 76.

### BANK PRODUCTION, BY INSPECTION DISTRICTS

Most production of anthracite from banks during recent years has come from the Western Middle and Eastern Middle Fields. There has been only limited output of bank coal from the Southern Field, and even less from most parts of the Northern Field. In 1959, production from

banks amounted to almost 3,000,000 tons, which represented about 15 per cent of total anthracite production. The most important producing districts were 15, 20, 23, and 26, each of which yielded over a third of a million tons.



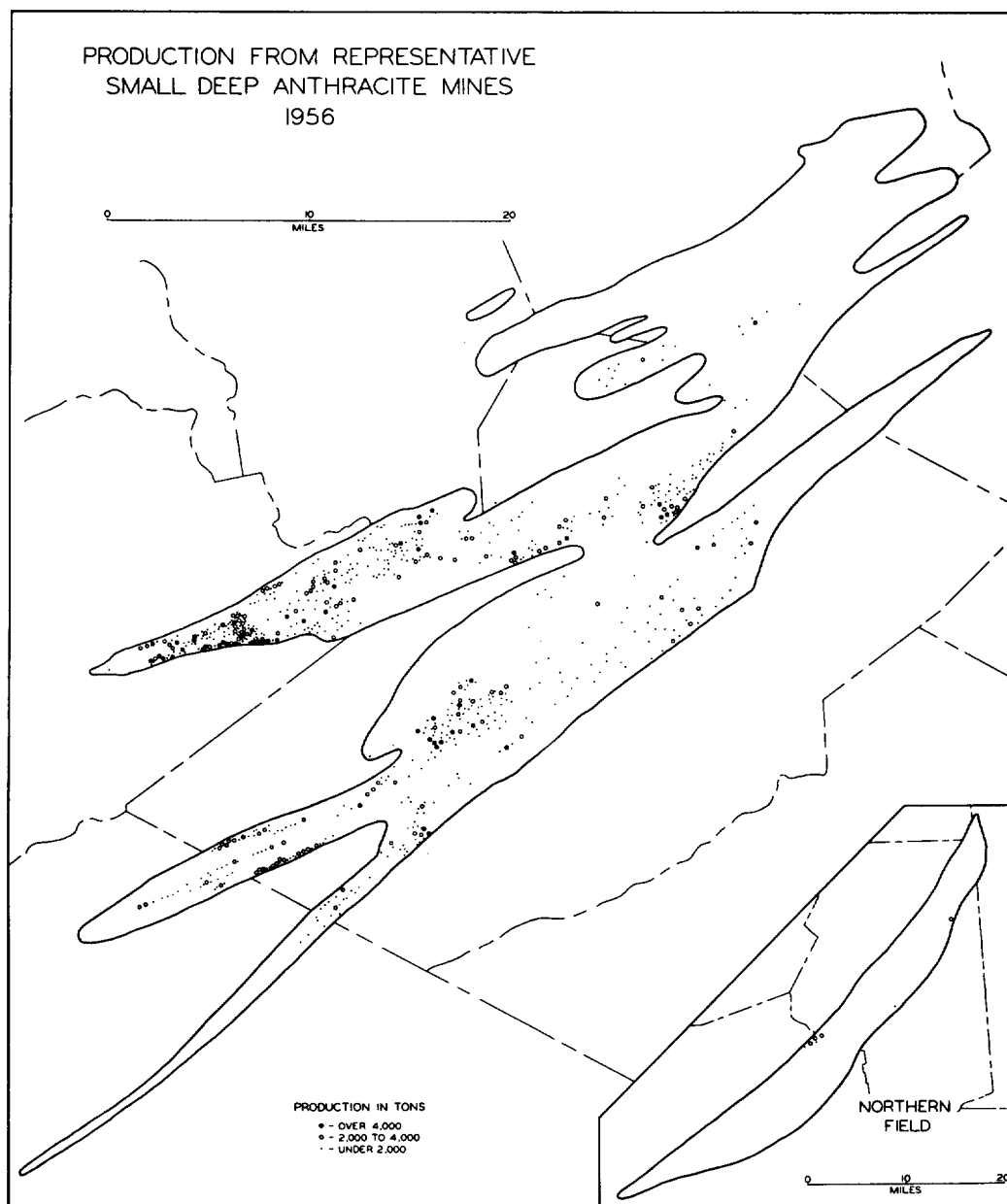


Appendix: Notes 29, 42, 43, 45, 46, 54, 55, and 77.

### PRODUCTION PER LARGE DEEP MINE

Production per individual large deep anthracite mine in Pennsylvania during 1956 ranged from a few thousand tons to 789,353 tons. Only 14 of the approximately 260 mines mapped above had an output in excess of 300,000 tons, and only 30 mines yielded from 50,000 to 300,000 tons. The great majority of these larger operations

were found in the Northern Field, and particularly in its southwestern portion. However, a majority of the so-called large mines in the Northern Field, and essentially all of those in the Middle and Southern Fields, were operated on what could be considered as an exceedingly modest scale.



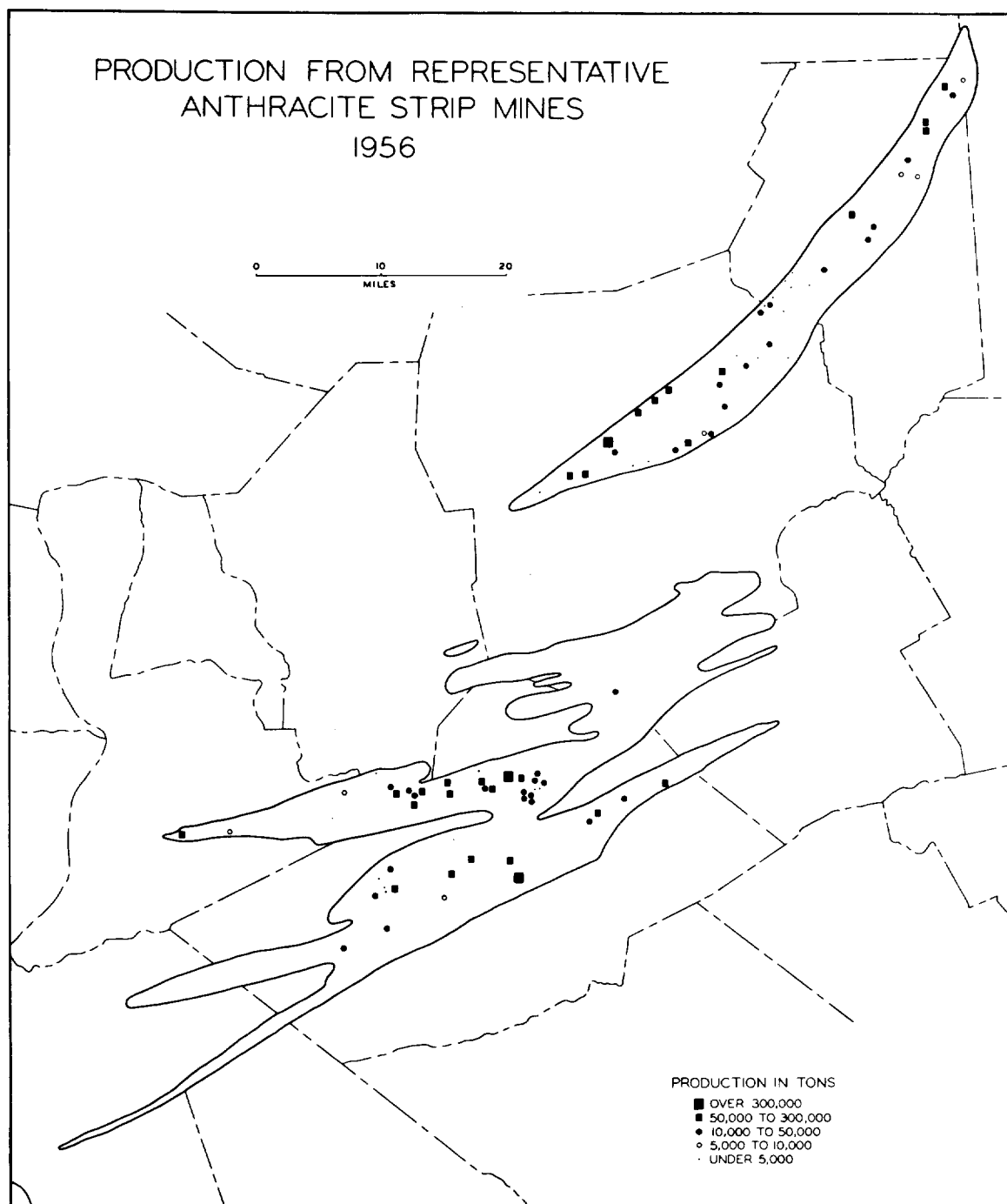
Appendix: Notes 29, 40, 43, 45, 46, 54, and 55.

### PRODUCTION PER SMALL DEEP MINE

Note that the scales of the main map and inset map, above, are dissimilar; and that both scales are different from those employed on the companion maps immediately preceding and following. Note, further, that the values of the production symbols used on the main map and inset map, above, differ from the values of symbols employed on the companion maps.

Production per individual small deep anthracite mine in Pennsylvania during 1956 ranged from a few tens of tons to 16,559 tons. Only 54

of the approximately 750 mines mapped above had an output in excess of 4,000 tons; most of these more productive operations were located in the western portion of the Western Middle Field. The great majority of the remaining small deep mines were scattered throughout the Western Middle Field and the western and central parts of the Southern Field. There were virtually no such mines in the Northern Field, and in most of the Eastern Middle Field.

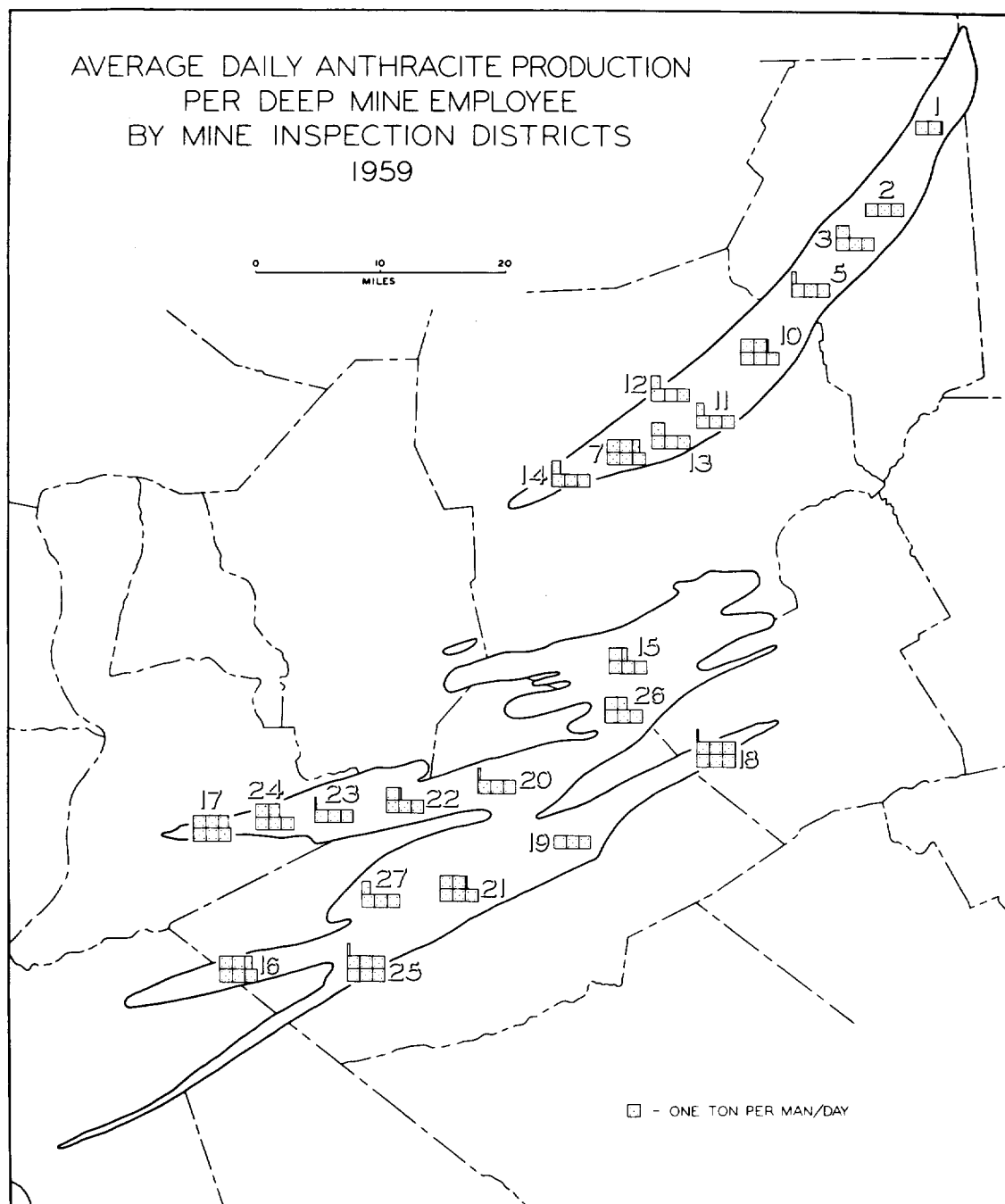


Appendix: Notes 29, 43, 45, 54, 55, 57, and 77.

### PRODUCTION PER STRIP MINE

Production per individual anthracite strip mine in Pennsylvania during 1956 ranged from a few thousand tons to 628,686 tons. Only three of 91 mines mapped above had an output in excess of 300,000 tons, and only 26 mines yielded from 50,000 to 300,000 tons. The Northern Field had

the largest number (12) of these bigger operations, but the proportion of large-scale to small-scale strip mines was greater in the Western Middle and Southern Fields. There was only one strip mine in the entire Eastern Middle Field in 1956.

