NPS Form 10-900-b
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National Register of Historic Places Multiple Property Documentation Form

This form is used for documenting multiple property groups relating to one or several historic contexts. See instructions in *How to Complete the Multiple Property Documentation Form* (National Register Bulletin 16B). Complete each item by entering the requested information. For additional space, use continuation sheets (Form 10-900-a). Use a typewriter, word processor, or computer, to complete all items.

X New Submission ___ Amended Submission

A. Name of Multiple Property Listing

Bituminous Coal and Coke Resources of Pennsylvania , 1740-1945

B. Associated Historic Contexts

(Name each associated historic context, identifying theme, geographical area, and chronological period for each.)

Pennsylvania Bituminous Coal Industry , 1740-1945

C. Form Prepared by

name/title Carmen Peter DiCiccio

organization Bureau for Historic Preservation/PHMC date September 29, 1993

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D. Certification

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this documentation form meets the National Register documentation standards and sets forth requirements for the listing of related properties consistent with the National Register criteria. This submission meets the procedural and professional requirements set forth in 36 CFR Part 60 and the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation. (☐ See continuation sheet for additional comments.)

Brent D. Glass, SHPO Brent D. Glass 12/22/93

Signature and title of certifying official Date

Pennsylvania Historical and Museum Commission

State or Federal agency and bureau

I hereby certify that this multiple property documentation form has been approved by the National Register as a basis for evaluating related properties for listing in the National Register.

for Edson H. Beall Entered in the National Register 6.3.94

Signature of the Keeper Date of Action

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Provide the following information on continuation sheets. Cite the letter and the title before each section of the narrative. Assign page numbers according to the instructions for continuation sheets in *How to Complete the Multiple Property Documentation Form* (National Register Bulletin 16B). Fill in page numbers for each section in the space below.

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Primary location of additional data:

- ☐ State Historic Preservation Office
- ☐ Other State agency
- ☐ Federal agency
- ☐ Local government
- ☐ University
- ☐ Other

Name of repository:

_____

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United States Department of the Interior
National Park Service

National Register of Historic Places
Continuation Sheet
Bituminous Coal and Coke Resources of Pennsylvania, 1740 - 1945

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Section number E

Bituminous Coal and Coke Context of Pennsylvania 1740-1945

November 9 , 1993

Carmen Peter DiCiccio

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"A diamond is a chunk of coal that made good under pressure."
Anonymous

The North American Review called Pennsylvania in 1836 "the Key-Stone State not solely by reason of its geographical position and its magnitude but on account of its natural resources also." [1] "The Keystone Arch" was the phrase used by Governor Bigler (1852-1855) when describing the state's abundant mineral wealth. Rich and extensive deposits of iron ore, limestone, natural gas, oil and coal underlay the Commonwealth. This vast storehouse of natural resources made Pennsylvania one of the principal mineral producing states throughout the nineteenth and twentieth century. The exploitation of these natural resources was a principal force in the development of the state's industrial economy.

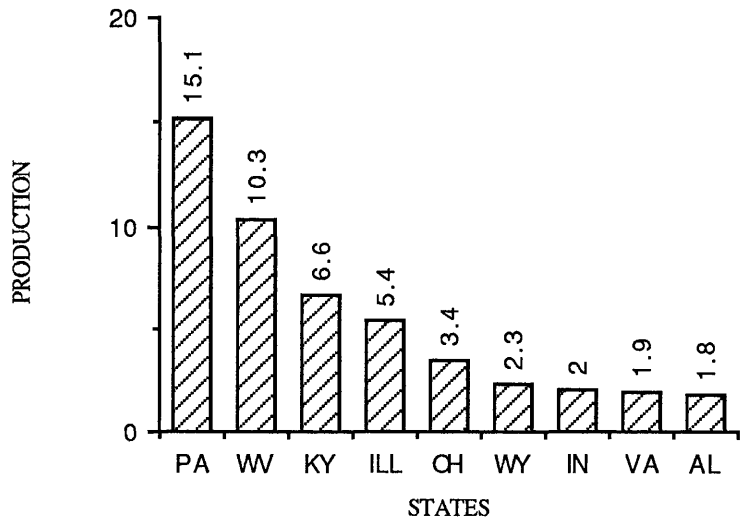
The coal and coke industries played a critical role in the industrial development of Pennsylvania. Vast coal deposits underlaying much of Pennsylvania made it a pioneer state in establishing the coal industry in the United States. Pennsylvania was literally the nation's coalbin producing more than one-half of the nation's coal until the eve of the Civil War. Coal was the state's principal mineral resource with reserves estimated at over 107 billion tons (84 billion tons of bituminous coal and 23 billion tons of anthracite and semi-anthracite coal). It was the principal commercial producer of anthracite coal; its output peaked at 100,445,299 net tons in 1917, employing a labor force of 156,148 men. The state has extensive bituminous coal fields located in some thirty counties that underlies about a third of the physical area of the state. Bituminous coal production surpassed anthracite coal during the 1890s and became the Commonwealth's most important mineral resource. Pennsylvania was the leading bituminous coal producing state in the union until the 1930s. Over 18 billion tons of bituminous coal and 10.75 billion tons of anthracite was mined in the state by 1970 . [2]

Pennsylvania coal, as late as 1983, accounted for 83 percent of the state's energy output compared with slightly over 28 percent of the United States total. Coal was produced in 27 states in 1990 although nearly one-half of the extracted coal was concentrated in three states. The Commonwealth produced 67.9 million tons and ranked fourth behind Wyoming

(184 million tons), Kentucky (173 million tons) and West Virginia (169 million tons) in 1990. [3]

About 55 billion tons of coal has been mined in the United States since the first commercial mines opened more than two centuries ago.

Cumulative Coal Production By States (1890-1990) in billions short tons)



Pennsylvania's greatest mineral resource is coal, not only for its fuel value, but because it made possible the growth of other industries in the past and today. The abundance and accessibility of high-grade coal and coke spurred production of the iron and steel, zinc, salt, and glass industries. The coal industry provided jobs for tens of thousands of its workers. Foreign-born workers emigrated to the state in search of employment in the booming coal industry, adding their diverse ethnic, linguistic, social, and religious customs to the fabric of the Commonwealth. Entire regions within the state were dominated by the coal industry. The industry defined its economic development providing employment and housing for a majority of its inhabitants. Some of the coal mining towns that emerged to

house miners are still visible on today's landscape and represent the physical legacy of this once vibrant industry.

The development of the Pennsylvania's bituminous coal industry between 1740 and 1945 can be divided into distinct historical stages or periods. The exact dating of these individual periods is imprecise because the principal processes that characterize each period are gradual and incremental and often do not conform to any artificial historical time model. Nevertheless, each chronological time period identified is distinctive and is based upon a series of recurring themes in the industry: the technology employed in the mining process (technology is considered broadly to include all mechanical, engineering, and managerial changes in the bituminous coal industry), the commercial uses of coal and its valuable by-products (coke and coal chemical by-products), the transportation system employed to distribute it to market, the expansion and development of new industries within the coal resource marketplace, and the changing social composition of its labor force. This coal and coke context of Pennsylvania will examine the pivotal role played by technology, business and social history (including labor and community history) in shaping the development of this essential extractive industry in Pennsylvania during the two centuries.

The Emergence of Coal in the Age of Wood, 1740-1840

Introduction

Bituminous coal had been mined on a small scale in a number of locations throughout the counties of western and central Pennsylvania for nearly a century prior to 1840. A limited commercial market for coal had developed but the trade was confined to a few localities within the Commonwealth. Coal usage was restricted to the blacksmith's forge fires, steam engines, home heating, glass and salt industries, and rarely for smelting iron ore in the iron blast furnace before 1840.

The economic expansion of the bituminous coal industry of Pennsylvania was restricted by a number of factors during its first century of production: a sparse population, underdeveloped and primitive transportation system generally restricted to navigable rivers usually running north and south, limited retail markets, and an abundant supply of wood. Since coal was a bulky commodity it was essential that it be transported by water to market. Second, its commercial market share was restricted by the dominance of wood. There was no energy crisis in the nation during this first century as forests seemed almost endless. The country was sparsely populated and wood was abundant, inexpensive and near at hand, so coal use was restricted to a few locations. Since the Colonial Era wood has been the principal energy source and as late as 1850 it provided 90.7 percent of the nation's energy. A number of requisites had to be met if the coal industry was to develop a broader commercial trade. These conditions were all essential, and a failure in any one of them would have been fatal to the expansion of the coal-trade: 1) a good quality of coal; 2) a sufficient quantity; 3) cheapness and regularity of production; 4) cheapness of transportation; 5) a sufficiency of transportation; and 6) a good market. [4]

The Geology and Chemical Composition of Coal

Coal has been called "Nature's Black Diamond" and is a black or brownish-black, combustible sedimentary organic rock that contains more than 50 percent carbonaceous material by weight. Coal is simply a rock that burns and compared with other rocks is relatively light, weighing about 80 pounds per cubic foot, about one-half the weight of most other rocks. [5] Coal is formed by the slow alteration of decaying plant life which was buried million of years under water in the absence of air. Heat and presure also contribute to this alteration. Geologists regard coal as a rock because rocks are defined as all natural solid substances, organic or inorganic, that compose the earth's crust. It is considered a mineral rock by geologists, and is known as mineral coal in trade, industry, and legal affairs. Coal is a mineralized vegetative material, being a rock-like portion of the earth's crust, deposited over a long period of time and its chemical composition modified by the effects of time, heat, and pressure. Coal, like natural gas and oil, is a fossil fuel although coal was formed exclusively from decaying plant vegetation. Three principal factors affect the formation of coal deposits 1) initiation, maintenance, and repetition of environments that favor large scale accumulation and preservation of vegetal sediment; 2) conditions within that depositional environment that favor biological degradation and alteration of the vegetal sediment to peat; and 3) geochemical processes that induce chemical coalification of the peat to higher rank coal. [6]

The Carboniferous Period, some 225 to 350 million years ago, was the great coal making age. The earth was warmer and more humid than today with ferns, mosses, and tropical plants growing profusely in large swamps. When these plants died, they fell into mud and water and were preserved from completely decaying by the water covering them over time a series of vegetative layers developed. Moisture and bacteria converted these deposits of partially decayed organic material into peat, which is a spongy substance. Peat bogs were buried under sediment and compressed by the heat and pressure of the earth. Peat is not coal, but represents the initial stage in the development of coal, and under favorable

geological conditions may give rise to coal seams. Peat is a dark-brown or black black residue produced by the partial decomposition and disintegration of mosses, sedges, trees, and other plants growing in marshes. It composed principally of carbon, hydrogen, and oxygen in varying proportion. Because of its high carbon content, peat will ignite and burn freely when dry. It was long burned for energy in Europe but peat was never produced as a commercial fuel in the United States. It was used almost entirely for soil improvement and as fertilizer. [7]

The formation of coal is called "coalification," and the process is advanced largely by pressure and heat from the earth's core. Coal is a complex material composed chiefly of carbon, hydrogen, and oxygen. There are smaller amounts of sulfur, nitrogen, and small traces of elements ranging from aluminum to zirconium. Mud, sand and debris seal peat from air which prevents its further decomposition. Pressure begins as soon as this material is buried under layers of sand and mud and as these layers of sediment grow thicker its weight compacts it to a fraction of its thickness and drives out existing moisture and gaseous compounds including oxygen, nitrogen, and hydrogen. The effect of this pressure is greater on deposits buried deeper in the earth. Pressure and high temperature release volatile matter or combustible gases such as carbon monoxide, carbon dioxide, methane (CH 4 or marsh gas) in large quantities leaving behind carbonaceous deposits called coal. Coal occurs in seams, sometimes called "beds" or " veins," that are interlayed or sandwiched between numerous layers of shale, sandstone, clay, and sometimes limestone.

Coal is not a homogeneous mineral rock, instead, its chemical composition varies within the same seam and even from coal mined at neighboring mines. Some underground mines extract more than one seam of coal simultaneously. Coal seams vary greatly in their thickness, from less than an inch to over fifty or more feet; in area, from a few acres to thousands of square miles; in depth, from a few feet below the surface to several hundred feet underground. Geologists estimate about 300 years is required to deposit sufficient vegetation to form one foot of bituminous coal from eight to twelve feet of compressed

vegetable matter. [8] Most coal seams are generally flat lying although some coalbeds are inclined, folded, or faulted, the result of geologic forces. Commercial coal seams vary from two to twelve feet in thickness, although a few seams are nearly a hundred feet thick.

Several methods of classifying coal have been developed by geologists using "chemical analyses" and physical tests that measure the progressive response of coal to pressure and heat. This process is called metamorphism. [9] Coal is graded according to its size, appearance,weight, structure, cleanliness, heat value and burning characteristics. The rank of coal pertains to the degree of metamorphism or geologic change through which it has passed from the time of its original deposit as peat to the present. All coal is divided into the following ranks: anthracite, semianthracite, low-volatile bituminous, medium-volatile bituminous, high -volatile bituminous, sub-bituminous, and lignite. [10]

The rank of coal describes its physical qualities. All coal contains varying percentages of combustible matter divided into volatile matter and fixed carbon, ash, moisture and sulfur. The chemical composition and percentages of these elements are the chief factors in determining both the economic value and the usage of coal.

The Ranks of Coal

Ranks of Coal	Fixed Carbon	Volatile Matter	Moisture
Lignite	28.7	25.8	45.5
Sub-bituminous	42.4	34.2	23.4
Low-rank bituminous	47.0	41.4	11.6
Medium-rank bituminous	54.2	40.8	5
High-rank bituminous	64.6	32.2	3.2
Low-rank semibituminous	75.0	22.0	3.0
Semianthracite	85.8	11.7	2.5
Anthracite	95.6	1.2	3.2 [11]

The chemical analysis of coal involves the determination of four principal constituents found in all ranks of coal. Water, called moisture; mineral impurity, called ash-inert

material left when coal is completely burned; volatile matter, consisting of gases and vapor expelled when coal is heated; and fixed carbon, the solid or carbon residue that burns at a higher temperature after the volatile matter has been expelled as gases. [12] Volatile matter and fixed carbon are the principal ingredients in coal that produce heat when it is burned while moisture and ash are inert ingredients which hinder the process of heat emission when coal is burned.

Carbon is the the solid combustible matter of coal and with ash is the remains of coal after its volatile or gaseous matter has been driven off as smoke. The fixed carbon content of coal found in Pennsylvania ranges from 55 percent located in western Pennsylvania to as high as 98 percent in the anthracite region of northeastern Pennsylvania, called superanthracite.

Volatile matter is determined by chemists by heating coal in a platinum crucible in an electric furnace at 950 degree for six minutes without contact with air. The loss of weight less moisture gives the percentage of volatile matter. Volatile matter does not represent a single compound but contains hydrogen, nitrogen, oxygen gas compounds and some non-combustible matter including traces of ammonia which are driven off as gases, tars and oils when coal is heated and deprived of oxygen. The heat energy value of coal when burned is measured in BTU (British Thermal Unit) and depends in large measure upon the relative percentage of fixed carbon and the volatile matter it contains. BTU is the quantity of heat necessary to raise the temperature of one pound of water by one degree Fahrenheit. BTU is a convenient measure to compare the energy content of various fuels. The number of BTU's in a ton of coal is a rough measure of the heating properties of that coal. The BTU of coal varies from 7,000 degrees for lignite to 13,850 degrees for high-volatile bituminous coal in the Pittsburgh District to 14,350 degrees in low-volatile coal found in the Broad Top coal field. The higher the BTU rating in coal, the more heat it will produce when burned. Low-volatile coal (under 20 percent volatile matter) yields more BTU's per pound than medium-volatile coal (27.5 to 35 percent volatile matter), while high-volatile coal (35 to 42 percent volatile matter) yields the lowest BTU. Low-volatile coal with high BTU in Pennsylvania is found in the Broad Top field, in southeastern Somerset and southern

Cambria counties. High volatile coal, with lower BTU, is found in such counties as Clarion, Butler and Lawrence.

Ash and sulfur are the two chief impurities that reduce the quality of coal. Ash is the inorganic matter or incombustible residue remaining after the combustibles of coal have been burned. It consists of silica, alumina, lime, and bisulphide of iron along with smaller quantities of magnesia and alkalis. Some of these substances are combined with sulphuric acid as sulphates. A high ash content is objectionable in coal because it inhibits burning. The ash found in coal after combustion is caused by some inferiority during the pre-coal making process by infiltration of foreign matter. Ash content ranges from as little as 2 percent in anthracite coal to 5 to 10 percent in medium and high rank bituminous coal and as high as 80 percent in lignite. The average ash content of coal from the famous Pittsburgh coal seam runs from 3 to 5 percent. [13]

Sulfur is the most important of all impurities in coal today because on combustion it is converted mostly into sulfur dioxide, a colorless, extremely irritating gas or liquid that is a dangerous water and air pollutant. Sulfur is found in several forms in coal as iron sulfides (pyrites amd marcasites); as sulphate of lime or alumina; in an organic form combined with carbon and hydrogen; and in rare cases as free organic sulfur chemically bonded to the coal -forming plant material. The fumes from burning high sulphur coal are extremely corrosive and a principal source of air pollution. Sulfur combines in the air chemically with oxygen and water to form acid rain that can destroy lakes and vegetation. The percentage of sulfur in coal is usually expressed separately because it is present partly in volatile matter, partly in fixed carbon and partly in ash. A low percentage of sulfur in coal is desirable for illuminating gas, for smithing purposes, for making metallurgical coke, and in the manufacture of pottery.

Moisture in coal is of two kinds. The first type is surface moisture produced through coal being dampened by mine water, or by rain, or by being washed to alter its chemical composition at a preparation plant. The second type of moisture is the inherent water found within the coal. The former disappears when coal is exposed to dry atmosphere but the later absorbs a definite part of the energy in the coal when burned. Coal with moisture

content of 10 percent would indicate 200 pounds of free water present in a ton of coal to disperse it would involve burning 33 pounds of average coal making a total loss of 233 pounds of coal. High moisture content of coal decreases the heating value of the coal. Coal mined in Indiana, Illinois and western Kentucky has somewhat higher moisture content than Pennsylvania coal.

Location of the Coalfields of the United States

The United States has the largest deposits of coal in the world and because of its extensive coal reserves has been appropriately called the "Saudi Arabia of Coal." Coal is present in 38 states in 1990, underlying a total of 458,600 square miles or 13 percent of the land area of the United States. Coal is by far the nation's most abundant fossil fuel, with total resources estimated at 1.7 trillion tons, including more than 400 billion tons of coal which can be mined with known methods and existing technology. Coal provides the nation with 80 percent of its known fuel reserves. The original coal reserves of the United States were made up of 29 percent lignite, 28 percent sub-bituminous coal, 42 percent bituminous and semi-bituminous coal, and less than 1 percent anthracite / semi-anthracite. [14] These extensive coal deposits have been divided into seven major regions: Anthracite Region, Appalachian or Eastern Region, Middle Western Region, Western Region, South-Western Region, Rocky Mountain Region, and Pacific Coast Region (Illustration 1- U.S. Coal Fields). Each of the principal coal regions has been divided into numerous subdivisions reflecting local variations in the quality of the coal and the thickness of the seams. The Appalachian Region covers an area of about 55,076 square miles and is a little over 900 miles in length and ranges in widthfrom 30 to 180 miles. It is located in nine states including "western Pennsylvania, and parts of the southeastern part of Ohio, the western part of Maryland, the southernwestern corner of Virginia, nearly all of West Virginia, the eastern part of Kentucky , portions of eastern Tennessee, the northwestern corner of Georgia, and nearly all of Northern Alabama." This region has been

the major source of U.S. coal production and accounted for about three-fourths of the total annual production as recently as 1970.

Appalachian or Eastern Coal Region:

States	Square Miles
Pennsylvania	12,656
Ohio	7,100
Maryland	550
West Virginia	15,900
Kentucky	10,700
Tennessee	3,700
Alabama	4,300
Georgia	170
Total	55,076

Coal is divided broadly into two principal groups - anthracite ("hard" coal) and bituminous ("soft" coal), which are further divided into four sub types: semi-anthracite, semi-bituminous, sub-bituminous (black lignite), lignite (brown or woody lignite). Bituminous coal, or soft coal, is by far the most abundant and widespread rank of coal found in the United States. There were more than 228 billion tons of mineable bituminous coal in the nation in 1976, located in the hills of Appalachia stretching from Pennsylvania and Ohio southward through Alabama with additional bituminous fields located in the flatter midwestern states and in scattered fields throughout the West.

Anthracite generally lies deeper in the earth than bituminous coal with deposits found in Scotland, Wales, the former Soviet Union, China, and the United States. It makes up the smallest amount of the major rank of coal with world-wide reserve estimated at seven billion tons. The majority of American anthracite coal is located in the mountainous counties of northeastern Pennsylvania with smaller deposits located in Alaska, Arkansas, Colorado, Massachusetts, Rhode Island, New Mexico, Utah, Virginia, Washington and West Virginia. Anthracite has the highest percentage of fixed carbon and lowest percentage

of volatile matter of all coal. It has a low sulfur content and burns slowly with a blue flame, producing little soot or smoke. The United States Bureau of Mines defined anthracite as " a hard, black, lustrous coal having 92 percent or more, but less than 98 percent, fixed carbon and 8 percent or less, but more than 2 percent, volatile matter, on a dry, mineral-matter-free basis." [15]

Sub-bituminous coal, frequently called black lignite, is dull black coal that contains about 15 to 30 percent moisture. The heat content of sub-bituminous coal ranges from 16 to 24 million BTU per ton. Major deposits of sub-bituminous coal are found in Alaska, Colorado, Montana, New Mexico. It burns easily and is used for household heat, in industrial plants and for generating electricity.

Lignite is brownish-black coal in which the vegetal matter has been altered more than in the case of peat but not as much as in sub-bituminous coal. It is the lowest rank of coal mined in the United States. Deposits of lignite are located in North and South Dakota, Montana, Texas and in western Canada. The terms lignite and brown coal have come to be used interchangeably in the United States. Lignite has a moisture content of 35 to 45 percent, and relatively low heat value of 6 to 7.5 million BTU per ton. This low heat value means it must be consumed locally, thus limiting transportation cost which would otherwise make it uneconomical to use. Lignite is ranked between coal and peat in its composition. Peat is distinguished from lignite by the presence of free cellulose and a high moisture content - exceeding 70 percent. The heat content of air-dried peat is about 50 percent moisture and produces about 9 million BTU per ton. Lignite is mined in California, Louisiana, Montana, North Dakota and Texas. Sub-bituminous and lignite are used primarily as steam boiler heat for electric generation. Processes to gasify lignite and sub-bituminous coals are being developed currently. [16] Low-volatile bituminous, also known as semi-bituminous and smokeless coal, is located in Pennsylvania, Maryland, West Virginia, Alabama, Arkansas and Oklahoma. It is mined in central Pennsylvania, Georges Creek, Upper Potomoc, Pocahontas, and New River fields. This coal is between bituminous coal and anthracite in rank, averaging 15 to 20 percent volatile matter. Medium-volatile is mined principally in West Virginia and Pennsylvania.High-volatile coal is located

in all coal-producing states except North and South Dakota. Sub-bituminous is mined principally in Montana, Wyoming, Colorado, New Mexico and Washington. [17]

Coal Fields of Pennsylvania

Anthracite, semi-anthracite, bituminous and semi-bituminous coal deposits are all located within the boundaries of Pennsylvania. The principal commercial coal fields of Pennsylvania are confined to rocks of the Pennsylvanian Period of earth history, formed from 270 to 310 million years ago in the Paleozoic times, long before the age of the dinosaurs. The coal fields in Pennsylvania were originally deposited as virtually flat-lying deposits and were physically connected. They were separated by the process of erosion over tens of thousands of years. Subsequent periods of mountain building in the state folded and broke rocks in varying degrees. Mountain building was responsible for changing the chemical composition of coal seams that experienced this process.

The Chemical Composition of Different Ranks of Coal by Counties in Pennsylvania:

District	Grade	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulfur
Anthracite Region	A	2.8	1.2	88.2	7.8	0.9
Sullivan	SeA	3.4	9.3	75.6	11.7	0.8
Tioga	SeB	2.3	20.9	66.9	9.9	1.3
Center	SeB	2.9	19.9	69.7	7.5	1.9
Clearfield	SeB	3.3	19.9	69.0	7.8	2.0
Clearfield	B	2.8	24.3	66.3	6.6	0.9
Indiana	B	1.0	26.1	63.8	9.1	2.7
Butler	B	4.6	33.0	54.4	8.0	1.3
Cambria	SeB	3.3	12.5	77.9	6.3	1.0
Cambria	B	3.1	26.0	64.4	6.5	1.4
Westmoreland	B	2.7	30.4	57.8	9.1	1.3
Allegheny	B	3.7	34.0	56.8	5.5	1.4
Broadtop Field	SeB	2.1	15.5	76.0	6.4	1.1
Somerset	SeB	2.5	12.5	78.8	6.2	1.1
Somerset	SeB	2.6	21.5	68.0	7.9	1.7

Fayette	B	2.8	30.0	59.8	7.4	1.2
Washington	B	1.4	34.6	57.8	6.2	0.8 [18]

Anthracite Coal Fields

The major commercial anthracite fields in the United States are exclusively located in the northeastern counties of Pennsylvania within a 1,400 square mile area, of which only 472 square miles contains anthracite. [19] Over 99 percent of the anthracite production of the United States is concentrated in this small area of Pennsylvania. The balance is produced in Arkansas, Colorado, Virginia and New Mexico. This compact region is geologically located in four irregular deposits or fields in counties located in northeastern Pennsylvania. Three of the fields - Northern, Western Middle, and Southern Fields - occupy valleys or basins, whereas the Eastern Middle Field occupies a plateau-like tableland. The four anthracite fields are as follows: 1)The Northern Field (in the Wyoming and Lackawanna Valleys in Luzerne and Lackawanna counties) extends from Forest City to Shickshinny, a distance of fifty miles, with a maximum width of six miles extending through Luzerne, Lackawanna, and small portions of Susquehanna and Wayne counties. The largest cities in the Northern Field are Scranton and Wilkes-Barre 2) The Western Middle Field, lies southwest of and adjoins the Eastern Middle Field, extending 36 miles in length and four to five miles in width in Northumberland, Columbia and Schuykill counties. The principal urban center is Shamokin. 3) The Eastern Middle Field, lies about 15 miles south and southeast of the western end of the northern field, has a maximum length of 26 miles and a maximum width of ten miles. It is centered on Luzerne County with extensions in Schuykill, Carbon and Columbia counties. Hazelton is the principal urban center. 4) The Southern Field, or Schuylkill Field, extends from Mauch Chunk (present-day Jim Thorpe) to Dauphin, a distance of 70 miles, with a maximum width of eight miles. The Southern Field is the largest area in size, occupying 180 square miles. It extends northeast - southwest in Schuykill, Carbon, Dauphin, and Lebanon counties. Pottsville is the largest city. [20] A number of small, detached anthracite areas, including the Bernice Basin of Sullivan County, are located north of the Northern Field. The Bernice Field consists of

three basins about 50 miles northwest of the western end of the Northern Field (Illustration 2 - Anthracite Coal Fields of Pennsylvania).

More than 200 seams of coal have been mined in the anthracite fields. The original anthracite reserves of Pennsylvania were 24.4 billion tons, of which 8 billion tons have been extracted between 1830 and 1959, representing ninety-nine percent of all anthracite coal mined in the United States. About 8 billion tons of the remaining 16.4 billion tons can be extracted employing contemporary mining methods. [21] The Pennsylvania anthracite fields have been subjected to great cracks or faults in the earth surface. This process created intense heat and pressure associated with intense folding and faulting of the surface. Rocks were compressed, fractured and heated, and this geological action drove out part of the volatile matter from the marsh deposits and pressed the carboniferous matter into coal. This action was more pronounced in the eastern part of the state and decreased westward in the state. Nearly all the volatile matter in anthracite coal was driven off leaving a jet black coal with a high luster and a high carbon content. A typical analysis of Pennsylvania anthracite is fixed carbon 87 percent, volatile matter 3.50 percent, sulfur .65 percent, ash (white) 5.90 percent, moisture (water) 2.95 percent. [22] True anthracite coal is 91 to 98 percent carbon while semi-anthracite, located in Sullivan and Wyoming counties, is 85 to 90 percent carbon. Semi-anthracite is softer and less lustrous than anthracite and is mined on a limited commercial scale in Arkansas, Virginia and Alaska.

Anthracite coal, also known as "hard coal" and "black diamond," is characterized by its black luster and hardness. Anthracite has no equal as a domestic home fuel in the world. Its high carbon content, low percentage of volatile material, and low sulfur content, makes anthracite a slow burning, clean, high BTU value fuel. It is difficult to ignite, since its ignition temperature, is approximately 925 to 970 degrees Fahrenheit but when lit burns cleaner and longer than bituminous coal. [23] Anthracite was first discovered in Rhode Island and Massachusetts about 1760 and has since been discovered in other states including Virginia and Pennsylvania, and in the state of Sonora, Mexico. [24] Anthracite coal was discovered in eastern Pennsylvania appearing on a map prepared by John Jenkins, Sr. in 1762, showing "stone coal" in two locations. [25] Parshall Terry and a company of

Connecticut pioneers found coal at the mouth of Mill Creek, on the banks of the Susquehanna near the present site of Wilkes-Barre. Obodiah Gore, a blacksmith from Wilkes-Barre, used anthracite for heating iron at his forge in 1769. Anthracite was shipped from the Wyoming Valley down the Susquehanna River to Harrisburg in 1775 and from there transported to Carlisle for use in a forge for the manufacture of firearms. Philadelphia businessmen investigated the feasibility of shipping anthracite coal along the Lehigh River in 1793 and the Lehigh Coal Mining was formed to mine coal in 1803. Two arkloads containing 200 tons of anthracite were floated down the Lehigh and the Delaware rivers to Philadelphia. The coal was sold in Philadelphia, a distance of about one hundred miles south, but the coal would not burn and was broken up and used as gravel in the city's walk ways. Anthracite was relatively ignored as a viable fuel, because it was very difficult to ignite and to keep burning efficiently. Anthracite's near carbon purity made it the purest coal in the world, but this chemical property made it difficult to ignite. It was nearly impossible, for early consumers, to burn it in conventional wood stoves. Frederick Glass and Oliver Evans of Philadelphia were successul in burning anthracite in a grate in 1802. Judge Jesse Fell of Wilkes-Barre in 1808 designed a grate that could withstand the intense heat produced by burning anthracite. Josiah White and Erskine Hazard, owners of the Fairmount Pennsylvania Nail and Wire Works at the Falls of the Schuykill River near Philadelphia, overcame these ignition problems during the War of 1812. The British naval blockade during the war prevented fuel from reaching the factory. The owners were determined to find an alternative for their usual charcoal fuel. They discovered that anthracite will become red hot if it was not constantly stirred. It was used by them in firing their furnaces. [26]

There was no systematic attempt to mine anthracite in any quantity until about 1820. The anthracite coalfields were located to far from the important port cities of Philadelphia and New York. Transportation cost made anthracite more expensive than bituminous coal imported from England and Virginia. Canals, and later railroads, were constructed by coal companies to transport anthracite to these markets. White and Hazard built the Lehigh Canal in 1818 to transport their coal to market. The canal ran seventy-two miles extending

from White Haven (upper Lehigh River Valley) to Easton on the Delaware River. The first delivery of 365 tons of anthracite to Philadelphia via Maunch Chunk was completed in 1820 by the Lehigh Coal Company. This company was organized in 1818 with capitalization of $55,000, merged with the Lehigh Navigation Company under the new business name of the Lehigh Coal & Navigation Company, with capitalization exceeding $100,000. The commercial anthracite industry began with this shipment. The output of the anthracite trade increased from 365 tons shipped to Philadelphia via the Lehigh Canal in 1820 to some 8 million tons in 1860. [27] Anthracite was originally used for domestic heat and in factories, railroad locomotives and steam boats during this pioneer period. Anthracite was used as an alternative fuel to charcoal in the smelting of iron ore about 1840, when it was burned in iron blast furnaces located in eastern Pennsylvania.

Bituminous Coal Fields of Pennsylvania

The bituminous coal fields of Pennsylvania are located entirely within the northern extremity of the Appalachian Field. About 90 percent of the nation's coal production comes from this coal region which geologists call "the greatest storehouse of high-rank coal in the United States if not in the world." [28] The Region is subdivided into three areas - Northern (Pennsylvania, Ohio, Maryland), Southern (West Virginia,Virginia, eastern Kentucky and northern Tennessee) and Alabama (including Georgia and southern Tennessee).[29] The Pittsburgh district, for example, is a subdivision of this coal field and is itself broken into various smaller fields. The western field is known as the Panhandle district; east of this is the Gas Coal field with the Westmoreland Coal field to the north and the Klondike coke district to the east with the Connellsville coke district on the eastern border. [30]

Pennsylvania's bituminous coal deposits are located in a number of irregularly shaped fields in the western half of the state and in a few coal fields in the northern part of the state bordering New York. These coal fields belong to the Upper Carboniferous Formation, the lowest lying within the Pottsville Series and the highest being contained in the Dunkard Series. While anthracite coal is located in a concentrated region, bituminous coal underlies

14,200 square miles of Pennsylvania or approximately a one-third of the spatial area of the state. Coal seams are found in nearly every county west of the Allegheny mountains and are located in several outlying coal fields east of the mountains. Bituminous coal has been mined commercially in more than 30 western and central counties since its discovery during the second half of the eighteenth century by fur trappers, pioneers and explorers. The expansive bituminous coal regions of Pennsylvania are divided into the following principal coal fields: 1) Main Bituminous Field - Allegheny, Armstrong, Beaver, Blair, Butler, Cambria, Cameron, Center, Clarion, Clearfield, Clinton, Elk, Fayette, Greene, Indiana, Jefferson, Lawrence, McKean, Mercer, Somerset, Venango, Washington, Westmoreland counties; 2) Broad Top Field - Bedford, Fulton, Huntingdon counties; 3) North-Central Fields (five small fields) - Bradford, Lycoming and Tioga counties; 4) Georges Creek Field - Somerset County. A majority of the Georges Creek Field is located in the western part of Maryland although a small portion of the field extends north into southern Somerset County. The Georges Creek Field, the most important coal field in Maryland, is a canoe-shaped basin about 25 miles long and 6 miles wide. The region is located almost entirely in the western part of Allegany County, Maryland in the valley between the Dans and Savage Mountains. The field is composed mostly of high-grade low-volatile bituminous coal called "smokeless coal." This coal is similar to coal located in the Windber region, Somerset County, Pennsylvania (Illustration 3 - Bituminous Coal Fields of Pennsylvania).[31]

The coal seams of Pennsylvania developed during the Carboniferous Age and usually occur in succession as follows: sandstone, limestone, clay, coal, shale, sandstone, in ascending order. This succession is not always present but is found more often than any other order. There are at least forty-two coal seams located in the state although all are not commercial seams. Washington, Waynesburg, Sewickley, Redstone, Pittsburgh, Upper Freeport, Lower Freeport, Upper Kittanning, Middle Kittanning, Lower Kittanning, Clarion, Brookville and Mercer are the principal bituminous coal seams in the state. Western Pennsylvania coal was extracted largely from the Pittsburgh seam (79.9 percent), Thick Freeport (12.8 per cent), and Upper Freeport (4.5 percent), with smaller production from the Lower Freeport, Kittanning, Redstone, Sharon, Sewickley (2.8 percent) by 1939. In Central Pennsylvania coal was

extracted from the Lower Kittanning (49.8 percent), Upper Freeport (20.3 percent), Lower Freeport (15.4 percent), Upper Kittanning (11.3 percent), and other miscellaneous seams (3.3 percent). [32] Most of these coal seams average less than five feet in thickness, although some attain a local thickness of seven to eleven feet.

Coal quality varies, both locally and regionally, throughout the expansive bituminous coal fields of Pennsylvania. Coal seams range from a few inches up to ten to twelve feet in thickness. The Pittsburgh seam, underlying four states, is the best known and most valuable coal seam in the state, averaging from five to eight feet in thickness and covering 5,729 square miles in area (Illustration 4 - Pittsburgh coal seam). [33] The bituminous coal mining industry of the state has been dominated from its inception by this seam. It is the most famous seam of high-volatile gas coal and coking coal in existence. Geologists have called this coalbed "the world's most valuable single mineral deposit" because it has yielded more mineral value than any single mineral deposit in the world. Production from this seam began in western Pennsylvania in 1759, in Ohio about 1795, in the western counties of what became West Virginia about 1800, and in Maryland about 1804. [34] It contained 54 billion tons of coal after the Civil War, and its economic value was appraised as being than the total output of the California gold mines for one thousand years. Nearly 80 percent of the entire coal production in western Pennsylvania was extracted from this seam as late as 1939. [35] The chemical composition of this seam in Allegheny County contains 57 to 65 percent fixed carbon, 30 to 35 percent volatile matter, 4 to 14 percent ash, and sulfur usually under 1 percent. [36] This was the principal seam of American coal production until the 1970s. The compact Connellsville coke district, the premier coking region in the nation is located entirely within the Pittsburgh seam (Illustration 5 - Connellsville coke district). An estimated 98 percent of all coal mined in Fayette County and 96 percent of coal mined in Westmoreland County came from this seam as late as 1922. [37]

Bituminous coal, unlike anthracite, was less affected by the process of mountain building although its chemical composition is not uniform throughout the state. Pennsylvania's soft coal ranges from high volatile coal to low volatile (semi-bituminous) coal that exhibits regional variation in percentage of fixed carbon, volatile matter, moisture content, and calorific value.

The composition of coal changes by counties as you travel from east to west from low-volatile bituminous coal (fixed carbon between 78 and 86 percent) through medium-volatile bituminous coal (fixed carbon between 69 to 78 percent) to high-volatile coal (fixed carbon less than 69 percent). Generally, the fixed carbon percentage of coal beds decreases from east to west, while the percentage of volatile matter increases from east to west throughout the coal fields. Coal in Cambria, Clearfield, and Clinton counties and in the Broad Top coal field contains 18 to 20 percent volatile matter, which is known as low volatile semi-bituminous or "smokeless" coal. Farther west the volatile matter increases to 36 percent in the Pittsburgh District, and rises as high as 40 percent in Mercer, Butler and Lawrence counties.

Volatile and Carbon Content of Bituminous Coal in Pennsylvania

		Volatile Matter	Carbon
Bituminous (high volatile)	Pittsburgh, Allegheny Co.	39.3%	60.7%
Bituminous (high volatile)	Irwin Basin, Westmoreland Co.	37.1%	62.9%
Bituminous (high volatile)	Greensburg, Westmoreland Co.	34.4%	65.6%
Bituminous (medium volatile)	Punxsutanawney, Indiana Co.	28.5%	71.5%
Semi-Bituminous (low volatile)	Huntingdon, Bedford Co.	16.1%	83.9%
Semi-Bituminous (low volatile)	Moshannon, Clearfield Co.	26.6%	73.4%
Semi-Bituminous (low volatile)	Snowshoe, Clearfield Co.	26.4%	73.6%
Semi-Bituminous (low volatile)	Blossburg, Tioga Co.	24.5%	75.5%

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Pioneer Development of the American Bituminous Coal Industry

The economic development of the bituminous coal industry in the United States was slower than the anthracite industry although its initial discovery and development began nearly a century earlier. The first recorded discovery of bituminous coal in North America was made on Cape Breton Island, Canada during the 1670s. Nicolas Deny, governor of French Eastern Arcadia in 1637, made mention of coal in a published account in Paris describing "mines of

coal within the limits of my concessions and upon the border of the sea." [39] French settlers mined coal on a small scale near Louisburg, Cape Breton during this period. Richard Cowling Taylor published statistics in 1848, showing that the discovery of coal in the United States was made by Father Louis Hennepin, a French Jesuit missionary. Hennepin was part of a French exploration party under the command of Robert de la Salle. The party was paddling down the Illinois River in hopes of reaching the Mississippi. Coal was discovered by them above Fort Creve Coeur, near Ottawa, Illinois about 80 miles from the present-day site of Chicago in December, 1679. Hennepin deemed the discovery on the Illinois River of sufficient importance to mark the location of the discovery on his map as "charbon de terra." [40]

Coal was commercially used in Europe as early as circa 1300 AD although it was not a major energy source until the advent of the Industrial Revolution during the mid-eighteenth th century. The word "coal" derives from the Anglo-Saxon word "col," which originally referred to charcoal. The spelling "cole" was used until about 300 years ago, at which time the present spelling of the word was adopted. European immigrants to the United States, although aware of its existence, turned to this mineral fuel only after the abundant supply of wood began to become depleted. Coal was found outcropping at the surface throughout Colonial America since Father Hennepin's discovery in Illinois.

Before the end of the 1750s the discovery of coal was reported in Pennsylvania, Ohio, Kentucky and West Virginia while anthracite was found in Pennsylvania about 1762. Bituminous coal was mined at two principal locations in the United States until about 1800 - along the James River of Virginia, a short distance north of present-day Richmond, and in the area around the present site of Pittsburgh and the Monongahela Valley. Coal was mined at the James River by French Huguenots, who settled on the river in 1699, at a place now called Manakin about fourteen miles north of Richmond, Chesterfield County. Small amounts of "fossil coal" or "stone coal " were originally used for local consumption for home heating and at the blacksmith's forges as a supplement to charcoal normally burned in their forges. Furnaces located at Massaponax,Virginia used coal as early as 1732. The earliest written record of commercial mining in the colony was 1750 when

African-American slaves were used to extract coal at a mine owned by an English company on the James River near Richmond. Virginia colonial records of 1758 noted that six hundred bushels of Virginia coal were shipped to England. [41] Samuel Davis advertised coal for sale at Richmond for 12 pence per bushel in the*Virginia Gazette* of July, 1776. Thomas Wharton Jr. and Owen Biddle of Philadelphia were authorized by the Colonial Assembly of Pennsylvania in 1776 to purchase coal from Virginia. An iron furnace, located at Westham, on the James River, used coal in the manufacture of shot and shell during the Revolutionary War until the facility was destroyed by General Benedict Arnold in 1783. Coal was exported to Philadelphia, New York, and as far north as Boston before the American Revolution from the Richmond District. Coal sold in Philadelphia for a shilling and six pence a bushel in 1789. [42]

The existence of rich coal deposits in southwestern Pennsylvania was known to trappers, hunters, and settlers since the 1740s when coal was observed outcropping at the surface or in river beds. An early written reference to bituminous coal in the region appears on a map made by John Pattin, an Indian trader, about 1752. Pattin's map indicated "sea coal" outcropping at a site along the Kiskiminetas River, a few miles below Saltsburg on the Indiana -Westmoreland county line. Lewis Evans, a Philadelphia cartographer, in "Analysis of Travels and Exploration in the British Colonies" located coal at Licking Creek, a few miles below Venango. [43] An early written reference to the rich Pittsburgh seam is found in a letter written by Captain Adam Stephen, George Washington's second in command during a military expedition in western Pennsylvania in May 1754. He wrote about his experience along the Monongahela River, near Redstone (present-day Brownsville), to a friend in London:

> Most of the hills on both sides of the Ohio are filled with excellent coal and a coal mine was in the year 1760 opened opposite Fort Pitt on the River Monongahela for the use of the Garrison. [44]

Swiss-born Colonel Henry Bouquet instructed James Burd to construct a road at a point near Christopher Gist 's plantation at Mount Braddock, Fayette County to Fort Redstone at Brownsville, Fayette County in 1759. Burd discovered coal two miles from the Monongahela River near Brownsville, and an entry in Burd's diary of September 22 noted that "the camp moved two miles to Coal Run. This run is entirely paved in the bottom with fine stone coal, and the hill on the south is a rock of the finest coal I ever saw. I burned about a bushel of it on my fire." [45] This was one of the earliest authentic written descriptions of coal in southwestern Pennsylvania.

The first map showing coal near Pittsburgh, according to coal historian Howard N. Eavanson, was by B. Raber, on *A Plan of Fort Pitt and Points Adjacent* in 1761. Captain Thomas Hutchins, who visited Fort Pitt in 1760, observed a coal mine on the opposite side of the Monongahela River. The mine was located on Coal Hill, later renamed Mount Washington, opposite Fort Pitt at the Point. [46] Major Edward Ward of the Fort Pitt garrison was the mine superintendent of the Coal Hill mine. Coal was dropped down the hill in a wooden chute and transported across the Monongahela River by flat boat to the fort. Coal was used to heat the garrison's kettles and heat the fort during the winter. The Coal Hill mine was the site of the first recorded underground mine fire in the nation. Charles Beatty and Reverend Duffield, two Presbyterian ministers, visited Pittsburgh to preach at Fort Pitt in 1766. Beatty described coal mining at Coal Hill and wrote, "A fire being made by workmen not far from where they dug the coal, and left burning when they went away, by the small dust communicated itself to the body of the coals and has set it on fire, and has been burning almost a twelve month entirely underground." [47] This drift-entry mine was still burning shooting sulphurous fumes through crevices in 1820 when the*Pittsburgh Gazette* reported "it was like a volcano." [48] From this period coal production grew, and Allegheny County was the largest producer of bituminous coal in Pennsylvania for many years.