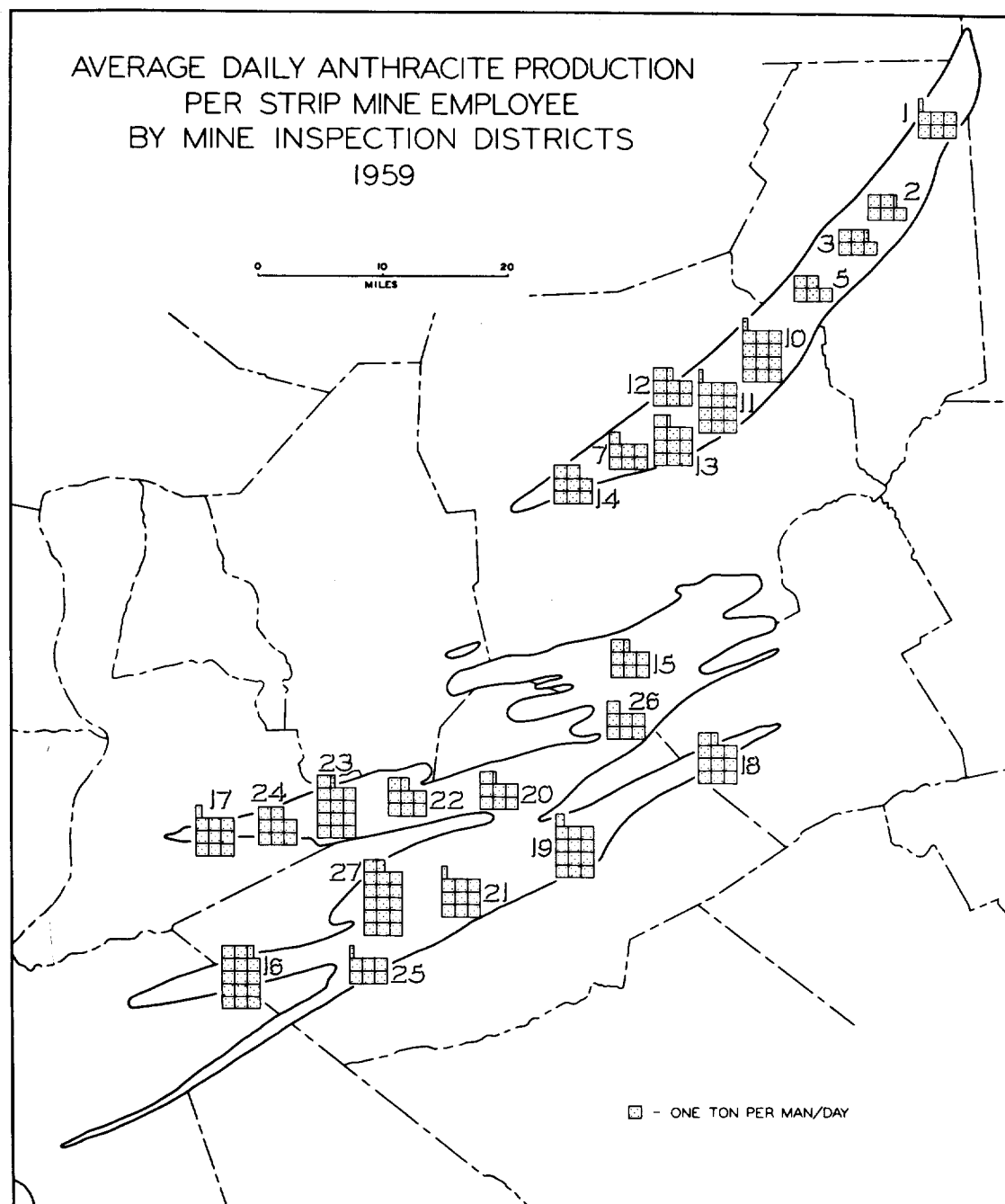


Appendix: Notes 29, 39, 42, 46, 78, and 79.

### PRODUCTION PER DEEP MINE EMPLOYEE, BY MINE INSPECTION DISTRICTS

Daily anthracite production per deep mine employee differed widely from district to district in Pennsylvania's anthracite fields during 1959. Figures ranged from a high of 6.2 tons in district 25, to a low of 2.1 tons in district 1. Average production per man/day for the deep mines

of the entire anthracite region was 4.1 tons. Generally, below average productivity per man/-day characterized the northeastern half of the Northern Field, and parts of the Western Middle and Southern Fields.

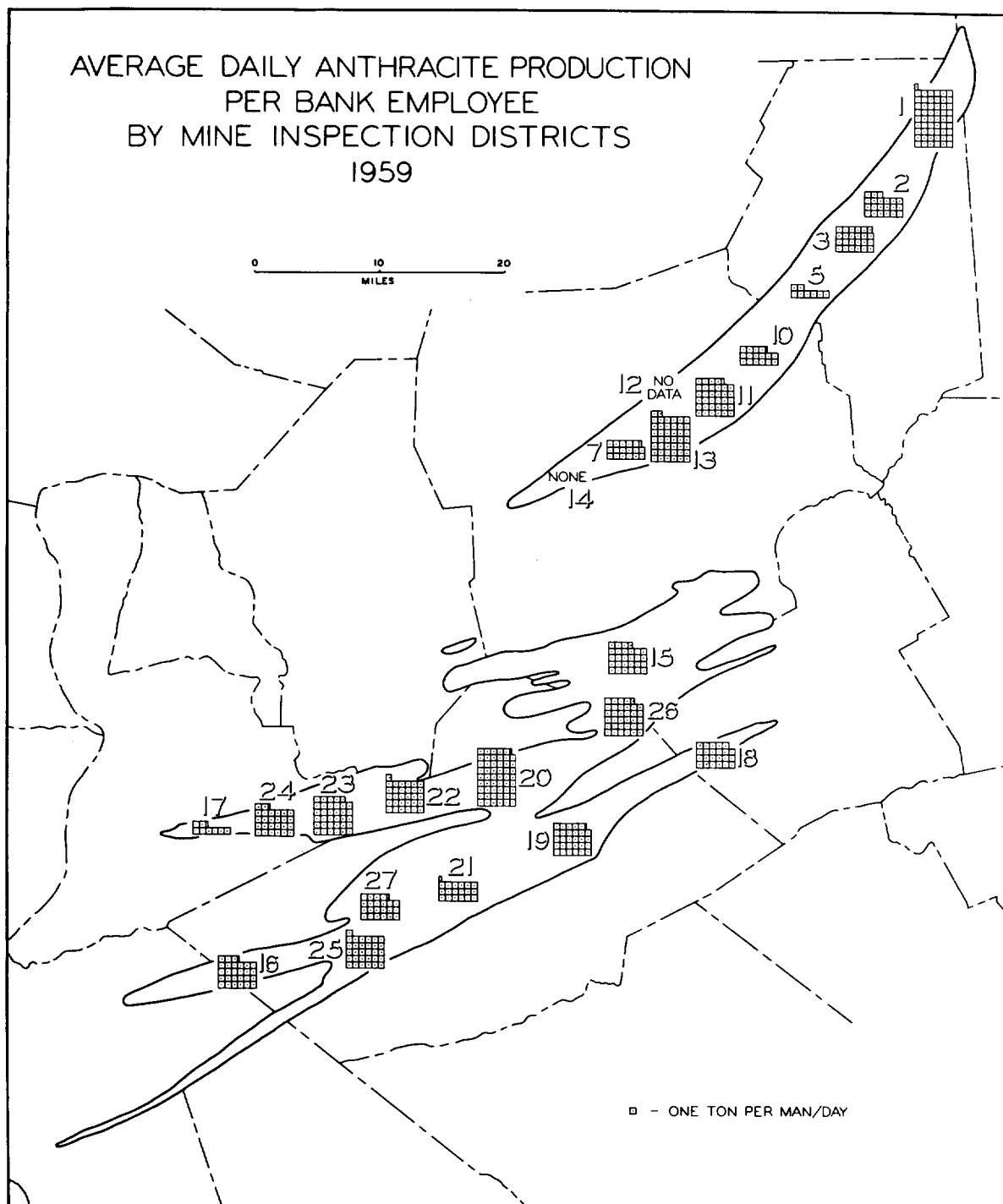


Appendix: Notes 29, 39, 78, and 79.

### PRODUCTION PER STRIP MINE EMPLOYEE, BY MINE INSPECTION DISTRICTS

Average production per man/day from the strip mines of the Pennsylvania anthracite region was 8.7 tons in 1959, a figure double that from the deep mines of the area. On a district basis, strip mine productivity per employee ranged from a high of 16.6 tons in district 27 to 4.9 tons

in district 5. Areas with above average productivity included much of the Southern Field, the western half of the Western Middle Field, and several districts in the southwestern portion of the Northern Field.

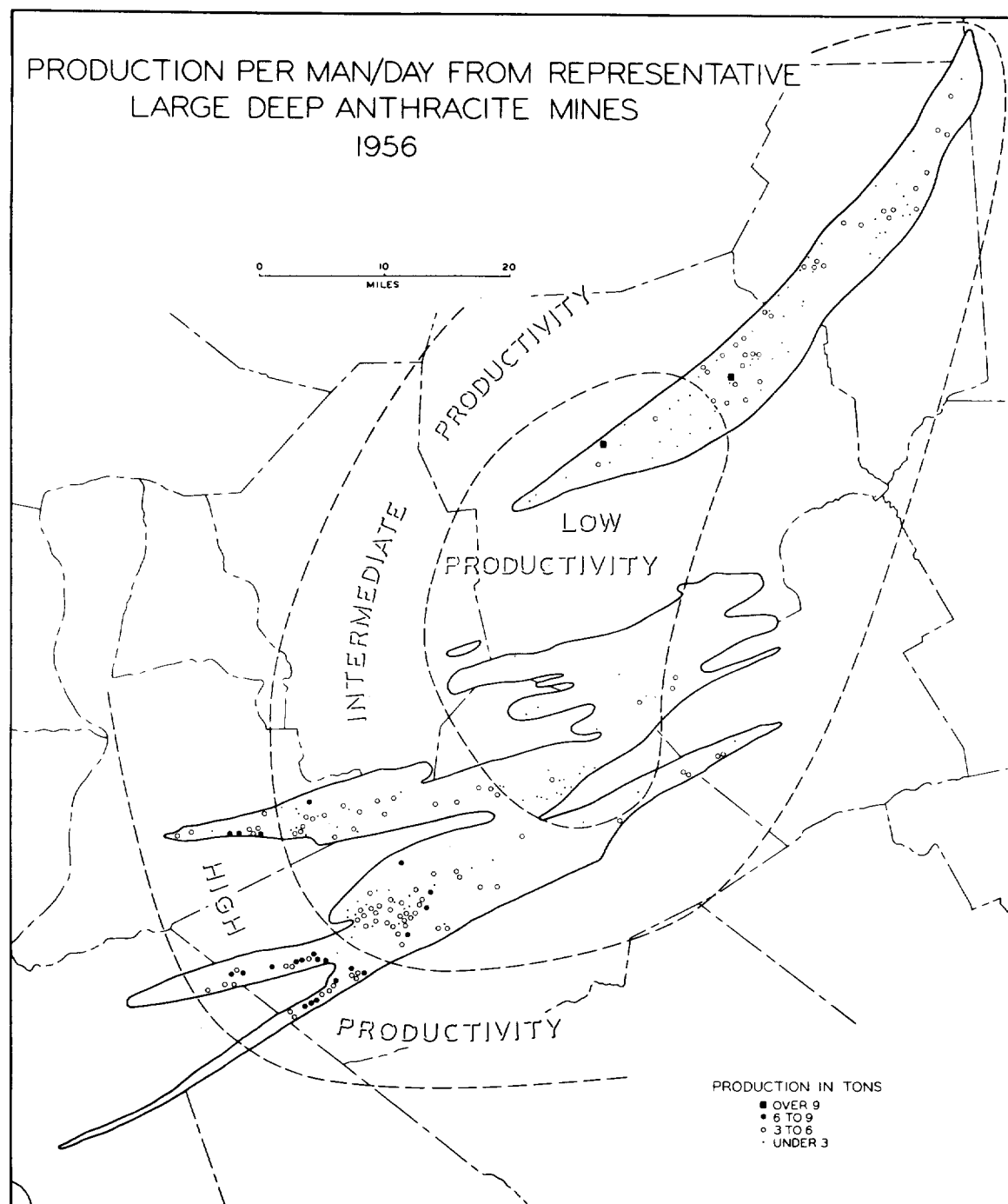


Appendix: Notes 29, 39, and 79.

### PRODUCTION PER BANK EMPLOYEE, BY MINE INSPECTION DISTRICTS

By far the most productive of the several types of anthracite operations in Pennsylvania are the bank mines. In 1959, average production per man/day from such mines was 31.1 tons, as compared with amounts less than one-third as large

from strip mines and approximately one-eighth as large from deep mines. On a district basis, bank mine productivity per employee ranged from a high of 54.7 tons in district 1 to a low of 8 tons in district 5.

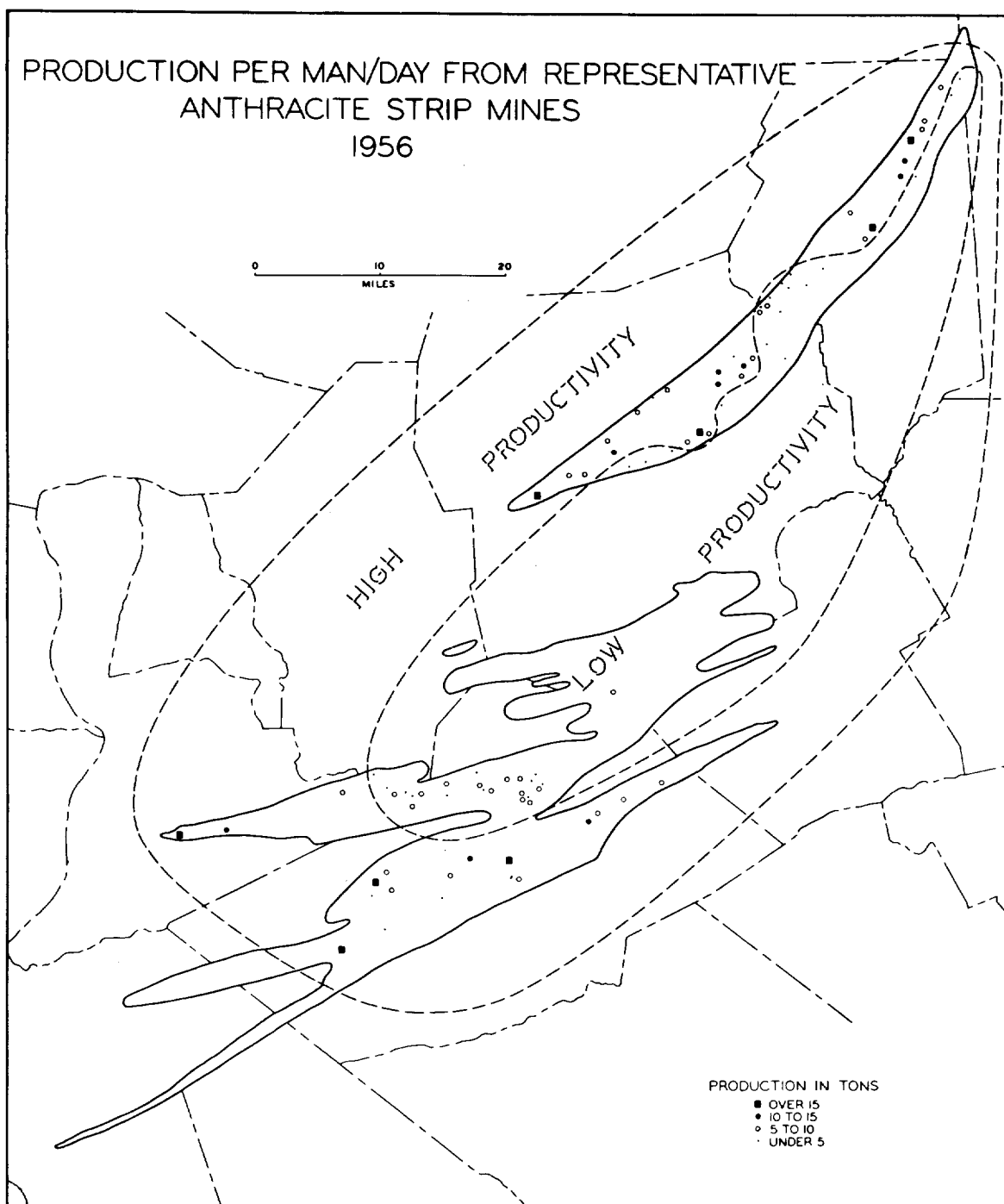


Appendix: Notes 29, 42, 43, 45, 46, 54, 55, 79, and 80.

### PRODUCTION PER LARGE DEEP MINE EMPLOYEE, BY INDIVIDUAL MINES

Operating efficiency differs greatly from mine to mine among the large deep anthracite mines of Pennsylvania. Two of the several hundred mines mapped above had a per man/day output in excess of 9 tons in 1956; and 22 produced from 6 to 9 tons daily per employee. Other large deep mines yielded less than 3 tons per man/day.

As the dashed lines indicate, the area with the largest percentage of low-productivity mines was found near the middle of the anthracite region, and progressively greater mine productivity characterized areas increasingly peripheral to the core area.



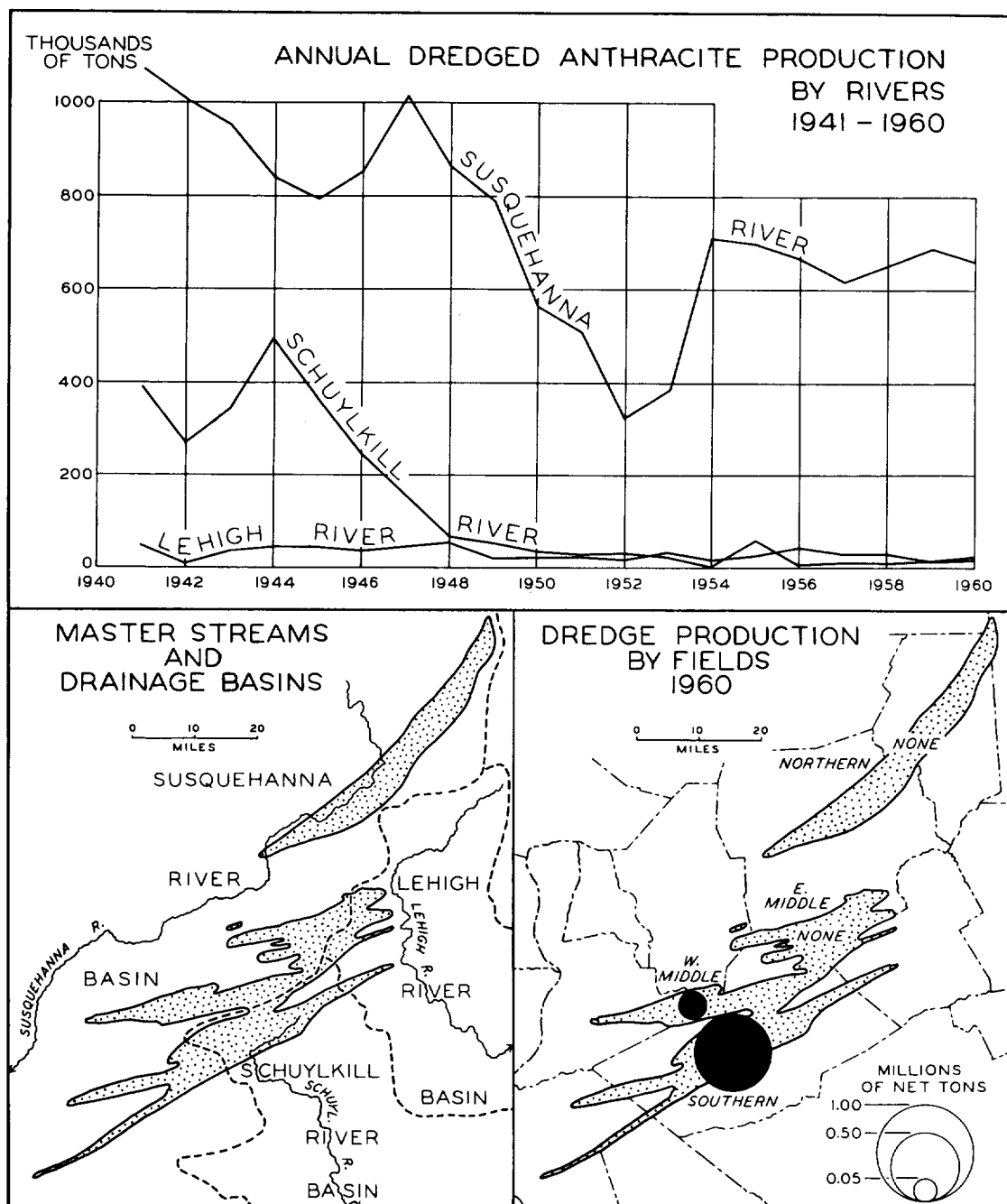
Appendix: Notes 29, 43, 45, 54, 55, 57, 79, and 80.

### PRODUCTION PER STRIP MINE EMPLOYEE, BY INDIVIDUAL MINES

As in the case of large deep mines, operating efficiency among Pennsylvania's anthracite strip mines differs greatly from mine to mine. Eight of the 88 mines mapped above had a per man/day output in excess of 15 tons in 1956; and 8 more produced from 10 to 15 tons daily per

employee. Some of the remaining stripping operations yielded less than 5 tons per man/day. A majority of the less efficient strip mines was found in the inner portion of the anthracite region, whereas all of the more efficient operations were located in the peripheral sections.



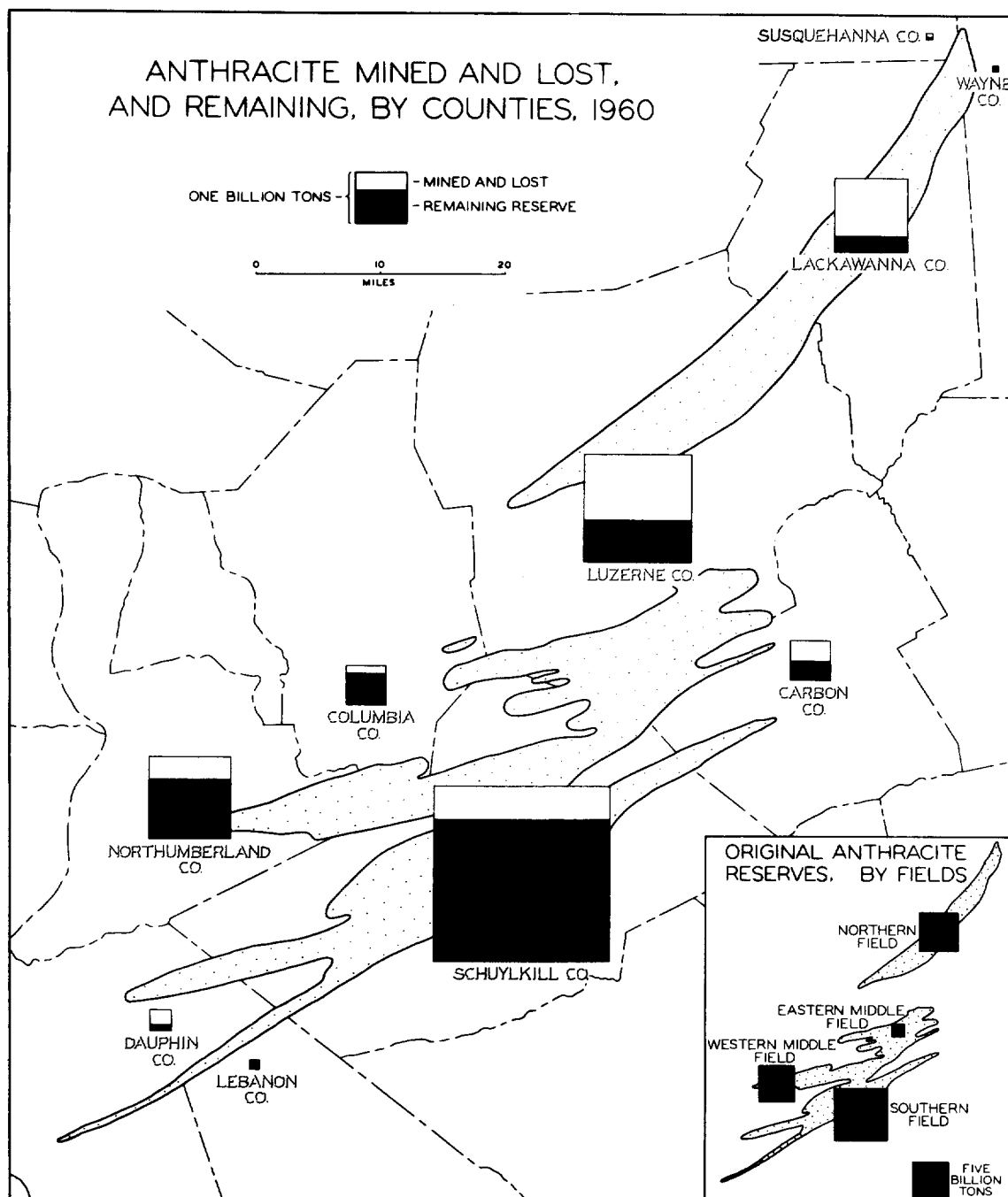


Appendix: Note 35.

## DREDGED ANTHRACITE

Production of river dredged anthracite is essentially a separate industry as compared with that dependent upon deep, strip, and bank mines, and as such dredged anthracite is not considered in any maps and graphs included in this atlas other than those above. The tonnage from dredging in 1960 (712,163) was less than four per cent of that from mines. During the

1940's most dredged anthracite came from the Susquehanna and Schuylkill river basins, but during the 1950's only the former basin was important. All dredged coal originated in the Western Middle and Southern Fields in 1960, and was largely recovered downstream along the Susquehanna River in Lancaster and Snyder counties.



Appendix: Note 81.

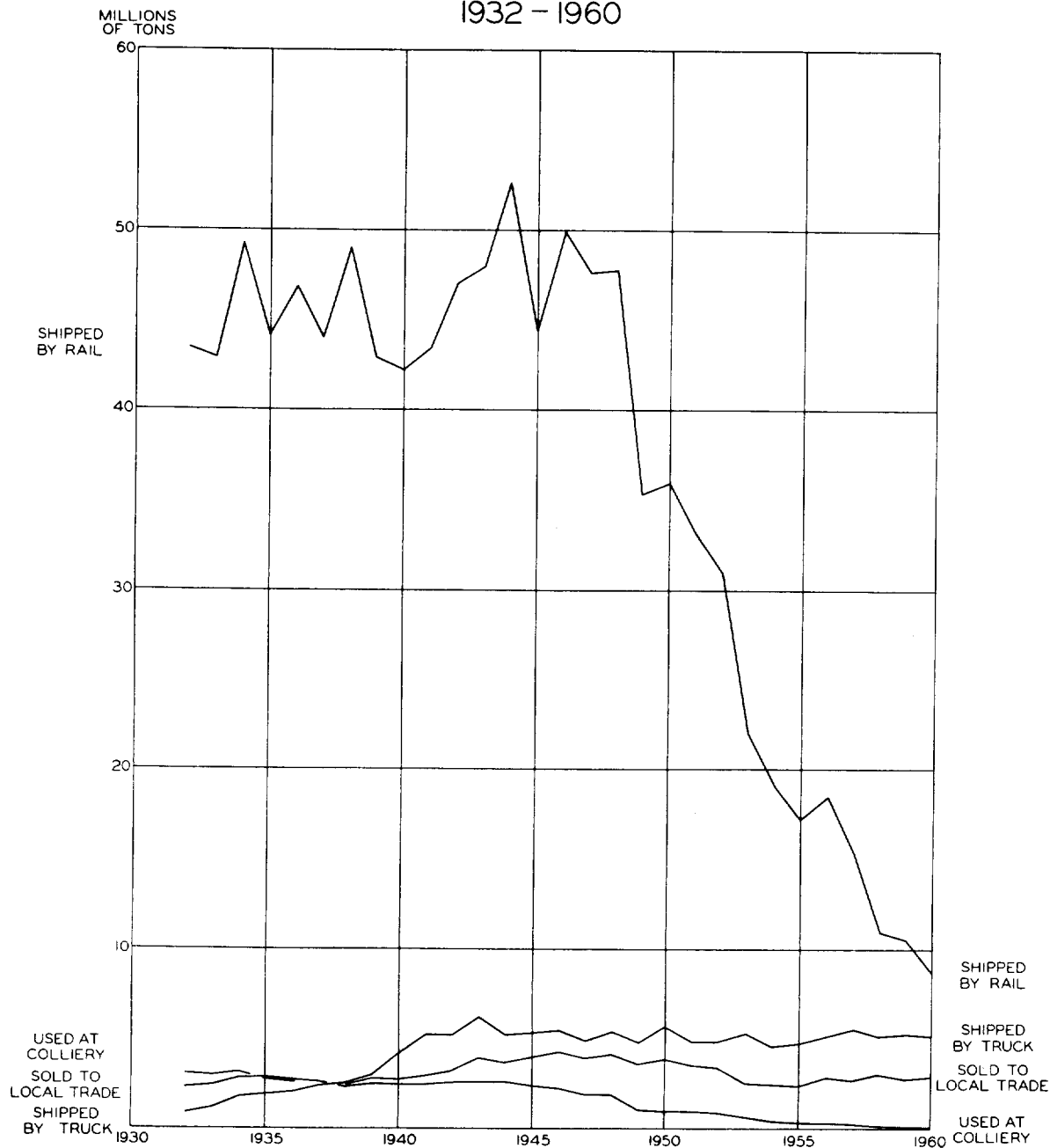
### ANTHRACITE RESERVES

Data on original reserves of anthracite, for both counties and fields, are based on estimates made by A. D. W. Smith in 1893 and subsequently modified by D. C. Ashmead in 1923 and by G. H. Ashley in 1945. Figures on coal mined and lost, by counties, are those given by Ashley for the period through 1944, to which have been added the amounts mined, and estimated by the

authors to have been lost, for the period 1945 through 1960.

The original anthracite reserves of Pennsylvania totalled some 22,770 million tons, exclusive of small amounts of semianthracite in Sullivan County. Approximately one-third of this had been mined and lost during the mining process through 1960.