The Penn family purchased the entire bituminous coal fields of Pennsylvania from the Chiefs of the Six Nations in November, 1768, except for that portion north of Kittanning which they acquired in 1784. [49] They purchased this land for $10,000, less than a cent

per acre. On January 6, 1769, John Penn, lieutenant governor of Pennsylvania, acting on instructions from the colony's proprietors, Thomas and Richard Penn, instructed John Lukens, surveyor general, to survey some 5,000 acres of known coal properties including Fort Pitt and the "Cole Mine" on Coal Hill. The Penns sold rights on the "Great Seam" to mine coal for £ 30 per lot in the hills around Pittsburgh in 1784 after the American Revolution. Bountiful coal reserves were discovered outcropping at the side of hills and in several stream valleys basins in the early frontier communities of southwestern Pennsylvania. The founding fathers of these pioneer communities, including Connellsville, Brownsville, and Canonsburg offered to each purchaser of land "the right to take coal for their use forever gratis from adjacent coal banks." [50] Most residents of these communities saw no real economic future for these vast coal deposits underlaying their properties. Cornelius Woodruff, a tavern owner in Connellsville, was a visionary who forsaw the potential economic value of coal. He wrote on the flyleaf of a book about 1800:

> For those who will come after us,will find vast and undeveloped mines of material for men to work upon,treasure of untold wealth that now are hid from us (sic)... It will give employment to millions, not only for war, but peaceful occupation and the wants of life... Some great invention will be made to carry on commerce and communication in this to-be-great country. [51]

The bituminous coal industry of Pennsylvania developed first in the Pittsburgh seam in the southwestern counties of Allegheny, Westmoreland, Fayette, and Washington bordering the Monongahela River. Small-scale coal mining activity also developed during this pioneer period in a number of coal-producing counties throughout the state. Clearfield County, along the West Branch of the Susquehanna River, was the next mining area in time. Samuel Boyd patented the first tract of coal land near Oldtown, Clearfield County in November, 1785. The first commercial shipment of coal from the county occurred in 1804 when William Boyd, his son, shipped an ark full of coal from the village of Clearfield down the Susquehanna River to Columbia, Lancaster County, a distance of 260 miles.

P.A. Karthaus opened a mine at the mouth of the Little Moshannon Creek, Clearfield County in 1813. Karthaus shipped semi-bituminous coal on arks each holding 800 to 1000 bushels down the Susquehanna River to Port Deposit at the head of the Chesapeake Bay on the way to Philadelphia in 1828. The coal sold for about 33 cents a bushel or $8.75 to $9.30 a ton. Other coal arks followed and all the towns along the Susquehanna River were familiar with semi-bituminous coal from Clearfield County. [52] Coal was discovered near Snowshoe, Centre County in 1819 by a party of hunters who saw coal outcropping near a spring. It was used by the blacksmiths of Bellefonte, about twenty fives miles from Snowshoe. Shipments outside Centre County were small until the construction of the Lock Haven and Tyrone Railroad connected with the Bellefonte and Snow Shoe Railroad in 1857-1859. [53]

Coal mining developed north of the Susquehanna River in Tioga, Bradford, and Lycoming counties in the North-Central Fields, a series of five small fields. The Patterson brothers discovered coal at Peters Camp (present-day Blossburg borough), Tioga County in 1792 while clearing a road for a party of settlers moving from Williamsport, Pennsylvania to Seneca Lake, New York. David Clemons opened a drift entry mine on Bear Creek about 1815. R.C. Taylor undertook the first detailed geologic survey of the region in 1832. Taylor also surveyed a railroad line from Blossburg to Tioga. Area blacksmiths used coal as fuel in their forges. Coal was discovered in Bradford County by Abner Carr while hunting on Towanda Mountain in 1812. Semi-bituminous coal was used locally by blacksmiths and for home heating shortly after its discovery.

The Broad Top mountain coal field is an isolated coal field comprising about 50 square miles and underlies parts of Bedford, Fulton, and Huntingdon counties. This coal region is strictly and geologically an independent and isolated coal region located between the anthracite district of northeastern Pennsylvania and the eastern boundary of the bituminous coal basin. It is located "in the form of a high tableland mesa known as the Broadtop Mountain, which lies between two mountain ranges, Sidling Hill and Tussey Mountain, in the Appalachian Valley." [54] The northern end of the Broad Top field covers a relatively small area in the southern part of Huntingdon County, located primarily in the townships of

Carbon,Wood and part of Todd townships. Coal was concentrated in the northeast corner of Bedford County while a very small part of the Broad Top coal field extends into the northwest corner of Fulton County. This isolated semi-bituminous coal field has been described as "being freak (coal) veins...[that] shouldn't be there." [55] There were 13 coal beds although the principal commercial seams mined in ascending order of value were Fulton, Barnett, and Kelly. Coal was discovered by Nathan Port Horton, a local blacksmith at Shreeves Run, near Coaldale village, Bedford County in 1765. Horton used local coal that outcropped at the surface at his forge. Samuel Riddle, a Bedford lawyer and a pioneer coal operators in the region, first shipped coal by boats from the area down the Juniata River to eastern markets by about 1800. J. Peter Lesley, geologist of the First Geological Survey of Pennsylvania, first surveyed the region in 1855.

Semi-bituminous coal is lower in volatile matter and sulfur than bituminous coal found in the Pittsburgh seam. These chemical properties made it a superb smithing and steamer coal because it produces more heat, less ash, and burns more uniformly than bituminous coal which has higher percentages of water and volatile matter. The principal deposits of semi-bituminous coal, outside of Pennsylvania, are found in the Pocahontas Field and New River Field,West Virginia, Georges Creek Field, Allegany County, western Maryland and in western Arkansas.

Transportation and Early Markets

Most coal was transported by wagon to the surrounding region in the Monongahela Valley and was consumed locally until about 1800. Coal was later shipped on flat boats on the Monongahela River and floated down the Ohio and the Mississippi to river towns after 1800. The first recorded shipment of coal from Pittsburgh was made in 1803. A company of French merchants shipped 350 tons of coal in a ship called the "Louisiana." The coal, acting as ballast on the ship, was transported to New Orleans and then on to Philadelphia, where it was sold for 37.5 cents a bushel (between $9.00 and $10.00 a ton). [56] Coal was usually bartered for molasses and sugar or exchanged for French and Spanish gold at New

Orleans. A small river traffic in coal had developed with western markets on the Ohio River from the Pittsburgh District by the time of the War of 1812. Regular coal shipments began to be made in 1817 down the Ohio River to Mayville, Cincinnati and Louisville which were principal early coal markets. Coal was mined in the winter, and these small commercial operators waited until spring to ship their coal out on flat boats to cities and towns located on the Ohio River.

Transportation via the Monongahela and Youghiogheny rivers served as the principal route for the shipment of bituminous coal from the Monongahela Valley to these western commercial markets. A variety of crafts-flat-boats, arks, rafts, keel boats and steamboats-were all employed to carry coal on the rivers. The larger mines shipped coal in the spring on flat boats called French-Creek boats. These boats, constructed at French Creek, a tributary of the Allegheny River, were used to transport pig-iron, walnut lumber, salt and agricultural products to Pittsburgh from this region. Local coal operators obtained these boats and enlarged their sides to hold more coal. Each boat averaged in size from 68 to 79 feet long, 16 feet wide and from 4 1/2 to 5 feet deep, and held between 4,000 to 6,000 bushels of coal. Pairs of these boats were sometimes lashed together with ropes and fitted with steering oars. The boats were sold for lumber or broken up when they reached their down-river destination. Keel boats and barges were also used to transport coal to market by 1810. Coal was shipped to market in the spring and fall. There were few shipments in the summer on account of low waters and in the winter because of ice on the river. River transportation was slow because of low water and the numerous rapids on the river. The boats moved with the current and were guided by long sweeps or oars by a crew of five to eight men. A trip from Pittsburgh to Cincinnati, a distance of 457 miles, took five days to complete.

Mining Technology

The abundant outcropping of coal from the Pittsburgh seam along the counties bordering the Monongahela and Youghiogheny rivers made possible the development of the small

commercial mining industry during the last quarter of the eighteenth century. Coal cropped out of the hills fronting the Monongahela River from Pittsburgh to Brownsville. An outcrop of coal is a seam or end of a seam of coal appearing at the earth's surface that may be visible or may be covered with a thin layer of earth. An estimated 30,000 tons of coal were being produced annually in and around Pittsburgh by 1790. [57] Coal output before 1840 was simply an educated guess because no government agency in the Commonwealth kept records of coal operators or coal production until after this date. The earliest bituminous coal miners and owners of western Pennsylvania were farmers who mined coal they found outcropping in their fields or located on a hillside fronting the river. These early coal operations were small scale and seasonal work since mining was simply a matter of the removal of surface coal on their farms.

Coal was quarried like stone from seams that were exposed at the surface. Farmers mined coal during the winter with pickaxes and crowbars until it was necessary to follow the seam underground. Coal was tied up in raw hides and rolled down the hill to the river bank, where it was empted into wagons or boats and the hides were then returned to the pit mouth to be reloaded. Coal was loaded manually onto wagons or carts and sold for home fuel or at the blacksmiths forges by the bushel locally. Coal was sold for home heat locally for a dollar and a quarter a ton in 1800. The borough government of Pittsburgh passed an ordinance on January 1, 1802 requiring coal carts and wagons to be clearly marked with their capacities measured in bushels. This ordinance is believed to be one of the first examples of government regulation of the weights and measures of coal. [58] A variety of measurements was used by coal operators to weigh coal during the nineteenth century. A bushel of coal is equal to 80 pounds and 25 bushels equal a ton. A barrel of coal is equal to 200 pounds or 2 1/2 bushels. A long ton contains 2,400 pounds while a short ton contains 2,000 pounds. Coal was weighed at the mines using the long ton measurement while the short ton measurement was used when sold to consumers. [59]

Early coal production ceased when spring arrived and farmers resumed planting their spring crops. After the outcropped coal was mined out locally, some farmers who were fearful of going into the darkness of an underground mine, sold or leased the mineral rights

on their properties. Some farmers dug small drift-entry underground mines into the side of a hill, variously called "country banks," "wagon mines," "dig holes," "gopher holes," or "father-and-son mines." It was common for workers to work underground from four or five o'clock in the morning until six o'clock in the evening. [60] Work underground was not steady and workers were idle for several months of the year. They worked on coal barges and made regular trips as far south as New Orleans.

The original coal operators were farmers who doubled as miners since they owned the property where the coal was located. Local business and professional men were early coal operators who purchased or leased coal properties and hired farmers or day laborers to work in the mine. Among the early producers and shippers in the Monongahela Valley were James and Robert Watson, who were credited with regular coal shipments to New Orleans around 1817. George Ledlie of Birmingham borough, Herron & Peterson, Colonel William L. Miller, D. Bushnell, Fawcett & Brothers, John Gill and William H. Brown were all pioneer coal owners in the Monongahela Valley. There are meagre written accounts of the activities of these pioneer mine operators. [61]

Thomas Hulme, a transplanted English miner, observed the higher wages and improved standard of living at a coal mine at Wheeling in 1819:

> ...They (coal) costs 3 cents per bushel to be got out of the mines. This price, as nearly as I can calculate enables the American collier (miner) to earn upon an average, double the number of cents for the same labor that the collier in England, can earn; so that as the American collier can, upon an average buy his flour for one third the price that the English colliers pays for his flour, he receives six times the quantity of flour for the same labor. [62]

Glowing accounts of the American coal industry by Hulme and other British travelers enticed British miners to emigrate to the United States. A small number of British miners emigrated to the United States after the Revolutionary War and found work in the nascent coal industry. Mass imigration of skilled miners from Great Britain was delayed until the

period between 1840 and 1880. English-speaking miners were attracted by higher wages and safer mining conditions. These skilled British miners worked underground with farmers and field hands during this period. Farmers and farm hands represented a valuable labor reserve for coal operators during periods of brisk business or when full-time workers threatened to strike. These full-time skilled British miners resented these part-time seasonal miners calling them "winter diggers," "wheats," "corn crackers," "hay johns," "pumpkin rollers" "greenies," "scissorbills" and "sagers." [63]

Eastwick Evans, a contemporary visitor of Pittsburgh, observed a number of coal operations in the Pittsburgh area in 1818. He described the quality of the coal: "[the hills] on the west of the Monongahela constitute a horizontal strata six inches [feet ?] thick and apparently unlimited in its direction through the mountain. This coal is superior to that of England." [64] There were about 40 or 50 coal pits carved out of the hills flanking the Monongahela River operating on the bank of the river south of Pittsburgh by 1814. These mines produced about one million bushels of coal annually. [65] There were ten mines alone overlooking Coal Hill producing 5 million bushels of coal annually by 1837. Zadok Cramer (1773-1813), a transplanted Quaker from New Jersey, arrived in the borough of Pittsburgh in 1811. He was the publisher of *Cramer's Alamanac* and *The Navigator,* a business and travel guide almanac. Cramer wrote an early account of mining activity in southwestern Pennsylvania in *The Navigator*. The passage written in 1814 describes the cost of coal, the location of mine sites, and contemporary mining techniques employed to extract and transport coal during the first two decades of the nineteenth century in western Pennsylvania:

> Little short of a million bushels [of coal] are now consumed annually; the price formerly six cents, has now risen to twelve cents keeping pace with the increased price of provisions, labor etc. ...
> There are forty or fifty pit openings [on Coal Hill] including those on both sides of the river. They are worked into the hill horizontally, the coal is wheeled to the mouth of the pit in a wheelbarrow, thrown upon a platform and from

> there thrown into wagons. After digging in for some distance, rooms are formed upon each side, pillars being left at intervals to support the roof. The coal is in the first instance, separated into solid masses, and is afterward broken into small pieces for the purpose of transportation. A laborer is able to dig upward of 100 bushels per day. [66]

Coal deposits are worked from surface mining and or by deep mining underground. Removal of coal from the surface is known as surface or "strip" mining and is employed when the coal seam lies close to the surface of the earth; otherwise underground mining is used. Surface mining or quarrying of coal is probably the oldest form of coal production. When the coal seam outcrops at the surface it is possible to remove it without tunneling underground. Early miners simply used picks and shovels to remove the surface coal. Large-scale surface mining was delayed in the United States until the last quarter of the nineteenth century and the introduction of large-scale mechanical earth moving equipment. [67]

Once the surface coal was removed it was essential to follow the seam underground. When the outcropping seams ran into the ground the coal-picker who followed it underground became a miner. Three methods of underground mining were employed to reach coal seams that were too deep to make surface mining techniques feasible. The types of underground openings were controlled by typography and depth of cover. Drift, slope, and shaft are the principal types of underground mine entries (Illustration 6 - Entries of coal mines). The drift entry was the easiest and earliest method of opening an underground mine during this era. Shaft and slope entry mines were rarely used in the bituminous coal industry by coal companies of Pennsylvania during this period. A slope is an inclined opening that may be at almost any angle from the horizontal. Coal cars in most slope mines are pulled by a rope operated by a hoisting engine, or in some cases, the coal is carried up the slope by conveyors. A shaft is a vertical opening in which loaded coal cars and miners enter and depart within a cage powered by a steam engine. Drift and slope type of openings are usually driven in coal or rock, but in most case the entries are driven directly into the

coal seam itself. A shaft mine entry must always be sunk through rock to reach the coal seam. Shaft and slope entries were rare during this period because these openings were costly to sink and install hoisting machines. The hauling technology was extremely primitive during this early period.

A drift mine is a tunnel driven into the coal seam at the point where it emerges from the side of the hill or mountain. The tunnel gradually slopes southward following the seam. Opening a drift-entry mine was known as "driving to the rise." It did not require much technical skill or capital on the part of the operator since no excavation through rock was required. This opening was essentially a large tunnel dug where the coal seam outcropped or was exposed on the hillside or a gulley. The opening was driven into the coal at a slight upward inclination to permit natural drainage of water from the mine. This entry was used only when the coal seam is nearly level and above water level. Extracted coal was usually run out level over railroad tracks in wooden carts in the drift entry, hauled at first by men and dogs and later by mules or horses to the pit-mouth entry, which was an opening about six feet high and eight feet wide (Illustration 7 - Early nineteenth century drift mine). Coal was then dumped down a wooden incline to the river tipple where it was weighed and loaded onto a variety of river boats.

Most coal was extracted from the drift-entry mines using a system of mining called room-and-pillar The new underground mine was opened by creating passages known as "main entries" or "main headings" in bituminous mines. The entries were driven to the coal seam as straight as possible to avoid turns in railroad tracks or sudden changes in the direction of the air current. From these main entries, tunnels or entries were driven at right angles creating a series of "rooms," "chambers," or "breasts." Most mining activity occurs in these rooms. Each room is about eight yards wide and between these rooms are solid blocks of coal called "pillars" or "columns" measuring twenty to one hundred feet wide, left standing between the rooms to support the roof of the mine. The rooftop of the mine must be supported or it will eventually cave-in. Timber was used as supplementary roof props. This method of mining coal was generally inefficient because there was no possibility of extracting coal pillars entirely. Some coal from the "pillars" can be "robbed"

or removed after they are not needed to support the room but "pillar drawing" is dangerous work and often causes the surface to subside. Pillars are frequently wider than the rooms themselves, and therefore if they are not drawn approximatelty half the coal seam is left underground. [68] A mining engineer, in the 1870s, estimated about one-third to one-half of all coal was abandoned in the mines, mostly in the form of pillars left standing. [69] This was the most popular system of extracting coal in the United States until wide spread longwall mining and surface mining was introduced after World War 11.

Commercial Uses of Bituminous Coal

Bituminous coal was used for a variety of commercial and residential purposes from 1740 to 1840. Pittsburgh, Allegheny City, and thirteen towns within a radius of five miles with an estimated population of 55,000 had established a modest commercial coal trade by the end of this period. The coal trade contributed nearly $1 million to the economy out of a total annual business of $3 million.[70] It was used in stoves to heat houses, and in the glass and salt industry. The frontier communities of Pittsburgh, Connellsville, Brownsville, and Washington were principal consumers of coal mined in the region. Coal had largely replaced wood as a household fuel in the Monongahela Valley by the 1790s. Pittsburgh was known as the "smokey city" by 1810 because coal, not wood, was the primary fuel used in the heating of private homes. A mechanic from Salem, Massachusetts, who visited the city on October 19, 1817, commented "coal is used for domestic purposes, as well as in their factories, and the city being hemmed in by the surrounding mountains, the air is always smokey. Coal is about six cents a bushel. It makes the best fire I ever saw, equal to the best walnut wood." [71] Wood was preferred for cooking stoves because of its ease in starting fires and because coal burned indoors gave off offensive odors.

The steam engine was another early user of coal during this period. Plentiful coal provided a cheap fuel for the production of steam power. Oliver Evans (1755-1819) of Philadelphia, introduced the first steam engine in Pittsburgh in 1809. Evans was the also the inventor of the automatic flour mill. Its operation is described in his book, *The Young*

Millwright and Miller's Guide , first edition, 1795. Steam engines using bituminous coal were employed to drive machinery at flouring mills, grist mills, rolling mills, breweries, glass manufactories and nail factories. Coal furnishing power in a grist mill was consumed at a rate of about twenty bushels per day, at a total cost of a dollar a day by 1810. Zadock Cramer reported three manufacturing establishments using Pittsburgh coal in 1814 and eight establishments using coal steam power in 1817. By 1833, 32 iron works existed in Pittsburgh alone including 10 engine and machine shops, 3 foundries, 11 rolling mills and nails, and 8 miscelleanous shops. These facilities employed 1,080 men and consumed 97,497 bushels of coal in 1833. Pittsburgh consumed 400 tons of bituminous coal per day (10,000 bushels) for domestic and light industrial use by 1830.

Coal was the principal fuel used in the expanding glass and salt-making industries of southwestern Pennsylvania. As these industries grew, so did local coal production in the area. Albert Gallatin established a glass factory on Georges Creek, near New Geneva, Fayette County on September 20, 1797. General James O'Hara and his partner Major Isaac Craig opened the first glass factory in Pittsburgh on the South Side of the Monongahela River, nearly opposite the Point. It was a frame factory with an eight-pot furnace for the production of window glass and bottles. This site was selected so the factory would be near the coal deposits located on Coal Hill. The south side of the Monongahela was the center of the glass industry of western Pennsylvania for most of the nineteenth century. Coal was used to fire the glass kilns. Glass manufacturers in the region consumed 1,480,000 bushels (59,200 net tons) of coal in the production of window glass, vial glass, bottles and flint glass in 1837. [72]

Salt-making was an important early industry in western Pennsylvania. Coal was used to separate salt from the brine. William Johnston bored a number of wells near the Conemaugh River, Armstrong County in 1812 and found enough brine to furnish salt for one million inhabitants. Salt was imported from the east by packhorses over the Allegheny Mountains before Johnston's discovery. This discovery initiated the local salt-making industry with salt wells sunk along the Conemaugh, Kiskiminetas, and Mahoning creeks, as well as along the Monongahela and Allegheny rivers. Over 200,000 tons of coal per year

were used by the salt industry to produce salt for domestic consumption by 1825. Salt production was a major industry in Armstrong and Indiana counties, which became principal salt producing counties in western Pennsylvania by 1830. There were 24 salt wells producing 65,000 tons of salt in 1830. Initially horse power was used to pump brine from the wells, but horses were replaced by coal powered steam engines. Salt brine pumped from the wells was boiled in large pans to evaporate the water. Coal supplied the heat to separate the salt from the brine. Each boiler furnace used almost 200 bushels of bituminous coal daily. A contemporary account written in 1828 notes that "coal is the only fuel used in the evaporation. This fuel costs nothing but the quarrying, about 3/4 of a cent per bushel, and is run out, and down to the furnaces upon railways without any hauling. All the furnaces lean against the coal hills, in which are two strata of this fuel 4 or 5 feet thick and inexhaustible." [73] Some one hundred thousand tons of bituminous coal were consumed annually by the salt-making industry between 1815 to 1870

Coal, Coke, and the Iron Industry

The iron furnace originated in the Rhine provinces at the beginning of the fourteenth century and spread to other Europeans nations. Charcoal was the principal fuel in iron production. The first great improvement in iron production process was the substitution of coke for charcoal fuel. The history of coke-making dates back to the late sixteenth century in England, when the process was first called "charking" coal. Coal was piled in a mound or placed in a pit and was burned slowly. Charcoal was used in the iron-smelting furnace and forges in both the United States and Great Britain until the eighteenth century. A voracious appetite for wood in iron production quickly depleted forests and forced British ironmakers to find a substitute fuel for charcoal by the beginning of the eighteenth century. Several patents were issued in the sixteenth and seventeenth centuries for various processes using coal and coke for iron smelting, although all these processes generally proved unsatisfactory.

Historians believe Abraham Darby, an English Quaker, first successfully smelted iron using coke in 1735. He leased an iron plant at Coalsbrook near the Severn River in Schropshire, England, intending to smelt iron from charcoal, but the rising cost of charcoal made the enterprise unprofitable. Darby was successful in using low-sulfur coal to make coke as a suitable fuel for iron smelting. He produced "pit coal pigs" which were used as bar iron stock for rolling. Darby sold cast iron pots, kettles, and other small iron items manufactured from iron produced by coke at a reduced cost. Darby's coke making process was not immediately embraced but improvement in the manufacture of coke and newer designs of the coke blast furnace by his son improved the process. Coke smelting became more efficient and economical than charcoal and coke iron was being widely used in England after 1760. [74] The Darby family managed the iron works at Coalsbrook for five generations.

The production of coke is essentially a distillation process in which coal is burned under controlled conditions that "cooks" out volatile gaseous matters including tars, oils, and gases at a temperature between 900 and 1150 degrees Celsius, so that the fixed carbon and ash are fused together. Coke, known as "the bones of coal" is a hard and extremely porous residue which has a dull to submetallic luster, and is dark gray to silvery gray in color. Coke was called "coak" by British iron makers and the introduction of coke revitalized the once-sagging British iron industry. The high carbon percentage of coke gives it the capacity of generating heating power superior to coal or charcoal. Coke is strong enough to support a load of iron ore in a blast furnace. It has a heat value of about 25 million BTU per ton. The quantity of coke derived from the controlled burning of coal varies from about 50 to 85 percent. Coal to become profitable in coke production should yield at least 65 to 70 percent coke. In theory, coke like charcoal functions in the same manner once in the blast furnace. Both fuels are placed at the bottom of the furnace and iron ore is dumped on top. The carbon in coke or in charcoal combines during combustion with the oxygen in the ore, freeing the iron to exist in pure form. Coke burns less easily than charcoal because it requires a much hotter fire. Raising the temperature in the furnace demanded years of experimentation and was accomplished after the steam engine replaced the water wheel in

working the bellows that blew the air (the furnace was kept "in blast" day and night) into the iron furnace. British ironmakers used low-sulfur coal to make iron, and the new iron process called puddling removed impurities from brittle coke-smelted iron. These technological advances improved both the quality and the quantity of iron production in Great Britain. The charcoal furnaces had all but disappeared from the landscape by 1796. The British iron industry more than quadrupled as iron output increased from 17,000 tons in 1740 to 68,000 tons in 1788. [75] All but eleven of Great Britain's 173 iron blast furnaces were using coke for smelting iron in 1806, with an annual output of 273,113 tons. [76]

American iron manufacturers did not adopt iron-making technology using mineral fuel (coal or coke) as rapidly as Great Britain. The American industrial revolution based on mineral fuel was delayed until the 1830s. Charcoal was the principal fuel in American ironmaking for more than a century because there was no wood shortage. American ironmaking was centered in Pennsylvania since 1716 when the first successful iron-making venture was undertaken on Manatawny Creek, a few miles above Pottstown, Berks County. Iron plantations were subsequently constructed in the Schuylkill, Delaware and Susquehanna river vallies. Pennsylvania was the foremost iron producing colony in America after 1750. Ironmasters had located their iron blast furnaces in rural areas to be near a ready supply of raw materials. Three principal ingredients are required to transform iron ore into iron - fuel (charcoal), flux (limestone or oyster shells were used to remove the waste matter, called slag) and fire. A typical blast furnace produced two tons of iron daily and consumed charcoal made from one acre of woodland. A wooded area of 240 acres yielded 5,000 to 6,000 cords of wood annually to feed a typical rural blast furnace. Large quantities of charcoal was used in forges and blacksmith shops in addition to blast furnaces. [77] The Hopewell Village Iron Plantation, Berks, County Pennsylvania consumed 15,000 cords of wood annually to produce charcoal. The use of charcoal was a rational fuel choice given the abundance of wood and the isolation of known coal deposits in the state before the 1830s.

A variety of groups and organizations in Pennsylvania attempted to find an alternative fuel for charcoal in the production of pig iron after 1820. Iron masters, state government

officials, and members of the business and the intellectual community all promoted experimentation to find an alternative mineral fuel for charcoal. The increased scarcity of wood and subsequent rise in charcoal prices, as well as the increasing competition from inexpensive British iron goods, prompted this frantic search. There was a demand for cheaper iron by consumers and all these impulses began a search for a new fuel to replace charcoal and create a new method to manufacture iron. Experiments with anthracite, raw bituminous coal, and coke as a mineral fuel to smelt iron ore were undertaken during this period. Hazard's *Register of Pennsylvania* in 1835 suggested the General Assembly award premiums for the smelting of ore with anthracite. [78] The General Assembly of Pennylvania passed an act on June 16, 1836 (P.L. 799), "to encourage the manufacture of iron with coke or mineral coal," and authorized the formation of companies for the manufacture, transportation, and sale of iron made with coal or coke. [79] Governor John Ritter (he was a member of a family in the iron business), in his annual address to the General Assembly in 1838, stated that "the successful union of stone coal (anthracite) and iron ore, in the arts, is an event of decidedly greater moment of our state than any has occurred since the application of steam in aid of human labor." [80] The General Assembly authorized the formation of the Geological Society of Pennsylvania in 1836 to begin an extensive five year geological survey to map and record the state's natural resources. The survey spawned three subsequent geologic and topographic surveys funded by the state during the next century. Pennsylvania was the first state to undertake a systematic geological survey of its coal resources by locating coal deposits and determining the quantity and the quality of coal that underlies the state. [81] Coal operators were dependent on prospectors to locate coal seams. A coal seam outcropped at the surface in rare cases but most coal was located underground and required considerable time and skill to locate. The typical coal prospector used a pick, hammer, a clinometer for measuring angles of dip and strike in formation, and an aneroid barometer for determining altitude. Coal prospectors studied rock formations in order to determine the geological age of the earth strata. [82] The Geological Commission was granted a budget of $6,400 to pay the salaries of a geologist, a chemist, and two assistants. Henry D. Rodgers established the First Geological Survey of Pennsylvania.

The survey stopped its research temporarily in 1842 because of a lack of funds although Rodgers published the first Survey in two large volumes in 1858. The finding of this original survey was augmented by later surveys conducted by the state.

The Franklin Institute of Philadelphia, founded in 1824 for the promotion of applied science and the mechanical arts, offered gold medals to "the person who shall manufacture in the United States the greatest quantity of iron from the ore during the year, using no other fuel than bituminous coal or coke, the quantity to be not less than 20 tons." [83] F.H. Oliphant produced iron from coke at the Fairchance Furnace near Uniontown, Fayette County and forwarded samples of pig iron to the Franklin Institute in 1836. Nicholas Biddle, president of the Bank of Philadelphia (successor of the second Bank of the United States), and some business associates, offered a reward of $5,000 to the first person who could keep an iron furnace in blast continually for three months using a mineral fuel. Bostonian William Lyman was the first ironmaker the claim a first prize of offered by Biddle and associates. He successfully burned anthracite at his Pioneer Furnace in Pottsville, Schuylkill County in 1839.

Anthracite has such a high carbon carbon, compared to bituminous coal, that it was believed it could be used in the iron furnace alone. All experiments with anthracite or anthracite mixed with coke or charcoal all failed. Anthracite, as a metallurgical fuel, required an extremely high fire in the furnace that could not be easily attained by American iron masters using a "cold blast" to heat their furnace by blowing cold air from outside the furnace under pressure directly onto the surface of the charcoal. The temperature of the cold blast used in an iron furnace ranged from 100 degrees Fahrenheit in summer to 10 degrees in winter.[84]

James B. Neilson, George Crane and David Thomas carried on the process to its successful culmination. [85] Neilson, superintendent of the Glasgow Gas Works, and Mr. Mackintosh and Mr. Wilson, two associates, achieved a technological breakthrough in 1828 when they designed and patented a new furnace that could maintain high and consistent temperature when using anthracite in the furnace. They designed bellows that blew preheated air at 300 degrees Fahrenheit rather than cold air into the bottom of the

furnace. Neilson patented the principle of the hot-blast furnace in both England and France and continued to improve the furnace and the process at the Clyde Iron Works. George Crane, an iron manufacturer from the anthracite coal region in Yniscedwin, Wales, and his manager David Thomas in 1837used Neilson's new hot-blast furnace process and successfully made iron using anthracite as a metallurgical fuel. [86]

Reverend Dr. Frederick W. Geissenhainer, a German-born Lutheran minister, secured a United States patent on December 19, 1833 for smelting pig iron with anthracite using a strong hot-blast in an experimental furnace that he constructed in New York City in 1831. He built the Lucy Furnace in 1836, near Pottsville, Schuylkill County, and made a few tons of iron with anthracite. Geissenhainer's experiment was the first successful attempt to use anthracite as an alternative to charcoal to smelt iron in the United States. He died at Lebanon, Pennsylvania shortly after this successful experiment and was unable to improve on his furnace's design.

Josiah White and Erskine Hazzard, owners of the Fairmount Nail and Iron Works, had been trying to make iron from anthracite in eastern Pennsylvania since the 1820s. Hazzard, White, and a group of Philadelphia investors formed the Lehigh Crane Iron Company and tried unsuccessfully to use anthracite in their iron blast furnaces. They traveled to Wales and tried to persuade Crane to return with them to Pennsylvania and construct a hot-blast furnace. David Thomas, Crane's iron plant manager and the actual designer of the hot - blast furnace in Wales, came to the Lehigh Valley and constructed a number of anthracite hot-blast furnaces for the iron company. Thomas fired the first anthracite-fueled hot-blast furnace at Catasauqua, near Allentown on July 4, 1840. The furnace employed the hot-blast process perfected by James Neilson in Scotland in 1828. Thomas adapted Neilson's concept of heating air in the chamber before it was blasted into the furnace. The furnace was producing fifty to sixty tons of foundry iron a week, and anthracite iron was made at this facility until it closed in 1879. This early success made the Lehigh Crane Iron Company the leading anthracite iron firm in the state.

Anthracite played the same pivotal role in reviving the iron industry of Pennsylvania as coke had played in Great Britain. Anthracite was abundant and its low cost made possible

the production of the cheapest iron ever made in America. [87] Anthracite was being used instead of charcoal fuel in a majority of iron blast furnaces by the end of the decade. The hot-blast process designed by Thomas, known as "The Father of the Anthracite Industry," required less fuel to raise the temperature to the melting point of the ore and reduced fuel consumption in the furnace. The new furnace, unlike contemporary charcoal iron blast furnaces, was distinguished "by its greater height and overall size, and the large dimensions and great power of its blowing engines." [88] The success of the hot-blast furnace with anthracite at Catasauqua was soon being duplicated by iron masters throughout eastern Pennsylvania. *Swank's History of the Manufacture of Iron* defined the significance of this technological transformation from cold-blast to the hot-blast furnace as "the line which separates the charcoal era of our iron history from the era which succeeded it, and which may be said to still continue, is marked by the simultaneous introduction of anthracite and bituminous coal in the manufacture of pig iron." [89] The advantages of the hot-blast furnace over the conventional charcoal blast furnace were numerous: "it permitted the use of anthracite which resulted in substantial savings in smelting costs, its inherent mechanical simplicity and relatively cheap installation cost, and its adaptability to existing cold blast furnaces." [90]

The new method of making iron with anthracite caused an explosive growth of iron manufacturing in Pennsylvania as hot-blast furnaces were constructed along the Susquehanna River, in the Wyoming-Lackawanna region, and in the Schuylkill and Lehigh valleys. The use of anthracite made it possible to shift iron manufacturing from a rural to an urban environment. Pig-iron production which amounted to slightly less than 50,000 gross tons in 1810 had risen to almost 600,000 tons by 1850 produced at some 370 iron establishments. [91]

Development of the Coke Industry of Western Pennsylvania

Bituminous coal had shown itself at an early date to be a useful fuel for the heating and puddling of pig iron since there was no direct contact between metal and fuel in the process;

therefore chemical impurities in the coal or coke did not matter. There was little success in using coal or coke in the iron blast furnace of western Pennsylvania before the 1830s. Several reasons can account for this tardiness. There was an ample supply of timber near the furnace to produce charcoal, a strong bias existed for pig iron made from charcoal by iron manufacturers, technological problems remained in the coking process, the proper blast for the iron furnace was hard to control, and there was the need for better grades of coking coal. [92]

Coke was used originally in Pennsylvania by blacksmiths and foundry men; however, the principal value of coke is its ability to reduce iron ore in the blast furnace. Coal was first coked to remove part of the sulfur and arsenic and to reduce the smoke. Coke is an effective blast furnace fuel because it is strong enough to support the ore and limestone, and yet sufficiently porous to be affected quickly by the air blast. The coking process was perfected in eighteenth century England but the process was generally not understood nor applied in the United States until the 1830s. A number of English and Welsh iron workers, familiar with the manufacture and use of coke in smelting iron in blast furnaces, had emigrated to the United States in the decades following the American Revolution. John Beal was one of these transplanted skilled artisans who offered to share his coke-making expertise with local ironmakers. Beal placed an advertisement in the *Pittsburgh Mercury* on May 27, 1813 volunteering to "convert stone coal into 'coak'":

> To properietors of blast furnaces:
> John Beal, lately from England, being informed that all the blast furnaces are in the habit of smelting iron ore with charcoal, and knowing the great disadvantage it is to proprietors, is induced to offer his service to instruct them in the method of converting stone coal into coak. The advantage of using coak will be so great that it cannot fail becoming general if put to practice. He flatters himself that he has had all the experience that is necessary in the above branch to give satisfaction to those who feel inclined to alter their mode of melting their ore.
> John Beal, Iron Founder. [93]

It is unknown if any local ironmaster answered this advertisement. Beal opened Beal & Company, an extensive foundry on the Monongahela River bank. Coke as a substitute for charcoal was first made in Fayette County, which was the principal iron producing county in southwestern Pennsylvania between 1790 and 1830. The Alliance Iron Furnace, which opened on November 1, 1790 on Jacobs Creek, 2 1/2 miles west of the Youghiogheny River, was the first blast furnace and forge located west of the Allegheny Mountains. Sixteen iron works developed in the county between 1790 and 1800. There were ten furnaces, one air furnace, eight forges, three rolling mills and slitting mills, one steel furnace and five trip hammers in the county by 1811. [94]

The history of the early coke industry in the United States, as in England, is more or less confused as authorities dispute events and dates in chronicling its historical development. Some historians believe the first manufacture and use of coke in this country began at the Allegheny Furnace in Blair County in 1811 while others credit Colonel Isaac Meason as early as 1818. Meason's Plumstock Iron Works was the first rolling mill west of the Alleghenies, founded in 1815 on Redstone Creek near Upper Middletown, nine miles east of Brownsville, Fayette County. Thomas C. Lewis, a transplanted Welsh-born iron worker and the superintendent of Meason's furnace was responsible for producing coke used in the rolling mill to heat and puddle iron and roll iron bars. Lewis employed three men to mine coal from the Redstone seam that was probably the earliest captive coal mine in the county. Coal was first made into coke in turf-covered "mounds" or "ricks" in a similar manner used to make charcoal from wood. He placed an advertisement in the *Pittsburgh Gazette* on June 15, 1818 advertising his iron works. Meason noted that he had " an inexhaustible pit of stone coal within one hundred yards of the forge. Three men with a horse and cart are sufficient to raise coke, and haul to the forge all the coal necessary for keeping the works in full operation." [95] The resulting coke was of unsatisfactory quality because coal from the Redstone seam was hard coal and had a high sulfur content and did not make a good coke. Meason returned to the use of charcoal within a few years.

The rising cost of charcoal fuel for blast furnaces and the success of eastern iron manufacturers using anthracite prompted iron manufacturers of western Pennsylvania to

find a way to use abundant bituminous coal to make high-quality iron using either coke or raw bituminous coal. A number of iron manufacturers throughout western and central Pennsylvania began to experiment with the production of pig iron using coke and raw bituminous coal in their blast furnaces. These experiments in the 1830s and 1840s encountered similar technical difficulties that had plagued English ironmasters nearly a century earlier. The weakness of the blast in the furnace was a major technical problem. The first coke iron furnace built in the United States was at Bear Creek Furnace, located one mile from Lawrenceburg, Armstrong County in 1819. It was believed to be the largest furnace in the United States in 1832. Coke was used at the furnace to make iron, but after a few casts the owners found that the (cold) air blast of five pounds to the inch was insufficient to raise the furnace temperature for the successful use of coke. The operators abandoned the use of coke after producing two or three tons of coke iron. The furnace changed back to the use of charcoal and went out of blast prior to 1850. [96] Peter Ritter and John Say rebuilt the Karthaus Furnace at Karthus, Clearfield County on the west branch of the Susquehanna River in 1836 under the name of the Clearfield Coke and Iron Company. The furnace made pig iron from coke in place of charcoal. The iron furnace was subsequently acquired by a group of investors led by Henry C. Carey, John White and Burd Patterson. They hired William Firmstone to convert the furnace to a hot-blast furnace, but poor transportation and an inferior grade of iron ore put an end to coke production the next year. Boston entrepreneurs attempted to smelt iron ore with coke at Ferrandsville, Clinton County, but their attempts failed after they made several hundred tons of coke pig iron between 1837 and 1839. A furnace at Frozen Run, Lycoming County, made pig iron from coke in 1838, but the furnace closed because of the inferior quality of the pig iron, and the furnace owners discontinued coke iron production and returned to the use of charcoal the next year.

Furnace men complained coal miners were sending them dirty coal while the latter retorted that furnace men did not know how to coke the coal properly, or failed in its proper application in the furnace. Coke was first successfully used for the production of pig iron by iron master William at the Mary Ann Furnace, Huntingdon County, in 1835. [97] He

used semi-bituminous coal shipped to his iron plantation from the Broad Top Mountain in Huntingdon County. The furnace made gray forge iron from coke but the furnace operated for only a month with coke. Fideleo H. Oliphant made 100 tons of coke iron at the Fairchance Iron Furnace near Uniontown, Fayette County in 1836. The George's Creek Coal Company built the Lonaconing Furnace, eight miles northwest of Frostburg, Maryland. The furnace was 50 feet high by 14 1/2 feet in the bosh and made 70 tons per week of good foundry iron using coke instead of charcoal beginning in 1837. [98] Five iron furnaces were in blast in Pennsylvania producing iron using coke by the 1840s.

Coke Making Technology

Coke was first produced in Pennsylvania employing a similar method used to make charcoal. Coal was first converted to coke in "mounds" or "ricks." Coal, which must be in lumps, is piled in the open air in a circular mound called a coking pit, with the coal lumps set on sharp angle so that air-spaces are left. The coal pile was covered with non-flammable material and then ignited. Coal was burned slowly in a moist, smouldering heat that drove impurities out. The exterior supply of oxygen was cut off by sealing all vents when the pile was ablaze. Coal was converted into coke in five to eight days. This simple method of coke production was a very wasteful method yielding less than 50 percent coke. It was also a slow process but was still used after the introduction of the dome-shaped brick beehive ovens especially in areas where the demand for coke was small and its manufacture had just begun (Illustration 8 - Mound or rick method of coke production).

The first production of coke in a beehive coke oven took place in what is now the city limits of Connellsville, Fayette County during the 1830s. These new ovens were called beehive coke ovens because the interior of the original ovens were shaped like beehives. Mr. Nichols, a transplanted Englishman, is generally credited with building the first beehive coke oven in the nation. Nichols is reputed to have made coke at Durham, England and was responsible for a series of unsuccessful coke-making experiments at Meason's Union Furnace (Dunbar Furnace), south of Connellsville in the 1790s. [99] He supervised

the construction of a small oven on the property of Lester LeRoy Norton, who operated a small textile mill near Connellsville. Norton subsequently added a small foundry next to his textile mill in 1831. John Taylor, a local farmer and stone mason, was contracted by Nichols to construct a single 12-foot-square oven made of stone, with a hive of bricks at a site near the the foundry on Connell Run in 1833. Coal was obtained from Taylor's nearby Plummer mine on a wedge of land formed by the junction of Mounts Creek with the Youghiogheny River just north of Connellsville. Nichols made coke in the single beehive oven and also made coke in ricks on the ground. Coal from the Pittsburgh seam made excellent coke that was in demand by local iron manufacturers in Fayette County. It was transported to Meason's foundry at Plumstock down the Youghiogheny River to McKeesport, then up the Monongahela to Brownsville, then hauled in wagons to the foundry. The first beehive coke ovens were constructed during the 1830s but their widespread usage for coke production was delayed until the 1850s.

ILLUSTRATIONS

Number 1 U.S. Coal Fields
Number 2 Anthracite Coal Fields of Pennsylvania
Number 3 Bituminous Coal Fields of Pennsylvania
Number 4 Pittsburgh Coal Seam
Number 5 Connellsville Coke District
Number 6 Types of mine entries
Number 7 Nineteenth century drift entry mine
Number 8 Mound or rick method of coke production

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There were three iron furnaces in southwestern Pennsylvania in the 18th century: Greene Furnace, in Greene County; John Probst's Westmoreland Furnace, near Ligonier, Westmoreland County; and George Anschutz, William Amberson and Francis Beelen's Shadyside Furnace, near Pittsburgh at Two Mile Creek.

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Transportation, Iron and Railroad Revolution as Impetus for Expansion of the Coal and Coke Industries, 1840-1880

Introduction

The future growth and prosperity of the bituminous coal industry was dependent upon its successfully breaking the energy monopoly held by wood and in the creation of a viable transportation system. Coal, despite its early limited usage and markets, was becoming a new revolutionary energy source in the United States, as production and consumption increased with each passing decade between 1850 and 1880. The demand for coal grew with the industrial expansion of "Smokestack" America during this period. Anthracite (14.3 percent) and bituminous (26.7 percent) coal produced 41 percent of the nation's energy supply by 1880 in contrast to 57 percent from wood. The significant and sooty age of "King Coal" would commence by the end of this period as coal successfully challenged wood's long-term energy hegemony.

Energy Sources as Percentage of Aggregate Energy Consumption in the U.S.

	Bituminous Coal	Anthracite Coal	Wood
1850	4.7%	4.6%	90.7%
1855	7.3%	7.7%	85.0%
1860	7.7%	8.7%	83.5%
1870	13.8%	12.7%	73.2%
1880	26.7%	14.3%	57.0%[1]

Population growth and rapid industrial development created severe wood shortages in parts of the nation during this period. The shortage of wood and charcoal used in the iron industry caused the price of wood to soar. Coal served as the sole alternative fuel created by the wood shortage until the introduction of natural gas and petroleum after the 1880s.

National Coal Production in Millions of Tons

Years	Bituminous	Anthracite	Total	Percent Increase
1850	4,029	4,327	8,356	
1855	7.543	8,607	16,150	
1860	9,057	10,984	20,041	1850-1860 - 139.8%
1865	12,349	12,077	24,426	
1870	20,471	19,958	40,429	1860-1870 - 101.7%
1875	32,657	23,121	55,778	
1880	50,757	28,650	79,407	1870-1880 - 96% [2]

Pennsylvania was the pioneer state in the establishment of the commercial coal industry in the United States. The Commonwealth had extensive reserves of high quality anthracite and bituminous coal. Howard N. Eavansen, a former professor of Mining Engineering in Pittsburgh and past president of the American Institute of Mining and Metallurgical Engineering observed in 1942: "unlike the bituminous part of the coal industry the production of anthracite has been fairly well publicized; in fact until about 1845 whenever the coal industry of Pennsylvania was mentioned in papers, magazines or books, anthracite only was meant." [3] Anthracite production was greater than all bituminous coal production nationally until 1870. This was the principal coal as measured in production, monetary value of coal production, and employment in Pennsylania until the 1890s. About 25,000 out of the nation's 36,500 miners worked in the anthracite coal region producing seventy-three percent of the total value of American coal in 1860. [4] Between 1840 and 1860 the bituminous coal industry in Pennsylvania expanded but production was still dwarfed by the state's anthracite industry. Fewer than five thousand miners were employed at the early bituminous drift-entry mines of Pennsylvania by 1860.