## DISPOSITION OF MINED ANTHRACITE 1932 - 1960



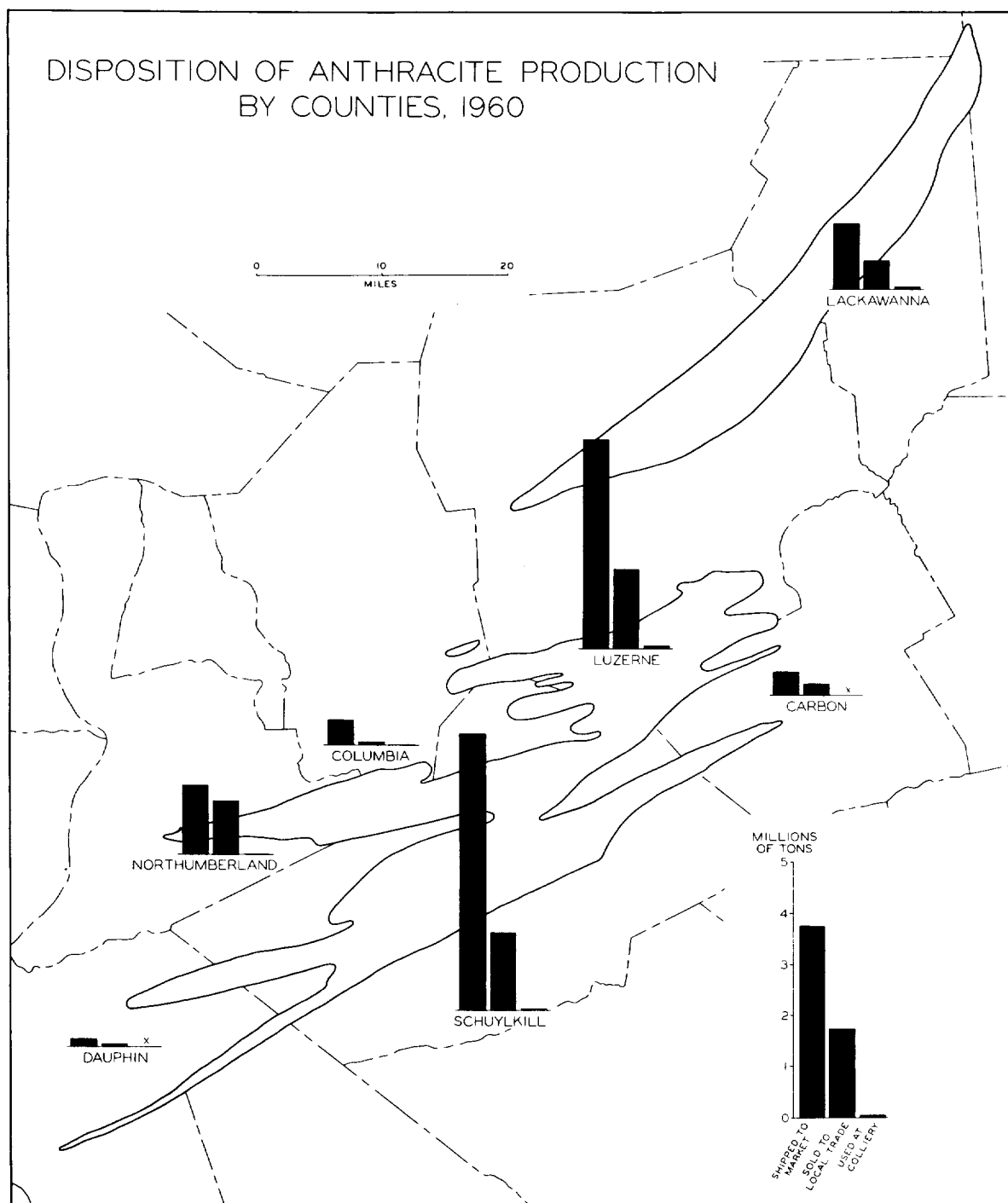
Appendix: Notes 29, 42, and 82.

### DISPOSITION, 1932 - 1960

The term "sold to local trade" covers sales to customers within and near the anthracite region; coal "used at the colliery" is employed for steam generation and heating purposes.

Note on the graph: (1) the great decline since 1948 in annual tonnages of anthracite shipped by rail, (2) the small amounts of coal used at

the collieries themselves in recent years, (3) the rather consistent level of coal sales to the local trade over the decades, and (4) the marked increase in tonnage of coal shipped by truck in 1960 as compared with 1932. Since most coal sold locally is trucked, almost one-half of all anthracite sold in 1960 was handled by truck.

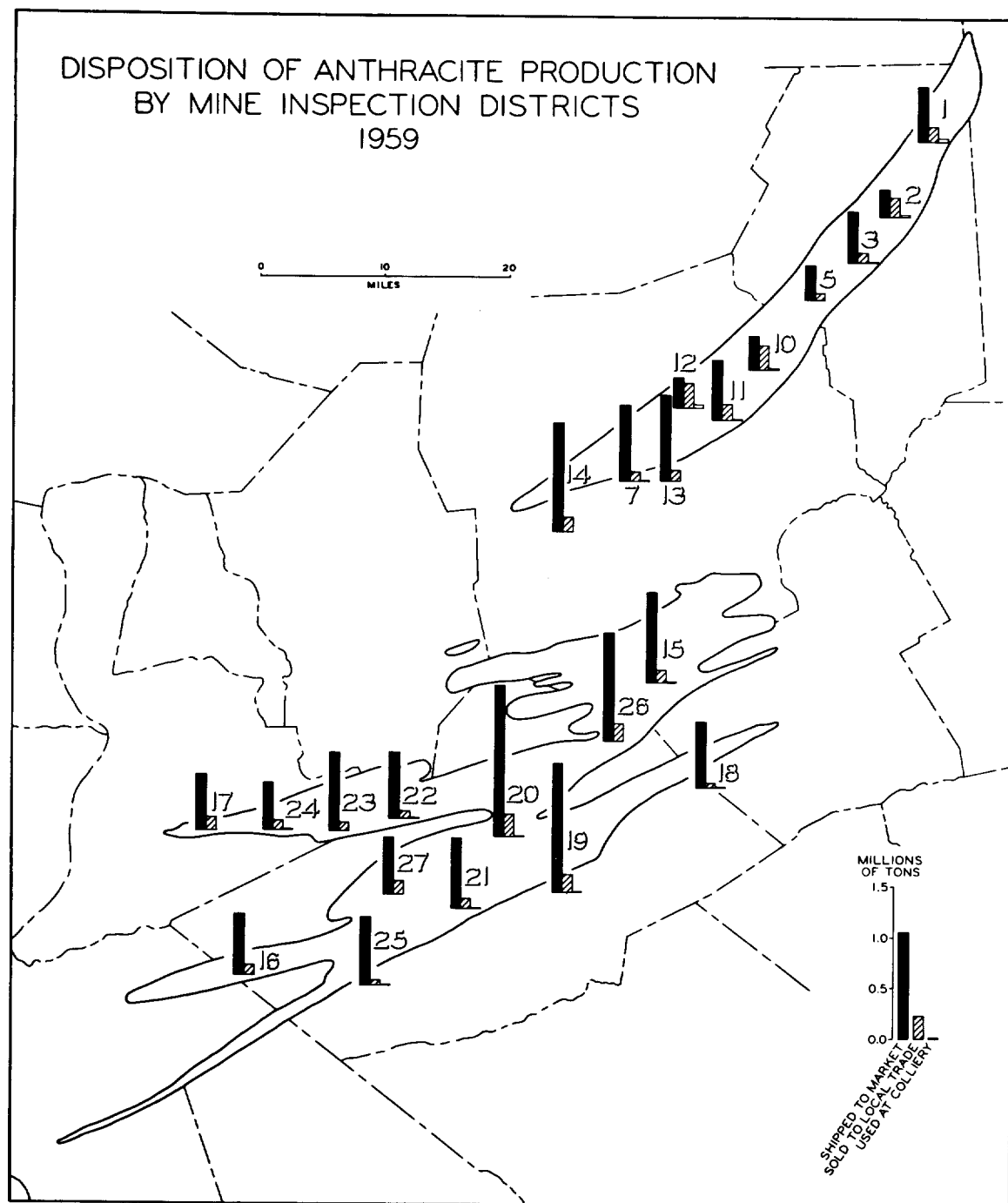


Appendix: Notes 35, 40, 83, and 84.

### DISPOSITION, BY COUNTIES

In every significant anthracite county of Pennsylvania during 1960, a larger tonnage of coal was shipped to outside markets than was sold within the producing region. The largest tonnage so shipped was from Schuylkill County.

Luzerne County producers sold the largest tonnage to local consumers, although the greatest percentage of local to total sales occurred in Northumberland County. In no county was there significant use of coal at the collieries.

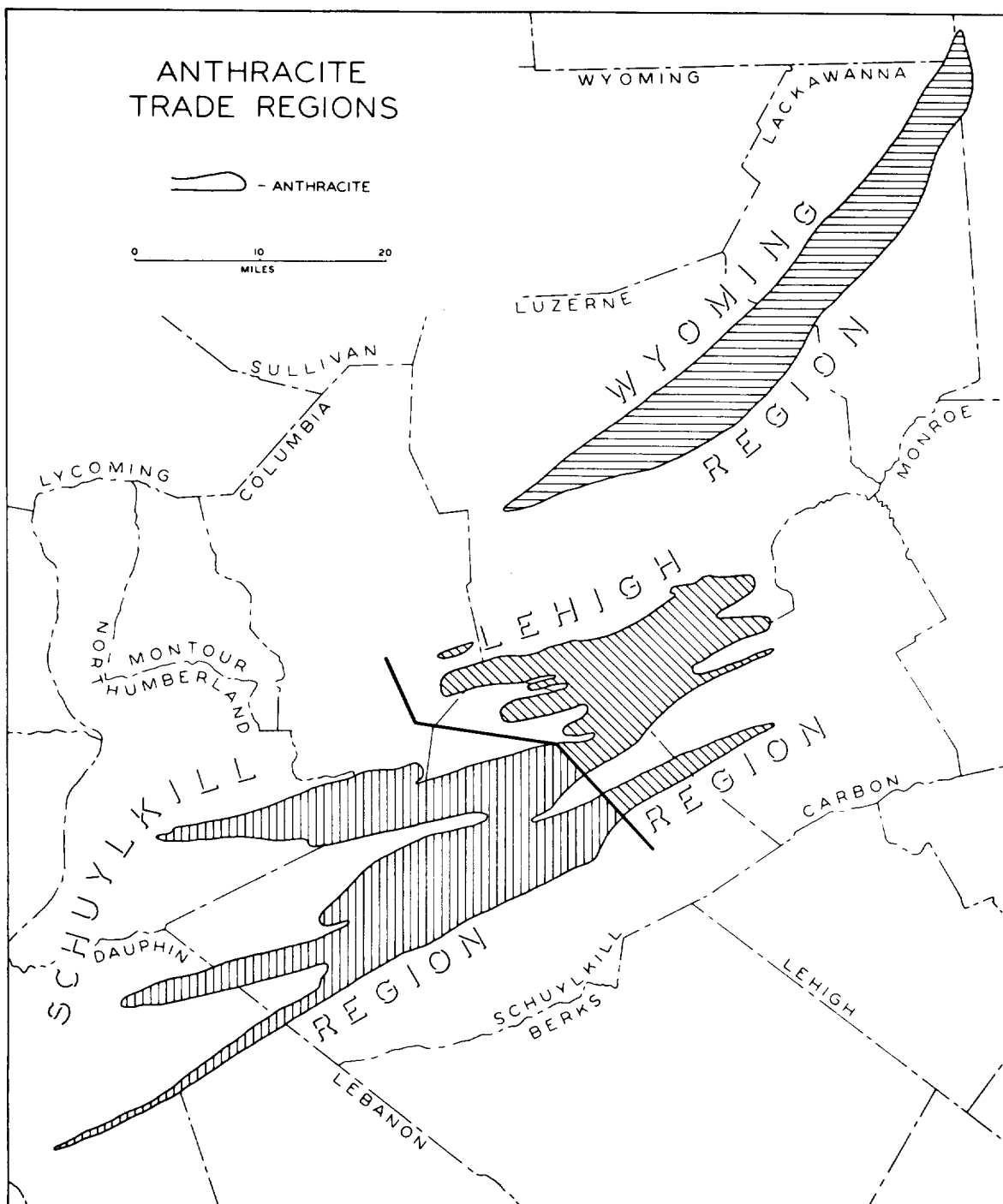


Appendix: Notes 29, 39, 42, and 85.

### DISPOSITION, BY INSPECTION DISTRICTS

For the anthracite region as a whole in 1959, some 84 per cent of total production was shipped to market, 15 per cent was sold to local trade, and one per cent was used at the collieries. Districts in which more than 100,000 tons each were sold to local trade included six in the Northern Field (1, 2, 10, 11, 12, and 14), two in the West-

ern Middle Field (17 and 20), two in the Eastern Middle Field (15 and 26), and two in the Southern Field (19 and 27). Such areas were mostly in the vicinity of the larger towns of the anthracite region, where industrial and residential demands for fuel were greatest.

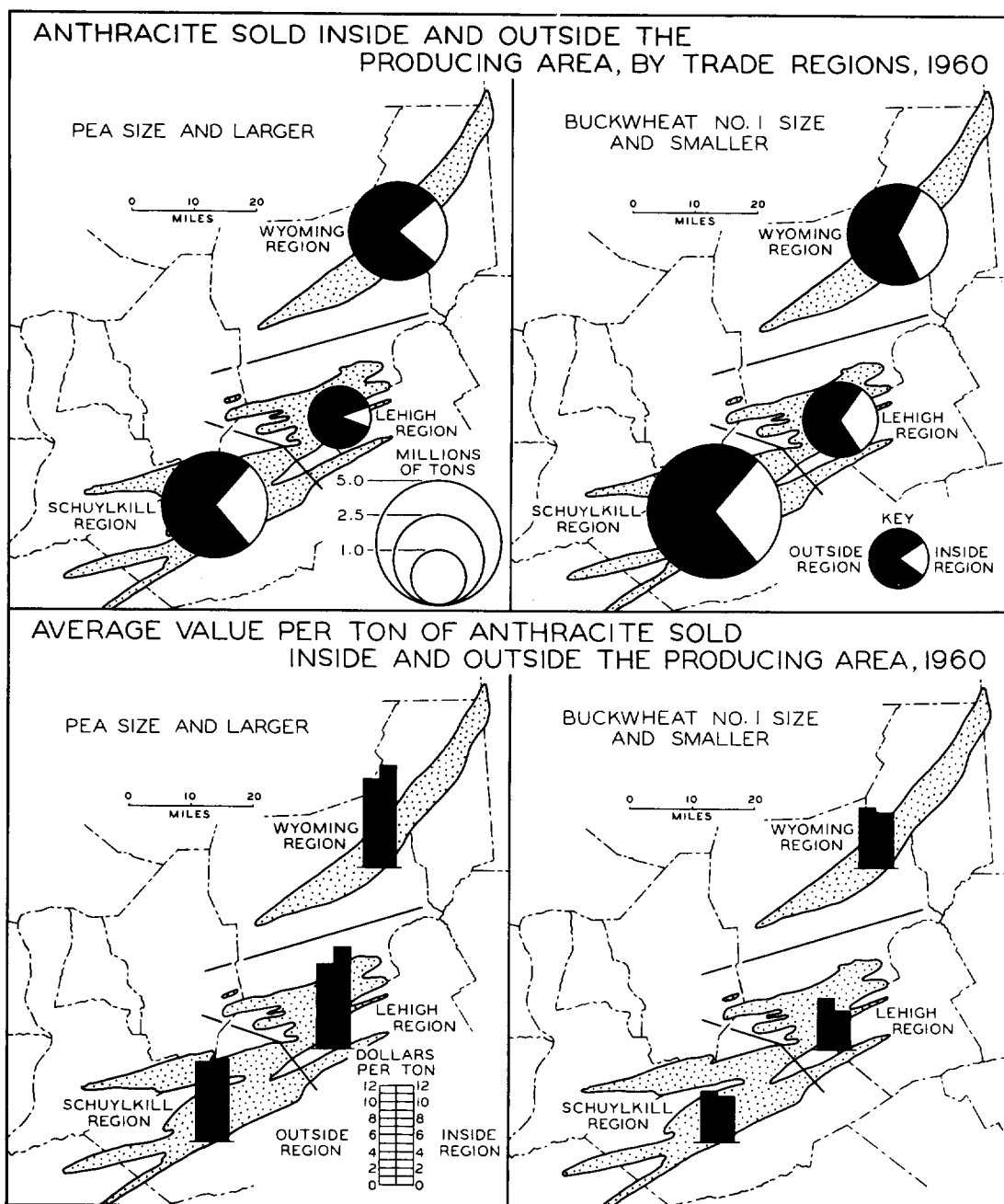


Appendix: Note 35.

## TRADE REGIONS

Considerable statistical material on the Pennsylvania anthracite industry is organized on the basis of three so-called trade regions rather than four producing fields. The Wyoming trade region coincides with the Northern Field (see page 6). The Lehigh trade region comprises the

Eastern Middle Field and that part of the Southern Field lying east of Tamaqua, while the Schuylkill trade region includes the remainder of the Southern Field and all of the Western Middle Field.



Appendix: Notes 35, 40, 86, 87, 88, and 89.

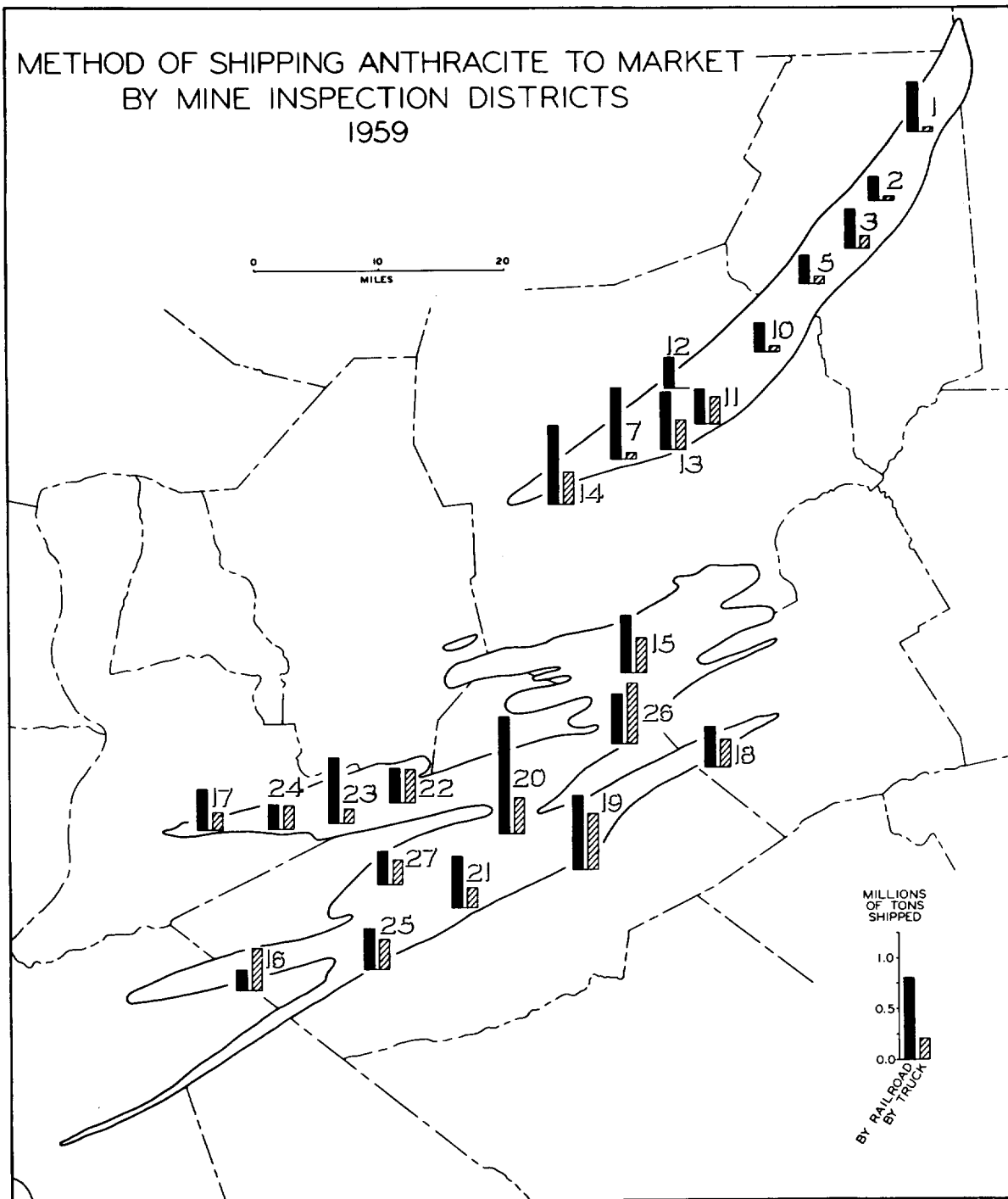
### SALES, BY TRADE REGIONS

Note, on the two top maps, that the major markets for both large and small sizes of anthracite from all three trade regions in 1960 were outside rather than inside the producing area. Relatively higher percentages of the larger sizes, rather than the smaller sizes, were sold outside the producing area.

The left-hand bottom map indicates that, in 1960, the larger sizes of anthracite brought high-

er prices per ton when sold inside, rather than outside, the producing area. Conversely, as is indicated on the right-hand bottom map, the smaller sizes brought lower prices per ton when sold inside, rather than outside, the producing area. Significant differences in value per ton are apparent from one trade region to another in both the large size and small size categories.

# METHOD OF SHIPPING ANTHRACITE TO MARKET BY MINE INSPECTION DISTRICTS 1959



Appendix: Notes 29, 39, 42, and 90.

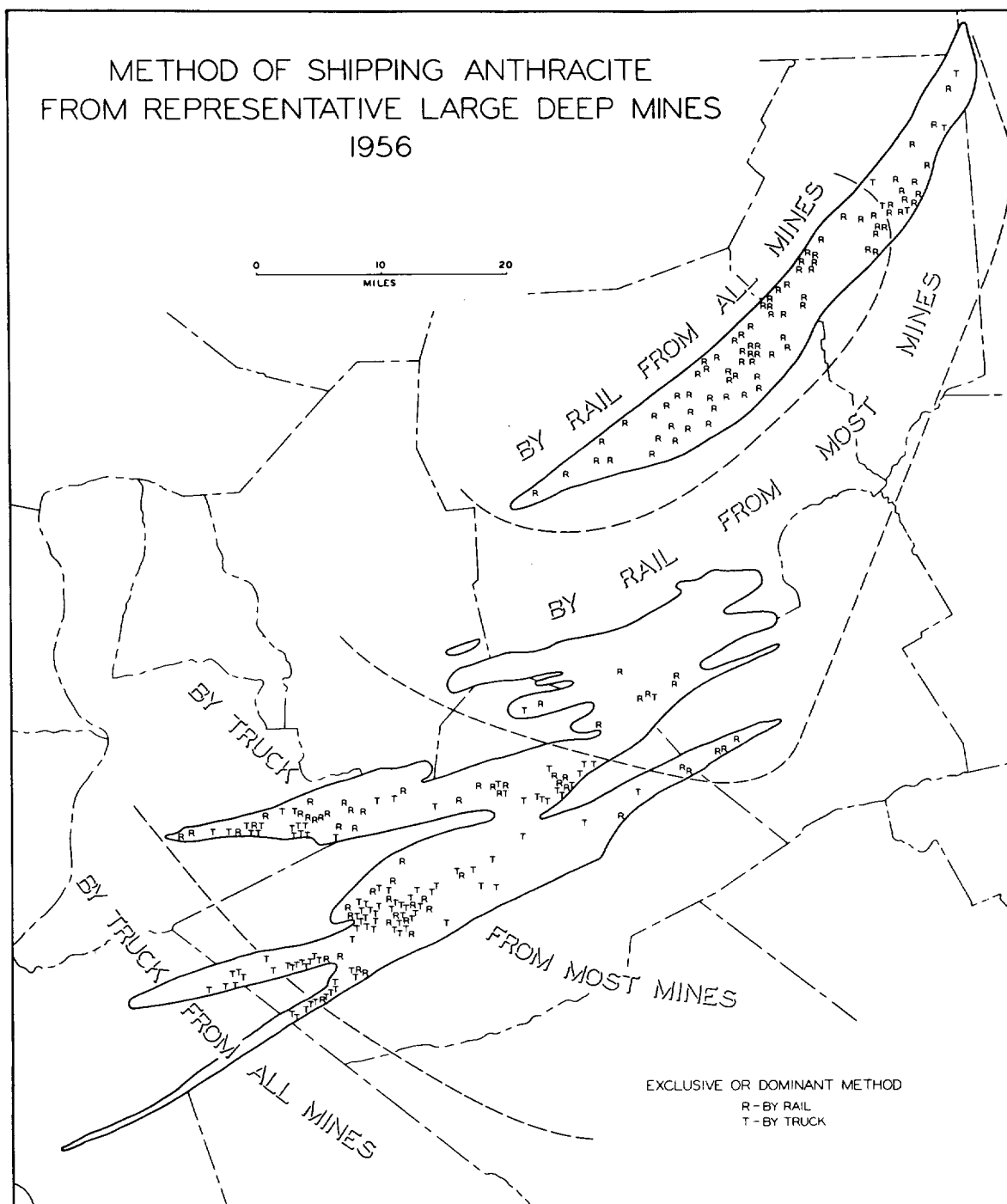
## METHOD OF SHIPMENT, BY INSPECTION DISTRICTS

For Pennsylvania's anthracite region as a whole, some 67 per cent of the total coal shipped to market (exclusive of the local market) was moved by railroad in 1959. The remaining 33 per cent was hauled by truck. Truck haulage

was more important than rail in only two districts, 16 and 26. Rail transport was most predominant in the Northern Field, and least so in the Eastern Middle Field.



# METHOD OF SHIPPING ANTHRACITE FROM REPRESENTATIVE LARGE DEEP MINES 1956

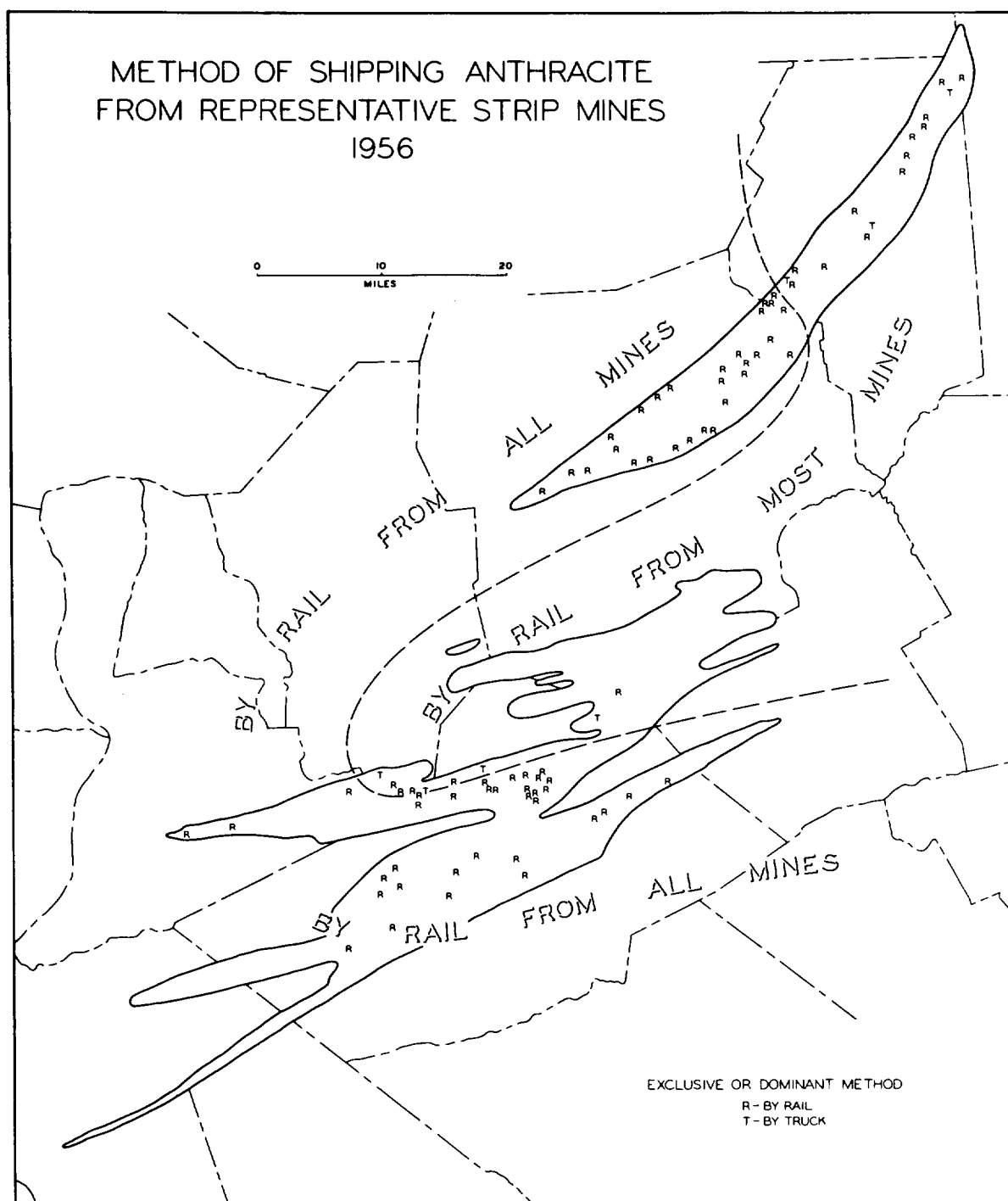


Appendix: Notes 29, 42, 43, 45, 46, 54, 55, 80, and 91.

## METHOD OF SHIPMENT, BY INDIVIDUAL LARGE DEEP MINES

A large majority of Pennsylvania's anthracite mines, of all types, utilize both rail and truck for shipping their product to market. The above map represents, for some 245 large deep mines, the predominant but not necessarily exclusive method of shipping coal during 1956. The im-

portance of rail transport as the dominant haulage method was greatest in the central and southwestern parts of the Northern Field. From this area outward, railroads became progressively less significant, and trucks more significant, as the dominant haulage method.