Anthracite and Bituminous Industry of Pennsylvania in 1860

PA	Number of Establishments	Capitalization	No. of Employees	Value of Product
Anthracite	176	$13,888,250	25,126	$11,869,574
Bituminous	134	$3,721,780	4,651	$ 2,876,579 [5]

The bituminous coal industry had established a secure but still modest place for itself in the nation's economy. Annual production of coal (anthracite and bituminous) rose from 2 million tons in 1840; to 8.3 million tons in 1850; and 20 million tons nationally by 1860. More than three-quarters of this total production was concentrated in Pennsylvania. Ohio was second with 600,000 tons annually; Virginia (including the western counties that became West Virginia after 1863), 350,000; and Illinois and Maryland, about 250,000 tons each in 1860.

Transportation

Transportation innovations in Pennsylvania were responsible for broadening the commercial markets of the bituminous coal industry with its production and employment. The bituminous coal industry in Pennsylvania was concentrated in the Monongahela Valley between Pittsburgh and Brownsville, a distance of some fifty miles. Coal production in the region was 357,140 tons, of which 70 percent was consumed locally in 1840.[6] The western coal trade was restricted by poor navigation on the Monongahela to the river towns on the Ohio and Mississippi rivers. Limited quantities of coal could be shipped during the summer on account of the low water table on the river. The lack of an adequate transportation system restricted coal export from the coal producing counties of western Pennsylvania. The needs of the eastern seaboard markets were fulfilled by anthracite producers of Pennsylvania, Virginia, and the oversea coal importation from England and Wales until this period.

Colonel Robert W. Milnor, chief engineer of the Monongahela Navigation Company, in a report submitted to the General Assembly of Pennsylvania on December 24, 1839, defined the need for river improvements and their economic advantages for the local coal trade:

> During the year 1837, a large number of flat boats were loaded at various points along the Monongahela, but, at that period when the owners wished to carry it to market, there was not sufficient depth of water on the ripples to enable them to float to the Ohio river ... in October of last year there were 150 flat boats at the coal landing up the Monongahela River, which had been waiting upwards to three months for the rise of water, in order to get to market. [7]

The Monongahela Navigation Company, a private corporation, was formed in 1836 to begin slackwater improvements on the Monongahela River from Pittsburgh to the West Virginia border. The Monongahela Slackwater Company, by which the improvements became known, had been organized primarily to aid the local coal trade. The company constructed a series of locks and dams on the river. Locks number 1 and number 2 were completed by 1841. Each lock consisted of a single chamber 190 feet long and 50 feet wide, and their completion by 1844 provided 55 1/2 miles of continuous slack-water transportation between Pittsburgh and Brownsville. Connellsville coke manufacturers on the Youghiogheny River, the principal tributary of the Monongahela River, petitioned the General Assembly of Pennsylvania to establish a navigation company to build locks and dams on the Yough. The Connellsville and West Newton Navigation Company was incorporated in 1841 to make the river navigable between these two towns but the company never completed the task . The Youghhiogheny Navigation, incorporated in 1843, completed construction of a series of locks and dams on the river in 1850. The new locks and dams on the rivers controlled the depth of water and permitted year-round river transportation, except when it was obstructed by ice.

The western coal trade was not created by the Monongahela Navigation Company but slack water river improvements were responsible for greatly increasing the volume of the coal trade. Coal was the principal product of the Monongahela Valley although agricultural products, especially fruits and grains, were important items shipped downstream. These river improvements enabled an expansion of mining from Pittsburgh to New Geneva above Brownsville in the 1840s. Dozens of new mines were opened as a consequence of these improvements and demands for coal by the river communities along the Ohio and Mississippi rivers. There were about sixty mining operators in Allegheny, Fayette, Washington and Westmoreland counties clustered around the Monongahela and Youghiogheny rivers by 1859. [8] The volume of coal shipments transported from the region rose significantly with each passing decade. Some 750,000 bushels of coal were shipped in 1844, the year the internal improvements were completed. Coal and later coke shipments increased to 12.2 million bushels in 1850, 22.2 million bushels in 1855, and 37.9 million bushels in 1860. The region mined and shipped 1,076,820,914 bushels of coal in 1877. [9]

"French Creek" flat boats, barges and arks had been the principal modes of river transportation for coal until this period. The construction of the *New Orleans,* built at Sukes Run on the Monongahela River near Pittsburgh began the steamboat industry of western Pennsylvania. Nicholas Roosevelt, Robert Fulton , and New York business associates spent nearly forty thousand dollars and one year in its construction. Roosevelt with his wife piloted the *New Orleans*, powered by local coal, from Pittsburgh to New Orleans in 1811. Steamboats and steam engines were manufactured in Pittsburgh and later Cincinnati after this successful voyage. Pittsburgh built 45 steamboats while Cincinnati constructed 32 steamboats in 1847 alone. Steamboats were not immediately used to transport coal up the river to market. Captain David Bushnell towed three small coal barges, each loaded with 2,000 bushels of coal, with his small stern-wheeler steamboat, the *Walter Forward*, to Cincinnati in 1845. Bushnell's successful trip revolutionized coal transportation by ushering in the era of the steam tow boat. Steam boat transportation of coal was in vogue within five years on the western rivers. Barges and flatboats were built in large numbers to carry cargoes of coal attached to steamboats for trips down the Monongahela River to the Ohio River and then south to the markets of Ohio and the lower

Mississippi valley. A steamboat could tow or push a dozen barges, with each barge holding about 12,000 bushels of coal after 1850. Some 184,200 tons of coal were shipped on the Monongahela to the Ohio river to Cincinnati in 1845 and more than 1.5 million tons were transported by 1860. [10] Fewer than 4,200 barrels of western Pennsylvania coal were shipped via the Monongahela River to New Orleans in 1816. Some 1,510,000 million barrels of coal were shipped to New Orleans by 1861.

The potentially lucrative eastern seaboard coal trade still remained untapped. Their demands for coal were satisfied chiefly by the bituminous coal fields of Maryland and Virginia, anthracite coal shipped from eastern Pennsylvania, and imported English and Welsh coal. The coal industry was responsible, to a great extent, for the initial development of canals and railroads systems in the United States. The early canals and railroads were developed in northeastern Pennsylvania to haul anthracite coal to the principal cities on the eastern seaboard. The Maunch Chunk railroad was the first steam railroad in the state and the second in the United States.The construction of this nine mile long railroad was begun in 1818 and completed nine years later by the Lehigh Coal and Navigation Company. At least a dozen railroads were constructed in the anthracite region in the next two decades to carry anthracite from the mines to the river and canals and then to market.

The first attempt to tap into the potentially lucrative eastern coal market by coal operators in western Pennsylvania came during the Age of the Canal with the successful completion of Governor DeWitt Clinton's Erie Canal. The success of the New York canal after 1825 spawned an era of canal building throughout the nation. Pennsylvania's own canal era began with the completion of the Pennsylvania Mainline Canal during the 1830s. This 394-mile system cost about $38 million to construct and was actually a combination railroad, canal, and incline railroad. The canal started at Columbia on the Susquehanna River and traveled west through the Juniata River Valley to Hollidaysburg, then over the Allegheny mountains via the Allegheny Portage Railroad and inclined planes to Johnstown. The canal traveled from Johnstown through the valleys of the Conemaugh, Kiskiminitas, and Allegheny rivers to Pittsburgh. The canal, with its 37-mile Portage Railroad with 10 inclines, took 8 years to complete. The first boat arrived from Philadelphia at Allegheny City, north of Pittsburgh, in 1834. Coal operators of the Monongahela Valley saw the

development of the Mainline Canal and the Allegheny Portage Railroad as a viable transportation route to sell their coal in the eastern seaboard markets.

Moncure Robinson, chief engineer for the Allegheny Portage Railroad, concurred with their sentiment and urged the installation of more powerful stationary steam engines for the five inclined planes located west of the summit in order to haul the heavy coal-laden barges over the Allegheny Mountains from Johnstown to Hollidaysburg. [11] Neither Robinson's nor the coal operators' high expectations that the canal and the Portage Railroad would open these potentially profitable eastern markets ever came to fruition. In fact, very few coal-laden barges traveled east on the Pennsylvania Canal System over the Portage Railroad from the mines of the Monongahela Valley. A mere five tons of coal were transported from Pittsburgh over the canal in 1832. The maximum annual tonnage of coal shipped east from the Pittsburgh Region never reached 30,000 tons between 1832 and 1880. Some 29,234 tons of coal were shipped to eastern markets in 1854 that represented the maximum annual tonnage. [12]

The inclined railroad and canal provided an outlet for coal mined on the eastern edge of the Great Allegheny Coal Field. The Broad Top mountain coal region is an isolated semi-bituminous coal region forming the eastern boundary of the bituminous coal basin. Parts of the region are situated in Bedford, Huntingdon, and Fulton counties. Semi-bituminous coal, iron, and grain were shipped down the Juniata River to the canal from these counties and Blair, and Center counties since its completion in 1832. Some 973 tons of semi-bituminous coal from the Broad Top region and Centre County were shipped on the Western Division of the Pennsylvania Canal by 1843.

Coal samples from mines located on the Monongahela River were shipped east in 1835 and tested for use as gas-coal for illumination purposes at the gas works of Philadelphia and New York. The report found this coal favorable for such use but little coal was actually shipped east until the advent of the railroad several decades later. The completion of the Pennsylvania Canal did not provide a viable solution to the transportation problem for the coal producing counties bordering the Monongahela River. Excessive freight rates, narrow locks, competition from coal producers from Virginia and Maryland, anthracite from

eastern Pennsylvania and coal imported from Great Britain made the western bituminous coal trade with the east unprofitable at this time.

The opening of the few miles of the Baltimore and Ohio Railroad and the South Carolina railroads during the 1830s marked the beginning of the railroad era in the United States and although these early railroads were crude, they proved the economic value of steam-railway transportation. Eleven state legislatures granted more than 200 railroad charters by 1835. The Baltimore & Ohio Railroad was organized in 1827 by a group of progressive businessmen in Baltimore who believed the construction of a railroad "from Baltimore to some eligible point on the Ohio river would tap the growing western trade and make Baltimore second only to New Orleans as the great outlet to the west." [13]

The locomotives of the 1830s and 1840s were powered primarily by wood, but the increasing scarcity and the subsequent higher cost of wood prompted railroad companies to search for an alternative fuel that was both inexpensive and plentiful. The B & O was an early user of anthracite coal, costing the company seven dollars per ton in the 1830s. The firm began experimenting with the use of bituminous coal in its locomotives in 1837 when the railroad reached as far west as Cumberland, Maryland. Bituminous coal was obtained from the Georges Creek Field coalfield of nearby Maryland and Pennsylvania. Bituminous coal began to replace anthracite by 1840-1841 because it was a more economical fuel. A number of technical problems in pre-Civil War locomotives delayed the widespread use of bituminous coal. Coal, unlike wood, generated hotter fires that burned through the fire box, created voluminous smoke, and generated sparks flying out the smokestack that often set nearby farm buildings on fire. Railroad operators expended large sums of money and time overcoming them, which persisted for nearly a quarter of a century, but on the eve of the Civil War the principal railroads - the Reading, the Pennsylvania Railroad and the Baltimore and Ohio -were all operating coal-burning locomotives. The B & O Railroad consumed seventy-five thousand tons of coal in its locomotives in 1856. All freight locomotives operated by the Pennsylvania Railroad were burning coal fuel not wood by 1862. [14] Railroads became a principal market for bituminous coal during this period and remained so until the introduction of the diesel locomotive during the 1930s.

The American railroad era had began in earnest during the 1850s. The inability of the Pennsylvania canal system to provide a viable transportation system to transport coal to eastern markets was one of the reasons that led to the formation of the Pennsylvania Railroad Company (P.R.R.) The railroad was incorporated by the General Assembly of Pennsylvania on April 13, 1846 and the construction of the 249-mile railroad linking Harrisburg to Pittsburgh was begun. The railroad entered Pittsburgh on December 10, 1852 and its completion began a railroad-building boom in the state. By 1880 railroads opened up isolated but rich coal fields throughout western and central Pennsylvania.

The Westmoreland Coal Company of Philadelphia pleaded with the directors of the Pennsylvania Railroad to reduce transportation rates so that they could ship their coal to the gas works of Philadelphia and New York. General William Larimer, Jr., one of the principal owners of this large antebellum coal company, argued before the directors of the Pennsylvania Railroad:

> Gentlemen: If you will grant us a freight rate that will permit us to enter into a contract with the city gas works to supply it with coal your company will enjoy the benefits of earning on that tonnage and we shall be able to reap benefits for our miners and our shareholders. All of us would be benefitted and none injured in the slightest degree. Other sales would assuredly follow. [15]

Larimer convinced the directors of the P.R.R. to reduce railroad rates to less than $6 a ton to haul coal east in 1855. The company acquired 24 railroad cars in 1856 and shipped coal to an eastern market; this was the first use of railroads to transport coal to this market.

The Westmoreland Coal Company was incorporated on July 5, 1854 by the General Assembly of Pennsylvania. The firm had its corporate office at the Fidelity - Philadelphia Trust Building, Philadelphia with a regional office located at Irwin,Westmoreland County. The original board of directors were General Larimer of Pittsburgh, John Covode of Lockport, James Magee and John Scott of Jeannette, and Herman Haupt of Philadelphia. Stockholders were prominent businessmen from Philadelphia, Baltimore and Pittsburgh. Covode was elected the first president of the Westmoreland Coal Company while William

F. Caruther served as its first mine superintendent until 1872 at which time he became the paymaster for five years. The Oak Grove mine (later renamed the Old North Side mine) near Irwin was the company's first mine. From this humble beginnings this coal company acquired more coal properties and opened mines principally located in the Irwin Coal Basin in Westmoreland County. It was one of the earliest and largest mining company in Pennsylvania or the nation. Today, it is the oldest incorporated bituminous coal company in the United States retaining its original name. [16]

The introduction of coal-gas for illumination purposes was a major factor in the expansion of the coal mining industry of western Pennsylvania. Mine operators located in the counties bordering the Monongahela Valley had found a viable new market for their coal to supplement their western river trade on the the Ohio and Mississippi rivers.They were soon shipping coal by rail to the fifty-eight gas works in Philadelphia and New York. The Philadelphia Gas Works, one of the largest and earliest gas works operated by the city government, became a principal consumer of western Pennsylvania coal as this region's coal replaced coal from Virginia and Wales by the end of 1850s. Coal was converted into gas-coal used for heating homes and for illumination in churches, in auditoriums and in street lamps. Some 50,904 tons of gas-coal from the Irwin Gas Basin, Westmoreland County, was being shipped from this county alone in 1855 by the P.R.R. Westmoreland County shipped some 206,636 tons in 1860, 866,498 tons in 1870 and 943,117 tons in 1880 to eastern markets.

Like bituminous coal, semi-bituminous coal of Pennsylvania, known locally as "smokeless" coal, was being shipped by rail to distant commercial markets before the Civil War. "Smokeless" coal was an excellent steam and smithing coal mined in the North Central fields and the Broad Top field. [17] The North Central fields, composed of five small coal fields located in Tioga, Bradford, and Lycoming counties, and the Broad Top Field shipped semi-bituminous coal to eastern market after 1840. Wood was still an abundant and low-cost fuel in most parts of the nation although some communities saw their supply of timber dwindle. The southern counties of New York bordering the northern counties of Tioga and Bradford, Pennsylvania faced a critical wood shortage by the 1830s. A committee was appointed by the General Assembly of New York to find a solution to this

energy crisis. The committee reported that "the bituminous coal has been brought to us either from Great Britain or from that part of our country which borders on, and lies west and south of the Susquehanna." [18] It was known by this time that coal deposits were located in the mountains at the head of the Tioga River. The General Assembly promoted the construction of the the Corning & Blossburg Railroad to run between Blossburg and Corning to connect with the Erie Railroad which reached north to Corning in 1838. The railroad, constructed by the Tioga Navigation Company, connected the Chemung canal, and the Erie Railroad, with the semi-bituminous coal fields of Tioga County, permitting coal shipment to the southern counties of New York. Some 4,325 tons were originally sent by rail to New York state in 1840 and 25,966 tons in the following year. The Arbon Coal Company, founded by William Magee, was the first coal company in Tioga County to ship coal by rail from the county to supply three rolling mills in Troy, New York. [19] The firm continued in the soft coal business until 1842 when W.M. Mallory and Company succeeded the company although this firm failed during the Panic of 1857. Imported coal was used at salt works and by blacksmiths throughout western New York. Regional mines had shipped about half a million tons of coal to New York state by 1860. The Blossburg Coal Company began developing a large tract of coal land in the Blossburg field four miles west of Blossburg Borough in 1866.

A railroad was constructed in neighboring Bradford County from Towanda to Barclay to open up the Barclay Mining District in the county. Bradford County, located east of Tioga County, contains the eastern extension of bituminous coal in Pennsylvania. The Barclay Coal Company was formed in September, 1856 and shipped coal north to New York state. The communities of Towanda, Montezuma, Syracuse, Oswego, Utica, Troy, Rochester, and Buffalo were the principal coal markets. Coal was used for blacksmithing and rolling mills (44 percent), steamboats (20 percent), and stationary engines (18 percent), salt works at Syracuse (8 percent), and glass works (10 percent). [20] Semi-bituminous coal was also located in Lycoming County in an isolated field north of Williamsport. Coal was mined east of Lycoming Creek on Lick Run, but its production was restricted to local consumption until the construction of the Williamsport & Elmira Railroad. This railroad connected these

isolated coal mines and provided coal for eastern markets used for "locomomotives, stationary engines, in the manufacturing of bar-iron and for house-hold purposes." [21]

Two railroads served the Broad Top coal district. The Huntingdon and Broadtop Railroad and Coal Company made an effort to obtain a charter from the state legislature in 1846 to construct a railroad and engage in commercial coal production in the western side of Broad Top mountain with eastern urban markets-especially Philadelphia. The Pennsylvania Railroad extended from Philadelphia through Huntingdon County to Altoona in 1850 reaching Pittsburgh by 1852. [22] The bill was passed the next year by the General Assembly but was vetoed by the governor. The H & B T RR received a state charter in 1852 and a railroad line was completed linking the western Broad Top coal field southward at Mount Dallas with the branch of the Pennsylvania Railroad which southward joins the Baltimore and Ohio at Hyndman, and northwards joins the main line of the Pennsylvania Railroad at Altoona. The other end of the Huntingdon and Broad Top Railroad leads northward to the main line of the Pennsylvania Railroad at Huntingdon. Coal was first shipped from this railroad to the Pennsylvania Railroad in February, 1856. The *Huntingdon Journal* reported in its August 13, 1856 edition on the opening of the railroad that "there is no end to the demand for Broad Top coal. Although hundreds of tons are brought in daily, yet the demand is greater than can be supplied." [23] The railroad transported 267,720 tons of coal annually to eastern markets by the 1860s. [24]

The East Broad Top Railroad (EBT), built in 1872-1873, was a 3-foot wide thirty mile narrow gauge railroad constructed to transport semi-bituminous coal from the Broad Top mines of Huntingdon County northeastward to the main line of the Pennsylvania Railroad at Mount Union, where the coal was transferred to standard guage railroad cars for shipment to eastern markets. This narrow gauge railroad also shipped sand, rock, lumber, and general freight as well as coal to eastern markets. Broad Top coal was a high-grade low-volatile semi-bituminous coal which was principally shipped by rail east for use, in general industries, railroad locomotives, for coking purposes and domestic purposes.

Bituminous coal was mined in twenty-nine counties of Pennsylvania by 1860, but within a generation coal production in Bradford, Cameron, McKean, Venanago, Lycoming and Warren counties was negligible. River improvements and the growth of the railroads were

responsible for increasing bituminous coal production and markets The principal coal producing regions in Pennsylvania were the counties bordering on the Monongahela River and the semi-bituminous coalfields of the Broad Top and the North Central Fields by 1880. The Pittsburgh district, including the counties of Allegheny, Fayette, Washington and Westmoreland, was the major bituminous coal region in Pennsylvania, producing about 5.5 million tons in 1870. Semi-bituminous coal was in great demand in eastern markets as a steam coal owing to its small amount of hydrogen gas. The two semi-bituminous coalfields of the Broad Top and the North Central fields were producing 2.1 million tons of coal annually by 1870.

Coal Companies and Output in Semi-Bitumious Coal Regions of Pennsylvania

1872 - Semi-Bituminous	Gross Tons
Fall Brook Coal Company, Blossburg	312,466
Morris Run Coal Coal, Blossburg	357,384
Blossburg Coal Company, Blossburg	321,207
Mcintyre Coal Company, Ralston	212,462
Towanda Coal Company, Towanda	252,329
Fall Creek Coal Company, Towanda	85,315
Shoe Shoe, Centre County	95,257
Clearfield County	612,036
Broadtop, Huntingdon County	350,246[25]

Railroads became a new and major user of coal and consumed nearly a quarter of all mined coal as late as the 1930s. The transportation of coal became a principal source of revenue for many railroads. Some railroads were constructed with the single purpose of hauling coal to market after the Civil War. More than thirty railroad lines were operating in Pennsylvania by 1859. Branch lines of the Pennsylvania Railroad Main Line began connecting the new mining communities scattered throughout western Pennsylvania. The Baltimore & Ohio Railroad followed the Youghiogheny River across the southwest corner of Westmoreland county with a branch line to Everson and Mount Pleasant. The Pittsburgh & Lake Erie Railroad followed the west bank of the Youghiogheny River and crossed into

Rostraver Township. The narrow gauge Ligonier Valley Railroad operated between Latrobe, Ligonier and the new mining town of Wilpen. The Pittsburgh, Westmoreland and Somerset Railroad operated from Ligonier across the eastern county line into Somerset County.

Railroads, Iron and Coke

The character of the iron industry was changing during this period. The railroad displaced farmers as the principal consumer of iron. Iron manufacturers of Pennsylvania had been chiefly producers of agricultural tools, grates and stoves but the increase demand for iron rails led to the formation of a number of iron manufacturers specializing in the production of iron rails. The construction of the Pennsylvania Railroad created new demands for iron rails. The percentage of the total American pig iron output used in making iron rails reflects this demand for rails: 1849-4.8%, 1855-25.3%, 1860-31.8%, 1865-54.6% ,1870-47.5 %, 1875-49.9%, 1880-48.6%. [26] The construction of new railroads opened markets for coke and anthracite as the principal fuel in the blast furnace during this period. With this boom, the need for miles of iron rails for the expanding railroad industry placed demands on iron manufacturers for increased iron production at reduced costs. The early railroad companies ran on a strap rail fastened to wood. These rails were susceptible to mishaps, and the advent of heavier trains created a demand for improved and stronger rails. Wrought-iron rails, imported from England, began to replace the strap rails. American mileage of rails increased from 30,000 in 1850 to 53,000 miles in 1870 and 94,000 miles in 1880. Iron-rail production rose from less than 25,000 net tons in 1849 to 365,923 net tons in 1865, although the railroad industry was still heavily dependent on English imports.

The Mount Savage Rolling Mill in Allegany County, Maryland, was the first manufacturer to produce heavy rails when it began making the inverted "U " rail in 1844. The Montour Rolling Mill at Danville, Pennsylvania, opened in 1845, also manufactured iron rails and made the first "T" rails in the country. The 1850s saw the establishment of a number of prominent iron companies in Pennsylvania including the Cambria Iron Works (Johnstown), Bethlehem Iron Company (Bethlehem) and Jones and Laughlin (Pittsburgh).

All these iron companies manufactured iron rails. The Cambria Iron Works, founded at Johnstown in 1852, contructed four coke blast furnaces to manufacture pig iron for iron rails. The Cambria Iron Works and the Great Western Iron Company (Brady Bend, Armstrong County) turned out about a seventh of the 150,000 tons of iron rails manufactured in the United States in the decade prior to the Civil War. [27]

Iron production in blast furnaces using anthracite exceeded charcoal iron production by the mid-1850s. Charcoal pig-iron production declined from 100 percent in 1840 to 45 per cent around 1855 and only 25 percent by 1866. Hot-blast furnaces using anthracite produced nearly one-third of all the pig iron made in Pennsylvania by 1860. About a half million tons of anthracite iron was produced in the United States in 1860, concentrated chiefly in eastern Pennsylvania.There were 28 anthracite iron furnaces in 1845, 60 in 1849 and 121 in 1853 on established coal routes. Anthracite furnaces were constructed, near or within the limits of eastern towns including, Danville, Pottstown, Steelton, Scranton, Allentown, Reading, Norristown, Phoenixville, and Columbia by the 1850s. [28] Anthracite pig iron cost $12 a ton in Pennsylvania as compared to $16 a ton for charcoal pig iron. Anthracite was the principal fuel used in iron-smelting by the mid nineteenth century and continued so until it was surpassed by coke during the 1880s. In contrast, the development and use of bituminous coal and coke for iron smelting in western Pennsylvania was a slower process.

The development of the coke industry in Pennsylvania was closely interwined with the iron production, which became the principal market for coke during this period. Coke production in western Pennsylvania began in the first quarter of the nineteenth century , but its acceptance as a metallurgical fuel by iron manufacturers was slow. Coke usage in iron furnaces in western and central Pennsylvania began during the 1830s; however, its widespread use as a blast furnace fuel developed very slowly during the next two decades. Pig iron production from coke or bituminous coal was modest in 1854. Pennsylvania produced 29,941 tons, Ohio 15,000 tons, and all other states produced 9,544 tons. [29] There were 21 furnaces in Pennsylvania and three furnaces in Maryland using coke as fuel by 1856. Their total production was 44,481 gross tons of pig iron.[30] The blast furnaces of eastern Pennsylvania used anthracite during the transition era between charcoal and

coke. The annual production of pig iron smelted by anthracite was 957,000 tons, 570,000 tons of iron using bituminous coal and coke, and 385,000 tons of iron smelted with charcoal in 1871.[31] Less than 8 percent of all iron manufactured in Pennsylvania was using either coke or raw bituminous coal by 1855 although at the end of this period usage had soared to 45 percent. By 1870 more pig iron was made with coke than with charcoal, and coke use surpassed anthracite fuel in the manufacture of iron rails after 1875.

Percentage of Pig Iron Production with Various Fuels

	Bituminous Coal and Coke	Anthracite	Charcoal
1855	8	46	47
1860	13	57	30
1865	20	52	28
1870	31	50	20
1875	41	40	18
1880	45	42	12 [32]

The coke industry, like the iron industry of western Pennsylvania remained a small and a localized industry until after 1859. The Clinton Furnace, erected by Graff, Bennett & Company in 1859 near Pittsburgh, ushered in coke as a reliable blast-furnace fuel. The Clinton furnace was the first successful iron blast furnace in Allegheny County since the demise of ill-fated Shadyside Furnace. That furnace was built in 1793 by George Anshutz, an Alsatian, and his partners, William Amberson and Francis Beelen on Two Mile Creek east of Pittsburgh and soon abandoned after 1794. The Clinton furnace, located on West Carson Street in Monongahela Borough a short distance below the Pittsburgh and Lake Erie Terminial, was a small furnace with a single stack, 45 feet high, with 12 feet bosh and an annual capacity of 12,000 tons. The furnace was located next to the Clinton Iron Works and was first blown in the fall of 1859. It made pig iron using coke manufactured from coal deposits near Mount Washington. Coke was made in kilns and by the "mound" method at

this location since 1833. The Clinton furnace operated for about three months when its owners, John Graff and James I. Bennett, shut the furnace down because local coke proved unsatisfactory in producing high-quality iron.

A trial run was made at the Clinton Furnace with Connellsville coke imported by river from Fayette County in 1860. Management noted that "the result was so satisfactory that ... arrangements (were) made to secure a continuous supply." [33] Joseph Weeks noted in 1880 that "it was not, however, until the development of the Connellsville Region, Pennsylvania, that the use of coke as a blast furnace fuel for the manufacture of iron itself in the country assumed any importance." [34] The successful experiment in 1859 with Connellsville coke at the Clinton Furnace acted as a powerful catalyst for a coal and coke boom in the Connellsville district.

The Connellsville coke district, located entirely within the Pittsburgh seam lies at the northern end of the Appalachian coal fields, became the principal coke producing region in Pennsylvania and subsequently the nation during the 1860s. This compact district straddling Fayette and Westmoreland counties in southwestern Pennsylvania extends "from a point near Latrobe on the Pennsylvania Railroad, in a southwesterly direction through Westmoreland and Fayette counties, a distance of 42 miles, almost to the [West] Virginia line, with an average width of 3.5 miles, covering an area of 147 square miles, and excluding barren measures, originally contained 88,000 acres." [35] This district was originally called the Youghiogheny coke district because of the concentration of coke plants on or near the Youghiogheny River at Connellsville and at McKeesport, Allegheny County. The term, Connellsville coke district, was first used to describe the district in a newspaper article in the *Keystone Courier* newspaper in 1879.

Coal from this part of the Pittsburgh seam was recognized as being physically and chemically suited for the production of coke and soon acquired a national reputation for producing excellent coke for the iron blast-furnace. Connellsville coal was used as run-of-the-mine coal in the blast furnaces, without the need to wash it to remove impurities often present within inferior grades of coal. Connellsville coke was of a silvery lustre and cellular, with a metallic ring, and its purity and strength made it the nation's best blast furnace coke. A contemporary observer noted bituminous coal in this part of the Pittsburgh

seam was "significant because there is no other seam that can compete with it in cheapness of production. There is no other coal so regular in form; so uniform in quality; of so convenient a thickness (8 to 9 feet); or so easily mined." [36] The carbon content of Pittsburgh coal ranged from 57 to 60 percent, volatile matter from 28 to 40 per cent, ash content from 6 to 10 percent, moisture content under 2 percent and most important its sulfur content was less than 1 percent. [37]

In the 1860s, the market for coke shifted from foundries and forges to blast furnaces. Five more blast furnaces were constructed in or near Pittsburgh during the 1860s that used imported Connellsville coke. Each blast furnace had an annual capacity of 8,000 to 15,000 tons of iron, several times the average size of a typical rural charcoal furnace. About twenty blast furnaces were erected in the Greater Pittsburgh region between 1861 and 1887 and all used Connellsville coke. [38] Ironmaking in the rural areas of western Pennsylvania began a period of decline in production after 1860. Allegheny County alone produced 80 percent of the total pig iron capacity in the Pittsburgh Region (Allegheny, Armstrong, Beaver, Butler, Washington, Westmoreland and Fayette counties) in 1880. [39]

The iron and later steel barons of Pittsburgh and the surrounding mill towns located up and down the Monongahela River took advantage of the proximity of high quality coke and excellent rail and river transportation to ship Connellsville coke to their facilities. Coke was shipped directly by railroad via the Baltimore & Ohio Main Line, the Mount Pleasant Branch, Baltimore & Ohio, and the Southwestern Railroad, and numerous branch lines recently constructed or on river barges pulled by steamboats on the Monongahela River. Connellsville coke was soon shipped by rail to the blast furnaces throughout Pennsylvania, Illinois, Michigan and Ohio. It was transported to California and the Rocky Mountain states where it was used in the smelting of gold and silver ore.

Coke was manufactured in Pennsylvania (92 percent) and Ohio (8 percent) in 1870. Alabama, Colorado, Georgia, Illinois, Indiana, Ohio, Pennsylvania, Tennessee and West Virginia were the nine coke producing states in 1880 although Pennsylvania, Ohio and West Virginia produced a majority of American coke.

The American Coke Industry in 1880

(1880)	Establishments	Capital	Employees
Pennsylvania	104	$4,262,525	2,444
Ohio	15	$144,012	153
West Virginia	12	$330,000	163
U.S. Total	149	$5,545,058	3,068 [40]

Pennsylvania produced 84.2 percent of the 2,752,475 tons of coke produced in the nation in 1880. The Connellsville district had 7,000 beehive coke ovens in 1880 and produced over two-thirds of the nation's coke. Fayette County produced 45.8 percent of all coke, while Westmoreland County was second with 27.4 percent. Allegheny County, the third most productive coke county in Pennsylvania, produced only about 3.5 percent. [41] The excellent quality of this coal, its accessibility, and large reserves were important factors leading to the concentration of the coke industry in this region. About 75 percent of all wage earners in this compact region, located less than fifty miles south of Pittsburgh, were employed in the coal-mining and coke industries by 1880. The beehive ovens of Pennsylvania manufactured over 65 percent of the United States coke, with a majority of this coke production still centered in the Connellsville region at the turn of the century.

Coke Making Technology

Two principal methods were employed during this period to produce coke. Coal was originally converted in a manner similar to the production of charcoal from wood. Iron manufacturers made charcoal from wood by stacking logs in a conical pile with an opening at the top, covering the logs with earth, and building a smouldering fire inside the pile. The heat of the fire caused the logs to release their fluids in the form of steam and heavy oils, leaving behind charcoal. The earliest coke production process was known by a variety of names -"coking in coke-fires," on "coke-hearths,""in ricks,""racks" and "on the ground." Coke was produced by the controlled combustion of coal piled in large mounds

covered with turf in the open air. Part of the coal was burned to supply the heat for converting the remaining coal into coke. This was not a revolutionary coke making process but it was a popular method of coke production because it required little capital and no permanent investment in equipment, and coke could be made anywhere that coal was available. This simple and inexpensive process however had a number of deficiencies which over time these advantages could not overcome. It was a wasteful and unpredictable method of coke production. It required specific type of coal and weather influenced the process; and under adverse conditions as many as eight days were required for the conversion of coal to coke. [42] A principal weakness of this inexpensive coke making process was its inability to produce a consistently high quality coke in sufficient quantities. Coke made by the mound process yielded from 50 to 55 percent carbon in contrast to an average carbon content of about 67 percent using the beehive coke oven. This primitive and an inefficient method of coke production largely disappeared as a viable coke-making process in western Pennsylvania by the 1860s. [43] It was used occasionally in areas where the demand for coke was small and its manufacture had just begun.

Provance McCormick, James Campbell, and William Turner Sr. hired John Taylor, a local farmer and stone mason, to construct two beehive coke ovens on his farm at Hickman Run below Broad Ford on the Youghiogheny River in 1841-1842.[44] Taylor constructed ovens with a fourteen-inch rise and a flat crown, and each oven contained between sixty and seventy bushels of coal. Taylor provided the coal and the business partners manufactured 1,600 bushels of coke in the ovens that were loaded onto a ninety-foot flat boat. They sailed to Cincinnati in the spring of 1842 in search of a buyer. [45] This river voyage was the first attempt to "export" coke from the Connellsville Coke District, but the trip down the Ohio River was a dismal business failure. They were unable to find buyers because the furnace operators from southern Ohio were unfamilar with "the silvery porous cinders." Mordecai Cochran and his two nephews, James "Little Jim" and Sample Cochran purchased the ovens. The new owners produced 13,000 bushels of coke and transported two coke filled flatboats down the Ohio river to Cincinnati on April 1, 1843. The coke was sold to Miles Greenwood, a Cincinnati foundryman, for seven cents a bushel, receiving one-half in cash and the balance in old mill irons. [46] This transaction was

the first commercial sale of beehive produced coke outside the Connellsville district. [47] The Cochrans continued making coke at this site which was enlarged to thirty beehive coke ovens in 1860.

Through numerous experiments coke manufacturers improved the design of the beehive ovens and mastered the production of coke during the next two decades. The Cochrans, residents of Dawson, Fayette County, was a prominent family long associated with the commercial coke industry of the Connellsville district. Each man established a number of important coke plants in Fayette County during the nineteenth century. The Cochrans were a prominent antebellum coke producing family long associated with the commercial coke industry of the Connellsville district. Each man established a number of important coke plants in Fayette County during the nineteenth century. Washington No 1. and No. 2 mines and coke plant at Star Junction, Fayette County was the last and largest facility opened by Philip Cochran, son of James Cochran in 1893. Colonel Alexander M. Hill, like the Cochrans, was another pioneer coal and coke producer. He purchased a farm and erected seven ovens in 1844 near Connellsville.

The dome-shaped refractory brick beehive coke oven developed near Connellsville subsequently became the universal method of coke production during this period. The design of the beehive oven evolved by trial and error during the nineteenth century as coke operators attempted to find an adeqate oven design that would yield high-quality metallurgical coke. The beehive oven is an arch-roofed circular brick room constructed of masonary firebrick and tile with an opening at the top. The space between the lining and the outside walls was filled with waste bricks, and other material to prevent, as far as possible, the loss of heat to the exterior (Illustration 1- Design of the Beehive Coke Oven). On the top of each oven was a twelve-inch circular opening called the trunnel head or "eye" which could be covered with a metal lid. The interior of the oven was shaped like a beehive and lined with heat-resistant refractory fire bricks measuring about 12 feet across the base and 7 feet high. There were no industry-wide standards on the physical size of the ovens interior, although larger coke operators including the H.C. Frick Coke Company did standardize the interior size of their ovens. The exact configeration of a coke plant was determined by local topography and operating costs. Operators constructed their ovens in batteries

arranged in single rows called "banks," or in double rows called "blocks." Block ovens were usually constructed in conjunction withsingle row bank ovens. The number of ovens at a coke plant ranged from a couple of ovens to continuous banks including as many as 300 ovens during this period (Illustration 2 - Beehive Coke Production Facility). The manual coking process took place in five distinct steps: charging, leveling, quenching, drawing and loading. Coal was delivered to the ovens from the nearby mine to the wood tipple by horse-drawn wagons. Coal was then transported on coal cars called larry or lorry cars (also known as "dinkey" cars) mounted on tracks and pulled by draft animals along the top of the ovens. Workers called "chargers" filled these cars with coal at the mine tipple, then positioned them over the oven to discharge the load into the trunnel opening. A charge of 5 to 7 tons of coal filled the oven to a depth of about 2 feet when leveled. Some larry cars were constructed to charge two ovens at the same time in block ovens. Coal gases escaped through this opening as flames and noxious smoke. A worker called a "leveler " then leveled off the dumped coal in the oven by reaching in through the oven's front opening. He used a hoe at least 12 feet in length with a specially designed scraper head to level the coal within each oven. The two-by-three-foot entrance was sealed almost shut with fire bricks and mud by a "dauber" to restrict air from entering the oven. The heat stored in the oven from the previous charge ignited the coal and the coke making process began again. After the coal was converted into coke the fire bricks were removed and the "puller" broke the coke loose and drew it from the oven. Pulling coke was the most arduous task at the ovens, requiring great physical strength to break up the hot coke and draw it from the oven. The coke was quenched by sprinkling it with water to prevent it from baking. Water lines for this function ran the length of the ovens. Coke was then loaded into awaiting railroad cars by hand, using a coke fork or with the aid of large wheelbarrows. Every third oven in larger coke operations was fired at the same time so that the shifts of men were kept working uniformly. (Illustration 2 - Manually extracting coke fron beehive ovens). A contemporary description of the coke-making process using the beehive oven follows:

> The charge of coal is dumped in at the crown of the oven and spread on the floor to an average depth of two feet to burn what is called 48-hour coke and 2 1/2 feet for what is called 72-hour coke. The front opening of the oven from which the coke is taken when finished having been nearly closed with brick and luted with loam. The heat of the oven from its previous coking fires the charge. As the coking progresses the air is gradually shut off by closing all openings. When the coke is thoroughly burned the door is opened, and the coke cooled (quenched) by a stream of water thrown upon it with a hose, after which it is taken out, and the yield of coke is from 63 to 65 percent of the coal charge. [48]

A standard charge per oven of this period was about 5 tons of coal producing approximately 3.1 tons of coke from Pittsburgh-seam coal. [49] A well-built beehive oven converted as much as 70 percent of each ton of coal into coke while approximately 30 percent of the coal was discharged into the atmosphere as noxious smoke. [50] The gaseous and liquid hydrocarbons were burned off in the beehive coking process, so that only carbon and ash remain in the oven. A ton of coal was reduced to 1,200 to 1,300 pounds of coke and this reduced weight and bulk lowered the cost of transporting coke to the distant blast furnaces. Coking time in the ovens varied from 48 to 72 hours depending on the character of the coke desired and the kind of coal used. [51] The coking time affects the quality of coke: forty-eight-hour coke was generally sold as "furnace" coke and seventy-two-hour coke sold as "foundry" coke. [52] This is a special coke used in furnaces to produce cast and ductile iron products. It is a source of heat and also helps maintain the required carbon content of the metal product. Foundry coke production requires lower temperatures and longer times than blast furnace coke. It took about three hours to draw and recharge each oven manually. Individual pieces of coke ranged in size from a golf ball to a basketball. Metallurgical coke must be made with a coal having a low ash and sulfur content. Coke has a heat value of about 25 million BTU per ton and high-quality coke is capable of burning in a steel mill blast furnace at a temperature ranging from 2,000 to 2,200 degrees Fahrenheit. [53]

The name Henry Clay Frick is synonymous with the coke industry of western Pennsylvania. [54] Frick was born in the heart of the Connellsville Coke District in the springhouse at his maternal grandfather's farm near the village of West Overton, Westmoreland County, on December 19, 1849. He was the second child and first son of John W. Frick and Elizabeth (nee Overholt) Frick. Frick was named after Henry Clay, a prominent antebellum Kentucky Whig politician, three-time presidential candidate and statesman. The Overholts came to the American colonies, landing in Philadelphia in 1732 from Lower Palatinate. The Fricks came to America from Switzerland landing in Philadelphia in 1767. Abraham Overholt, his maternal grandfather, was a prominent local land owner, miller, whiskey distiller and the wealthiest resident in the county. The A. Overholt & Company distillery was constructed on the banks of the Youghiogheny River at Broad Ford near Connellsville before 1834. Frick attended school at West Overton, Alverton, and Mount Pleasant and after completing his formal education worked as a clerk for Macrum and Carlisle, a Pittsburgh department store. He contracted typhoid fever in Pittsburgh and returned home to West Overton in 1868. After his recovery, Frick was the chief bookkeeper for his grandfather's firm, A. Overholt & Company, from 1869 to 1871.

There were only twenty-five small coke plants in the entire Connellsville region in 1870, and coke production was not a principal industry in the area's economy. Frick became involved in the coke industry with A.O Tinstman, his cousin, and Joseph Rist when they established Frick and Company in 1871 to furnish coke to iron foundries and blast furnaces in western Pensylvania. The partners purchased 123 acres of coal lands at Broad Ford at a cost of $52,995. Frick and Company had two coke plants in operation with 200 beehive ovens by 1872 located near Broad Ford, Fayette County.

The Panic of 1873 reduced the price of coke to less than 90 cents a ton and forced many coke operators to the brink of bankruptcy. Money was scarce and the depression made it nearly impossible for coke producers to obtain loans. Frick borrowed $10,000 from Judge Thomas Mellon, president and founder of the Mellon and Sons on Smithfield Street in Pittsburgh and used these funds to expand his coke business by acquiring smaller rivals who were anxious to sell their unprofitable coke plants. Frick who was an astute businessman bought out his partners in 1876 and continued in the coke business by

himself and by the age of thirty was a millionaire. He was prepared to monopolize the coke industry following the end of the depression as the price of coke rose from about ninety cents to $4 and $5 per ton to meet rising demands from the expanding steel industry in the Pittsburgh district. Frick insisted to friends and associates that "coke's the thing they can't make steel without." The Bessemer steel-making process permitted the rapid shift from iron to steel production and increased steel production. Frick coke operations in Fayette and Westmoreland counties shipped high grade metallurgical coke in nearly 100 railroad cars daily to the foundries and blast furnaces of Pittsburgh mills in the 1880s, much of it to the Edgar Thomson Steel Works at Braddock, situated twelve miles down the Monongahela River from the Point. This Carnegie constructed steel plant was the first Bessemer steel plant in the region, opening for steel rail production in 1875.

Bituminous Coal as a Coke and Charcoal Substitute

Raw bituminous coal known as splint or block coal was used directly in the blast furnaces by iron companies located in Mercer and Lawrence Counties, bordering Ohio. Block coal found in the Hocking Valley of Ohio and Indiana was also dumped directly in the furnace under nearly the same conditions as Pennsylvania block coal. This peculiar kind of hard free-burning bituminous coal found in these Pennsylvania counties bordering Ohio because of its geological formation, splints along the seam like slate. Like anthracite, splint or block coal is a low volatile coal that is slow to ignite and burn. Its chemical structure is of sufficient hardness to bear the charge and high temperature required in the blast furnace of this time. This coal was used directly in blast furnace in the smelting of iron or the manufacture of pig or cast iron. Raw splint coal was first successfully used iron production at Himrod & Vincent Company's Clay Furnace, Mercer County, in July 1845. [55] The Mahoning Iron Works of Wilkinson, Wilkes and Company of Lowell, Ohio, produced pig iron with splint coal in their blast furnace the following year. Raw block coal was used in the furnace although iron masters in larger furnaces used a small amount of coke to keep it open and enable it to take the blast with greater freedom. These pioneer successes led to an increased use of splint coal as a blast furnace fuel in the Mahoning and Shenango valleys.

There were eleven iron blast furnaces in the immediate region using splint coal by 1850 - four furnaces in the Mahoning Valley, Ohio and seven in Mercer County, Pennsylvania. [56] There were six blast furnaces in western Pennsylvania and thirteen in Ohio making iron using splint coal by 1856. Coal output in Mercer County exceeded 2,500 tons per day during the Civil War; this was a considerable quantity for the period. Mercer County produced about 500,000 tons of splint coal, for use in twenty-three blast furnaces in the county and for sale to furnace operators in neighboring western Ohio by 1870. [57] Splint coal production in 1870 was 267,257 tons. Coal was transported from Mercer and Lawrence counties by canal (Erie and Beaver Canal) and the Erie & Pittsburgh RR (Mercer County) and Shenango & Allegheny RR (Lawrence County) to distant commercial markets.

The Arrival of Skilled British Miners and Mining Technology

A majority of mine workers before 1840 was originally drawn from neighboring farms and villages. These farmers and day laborers worked underground in drift-entry mines in the winter when there was little demand for labor on the farm. The new demand for coal increased production and transformed the industry from a seasonal to continuous year-round industry between 1840 and 1880. This increased production placed a new demand for labor that was fulfilled by English-speaking miners from England, Wales, Scotland, and Ireland. Some 2,000 English-speaking miners arrived during the 1840s and an additional 37,000 miners arrived from Great Britain during the 1850s. [58] A contemporary writer of the American coal industry observed that "the mining population of our Coal Regions is almost exclusively composed of foreigners, principally from England, Scotland, and Wales, with a few Irish and Scotsmen." [59] These skilled British miners toiled underground in both the anthracite and bituminous coal fields of Pennsylvania. English, Welsh, Scotch, Irish, German, Canadian and native-born Americans were the principal nationalities of mine workers before 1880. These skilled English-speaking miners would dominate the coal mining industry until waves of immigrant workers from eastern and

southern Europe would supplant them as the principal coal-diggers in the nation after the 1880s.

These immigrant miners gave the American coal industry a distinctly British flavor. They had served long and arduous apprenticeships in British mines and were skilled in all facets of mining. The coal-mining industry in Great Britain, Germany, Belgium, and France was well established by 1600. The coal output of Great Britain for 1660 was estimated at about 2.2 million tons; in 1700 about 2.5 million tons, and in 1800 over 10 million tons. The city of London alone consumed nearly 500,000 tons annually in 1600 and the city used some 850,000 tons annually at the beginning of the American Revolution. Historian Keith Dix noted that "these independent craftsmen learned their job during an extensive apprenticeship period and once having mastered these skills worked largely without immediate supervision and at their own pace. The early pick miner was not only in control of his job but also in control of his own time in the job." [60] These British miners took virtual control of the American coal industry as "their mining methods, tools, and much of their terminology became part of the American technique. They also initiated the miners labor movement." [61]

J. Peter Lesley Jr. (1819-1903), the State Geologist of Pennsylvania, held a negative opinion of these slilled British miners. He was chosen in 1874 to become the State Geologist of the Second Geological Survey of Pennsylvania (1874-1889). Lesley castigated their mining skills and their inability to adapt to mining conditions found in the United States. He wrote in 1876 that :

> the mines in the State were (with some honorable exceptions) bossed by the commonest miners from foreign and quite different geological regions, who had suddenly exchanged the character and position of the hewers of coal and pumpers of water at home, for the character and position of mining engineers in America. Ignorant, undisciplined, obstinate, narrow-minded, and supersititous by nature and habit, and rendered presumptuous by their strange advancement, they were unwilling to accept as they were unable to acquire a correct knowlede of our geology, so different from their own, and hated professional geologists because they had never lived in childhood, pick in hand underground, - because they taught new things hard to

comprehend... (sic) [62]

Lesley's castigation aside, life and work deep underground in the pre-mechanized nineteenth century mine was defined, organized, and controlled by these immigrants. These British miners, known as "practical" miners, were proud that "no dammed foreman can look down my shirt collar." [63] Each skilled miner was employed as an independent petty contractor who entered into a contract with the individual mine owner. Each contract stipulated rates of pay per bushel, ton, or car of mined coal delivered in the entry where it was collected by the "mule skinners," or trip ridders. As piece-rate workers, they determined both the hours of their daily labor and the tempo of work at the face in the room where coal is extracted daily. They were required to work long hours underground averaging from ten to fourteen hours a day because rates were low. The miner's work was hard, dirty, and carried on underground in a cool environment with an average temperature of about 45 degrees Farenheit although underground temperature can vary slightly with the extremes of the seasons. The antebellum coal miner worked alone or with a companion called his "buddy" or "butty." These skilled workers usually worked two in a room and exchanged mining duties. They hired and paid one or more day laborers to load the coal onto wooden wagons and transport it to the surface tipple.

The miners and their assistants entered the drift mouth or down the mine's slope entry by foot to their "room" before sunrise, carrying with them a variety of hand mining tools, their lunches, and their lamps. Miners were transported to the working face underground in a cage or elevator powered by a steam engine located in the hoist house in a shaft entry mine. The principal method of opening a mine was the drift entry although a number of slope and shaft mines were opened by coal companies in Pennsylvania during this period. A slope entry, the second most common type of mine entry, is employed when the coal seam outcrops on the surface, but is inclined downward at angles varying sixty or more degrees. A slope mine is really an inclined passageway cut into the earth to reach the seam. This entry is driven from an outcrop generally southward along the dip of the seam. This entry is a more costly than the drift entry to maintain because mechanical equipment is often required to haul coal out of the mine and the need to expel accumulations of ground

water. The angle of the tunnel's inclination is often too great for the strength of working mules to haul the coal cars up to the mine's entry. Mules hauled coal in small wooden wagons on tracks to the foot of the slope, and then the loaded coal cars were pulled up by cables or ropes operated by a coal-powered steam engine at the mine's entrance.

A shaft mine is a vertical entrance that is sunk when the coal deposit is located some distance from the surface or when the coal seam is located below water level. A vertical tunnel is dug through sandstone and shale deposits until the coal seam is located. Miners then dig horizontal entries through the coal seam. Miners, equipment, coal and waste are transported between the coal seam and the surface by an elevator system. This entry was capital intensive and requires the installation of elaborate hauling equipment to move coal, waste, miners, draft animals and equipment vertically by an elevator or cage powered by steam. Some slope mines and most shaft mines presented difficult problems of water drainage and ventilation. The entry was expensive to maintain because the coal operator had to provide mechanical ventilation which meant digging separate air shafts and maintaining a variety of equipment for haulage purposes. A shaft mine located below the water table required the installation of water pumps because these mines were often wet and flooded by water seeping into the mine from underground springs. Water in the mine was a great barrier in coal mining and the constant pumping of water from the mine added to the cost of mining coal. The folding of the deeper coal seams often interfered with natural drainage, therefore, water had to pumped out constantly or it soon filled up the mine. [64]

The general operation of mines in this period was still the room-and-pillar system. The lengthy inventory of equipment needed to mine coal included a broad shovel, picks, dynamite or black powder, an auger (6 to 8 feet in length), tampering box or stick, sledge hammer, wedge, and some source of illumination. Miners never saw sunlight except on those days when they did not work during the long winter months. They entered the dark mine before the sun rose and left it after the sun had set. Miners brought a variety of light sources underground to illuminate their work area. An old Belgium miners' song expressed the importance of the miner's lamp: "my lamp is my sun - And all my days are nights" (Illustration 4 - Sunshine Lamp). [65] Originally, miners used large candles to produce sufficient light underground to mine coal. An individual miner used six to eight

candles during a typical shift. "Lard" oil lamps were introduced in the mines during the 1850s. They had a small conical font in the front of the lamp that held its fuel in a long sprout that extended outward from the font. The fuel was a mixture of lard and oil - cottonseed oil, kerosene, or crude oil. The lard lamp was soon replaced by sunshine fuel which was a mixture of paraffine wax and three percent mineral oil, which unlike the lard lamp burned without smoking.[66] The "Sunshine" lamp resembled a miniature pitcher with a wick extending from the sprout and was attached to a miner's canvas cap. This lamp was hazardous to miners since the paraffin fumes eventually solidified in their lungs.

The Anton Brothers of Monongahela City, Washington County, manufacturered sunshine lamps around 1874. Brothers George, John, Fred, and Christopher came from Bavaria in 1849 and settled in Monongahela City, Washington County. They operated a number of lamp factories in the Monongahela Valley beetween 1874 and1918. The *STAR* brand lamp made by them was the best selling wick lamp in the nation owing to their quality construction, although the lamps were primitive in function. The Anton Brothers held several patents on their designs which made them competitive in international markets. They made a variety of miners' wick lamps for different uses that were sold by jobbers in all the mining regions of North America. They called their lamps *Anton Lamps* although most miners simply called them sunshine lamps. The introduction of the carbide lamp in the 1890s and the demise of the wick lamp destroyed their market. The brothers were unable to make the conversion to carbide lamps and closed their company in 1918. [67] The carbide lamp with a reflector was a superior lamp because it provided more light and were less expensive to operate.

Miners checked for air quality and explosive gases that might have accumulated during their absence. Mine air was seldom pure, instead the underground mine atmosphere carried a variety of poisonous or highly flammable gases. Pure air contains 20.9 percent of oxygen, 78 percent nitrogen, three parts in 10,000 of carbon dioxide, and small amounts of argon, helium, and other gases. Fire and explosions presented major hazards to underground workers in the mining of coal. Methane, ethane hydrogen, carbon dioxide, carbon monoxide and hydrogen sulphide are found in underground mines. Methane (CH_4), known as "swamp gas," "marsh gas," or "light carburetted hydrogen" is a non-

poisonous, tasteless, ordorless, and colorless gas. Methane is the result of the decomposition of organic matter in the mine and the amount of methane is dependant on its depth below the surface. Deep mines, as a rule, have more methane gas than shallow mines. Methane is removed from the mine naturally by brisk air currents that are of sufficient quantity and properly directed. Methane when it mixes with air forms "fire damp" which is a highly volatile gas, easily ignited by an open flame or an electric spark. Fire damp is formed when a concentration of between 5 to 15 percent methane mixes with air. Since this gas is one-half lighter than air it tends to gather along the top of mine workings. The proportion of "fire damp" may be determined by the fire boss with considerable accuracy of 1 percent or less by using a gas safety lamp. The height of the flame determines the presence of this gas. The fire boss was assigned the responsibility of checking gas and air quality in the mine. Carbon dioxide (CO 2) is a product of combustion from the breathing of men and draft animals, fires, decay of organic matter, explosion of coal gas or dust. Like methane, it is orderless, colorless, and non-poisonous and will not support combustion by itself. This gas is called "choke damp," "black damp" or "stythe" because it excludes oxygen and settles close to the mine's floor. It received its name from the choking or distress caused by inhaling it. Miners subjected to air containing 3 or 4 percent carbon dioxide suffer headaches and choking. A concentration of ten percent is fatal in a few minutes. Carbon monoxide (CO) is an orderless, colorless, but extremely poisonous gas. "White damp" gas is a mixture of mine gases which contain carbon monoxide in dangerous quantities. The inhaling of this gas can kill a miner immediately even in small concentrations. "White damp" will burn and explode with air but the gas will not support combustion. After damp is any mixture of gases formed from a mine fire or an explosion. After damp may be an explosive or flameable mixture or it may be non-flamable but extremely poisonous.

Miners brought small birds (usually canaries) and animals with them underground to detect and warn them of the presence of lethal mine gases. [68] If the animals died it was a sign that deadly gases were present in the air. Some miners would burn hemp rope in the mine to detect the presence of methane. Methane was present if the rope burned brightly.

Safety gas lamps were introduced to measure the presence of methane gas in the mine beginning with the manufacturer of Sir Humphrey Davy's lamp in Great Britain on December 5, 1815. [69] The Davy lamp was one of the earliest safety lamps to successfully detect methane gas as low as 2 to 2.5 percent in air (Illustration 5 - Davy Lamp). The lamp has an open gauze which allows the free flow of air in and out of the lamp. The flame in the lamp was enclosed within the wire gauze, being a good conductor of heat, conducts it away so that the heat of the flame was not sufficient to ignite the gas outside the gauze unless the gas concentration in the mine was high and the flame became to high. The early safety lamps burned naptha which is an artificial, volatile, colorless liquid obtained from petroleum. If the air in the mine was pure the flame in the Davy lamp was a clear yellow color while a blue flame indicated the presence of gases in the air. The light output of the Davy lamp was poor, seldom exceeding 13 percent of one candle power. The flame could also be easily blown out. A variety of improved safety gas lamps were introduced by several American and European manufacturers throughout the nineteenth century. The most popular safety lamps used by American miners were manufactured by Wolf and Koehler.

An old definition of a mine was "any excavation for the extraction of mineral and in which artifical light is needed." To this someone added the following remark, " and in which the air is bad." There was no need for mechanical ventilation in the early small drift-entry mine because a natural draft was created resulting from the difference in the weight of air in the intake and the outtake. The outside atmosphere were dense and heavier than air in the mine in the winter, while during the summer these climatic conditions were reversed. Proper ventilation was an important part of mining for the health and safety of the miners as coal miners went deeper underground to extract coal. Mine ventilation was required to remove the accumulations of gases and provide fresh air for the miners. Smoke from explosions of black powder, the reek of the miners' oil wick and coal dust from undercutting coal by hand or with machines made air deep underground almost unbreathable. A well-ventilated mine was not subject to the build-up of poisonous or explosive gases and reduced the danger of explosion. Natural ventilation was not always feasible in slope and shaft mines located far below the surface. An early ventilating technique involved installing a furnace at the bottom of the shaft. An air intake shaft was

sunk some distance away. The furnace shaft acted as a chimney by drawing the warm air up and out while fresh air entered the intake shaft to replace the air drawn out of the chimney. [70] This method of ventilation posed a very serious fire hazard, and its wide-spread use was discontinued after such a furnace caused an explosion at the Steuben Shaft at Avondale, near Plymouth in Luzerne County. This new mine was constructed in 1868 by the multi-colliery Nanticoke Coal Company, a subsidiary of the Delaware, Lackawanna and Western Railroad, which was owned by three large coal, iron and railroad corporations. A wooden breaker was constructed directly above the single 300 foot shaft which led to the mine below. Sparks from burning wood, used in lighting the furnace, set fire to the wooden base of the shaft which in turn ignited the wooden breaker at the top of the shaft entry and trapped the miners underground. [71] There was only this one exit or egress from the mine and therefore most of the trapped miners died of asphyxiation or smoke inhalation. [72] The Avondale disaster was the worst coal mining disaster to occur in the United States up to this time, claiming the lives of 179 miners on September 6, 1869.The tragedy prompted the passage of legislation requiring that every mine in the Commonwealth have at least two exits and that no breaker could be built directly over the shaft opening.

Early mine fans were powered by water, wind, and hand. The Guibal fan, named after the Belgium inventor who designed it, was one of the earliest mechanical fans. It was introduced in 1844 and was used extensively until the 1870s. The fan had a large metal blade revolving about fifty times per minutes. [73] Larger mines adopted a system of multiple entry airways to provide adequate ventilation. A second drift entry or tunnel was driven parallel to the first and 40 to 100 feet distant. At intervals as the two parallel enteries are driven forward cross tunnels are driven to connect the entries. As each new break through is cut the last one behind is sealed. A fan is installed at the mouth of the ventilating entry designed to force air through or to withdraw air from the mine. The movement of fresh air into underground workings extending for several miles required the development of a sophisticated system of barriers and trapdoors to direct and maintain a constant supply of fresh air because air current passing in a mine meets with resistence, called the "ventilating pressure" owing to the friction of moving air against the sides, top and bottom

of the airways. [74] A series of partitions called brattices made of wood and cloth closed off abandoned areas. These barricades separated different parts of the underground passages and controlled the flow of fresh air in the mine. Trapper boys, often less than ten years of age, were responsible for manually opening and closing these barricades as needed.

The collapse of the mine's roof was a leading cause in the death of workers during this period. A principal unpaid task of the miner was to maintain the roof. They checked the mine's roof to see if it was secure or needed to be timbered. A miner would "sound the roof" to see that it was secure by holding his hand up against the roof with the fingers spread out, and then tapped the roof with the end of the pick handle. A hollow sound indicated the roof was pulling loose, but if the sound was solid the roof was stable. If coal began to peel off the wall, the miners stopped working and corrected the condition. The mine roof was supported by wooden props or logs which were wedged between the roof and floor.

Miners had to perfom preparatory and maintenance work prior to beginning the actual task of mining. All tasks in the mine in addition to the work of cutting, shooting, and loading coal were time consuming activities. Miners called this work "dead work" or "unproductive work" because they were unpaid tasks and ancillary to production. They were paid for only the coal they actually mined. Some miners were often careless in adequately protecting themselves against roof collapses, gas detection, ventilation, and their inaction to this unpaid work often proved fatal to many.

Coal mining was an arduous, tedious, and dangerous occupation. Miners used pick and shovel to dig coal and mule drawn wooden cars to haul it from the room to the surface to the weigh station and tipple. The process of extracting coal entailed a series of distinct steps and throughout this period there was little mechanized equipment; instead, workers relied exclusively on human and animal "muscle" power. Four basic tasks were involved in mining coal in non-mechanized mining : undercutting the coal face, drilling the face, blasting the coal, and loading the coal for transport out of the mine. Miners extracted coal from the seam by using a variety of primitive hand tools including a wedgepin, a sledge hammer, a variety of picks, an auger, shovels, tampering bars and needles. The workplace at the seam ranged in area from two to twenty feet high, depending on the seam's

thickness. The work of "undercutting" (undermining) coal was the most skilled, dangerous, and time consuming activity in the pre-mechanized mine. The undercutting of coal permitted the coal to break into chunks when it was knocked or shot from the seam. The skilled miner usually had to lie on his side and using his sharpened pick, he made a series of three-or four-foot horizontal cuts into the base of the face. When the cut was part way through the seam, the miner placed short wooden blocks or props known as "sprags" under the face of the coal after it was undercut to prop it up so that the overhanging mass would not fall on him, as he lay underneath to finish the job. This process is called "spragging." The term is used also to define a primitive system of braking mine cars. The miner made two vertical cuts from the top of the seam down to the undercut and then hammered iron wedges into the top of the outlined block of coal and then attempted to remove the coal without shattering it. The advantage of a deep undercut was that more coal could be removed in a day's work. This task took up to several hours, dependent on the miner's skill, the sharpness of his pick, and the hardness of the coal seam. [75]

Coal that was too hard or difficult to remove from the seam by the undercutting and wedging method, was later dislodged by explosives. The use of explosives was objectionable because if improperly used it broke up the coal into fine coal, or "slack" which was waste coal since a market for fine coal was undeveloped during this early period. Miners became experienced in the use of a variety of explosives- first black powder and dynamite and later nitro-glycerine. Explosives were first used to remove anthracite coal from the seam because the coal was too hard to extract manually. Blasting coal from the seam gradually replaced the wedging method although there was some opposition to its wide-spread use. The extensive use of explosives was seen by some skilled miners as constituting an intrusion on their skill since it required considerable less expertise than employing the wedging method. Improper use of black blasting powder by miners was a principal cause of many serious mining accidents. A skilled miner, who opposed the increased use of explosives, wrote in 1875:

> A practical miner works all such coal without the use of (blasting) powder, unless there is some trouble in his place where he cannot take it down by

> the use of a wedge. On the other hand some Tom, Dick, or Harry that perhaps knows very little about coal mining brings a drilling machine and a keg of powder and by mere force of blasting puts out perhaps as much coal as another man, not caring who is suffocated by his powder smoke. The skilled miner has no advantage over the greenhorn. [76]

Black blasting powder, a slow-acting granular explosive, was originally used to remove coal from the seam. This powder was also used in quarrying stone, road and railroad grading, general excavating and clay mining. Black blasting powder is a combination of three principal ingredients: saltpeter (potassium nitrate), 76 percent; sulfur, 14 percent; and charcoal, 10 percent. The powder, which does not freeze, was manufactured in two grades, "A" and "B." "A " powder contained potassium nitrate and is more water resistent, stronger and quicker than "B" powder whose active ingredient was nitrate of soda. Blasting powder was not completely water resistent and not usable in wet work areas. Glazed (polished) or unglazed powder was manufactured. Glazed powder was the more popular type. Glazing was done by using a small amount of graphite to polish the outside of the grains. Black blasting powder, unlike dynamite, was not made in different strengths, but was manufactured in only one strength. The powder was packaged and sold in 25 pound metal kegs called powder kegs after 1874. [77]

The miner used the following procedure when blasting coal from the seam with squibs and black blasting powder: 1) drill a hole with a hand auger, a churn drill or sometimes a breast auger strapped against the miner's chest from an upward angle after the coal was undercut (undermined), 2) place a black powder cartridge in the bottom of the drill hole, 3) place a needle into the black powder cartridge (the needle is a thin copper rod, usually five to 6 feet long with a loop handle on one end and pointed on the other, 4) tamp stemming into the hole around the needle, 5) pull out the needle, 6) place a squib in the hole left by the needle, light the match end of the squib. The squib, also known as a match, reed, or rush, was used by miners to detonate the black powder. It was a small paper tube filled with quick burning powder and with a slow match at one end acting as a fuse to permit miners time to evacuate the area. As soon as the squib began to fizzle the miner and his

laborer ran for safety in a corner until the coal was blasted off the wall and the smoke cleared. [78] A single explosion could dislodge a ton or two of coal from the face. [79]

The dislodged coal was shovelled with a broad-billed, flat-backed shovels into small baskets or wooden cars by hired laborers. A brass check with the loader's identification number stamped on it was placed on the coal-filled car and then the loader pushed it from the room into the main passageway, where the mule driver collected the car. The check identified which worker had loaded the car. Miners were paid on a piece-rate based on the number of tons or bushels loaded daily. Coal was originally removed from the mine by miners using a crude harness that fit across their shoulders. Coal and waste was later removed from the mine on sleds and small wagons. A variety of animals-oxen, horses, ponies, goats, mules and dogs-were all used to haul wooden carts or wagons underground to the surface on narrow-gauge wooden railroad tracks (later iron rails were used). Dogs were the first animals used by pioneer miners to haul their coal to the surface. A dog or a number of dogs were harnessed to the front of a wooden cart while the miner pushed from behind. Michael Dravo, a mine owner near McKeesport, Allegheny County, is credited with first using mules instead of men and dogs for this laborious task during the 1830s. Mules or horses had succeeded men and dogs in moving coal through the main mine tunnel by the end of the period. Coal carts were dragged on narrow-gauge iron railroad tracks, branching into the various rooms in which the miner worked alone or more often in pairs.

Surface buildings and structures at a typical bituminous coal mine of this era consisted of a wooden tipple, a loading platform, a small storage shed for mining supplies, and a mule stable if draft animals were used for coal haulage. The coal cars in the few shaft and slope mines operating during this period were delivered to the shaft bottom where they were elevated to the surface by a steam-powered engine in the hoist house. A fan house to enclose the fan that provided mine ventilation was located at these mines. Most tipples of this era were located on the river. The river tipple extended out over the bank of the river (Illustration 5 - River tipple on the Monongahela River). The tipple was a large tower-like structure at the entrance to the mine. Coal from the mine was delivered into the tipple from which it was loaded into river barges or railroad cars below. This wooden structure was called a tipple because after the coal was weighed by the weighmaster, each car was

"tippled" or " dumped," into the top of the structure. Coal slid from the car onto a series of screens in the tipple or directly into railroad cars or a barge. Coal was sorted into a variety of different sizes by passing through a series of different size screens inside the structure - lump (largest), nut (one-inch) piece, and slack (one-half inch). Coal shipped to market after it was weighed but not sorted or processed in the tipple was called run-of-the-mine coal. A majority of coal was shipped to market without much processing at the tipple during this period. [80] Anthracite, unlike bituminous coal, was subject to extensive processing before its shippment to commercial markets after it was removed from the mine. Gideon Bast constructed the first successful wooden "breaker" in the anthracite region at his Wolf Creek Colliery in 1844. In the anthracite region, the preparation plants were called "breakers," the name originating from the fact that anthracite is broken and sized in the plant. The breaker was an imposing often windowless wooden building where run-of-the mine coal was broken up, washed, separated into uniform sizes and cleaned of impurities especially slate by "breaker boys" before shipment to market.

Most contemporary mines had single entries and employed natural drainage and ventilation. Mine entries were usually a drift-entry type located in the face of a river hillside, employing fewer than fifty miners. These mines were usually owned locally with daily output of about a hundred tons. Seven thousand workers were employed in the mines on the Monongahela Valley in 1868, producing 2.5 million tons of coal annually, of which two-thirds were barged out of the region to markets down the Ohio River to markets as far south as New Orleans. A half million tons of coal were moving out of the Monongahela Valley to New Orleans by 1885. [81] The Mingo Coal Works, Washington County described in George Thurston's *Directory of the Monongahela and Youghiogheny Rivers* of 1859 was an accurate description of a typical large mine of this era:

> The ground is leased. There are in the works 80 rooms, and 1,200 yards of entry. The improvements cost $15,000, and the works have a river front of one half mile. There are 100 hands employed at the colliery, who mined 550,000 bushels in 1858-1859, all of which was taken to Cincinnati. This company has 25 barges, worth $20,00, and one steam boat, the Mingo, worth $18,000.

Miners' Organizations

Pennsylvania did not maintain a monopoly on its production of bituminous coal as was the case with anthracite between 1840 and 1880. There were fifteen bituminous coal producing states and 36,500 miners in the United States on the eve of the Civil War. [82] Besides Pennsylvania, the principal bituminous coal-producing states were Maryland, Illinois and Ohio. The skilled British miners, who came to dominate the American coal industry, were militant industrial workers who had pioneered the early labor movement in Great Britain. They founded the Miners' Association of Great Britain and Ireland, the first national mining union in the world during the 1840s. These transplanted skilled miners were imbued with a strong trade union tradition and were responsible for organizing local miners and establishing the early miners' unions in the United States. Miners, like other industrial workers, recognized that the only hope of advancing their shared economic interests lay in their collective and unified action. The complaints of the early coal diggers with individual owners, aside from low wages, were against the quality of company houses, high prices charged in the company stores, poor underground air ventilation and the method used by coal operators in weighing their coal.

Miners were militant workers, although most miners were not organized into unions during the beginning of this period. They were willing to leave the mine, as a group, if they felt they were being exploited by coal operators. Monongahela Valley miners struck against a wage reduction in 1848 when operators reduced their wages from 2 cents to 1 3/8 cents a bushel. They returned to work at 1 3/4 cents after a three-week strike. These miners struck again in 1859 and demanded the installation of weigh scales at the tipple. Miners worked under a piece-rate, or contract basis, earning their wages based on the cars filled daily. This method was often inaccurate and cheated them. The size of the carts and wagons used to transport mined coal were not standardized vehicles. This local dispute quickly spread throughout the coal districts of western Pennsylvania before the strike ultimately collapsed.

Many Americans looked upon labor unions with displeasure and hostility, viewing unions as simply a foreign importation, and contrary to the spirit of American values of

self-reliance and hard work. Labor organizers and leaders were denounced by opponents of unions as demogogues who were too lazy to work themselves, and unwilling to permit self -respecting men to work. English-speaking miners who emigrated to the United States during the 1840s and 1850s were aware of the great upheaveal of the Chartist movement in England and were strongly influenced by these ideas. [83] The political principles of the Chartists movement, published by the London Workings Men's Association, was embodied in the following six points: annual parliament, universal manhood suffrage, vote by secret ballot, abolition of property qualification for membership in the House of Commons, payment of members of Parliament, enabling others besides the wealthy to hold office, and equal electoral districts.

The first attempt at unionization by miners occurred in the anthracite coal fields of eastern Pennsylvania in Skulkykill County in 1848. The John Bates' Union, a local miners' organization, named after John Bates, the union's founder and its first president. Bates was an Englishman who was imbued with the lofty principles of Charterism. Anthracite miners demanded higher wages, better and safer working conditions in the mines, reduced hours of work and the abolition of the use of coal scrip. In 1849 they called an unsuccessful work stoppage that lasted from May 11 to June 21 as miners were forced to return to the pits by coal operators who granted none of their grievances. [84] Several unions followed, but likes the Bates' Union they also floundered and ultimately collapsed. [85]

The first attempt at organizing miners into a national union was made by Thomas Lloyd and Daniel Weaver, in Illinois in 1860. These two skilled English miners had recently arrived in the coal fields of southern Illinois. Both Lloyd and Weaver, like John Bates, had participated in the Chartist movement and aroused Illinois miners to form a national miners' union. Miners from Maryland, Missouri, Ohio, and Illinois sent delegates to St. Louis who listened to Lloyd's passionate pleas for a miners' organization:

> Men can do jointly what they cannot do singly; and the union of minds and hands, the concentration of their power, become almost omnipotent. How long then, will miners remain isolated. Our unity is essential to the attainment of our rights and the amelioration of our present condition; and our voices must be heard in

the legislative halls of our land. Come, then, and rally around the standards of union - the union of states and the unity of miners. [86]

The American Miners' Association was formed on January 28, 1861. The delegates elected Thomas Lloyd, president, Daniel Weaver, vice-president, and Ralph Green, treasurer. The A.M.A. was the first miners' union to extend beyond one state and published *The Weekly Miner*, the first official mine workers' journal. The delegates wanted to establish a uniform wage scale for all miners and demanded that the General Assemblies of coal producing states pass legislation to regulate the weighing of coal. The American Miners' Association had dues paying members from the Pittsburgh district and Blossburg field, Tioga County in Pennsylvania by 1863, although the union did not recruit members in the anthracite region of Pennsylvania. [87] Local state organizations of the A.M.A.were divided into districts with each mining district having its own constitution and electing its own union official. The A.M.A. survived only a few years before collapsing in 1867 as a result of internal dissension. A number of local unions survived its demise in the Hocking Valley of Ohio, the Pittsburgh district, and in southern Illinois.

The anthracite industry was expanding by the 1860s and being inundated by new mine workers. The anthracite miners were English,Welsh, and German until the Irish came later. The number of anthracite workers doubled from 25,000 to 53,000 during the 1860s. [88] The labor shortage was filled by unskilled Irish Catholic laborers who constituted thirty-two percent of the region's miners between 1860 to 1870. By 1870, there were 44,000 Irish immigrants in the Northeastern counties, mostly concentrated in Luzerne and Schuylkill counties. "Old stock" American miners saw the Irish-Catholic immigrants as lazy, stupid, drunkards, and criminals. They were regarded them as "foreigners" and described as unassimilable. English and Welsh disproportionately held skilled jobs underground while the new Irish-Catholic miners were delegated to manual labor. The Miners' and Laborers' Benevolent Association, formed in the anthracite region about 1867, was the next major miners' union. The union spread from the anthracite fields to the bituminous coal fields of western Pennsylvania and Ohio. This union was subsequently absorbed by the Miners' National Association of the United States (1873-1876), which

was organized in Youngstown, Ohio, in October, 1873. John Siney (1831-1880), an anthracite miner from St. Clair, was elected its first president. St. Clair, Schuylkill County, Pennsylvania was a small coal mining town in the heart of the anthracite district of northeastern Pennsylvania.[89] The union achieved a measure of short-term success in its attempt to increase wages, reduce hours, improve mine safety and preferential work assignment. The union established 347 lodges in thirteen states with 35,000 members or roughly one-quarter of all coal-diggers by 1875. [90] The conditions of workers were declining as owners reduced their wages throughout the depression decade of the 1870s. Miners from the Tuscarawas Valley of Ohio, Connellsville coke region of Pennsylvania, and the Shenango and Mahoning Valleys on the western border of Pennsylvania and Ohio engaged in a series of hard-fought strikes before 1880. Miners declared "their willness to eat grass, stone, dried leaves, etc, rather than to submit to mine coal for such prices." [91] To combat the new organization mine owners compelled their workers to sign "yellow-dog" contracts as a condition of their employment and refused to increase their wage cuts, reduce costs at the company store and improve ventilation in the mine. The Miners National Association could not weather the harsh depression of 1870s and soon dissolved. [92]

The Knights of Labor was formed on December 9, 1869 as a secret fraternal organization by nine tailors in Philadelphia. Uriah Smith Stephens (1821-1882) a tailor, Mason, and Greek scholar, was elected the union's first president and headed the organization until 1879, when he was succeeded by Terence V. Powderly, who held the post until 1893. Stephens stated that the Knights of Labor was created "to secure for American workers the full enjoyment of the wealth they create" and that the goal of the secretive labor organization was "the consolidation of all branches of labor into a compact whole." Their slogan was "an injury to one is the concern of all." The Knights was organized as an industrial union headed by a General Assembly to which workers belonged as individuals. The structure of this industrial union was organized as follows: Grand Master Workman-head of the General Asembly (national body), District Master Workman-head of the District Assembly, and Master Workman-head of the Local Assembly (5 or more to a district). All gainfully employed workers regardless of sex, race, or color were admitted into the union. Bankers, lawyers, capitalists, gamblers, and stockbrokers were all forbidden membership in the

secret organization. These occupations were representative of the new industrial large-scale enterprises or were regarded by workers as simply "parasitical" occupations.

The Knights remained a secret organization to protect its members from harassment by factory owners. This policy of secrecy was dropped by the late 1870s, partly in response to its members being accused by the general public and the Catholic Church of membership within the Molly Maguires, a militant and secret organization of Irish-Catholic immigrants operating in the anthracite region of eastern Pennsylvania between 1862 and 1877. [93] The Mollies were founded in Ireland as one of a number of protective societies that Irish-Catholics had joined in their native country to fight British imperialistic control of Ireland. Branch organizations were established in the anthracite coal districts of northeastern Pennsylvania within the Ancient Order of the Hiberians (A.O.H.), the largest protective Irish benefical society in America. The center of Molly Maguire activity was the Schuykill coal field. They advocated the use of violence and intimidation as legitimate weapons to address and improve oppressive living conditions and poor wages of anthracite miners. Protestant Welsh, Scotch, and English miners maintained control over the most lucrative and skilled jobs within the mines while the Irish-Catholic workers were poorly paid and assigned the most difficult and hazardous jobs in the mine. During its nearly ten year "reign of terror" its members were accused of committing at least 42 murders and 162 felonious assualts and a myriad of other acts of destructions against coal and railroad properties. They destroyed collieries, and assaulted or murdered mine bosses and company officials. Company officials were required to carry weapons and night-watchmen were employed at the breakers by the companies to protect against acts of vandalism. The railroad and coal companies, led by president Frank B.Gowen of the powerful Philadelphia and Reading Coal and Iron Company, employed the Pinkerton Detective Agency to infiltrate and break up the secret organization. James McParland, an Irish immigrant, using the alias of James McKenna successfully infiltrated the Mollies; later he was elected secretary of the organization. McParland provided the Pinkerton Agency with a list of 375 Mollies and these men were arrested and tried for their crimes. Some 20 members were brought to trial in 1876 and 1877 and subsequently hanged in 1877. Ten Mollies were hung on June 21, 1877, six in Pottsville and four at Mauch Chunk. Ten more men were hung during the next

two years, bringing the total to twenty. The A.O.H. revoked all its chapters in Schuykill, Carbon, Northumberland, and Columbia counties in May of 1877. The era of the Molly Maguires was the bloodiest period in the anthracite regions of northeastern Pennsylvania. The organization disappeared from the anthracite coal region following these trials and was never heard of thereafter. [94]

The Knights became a public and national labor organization during the tenure of Terence Vincent Powderly (1849-1924), an Irish-American born in Carbondale, Pennsylvania in 1849. Powderly worked on the railroad and served three terms as mayor of Scranton elected on the Greenback-Labor ticket from 1878 to 1884. He was initiated into the secret order of the Knights of Labor in 1874, was elected its Grand Master Workman in 1879, and served in this capacity until 1893. The organization grew in spurts through the 1870s although membership ballooned to 700,000 members in 1886 after the Knights won a number of major strikes in 1884 and 1885. District Assemblies of the Knights of Labor organized coal miners from the Pittsburgh district, Pennsylvania, Maryland, West Virginia, Ohio, Indiana and Illinois between 1874 and 1879. Organizational drives were undertaken by the Knights in the coal fields of Colorado and New Mexico in 1882.

ILLUSTRATIONS

Number 1 Design of the Beehive Coke Oven
Number 2 Men manually extracting coke fron beehive ovens
Number 3 Beehive Coke Production Facility
Number 4 Sunshine Lamp
Number 5 Davy Lamp
Number 6 River tipple on the Monongahela River

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[1]Sam Schur, editor, *American Economy 1850-1975 : An Economic Study of Its History and Prospect* (Baltimore : Johns Hopkins Press, 1960) p. 36.

[2] Ibid p. 63.

[3] Howard N. Eavanson, *The First Century and a Quarter of American Coal Industry* (Pittsburgh : Privately printed, 1942) p. 138.

Howard N. Evanson, " The Early History of the Pittsburgh Coal Bed," *Western Pennsylvania Historical Magazine*. September, 1939.

Eavenson was also a professor of Mining Engineering in Pittsburgh and a former president of the American Institute of Mining and Metallurgical Engineering. Eavanson was a mining engineer and author who also operated his own coal company in Harlan County, Kentucky.

[4] *U.S. Census Eighth Census, 1860 Manufactures of the U.S. in 1860* (Washington, D.C.: U.S. Census Bureau) pp. clx111-clxiv.

Production in Millions of Tons of Anthracite and Bituminous Coal in Pennsylvania

Years	Anthracite	Bituminous
1840	1,129,206	699,994
1845	2,625,757	1,130,000
1850	4,326,969	2,147,500
1855	8,606,687	3,429,700
1860	10,983,972	4,710,400
1865	12,076,966	6,372,900
1875	23,120,730	12,433,860
1880	28,649,812	21,280,000

[5] William Sisson and Bruce Bomberger, *Made in Pennsylvania : An Overview of the Major Historical Industries of the Commonwealth* (Harrisburg : Pennsylvania Historical and Museum Commission, 1991) p. 18.

[6] George H. Ashley, *Bituminous Coal Fields of Pennsylvania* (Harrisburg : Department of Forests and Water, 1928) p. 179.

[7] J. Sutton Wall, *Report on the Coal Mines of the Monongahela* (Harrisburg : Board of Commissioners for the Second Geological Survey, 1884) p. xxviii.

Wall's study is the most through examination of individual mines in the Monongahela River district in the late nineteenth century.

8 George Thurston, *Directory of the Monongahela and Youghiogheny Valley* (Pittsburgh : A.A. Anderson, 1859) pp. 253-266.

9 James M. Swank,*Introduction to the History of Ironmaking and Coal Mining in Pennsylvania* (Philadelphia : Published by Author, 1878) p. 113.

Western Pennsylvanian (Pittsburgh : James O. Jones Company, 1923) p. 35.

10 Frederick Binder, *Coal Age Empire* (Harrisburg : Pennsylvania Historical & Museum Commission, 1974) p. 168.

11 Frederick Binder, *Coal Age Empire* (Harrisburg : Pennsylvania Historical & Museum Commission, 1974) p. 159.

12 Howard N. Eavanson, *The First Century and a Quarter of American Coal Industry* (Pittsburgh : Privately printed, 1942) p. 496.

13 Frederick Binder, *Coal Age Empire* (Harrisburg : Pennsylvania Historical & Museum Commission, 1974) p. 111.

14 Ibid pp. 111-131.

15 "The Century of Coal Production," *The Coal Industry*. January, 1918.

16 Sylvester K. Stevens, *Pennsylvania : Titan of Industry* Volume 3 (New York : Lewis Historical Publishing Company, 1948) pp. 864-865.

Helene Smith, *Export : A Patch of Tapestry out of Coal Country America* (Greensburg: McDonald/Saward Company, 1980) p. 102.

The firm operated mines at the mining towns at or near Yukon, Rillton, Irwin, Manor and Hutchinson in Westmoreland County by 1925.

17 Howard N. Eavanson, *The First Century and a Quarter of American Coal Industry* (Pittsburgh:Privately printed, 1942) p. 206.

18 Ibid p. 205.

[19] Ibid p. 206.

[20] Ibid p. 207.

[21] Ibid p. 208.

[22] Nancy Shedd, editor, *Huntingdon County : A Inventory of Historic and Engineering and Industrial Sites* (Washington, D.C. : National Park Service, 1991) p. 13.

[23] Lola M. Bennett, *The Company Towns of Rockhill Iron and Coal Company : Robertsdale and Woodvale, Pennsylvania* (Washington, D.C. : National Park Service, 1990) p. 7.

[24] James McFarlane, *The Coal Regions of America* (New York : D. Appleton Company, 1873) p. 667.

[25] James M. Swank, *Introduction to the History of Ironmaking and Coal Mining in Pennsylvania* (Philadelphia:Published by Author, 1878) p. 125.

[26] *Region in Transition : Report of the Economic Study of the Pittsburgh Region* (Pittsburgh:University of Pittsburgh Press, 1963) p. 260.

[27] Frederick Binder, *Coal Age Empire* (Harrisburg : Pennsylvania Historical & Museum Commission, 1974) p. 83.

Guy Mankin, *Power Handbook on Fuels* (New York : McGraw-Hill Publication, 1934) p. 11.

[28] Frederick Binder, *Coal Age Empire* (Harrisburg : Pennsylvania Historical and Museum Commission, 1974) p. 66.

Peter Temin, *Iron and Steel in Nineteenth Century America : An Economic Inquiry* (Cambridge, MA : M.I.T. Press, 1954) pp. 268-269.

[29] James M. Swank, *Introduction to the History of Ironmaking and Coal Mining in Pennsylvania* (Philadelphia : Published by Author, 1878) p. 72.

[30] William Nichols, *The Story of American Coal* (Philadelphia : Lippincott Company, 1897) p. 331.

[31] Robert D. Billinger, *Pennsylvania's Coal Industry* (Gettysburg, PA : Pennsylvania Historical Association, 1954) p. 25.

[32] Peter Temin, *Iron and Steel in Nineteenth Century America : An Economuc Inquiry* (Cambridge, MA : M.I.T. Press, 1954) pp. 268-269.

[33] John Enman, *The Relationship of Coal Mining and Coke Making to the Distribution of Population Agglomoration in the Connellsville (PA) Beehive Coke Region* (University of Pittsburgh Dissertation, 1962) p. 87.

The Clinton furnace operated continously from 1859 until its closure in 1927.

[34] *U.S. Census Report on the American Coke Industry*: p. 26.

[35] Fred C. Keighty, "The Connellsville Coke Region," *Engineering Magazine*. Volume 20, 1901.

Keighty served as mine superintendent of Mammoth Number 1 mine, and later general superintendent of the Oliver and Synder Steel Company coke works near Uniontown. He was president of the Coal Mining Institute of America in 1900.

[36] Fred C. Keighty, "The Connellsville Coke Region," *Engineering Magazine*. Volume 20, 1901.

[37] *Pittsburgh and the Pittsburgh Spirit* (Pittsburgh : Chamber of Commerce of Pittsburgh 1927-1928) pp. 213-214.

E. Willard Miller, *Pennsylvania : Keystone to Progress* (New York : Windsor Publication, 1986) p. 59

[38] Franklin Ellis, *History of Fayette County, Pennsylvania with Biographical Sketches of Many of Its Pioneers and Prominent Men* (Philadelphia : Louis H. Everts and Company, 1882) p. 245.

[39] *Region in Transition : Report of the Economic Study of the Pittsburgh Region* (Pittsburgh : University of Pittsburgh Press, 1963) p. 260.

[40] *Tenth Census of the United States : General Analysis of the Bituminous Coal Statistics* (Washington, D.C.: Bureau of the Census, 1881) p. 1208.

[41] George Littleton Davis, *Greater Pittsburgh's Commercial and Industrial Development 1850-1900* (University of Pittsburgh Dissertation, 1951) p. 246

[42] John Enman, *The Relationship of Coal Mining and Coke Making to the Distribution of Population Agglomoration in the Connellsville (PA) Beehive Coke Region* (University of Pittsburgh Dissertation, 1962) p. 87.

[43] Ibid p. 87.

[44] Howard N. Eavanson, *The First Century and a Quarter of American Coal Industry* (Pittsburgh : Privately printed, 1942) p. 175.

[45] John N. Boucher, *History of Westmoreland County* (New York : Lewis Publishing Company, 1906) p. 276.

[46] Margaret Mulrooney, *A Legacy of Coal : The Company Towns of Southwestern Pennsylvania* (Washington, D.C. : National Park Service, 1991) pp. 35-50.

Fred C. Keighty, "The Connellsville Coke Region," *Engineering Magazine*. Volume 20, 1901.

Jim Cochran was the father of Phillip Cochran who owned the Washington Coal and Coke Company which constructed the coal town of Star Junction, just south of Perryopolis, Fayette County in 1893. Star Junction was one of the largest turn-of-the century coke facilities with 999 beehive ovens. Coal was extracted for the beehive ovens at two mines, Washington No. 1 and No. 2. Sarah Cochran, widow of Philip Cochran, constructed Linden Hall, an opulent thirty-five room mansion at a cost of two million dollars in 1911-1912, north of Perryopolis on Route 51 South. The United Steelworkers of America purchased and restored the mansion in 1976.

[47] W.O. Hickok and F.T. Moyer, *Geology and Mineral Resources of Fayette County* (Harrisburg : Department of Internal Affairs, 1940) pp. 351-352.

[48] George Thurston, *Pittsburgh's Progress : Industries and Resources* (Pittsburgh : A.A. Anderson and Company, 1888) p. 181.

[49] Douglas Fisher, *Epic of Steel* (New York : Harper and Row, 1963) p. 110.

[50] George H. Ashley, *Bituminous Coal Fields of Pennsylvania* (Harrisburg : Department of Forests and Water, 1928) p. 216.