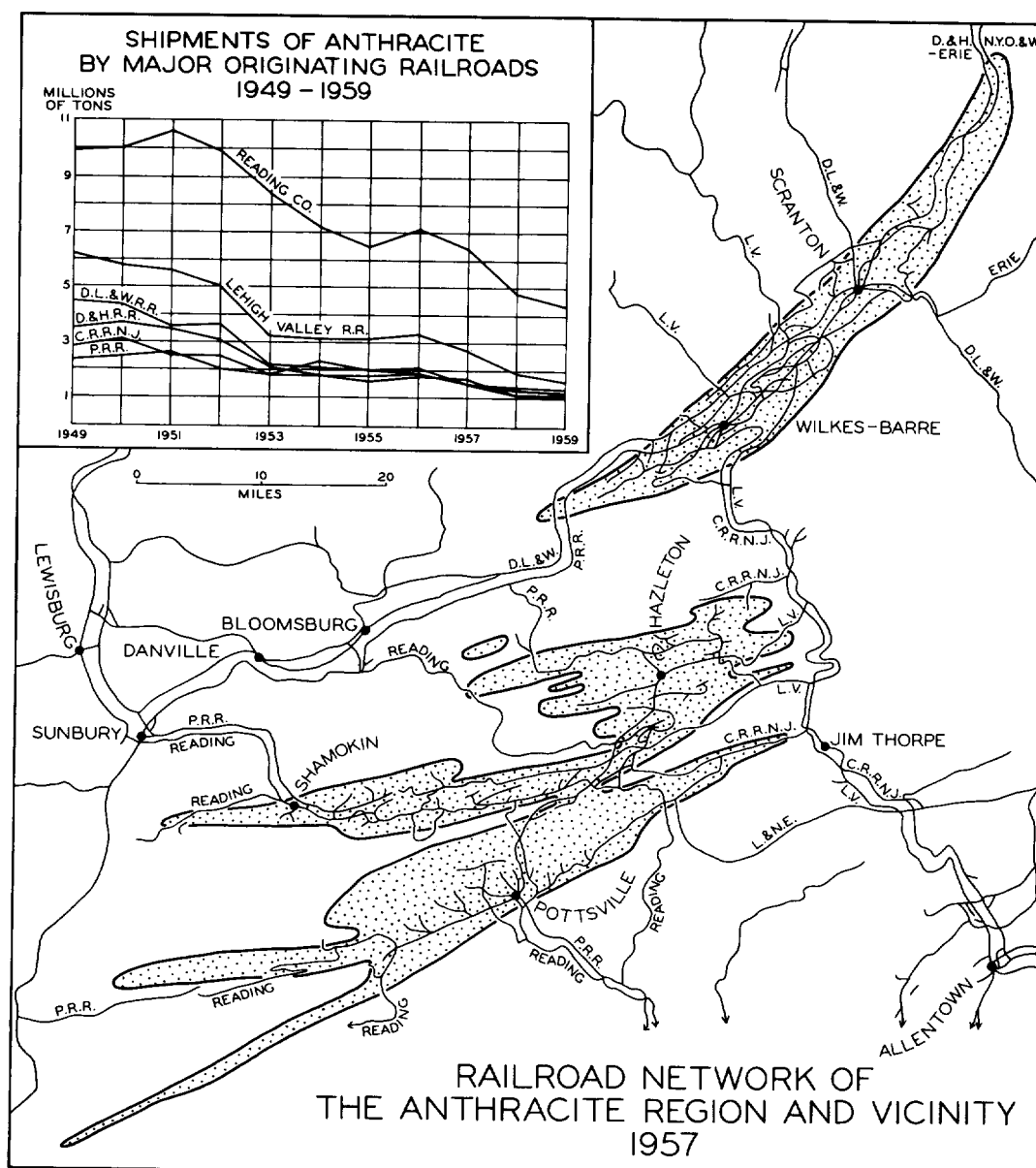


Appendix: Notes 29, 43, 45, 54, 55, 57, and 80.

### METHOD OF SHIPMENT, BY INDIVIDUAL STRIP MINES

As in the case of deep mines in Pennsylvania's anthracite region, many of the strip mines employ both rail and truck for shipping coal to market. In the case of strip mines, however, the importance of rail shipments is much more pro-

nounced. The above map represents, for some 86 strip mines, the predominant but not necessarily exclusive method of shipping coal during 1956. Note the very limited number of mines at which trucking was of major significance.



Appendix: Notes 92 and 93.

## RAILROAD NETWORK AND SHIPMENTS

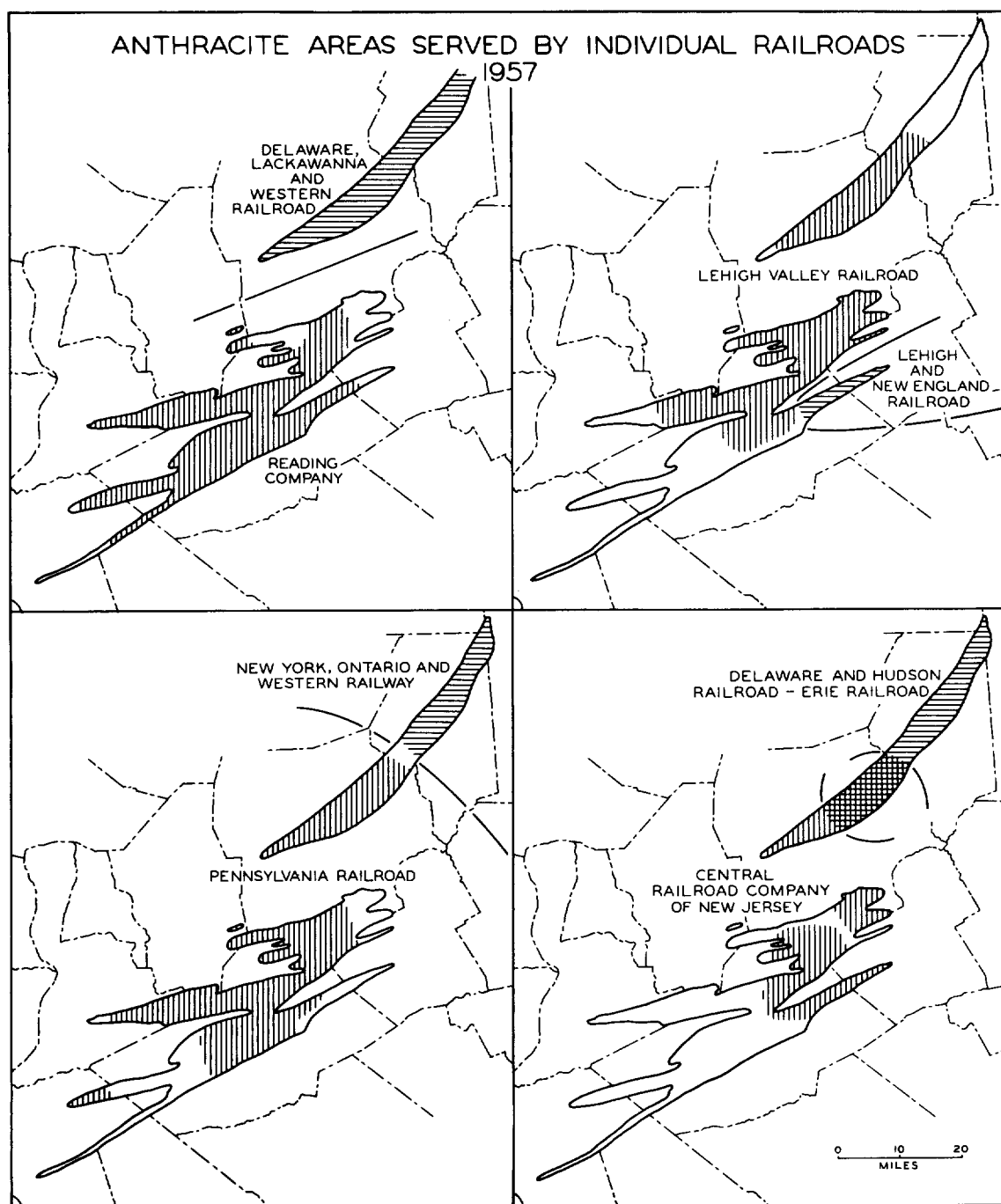
The above map represents all rail lines in operation in the area mapped as of January 1, 1957. The New York, Ontario, and Western Railway ceased operations on March 29, 1957.

Railroads terminating with arrowheads were interconnected with other lines outside of the area mapped; those terminating without arrowheads were dead-end branch or spur lines. Note the excellent network of railroads in the anthracite region as compared with the few lines in most of the surrounding territory.

Abbreviations of railroad names are as follows:  
C.R.R.N.J. — Central Railroad Company of New

Jersey; D.&H. — Delaware and Hudson Railroad; D.L.&W. — Delaware, Lackawanna, and Western Railroad Company; Erie — Erie Railroad; L.&N.E. — Lehigh and New England Railroad; L.V. — Lehigh Valley Railroad; N.Y.O.&W. — New York, Ontario, and Western Railway; P.R.R. — Pennsylvania Railroad; Reading — Reading Company.

The graph excludes three of the so-called anthracite railroads that shipped less than one million tons annually in recent years. Shipments on the graph include coal moving into, but not out of, storage.

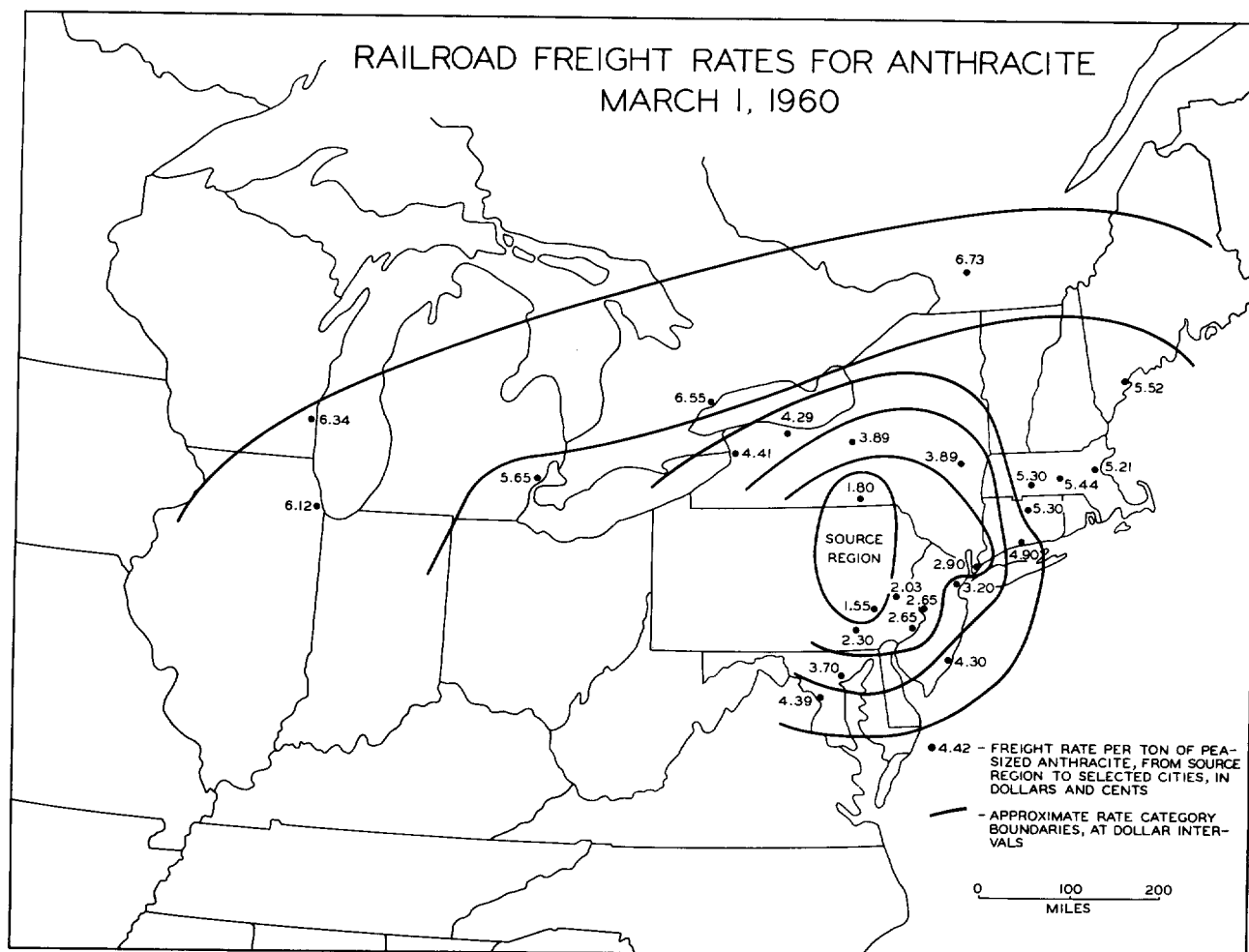


Appendix: Notes 92, 94, and 95.

### RAILROAD SERVICE TERRITORIES

The territory within the anthracite region served by each of the nine anthracite-originating railroads on January 1, 1957 is shaded on the above series of maps. The service territory of each railroad is considered to be all anthracite lands situated within five miles of its lines. On the lower right-hand map, the areas served by

both the Delaware and Hudson and the Erie railroads virtually coincided, and are jointly represented by the horizontal line pattern. Outlet lines for each railroad, over which the anthracite was transported from the production region, are shown and labelled on the immediately preceding map.



Appendix: Note 93.

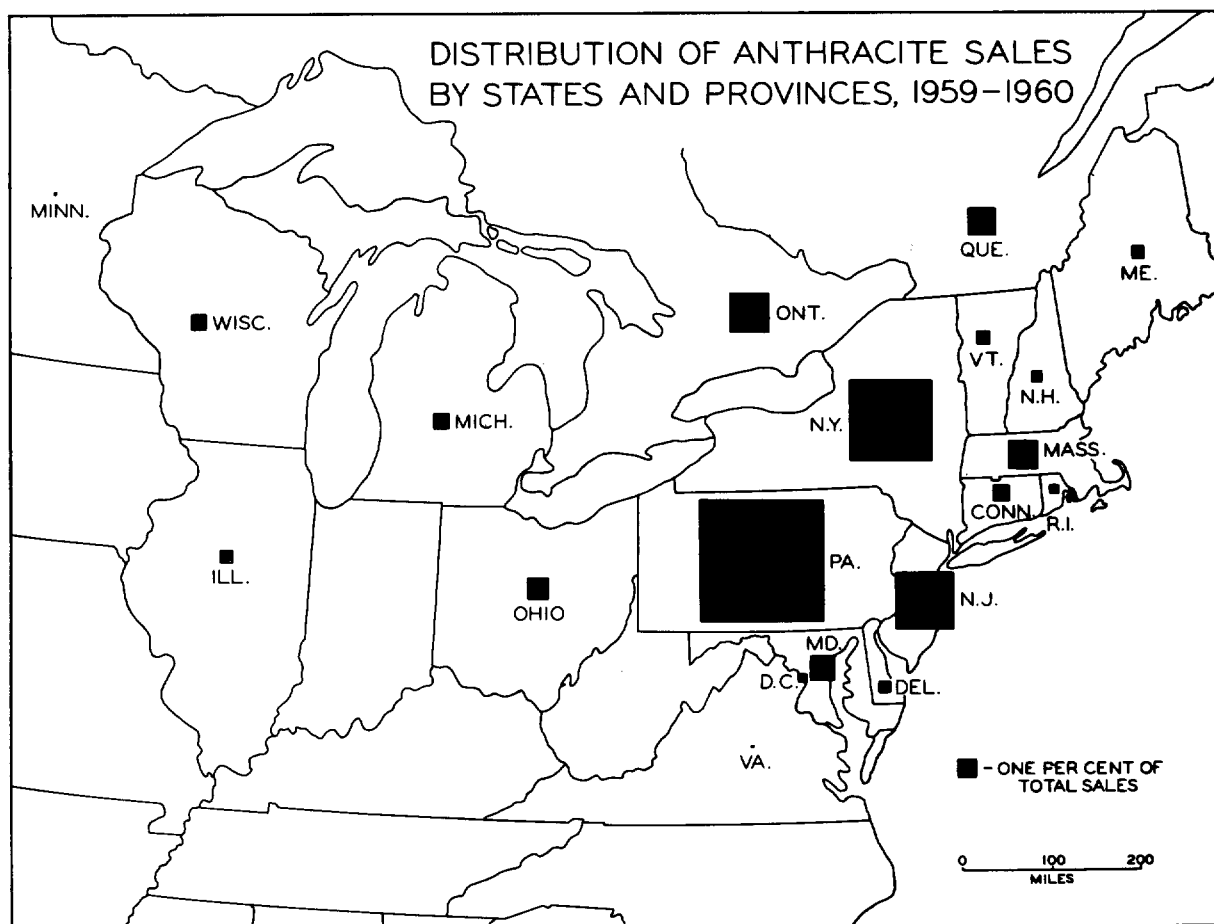
## RAILROAD FREIGHT RATES

The March 1, 1960 railroad freight rates indicated on the above map are based upon published tariffs of the originating carriers. The figures represent going rates from the anthracite mines to the specific urban destinations shown. In some cases, higher rates were in effect for certain other railroads, or from certain portions of the source region. The rates mapped are for pea-sized anthracite; rates for other sizes (prepared sizes, buckwheat, and rice and smaller) were identical in most cases to those for the pea size. When deviations existed, they were of small magnitude.

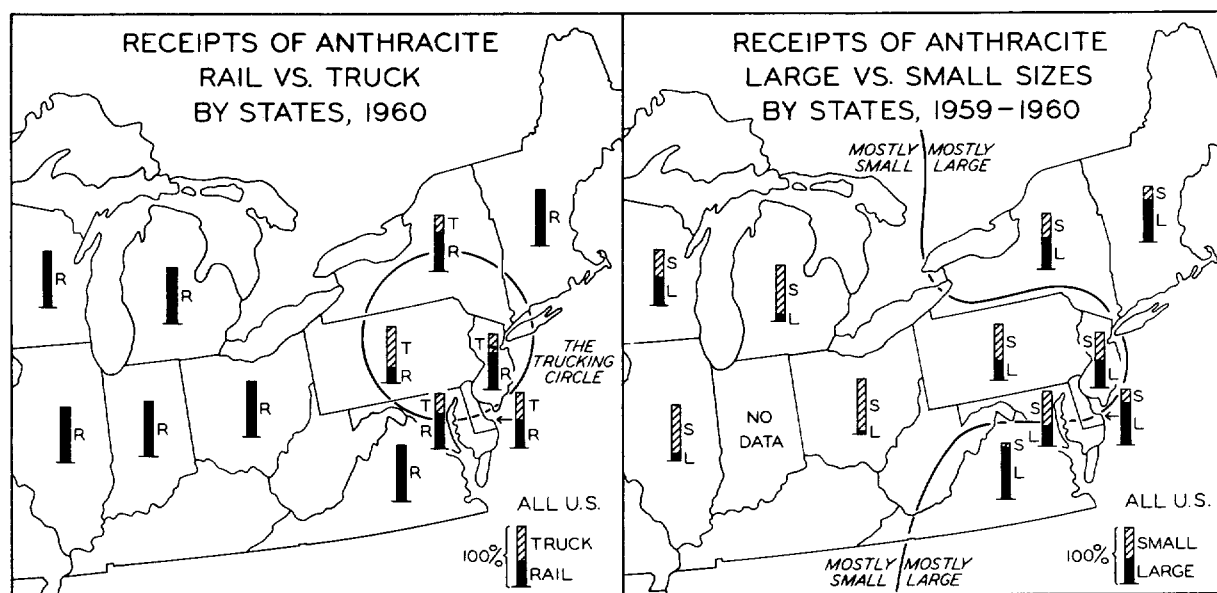
The rate category boundaries (heavy lines on the map) are not intended to represent isolines; they merely separate cities with anthracite freight rates in one dollar category from other

cities in higher or lower categories.

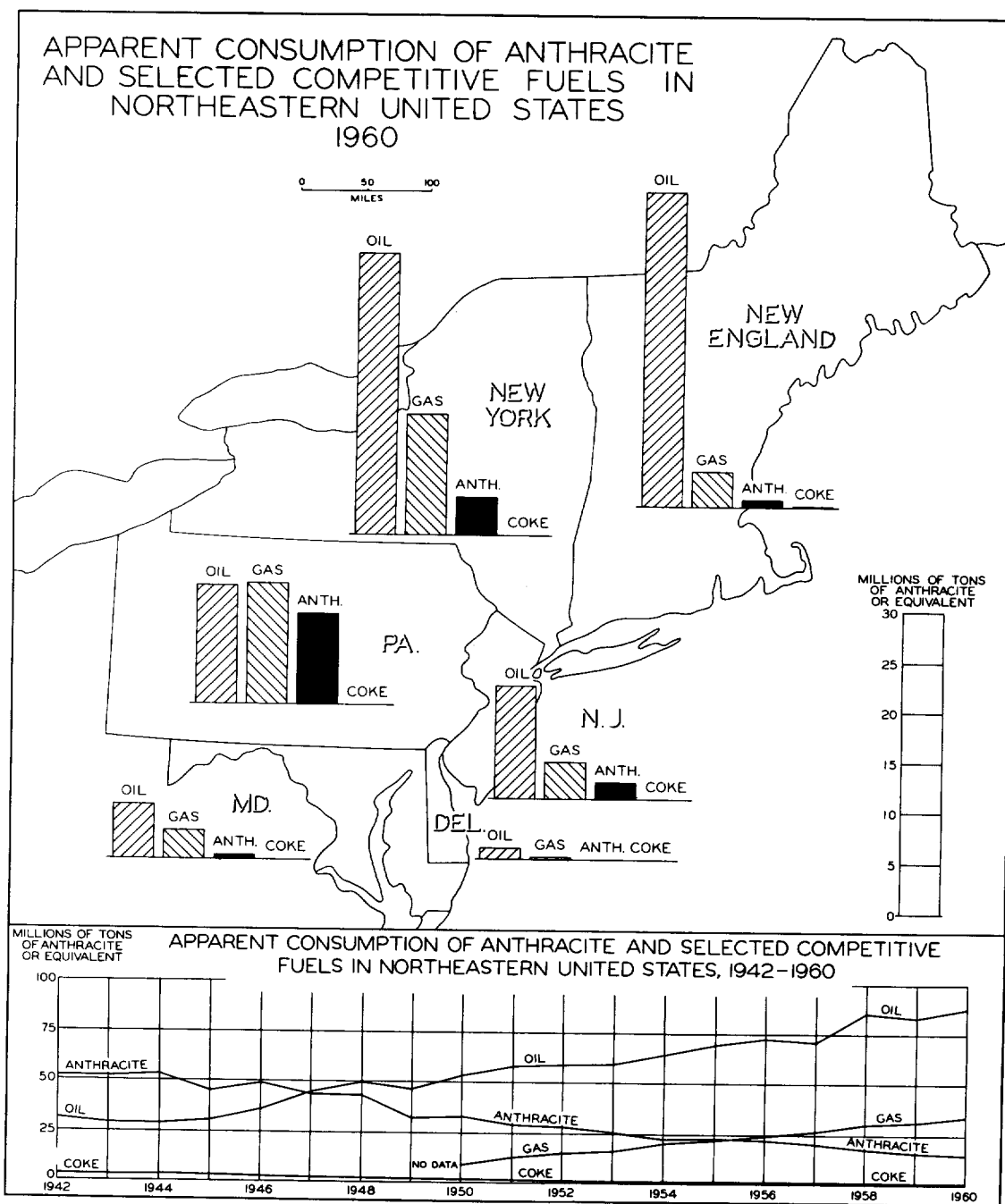
The names of the cities for which specific freight rate data are mapped are as follows: in Maine — Portland; in Massachusetts — Boston, Springfield, and Worcester; in Connecticut — Hartford and New Haven; in New York — Albany, Binghamton, Buffalo (local sales only), New York (Lower Piers), Rochester, and Syracuse; in Pennsylvania — Allentown, Lancaster, Philadelphia, and Reading; in New Jersey — Atlantic City, Jersey City (local sales only), Newark, and Trenton; in Maryland — Baltimore; in the District of Columbia — Washington; in Illinois — Chicago (local sales only); in Michigan — Detroit; in Wisconsin — Milwaukee (local sales only); and in Canada — Montreal and Toronto.



Appendix: Notes 35 and 96.



Appendix: Notes 35, 97, 98, and 99.



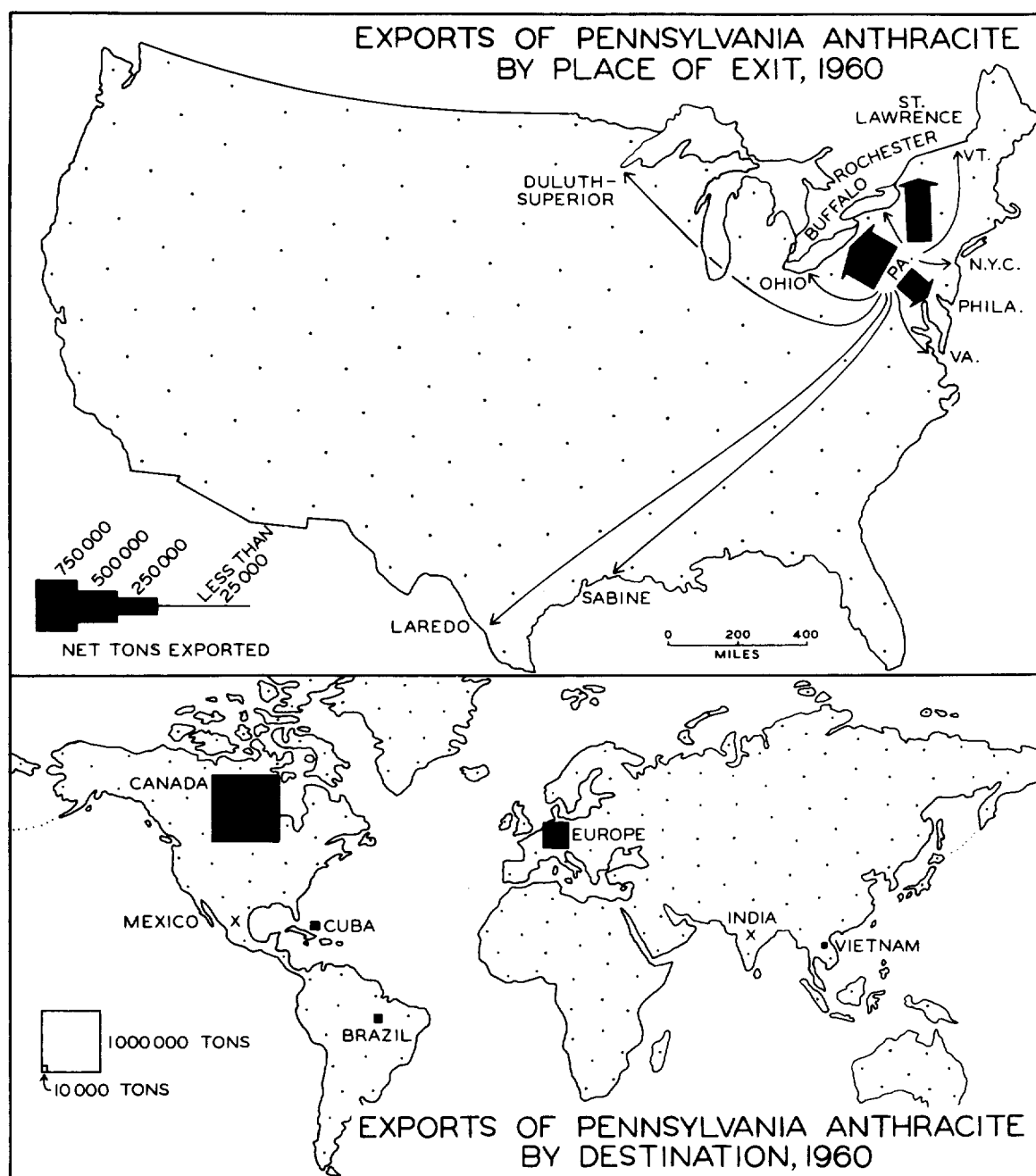
Appendix: Notes 35, 100, 101, and 102.

### COMPETITIVE FUELS

The area mapped above represents the principal anthracite market in the United States. It is apparent from the map that Pennsylvania is the only state in which consumption of anthracite ranks on an approximate par with that of oil and gas. Anthracite plays a far less important, but still significant, role in the domestic fuel markets of New York State and New Jersey,

but is currently of no significance elsewhere in northeastern United States.

As can be seen on the graph, the domestic fuels situation in the northeast was formerly far different from that of today. During the early 1940's, anthracite was the leading home fuel; but in 1947 it was surpassed by oil, and in 1956 by gas.



Appendix: Notes 35, 103, and 104.

## EXPORTS

During the 12-month period, April 1, 1959 to March 31, 1960, the domestic market of the United States purchased 91.44 per cent of all Pennsylvania anthracite sold, and foreign countries purchased the remaining 8.56 per cent.

As the top map, above, indicates, some 50 per cent of Pennsylvania anthracite exports left the country via Buffalo in 1960, and most of the re-

mainder was exported via Philadelphia and the St. Lawrence River.

The bottom map, above, represents the dominant position held by Canada as a market for Pennsylvania anthracite in 1960. Europe — and more specifically Belgium, Luxembourg, France, Italy, and the Netherlands — was of secondary importance. No other part of the world imported significant quantities of the fuel.