[51] Adam T. Shurick, *The Coal Industry* (Boston : Little, Brown and Company, 1924) p. 173.

Joseph D. Weeks, *Report on the Manufacture of Coke* (New York : David Williams, 1885) p. 32.

52 Franklin Ellis, *History of Fayette County, Pennsylvania with Biographical Sketches of Many of Its Pioneers and Prominent Men* (Philadelphia : Louis H. Everts and Company, 1882) p. 246.

53 Elwood S. Moore, *Coal : Its Properties, Analysis, Classification, Geology, Extractions, Uses and Distribution* (London : John Wiley and Company, 1940) pp. 338-339.

54 C.S. Wardley, "The Early Development of the H.C. Frick Coke Company," *Western Pennsylvania Historic Society Magazine.* Volume 32, 1949.

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The Golden Age of King Coal, Queen Coke, and Princess Steel, 1880-1920

Introduction

The "Golden Age of King Coal and Queen Coke, and Princess Steel " occurred during this brief forty year period. Its impact on the social and economic development of the nation and the Commonwealth, as the principal coal and coke state, was long-term and profound. "Ole King Coal" had toppled wood as the nation's principal energy source in the mid-1880s. William Stanley Jevons (1835-1882), an English political economist and logician, while visiting Pittsburgh in 1882 observed "Coal in truth stands not beside but entirely above all other commodities. It is the material energy of the country - the universal aid - the factor in everything we do. With coal almost any feat is possible; without it we are thrown back into the laborious poverty of early times." [1] Jevons had realized that abundant high quality coal and coke near the Pittsburgh district had transformed the "smokey city" into the principal metallurgical center of the United States.

The United States Census Bureau issued a report in 1902 and like Jevons recognized the pivotal role coal played in the rapid economic expansion of "Smokestack America." Coal supplied 72.5 percent of the nation's energy needs by this date. This fossil fuel drove the industrial revolution of America and the miners who extracted it had fundamentally transformed the nation into an industrial juggernaut. The report observed that:

> coal has been coincident with the rapid advancement of this country ... to the front rank among industrial nations of the world. Indeed the country's progress has been due largely to the abundance of its mineral fuels, chief among them was coal. Most of this development had taken place during the last two decades and has far exceeded the growth in population, indicating a rapid change from an agricultural to a manufacturing nation. [2]

The Commonwealth was the principal bituminous coal producing state throughout this entire period. Bituminous coal of Pennsylvania had supplanted anthracite as the principal mineral resource in the state during the 1890s. The state's soft coal industry employed more than 180,000 miners who extracted an incredible 166.9 million net tons in 1920. The compact Connellsville coke district was the nation's principal coke producing region. Beehive coke production was consumed at iron and steel companies in the Pittsburgh district, eastern Pennsylvania, and Connellsville coke was shipped west by rail for use in the silver industry. Literally hundreds of new company-owned coal towns were constructed throughout the counties of central and western Pennsylvania to house its large and increasingly foreign-born labor force. Unorganized miners formed the United Mine Workers of America in 1890 and from this humble beginning the miners' union evolved into the largest and most powerful labor union in the United States by the end of the era. The UMWA had successfully organized nearly one-half of all mine workers nationally by the end of this period. This brief era was indeed the "Golden Age of Coal" in Pennsylvania and the United States.

American Coal and Coke Production

The rapid expansion of the iron and steel industry and of the railroad system during the last quarter of the nineteenth century created energy demands for an abundant and inexpensive alternative to wood. Coal supplied this energy as the industry experienced a period of phenomenal growth in terms of production and employment. Wood had provided about 90.7 percent of the nation's aggregate energy consumption, excluding wind, water, and human power as late as 1850. Wood supplied nearly three-fourths of the country's energy supply (73.2 percent) as late as 1870 but in 1883 it provided only 47.5 percent of the nation's aggregate energy consumption while coal provided 50.3 percent (bituminous coal - 33.4 percent and anthracite -16.9 percent). [3] Soft-coal production reached a staggering 110 million tons in 1885 and had replaced wood as the nation's principal fuel. Great Britain was the leading coal-producing nation as recently as 1875 mining 46.6 percent of the world's

production, while the United States produced only 17.1 percent. [4] The U.S. Department of the Interior observed that in each decade from 1850 to 1905 the output of coal had practically doubled. Consumption per capita of coal also rose during this period:

Per Capita Production of Coal in the United States

1850 0.278 tons
1860 0.514 tons
1870 0.857 tons
1880 1.42 tons
1890 2.50 tons
1900 3.53 tons
1905 5.00 tons [5]

The United States supplanted Great Britain in 1899 as the leading coal-producing nation and became the premier nation in both the production and consumption of coal during this era:

Coal Production in the United States and the World

Net Million Tons	World Total	U.S.A.
1890-1894 (average)	538	156
1905-1909 (average)	1,053	392
1915	1,193	482
1920	1,319	597 [6]

American bituminous coal production increased from 43 million tons in 1880 to 212 million at the turn of the twentieth century and 569 million tons in 1920 - more than a ten fold increase. Employment, like output, saw the number of miners increase from 100,207 in

1880 to 304,375 in 1900 and 639,547 in 1920. Coal productivity, as measured per man-day in the industry, rose during this period from 2.5 to 4 tons.

American Coal Production in Millions of Tons

Year	Bituminous	Anthracite	Total	Percent Increase
1880	50,757	28,650	79,407	1870-1880 - 96%
1885	71,773	38,336	110,109	
1890	111,302	46,469	157,771	1880-1890 - 98%
1895	135,118	57,999	193,117	
1900	212,316	57,368	269,684	1890-1900 - 70.9%
1905	315,063	77,660	392,723	
1910	417,111	84,485	501,596	1900-1910 - 86%
1915	442,624	88,995	521,619	
1920	568,667	89,598	658,256	1910-1920 - 31.2% [7]

There were twenty-five coal-producing states in 1880. Pennsylvania, Illinois, Indiana, and Ohio were the principal coal mining states accounting for nearly three-fourths of all bituminous coal production.

U.S. Coal Production By States

1880	25 states produced	71,481,570	short tons
1890	28 states produced	157,770,963	short tons
1900	28 states produced	269,684,027	short tons
1910	27 states produced	492,647,863	short tons

Each of these four states increased their coal production by more than 130 percent between 1870 and 1880. The bituminous coal fields of western Pennsylvania measured about 9,000

square miles in 1881. Both production and number of workers employed increased continuously throughout the period. There were 666 establishments mining soft coal in Pennsylvania with an annual production of 16.5 million tons in 1880. Eleven of the sixteen American counties producing over a half a million tons annually of bituminous coal were located in Allegheny, Bradford, Cambria, Clearfield, Elk, Fayette, Mercer, Somerset, Tioga, Washington and Westmoreland counties, Pennsylvania. [8] Six of these eleven coal counties produced more than three-quarters of the state's annual production. The principal coal-producing counties in 1880 were: Allegheny - 6.7 million tons; Westmoreland - 4.3 million tons; Clearfield - 2.8 million tons; Fayette - 2.7 million tons; Washington - 1.3 million tons; and Tioga - 1.2 million tons. Production in Pennsylvania increased ten fold from 16.5 million tons to 166.9 million tons while employment increased by almost six fold from 33,391 to 184,168 between 1880 and 1920. [9]

Pennsylvania's annual bituminous coal production surpassed the state's anthracite production in 1897 for the first time. Bituminous coal output was 54,62,272 net tons in 1897 while anthracite output was 52,581,036 net tons. Combined bituminous and anthracite coal production of Pennsylvania more than one-half of all coal mined in the United States between 1880 and 1899. The Commonwealth produced 66 percent of the entire coal output of the United States in 1880, and although this percentage decreased after 1900 Pennsylvania had the distinction of producing more than 50 percent of the entire coal output in the nation until 1902. The violent and protracted 1902 anthracite strike restricted production as the state's production was only 46 percent during the strike period. At least one-quarter of all bituminous coal mined in the United States during this entire period was extracted by Pennsylvania miners.

Pennsylvania's Bituminous Coal Production and Employment

Year	Production Net Tons	Employees	Percent Net Tons U.S. Total
1880	16,564,000	33,391	25.9
1885	23,413,692	44,145	23.4
1890	40,625,054	67,383	26.9
1895	51,818,112	84,976	26.0
1900	79,318,362	108,735	29.7
1905	119,361,514	164,941	30.2
1910	148,770,858	193,488	30.0
1915	157,420,068	187,734	29.7
1920	166,929,002	184,168	25.9 [10]

The counties surrounding the Monongahela River and the semi-bituminous "smokeless" coal fields of the Broad Top Mountain and the North Central coal fields were the principal coal producing regions in the state until this period. The increased demand for coal and coke from the iron and steel industry and railroads witnessed the opening of new bituminous coal fields in Pennsylvania. The Second Geological Report of Pennsylvania, established in 1874, surveyed and identified the location of new coal reserves in the counties of central and western Pennsylvania from 1874 to 1884. The survey, under the direction of J.P. Lesley, the State Geologist, published nearly 120 atlases and volumes, including geologic maps of the state's existing counties and one map for the entire state in 1885. The detailed survey helped "to uncover with precision the economic mineral resources of Pennsylvania in an age of great industrial expansion providing a firm foundation for later detailed studies produced by industry, government and academia." [11]

The expanding railroad system of Pennsylvania was responsible for the opening of commercial coal-mining operations in a number of formerly isolated and underdeveloped coal producing regions. These counties had all produced coal for local consumption before the Civil War, but large-scale commercial mining operations was delayed until the arrival of

railroads and increased demand for coal. Many spur lines were constructed off the main lines of the Pennsylvania Railroad and the Baltimore &Ohio Railroad connecting the newly opened mines. The expanding coal industry contributed to the economic prosperity of these new coal-producing counties and encouraged population growth as European immigrants arrived to mine coal and reside in the dozens of new mining communities that were being rapidly constructed during this period in Armstrong, Jefferson, Cambria, Indiana and Somerset counties.

Only Illinois, with 10,872 miles of railroads, exceeded Pennsylvania's 10,181 miles of railroads in operation by 1899. Railroads provided coal operators with low hauling rates to distant markets since hauling coal was becoming the principal source of revenue for many railroad corporations. Railroads were the principal consumers of coal and became the principal owners of many of these newly opened mines and coal towns.The railroad and coal companies became interdependent as mining mining operations were often organized as "captive" mines by railroad companies. The Rochester & Pittsburgh Coal Company and the Pennsylvania Coal and Coke Company, for example, were railroad companies that developed mines in this region to supply their own need for steam coal. The development of these counties replaced the semi-bituminous Broad Top field and North Central fields as principal mining regions. Coal was still extracted in these fields but their production was dwarfed in contrast to the large output of these new coal-producing counties. After the 1880s Pennsylvania's principal coal-producing regions were located in the Pittsburgh district, including Allegheny, Fayette, Westmoreland and Washington counties and the newly opened counties of southwestern Pennsylvania. The commercial development of the coal industry in these counties was delayed because of the plentiful thicker coal seams located nearer Pittsburgh. Greene County was part of the Pittsburgh district but production in this county was moderate until after 1910 when the rich Pittsburgh seam that underlay the county was opened for coal exploration.

The following is a brief description of the development of commercial mining in these counties with emphasis on the leading coal operators and coal mining towns constructed by them:

Armstrong County

Coal was Armstrong County's most important mineral resource in the county in the twentieth century. Cannel coal was the first mined in the county that was used as illuminating oil. This coal, which is very rich in volatile matters especially hydrogen is composed almost entirely of spores, spore cases, seed coats, and resinous or waxy products of plant that lived at the time of the coal-forming swamps. The absence of woody material gives cannel coal a regular texture and grain not found in other types of coal. Cannel coal breaks like glass, with a conchoidal fracture and because of its high content of volatile matter ignites easily burning with great heat and a long flame.[12] The Allegheny Valley Railroad was completed into Armstrong County in 1856 although large-scale commercial coal mining was delayed until 1899 when the Cowanshanock Coal and Coke Company erected the first company towns of Yatesboro and Numine. The coal industry employed 4,290 workers and produced more than 3.5 million tons of coal by 1910. The Yatesboro mine and company town, with rail connections, was quickly erected in less than a year. A railroad spur line extended to Echo, where it joined the mainline of the Buffalo, Rochester and Pittsburgh Railroad. Coal was shipped on this railroad to Great Lakes markets. This was the largest and most productive mine in the county by this period.[13] The principal coal companies in Armstrong County were the Helvetia Coal Mining Company, the Allegheny River Mining Company and the Buffalo and Susquehanna Coal Company.

Somerset County

Mining began in Somerset County during the last quarter of the eighteenth century. Coal was used by local blacksmiths who hauled it themselves to their shops, probably before 1800. Coal mining remained essentially a local industry until the completion of the first railroad into the county in 1872. The railroad era brought on a new era of land speculation and economic growth to Somerset County. The Baltimore and Connellsville Railroad constructed a route connecting Baltimore and Pittsburgh, via Cumberland, Maryland. In Somerset County the railroad followed the Casselman River from Turkeyfoot to Myersdale, then through a mountain tunnel at Sandpatch to Wills Creek, Maryland. Irish

and German laborers were imported in 1870 to the region to construct the railroad. The railroad was completed in 1871 when the final spike was driven in near Casselman and provided passenger and freight service through county. The railroad allowed the development of the county's rich coal and lumber resources and fostered Eurpean emmigration. The Keystone Coal and Manufacturing Company was founded by Henry A. Stiles of Philadelphia, Henry T. Weld of Mount Savage, Maryland, and George F. and William J. Baer of Somerset in 1870. The company opened Keystone, the first coal-town in the county in 1872. Keystone was also known locally as "Stilesville" after Henry A. Stiles who served as the first president of the company. Baer was a prominent lawyer, judge, businessman and president of the Somerset and Mineral Point Railroad. The mine and village was located about two and a half miles southeast of Meyersdale in the eastern part of Summit Township. Coal was hauled from the Keystone tipple to Keystone Junction over a narrow-gauge railroad which was abandoned after the Salisbury and Baltimore Railroad was built in 1878. The Cumberland and Elk Lick Company established the Shaws Mine complex in Summit Township in 1875. Shaw was the second coal-company town constructed in Somerset County. [14] Beehive coke ovens were constructed at the mine with coke production beginning in 1886. The principal coal companies by 1920 were the Consolidation Coal Company, the Berwind-White Mining Company and the Quemahoning Coal Company. Daniel B. Zimmerman of Somerset County was an astute businessman who was a cattle dealer, agriculturalist and coal operator. Zimmerman, like William J. Baer, was one of the local pioneer coal operators in the county. He was president of the Quemahoning Coal Company that was founded in 1898. He developed numerous mines and the company mining towns of Goodtown, Wilson Creek, Raphton, and Zimmerman, Somerset County. His coal interests in the county totaled 140,000 acres of coal lands in 1907 with additional holdings located at Listie, Jerome and Rockwood. These resources made Zimmerman the largest local and independent coal operator in the county. The communities of Cairnbrook, Boswell, Hollsopple, Hooversville, Jenners, Jerome, Windber, had their origins as coal company towns.

Cambria County

Cambria County is one of the few counties in the bituminous coal regions of Pennsylvania that mine four important commercial seams. The Lower Kittanning coal is the most extensive seam and is located in the southern part of the county. The Upper Kittanning lies about 125 feet below the Lower Kittanning seam. This seam was mined for steam coal. The Lower Freeport seam, located in the northern part of the county is an excellant coking coal with low sulfur content. This seam is located 120 to 190 feet above the Lower Kittanning seam. The Upper Freeport seam, the fourth principal commercial seam in the county, is mined in the area around Barnesboro. This coal was used in railroad locomotives and with varying results in coke production.

A number of small coal mines were opened in the South Fork area of the county before the Civil War. A number of commercial coal operations began around Barnesboro and Patton in northern Cambria County by the 1870s. The Blacklick coal fields were opened in the 1890s by the Berwind-White Mining Company of Philadelphia in the Windber area on the northern boundary of Somerset County. Bakerton, Colver, Revloc, Spangler, Barnesboro, Vintondale, Dunlo, Nanty Glo and Cassandra are all communities that owe their existence to the coal boom during this period. The principal mining companies were Barnes and Tucker Company, Berwind-White Mining Company, Heisley Coal Company and Coleman and Weaver Company.

Indiana County

Coal was discovered in Indiana County as early as the 1760s. The Upper Freeport is the largest reserve of valuable and accessible coal in the county. The Lower Kittanning, Lower Freeport, and the Pittsburgh seams are also mined commercially in the county. Local coal played a pivotal role in the development of the pioneer salt industry in the county. The Blairsville division of the Pennsylvania Railroad was opened in 1856, and small coal shipments were made from the county after this date. The Western Pennsylvania Railroad traveled from Blairsville to the Allegheny river once it was opened in 1864. Glen Campbell, founded by the Glenwood Coal & Coke Company in May, 1889 with a

population of 300, was the first company town constructed in Indiana County. [15] The Rochester and Pittsburgh Coal Company, founded in 1881, acquired coal properties in Indiana in 1899 and 1900 and within a decade was the largest coal producer in the county. R&P operated numerous mines and constructed the company towns of Ernest, north of Indiana, and Lucernemines, Center Township near Homer City. Aultman, Clymer, Commodore, Graceton, Iselin, McIntyre, Rossiter and Sample Run, were all new booming mining towns founded in the county during this period. The principal commercial coal companies in Indiana County were the Rochester & Pittsburgh Coal & Iron Company, Clearfield Bituminous Coal Corporation and the Pennsylvania Coal and Coke Company.

Jefferson County

The Rochester & Pittsburgh Coal & Iron Company was organized in 1881 to tap into the new coal resources of Jefferson and Clearfield counties. The corporation was financed by Walston H. Brown, a New York financier and the Adrian Islin family of New York. The firm acquired more than 6,000 acres of coal land near Punxsutawney, Jefferson County and constructed the earliest coal-mining towns in the county during the 1880s: Beechtree, Washington Township north of Dubois in 1882 and Walston, outside Punxsutawney, in 1883. The company constructed houses at Beechtree; they cost $250 each and were rented by the company to miners' and their families for $60 a year, while those at Walston cost $200 each, and were rented for $48 annually. Horatio, Adrian, Anita and Eleanora were mining communities in the county. The Rochester & Pittsburgh Coal & Iron Company, Jefferson Coal Company, and the Anita Coal Company were the principal mining companies.

Coal Production Growth of Central Pennsylvania

Year	Armstrong	Somerset	Cambria	Indiana	Jefferson
1881	245,000	298,000	780,000	52,000	420,000
1891	299,945	441,070	3,073,098	539,628	3,600,052
1901	1,686,075	3,8898,738	8,614,492	815,659	6,034,656

1911	3,760,460	8,330,274	16,371,550	8,555,610	5,356,338
1921	3,386,951	9,141,045	15,713,730	6,192,613	2,639,997 [16]

Industrial Expansion and the Burgeoning Coal Industry

The economic expansion of "Smokestack America" during the last quarter of the nineteenth century was predicated on increasing energy supplies and an enlarged labor force. Coal solved America's burgeoning energy demand. Every man, woman and child was the beneficiary of coal during this period. The annual consumption of coal per capita rose nationally from one ton in 1870 to two tons in 1896 and to 6.6 tons in 1918. [17] The American coal industry expanded as a result of increased energy demands of the growing iron and steel and railroad industries. The Bessemer and the Siemens-Martin open-hearth processes, introduced during the second half of the nineteenth century, represented new steel-making technologies. American steel production was previously measured in pounds but the wide-spread use of these processes made it possible to mass produce steel in large quantities quickly and at a reduced cost. Steel production surpassed iron production in the United States for the first time in 1892. The United States became the greatest steel-producing nation in the world by 1900 when annual steel production was twice as large as Great Britain, its nearest competitor. [18] Per capita consumption of steel increased from about 500 pounds in 1900 to about 1,200 pounds in 1920.

The initial breakthrough of a viable steel-making process came in the 1850s with the invention of the Bessemer process. Charles Henry Bessemer of Sheffield, England (1813-1898) and his American counterpart William Kelly (1811-1888), a Pittsburgh native and kettlemaker both claimed simultaneously to have invented the Pneumatic or Bessemer Process of converting pig iron into steel. These inventors discovered that when drafts of air were blown through molten iron, this created a superior metal relatively free of carbon. In 1854, Bessemer began his experiments in designing a converter near his Sheffield cutlery works capable of transforming iron to steel by removing carbon. The first official news of Henry Bessemer's new steel-making process in the United States came in an

article of the *London Times* of August 14, 1856. Bessemer created steel in thirty minutes - not the usual three months - that was only a little more costly to produce than iron. He received an American patent for the pneumatic process in 1856. Kelly developed a crude pneumatic converter for the transformation of iron into steel in a matter of minutes at the Cambria Iron Company, Johnstown, Pennsylvania in 1857 and 1858. [19] William Kelly's original converter is now housed at the Smithsonian Museum in Washington, D.C. Kelly contested Bessemer's American patent on the basis of work undertaken by him in the 1840s and 1850s. He proved to the satisfaction of the United States Commissioner of Patents that he had the idea of applying air in a pneumatic converter in 1847. He received a patent for the invention that was renewed in 1870. In 1861, Kelly made the first American steel made by the Bessemer-Kelly pneumatic process employing the bottom-blown tilting converter at Johnstown. Bessemer took out the earlier patents on his converter but Kelly, in conjunction with David Morrell, President of Cambria Iron Company and others, secured later patents on the process. The Johnstown Iron Plant began operation in 1852. The facility operated under the following ownerships since its formation: Cambria Iron Works, 1852-1855; Wood, Morrell and Company,1855-1862; Cambria Iron Works, 1862-1898; Cambria Steel Company, 1898-1916; Midvale Steel and Ordinance Company, 1916-1923; Bethlehem Steel Company, 1923-present. The Bessemer and Kelly groups of patent holders combined their interests and ended their litigation and joined forces in 1866. An agreement was concluded by which the Bessemer group received 70 percent of American royalties, while the Kelly group received 30 percent.

The first commercial Bessemer converter was erected in Wyandotte, Michigan, by the Wyandotte Iron Works in 1864 that produced steel of commercial quantity. The firm produced 2.5 tons of steel at a time - in one "heat." Alexander Holley was impressed by the importance of Bessemer's invention and after acquiring rights to Bessemer's American patents erected an experimental Bessemer converter at Troy, New York. Holley started Bessemer steel production under these patents at the Troy plant, on February, 1865. The Pennsylvania Steel Company facility at Steelton, near Harrisburg, erected the first Bessemer furnace in Pennsylvania. Steel rails were rolled by the Cambria Iron Company

from ingots produced at the Pennsylvania Steel Company in 1867 and the company erected its own Bessemer works in 1869. The Bessemer process dominated steelmaking during the ninetenth century, but the process gradually gave way to the open-hearth process in the twentieth century. [20]

Cheap Bessemer steel revolutionized the iron industry. The pneumatic process introduced the mass production of steel. Steel rarely sold for less than $250 per ton before this new steel making technology was introduced. The production of inexpensive steel prompted Andrew Carnegie to note "The day of iron is past! Steel is king!" In 1873 the Carnegie Company began construction of the Edgar Thomson Steel Works, named for the president of the Pennsylvania Railroad, at Braddock, twelve miles down the Monongahela River from Pittsburgh. The mill was constructed on Braddock's Field, the site of the historic battle in 1755 between the English and colonial army commanded by General Edward Braddock, and the French and Indian forces. The Edgar Thomson Works, completed by Andrew Carnegie in 1875, received its first order for 2,00 steel rails from the Pennsylvania Railroad. Pig iron was orginally obtained from Carnegie's Lucy Furnace built in 1871-1872 at Fifty-First Street and the Allegheny River, Pittsburgh but its owns blast furnaces were constructed in 1880. There were nine steel companies in the United States with capacities in excess of 100,000 tons of steel annually in 1890 along with nearly 500 smaller firms with steel capacities as small as 3,000 tons. Carnegie's Edgar Thomson Steel Works was the largest steel plant in the nation with an annual capacity of 450,000 tons in 1890. Carnegie's steel companies had an annual production of 3,500,000 tons of steel ingots and over 3,000,000 tons of finished steel products at the turn of the century.

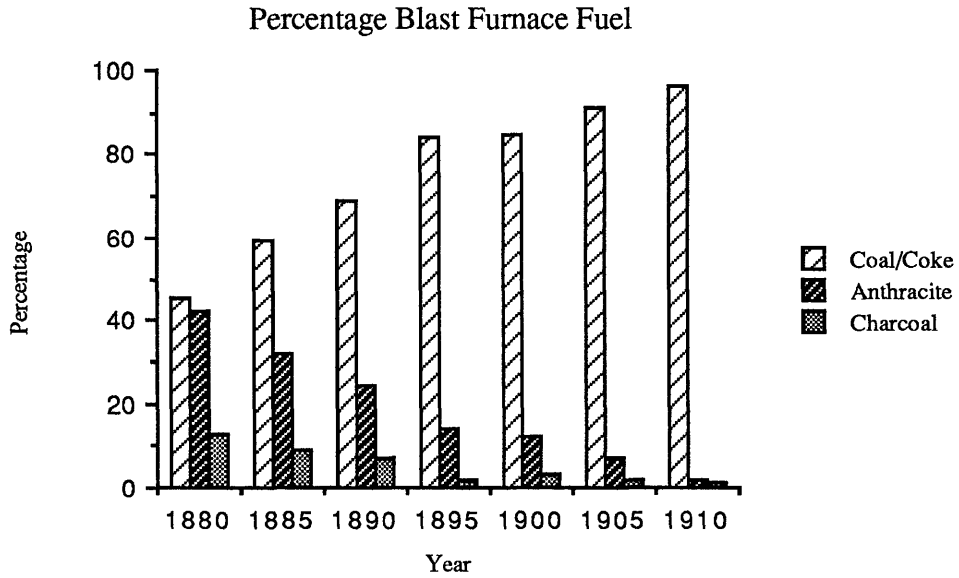
The rise of American steel production was metoric during the next forty years. Steel production rose from a mere 22,000 tons in 1867 to 26,205,913 tons in 1906. The production of Bessemer steel, which was centered in southwestern Pennsylvania, dominated the steel industry by 1880. Each Bessemer converter was larger than a typical anthracite furnace and provided a cheap means of producing large quantities of steel. Most of this steel went into the production of rails. Steel rails were preferred to iron rails because of their durability, their ability to support heavier freight cars, and their strength that

permitted trains to travel at faster speed. Steel production was concentrated in Pittsburgh and the surrounding Monongahela Valley. Johnstown (Cambria Iron Company and the Johnstown Steel Rail Company), the Mahoning and Shenango valleys, Youngstown and Stuebenville were other principal steel centers in the region. The steel mills in these metallurgical centers all used coke from the Connellsville district, shipped by rail or river. This expansion of steel capacity insured the growth and popularity of the Bessemer steel process during the last quarter of the nineteenth century and insured the expansion of the nascent coke industry of Western Pennsylvania.

Pierre Martin (1824-1915), son of a French ironmaster, developed the open hearth, or Martin furnace in 1865 that used recycled steel scrap, improved the efficiencies of blast furnaces and enabled manufacturers to produce a more refined steel. Abram S. Hewitt introduced the open-hearth process at Trenton, New Jersey in 1868. This process removed sulphur and phosphorous and permitted the usage of poor quality iron ore. The percentage of steel made by the open hearth method replaced that of Bessemer steel production in 1908; after this date a majority of American steel was produced by the open hearth process. This process accounted for 36.5 million tons of ingots as opposed to ten million tons of Bessemer steel ingots in 1920. [21] The development of the coke industry was the foundation of the iron and steel industry of the United States. The increased production of steel placed new demands for coke that stimulated the coal industry.

The Coke Industry

Raw bituminous coal, anthracite, charcoal, and coke were all used by iron manufacturers in Pennsylvania as fuel in their blast furnaces during this entire period. [22]



Iron blast furnaces, located principally in eastern Pennsylvania, continued iron production with anthracite although the quantities of anthracite iron production continued to decline with each passing decade. There were 158 anthracite or anthracite / coke furnaces in America in 1880, and 90 such furnaces in Pennsylvania, 15 furnaces in New York, and 12 furnaces in New Jersey in 1896. Their combined annual production was 3,156,487 tons. Eastern anthracite iron manufacturers found it cheaper to import coke from western Pennsylvania to fuel their furnaces by the dawn of the twentieth century. [23] Anthracite was last used alone as a fuel in an iron blast furnace in 1900, and all use of anthracite in furnaces was completely discontinued by 1923. [24] Ironmakers found it easier to get oxygen from iron ore to combine with the carbon in coke, because the air holes permitted greater contact between the two elements. [25] The quantity and ingredients of materials required to produce a ton of pig iron in a typical iron furnace during the 1880s were 1.77 tons of iron ore, 9.58 tons of coke, 4.44 tons of limestone and 4.22 tons of air. This produced one ton of pig iron, 5517 tons of slag, .063 tons of flue dust and 5.82 tons of gas. [26] Coke provided more energy per pound at less cost than anthracite or charcoal. It produced a higher and more efficient operating temperature in blast furnaces because it was more porous than anthracite. Anthracite furnaces were smaller than contemporary western coke blast furnaces

which were on average two and a half time larger. Expansion of the coke fueled iron and steel industries spelled the demise of the anthracite furnaces of eastern Pennsylvania.

The once dominant iron charcoal furnaces of Pennsylvania had become a relic of a former era by the turn of the twentieth century. The eight remaining charcoal furnaces in Pennsylvania produced less than one per cent of the total iron production by 1910. Charcoal furnaces hung on in other parts of the country and by 1890 charcoal production nationally was 703,522 tons of iron, of which nearly a quarter of a million tons was produced in Michigan. The charcoal-iron industry thrived in Michigan and Wisconsin as long as timber was plentiful near the sites of the furnace. [27]

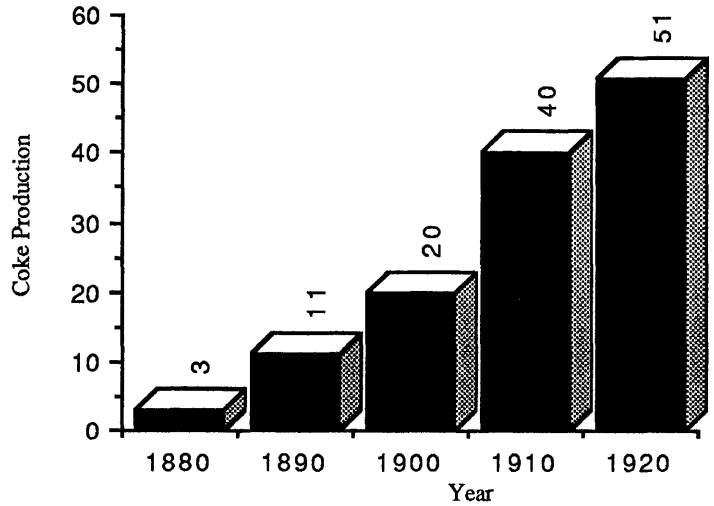
A number of factors favored the concentration of iron and steel production in southwestern Pennsylvania and eastern Ohio after the Civil War. There was an ample supply of water for industrial uses; accessibility to markets; availability of Mesabi iron ore and the proximity of excellant metallurgical coke. The best coking coal was located in Westmoreland and Fayette counties, in what is known as the Connellsville coke region. Coal from this region was eminently suited for the production of coke because it was "thick, contiguous, clean, soft, friable, and advantageously positioned for cheap and easy mining." [28] connellsville coal had the following traits required of a superior metallurgical fuel for the blast furnaces: 1) mechanical strength, sufficient to withstand the crushing strain in the blast furnace; 2) sizes over 2 inches; 3) hardness or resistence to impact, a lack of brittleness permitting rough handling without undue fragmentation; 4) porosity, in order that the coke may expose a maximum surface for reaction with furnace gases; 5) low ash content, under 8 percent, if possible; 6) Low moisture, under 1 percent; 7) low phosophorous, under 0.02 percent; 8) low sulfur, under 1.25 percent ; 9) and a high carbon content. [29]

There were 256 blast furnaces using either bituminous coal or coke in the United State in 1896. These furnaces were distributed in 17 states producing more than 13 million gross tons of pig iron annually which was four times the amount of all anthracite furnaces in the United States. There were 76 blast furnaces in Pennsylvania, 53 in Ohio, 39 in Alabama, 24 in Virginia, 17 in Illinois, 12 in Tennessee, 6 in Kentucky, 5 in Maryland, 4 each in West

Virginia and Wisconsin, 3 in New York, 2 each in Missouri, Colorado, Georgia and Indiana, and 1 in Minnesota. [30] A typical blast furnace of the period used about 3,330 pounds of iron ore, 1,200 pounds of coke and 500 pounds of limestone to produce 2,000 pounds of iron. [31] Between 1871 and 1919, 88 percent of all iron in the United States was made with coke produced in the beehive coke oven. [32] In 1909, the high-water mark during this period, there were 579 coke plants with 103,982 beehive ovens in the United States. [33] By 1908 fully 98 percent of the total production of pig iron in the nation was made with coke, either alone or in combination with raw bituminous coal. Pennsylvania was the leading coke producing state in the nation with its peak market share of 70.3 percent attained in 1907. The peak output of coke production nationally was reached in 1916, when nearly 40,000 coke ovens were in operation, converting 33,792,000 tons of bituminous coal into 22,486,000 tons of coke. [34]

The annual production of coke, like coal, increased phenomenally from 3.3 million short tons to more than 51.3 million tons in 1920 during this entire period.

U.S. COKE PRODUCTION (MILLIONS OF TONS)



Large scale beehive coke production spread to thirteen states and territories during the 1880s as beehive coke ovens produced nearly 3.3 million tons of coke at 186 establishments

nationally in 1880. Pennsylvania was the leading coke-producing state with 124 establishments producing 74.5 percent of the country's coke, valued at $16.3 million in 1880. The Connellsville coke district was the nation's premier coke-producing region. Fayette County produced 45.8 percent and Westmoreland County produced 27.4 percent of the state's coke production in 1880, while Allegheny County production, a distant third produced only 3.5 percent of the state's annual coke production.[35]

There were at least fifty individually operated coke plants in the region utilizing several thousand beehive ovens as early as 1882. [36] From 1870 until World War One, the Connellsville coke district supplied a majority of all coke used by the iron and steel companies in western Pennsylvania, northern West Virginia, and eastern Ohio. The economic expansion of the district is reflected in increases in the number of beehive ovens, tonnage output of coke, value per ton of coke, and gross revenue for the district. From 1880 to 1900 the number of beehive ovens increased from 7,211 to 20,954, production rose from 2.2 million tons to 10 million tons, price per ton of coke rose from $1.79 to $2.70, and finally gross revenue rose from $3.9 million to $27.4 million. [37]

The ever-increasing growth of the coke business in the region provided employment, spurred the growth of coal mining towns in the region, and necessitated a railroad building boom to transport coke north to the Pittsburgh district. A Pennsylvania official in 1887 observing the changes in the region as a result of this coke boom noted that "this coke region had grown from 3,600 coke ovens in 1876, into a vast furnace of 13,000 ovens, while a poorly-paid, helpless band of workmen of ten years has grown into a vast army of 13,000 cokers." [38] Nearly 75 percent of all wage-earners in the region were employed in the coal-mining and coke industries about 1880. From 1900 to 1910, it is estimated that 80 percent of all capital investments in the region were in these industries. [39] For example, the population of Mount Pleasant borough,Westmoreland County grew from 1,197 in 1880 to 3,652 in 1890 to 5,810 in 1910. The coal company towns of Grace, Adelaide, Trotter, Leisenring, Paul, Leith, Wynn, Morrel and Calumet were all constructed in Fayette and Westmoreland counties between 1880 and 1889. [40]

The H. C. Frick Coke Company, which was formed in 1882 by a number of Pittsburgh iron and steel manufacturers, including H.C. Frick was the largest coke company in the region and in the nation. The new firm issued 40,000 shares of stock at $50 a share with capitalization valued at $2 million in assets and stock issue in 1882. These men and corporations held the following shares as recorded on May 5, 1882: Andrew Carnegie - 1,000, Thomas M. Carnegie - 500, Henry Phipps, Jr. - 500, H.C. Frick - 680, E.M. Ferguson - 660, Walton Ferguson - 660, Carnegie Bros. & Company Ltd. - 2,500 and H.C. Frick & Company - 33,500. [41] The company owned 1,026 beehive ovens and 3,000 acres of coking coal in the year the company was formed. The company controlled 35,000 acres of coal land and owned 9,000 beehive ovens in 1890. The principal competitors to the H.C. Frick Coke Company in the Connellsville region were the W.J. Rainey Company, the McClure Coke Company, Sample Cochran, Sons and Company, Joseph R. Stauffer and Company, A.A. Hutchinson and Brother, and James Cochran and Company during the 1880s. Frick purchased the McClure Coke Company, the second largest coke business in the district in 1895. It had operated 15 coke plants constructed between 1871 and 1879 and when acquired it operated eleven plants and 1,900 ovens

Frick was elected president of the H.C. Frick Coke Company and the firm erected a new corporate office at Broadway and Walnut Avenues, Scottdale, Westmoreland County in 1880. A second corporate office was constructed next door to the original office in 1904. Both offices are still extant and have excellant integrity. The vast coke empire of the H.C. Frick Coke Company was created by acquiring existing coke plants in the Connellsville district as the firm constructed only twelve coke plants in the Connellsville coke region between 1871 and 1907 - Adelaide, Standard Mine Number 2 (which replaced Standard Number One destroyed by fire), Shoaf, Brinkerton, Henry Clay, York Run, Hopwood, Collier, Phillips, Bitner, Frick (Novelty), and Smiley. Management preferred instead to purchase established coke plants and between 1870 and 1908 acquired nearly fifty plants. H.C. Frick Coke Company purchased four facilities between 1870 and 1879; 17 facilities between 1880 and 1889; 17 facilities between 1890 and 1899; and 14 more coke plants

between 1900 and 1908. The new American millionaire "Coke King" operated 10,000 ovens with 11,000 employees in the Connellsville district by the late 1890s. [42]

Andrew Carnegie became acquainted with the coke baron soon after Frick's marriage to Adelaide Howard Childs in December, 1881, beginning a long-term and often tumultuous business relationship. Frick was entrusted by Carnegie in 1889 to reorganize and consolidate Carnegie Brothers Steel and by the turn of the century had successfully consolidated the various companies into the Carnegie Steel Company. The new company produced between 25 to 30 percent of the nation's steel, 50 percent of the armor plate, and 30 percent of steel rails.

Carnegie was associated with Frick because according to him Frick and Company "owned the best coal and coke property." [43] This business arrangement assured Carnegie a reliable and inexpensive supply of coke, which along with iron ore and limestone is the principal raw ingredient required in the production of steel. "What is Steel," a poem appearing in the *New York Herald* in 1893, identifies the principal ingredients of steel and the geographic advantage of the Pittsburgh district for the development of the nascent steel industry:

> The eighth wonder of the world is this;
> Two pounds of iron-stone purchased on the shares of Lake Superior and transported to Pittsburgh;
> Two pounds of coal mined in Connellsville and manufactured into coke and transported to Pittsburgh;
> One pound of limestone mined east of the Alleghenies and brought to Pittsburgh ;
> a little manganese ore; mined in Virginia and shipped to Pittsburgh;
> And these four and one half pounds of material manufactured into one pound of solid steel and sold for a cent;
> That's all that need be said about the steel business.

The major counties and coking seams of Pennsylvania are: 1) Allegheny -Pittsburgh, Upper Freeport, 2) Armstrong-Lower Kittanning, Upper Freeport, 3) Butler-Brookville,

Upper Freeport, 4) Cambria-Lower Kittanning (B), Upper Freeport (E), Upper Kittanning (C), Lower Freeport (D), 5) Clearfield-Lower Freeport, 6) Fayette-Lower Kittanning (B), Pittsburgh, Redstone, Sewickley, 7) Greene-Pittsburgh, Sewickley, 8) Indiana - Lower Freeport, Lower Kittanning, Upper Freeport; 9) Somerset-Brookville (A), Lower Freeport, Lower Kittanning (C), Pittsburgh, 10) Washington-Pittsburgh, 11) Westmoreland - Kittanning (B), Pittsburgh, Upper Freeport. [44] While a majority of Pennsylvania coke was produced in beehive ovens in the compact Connellsville coke district straddling parts of Fayette and Westmoreland counties, there were sixteen counties in the state producing more than 3.5 million tons in 8,456 beehive coke ovens during the 1880s. [45]

Pennsylvania Coke Producing Counties in 1885

Counties	Tons of Coke Produced	Number of Ovens Operating	Number of Ovens Idle
Allegheny	19,416	95	107
Armstrong	10,311	66	
Beaver	438	2	6
Bedford	41,682	110	
Blair	91,459	196	20
Butler	5,015	32	68
Cambria	100,606	228	2
Center	6,127	40	25
Clarion	7,057	58	12
Clearfield	49,552	200	16
Elk	3,438	36	
Fayette	2,074,734	4,701	1409
Huntingdon	62,838	241	
Jefferson	90,053	151	206
Somerset	5,382	32	
Tioga	16,100	75	100
Washington	900	4	
Westmoreland	1,001,768	2,189	3,443

Blair and Cambria counties were the next most important coking region in Pennsylvania during the 1880s and 1890s. Coke production in these counties was located in the

bituminous coal basins along the sides and near the summit of the Allegheny mountains. The coking industry in Cambria County developed in the eastern and northern townships with the largest beehive coke establishments located in the Cresson area, and in the vicinity of Barnesboro and Hastings. The Pennsylvania Coal & Coke Company dominated the county's beehive coke industry by the early 1900s. The county's coke production experienced a rapid decline in the decades after World War One as the by-product ovens replaced beehive coke production.

Blair county had four coke-making establishments, 190 ovens, and 107 employees in 1880 while there were three coke plants, 119 ovens, and 45 employees in Cambria County. The combined coke production of both counties was about 150,000 tons of coke in 1880. The Bennington coke plant, owned by the Blair Iron and Coke Company, was one of the largest coke plants, but was acquired by the Cambria Iron Company in the 1870s and remained active until about 1884. [46]

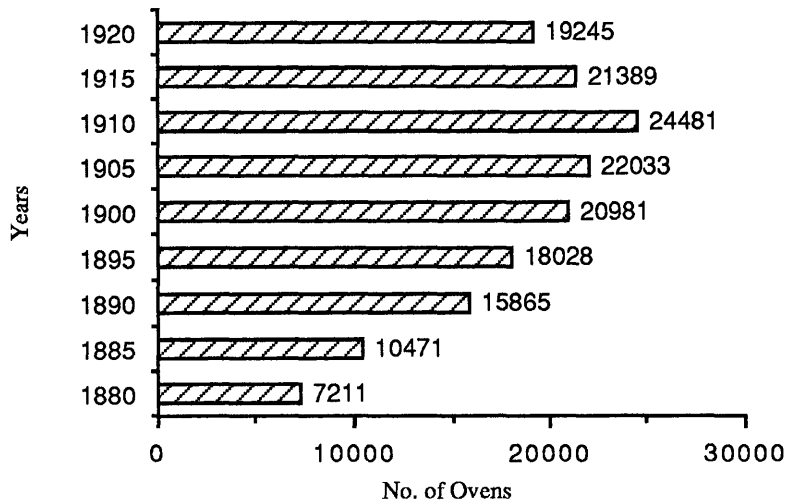
Coke manufacturing also developed in the semi-bituminous coal region of the Broad Top field, located in parts of Huntingdon, Bedford and Fulton counties, during the last quarter of the nineteenth century. Two coke manufacturing reports were issued on this isolated semi-bituminous coal region by the Second Geological Survey of Pennsylvania. John Fulton, author of these reports and the general mining engineer of the Cambria Iron Company of Johnstown, observed that "(Broad Top) coke is destined to become the leading fuel for blast furnaces, and to retain this position from its almost inexhausitable source of supply, its calorific efficiency, and its continued economy." The first large-scale coke operation in the region began in 1875 at the Rockhill Furnace Number 2, owned by the Rockhill Iron and Coal Company, Huntington County. [47] The Kemble Coal and Iron Company constructed beehive coke ovens at the company town of Riddlesburg, near Defiance, Bedford County during this period. The ovens produced coke used by the company's blast furnace which was constructed in the late 1860s. Riddlesburg was an active mining community between 1870 and 1952. Colonial Iron Company was the last operator of the Riddlesburg's ovens which were last fired in 1950.

The Introduction of Alternative Coke-Making Technology

Bituminous coal or coke did not surpassed charcoal usage in blast furnaces in 1869. Anthracite continued to be the leading blast furnace fuel nationally until 1875 when it was superseded by bituminous coal and coke. The beehive coke oven was firmly established as the universal method for the production of coke during this period. From 1871 to 1919 about 88 percent of all iron produced in the United States used coke made in these ovens. Beehive ovens were producing nearly 100 percent of all coke used as blast furnace fuel in the nation until 1893 and as late as 1910 they produced 83 per cent of all metallurgical coke. [48] The American beehive industry attained its maximum peak in terms of the number of ovens in 1910, when 100,362 beehive ovens were in operation in 19 states. The following states had at least 1,000 beehive ovens by this date: Pennsylvania 54,360; West Virginia 19,792; Alabama 9,852,Virginia 5,389; Colorado 3,611; Tennessee 2,792 and New Mexico 1,030. [49] The peak production of beehive coke in the United States was reached in 1916, when under the influence of war coke production nationally reached a total of 35,464,224 tons. Of that total 27,158,538 tons were produced in Pennsylvania, while the Connellsville coke region alone produced 21,654,502 tons. This represented 80 percent of the total coke production in Pennsylvania and 61 percent of the entire national production. [50]

The mid-nineteenth century design of the beehive oven had changed very little by the dawn of the twentieth century. The number of beehive ovens constructed continued to expand in the Connellsville coke district from 7,211 ovens in 1880 to 24,481 ovens in 1910. [51]

Beehive Ovens in Connellsville District



These ovens represented an increasingly archaic and wasteful technology although they still produced excellent "met" coke. Hot coke was manually drawn by hand from them and this was a costly and time consuming process. A well-constructed beehive oven converted about 70 percent of the burned coal into coke but the remaining volatile matters was expelled from the oven's "eye" into the atmosphere as noxious smoke and gas. Their inefficient design permitted the loss of valuable chemical by-products - oven gas, ammonia, light oils, and coal tars. The Smithsonian Institution issued a report in 1924 that identified the wastefulness of the beehive coke oven design:

> In 1920, there were 24,000,000 tons of coal used to make 16,0000,000 tons of beehive coke. The principal by-products that were wasted from this source were: 216 million gallons of tar; 600 million pounds of ammonium sulphate, which could be used as fertilizer; and 120 billion cubic feet of gas; which could be used, the same as manufactured gas, for public utility. [52]

Two alternative coke-producing ovens were developed during this period which challenged the supremacy of the venerable beehive coke oven. They were the by-product or

retort oven developed by European engineers; and the rectangular, Belgium, or Mitchell oven. The by-product or retort coke oven represented a revolutionary new coking technology designed by engineers in England, Belgium and Germany during the 1880s. The by-product oven would replace the beehive coke oven as the principal source of blast furnace coke in the United States at the end of this period. These ovens were used with marked success in Europe for about a decade, although their adoption was initially resisted by American coke manufacturers who were prejudiced against them. They were satisfied with the excellent coke obtained from the beehive ovens and were reluctant to embrace this alternative coke oven. [53] The high cost of their installation and lack of markets for their by-products slowed their initial development. There were no adequate markets for such coke by-products as benzol, ammonia, naptha, tar, and pitch in the country. The beehive oven was an inexpensive installation in contrast to the costly by-product oven. A comparison of these two types of ovens in 1912 indicated the cost of an individual beehive oven at $700 to $800 while a single by-product oven cost $12,000 to $18,000, depending on the type of oven constructed. [54] By-product coke ovens were more or less experimental ovens in the United States during the 1890s because of this hesitation to embrace this new coke-making technology.

The by-product coke oven was described by a proponent as "one in which the gas evolved by distillation of the coal, in externally heated air tight ovens, is withdrawn and saved." [55] These ovens, besides producing excellent metallurgical coke, were designed by European engineers to capture and recycle the chemical by-products of the coking process. The principal products are gas, ammonia, light oil and tar. These recycled gases and chemicals became the foundation of the chemical and plastics industries of the United States in the near future. The original by-product ovens of the 1890s saved some 100,000 cubic feet of gas. Some 7,000 cubic feet were used for heating the ovens, and the remaining gas was clear profit for the coke operator. Each ton of burned coal in these early ovens produced 1,300 to 1,500 pounds of coke, 8 to 10 gallons of coal tar, 3 gallons of light oil, 5 to 6 pounds of ammonia and 9,500 to 11,500 cubic feet of coal gas. Better designed by-product ovens increased by-products saved during the next decade. The average amount of by-product

recovered from every ton of coke rose in 1912 as follows: ammonium sulphate 31 pounds / net ton of coke; tar 10.7 gallons / net ton of coke; and surplus gas of 7,143 cubic feet / net ton of coke. [56]

The first by-product ovens were introduced in the United States in 1887 with actual production dating from 1892. The first by-product coke in America was made in a small battery of 12 ovens built by the Semet-Solvay Company at the Solvay Soda Ash Works at Syracuse, New York in December 1892. [57] The facility produced 12,850 net tons of coke the following year. The dozen ovens recovered ammonia for use in making soda ash and caustic soda. The ovens were developed ten years earlier by the parent Solvay Company in Belgium. A single battery of 50 ovens was first constructed by the Semet-Solvay Company in western Pennsylvania at the Dunbar Furnace Company of Connellsville at Dunbar, Fayette County, in 1894. C.M. Atwater of Syracuse, who directed the construction of the by-product ovens at Syracuse, constructed the Dunbar coke plant. An additional 60 ovens were constructed in 1903-1904. Run-of-the mine coal from the Pittsburgh and Upper Freeport seams was used in the ovens to make coke burned at the adjacent blast furnace. The Dunbar ovens yielded 6 to 8 percent more coke per ton of coal than neighboring beehive ovens. Gas recovered from the ovens was shipped to chemical companies for further refining, pitch was sold locally, and ammonia was shipped to Syracuse. The ovens had horizontal moveable flues for the recovery of ammonia. The Dunbar system included gas washers, an ammonia container, and two engines. The American Manganese Company of Philadelphia acquired the Dunbar Furnace Company on July 1, 1914. The firm manufactured manganese alloys, ferro-manganese, spiegeleisen, high manganese iron, and various grades of pig irons. [58] The American Manganese Company enlarged the original facility by erecting more ovens and constructing a new draining bin, a washery, an oil house, and a stir house. The firm employed 328 workers in 1916 and 523 workers in 1922. The facility ceased operation following the protracted 1922 national coal strike and in February, 1924 was demolished by the owners.

The Dunbar location was unique because subsequent by-product ovens, unlike the beehive coke ovens, were erected near steel plants usually located some distance from the

coal fields. The Cambria Steel Company of Johnstown was the first American steel corporation to construct by-product ovens to make coke in conjunction with a blast furnace in 1895. The firm constructed sixty Otto-Hoffmann by-product ovens at its new installation at Franklin Borough, northeast of Johnstown. The plant consisted of gas coolers, ammonia washers, ammonia stills and ammonium vats. Tar and sulphate of ammonia was recovered from the ovens. The number of by-product ovens increased from 160 to 260 ovens between 1901 and 1904 at the Franklin facility. Coke and by-product gases were produced from coal extracted from the firm's Rolling Mill mine. This "captive" mine, located at the foot of Westmont, Johnstown, was operated by the Cambria Iron Company since opening in 1856.

There were numerous manufacturers of by-product ovens and their designs changed over time; therefore, design and size specifications were not standardized. H. Koppers Company, Semet-Solvay Company, Wilputte, United Otto, and Otto-Hoffmann were the principal of these ovens (Illustration 1 & 2 - Types of By-Product Ovens).[59] Each by-product oven was about thirty-six to forty feet long, seven to ten feet tall, and twenty feet wide. The ovens were usually constructed in batteries containing fifty or sixty units, with the largest plants having 600 or more ovens. Each oven was a steel chamber surrounded by flues and lined with silica brick. About eight tons of coal were fed into the top of each oven by a charging machine and then fired from 17 to 24 hours, depending upon the type of coke required. [60] Coal was converted into coke in air-tight chambers that were charged at the top with coal that was burned for about 24 hours, one half the time required by the beehive oven. While coal was burned without any external fuel on the inside in the beehive oven, the coal in the by-product oven was burned from gas on the outside. On each side of the oven were three horizontal flues that carry the gas which heats the oven. The flues were made of tiles, two inches thick, about which the gas travels from other ovens that have been burned. The ovens were fired from heating flues in the walls. Each oven has a door opening at each end, both doors were closed during the coking operation. When the coking process was completed, a ram operated from a car at the rear forces the coke up onto a cooling platform. Coke was quenched with water and was now ready to be loaded onto cars and shipped to

the blast furnaces. [61] Gas from the oven was transferred to the by-product house where it is cleaned and the by-products are obtained. The oven has a coking chamber, from which the gases from the heated coal were drawn through uptake pipes into water-sealed collecting troughs. The gases were then drawn through a series of condensers and scrubbers from which the various by products were deposited.

The real beginning of the American by-product coking industry began in 1906 when Dr. Heinrich Koppers of Essen, Germany was brought by the United States Steel Corporation to the United States, to design and construct 280 by-product ovens at their Illinois Steel Company at Joliet, Illinois. Dr. Koppers had designed by-product coke ovens in Germany which were capable of producing 1500 pounds of coke from each ton of coal carbonized. These ovens were able to recover valuable by-products formerly wasted as noxious smoke. United States Steel Company executives were satisfied with the quality of coke produced from the new Kopper's ovens and later installed 490 Koppers ovens at their new Gary, Indiana Works.

The H. Koppers Company was incorporated in Chicago in 1912 and became engaged in the construction of by-product ovens for a number of steel companies. A group of investors from Pittsburgh, led by H.B. Rust, purchased the company in 1914 and renamed it the Koppers Company. The company moved their corporate offices from Chicago to Pittsburgh, to be nearer to the coal fields of western Pennsylvania. [62] The Koppers Company was the largest designer and builder of these chemical recovery coke ovens in the United States by 1915. [63] A typical by-product oven built by the company in 1930, "consists of a silica brick chamber which is maintained at a temperature -about 2000 degree Farenheit. This chamber is tapered 17 to 19.5 inches in width, 10 feet in depth, and 37 feet in length and holds 12.5 tons of coal." [64]

Dr. C. W. Saleeby, a leading proponent of these ovens, described coal "as an inexhaustible treasury of infinite and manifold riches" because of the gaseous by-products created by the "cooking" of coal. [65] Coal has been called a "black diamond" because of its valuable by-products. Dyes, inks, antisepectics, aspirin, saccharin are just a few of the many products derived from refining coal. The burning of coal in the by-product ovens

created a number of principal materials that are used in the production of other goods. Coal tar is the basic material for hundreds of compounds including naphthalene, heavy oil, pitch, resins, and explosives. Tar is a thick, brown to black viscous liquid, obtained by the distillation of coal, wood, peat and other organic materials. The bulk of the ammonia goes into the production of ammonium sulphate, which is used in the manufacture of nitric acid, explosives and fertilizers. Light oil contains benzene used in tanning fluids, aniline dyes, motor fuel, plastics and synthetic rubber. Toluol is the basic ingredient in explosives, particularly TNT, (trinitrotoluol). It was also used to make antiseptics, fingernail polish, printing ink, saccharin, and detergent. Xylene is used to make motor fuel, gasoline solvent, herbicides and solvent naphtha used as a rubber solvent, electrical insulation, linoleum, varnish and a variety of products which are used in the manufacture of dyes, drugs, and chemical reagents (Illustration 3 - Chemicals derived from the by-product ovens). [66]

A second advantage of these new alternative coke ovens was that they yielded more coke per ton of coal. The beehive coke oven produced 66.8 percent coke per ton while the by-product oven averaged 73.6 percent. [67] The new by-product oven design also permitted the use of inferior quality coal, although it had to be crushed, sorted and washed to remove impurites, especially sulfur.

The growth of the by-product oven, as an alternative to the beehive oven, was a slow and evolutionary process. *Engineering Magazine* compared the two coke ovens in 1899: "Dr Johnson once defined a weed as a plant of which the use had not yet been discovered; perhaps we might equally define a by-product as something valuable which most people willingly permit to run to waste, and in these days of close competition the difference between waste and economy frequently means all the difference between commercial failure and success." [68] Seventeen steel firms installed by-product ovens at their facilities from 1895 to 1903. Additional by-product batteries were erected by Bethlehem Steel Company at their Sparrow Points, Maryland facility in 1903 and the Pennsylvania Steel Company at Steelton near Harrisburg in 1907. There were twenty-nine coke by-product plants in the United States producing about 5.6 million tons of coke by 1906. There were three by-product facilities in western Pennsylvania operating 442 by-product ovens by 1910. [69]

The proximity of the beehive coking industry in the Connellsville district was largely responsible for the delay in the adoption of the new by-product coke ovens by the steel companies of the Pittsburgh district.*The Weekly Courier* noted in 1914 " few operators in either the Connellsville or Lower Connellsville regions have sufficient coal acreage to warrant replacing the beehive installation they now have with the expensive by-product oven." [70]

The H.C. Frick Coke Company became a subsidiary of United States Steel Corporation when it merged with the American Coke Company, the Continential Coke Company, South West Connellsville Coke Company, and the United Coal and Coke Company on April 1, 1903. [71] United States Steel Corporation management, unlike rival steel companies in western Pennsylvania, declined to invest immediately in the new by-product technology. The firm had major investments in tens of thousands of beehive ovens located in the Connellsville and Klondike coke districts and management used beehive ovens as long as they were profitable.

United States Steel Corporation erected its first by-product coke plant in the Pittsburgh district at Clairton, Pennsylvania, about 20 miles downstream on the Monongahela River from Pittsburgh in 1916-1917. The St. Clair Steel Company, a subsidiary of the Crucible Steel Company, built the Clairton Works in 1901.The plant was sold in 1902 and became the Clairton Steel Company. The plant had three 400-tons per day blast furnaces, twelve open hearth furnaces (eight basic and four acid) sixty tons heats each, a forty inch blooming mill and a twenty-eight inch three-stand billet mill. The plant was sold again in 1904 to the United States Steel Corporation. The physical size of the Clairton steel facility continued to grow during the second decade of the twentieth century. A coke by-product plant at Glassport, Allegheny County was the only such facility in the Pittsburgh district until the construction of by-product ovens at the Clairton plant. The Chicago, Youngstown and Birmingham districts produced more by-product coke than the Pittsburgh district before 1917 and the construction of the Clairton Coke Works.

The Clairton by-product coke ovens were put into operation in 1919 and consisted of 640 ovens with a daily coal capacity of 10,500 tons. Ten more by-product coke oven batteries

were added. Six of these batteries containing sixty-one ovens each were put in operation in 1924. The other four batteries containing eighty-seven ovens each were put into operation in 1928. Clairton was the largest by-product coke plant in the nation and its completion made the Pittsburgh district the largest by-product coking district in the United States. Raw bituminous coal was shipped daily by means of 1,000-ton barges on the Monongahela River from the Connellsville district (Illustration 4 -Typical View of a By-Product Coke Plant).[72]

Coal was burned in the by-product ovens at Clairton for about 19 hours to drive out volatile gaseous matter, then the oven doors were opened and the coke removed and pushed into the quenching car. Water was sprayed for 45 seconds to quench the coke. The watered coke should not contain more than three percent water and once watered down it was allowed to drain for one minute. The coke was then dropped upon a wharf from which it was fed by a rotary belt and pushed through chutes into railroad cars for delivery to the blast furnaces at the Edgar Thomson Works at Braddock, and the Homestead, Duquesne, and Clairton Works. [73]

By-product coke output was controlled by the demand for coke, which in turn was dictated by the demand for steel. American involvement in World War 1 was a powerful catalyst for the expansion of by-product coke production. The European War had restricted the import of coal tar derivatives used to manufacture many essential dyes, drugs, and explosives products. America was still dependent upon Europe for part of its supply of creosote, benzol and similar coal derivatives. A shortage of toluol, benzol and sulphate of ammonia needed in the production of explosives developed with the closing of trade with Europe. These by-products were traditionally imported from Germany and Great Britain, which had developed sophisticated and extensive chemical industries since the 1890s, unlike the small coke residues market in the United States. Four new by-product plants were built between 1915 and 1918 at Clairton, PA (768 ovens), Cleveland, Ohio (180 ovens), Lorain, Ohio (208 ovens) and Gary, Indiana (140 ovens) to meet this demand of the munition industry. [74]

A serious reappraisal of existing coking methods was undertaken during the First World War. The Pennsylvania Department of Mines in 1918 urged coke operators to embrace the more productive by-product oven instead of the wasteful and inefficient beehive oven:

> The value of the by-products such as tar, ammonia, gas, benzol, and the varied dyestuffs was not appreciated until the war in Europe revealed our dependence upon foreign nations, particularly Germany, for these materials ... The trade in by-products may be considered established on a really large scale, and the many millions of dollars formerly wasted every year will be saved. [75]

By-product coke production initially developed very slowly. These alternative coke ovens supplied less than 0.1 percent of all metallurgical coke manufactured in 1893 although coke production doubled from 11,219,943 tons in 1914 to 25,997,580 tons in 1918. [76] By 1912 one-fourth of the annual coke production of the United States was obtained from by-product ovens; and the ascendency of the beehive oven was lost permanently in 1919 when by-product coke ovens produced 56.9 percent of all coke compared with 43.1 percent of coke produced in the beehive ovens. According to the eighteenth annual report of the United States Steel Corporation, for the fiscal year ended December 31, 1919, the firm's subsidiaries mined more than 28 million tons of coal in 1919. The subsidiaries, located chiefly in the Pittsburgh district, produced 15,463,649 tons of coke, of which 5,933,056 tons was produced in beehive ovens while 9,530,593 tons in by-product ovens.[77] United States Steel management, like other steel companies that operated "captive" mines were embracing the by-product ovens and this alternative method of coke production by the end of this era. The increased popularity of the by-product coke ovens caused the decline of coke production from the venerable but wasteful beehive ovens.

National Coke Production in By-Product and Beehive Ovens

U.S. Year	By - Product Ovens Coke (Net Tons)	Beehive Ovens Coke	Total Coke Production	Percent Production By - Product Ovens	Beehive Ovens
1880	0	3,338,000	3,338,000	0%	100%
1885	0	5,107,000	5,107,000	0%	100%
1890	0	11,508,000	11,508,000	0%	100%
1895	19,000	13,315,000	13,334,000	0.14%	99%
1900	1,076,000	19,457,000	20,533,000	5%	90%
1905	3,462,000	28,769,000	32,231,000	11%	89%
1910	7,139,000	34,670,000	41,709,000	17%	83%
1915	14,072,895	27,508,255	41,581,150	34%	66%
1920	30,833,951	20,511,092	51,345,043	60%	40% [78]

Seven steel corporations operated by-product coke plants in the Pittsburgh District by 1920 alone. The American chemical industry underwent a period of rapid growth during the 1920s as more outlets for these chemical by-products were developed. The following figures identify the primary products and their yields per net ton of coal during the period between 1917 to 1924: Coke - 1,386 to 1,424 pounds,Tar - 7.0 to 8.6 gallons, Ammonium sulphate - 17.8 to 22.8 pounds, Light Oil - 2.4 to 2.9 gallons, Gas - 10.4 to 11.6 Metric Cubic Feet. Steel companies' profits from by-product chemicals from the by-product ovens came to equal those made from coke. The wide-spread use of these ovens by steel companies removed most of the economic advantages of the Connellsville's coke district. The change from the beehive to the by-product method of coke production ranks as one of the most revolutionary changes in the coal industry. The decline of the beehive oven was imminent by 1920 and these ovens ceased to exist as a viable method in coke production during the 1930s. Several advantages of the by-product ovens accounted for their success in replacing the beehive ovens:

1) The yield from the by-product oven was greater. A ton of Connellsville coal coked in a beehive produced on average .67 tons of coke while a ton of coal in the by-product oven yielded .72 tons of coke.
2) A purer coke-lower in ash, phosphorous and sulfur - was produced from coke made in by-product ovens. This made it possible for steel companies using by-product ovens to use poorer quality coal in the production of coke.
3) Coals that would not produce good metallurgical coke in beehive ovens would produce adequate quality coke in the by-product oven. This meant that harder and more sulphurous coal from other coal tracts, especially those in the upper Monongahela River, could be used. Ordinary "steam" coals could be used in the by-product ovens by a blending and washing process that removed its high sulfur content. This process ended any shortage of metallurgical coke.
4) The by-product ovens produced a variety of valuable by-products. Each ton of coal produced 130 pounds of breeze (pulverized coke,used in the domestic trade), 24 pounds of ammonium sulphate, 9.5 gallons of tar, 3 gallons of light motor oil, and 1,100 cubic feet of gas.
5) Larger capacity by-product ovens were designed and the coking process was shortened. This improved the economies of production in addition to the utilization of the by-products (including benzol and toluol). [79]

The Rectangular Coke Oven

The rectangular oven, developed in Belgium, was the second type of coke-producing oven introduced during this period. This European designed coke oven was introduced in the Connellsville coke district by Thomas Jefferson Mitchell, superintendent of the W.J. Rainey Coal Company. This Cleveland based coke company, founded by W.J. Rainey (1833-1900), was the chief competitor of the H.C. Frick Coke Company in the district. Rainey was born at Martin's Ferry, Belmont County, Ohio of Scotish-Irish immigrants. He became involved in the coal industry when he mined coal located under his father's Ohio farm. He

opened his first mine in the Connellsville district in 1879 when he purchased the Fort Hill Works near Vanderbilt, Fayette County. The W.J. Rainey Coke Company, from this humble beginning, expanded to become the second largest coke operator in the Connellsville coke district as the company had at least a dozen mines and coking plants throughout Fayette and Westmoreland counties. The company also owned the Cleveland Rolling Mill of Ohio.

This company, unlike its chief competitor the H.C. Frick Coke Company, aggressively installed rectangular ovens at their coke plants and soon became the principal coke operator in the Connellsville district employing these alternative ovens. T.J. Mitchell was the brother-in-law of W.J. Rainey and the general superintendent of the firm's numerous mines, some 3,000 beehive ovens and thousands of acres of coal land. He wanted to develop a coking oven that was conducive to mechanized operation and still yielded high-quality coke. Beehive oven coke was still drawn by hand and labor costs were expensive. *The Mining Journal* determined the production cost of making a ton of coke by surveying three beehive coke plants in the Connellsville coke district in 1888 and found coking costs ranged from $1.00 to $1.25 per ton with labor costs contributing about 85 percent of the total expense. It took each coke drawer about three hours to draw and recharge each oven. Each man was responsible for six ovens, and each oven was drawn every other day (Illustration 5 - Manual extraction of coke from the beehive oven). [80]

The rectangular oven made coke in a similar manner to the beehive oven, but each oven was larger than the conventional beehive oven, each rectangular oven occupied about twice the area of a beehive oven. The standard beehive oven was about 12 feet in diameter and about 7 feet high while the rectangular oven measured around 30 feet long, 4 1/2 feet to 5 feet wide and 8 1/2 feet high. [81] The rectangular oven's larger interior space permitted each oven to produce 5 1/2 tons of coke with each charge as compared to a 4 1/2 tons per charge in an average beehive oven. Beehive ovens were constructed in either single or double banks called block ovens while the new design of the rectangular oven abandoned the circular shape and the single door of the beehive oven. The rectangular oven, unlike the beehive oven, was designed specifically for the mechanical drawing of coke. Each oven had

a door at either end for the mechanical removal of coke and therefore such ovens were constructed in single banks. The mechanical pusher moved on tracks in front of the ovens pushing the coke out the opposite door to be quenched. The hot coke was sprayed with water to stop its baking and then loaded for shipment to market.

The first bank of rectangular ovens was constructed under Mitchell's direction at Rainey's Mt. Braddock Works, Fayette County between 1905 and 1908. The experimental rectangular oven was 30 feet long, 4 feet wide, and had a vaulted, horizontal crown. This prototype oven proved successful after a number of technical problems were resolved. The company had erected 50 rectangular ovens at the Mt. Braddock Works by 1907. The company operated about 2,600 rectangular ovens at its Acme, Allison Number 1 and Number 2, Elm Grove, Fort Hill, Grace, Paul, Rainey, Revere, Royal and Union coke plants. [82]

The early successes of these rectangular ovens prompted other coke operators in the Connellsville and Klondike districts district to construct these ovens. The H.C. Frick Coke Company's Phillips mine near Uniontown was the last beehive coke plant constructed in the Connellsville region in 1907 and from that year until 1910 rectangular ovens were the only coke ovens constructed in the district. Jones and Laughlin Steel Company built ten rectangular ovens at its Pittsburgh's facility in 1907 while the Connellsville Central Coke Company constructed 100-rectangular ovens near New Salem, first fired in September, 1907. The River Coal Company constructed 100-rectangular ovens at its Bridgeport plant near Brownsville; the Tower Hill Connellsville Coke Company erected 48 ovens at Tower Hill Number 2 Works, and E.A. Humphries erected 40 ovens at Bradenville, Westmoreland County, east of Latrobe. The greatest number of rectangular ovens in the Connellsville district was reached in 1914. There were 1,132 ovens in the Upper Connellsville district, 2,666 ovens in the Lower Connellsville district (Klondike district). In contrast, there were some 24,071 beehive coke ovens in the region in 1908. [83]

The new rectangular-oven technology was employed by a number of coke operators outside of the Connellsville district. The Pittsburgh-Westmoreland Company built 300 ovens at Bentleyville, Washington County; the Keystone Coal Company and the Atlantic

Crushed Coke Company built rectangular-oven coke plants at their Greensburg plants; and the Jamison Coal and Coke Company of Greensburg constructed these ovens at their coke plant near Fairmont, West Virginia. The Cascade Coal & Coke Company of Buffalo, New York constructed 200 rectangular ovens at their shaft entry Sykesville Mine, Clearfield County in 1917-1918. Coke was produced from coal extracted from the 48-60 inch Lower Freeport seam. There were 200 beehive type ovens already in operation at their mine. The rectangular ovens were constructed during the Great War by the firm in an attempt to reduce high labor costs. The new rectangular ovens were laid out in three parallel rows approximately 1600 feet long. Each oven measured 5 1/2 feet wide by 32 feet deep and had a charging hole located in the center of the top. These ovens required 26 men to operate them while the same number of beehive ovens employed 48 men. The men working at the rectangular ovens were employed as follows: one man for each larry car, leveler, pusher and loader; 4 men on the watering machine; 4 men on the daubing machines; 5 men cleaning up coke breeze after the loading machine; 2 men placing oven doors in position; 2 men shifting railroad cars; 1 man cleaning up railroad track; 2 men attending the ashes; and 2 masons (Illustration 6 - Rectangular Oven).[84]

The rectangular oven had a number of disadvantages that restricted their wide-spread usage in the coke fields. First, the oven was more costly to construct than a beehive coke oven. Many coke operators, including the H.C. Frick Coke Company, the largest users of beehive ovens, had too much invested in beehive ovens to embrace the new and more expensive ovens. The Frick Coke Company owned 16,700 ovens in the Connellsville region with a daily capacity of about 36,000 tons of coke in 1903. [85] There were already 24,071 beehive ovens when the first rectangular oven was constructed in 1908.[86] Second, there was the prevalent belief that coal exhaustion in the district was imminent and therefore it was prudent for operators to maintain the existing beehive ovens. The Pittsburgh seam, that underlies the entire Connellsville coke district, produced between 10,000 and 13,500 tons of coal per acre. One hundred beehive ovens consumed about nine acres of Pittsburgh coal annually. [87] This continual rate of use insured the inevitable depletion of the coal reserves in the original Connellsville district. The Connellsville coke district was extended

southwest of Uniontown as new coal fields were opened in German, Menallen, Georges, Nicholson, and South Union townships, Fayette County in 1899. This new area was dubbed the "Klondyke" Field or Lower Connellsville region because the area was opened to extensive coal mining at the turn of the century shortly after the gold rush in Alaska. Its rapid development by the coal companies and coal speculators resembled the recent gold rush in the Yukon (Illustration 7-Lower Connellsville district). This region was predominantly agricultural but was transformed in a relatively short period of time into a major coke-producing region. The development of the coal and coke industry in the region turned the local inhabitants "coal crazy " as "farms that had been considered only heirlooms of dead fathers and grandfathers suddenly blossomed into gold. Options were taken on every acre of coal land on the southern end of the county. These options were sold and resold again, till, finally, the coal seam alone with mining rights brought as much as two thousand dollars an acre! " [88]

Coal companies, coal spectulators, and steel corporations from Pennsylvania and Ohio began acquiring coal lands here and in neighboring Greene County during the 1890s. T.J. Tuit, a pioneer investor of coal properties, purchased his first property in Greene County from S. Sealy Bayard, a farmer in Cumberland Township for $12,885 on May 28, 1897 for 257 acres. A major portion of the rich coal reserves of the Pittsburgh seam of Greene County was acquired by coal speculators, coal companies and steel companies by 1907. Land that originally sold for less than $25 an acre during the 1890s was commanding from $100 to $600 an acre in 1907 (Illustration 8 - Expansion of coal into Greene County). [89] Some 2,033 beehive coke ovens were constructed in the region producing 385,909 tons of coke valued at $792,88 by 1900. [90]

A major disadvantage with the beehive oven which had made the rectangular ovens attractive to some coke operators was their inability to mechanically unload coke. Efforts had been made for many years to reduce the high cost of handling coke as discharged from the beehive ovens. Labor costs were high and the number of ovens that could be fired and unloaded daily was restricted. Machinery was invented at the turn of the twentieth century to mechanically draw coke from beehive ovens This new technology doomed the spread and

popularity of the rectangular ovens. [91] These machines had a number of advantages over hand loading.The mechanical coke extractor, manufacturered by the Covington Machine Company, Founders and Machinists, of Covington, Virginia, was the most widely used electric coke drawer and mechanical loading machine and soon became the industry's standard. The company was formed in 1892 and operated a number of large machine shops between Newport News, Virginia and Huntington,West Virginia. The firm manufacturered power and hand punches, shears and rolls, iron and brass casting of every description. The firm manufactured coke drawing and loading machines and coal leveling machines for beehive coke ovens. Each Covington machine increased daily coke production because each machine could draw about five beehive ovens per hour or about thirty-six ovens a day. Each electric coke drawer could level from 30 to 40 ovens per hour and required only one man for its operation by 1913. [92] The use of mechanical remover was also an advantage during strikes or at times of labor scarcity for a coke operator. The principal disadvantage of the machine was its high cost and the need to redesign the doors on existing beehive ovens. The original beehive coke oven doors were too narrow to permit coke removal by the mechanical extractor and therefore had to be redesigned and enlarged by the coke operators.

The Covington machine consisted of two parts - an extractor for drawing the coke out of the ovens, and a conveyor for screening and loading the coke (Illustration 9 - Coke-drawing machine). The Covington Machine Company issued a catalog to prospective coke operators describing in detail its electric-driven coke machine and its operation as follows:

> The machine, as it is made today, has an extension on the conveyor which runs along in front of the ovens, so that while the machine is drawing oven No. 2 the small amount of coke remaining in oven No. 1 may be pulled directly onto the conveyor. While the foregoing description mentions electric power only, we are prepared to furnish steam-driven machines, also steam being furnished by a small boiler carried on the machine. The steam-driven machine, however, requires an extra man to look after the boiler, and we recommend, when possible, that electricity be used. [93]

The Covington Machine Company installed the first electric-driven coke machine at Continental Works, Number 1, Fayette County, H.C. Frick Coke Company on October 1904. Frick's managers and engineers calculated the operating cost of using the Covington machine, including labor, electricity, and depreciation, at about 50 cents per oven while the average cost of drawing coke manually was calculated at 92 cents per oven. The electric coke drawer proven successful in its task at Continental Works, No. 1,where three machines were in operation and 2 machines were working at the Oliver plant by 1906. The H.C. Frick Coke Company installed additional electric coke drawing machines at Baggaley, Fairchance, Hecla Number 1, Leisenring Number 1 and Number 3, Lemont Number 2, Oliphant, and Standard coke plants in Fayette and Westmoreland counties. There were 150 electric-driven coke extracting machines in use throughout the Connellsville district by 1908. It is unknown if these mechanical coke extracting machines were employed in the other coke producing regions in Pennsylvania. The Covington Company sold coke-drawing machines in the coke regions of West Virginia at the Kanawha, New River, and Pocahontas fields. The Low Moor Iron Company at Kay Moor, West Virginia introduced three Covington machines at their coke plant in 1901. [94]

The New "American" Miners

Rapid industrialization in the decades following the Civil War was accompanied by a remarkable increase in the nation's population that increased from 23 millions in 1850 to 76 million in 1900. Some 23 million immigrants came to America from 1860 to 1910. Pennsylvania was second to New York state in attracting immigrants between 1860 and 1920. The foreign-born population of the Commonwealth was fifteen percent (430,000 people) in 1860 and sixteen percent (1,400,000) in 1920. European immigration to Pennsylvania between 1901 and 1919 was: 1901-1905 - 226,007; 1906-1910 - 259,979; 1911-1915 - 273,473; 1917-1918 - 16,470; 1918-1919 - 11,257. [95] Immigrants were "pulled" to the United States for a variety of reasons, although most came because of economic necessity to escape grinding poverty and to improve their wages and living

conditions. Many industrial companies sent agents to recruit workers in Europe to fill their growing demand for cheap and unskilled workers. Advertisements by American capitalists promoting America as a land of milk and honey and opportunity for good jobs successfully lured millions of hopeful immigrants from southern and eastern Europe. Operators paid the cost of the trip from southern and eastern Europe to the mine or factory and then the cost of the voyage was deducted from the worker's pay. A second-generation coal miner's wife from Oscela Mills, Pennsylvania noted:

> I quess my family and my husband's family thought it would be milk and honey when they came to America. People told them how it would be the promised land over there. They weren't prepared for what they found. [96]

The expansion of the steel and coal industries created a series of long-term fundamental changes in the social, economic, and organizational structure of the state's bituminous coal industry. The increased demand for coal and coke created a severe labor shortage within the Commonwealth that the existing labor force was simply unable to supply. Surplus labor from the neighboring farms and villages was simply too small to fill this acute labor shortage. The availability of jobs in the expanding coal fields of western Pennsylvania acted as a powerful magnet for a large number of workers from southern and eastern Europe. This immigrant and largely unskilled labor force found employment in the hundreds of isolated coal towns hurriedly constructed throughout western Pennsylvania since the 1880s. The "new" wave of immigrants represented numerous and diverse ethnic and religious groups including the former citizens of the Austro-Hungarian Empire, Russia, Italy, Greece and Poland. Most Americans, including the mine owners, regarded them as representatives of the "beaten races of the world" and collectively labeled them all as simply "hunkies."

These new immigrants created dramatic and fundamental changes in the ethnic and religious composition of the state that were reflected in the bituminous coal industry of Pennsylvania. Between 1881 and 1890, 72 percent of European immigration to the United States arrived from the nations of northern and western Europe while the remaining 18

percent came from the nations of southern and eastern Europe. The character of American immigration changed after 1890, and of the nearly 12 milion immigrants who came between 1900 and 1914, a majority came from the nations of southern and Eastern Europe. The pattern of European immigration was nearly reversed from 1901 to 1910 when northern and western European immigrants accounted for 21.7 percent of all immigrants while 70.8 percent arrived from the nations of southern and eastern Europe. [97]

Before 1890, most miners in the bituminous coalfields of Pennsylvania were American born, English, Scotch, Welsh, Irish or German. Magyars, Italians, Poles, Slovaks, and Greeks replaced them after 1890. The United States Immigration Commission of 1911 observed that miners and coke workers in the bituminous coal regions of Pennsylvania during the 1870s were "Americans or representatives of English, Scotch, Welsh, German and Irish races. The employment of immigrants from southern and eastern Europe began in about 1880. The arrival of unskilled, immigrant workers, the bulk from southern and eastern Europe, swelled the ranks of coal diggers. The Slovaks were the first arrivals that immigrated in considerable numbers. The great bulk of all immigrants from southern and eastern Europe, however, has occurred within the past eight or nine years." [98] Slovaks began working in the coal industry of Pennsylvania in the early 1880s and were soon joined by Croatians, Hungarians (Magyars), Italians, Poles, Russians, Ukrainians, Lithuanians, Bohemians and other ethnic groups from southern and eastern Europe. Nearly one-half of all coal miners were foreign-born, and one in seven miner was the American-born son of a foreigner in 1910. [99] Fewer than 8 percent of the foreign-born mine workers were English, Irish, Scotch, German, or Welsh. Nearly a quarter of all mine workers were under the age of 25; and half of all miners were under 35 years of age. The social composition of the coal-mining population nationally according to the 1920 United States Census Schedules was 62.9 percent native-born and 37.1 percent foreign-born workers: native born white 56 percent; native-born colored 6.3 percent ; alien 19.2 percent ; first paper taken out 6.1 percent ; foreign-born American citizens 11.8 percent. [100] Poles were the largest single foreign-born group of miners numbering about 50,000 by 1920. They worked in both the bituminous and the anthracite fields of Pennsylvania. Some 2,000 Poles moved west and

worked in the coal fields of Ohio, West Virginia and Illinois. Italians were the second largest group of foreign-born coal workers.[101] The marital status of coal miners was 35.5 percent single, 62.7 percent married, 3.7 percent divorced or widowed and 5.1 percent with wives elsewhere. [102]

This immigrant and generally unskilled labor force was employed in both the bituminous and the anthracite fields of Pennsylvania. *The United Mine Workers Journal* observed in 1892 that "in the mines surrounding Scranton it was found that nine-tenths of the miners at present employed are Hungarian, Italian, and Slavs. Five years earlier the mines were nearly all American." [103] The Welsh, English, Scotch, and Irish who were the dominant ethnic groups among coal miners in Pennsylvania were soon replaced by these new unskilled workers in the mines. A survey of the nationalities of coal miners conducted by the Pennsylvania Department of Mines in 1912 identified more than 35 different nationalities working in the state's mines. The table below, derived from this study, identifies the major nationalities of both underground and surface mine workers employed in Fayette and Westmoreland counties at this time:

Underground Workers

Nationality	Fayette County	Westmoreland County
American	2,453	3,072
Slavonian	3,079	1,852
Italian	1,157	3,207
Polish	961	1,337
Hungarian	1,151	720
Total	8,701	10,188

Surface Workers

Nationality	Fayette County	Westmoreland County
American	1,613	1,444
Slavonian	1,139	423
Italian	752	533
Polish	544	248
Hungarian	261	120
Total	4,859	2,758 [104]

The influx of European immigrants provided coal operators with a surplus and cheap labor force. A Welsh anthracite miner complained in 1895 that "labor is so plentiful that operators can do just as they please. Pennsylvania is swarming with foreigners - Poles, Hungarians, Slavishs, Swedes and Italians ... who are fast driving out English, Welsh, and Scotch miners out of competition." [105] Some skilled British miners moved to the newly developed coal fields of the West and Southwest. Many English-speaking miners left the dangerous mines and became mine bosses, superintendents, or mine owners, while others were appointed coal inspectors or found employment in the state Bureau of Labor Statistics. And finally some British and Irish miners simply left the dirty and unsafe mines and found employment in the burgeoning industrial cities.

The new immigrant mine workers, unlike the antebellum English, Irish and Welsh miners, had less mining experience or no skill or experience in coal mining. A majority of the new mine workers were farmers or agricultural workers, urban industrial workers, or skilled artisans,without little or no mining experience. The Dillingham Commission of 1911 noted 7.7 percent of the southern Italians, 13.7 percent of the northern Italians, 9.8 percent of the Poles, 10.9 percent of the Magyars, and 10.7 percent of the Slovaks who emigrated after 1880 had been coal miners in their native lands; in contrast, 82.2 percent of the Scottish and 55 percent of the German mine workers had had mining experience in their native land. [106]

Most of these "novice" mine workers were drawn to the coal towns for the same reasons as the immigrant-born Pittsburgh-area miner, who wrote in his journal:

> I heard about America from my cousins. My cousins were working in the coal mines and I thought I could do that. I came across in 1900. I was 16 years old. Passage cost $105. I stayed a few days in Wheeling. Then I went up to the mining camp where they gave me a number (check). The next day I started to work. [107]

In contrast, less of these immigrants worked in the newly developed coal fields of southern Appalachia - Virginia, West Virginia, Kentucky, Alabama and Tennessee. Rural mountain whites, along with a growing African-American labor force, worked the southern coal mines which began large-scale commercial production during the 1880s. Coal production in this region experienced a coal boom during World War One. African-Americans, as slaves, had worked in the coal industry in Colonial Virginia since the 1750s. The development of the southern coal industry created severe labor shortages and represented new economic opportunities for them in contrast to agricultural work as sharecroppers. In 1900, African-Americans constituted 54.3 percent of Alabama's mine force, 25.9 percent of Virginia's; 28.4 percent of Tennessee's, 23.7 percent of Kentucky's, and 22.2 percent of West Virginia's. Nine percent of all coal miners nationally were African-Americans by 1910. [108] Approximately 70 to 80 percent of them worked in the non-unionized southern coal fields by 1920, concentrated chiefly in three southern states: West Virginia (25,000), Birmingham District of Alabama (17,000), and Kentucky, mostly in the western Kentucky coal field (10,000). An estimated 3,500 African-American miners worked in the coal fields of Virginia and Tennessee. There were 12,000 African-American miners in the northwestern and western field with more than 3,500 miners in Pennsylvania, chiefly employed in the Pittsburgh district and the Connellsville coke district. [109]

The Coal Company Towns

James B. Allen defined a coal-mining "company town" as "any community which has been built wholly to support the operations of a single company, in which all homes, buildings, and other real estate property are owned by that company, having been acquired or erected specifically for the benefit of its employees, and in which the company provides most public services." [110] Some miners called these single industry village the "patch" or "patch town" although the precise origins of these terms is still unknown.

The mining town was financed, built, and operated by the coal company for the sole purpose of housing a labor force to extract coal or produce coke at a nearby mine. The practical purpose of the construction of company housing was to increase productivity and profits for the coal company by 1) attracting labor, 2) reducing labor turnout, and 3) establishing control over the labor force. The General Assembly of Pennsylvania passed a statute in 1854, permitting owners of extractive industries to develop their private property as they saw fit. The statute stated:

> At any time hereafter when any five or more persons, who may be joint owners, tenants in commons or joint tenants of mineral lands within this Commonwealth, may desire to form a company for the purpose of developing and improving such mineral lands, it shall be lawful for any company formed under this provision of this act to construct railroads in and upon their lands; also to erect dwelling houses and other necessary buildings; also all necessary machinery for raising, moving and preparing all minerals, found in their land, for markets. [111]

The statute granted complete legal, economic and political autonomy to the individual mining corporation of these communities to construct and administer them as private and unincorporated entities. The first company mining towns were constructed in the anthracite region, but by the 1850s a number of mining towns were constructed in the bituminous coal fields of Pennsylvania. Some of the earliest mining communities were located in the

semi-bituminous "smokeless" coal fields of the Broad Top coal field and North Central fields. Robertsdale was constructed by the Rockhill Iron and Coal Company in the Broad Top field in 1873. [112] The Blossburg Coal Company, the Morris Run Coal Mining Company and the Fall Brook Coal Company were the three largest coal companies in Tioga County before 1860. These firms all built a number of mining towns for their workers. The Tioga County communities of Morris Run (Tioga Improvement Company), Arnot (Fall Brook Coal Company) and Fall Brook (Fall Brook Coal Company) located in the rich Blossburg seam were developed before 1880.

These coal towns were an almost instant creation. Their location was established by geological considerations rather than transportation. They developed adjacent to the mining operation in order to minimize the walking distance of the miners. It was recomemmended that the work site be no more than fifteen minutes walking distance from the town, or thirty minutes by "dependable transportation." Mines were rapidly opening in unsettled rural and often remote townships with little housing available for the influx of workers and their families. The absence of towns and infrastructure required the coal companies to construct entire "camps" or "patches" to house and service their workers and their families. Housing, like mining buildings and structures, was simply part of the general investment in the mining enterprise. If miners could afford their own homes, they were simply unwilling to invest in them because they did not know the probable life-span of the mine. Most of these mining towns were constructed on the premise that coal mining at a particular site was a short-term business enterprise. Owners were aware that coal existed in a region but the exact quantity and quality of underground coal at a particular location was often unknown. The sole purpose and life blood of the mining town was coal and when the seam was exhausted the mining towns were quickly abandoned and often became ghost towns. [113]

The mining town was created as a single-industry community whose general layout was determined by a number of factors-geographic location and physical setting (whether the site was a narrow valley or an open flat plateau area), location with respect to other towns, size and probable life of the mine, class and nationalities of employes, and the conscientiousness of the company in community planning. [114] Depending on the size and location of the

mine, some coal operators constructed workers' housing and also furnished their labor force with such necessary appurtenances as water, a retail store, medical facility, a school, a church, a medical facility, and often a social center. They hired the teachers, the pastor, the store keeper and the doctor.