# APPENDIX

## NOTES ON MAPS AND GRAPHS

- Note 1. A small amount of production in New Zealand is not shown. The symbol "x" indicates production of less than 100,000 tons in 1957. Production data for all countries in the Communist bloc and for Switzerland are estimates, and data for the Republic of South Africa represent an estimate of sales.
- Note 2. The symbol "x" represents less than 10 million tons.
- Note 3. Data are based on the assumption that losses in mining equalled known recovery, i.e., there was a 50 per cent recovery rate.
- Note 4. Excluding states producing less than 2.6 million tons of bituminous coal each in 1957.
- Note 5. Excluding counties producing less than 100,000 tons each in 1958, as well as all production of dredged anthracite.
- Note 6. Modified from Sisler, J. D., **Map of the Coal Fields of Pennsylvania**, Pennsylvania Topographic and Geologic Survey, 1929.
- Note 7. Modified from Lobeck, A. K., **Physiographic Diagram of Pennsylvania**, The Geographical Press, 1951.
- Note 8. Based on **Geologic Map of Pennsylvania**, Pennsylvania Topographic and Geologic Survey, 1960.
- Note 9. Major faults are based on **Geologic Map of Pennsylvania**, Pennsylvania Topographic and Geologic Survey, 1960; generalized stratigraphic sections are based on U.S. Bureau of Mines, Bul. 245, 1927.
- Note 10. Structure contours from U.S. Bureau of Mines, Bul. 72, 1915; surface contact line between Pottsville Group and Post-Pottsville formations from **Geologic Map of Pennsylvania**, Pennsylvania Topographic and Geologic Survey, 1960.
- Note 11. Based on U.S. Geological Survey, **Coal Investigations Map C43**, Sheets 1 and 2, 1958.
- Note 12. Modified from U.S. Bureau of Mines, Bul. 245, 1927.
- Note 13. Data from U.S. Bureau of Mines, Technical Paper 659, 1944.
- Note 14. Data refer to breaker samples of rice size coal.
- Note 15. Data refer to coal on a dry, ash-free basis.
- Note 16. Locations of sample sites are approximate.
- Note 17. Data are based on samples taken and analyzed, utilizing standardized methods, by personnel of the U.S. Bureau of Mines at various dates between 1931 and 1942.
- Note 18. Dashed lines on the map, and related descriptive phrases, indicate broad regional variations in the character of the coal samples. If the term "average" is used, it is not employed in the strict mathematical sense, but instead implies an intermediate quantity of some range of values.
- Note 19. Percentages are based on the results of proximate analysis.
- Note 20. Data refer to coal on an as-received basis at the laboratory.
- Note 21. Percentages are based on the results of ultimate analysis.
- Note 22. Data from Gillmore, D. W., Wright, C. C., and Walker, P. L., Jr., "Grindability Data on Pennsylvania Anthracite," **Proceedings of the Anthracite Conference, October 18 and 19, 1956**, Bul. 70, Mineral Industries Experiment Station, The Pennsylvania State University.
- Note 23. Data refer to mine samples of coal.
- Note 24. Data refer to coal on a moisture-free basis.
- Note 25. Index figures are determined mostly by the standard Hardgrove-Machine Method; in cases where Ball-Mill Method data are used, the values are converted to approximately equivalent Hardgrove figures.
- Note 26. Precise locations of sample sites are not specified in the source article; instead, 71 samples in the original source are verbally assigned positions within a network of 10-mile-square grid blocks superimposed upon a map of the anthracite region. Hence, positioning of the sample sites on the map in this atlas is more or less arbitrary within each grid block, the positioning being guided, however, by some general principles stated in the source article, and by the knowledge that the sample site had to be located within, rather than outside of, the boundaries of the coal fields.
- Note 27. The Hogarth specific-gravity bottle with side tubulure is used for this determination.
- Note 28. Based on a map in U.S. Bureau of Mines, Bul. 72, 1915. Areas in which coal beds are indicated as being exceptionally gase-

ous include only those localities known to possess this characteristic from mining activities up to 1915.

- Note 29. Data from one or more annual reports of the Anthracite Division, Department of Mines and Mineral Industries, Commonwealth of Pennsylvania.
- Note 30. Includes all types of employees except that, prior to 1955, employees of deep mines using fewer than five persons underground are excluded.
- Note 31. Includes data on the small semianthracite industry of Sullivan County.
- Note 32. Data for Lebanon County are included with those for Schuylkill County; and data for Susquehanna and Wayne counties are included with those for Lackawanna County.
- Note 33. The inset graph includes data on the small semianthracite industry of Sullivan County.
- Note 34. Data for Dauphin County, from 1942 to 1959, cannot be shown on the graph because of scale limitations.
- Note 35. Data from one or more of the annual volumes issued by the U.S. Bureau of Mines and titled either **Mineral Resources of the United States** (prior to 1932) or **Minerals Yearbook** (from 1932 to date).
- Note 36. Figures for the period between 1916 and 1950 exclude employees in "bootleg" operations, but these are included in subsequent years. Figures for the Wyoming Region for 1959 and 1960 include the small number of underground employees in the semianthracite industry of Sullivan County, which were excluded in earlier years.
- Note 37. No comparable data are available for years prior to 1916 in the sources consulted.
- Note 38. See map on page 108 for boundaries of the anthracite trade regions.
- Note 39. Symbols are located approximately in the centers of their respective mine inspection districts. See map on page 83 for the 1959 boundaries of the anthracite mine inspection districts as established for that year by the Department of Mines and Mineral Industries, Commonwealth of Pennsylvania. Figures on the map are mine inspection district numbers.
- Note 40. Includes data on deep mines employing fewer than five persons underground, i.e., so-called small mines.
- Note 41. The same scale of symbols is employed on all maps from pages 39 through 44; hence the maps are directly comparable with one another. Dashes associated with certain

district numbers on some maps indicate that there are no employees of the types specified in those districts. The employees represented in the maps on pages 40, 42, 43, and 44 constitute 100 per cent of all workers in the Pennsylvania anthracite industry.

- Note 42. Excludes data on deep mines employing fewer than five persons underground, i.e., so-called small mines.
- Note 43. The location of mines is based on the latest available series of manuscript maps covering the entire anthracite region. These maps were prepared by state mine inspectors and are filed with the Department of Mines and Mineral Industries, Commonwealth of Pennsylvania.
- Note 44. No data are available for approximately 10 per cent of the large deep mines of the anthracite region, i.e., those employing five or more persons underground.
- Note 45. In some instances, data for one of the preceding or succeeding years are substituted when data for the year mapped are not available.
- Note 46. The term "deep mine" denotes an underground, as opposed to a surface (strip or bank), operation.
- Note 47. No data are available for approximately 25 per cent of the strip mines of the anthracite region.
- Note 48. No data are available for approximately 20 per cent of the small deep mines of the anthracite region, i.e., those employing fewer than five persons underground.
- Note 49. The dots represent the approximate places of work rather than of residence.
- Note 50. Includes persons employed at preparation plants associated with the mines.
- Note 51. On this graph, the term "small deep mine" denotes one with fewer than five but not fewer than two persons working underground, for the years 1947-1954; and one with fewer than five persons working underground, for the years 1955-1960. No figures are available as to the number of small deep mines prior to 1947; presumably there were relatively few such mines before the 1930 depression years. All data are approximate.
- Note 52. The locations and names of selected towns are shown for orientation purposes. Urban boundaries are those of 1952.
- Note 53. Based on **General Map of the Entire Anthracite Regions of Pennsylvania**, Pittston Company, Dunmore, Pa., August 1934, scale 1:63,360.

- Note 54. The locations of map symbols are approximate, especially in areas of greatest concentration.
- Note 55. Locational data are for 1955 in the Northern Field, and for 1957 in the Eastern and Western Middle Fields as well as in the Southern Field.
- Note 56. The same scale of symbols is employed on the maps on pages 55, 58, 59, and 60; hence the maps are directly comparable with one another.
- Note 57. Mine symbols represent the approximate sites of stripping operations being conducted at the times the data were collected.
- Note 58. Based on one hundred and twenty-three 1:20,000 scale aerial photographs of the anthracite area that are available from the Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture. Photographs of Lackawanna County were taken in 1960; for Carbon, Columbia, Luzerne, and Northumberland counties in 1959; for Schuylkill County in 1958; and for Dauphin County in 1956.
- Note 59. Stripped lands shown on the map include areas from which coal has been removed by means of surface excavation, plus additional territory covered with some of the overburden that was removed during the mining process. Also included may be a small number of clay, sand, and gravel pits that could not be distinguished from coal pits on the photographs.
- Note 60. Circles representing selected towns are roughly proportional in area to the population of the towns.
- Note 61. Includes only plants that were active at the date indicated.
- Note 62. Names of the settlements with which the preparation plants are associated are shown. In a few cases, plants with a rural delivery address are assigned to the nearest town. Abbreviations of town names are as follows: Ashland - Ash., Gilberton - Gilb., Minersville - Min.
- Note 63. No accurate record of anthracite mining fatalities was kept previous to 1870.
- Note 64. Data are not indicated individually for Lebanon, Susquehanna, and Wayne counties, nor for the small semianthracite industry of Sullivan County, but figures for these counties are included in the totals shown on the inset graph for the entire anthracite region.
- Note 65. Vertical lines following the shortened curves in Carbon and Dauphin counties represent data for single years; interruptions in the Columbia County curve represent years when no fatalities occurred.
- Note 66. Includes fatal accidents involving either inside or outside employees. Data for Wilkes-Barre include four residents of Wilkes-Barre Township; those for Pittston include one in West Pittston; Avoca, one in West Avoca; and Plains, one in Plains Township.
- Note 67. One fatality from roof fall, and one from underground machinery and equipment, are not plotted due to lack of adequate information. All but five of the deaths at strip and bank operations occurred at strip mines.
- Note 68. The name of the settlement nearest the site of each major accident is given on the map.
- Note 69. Two major accidents are not plotted because of lack of adequate data.
- Note 70. Ten deaths resulting from major accidents are not plotted because of lack of adequate data.
- Note 71. Based on manuscript maps prepared by the Chief Mining Engineer, Department of Mines and Mineral Industries, Commonwealth of Pennsylvania.
- Note 72. Prior to 1955, production from deep mines employing fewer than five persons underground is not included.
- Note 73. No accurate production figures of any type are available prior to 1870, no separate data on bank production are available earlier than 1894, and none can be had on strip production before 1932. The small amount of production from bank and strip mines is included with underground production during earlier years.
- Note 74. No comparable data are available for years prior to 1913 in the sources consulted. Data represent gross tons of coal from 1913 to 1927, and net tons from 1928 to 1960.
- Note 75. There are minor variations from year to year, and from field to field, in the basis on which tonnage data are compiled. For example, all figures include production from breakers, but some also include production from washeries and/or dredges. Also, production figures for the Northern Field sometimes include, and at other times exclude, the small amount of semianthracite production from nearby Sullivan County. These discrepancies do not alter the essential comparability of the annual figures for the various fields.
- Note 76. The same scale of symbols is employed on all maps from pages 90 through 94; hence these maps are directly comparable with one another. Dashes associated with cer-

- tain district numbers on some maps indicate that there is no production of the type specified in those districts. Production represented on the maps on pages 91, 93, and 94 constitutes 100 per cent of non-dredged production in the Pennsylvania anthracite industry.
- Note 77. The same scale of symbols is employed on the maps on pages 95 and 97; hence the maps are directly comparable with one another.
- Note 78. The same scale of symbols is employed on the maps on pages 98 and 99; hence the maps are directly comparable with one another.
- Note 79. Excludes persons employed at preparation plants associated with the mines.
- Note 80. Dashed lines on the map, and related descriptive phrases, indicate broad regional variations in values of the data plotted.
- Note 81. Data from Pennsylvania Topographic and Geologic Survey, Progress Report 130, 1945; and from Pennsylvania Department of Mines and Mineral Industries, Anthracite Division, annual report for 1960.
- Note 82. No data are available in the sources consulted on shipments by truck prior to 1932.
- Note 83. The symbol "x" indicates no tonnage.
- Note 84. Data for Susquehanna and Wayne counties cannot be shown because of scale limitations.
- Note 85. For districts in which less than 1,000 tons were used at the collieries, the amount is not shown on the map.
- Note 86. The term "producing area" includes all Pennsylvania counties in which anthracite is mined.
- Note 87. Tonnage data refer to net tons.
- Note 88. The term "pea size and larger" includes the following sizes: pea, chestnut, stove, egg, and lump and broken. The term "buckwheat No. 1 size and smaller" includes buckwheat No. 1, No. 2 (rice), No. 3 (barley), No. 4, No. 5, and other (various mixtures of buckwheat Nos. 2 to 5 plus other coal of relatively low value).
- Note 89. The term "average value per ton" indicates the average sales realization f.o.b. mines, but does not include margins of separately incorporated sales companies.
- Note 90. Does not include coal sold to local trade and that used at collieries for steam and heat.
- Note 91. For two mines, tonnages shipped by truck and by rail are identical; these mines are not mapped.
- Note 92. Based in part on **Railroad Map of Pennsylvania**, Pennsylvania Public Utility Commission, 1956.
- Note 93. Statistical data are derived from **Manual of Statistical Information, 1960**, Anthracite Institute, Wilkes-Barre, Pa.
- Note 94. Based in part on **Steam Railroad Map of Pennsylvania**, Pennsylvania Public Service Commission, 1929.
- Note 95. The cross-hatched area on the lower right-hand map is served by the Central Railroad Company of New Jersey and by the Delaware and Hudson and Erie railroads.
- Note 96. The period covered by the data extends from April 1, 1959 to March 31, 1960. In the key, one per cent of total sales represents 188,128 tons. Not shown on the map are the following: 1.47 per cent to other states, 0.08 per cent to other Canadian provinces, and 1.21 per cent to foreign countries other than Canada.
- Note 97. Data for the New England states are combined on each map; and data are not shown for the District of Columbia, Minnesota, and a few other states. Both maps include so-called local sales in Pennsylvania.
- Note 98. On the right-hand map, the period covered extends from April 1, 1959 to March 31, 1960. The term "large sizes" refers to pea and larger, and the term "small sizes" refers to buckwheat No. 1 and smaller. In 1959-1960, 57 per cent of total United States anthracite receipts were in small sizes, and 43 per cent in large sizes.
- Note 99. On the left-hand map, the so-called trucking circle represents the general area in which at least some anthracite is received via truck. In 1960, 54 per cent of total United States anthracite receipts were by truck, and 46 per cent were by rail.
- Note 100. Data on anthracite include apparent consumption by all users; on coke include only that used for domestic purposes; and on oil and gas include only that used for heating and range purposes. Oil and gas are converted to anthracite equivalents on the basis of four barrels of fuel oil and 24,190 cubic feet of natural gas equaling one ton of coal. Data include imported as well as domestically produced fuels.
- Note 101. An important but undetermined part of the anthracite shown on the map as shipped to New Jersey is reshipped to New York City. The bar graph for Maryland includes data for the District of Columbia.

Note 102. On the graph, consumption of "illicit" anthracite is not included in the data for 1942 through 1949, and consumption of natural gas in Virginia is included in the data for 1950 through 1953.

Note 103. The top map indicates all places of exit handling a net export tonnage of anthracite in excess of 1,000 tons in 1960. Places of exit handling smaller tonnages include Maine and New Hampshire; El Paso, Texas; the Dakotas; and Michigan.

Note 104. The bottom map indicates all foreign areas taking over 1,000 tons of Pennsylvania anthracite in 1960. Countries importing between 1,000 and 2,000 tons each are represented by an "x". The map does not indicate minute tonnages of Pennsylvania anthracite imported in 1960 by Argentina, Australia, Indonesia, Israel, Paraguay, the Philippines, Saudi Arabia, Uruguay, and Venezuela.

Note 105. Data from U.S. Censuses of Population, U.S. Bureau of the Census.

Note 106. Net migration is determined by the vital statistics method of estimation. First, the natural increase occurring between 1950 and 1960 is added to the 1950 population. In the absence of migration, this sum would be the 1960 population. This expected 1960 population is then compared to the enumerated population in 1960, and the difference, either positive or negative, is credited to net migration. In the smaller civil divisions, for which data on natural increase are not available, it is assumed that each division will have the same proportion of the natural increase of the county as that division has of the population of the county. Vital statistics are from the Pennsylvania Department of Health; population data are from U.S. Censuses of Population, 1950 and 1960.