The coal company owned all surface property including the mining buildings and houses, which were rented to the miners on a monthly basis with their rent deducted directly from their wages. The construction of these mining villages varied throughout the different coal fields. Mine engineers, rather than architects or town planners, were employed by the coal companies to lay out the mining complex, including buildings and structures needed to extract coal or manufacture coke. Many mining villages were extremely primitive settlements consisting of the minimum accommodations needed to attract and house an increasingly immigrant labor force. They were constructed from simple designs with minimal attention to aesthetic qualities or town planning that could foster any sense of community. The usual mining village was composed of plain, serviceable buildings, often standing starkly in rows with little variation in their architecture. This construction gave most mining towns a drab and monotonous appearance. Housing was erected of inexpensive materials to minimize cost to the company. There was a wide variety of construction designs and materials, but generally the houses were built with cheap lumber and the exterior walls were clapboard. A minority of housing, estimated at about five per cent of all mining housing, was constructed of brick, tile or stone. Mixtures of single, double family, and semi-detached houses were often found in the same town. Single family houses consisted of three, four, or five rooms. Duplex houses were 8 , 10 , and 12 rooms rented to two families. Multiple housing, including six or more units, were also constructed by some companies. Boarding houses and hotels were constructed to house single or transient workers. Many married immigrant miners traveled alone intend on making sufficient money in the new world before sending for their families. These single workers crowed into the boarding houses that rented rooms, provided meals, and laundry service for single miners. The exteriors of the wooden houses were whitewashed or painted with cheap barnboard paint - lead gray, dull brown, or drab red. Flooring was a single layer of

knotted or split board, permitting cold air through the holes, and was generally carpetless. Few houses were constructed with cellars, and houses sat directly on the ground or were propped on stilts. They were generally constructed without electricity, water, and indoor plumbing. Electricity was used in mines for lighting and operating machinery after the 1880s but few houses before 1910 were originally wired for its use. Light was usually provided by candles and kerosene lanterns, and the coal stove found in the kitchen was used for cooking and for home heat. Most houses had no piped water. Water for cooking and bathing came from outside pumps or hydrants in front of the houses, with one unit located every 75-100 feet. Bathtubs were seen as a luxury item and were generally not found in company houses. As late as 1922, less than 3 percent of all miners' dwellings nationwide had bathtubs or showers. Mining was an extremely dirty occupation and miners returned home each evening often wet and always covered with dirt, grime, and minute particles of coal dust, called "bug dust." The inhaling of "bug dust" over many years was the primary cause of the debiliating black lung disease (pneumocniousis). [115] Coal miners had to bathe themselves every evening in a large tub in the kitchen until mine companies were forced by state statute to erect a bath house to perform this daily task. Miners asserted humorously that they were the cleanest men in the nation because they took baths daily. An important duty of the miner's wife was to have hot water ready for their husband's evening bath. Other duties of the women of the" patch" were purchasing food, selling surplus food and taking in boarders to stretch the family's income. Wives took in boarders,usually of the same nationality, to make ends meet. Journalist W. Jett Lauch explained the cost of rent in the American bituminous coal fields as following:

> The monthly rent for company houses in the different mining fields varies from $1.50 to $2 a room. The rent of a specified house being based on the number of rooms. It is apparent that by crowding, the rent payment for each person can be materially reduced.[116]

A variety of buildings was located at the rear of the houses. There were usually no sewers and every house had an outdoor privy-one for single houses and double ones for duplexes. Near each privy was an outdoor bin for coal storage. The miner, like any other coal consumer, had to pay for his coal that he carried home on his back in a sack from the tipple. Bread was a principal food consumed by miners and their families. Common baking ovens were located in the backyard for baking bread, pies, rolls and specialty dishes made by the various immigrant groups. [117] Some mining companies permitted their workers to enclose the houses with fences so they might keep a cow, chickens, or pigs. Common land in coal towns was sectioned in lots with garden plots ranging in size and type of crops grown. [118] Mining families were able to supplement their diet by raising their own vegetables and owning livestock, without making these costly purchases at the company store. Many miners' wives cultivated large gardens, kept chickens and occasionally a cow for this purpose. Dorothy Schweider, in her study of miners' wives and their prominent economic role in the mining town, noted that wives sold surplus vegetables, eggs, and milk which contributed from one-fourth to one-half of the family income. [119]

Coal mining was largely an immigrant industry as a majority of its operatives were workers from the nations of southern and eastern Europe. All position of authority was reserved for native-born men or immigrants from western Europe who had lived in the United States for many years and received American citizenship. The company-owned mining towns were multi-cultural communities that were usually socially stratified by race, ethnicity, and class. Ethnically-segregated settlement patterns in these remote communities represented conscious attempts by some coal companies to fan and maintain Old World racial, ethnic, religious and political antagonisms and thereby keep their workers divided. There appears to have been four general types of segregation patterns although not all are always clearly defined in each mining town. First was an area in the village occupied by members of management and key personnel - the "bosses" -who were usually Americans or of the so-called "Anglo-Saxon" stock. They lived in the best houses if they resided in the community at all; often they resided in a nearby town away from the dirt, grime, and smoke of the village. Irish, Scotch, Welsh, English along with native-born Americans were

the primary foremen and superintendents at most mines. Housing for management including the mine superintendent, mine foremen, company-store manager, mine foremen, payroll clerk and other office personnel was called "bosses" row" or "silk stocking row" by foreign-born workers. The houses were generally larger and more sturdy in construction than regular workers' houses. The bosses' houses, usually located a short distance from the miners' houses, were furnished with furnaces, complete indoor bathrooms, and hot and cold running water. The houses were often of individual design, in sharp contrast to the monotonous sameness that characterized most workers' houses. The houses had elaborate porches and were landscaped with lawns, trees, and shrubbery. The superintendent of the Crucible mine, owned by the Crucible Fuel Company, Greene County lived in a fourteen-room house, surrounded by a tennis court and a swimming pool. A second segregated area included white miners of American, "Anglo-Saxon," or "Northern European stock." The English-speaking immigrants constituted a majority of early miners and residents of the coal towns until the 1890s. The non-English miners, from southern and eastern Europe, called them "Johnny Bulls." The third segregated area in the town housed foreign-born white miners of eastern and southern European extractions. Most coal operators believed their new immigrant labor force were "subhuman" derisively calling them "Wops", "Polacks" and" Hunkies." Each ethnic group resided apart in areas within the community called "Siberia,""Dago Hill," "Russian Hill," and "Hunkytown." African-Americans occupied the lowest rung of the social and economic ladder in the company town. [120] Their housing was often mere shanties and was usually located some distance from the other miners' housing.

This policy of creating and enforcing the segregated company town was not universally employed by all coal companies. The Vesta Coal Company, a subsidiary of Jones and Laughlin Steel Corporation, was incorporated on December 22, 1891 under Pennsylvania law for "the purpose of mining, producing, transporting and selling its products." [121] The company operated seven "captive" mines on the Monongahela River between Allenport and Fredericktown on the border of Washington and Greene counties between 1892 and the 1970s. Vesta No. 1 was located at Allenport; Vesta No. 2 was located near Roscoe; Vesta

No. 3 was located at Coal Center; Vesta No. 4 was located at Richeyville, Smallwood, and Daisytown ; Vesta No. 5 was located at Vestaburg; Vesta No. 6 was located at Denbo; while Vesta No. 7 was located at West Brownsville (Illustration 10 - Location of the Vesta Company Towns). The company had an informal housing policy at its company towns that permittedany family to occupy a vacant house in the "patch." It was a common practice that relatives and fellow countrymen were encouraged by neighbors to move into the recently vacated house. Segregation in housing, based on ethnic and religious differences, existed at these villages but this practice was self-imposed by workers and their families and was not part of a long-term systematic policy formulated by the company. [122]

President Harding and Congress created the Coal Commission to investigate all facets of the coal industry after the especially violent 1922-1923 national strike. This eleven month study, better known as the Harding Commission report, was the most in-depth examination of community life and living conditions of miners in the bituminous coal fields undertaken until this time by the federal government. The Commission's findings were released in a voluminous multi-volume report in 1923. The report was an excellent in-depth descriptive study of the physical composition of housing and daily life in coal mining communities. Agents were sent to field-visit 713 company-controlled communities in the soft coal fields of western Pennsylvania, West Virginia and Ohio. The study estimated that 70 percent of the nearly 600,000 miners lived and worked in the Appalachia Coal Region. Approximately one-half of all bituminous coal miners in the United States lived in company towns by 1922-1923. Eight out of ten miners in the bituminous coal fields of Pennsylvania lived in villages with less than 2,500 population and about one-half of them leased and lived in company-owned houses. [123] About two-thirds to four-fifths of all miners in the coal producing states of Southern Appalachia in West Virginia, Tennessee, Virginia, Maryland, and Alabama lived in company housing. Eighty percent of West Virginia miners lived in company-owned housing compared with fewer than nine percent in Indiana and Illinois. [124] As would be expected, the visited company-owned towns represented a variety of living conditions The report summarized their findings of company-owned housing as follows:

> In the worst of the company-controlled communities the state of disrepair at times runs beyond the power of verbal description or even phototographic illustration, since neither words nor pictures can portray the atmosphere of abandoned dejection or reproduce the smells. Old, unpainted board and batten houses, -batten going or gone, and boards fast following, roofs broken, porches staggering, steps sagging, a riot of rubbish, and a medly of odors - such are the features of the worst camps. They are not by any means in the majority; but wherever they exist they are a reproach to the industry and a serious matter for such mine workers' families as dependent upon the companies for living conditions. Ninety-five percent of the company-owned houses in the 713 communities studied were built of wood. More than two-thirds were finished outside with weatherboard, usually nailed directly to the frame with no sheathing other than paper, and sometimes not even that. The weatherboard commonly used was plain overlapping siding, but in the northern coal fields a better sort of fitted weatherboard was frequently seen. Over two-thirds of the roofs were of composition paper. The houses usually rest on post foundations, with no cellars; but the double houses, especially in the vigorous climates, often have solid foundations, and occasionally excavated cellars. There are porches on nearly all except "shanties." Wood sheating forms the inside of half the houses, plaster is 38 percent. Board and batten, the cheapest type of construction, was used in over a fourth of the dwellings, and in communities presenting a conspicuous range of general conditions. [125]

The Coal Commission devised an elaborate rating system to assess the quality of company housing and the quality of daily life in the village. Eight categories, on a scale from 0 to 100, were used in comparing and ranking the coal communities. Housing, water supply and distribution, sewage and water disposal, community lay out, food and merchandise supply, medical and health provisions, recreation, religion and education were the eight categories

used to rate the company villages. The communities scored from the worst at 21.5 percent to the best village rated at 93 percent. The report concluded that 66 communities were of excellent quality receiving a score of seventy-five percent or above; 82 communities had substandard housing and scored less than fifty percent and were described as "dreary and depressing places in which to live." The majority of the company -owned towns were judged by the investigators as being average. [126] Ninety five percent of the company-owned houses in the 713 communities were built of wood. Tile, brick and stone were used in the construction of a minority of workers' housing. Most of these wooden houses were three to five rooms. There were also one and two-room shanties and a minority of miners' houses had six rooms or more. The study noted fewer than 14 percent of the 71,000 dwellings had indoor running water; bath tubs and showers were found in 2.4 percent of all dwellings, flush toilets in three percent, and running water in fourteen percent. Two-third of the houses had electric or gas lights by 1920 (Illustrations 11-12 - Company Housing) [127]

Churches were found in a majority of the company-controlled communities. Each building often served more than one denomination and services were often segregated. Mine workers raised the money to build the churches in some villages, and the company contributed the land and some funds for their construction. Larger coal companies provided a doctor and dental services at the larger mining communities while the smaller communities had no medical services including a doctor. Professional facilities, including hospitals with medical services, were found in neighboring towns. The company trained first-aid teams to treat victims of mining accidents. Some large coal companies helped to subsidize wards for their workers at the local hospital. Minor medical services in the smaller "patch" towns were often provided by skilled mid-wives. Most miners of this period were practitioners of folk medicine. A variety of superstitious folk-medicine practices developed in the mining villages that were employed as cures for a variety of ailments derived from mining coal and other medical ailments. They took wild cherry bark to winterize their bodies, wore sacks made of asafetida (an offensive plant resin used in medicine) to prevent disease, sucked on a piece of coal to cure heartburn, rubbed coal dust on cuts to stop bleeding, wore red woolen underwear to cure rheumatism, carried an onion or garlic with them to fight a cold, drank

kerosene to cure pneumonia, used chicken blood to cure shingles, wore a rattlesnake skin belt to prevent lumbago, wrapped a red sock around their neck for a sore throat, set a pan of water under the bed for night sweat and pierced their ears to fight weak eyes. [128]

In summary, the exact layout, size, and architecture of company towns varied from one town to another in the bituminous coal fields. Types of company housing with respect to the number and size of rooms, quality and type of building materials, and workmanship were dependent on the enlightenment and good will of the individual coal operator. [129] All the same, Margaret Mulrooney observed in *A Legacy of Coal* that most housing in Pennsylvania shared five fundamental characteristics:

1) Each town was financed, built, owned, and operated by only one company. Unlike other single towns, the primary employer was also the primary landholder. In this dual capacity, the company town determined not only the economic character of the community, but the social, political, and cultural character as well.
2) Houses in these towns tended to be two-story, wood-frame structures, whether detached or semi-detached, with four or six rooms per dwelling.
3) There was a clear hierarchy of architecture in each town that segregated management from labor and reinforced ideas of ethnic and occupational segregation.
4) Houses within a given community were remarkably similar in style and materials since construction was carried out as cheaply as possible.
5) Coal towns shared a similarity of spatial arrangement. In almost all cases, the location of the mine site and its associated buildings received primary consideration while housing took a secondary role. Nevertheless, housing was always located near the work site to minimize travel time. [130]

Welfare Capitalism and the Construction of Model Industrial Coal Towns

As noted, many miners' houses were dilapidated, without weatherproofing, and many company towns lacked decent sanitary conditions and water supplies. These mining villages provided only basic necessities for miners and their families to sustain life as few coal companies made provisions for social and leisure activities for their workers. Progressive reformers, who began field-visiting and examining industrial housing, deplored the squalor and overcrowded conditions that they witnessed. They demanded industrial companies that provided housing for their workers and their families should make immediate housing reform. This negative publicity by urban reformers about the living and working conditions of industrial workers compelled some enlightened capitalists, including coal operators, to undertake improvement of their workers' environment. Paternalism is the best term to describe this changing attitude practiced by a small number of enlightened coal company executives. They insisted that their new interest in the welfare of their workers was not motivated by any philanthropic considerations but rather by sound business strategy. They believed a well-treated labor force would create a contented labor force and hence more efficient and productive workers. In return, management expected their employees to be grateful and loyal for what the company offered. A coal industry spokesperson clearly defined this changing attitude to improve the environment in the mining town, stating that "we are at last beginning to recognize that people who live in pigsties are likely to act like pigs. If we want respectable and intelligent men and women to work for us in our plants, we must see that they have decent, healthy and comfortable houses." [131] A western Pennsylvania coal operator interviewed in 1916 by a reporter explained this new paternal attitude by stating "If you would make your business a success, you must get good service from your workmen, and if you would get good service from your workman; you must make it worth their while to serve you." [132]

Some larger independent coal companies and "captive" mine operators began the construction of a number of well-designed, planned model industrial communities after the 1890s. [133] The company towns of Slickville (Cambria Steel Company of Johnstown), in

Westmoreland County, Nemacolin (Buckeye Coal Company of Ohio, a subsidiary of Youngstown Sheet and Tube Company), in Greene County, Mather (Picklands, Mather & Company of Cleveland, Ohio), in Greene County and Indianola (Inland Collieries Company, a subsidiary of the Inland Steel Company), in Allegheny County, were all examples of new towns reflecting corporate paternalism. These are all captive coal mines and communities constructed by steel companies in western Pennsylvania. [134] Independent coal companies also constructed "model" mining towns including Windber (Berwind-White Mining Company), Somerset County, Jenners (Consolidation Coal Company) Somerset County and Star Junction (Washington Coal and Coke Company), Fayette County.

The earlier "patch" towns developed in an ad hoc fashion during this economic boom period with construction proceeding according to need. This long-term development accounts for a variety of building styles found in individual mining communities. These planned towns were designed by landscape architects and urban planners as completely integrated communities consisting of a variety of social and institutional buildings besides the obligatory workers' housing and the company store. Daily life in many of the early mine camps was known for its drabness and monotony, which these "enlightened" operators attempted to address by building playgrounds, swimming pools, dance halls, recreational halls and movie theaters. These new towns usually included a school, a water-filtration plant, and churches, and featured sewers and paved roads that were often tree-lined. *Coal Age* estimated monthly rental costs for these houses in 1923 as follows: superintendent's house, $25 per month; minor company official's house, $15; miners' housing $6 to $10.

These companies took meticulous care of the company houses. Each spring fences were repaired and white washed, and the leased houses were completely painted about every three or four years. They granted miners common ground on the outskirts of the village where animals could graze and vegetable gardens could be maintained. They permitted and encouraged miners and their families to plant their vegetable and flower gardens. Companies would award cash prizes for the best gardens in the village. Grindstone, Fayette County, owned by the H.C. Frick Coke Company, awarded prizes annually to the three best gardens. There was a five-dollar first prize, a three-dollar second prize, and a one-dollar

third prize.[135] Each year some companies, for example Marianna owned by the Pittsburgh-Bufffalo Company, gave prizes to the family with the best groomed yard in the town.

The villages of Marianna, Washington County and Mather, Greene County are representative of these new "model" company communities for miners constructed in Pennsylvania during this period. The Jones' family of Monongahela City organized the Pittsburgh & Buffalo Company on January 4, 1904. The company was incorporated from a number of smaller coal companies and was capitalized at $6 million ($5 million common stock and $1 million preferred)with total assets valued at $7.9 million. The company owned 30,000 acres of coal lands in Allegheny, Greene, Washington, and Armstrong counties. John H. Jones, president of the company, constructed a modern mine and "model" town at Marianna, Washington County in 1907. [136] Marianna village was part of West Bethlehem Township until it was incorporated as a borough on January 24, 1910. The company erected 282 yellow brick houses, mostly single family dwellings of four, five, and six rooms each, and a boarding house of fourteen rooms on the hillside behind the mine's shaft. It was one of the few mining communities in Washington County to have brick houses with indoor plumbing. James W. Ellsworth, a Chicago capitalist, laid out the model town of Ellsworth near Bentleyville in December, 1899. Ellsworth constructed brick cottages for his workers modelled after housing that he encountered during a visit to Wales. The houses were constructed with a yard and sufficient property for a small garden. Each miner paid $6.50 to $9.00 a month rent for his house which could be applied towards the future purchase of the house. Ellsworth constructed the neighboring company town of Cokeburg about 1900. Ellsworth sold out his coal properties to the Lackawanna Steel Company of Buffalo in 1907 and then left the region never to return.

The Pittsburgh & Buffalo Company erected in Marianna workers' housing, a company store, a three-story public school and an arcade (community hall). Inside the arcade was a drug store, an ice cream parlor, a bowling alley, pool and billiard tables, a dance floor, a skating rink, a movie theater, and a gymnasium. The company erected Saints Mary and Ann Roman Catholic Church. The large company store, located at the lowest part of town, was divided into a meat market, a section for groceries and dry goods, and an area for

hardware and furniture. A railroad siding was located near the basement of the store to facilitate the transportation of food to the store. The company built a two million gallon cement-lined reservoir to provide water for residents and to quench coke made at the beehive ovens. A playground for miners' children was constructed below Second Street above the beehive coke ovens. The town was constructed in a few short months and advertisements for mine workers appeared locally and in European newspapers. Marianna attracted White Russians and Italians as well as Scotch, English, and Slavic workers. The population of Marianna was over 2,000 in 1910 while its population in 1970 was 872. The mine and community was acquired by Bethlehem Steel Corporation and was an operational mine until the 1980s when an underground fire forced the mine's closure.

The company developed the Rachel and Agnes mines at Marianna as the safest and most up-to-date facilities in the nation. The new tipple, washer and beehive coke ovens were the most modern installations at the time of their construction. The equipment and preliminary development at Marianna cost the Jones family more than a million dollars. The facility had a daily capacity of five to ten thousand tons. The Marianna mine and village was regarded by the Jones family as the most livable mining town and the best-built and safest mine in the nation. This assertion was ironic because the Rachel mine was the site of a disastrous explosion on November 28, 1908, killing 154 miners; only one survivor was pulled out of the rubble alive. The mine was noted as a gassy mine but the disaster was caused by a coal dust explosion from the flame of a miner's lamp or an electrical spark. Thereafter, state regulations were passed to limit the accumulation of coal dust in the mine and the use of sealed electric miners' lamps.

The village of Mather, Greene County, located on the south branch of Ten Mile Creek near the village of Jefferson, was constructed by Picklands, Mather & Company of Ohio in 1917. Mather, like Nemacolin, Bobtown, and Crucible, was a "model" company town constructed in Greene County during this period by an out-of-state steel company. These captive mines provided them with a steady supply of coal and coke for their blast furnaces. This Cleveland based steel company acquired more than 400 acres of coal from the Pittsburgh seam. Ground was broken for the first shaft on the old Moredach farm, near the

village of Jefferson on August 7, 1917. The first shaft of the Mather Collieries was 348 feet deep, and 947 feet above sea level, at the village of Mather, located on the Pennsylvania Railroad. The Mather mine supplied coal for its by-product coke ovens at their Toledo and Canton, Ohio facilities, the Cleveland furnaces of the Allied Steel Companies, and the furnaces of the Steel Company of Canada (located at Hamilton, Ontario), as conditions from time to time warranted since its first shipment in 1918.

Baton & Elliott, consulting and contracting mining engineers of Pittsburgh, designed the mining complex and the village of Mather. They constructed nearly three hundred small but attractive and brightly painted, multicolored bungalows on shade-lined, paved streets. Each bungalow was equiped with a cellar, electric lights and running water. The firm constructed some recreation facilities. A two story stucco recreation clubhouse included a living room, bath rooms, dining hall, barber shop, bowling alley and billiard tables on the first floor. The second floor was occupied by a dance hall. Baton & Elliott built a filtration plant, several churches, a school, and a well-equipped playground for the miners' children. A tennis court and band stand were later erected in the center of the village. [137]

A number of manufacturing companies provided coal operators with an alternative method of constructing workers' housing. They manufactured a complete line of pre-assembled industrial housing ready to be assembled at a distant mining site. They also manufactured pre-fabricated hotels, stores, banks, churches, and bunk houses that could be purchased and assembled along with the housing at a distant site. For a few thousand dollars per house a coal company received floor plans, precut lumber, nails, paint, doors and light fixtures all shipped to their mining site by rail. There were a variety of companies involved in the catalogue-house business after 1890. The "Big Six" were Sears, Roebuck & Company, Montgomery Ward & Company, Gorden-Van Tine of Davenport, Ohio, and three companies located in Bay City, Michigan - Aladdin Company, Lewis / Liberty Manufacturing Company and Sterling System Homes. [138]

The Ford Collieries Company of Detroit, Michigan operated the Berry Mine at Bairdford and the Francis Mine at Curtisville, Allegheny County, mining coal from the Thick Freeport seam. The company town of Bairdford was constructed of prefabricated ready-

made housing manufactured by the Aladdin Company of Bay City, Michigan. The unassembled houses were shipped by rail to Bairdsford around 1920. The Indianola Mine of the Inland Collieries Company, a subsidiary of the Inland Steel Company, acquired the property formerly owned by the Indianola Coal Company in 1916 at Indianola, Allegheny County. This was a 200 foot shaft entry mine that extracted coal from the Thick Freeport seam, located about 500 feet below the Pittsburgh seam and 120 feet above the Kittanning seam. This seam was mined extensively along the Allegheny and Kiskiminetas rivers with an average thickness of 7 feet. The coal was used exclusively for the production of by-product coke. About one-sixth of the coal was washed by 1925. The mine's tipple was equipped with picking tables, screens, and crushers for preparing coal before shipment. Thomas G. Fear was hired by Inland Steel in 1916 as the mine's first superintendent to design the mine and to construct a model town in Indiana Township. Fear was a graduate engineer from Birmingham, Alabama who had constructed mining complexes in Tennessee and Alabama. Superintendent Fear built mining buildings, workers' housing, an office, a hospital and sewage deposal plant with water and sewer lines at Indianola. [139] The prefabricated miners' houses were shipped by rail from the Lewis Manufacturing Company, Bay City, Michigan in October, 1918 to Indianola. A local newspaper described the new community in 1919 as "the last word in coal producing and miners' home development." The homes featured electric lights, indoor bathrooms and spacious backyards. The village houses, all with front porches, were constructed with their backs facing the roads around the cul-de-sacs. This was done to prevent coal miners, filthy after working in the mine, from entering and soiling the living rooms and furnishings. Instead miners entered their kitchens. The office and hospital were located next to each other near the tipple. The hospital had four beds, a treatment room, a dispensary for drugs and a fully equipped operating room. The company donated land for the construction of the two churches in the village.

Prefabricated housing was constructed by other mining companies in other coal fields besides Pennsylvania. The Kaymoor Mines of New River, West Virginia owned by the Lowmoor Iron Company provided coal and coke for the company's iron furnaces. The

company purchased 19 "Redi-Cut Homes" from the Aladdin Company of Wilmington, North Carolina in anticipation of a coal boom after 1918 which never occurred. The prefabricated houses were wooden bungalows, each holding two families, constructed from precut weatherboard with plastered lath interior. The bungalows were shipped to the new mining town of Kaymoor One by rail. [140]

In summary, the quality of houses inhabited by coal miners and their families in Pennsylvania and surrounding mining states was uneven, from literal wooden shacks to roomy six room houses equipped with the latest amenties including indoor plumbing, electricity and running water. Diversity existed in their size, method of construction and material employed by the coal company in their construction of miners' housing. Four recognizable types of miners' housing emerged nationally based on these standards:

1) The Shotgun, typically a one-story, two bay, wood-frame structure with a gable roof, post foundation, end chimney and two or three rooms.
2) The Pyramidral-Roof House, a one-story, three-or four bay frame dwelling, often semi-detached,with post foundations, central chimney and four rooms.
3) The Pennsylvania Miners' Dwelling, always a two-story structure but either detached or semi-detached,with two bays per dwelling unit, a wooden frame, four or five rooms, front- or side-gable roof, end chimneys, and often a rear ell containing one or two more rooms per unit.
4) The Gable - Roof House, a one-story residence with two, three, or even four rooms, end chimneys,wood-frame construction, and occasionally a projecting one-story ell which resulted in a T or L-shaped plan. [141]

Company Store

Virtually all coal towns had company stores and like housing were constructed as a convenience by coal companies for their workers and their families. As in housing, there was a great variety in the physical size and architectural style of the company store. Each store was custom-built for each mining community of brick or wood except for prefabricated stores. Many mining communities were isolated with poor road connecting them to neighboring towns. This reality made the company store (known as the commissary in the Southern coal fields) the commercial heart of the mining community. The store served as a gathering center, post office, bill-collection center, and shopping center. It provided all the daily material necessities of life in the isolated village. The miner and his family were dependent upon it for their food supplies in both good and bad times. They paid their bill for the company doctor, usually about one dollar a month, and received their mail at the store. The company doctor was hired and his tenure was determined by the company while his salary came out of the miners' wages. All stores stocked and sold food stuffs and a variety of mining equipment. Coal miners, unlike most other industrial workers, were responsible for providing and maintaining their own tools and mining supplies. The store stocked a variety of tools including black powder or dynamite, caps, miners' lamps and fuel for carbide and oil wick lamps, squibs (fuses), electric exploders, picks, shovels, flints and machine oil.

A retired miner described the company store as "a variety store like Gee Bee. But it wasn't that big. It was a grocery, clothing, hardware, and gift store all in one. It was also the post office and gas station for the patch. It was two stories. The food was sold on the first floor and miscellaneous items on the second floor." [142] Small stores, usually constructed of wood, sold basic food items, such as groceries and meats, and also mining tools and supplies. The larger stores were similar to a conventional retail department store found in a larger town or city. These spacious stores were often three stories with different functions on each floor : the first level was used for the storage of goods, the second level

for retailing and offices, and the third floor exclusively for offices. [143] The larger stores sold a greater variety of goods including furniture, clothing, plumbing, hardware, and building supplies. If the item desired by the miner was not in stock, the store manager could special order it. Many stores employed an "order" boy who delivered store goods to houses in the "patch" if miners were unable to shop. The larger company stores operated ice cream parlors and soda fountains. Some larger company stores provided additional services including laundry, millinery, and gristmill.

The Rise of Large Coal Corporations

The bituminous coal industry was composed of numerous small companies as late as 1880. These coal companies were usually family owned and locally controlled. Mines were of small annual capacity. A mine producing a thousand tons a day was considered a large operation. The United States Census of 1880 estimated that there were more than five thousand small "country bank" mines and together they contributed less than a million tons of coal toward the national total of some forty million tons. The average production of bituminous coal mines in the country was 14,269 tons a year in 1880. The largest output by any mine in Pennsylvania in 1880 was 332,056. [144] There were a few large bituminous companies at the beginning of the era but they represented a minority of all coal companies. Consolidation Coal Company, Westmoreland Coal Company and Penn Gas Coal Company - had absentee owners with corporate offices in eastern cities that controlled the daily lives of tens of thousand of miners in distant and isolated coalfields. For example, the Penn Gas Coal Company, a Philadelphia-based company founded during the 1850s, employed more than a thousand men and boys at their mining operations principally located in Westmoreland County. [145]

The rapid expansion of coal production and an enlarged and increasingly immigrant labor force created a series of organizational and technological changes within the bituminous coal industry. A number of large coal companies were formed during this period, but none of these corporations acquired monopolistic control of the industry. Both the ownership and

the operation of the bituminous coal industry was widely diffused between 1880 to 1920. Edward T. Devine, a leading observer and author of an excellant narrative history of the American bituminous coal industry, noted " there was no typical bituminous coal operator, but only a heterogeneous, unorganized, infinitely diverse, and hotly competing aggregate, with many representatives of almost any group that could be described, from a great corporation to an impecunious, struggling individual." [146] Coal-mining companies ranged in size from the local "country bank" mine employing as few as five workers with coal production limited to a few hundred tons annually, to huge firms with corporate office located in Philadelphia, Baltimore, or New York. Their mines employed as many as a thousand workers with annual output exceeding a million tons. Twelve of the hundred largest industrial corporations in the United States were mining companies in 1900. Many of the largest bituminous coal mining operations were increasingly owned and controlled by utility companies, railroads, and iron and steel corporations; they were called "captive" or "consumer" mines. Captive coal refers to coal produced and consumed by these industrial firms for the purpose of insuring an uninterupted energy supply. Railroad corporations controlled more than one-fourth of the nation's coal production by 1909."Captive mines" accounted for 21.4 percent of all mined coal in Pennsylvania in 1913 and 24 percent in 1919. [147]

There were more than 5,000 coal mines nationally in 1905 and the largest 665 coal companies produced about fifteen percent of the nation's 315 million tons of coal during that single year. [148] Major mining operations in the United States were increasingly owned by companies with corporate offices located in New York, Baltimore, or Philadephia. There were 27 coal companies in Pennsylvania with annual coal production exceeding one million tons in 1910. Each of these large coal companies employed from 1,432 (Shawmut Mining Company) to 19,406 workers (Pittsburgh Coal Company). [149] Westmoreland Coal Company, Consolidation Coal Company, Berwind-White Mining Company, Pittsburgh Coal Company, W.J. Rainey Company, Pennsylvania Coal and Coke Corporation, Keystone Coal and Coke Company, Rochester and Pittsburgh Coal and Iron Company and

the H. C. Frick Coke Company were the largest bituminous coal and coke corporations in Pennsylvania in 1920.

No company or combination of coal companies was able to establish a monoply within the industry. From a national perspective no single coal company controlled more than 3 percent of the bituminous coal production in 1905. Large bituminous coal corporations were simply unable to establish a monopoly or oligopoly in the industry as had developed in other industries during this period.There were 276 big-business combinations between 1897 and 1903 with a total capitalization of slightly more than $6 billion. Some 300 firms with assets totalling $20 billion controlled 40 percent of the industrial wealth of the nation by this date. John D. Rockefeller's Standard Oil of Ohio formed the first monopoly of a natural resource in the nation during the 1870s. Standard Oil controlled nearly ninety percent of the nation's oil industry, prompting Rockefeller to quip "Oil is my Business." Henry Demarest Lloyd observed in *Wealth Against Commonwealth,* 1894 that "Standard Oil did everything to the Pennsylvania legislature except refine it."

The creation of the United States Steel Corporation, under the direction of J. Pierpont Morgan, the New York banker, was the most recognized example of business consolidation as an attempt at monopoly control of a particular industry. The Corporation was a merger of more than 200 separate companies into the nation's first billion dollar corporation The New Jersey holding corporation was incorporated on February 25, 1901, capitalized at $1.4 billion, three times the annual budget of the federal government. The company owned 78 blast furnaces, 500,000 acres of coking lands, more than 1,000 miles of railroads, and large reserves of iron ore. The original member companies were: Carnegie Company, Federal Steel Company, National tube, American Bridge, American Tin Plate Company; American Steel Hoop Company and American Sheet Company). H.C. Frick became a director of J.P. Morgan's United States Steel Company, which he helped to organize. United States Steel Corporation controlled 40 percent of the steel industry in 1920. Monopolies or ologopolies in other industries were created by Standard Oil that controlled 64 percent of the oil industry in 1911; International Harvester controlled 64 percent of the agricultural machinery industry in 1918.

A variety of factors were responsible for making the bituminous coal industry a highly competitive one, despite the appearance of large corporate giants. High quality coal was both abundant and located in some twenty-five coal producing states covering thousands of square miles. High quality coal deposits in Pennsylvania were located in more than two dozen counties in an area covering more than ten thousand square miles. In addition, unlike other extractive industries, the amount of capital required to open a mine was small and therefore the larger corporations could never successfully eliminate small or medium size companies. This inability to create a monopoly within the industry had catastrophic effects on the expanding bituminous coal industry.

Coal operators were aware of the competive nature of the industry and the tendency towards over-development or undue expansion of the bituminous industry as early as the 1890s. Coal miners worked an average of only 214 days a year from 1890 to 1921. An overmanned coal industry meant reduced daily wages per miners and created a glut of cheap coal on the market. Government agencies considered 304 days a full working year in the industry. The maximum year of employment was 248 days in 1918, during the peak World War 1 period. [150] Coal operators were simply employing more workers than the industry could steadily employ throughout the entire year. Underemployment of miners was a conscious choice made by some coal companies, as documented by a survey undertaken in 1909 by the United States Census Bureau. The survey found that the true profit of many coal companies did not come directly from coal mining instead "it should be noted that many mine operators make a considerable profit by renting houses and selling merchandise to their employees at the company store." [151]

A surplus, inexpensive labor force, and expansive coal reserves requiring little technology or capital to develop encouraged coal operators, both the individual or a corporation, to overdevelop production. Seasonal demand and the inability to store coal also led to periods of excessive output. Railroads were competing for business and offered some coal companies reduced rates for long hauls to market. Economic enticements by railroads in the form of reduced freight rates constituted another reason for the expansion of the new southern Appalachia coalfields of West Virginia, Kentucky and Alabama.

Some coal operators formed trade associations or merged with competitors to set prices and limit coal output and wages in an attempt to check the ruthless and competitive condition endemic in the industry. For example, more than 140 small to medium-size coal companies were operating up and down the Monongahela Valley by the 1890s (Illustration 13 - Mines on the Monongahela River Valley). Fierce competition between these owners and against the new challenge from the southern coal producers reduced the price of mined coal to a point below the actual cost of production. A futile attempt was made by these operators to voluntarily limit production in order to fix and maintain a minimum price for coal. These informal agreements or pools were generally ineffective. Cut-throat competition in the region was resolved temporarily by a series of consolidations that created two principal coal corporations in 1899. The Monongahela River Consolidation Coal and Coke Company was organized on June 9, 1899 under the leadership of J.B. Findley, a businessman and a native of Monongahela City, who was the guiding spirit in the consolidation movement. The new firm was known locally as the " River Combine." The firm was originally capitalized at $30 million, one-third preferred and two-third common stock, and $10 million in bonds. The firm controlled dozens of coal mines located on the river. The Black Diamond, Catsburg, Coal Bluff, Cincinnati, Eclipse, Crescent, Knob,Vigilant, Beaumont and Champion mines on the Monongahela River were owned by the new corporation. The corporation also owned towboats, barges, coal boats, river tipples and coal loadings and docks on the banks of the Monongahela River. [152]

Pittsburgh Coal Company was the second firm formed from the merger of small Monongahela River mines. The company was founded in Pittsburgh and organized under New Jersey statutes as a $ 64 million corporation. The company controlled 140 coal mining and distributing properties including its own docks, loading and unloading facilities, railroad lines and coal mines within a seventy-five mile radius of Pittsburgh. Nine-tenths of their coal mines were located in Allegheny, Westmoreland, and Fayette counties in western Pennsylvania (Illustration 14 - Extent of Pittsburgh Coal Company properties in western Pennsylvania).[153] The United States Industrial Comission identified it as the largest coal company in the United States in 1900. The Pittsburgh Coal Company secured the majority

of the stock of the Monongahela River Consolidation Coal and Coke Company in October 1903. The two companies formally mergered in 1916. [154] A.W. Mellon, Henry R. Rea, Henry W. Oliver and H.C. Frick, all prominent Pittsburgh capitalists, were among the early directors of the Pittsburgh Coal Company. The company owned seventy mines located in Pennsylvania, Ohio, Illinois and Kentucky with an annual production of 30 million tons in 1920. Sixty collieries were located in the heart of the Pittsburgh district as the company owned 152,745 acres of unmined coal land within the district.[155]

The Coal Association of Illinois and Indiana submitted a report entitled *A Statement of Facts Concerning the Conditions in the Bituminous Coal Industry in the States of Illinois and Indiana* to President Wilson in 1914. The Association was seeking relief from conflicting regulations of states and the federal government which had rendered coal companies powerless to prevent cut-throat competition within the industry. An Association spokesperson, on the eve of the World War 1, clearly identified the plight of the bituminous industry through uncontrolled overdevelopment:

> They (industry) have opened three mines where only two were needed; they have employed three men where only two were necessary. These mines and men can find productive work only during 175 instead of a possible 300 days in a year. This idle time of the miners is not confined to one season or period during which they can find employment. To the contrary, the men are always subject to call, for which they urge a greater daily wage that their annual income may be sufficient for their needs. [156]

Government was generally unresponsive to intervene and regulate the coal industry by maintaining wages and hours or by establishing a minimum price of coal. The federal and coal producing state governments were opposed to mergers of coal companies as unfair restraint of trade. The New River Consolidated Coal and Coke Company was fined under the Sherman Anti-Trust Act for establishing minimum prices of coal mined in the New River and Kanawha Fields, West Virginia. Congress passed the Sherman Anti-Trust Act in 1890.

The act consisted of eight major provisions that declared "every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce, among the several states or with foreign nations, is hereby declared to be illegal." The Supreme Court, under this law in 1911, found that Rockefeller's Standard Oil Company and the American Tobacco Company were monopolies or trusts and were ordered to break up. The Supreme Court in 1920 however ruled by a close vote of 4 to 3 that the United Steel Steel Corpration was not a monopoly according to the Sherman Act.

Their was no consensus among coal companies on how to address over-development, maintain high price per ton of coal, and reduce wages. Some coal operators wanted limited government regulation while other companies opposed any form of imposed government regulation or intervention in the bituminous industry. It was suggested by some coal companies that the health of the industry could be improved by establishing a maximum and a minimum price at which coal could be sold, and then base the miners' wages on the selling price. Others advocated that a law be passed taxing all the coal mines in the United States so as to provide for the families of miners killed in mining accidents. [157] The Berwind-White Coal Mining Company, like some other coal companies, opposed any attempts at corporate mergers and opposed any form of government regulation of the industry. E.J. Berwind, president of the New York based company, expressed his company's position stating "he would never join any operators' association, holding that they are all right for ordinary operators but were beneath his dignity." [158]

Attempts at monopoly control of the bituminous industry by large coal corporations were dismal failures as the industry was still widely diffused by 1920. Coal output from mines ranged from a few thousand tons, or even less, up to more than five million tons annually. The United States Geological Survey identified 12,122 corporations, partnerships and individuals involved in the production of bituminous coal in 1920. There were 14,776 mines, including 1,440 "country banks" with a strictly local market with annual production of a thousand tons each, and 4,405 "wagon mines" shipping by rail nation wide. The remaining 8,921 "commercial mines" were divided among 6,277 producers. Only eighty of these "commercial mines" had an annual output of over a million tons each. [159] "Snow-

bird" or "fly-by-night " mines were terms used in the industry to describe tiny mines that opened with the first snow and disappeared with the advent of warmer weather. These mines were always small scale, inefficient, and crudely operated. They operated during winter when demand for coal was greatest and the price of coal was highest. These mines, often no more than a hole in the ground, were a convenient scapegoat, upon which many of the ills of the industry were blamed, in spite of the fact that their total production was insignificant in the total annual production.

This national situation was reflected in Pennsylvania's own coal industry. There were 3,695 coal operators, including bituminous and anthracite in Pennsylvania in 1909. These coal operators were organized as following: individual 1,058 28.(28.6 percent;) firm 664 (18 percent) ; corporation 1,942 (52.6 percent) and other 31 (.8 percent). [160] The Bureau of Mines of Pennsylvania estimated that there were 1,938 coal companies operating 2,584 mines and employing 154,992 workers in 1919. There were 20 mines with production over a million tons; 22 mines with production exceeding half a million tons but less than a million tons; 112 mines with production of 200,000 to 500,000 tons; 144 mines with production of 100,000 to 200,00 tons; 174 mines with production of 50,000 to 100,000; and 118 mines with production of 25,000 to 50,000 tons; while 1,398 mines had production less than 25,000 tons. Forty-four mines or 2.2 percent of the nearly 2,000 mines produced half a million tons or more annually, or nearly one-third of all coal output, and employed about one-third of all miners in the Commonwealth.

Size of Bituminous Mines in Pennsylvania in 1919

Tons of Coal	Number of Enterprises	Number of Mines	Workers
less than 25,000	1,348	1,452	17,860
25,000-50,000	118	138	5,354
50,000-100,000	174	229	14,417
100,000-200,000	144	220	21,629
200,000-500,000	122	216	33,151
500,000-1,000,000	22	74	14,770
one million plus	20	255	47,811 [161]

Changes in Mining Technology

The trend toward concentration of production into fewer and larger firms affected the coal industry. The large coal corporations fundamentally changed the work process in their mines during this period. Most mines, even larger mines before the 1880s, represented a proliferation of small organized underground workshops controlled by the skilled miners. The craft process of mining coal took place within individual rooms spaced about 20 feet wide. An unskilled laborer described work undergound before the 1880s as following "We were paid so much a ton about seventy-five cents, we'd be in a chamber (room) filling carts with coal. We didn't work in gangs together, we worked each one alone. I had a pick and I had a shovel and I had an auger to drill a hole - the auger could drill six feet in the face. There were eight hundred and some workers and each of them had their own room." [162]

The larger mining corporations introduced new management practices of increased supervision that was instituted to control the work process and make underground production more rational and efficient. Each miner was assigned a specific task to perform and this gave the company more control over their labor force underground and at the surface. This policy of increased supervision was disliked by most contempory miners and

as one worker observed "the large corporation are slowly but surely, riveting the chains of slavery around us." [163] The contract miner was increasingly becoming like an operative in a iron or steel mill and less an independent artisan. Skilled miners, still known as "practical" miners, had historically controlled the work process underground. Coal operators had provided little direct supervision in the mining process; instead they had consciously abdicated control of the mine to the "practical miner." The skilled miner decided the amount of production, dictated the tempo of work, and was generally independent of any form of direct supervision underground. This control and autonomy of the mining process by skilled miners was clearly described in the *Report of the Illinois Bureau of Labor Statistics* issued in 1888:

> The skilled miner takes his tools into the pit and undertakes to deliver from the wall of mineral before him certain tons of coal for a certain sum per ton. He mines and drills and blasts and loads his own coal, timbers his own roof, takes care of his tools, and is responsible mainly for his personal safety and the amount of his output. [164]

The large coal corporations were organized in a hierarchical structure like other large contemporary industrial companies (Illustration 15 - Hierarchical organization of a large coal company). The president or executive head supervised the entire coal operation. A number of specialized departments were created devoted exclusively to operate a particular facet of the mining business. These specialized departments included engineering, mechanical, electrical, accounting, sales, purchasing, medical and safety division. These firms employed a number of managerial supervisors to oversee coal production from its removal from the seam to its shipment to market. The general superintendent oversaw the operation of several mines while the mine superintendent was in charge of the entire operation of a single mine supervising all facets of the mining process. The superintendent acted as the connecting link between management and the miners. He was a former fire boss or mine foreman who was appointed to this position because of his practical expertise in the operation of the mine or he was selected from the engineering department. He employed a number of subordinates who

were responsible directly to him to supervise a part of the work process. Surface and underground foremen were hired by the superintendent to supervise the extraction, hauling and tipple operations. The inside foreman would hire one or two fire bosses who in turn hired a few assistants. The term "fire boss" is actually a misnomer since he is really a gas boss responsible for testing the mine air for the presence of gas before the miners' enter the mine in the morning. [165] The fire boss was an experienced miner who entered the mine before the morning shift, as early as 3:30 A.M., and with his naphtha-burning flame safety lamp inspected every room in the mine and chalked his approval on the face and side of each examined room showing the date and time of examination and measurement of the presence of gas, especially methane. [166] The fire boss was also responsible for seeing that the brattices (barricades) were put up as required to regulate air ventilation in the mine. These barriers were operated by young boys called "trapper boys." The Bureau of Mines of Pennsylvania required state certification by 1900 which the fire boss obtained by passing a written examination. His office was usually located underground.

Workers, besides the fire boss, and shot-firer, who used electrical machines were all issued safety gas lamps to detect methane by the lamp man who was responsible for their cleaning and repairing by the coal companies by 1900. The Pennsylvania Department of Mines approved the use of safety gas lamps manufactured by Clanney, Davis Deputy, Wolf, Schenk, Seippel, and Ackroyd & Best companies for gas detection by 1910. These approved safety lamps were tested by the National Bureau of Mines at Pittsburgh. [167] Charles Wolf of Saxony constructed the Wolf safety gas lamp using naptha instead of oil in 1883. The Wolf lamp, manufactured by the Wolf Safety Lamp Company of America, New York after 1913, was a self-extinguishing lamp in the presence of fire-damp, in explosive mixtures, or in case of being overturned. The lamp was provided with a magnetic lock that could not be picked, had an igniter by which the lamp could be lighted without opening it, and provided a good light.

Miners used to work alone or with his partner or "buddy" in a room but after the 1880s large coal companies wanted their workers to be part of an interdependent coordinated group of workers who were carefully supervised by management. This transformation of work

from an individualized work process to a complex division of labor was a major intrusion in the work place by management and represented a major challenge to the skilled miners in their control of the work process. Under the new system introduced first at the larger mines, the miners' tasks were delegated to a variety of specialized workers. This division of labor created a number of specialized jobs and witnessed the introduction of a two-tiered system of workers and wage payment. This division of labor became the standard practice throughout the bituminous coal industry by 1900. Mine workers fell into two distinct and large groups, called "tonnage men" and "company men." Underground workers who were engaged in the actual extraction of coal from the seam, were called "tonnage men." They were responsible for the drilling, shooting, and the loading of coal in each room. The coal company paid their "tonnage men" piece-rate by the ton, the yard, or per cart of coal loaded daily. Tonnage men included the following categories:

Cutter ("Machine Man" or "Machine Runner") / Scraper (Helper): The operator of the mechanical cutting machine, his assistant, the scraper and two loaders were assigned by the underground foreman to a group of rooms. These men moved the undercutting machine from room to room and under cut the coal seam at the bottom for a number of loaders. Each machine was operated by a single worker who cut a six foot deep channel under the working face using a continuous chain with metal bits that were removable. The bits was sharpened daily at the blacksmith shop. The cutter was one of the highest paying jobs in the mine but it was dusty and dirty work and the constant inhaling of small particles of coal dust for years contributed to black lung disease. The scraper assisted the cutter by shoveling fine coal (bug dust) and debris aside or behind the machine. The scraper assisted the cutter by removing quantities of coal dust that lodged inside the cutting machine. This task was known as "pulling the slack." He was responsible for setting the pipe or jack so that the machine could start cutting the channel under the coal.

Coal Loader: He loaded coal by hand or with a broad bill shovel into mine cars after it was removed from the wall by the shot firer. He was responsible for separating

impurities especially shale, slate and clay from the coal. The carts were regularly inspected by the underground mine foreman and if the load was determined to contain "dirty" coal the loader was not given credit for the wagon. He attached a small metal brass tag called a "check" with his number on each coal car after it was loaded. Each miner had a check with his number stamped on it and after the car was delivered to the tipple he was credited with the coal. An average loader filled 2 or 3 cars daily during this period.

Shot firer/Shooter/Shot Fireman: He was the responsible for firing the blast of dynamite or black powder which knocked the coal loose from the seam after the holes were drilled by the driller. The mine wall from which the coal is blasted is called the working face, and the process of blasting coal with powder at the working face is called "shooting coal." Coal was originally blasted from the working wall with black blasting powder. Dynamite and permissive explosives were later used. This was the responsibility of the skilled miner in the pre-mechanized mine but the inproper use of black blasting powder was attributed to many major mining explosions While miners might still be required to drill the holes and take charge of permissable explosive cartridges, the shot firer performed the actual blasting. He moved from one room to another carrying an electric detonator and electric firing apparatus. The professional shotfirer was required by state statute to shout three times "Fire in the Hole" before he shot the explosives. He carried a safety gas lamp with him and measured for the presence of gas before blasting coal from the seam.

Pickman: He did retreat work using picks after the loaders had finished removing coal from the "room." In room-and-pillar mining method from 25 to 30 percent of the coal is usually removed in the first working. A higher extraction of coal requires most of the pillars of coal to be eventually removed. The coal pillars were often removed without adequately supporting the roof. This work was called "robbing of the pillar" and occurred after the rooms of a heading or section had been advanced as far as possible. The coal pillar supports the mine roof, and "robbing" it is extremely dangerous work because of the possibility of roof cave-ins.

Pick miner: He removed coal from the seam in the pre-mechanized mine using a variety of hand tools-picks, augers and explosives. His future in the larger mine was curtailed with the

introduction of undercutting machines, such as the Harrison machine, by the 1880s. Nearly one-quarter of all coal was undercut from the seam mechanically by 1900.

"Daymen" or "company workers" were the second group of mine workers. This group was further divided into "inside" or "outside" workers. They were paid a fixed rate by the hour, day, or month. The exact number of workers and various occupations, both inside and outside, at an individual mine was dependent on the size of the mine and its condition. The "daymen" were responsible for all activities except those engaged in shooting, cutting, or loading coal. They were involved in maintenance, construction, repair work, haulage of coal, mine ventillation, and tipple operations. They were also responsible for propping up the roofs along the hauling ways with timber and masonry. "Daymen" laid iron tracks, repaired them, and kept them clear of coal and rocks which might have fallen off the loaded cars. If the mine was wet, a crew of pumpmen was on duty day and night to keep underground mine water under control. The largest group of company men was the tipple gang. They prepared raw coal for transportation to market by weighing, sorting, washing and loading it. Company men included the following categories:

Weigh Boss: He recorded the weight of each coal car as it came from the mine entry to the tipple. After hand loading the cart each loader attached his brass check on it. These records were given to the mine clerk, who credited the miner's account. His office was at the tipple. The tipple was a large, tower-like building constructed principally of wood during this period. It resembled a large cylinder and averaged fifty to sixty feet in height and some twenty feet in diameter. It was located at the entrance to the mine; coal from the mine was hoisted and poured into the top of the structure directly from the mine. Coal was weighed and then was sifted down the tipple through a series of different size screens so coal could be sorted into a variety of sizes ranging from one to four inches in diameter. Processed coal was then loaded from the tipple into railroad cars below or onto river barges.

Check-weighman: His chief responsibility was to check the accuracy of the company's coal scales at the tipple. He observed the weighing of the coal since the men were paid by the ton. Miners were often defrauded of part of their wage by deliberate and systematic "shortweighing" of their coal by unscrupulous non-union coal companies. Nonunion miners had no legal redress against this economic exploitation. One of the first demands of miners when the United Mine Workers of America was formed was for the employment of their own check-weighman to monitor the company weighman. The union weighman was paid by the miners themselves with a percentage of each man's tonnage.

Check Boy: He removed the miner's brass check from the coal car and handed it to the weightman when it arrived at the headhouse scale. A loader who complained about conditions in the mine was often punished by the superintendent when his check, which he hung on each coal car to identify his load, might be "mysteriously" lost.

Greaseboy: He sprayed lubricant on the iron axles of the coal laden car to prevent them from overheating. This was one of the many mining jobs done by young boys. There were 45,000 boys under the age of 18 working in the coal industry nationally by 1920. [168] A majority of boys, as young as 10, entered the mine as their fathers' helpers and during this apprenticeship mastered the mining craft. They worked as checkboys, trappers, greaseboys or spraggers earning about 50 cent per day for their family. In Pennsylvania, children under the age of 14 were not permitted by a law passed in 1903 to work underground, and under age 12 outside but the law was routinely ignored by both miners and the coal companies. Large families and low miners' wages forced many families to lie about the ages of their sons to get them work. The company evaded the laws by not listing the boys on their payroll list. Their wages were paid directly to their fathers by the company. The isolation of the mines made rigorous enforcement of the law impractical. [169]

Trip Rider / Mule Driver: He operated the underground transportation system. Mines that used mules or horses to haul coal employed drivers to lead the draft animals to the surface with wagons loaded with coal. Each wagon or mine car held about fifty bushels of coal. A close relationship often developed between a mule driver and his mule. A number

of regional minstrel songs were dedicated to these sure-footed animals including "My Sweetheart's the mule in the mine"

My sweetheart's the mule in the mines,
I drive her without reins or lines,
On the Bumper I sit, with my whip in my hand,
I chew and I spit
All over my sweetheart's behind. [170]

Brattice Man: He constructed linings or partitions made of canvas, wood, or concrete called brattices used in mine passages to confine the air and force fresh air into the working place of the mine.
Spragger: He traveled with the load of mine cars and inserted a "sprag" or rod between the spokes of the mine-car wheels and acted as a brake to slow the downward momentum on the trip out of the mine. A sprag is a short round piece of hardwood, pointed at both ends measuring 1 1/2 feet in length and 2 1/2 inches in diameter. A sprag was also used by pick miners set in a slanting position for keeping the coal during the undercutting operations.
Hoisting engineer: He operated the steam-powered or electric hoist that lowered mens, upplies and coal in the "man-trap"or cage in the shaft and slope mines.
Fireman: He worked in the boiler house where coal was transformed into steam used to produce electricity in the power house.
Tipple crew: A variety of men were employed at the tipple or plant washer, their jobs being to weigh, dump the mine cars, and prepare the coal for shipment by sorting it after it arrived from the mine.
Machinist: He repaired mechanical equipment including coal cars, trolley locomotives and other types of machinery used at the mine. The introduction of mechanical coal loaders kept machinists busy repairing these machines.
Dumper: He worked at the tipple and operated the latch on the pit-car which permitted the front end of the car to open when the car was tipped forward and coal fell into railroad

hopper cars.

Blacksmith: He sharpened the miners' tools including picks, augers, bits, and the metal teeth on the undercutting machines daily. Miners paid him for these services at the company store with deductions from their pay. The blacksmith was called on to repair a variety of machines used in smaller mines. He shoed the horses and mules used for coal haulage.

Snapper: He worked with the motorman and took the cable on the front of the motor, which was on a reel, and went into each room and hooked it onto the front end of the loaded car. He also coupled the coal cars.

Stable Boss: In larger mines he took care of the mules or other draft animals used to haul coal out of the mine. These animals were very valuable and many miners insisted that the companies cared more for their horses and mules than for their workers. If a draft animal died, somebody usually got fired; this did not happen when a miner was killed. Draft animals were housed each evening in the mule barn in drift and slope entry mines. In shaft mines and steep slope mines, mules or horses resided in underground stables and were brought to the surface only if ill or dead or during prolonged strikes. The General Assembly of Pennsylvania passed a statute in December, 1965 making it illegal for coal companies to keep mules and other draft animals underground overnight.

Motorman: Many of the bigger mines had replaced the mules and other draft animals by the 1920s. Electric or battery powered locomotives manufactured by the Jeffrey, Joy, Goodman, and Westinghouse companies were used to transport coal and waste from the mine to the surface. The haulage motorman drove these machines with loaded mine cars from the haulage ways to and from the tipple.

Brakeman: He was in charge of the coupling or uncoupling of coal cars, and applying of the brakes. The brakeman, also known as a snapper, trip rider, or car coupler also operated track switches.

Trapper-boy or door tender ("patcher" in the anthracite region): He was employed to open and close ventilation doors for the horse-drawn coal cars and their driver to pass. The operation of opening and closing doors was called "trapping." He also worked with the motorman and was responsible for opening and closing doors and throwing switches. The

trapper maintained and cleaned the switches. Trappers were usually young boys and with experience worked their way up the mining hierarchy from trapper-boy to mule driver, to miner's helper and finally contract miner.

Tracklayer: He was an intregal part of the mines and his duties included laying new track and the maintenance of existing tracks upon which mine cars traveled, both inside and outside of the mine. Tracklayers usually worked in groups of four in specific sections of the mine to which they were assigned by the underground foreman.

Wireman: He drilled holes in the roof and attached wire hangers, then strung and clamped the electrical wires for mining equipment especially electric locomotives.

Pumper: He was responsible for keeping the mine dry and free of water. Some mines were as dry as dust but many mines, especially those located under subterranean streams were prone to flooding. Water enters a mine from the roof and floor and sometimes it enters through an adjacent abandoned mine. The amount of water in the mine varies widely with season, consequently a large pumping capacity must be provided by the company. The presence of excessive water in a mine increased the cost of coal mining in proportion to the number of gallons pumped and the distance which water was pumped.[171]

Timberman: He was responsible for cutting, framing and putting in place props (timber posts) used to support roofs in the underground mines. This was an important feature of underground operations because the falls of roof are the most frequent cause of mine injuries and fatalities. The term is also applied to any person who draws or recovers props or posts.[172]

About 85 percent of bituminous coal miners worked underground and 15 per cent worked on the surface by 1920. Sixty percent of mine workers employed in the bituminous coal mines were "tonnage" men, operating cutting machines, mining coal at the face with picks and shovels, and loading coal. [173] This division of labor in the extraction of coal with its new emphasis on specialized jobs and intensified supervision and managerial control over the workplace, both at the surface and underground, is seen in the operation of the Leisenring and Standard Shaft Mines. These coal mines, although principally coking operations in the Connellsville coke district, are representative of the two-tier division of

labor found in larger mines during the last quarter of the nineteenth century. John Leisenring of Philadelphia, owner of the Connellsville Coke & Iron Company, opened Leisenring Number 1 Coke Works and the company town of Leisenring, Fayette County in 1880. Leisenring also operated Lesisenring Mine Number 2, opened in 1882, at West Leisenring and Leisenring Mine Number 3, opened in 1886, at Monarch, Fayette County. Leisenring Mine No. 2 was the site of a major mining accident that claimed the lives of 19 miners on February 20, 1884. The accident was caused by an explosion of gas and dust on February 20, 1884. The H.C. Frick Coke Company purchased the three Leisenring mines in 1890.[174]

Leisenring Mine Number 1 was a 385 foot deep shaft, located 1,000 feet above sea level. The mine produced 348,000 tons of coal used in 500 beehive ovens producing about 247,000 tons of coke in 1888. The mine employed 442 workers divided among 252 underground workers and 170 surface workers as follows in 1888:

Underground	Surface
1 foreman	1 foreman
180 miners	6 blacksmiths and carpenters
23 company men	6 engineers and firemen
28 drivers	132 cokers and yardmen
5 miners' boys	19 company men
	6 office personnel, including the superintendent, bookkeepers and clerks [175]

The Standard Shaft Number 2 mine located near Mount Pleasant, Westmoreland County was built by A. A. Hutchinson & Brothers of Pittsburgh who opened the mine in 1878. It was a shaft entry mine situated in the Pittsburgh seam that was 84-92 inches thick. A.A. Hutchinson & Brothers erected 150 company houses, a company store, and 509 beehive coke ovens. The mine's underground workings ran about four miles from the village of Standard to the village of Hecla. The H.C. Frick Coke Company bought the mine in 1883

and immediately increased the number of coke ovens to 901, making this facility one of the largest beehive coke plants in the world by 1900. Standard Shaft mine produced 483,813 tons of coals making it the second largest mine in Westmoreland County in 1904. The Frick Company constructed an underground well-equipped mule stables at Standard lighted by electricity. The firm, like other major coal companies, acquired its own railroad steel hopper cars. They purchased their own railroad cars to assure transportation without delay by avoiding he assignment of hopper cars from the railroad company. [176] By 1910 this was one of the largest coke plants in the world with 908 coke ovens consuming over 3,000 tons of coal daily and producing 125 car loads of coke daily. [177] The coke was transported by rail to the blast furnaces in the Pittsburgh region. Job classifications and number of workers in the Standard Shaft Number 2 mine in 1880 included:

Underground	Surface
2 foreman	5 foremen
448 miners	14 blacksmiths and carpenters
35 company men	14 engineers and firemen
45 drivers or runners	340 cokers and yardmen
5 miners' boys	35 company men
16 doorboys or helpers	5 persons in office and clerks superintendent, bookkeepers

As the scale of mining increased, individual mines were becoming more complex extractive facilities. There was a growth in the number of surface structures and buildings located at a typical mine. There was no standard extractive mining complex in the bituminous coal fields. A typical large complex, by the turn of the century, had a variety of specialized buildings and structures. A mine could include all or only a few of the following structures or buildings: ventilation fan houses, mule stable (either surface buildings or underground), tipple and scales, hoist house, head frame, supply house, repair sheds, blacksmith shop, machine or motor barn, carpenter shop, cap and powder houses, lamp

house, mine office, motor barn, cleaning plant, power station, boiler room, substation, wash house and perhaps coke ovens. A variety of factors determined the exact configuration of the surface structures and buildings found at any particular mining operation. These factors included the type of mine entry, whether the mining facility was also a coke plant, the physical size of the operation, and the date when the facility was in operation. A drift-entry, unlike a slope or shaft mine did not require a hoist house since there was no need to haul coal, miners or material to and from the mine. In 1900, there were 94 mines in the Connellsville coke region - 38 drift mines; 32 slope mines and 24 shaft mines. By 1909 there were 889 underground mines in Pennsylvania - they included 55 shaft-entry mines (6.1 percent), 76 slope-entry mines (8.5 percent), and 758 drift-entry mines (85.2 percent). [178] Most small drift-entry mines employed natural ventilation and usually did not require mechanical ventilation, therefore there was no need for fan houses to contain large mechanical fans. Larger mines using electricity to operate under-cutting machinery, haulage trolleys and underground lighting needed a power house, boiler house and sub-generator shop to produce electricity and convert it from direct to alternating current to operate mine machines and provide electricity for electric fans and power to the company town. Mines involved in the production of coke would require some type of coking ovens, usually constructed near the mine's entry to reduce transportation costs. Shaft entry mines required a head frame located at the entry. The metal or wooden structure supported mechanisms used for hauling mine cars, coal and miners to and from the mine.

The tipple (known as a "breaker" in the anthracite region) was a wooden structure where raw coal transported out of the mine was weighed, sorted, cleaned and loaded for market. The structure was located near the mine's entry. After 1900 many of these structures were constructed of steel and concrete. Raw coal transported from the mine was dumped into the tipple employing a variety of methods by the 1920s - the bottom dump where coal was released from the bottom of the mine car; the cradle dump where coal is released by tilting the mine car to one side ; and the end dump where coal was released by tipping the mine car on end.[179] Waste materials, like slate and shale, were removed from the mine along with coal and placed in piles near the entrance of the mine. The gob pile was a mixture of slate,

boney coal, and coal dust. These refuse piles were also called boney, ash pile, or the slate pile and existed at most bituminous mines. The frequent deposits of mine waste over time made these heaps or hills quite large. The waste or slack pile of Pennsylvania's anthracite mines were called culm banks.

Some coal seams contain solid coal from top to bottom,while other seams are split by partings of slate or other impurities of varying thickness. Certain coal seams contain high ash coal called bone, boney, or bone coal, which has no commercial value and must be separated from coal. Slate is a dense, fine-textured metamorphic rock, produced chiefly in Pennsylvania and Vermont. It is used for a variety of commercial uses including blackboards, billiard tables, and grave vaults, but in coal mining it is waste material. Shale is a fine-grained sedimentary rock, which is fragile and uneven in composition. It is often incorrectly called slate. Slate has a clearer lamination than shale and often contains beautiful fossil impressions of ancient origin including ferns and plants.

A coal washer or preparation plant does the identical functions of a tipple although it also washes coal. A majority of bituminous coal was shipped to market as run-of-the-mine coal during this period without much surface preparation. Some impurities were usually removed underground by loaders but little coal processing was done at the surface. A small minority of coal operators did prepare their coal prior to shipment to market. Their coal was sorted according to size and impurities were removed and washed.

The Larimer Coke Plant of the Carnegie Coal Company was an early coke operation located midway between Larimar Station and Ardara, Westmoreland County that cleaned and washed coal. Beginning in 1871, Andrew Carnegie experimented with making coke from fine coal or slack (bituminous coal one-half inch or smaller in size) at this coke plant about two miles from Irwin. The Carnegie Coal Company's experiments proved conclusively that slack coal could be used for coke production if it was prepared before coking. Slack coal was washed to reduce its high concentration of ash and sulfur before usage in the beehive coke ovens. Carnegie, at first, used the "mound" process of coke production; then the company erected 122 beehive coke ovens at the Ardara site. Coke was made from slack coal shipped by rail from the neighboring mines operated by the Penn Gas

Coal Company and the Westmoreland Coal Company. The company produced a good grade of coke continuously until 1900, when coke production was abandoned. The increasing demand for slack coal for steam made it no longer profitable to use it in the making of coke.[180] Slack coal was an excellent gas coal used in Philadelphia and New York and other Atlantic coast cities for gas manufacture from the 1850s for street lighting. The coking facility operated successfully until about 1900, when it closed because the new demand for slack coal for steam-making made coke production an unprofitable activity. [181]

Thirteen coal-washing plants with twenty-two washers operated in the Pittsburgh district (Allegheny, Fayette, Washington and Westmoreland counties) by 1880 although few coal wash-plants were constructed after 1900. Coal companies concluded the added cost in cleaning coal was not economically justified, and therefore coal washers were seldom used in the bituminous coal industry until the 1920s. [182]

Mining Technology

Coal mining was an extractive industry which had stubbornly resisted the introduction of machines and remained essentially a labor-intensive industry during its first century of development. Pick-and -shovel mining kept miners' productivity steady, as expressed in tons of coal mined per man per day. A majority of miners were still using the same crude hand tools and techniques employed before the Civil War as late as the 1880s. A number of factors contributed in keeping machinery out of the mine and keeping daily productivity low until this decade. Workers' resistance, lack of capital, technical difficulties in the development of machinery, and coal operators' passive indifference to mechanized mining. Contract miners and small individual mine owners also shared the goal of high-priced coal. They believed the prosperity of the industry was possible by limiting production in order to make coal scarce in the market. This was a feasible strategy because a majority of the mines were still small, employing from a few miners to fewer than a hundred men. This small scale of operation also made investment in machinery an unsound business decision. Labor was cheap and abundant, so there was little incentive to invest in costly machinery.

Large coal companies wanted to increase daily coal production. They believed that they could maintain profits by increasing daily productivity by introducing mining machinery. The undercutting machines was the first fundamental change in the work process since the origins of the coal industry in the colonial days. Coal-cutting or punching machines, powered by compressed air were the first successful attempt at mechanizing coal mining. Michael Menzies invented and patented a mechanical coal cutter in England about 1761. He proposed "to transmit power from an engine at the surface through a series of reach rods and chains passing over pulleys to a machine carrying a heavy pick, which was to undercut the coal." [183] To drive these reach rods he proposed to use a fire engine, a water mill, or a horse gin. Miners were paid about 4 cents to 5 cents per ton to mine coal during the 1860s. An average miner could dig upwards to one hundred bushels per day, but this required him working long hours to earn a decent living. [184] The undercutting of coal was the most skilled and highest paid job in the pre-mechanized mine. This was tedious, time consuming and extremely dangerous work. There was a growing reliance by miners on a variety of explosives to remove coal from the seam but the actual work of undercutting coal from the seam during the first century of coal mining had not fundamentally changed until the introduction of the mechanical undercutting machinery. The early "punching" machine was a horizontal jackhamer used to undercut coal. A mechanical undercutting machine was first introduced at a mine about two miles from Brazil, Indiana in 1873. Brazil is located in the northern section of the Indiana coal field which lies in the southwest part of the state. [185] The machine consisted of "an iron rim, four feet in diameter with moveable steel teeth placed about one foot apart. The rim rested on small wheels which supported it, and had cogs, on its under surface, which engaged on a shaft turned by the engine." [186] The machine ran on moveable track and was fed by means of a screw working in cogs. The track ran parallel to the vein and could cut about 100 tons of coal in 24 hours. The machine was originally run by a 5-horse power engine that was later changed to compressed air.

J.W. Harrison of Chicago patented a portable air-compressed undercutting machine in 1877 that was first successfully used by the St. Bernard Coal Company, Kentucky in 1880 (Illustration 16 - Harrison undercutting machine). The original machine was a compressed

air-drill puncher that struck the coal seam at an average of forty times a minute, which was about the same rate that a pick miner struck the coal seam with his sharpened pick. The Harrison machine mimicked the motion of the miner's pick, delivering a series of rapid blows intended to pulverize the coal. One man operated the machine by two handles - one handle being held in each hand. The miner guided the machine and directed its blows on the seam, and with pressure from his foot forced the machine forward. A second miner shovelled away the fine coal (bug dust). Improvements on later models permitted the machine to strike the coal with a "punching action of two hundred strokes per minute to the base of the seam at a depth of more than three feet. The pneumatic puncher offered great reliability and ease of control for untrained operators because it operated like a horizontal jack hammer. In 1876, the Lechner Machining Company introduced another type of cutting machine at mines of the Straitville Central Mining Company, in the Hocking Valley, western Ohio. The Lechner machine consisted of an engine operated by "a revolving bar into which sharp steel points were inserted. The bar was driven into the bottom of the seam, making a cut three feet wide and six feet deep." [187] The deep undercut allowed the coal to break cleanly away from the seam when the "shot-firer" fired the coal from the face. If the coal face was insufficiently undercut, the blast would pulverize the coal and the powdered coal was of little commercial value and use during this period. These two machines were both operated by compressed air producing steam for the engines which drove the compressor above ground and conducted air in pipes into the mine. Air technology was safe and unlike the later use of electricity could not ignite a mine fire, although the air hoses made the puncher's use in the mine less flexible. [188] Compressed air punchers weighing 700-pounds each were widely used underground in larger mines during the 1880s.

The Harrison machine and similar undercutting machinery were expensive during their first decade of usage underground. Each machine costs about three hundred dollars. These expensive machines were also plagued with numerous mechanical breakdowns and parts had to be ordered from the manufacturer or made by the mine's blacksmiths in the machine shop. The poor quality of these pioneer machines were improved after the 1890s. The electric chain-breast cutter was an alternative type of undercutting machine to these earlier

air-compressed punching machines. The machine was first manufactured in 1893. The machine was equiped with a 35-HP motor using a horizontal blade or cutter bar fitted with an endless chain which was capable of making a seven foot deep undercut. The front of the machine sticks out like a duck-bill and was edged with a toothed chain. As the chain goes around, its sharpened teeth gouged out a groove near the bottom of the coal face. The chain-driven machine was superior to the earlier pneumatic machines because it operated faster, used less energy, and produced less "slack" or pulverized coal in making cuts. The chain-breast cutter also spared the coal operator the expense of installing expensive compressed air lines in the mines. A majority of coal operators had replaced compressed air machines with electric undercutting machines by 1910. Undercutting machines were not extensively used on a large scale in the anthracite mines of Pennsylvania because of the hardness of the coal and because the highly disturbed condition of the strata in these mines made their usuage economically impractical. [189]

The use of mechanical undercutting machines continued to increase substantially with the passage of each decade after the 1890s. The quantity of coal undercut by machine depended on a variety of local variables including the thickness of the seam, expertness of the machine operator, hardness of the coal, and the width of the working place. Undercutting machines provided coal operators who desired to increase productivity a means for doing so. The machine elevated the individual miner's daily output of coal from 2.57 tons in 1891 to 3.71 tons in 1914. Union operators in western Pennsylvania, Ohio, Indiana, and Illinois employed these coal-cutting machines in an attempt to boost productivity and lower their high operating costs. Northern operators were paying their union employees higher rates than nonunion southern mines and the new competition from southern nounion coal producers had motivated them to seek methods of reduction cost to mine coal. The production of bituminous coal per man nationally as a whole stood at 4.28 tons per day per man in 1922 while productivity in machine-equipped mines was about 5 tons. [190]

The pneumatic undercutting machines were first introduced in the 1870s but general production figures on mechanically undercut coal were not kept until about 15 years later. Only 6,211,732 tons, equal to 6.6 percent of the total bituminous coal, was mechanically

undercut nationally in 1891. Five years later the output of machine-mined coal reached 16,424,932 tons or 14.7 percent of the total output. In 1900 52 million tons or about 25 percent of the production of coal nation-wide was machine cut. One-third of Pennsylvania's coal production and nearly one-half of Ohio's production was machine cut by 1900. [191] In contrast, by this date only 1.5 percent of British coal was undercut by machinery. [192]

Undercutting Coal By Machines and Picks in the U.S.

	Percentage by Pick Mining	Percentage by Compressed Air Machines	Percentage by Electric Machines
1900	58.9	22.9	18.1
1905	57.7	22.4	19.8
1910	51.0	19.8	29.1
1915	44.6	9.7	45.5
1920	40.8	5.8	53.3 [193]

Coal-cutting machinery were gradually replacing the miners's pick. These machines could undercut more coal in an hour than a pick miner could dig in a day and their increased use meant thousands of workers were technologically displaced workers in the larger mines. One compressed air cutter operated by a pair of workers could undercut 4 to 6 typical rooms in a ten hour shift. This same work required twenty pick miners to accomplish this work. As the use of the mechanical cutter became more general, undercutting coal by hand ceased to be part of the miner's craft. A new group of mine workers called machine runners was created. The machine runner, along with a helper called a scrapper, took over the undercutting of coal. They were assigned a number of "rooms" by the underground foreman and with a few loaders were responsible for the drilling, shooting and loading coal. Mechanical undercutters were generally not employed by coal operators who operated the thousands of small "country banks" mines during this period where coal was still undercut using a pick.

After the coal was undercut, miners used an electric drill to bore a hole in the coal face. A cartridge of dynamite was placed into the hole. Attached to the dynamite was a cap and two wires that extended for several feet. The "shot-firer" exploded the cartridge by electricity from a safe distance. After the blast the broken lumps of coal was ready to be picked up either by hand loaders or by a mechanical loading machine. The loaded coal is transported from the mine by animal drawn carts or by electric locomotives called "electric mules."

The underground mine, besides being a work place for the extraction of coal, was an environment containing an extensive and elaborate transportation system. Workers and supplies were conveyed to and from their work area and coal and waste materials had to be transported out of the mine daily. A majority of coal was still hand-loaded by loaders into wooden coal cars that held between one and three tons capacity by 1910, then hauled by draft animals to the mine entry (headhouse). A variety of animals - dogs, ponies, goats, oxen and horses -were all used by coal companies to haul loaded coal cars to the surface although a majority of mine owners preferred the stubborn but sure-footed mule after the Civil War.

The increase in coal production after 1880 made many mines very large and the increase in the underground mine workings made travel distances greater. This growth in spatial size created a need for improved methods of underground transportion. Large commercial mines had underground workings ranging in size from 1,000 to nearly 100,000 acres. For example, the Maple Creek Mine of the United States Steel Corporation on the Monongahela River between New Eagle and Monongahela City, Washington County had underground coal reserves of approximately 17,000 acres of Pittsburgh coal seam situated in four townships of Washington County. The Renton Mine mined 100,000 acres of coal lands in Allegheny County while the Shannopin Mine, mined 7,500 acres of its nearly a 13,000 acres of coal reserves in Greene County. With existing mining techiques this reserve represents a 20 year coal reserve. A variety of conveyances have been used in transporting coal from the mines, ranging from baskets,wheelbarrows and coal cars. A variety of draft animals were used to haul coal. Most commonly mules and horse, but dogs, goats or oxens were used in small mines or thin coal seams mines coal to haul coal and refuse out of the

mine. These draft animals were gradually replaced by electric locomotives, dubbed "electric mules," and other haulage machines during this period. Gasoline, electric and battery powered haulage locomotives were all introduced in larger mines for underground haulage. Gasoline engines were installed in Kentucky mines in 1898. The gasoline engine gave off noxious gases, air pollution, and posed a serious fire hazard which restricted their widespread use within the industry underground. Electricity was introduced into many larger mines at the turn of the century and changed the work of miners. Electricity was used to operate cutting machines, air fans for ventilation, electric drills, firing shot, motor haulage, underground telephone and signal systems and the opening and closing of ventilation doors. The widespread use of electricity made the bituminous coal industry a more productive industry but its increased usage also made the workplace an unsafe environment.

The first electric-trolley haulage locomotives were introduced in 1887 and 1888 and were used in individual mines in Pennsylvania, Ohio, and Illinois. Larger companies were all using electric-mine locomotives or battery powered locomotives to transport coal, workers, and refuse from the mine to the surface by 1900 (Illustration 17 - Electric-haulage locomotive). These locomotives were installed on the main haulageways of larger mines while mules and mule drivers were still employed to gather loaded coal cars from the individual rooms. The electric-trolley locomotives were generally not used in mines where the air is gassy because of the danger of explosions caused by sparks between the trolley and the wires. When these electric trolleys were used for gathering cars from the working faces, they were equipped with an insulated cable that transmitted the electric current from the trolley line to the motor. The principal advantage of storage battery locomotives is that unlike electric trolleys they did not require direct current to operate and could travel underground wherever the track is laid, regardless of connection with an outside source of current. They were used extensively in gassy mines to avoid possible explosions caused by electrical sparks. The chief objection to these locomotives was their need to be charged regularly and therefore were out of service part of the time. The first storage-battery locomotives were employed in the Pocahontas Field, West Virginia. The storage-battery locomotives of 1914 ranged in size from two to ten tons . The introduction of these electric

and battery-powered locomotives permitted the introduction of larger capacity coal cars. [194] It was common practice in mines using both hauling machines in 1920 to employ the electric engine trolleys with trolley-wires for main haulage and the storage-battery locomotives for gathering.

Life Underground "Where the Sun Doesn't Shine"

Miners were becoming increasingly discontented with their daily lives underground and at "patch" towns during the last quarter of the nineteenth century. They resented what they perceived as coercive and exploitive practices on the part of management. A majority of mine workers, who were still unorganized workers, toiled long hours underground for poor pay in often deplorable and unsafe working conditions. Work in the industry was sporadic as coal production often far exceeded demand. From 1890 to 1920 miners were idle an average of 93 working days each year. They were overworked to fill demands for home-heating coal in the fall and winter, while in the spring and summer, there was much underemployment in the industry.[195] A typical miner during this period "worked in water half-way to their knees, in gas filled rooms, in unventilated mines where the air was so foul that no man could work long without seriously impairing his health. There was no workmen's compensation law, accidents were frequent and there was no common ground upon which employer and employee could meet. They had no interest in common as they regarded each other with hostility and distrust." [196] Underground mining of coal and other minerals by its very nature is performed under potentially dangerous conditions. The dangerous conditions in the mines were caused by poor or inadequate ventilation, use of open flames especially miners' candle or oil lamps in gassy mines, inadequately timbered mines, negligence in testing for mine gases, failure to control the accumulation of coal dust and the improper use of explosives.

Coal mining has historically been a dangerous industry causing death and injuries to the men and boys who ventured underground to extract coal. That coal miners grow old before their time was proverbial. The work place at the face could be from two to twenty feet high

depending on the thickness of the seam although it was usually shorter than the miner. John Brophy, UMWA District 2 president, explained in his memoir, *A Miner's Life,* that "one of the most exhausting things about mine work was the necessity of working ten to twelve hour day without a single chance to stand erect and stretch." [197] This continuous hunching for 10 to 12 hours straight permanently altered a miner's posture. Inhaling stale air, gases and dust, hard and prolonged work in a stooping strained position were all factors in aging coal diggers. The mine's atmosphere was teeming with dirt and dust and miners suffered from a variety of occupational hazards including black lung (pneumoconiosis) caused by their inhaling "bug dust." This medical ailment was referred to as "miner's asthma" or *phthisis pulmonalis nigra* . This ailment snatched the miner's breath away leaving him to sit up at night gasping, unable to walk or lie down. Even after scientific evidence proved conclusively that breathing coal-mine dust caused irreversible respiratory disease including black lung, coal companies denied the connection. Some operators maintained the inhaling of coal dust was good for miners. Tens of thousands of miners died or suffered from "miners" asthma while the industry and government ignored the horrible consequences of this debiliating occupational disease. Another seven decades would pass before pneumoconiosis became recognized by federal law as an occupational disease in the coal mining industry. The federal government provided black lung compensation for coal miners and their dependents following the passage of the Federal Coal Mine Health and Safety Act of 1969.

The physical description of a miner in an 1886 issue of the *Union Pacific Employees Magazine* vividly describes the toll long-term mining had on the miner's body:

> Look at the man forty years of age, that has dug coal all his life is a deformed wreck, physically, if not mental. ... Look at the number of miners with broken bones; the number with burns; with stooped shoulders; with weak and improverished blood; with rheumatic pains from working in water; with affected lungs from working in bad air. A physically sound man fifty years of age, who has dug coal all his life, is almost impossible to find. [198]

Coal operators, like miners, had accepted the fact that mining was a dangerous and potentially unhealthful occupation throughout most of the nineteenth century. Miners were regarded as skilled independent contractors employed by the coal company and hence were responsible for their own safety and welfare while working at the mine. Most miners believed that coal operators evaded any responsibility in making coal mining a safer industry by simply dismissing all accidents and explosions as the result of human carelessness, neglect or ignorance of their employees. Coal operators told state coal commissions that accidents in the industry was caused by miners who took foolhardy risks or imprudently attempted tasks that were surrounded by known elements of dangers. Since they were paid by tonnage, many miners were neglect in assuring that the mine was safe. Instead of securing the roof and checking for dangerous level of gases immediately began mining coal. The Bureau of Industrial Statistics in Pennsylvania accepted the biased position of coal operators. The agency asserted in 1908 that "more than half the accidents reported (in the industry) are chargeable to such causes." Management maintained a lax attitude in promoting any systematic safety programs in their mines in the face of this rising danger during this period. Mine safety was given little consideration by most coal companies, and this callous indifference regarding their health and welfare was clearly stated by a contemporary miner who angrily observed "If I sell my labor to produce profits for my master at a bare existence for myself and my family, my master is responsible for any accidents that deprive me of the power to produce profits. I have given my all when I sell my strength." [199] A coal operator clearly expressed the typical attitude held by a majority of fellow coal operators when he told the Ohio Mining Commission that "the miner is free and can protect himself for he can engage in mining or not." [200] Operators regarded any government attempts to regulate mine safety laws as "unnecessary and unwarranted interference with the business of coal mining." [201] The UMWA, at its first annual convention held in 1891, passed a resolution demanding regular inspections of all mines by a state or federal government agency and the passage of legislation for "the adoption of a law, with heavy penalties attached, holding

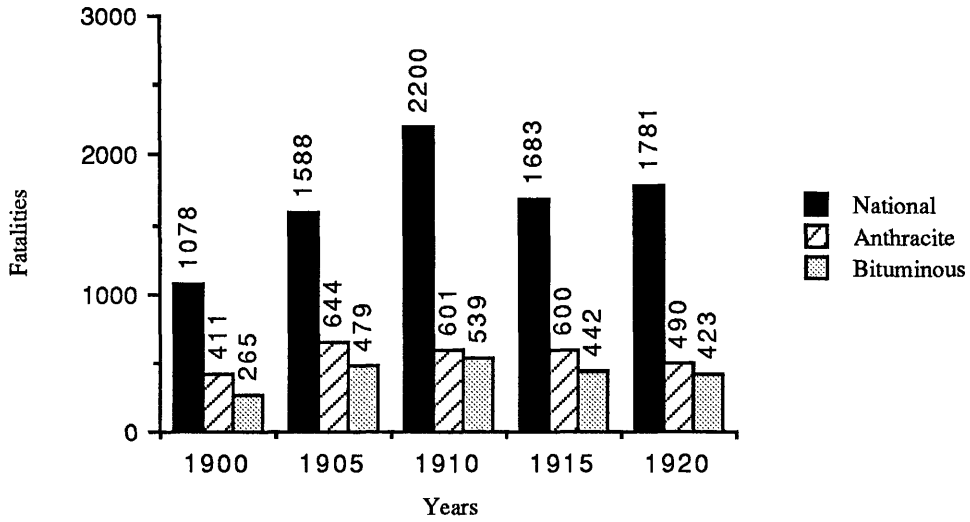
employers of labor liable for any and all accidents that may happen to their employees while in the line of service." [202]

This brief forty year period was the most hazardous in the history of American mining. Nearly 50,000 miners died in American mining accidents from 1870 to 1914. Fourteen states had experienced at least one major mine explosion by 1890. The expansion in production, the increased size of the work force, the introduction of mechanical machinery and electricity were all contributing factors to the higher fatalities in the industry. Some English-speaking miners accused the new unskilled immigrants entering the industry in large numbers after 1880 of causing the rising fatalities in the industry. Their ignorance and inexperience as miners according to them contributed to the high accident rates in the mines. The new immigrant miners, unlike the earlier miners from Great Britain, had had less mining experience abroad. The presence in the mines of skilled Scotch, English, Irish and German miners underground was declining rapidly throughout this era as they were replaced by these unskilled workers. These earlier immigrant miners regarded the new immigrant arrivals as inferior miners and spoke of them in derogatory terms dismissing them as those ignorant foreigners. The UMWA district president of Pittsburgh in 1902 after the Rolling Mill Mine disaster in Johnstown accused mine operators of neglect for hiring these unskilled immigrant miners.

> As long as they import foreigners by the hundreds, dump them into the mines without any instruction or training, and run along the theory that the mine boss, who gets his certificate from the State, is wholly responsible for the lives of hundreds underground, we will be be greeted every few months by news of ...appalling disasters. [203]

The United Mines Workers Journal seems justified in concluding that "the peril of the mines lies in the immigrant ship." [204]

MINING FATALITIES IN US and PA



Most of these mine deaths were in ones or twos, although the spectacular underground mine explosions received the most media attention and reaffirmed to the general public the inherent dangers of the industry.[205] The major mine explosions of the era were caused by mine gases that came into contact with open flames underground. These explosions originated from the ignition of two materials commonly found in all coal mines - methane (CH4) and the dense clouds of "bug dust" suspended in the atmosphere. Fine coal dust was extremely volatile matter and was created by electric undercutting machines as they pulverized coal at the working face and by the blasting of coal from the seam with dynamite or black powder. [206] The use of fine powdered limestone dust called rock dust was later applied to the mine's roof ribs and floor as a safety measure to render explosive coal dust inert. Rock dusting also provided for better illumination in the mine. The widespread practice of rock dusting was instituted in most larger mines during the 1920s.

Open lighting was once universal in most mines and caused many explosions underground. The miners' open flame sunshine lamp and use of candles constituted a

serious hazard in gassy mines. The acetylene lamp, called the "carbide lamp" by miners made its appearance in the mines at the turn of the twentieth century. This lamp was a significant improvement as a source of underground illumination over candles and oil lamps (Illustration 18 - Carbide Lamp). The carbide lamp burned with a brighter light comparable to these earlier means. The carbide lamp, attached to the miner's canvas hat, was made of brass and composed of two parts. The upper chamber of the lamp was filled with water which was fed by capilliary action into the bottom chamber that contained carbide pellets (calcium carbide, Ca C2). The water acted on the carbide pellets producing acetylene illuminating gas which is ignited by striking a serated wheel acting upon a flint to produce a spark. Acetylene, C2H2, is a pungent gas formed by the action of water on calcium carbide. The carbide lamp burned for about four hours with a bright yellow-white flame that could be adjusted from one to three inches. The three major manufacturers of carbide miners' lamps were Arras of France, Seippel of Bochum, Germany, and the Wolf Company with manufacturing facilities in England, Germany and the United States. [207]

The carbide lamps were replaced by electric-battery lamps to reduce fire hazards from the lamp's open flame. Electric miners' lamps were introduced by 1915 in some larger mines. The Edison battery lamp was one of the most popular models of the era. The lamp was attached to the front of the miner's cap with a wire leading from it to a battery secured to a belt around the miner's waist. The electric lamps were charged overnight by miners or the lamp man at the lamp house. Although this electric lamp was safer because it was not an open flame, only 53 percent of all miners nation-wide were using them as late as 1940. [208]

Pennsylvania did not begin compiling accurate mine accident statistics until 1870. The Department of Mines of Pennsylvania has issued annual reports on the bituminous and anthracite coal industry since 1877. The agency routinely compiled such mining statistics as annual production, employees, fatalities including the ethnic origin of the mine worker, production per fatality, fatalities per 1,000 employees, and fatalities per 1,000,000 tons produced. These grim calculations of human life were regarded as simply production variables by mine owners and the agency. A "major" disaster was defined by the agency as one in which five or more workers were killed. There were sixty-four major mining

accidents in the bituminous coal fields of Pennsylvania from 1884 to 1945, using this arbitrary criteria. [209] Five of these mining accidents claimed more than one hundred lives.

Mining Accidents in Pennsylvania Claiming 100 or Miners

Mammoth Mine - Mt. Pleasant, Westmoreland County (1891) 109 killed
Rolling Hill Mine - Johnstown, Cambria County (1902) 112 killed
Darr Mine - Jacobs Creeks, Westmoreland County (1907) 239 killed
Marianna Mine - Marianna, Washington County (1908) 154 killed
Cincinnati Mine - Finleyville, Washington County (1913) 113 killed

Fifty-four of these sixty-four mining accidents were caused by explosions of gas or dust; the remaining accidents were caused by roof falls, faulty mine cars, mine fires, and workers falling down mine shafts. From the founding of the UMWA in 1890 until 1907, over 26,000 men died in coal mining accidents. Nation-wide 1907 was worst year in the history of coal mining when 3,242 miners perished and tens of thousands were injured in non-fatal accidents. Of this national total 1,614 miners perished in Pennsylvania alone (806 in the bituminous coal industry and 708 in the anthracite industry). Five mine disasters alone in 1907 claimed over eight hundred victims. The Darr Mine of the Pittsburgh Coal Company, located in Rostraver Township near Van Meter, Westmoreland County, on the Youghiogheny River, was the site of the deadliest coal mining disaster in Pennsylvania history and the fourth worst mine disaster in the nation. Miners who worked at the Darr Mine lived in the surrounding communities of Van Meter, Jacobs Creek, Banning, and Wickhaven. On December 19, 1907, 239 miners were killed as the result of an explosion of gas and dust. The Monongah disaster of West Virginia was the worst mine disaster in American history. This disaster occurred on December 6, 1907, "Black Friday," at Monongah Mines Six and Eight, near Fairmont, West Virginia, when 360 men were trapped underground and a 12-year-old trapper boy was killed at the surface. Child labor was routinely used in bituminous coal mines. Boys, as young as seven, worked underground as

runners, mule drivers, trappers and couplers. Some coal producing states passed laws prohibiting the use of children younger than 12 (later raised to 14) from working in the mines. These laws were rarely enforced. Pennsylvania coal operators were fined on average 23 cents for violating child labor laws in 1904. The miserable wages paid miners forced parents to send their boys underground instead of watching them starve for lack of food. Federal legisation was passed in 1938 banning child labor in "hazardous occupations." The UMWA won a contractual agreement from coal companies in 1941 requiring a minimum age of 18 to work in a mine.

The Monongah Mines 6 and 8, located in Monongah, Marion County in the northern part of the state, was operated by the Fairmont Coal Company, a subsidiary of the giant Consolidation Coal Company of Maryland. The exact cause(s) of the most deadly underground explosion in American mining history has never been conclusively determined. Most of the victims were immigrant workers from Italy, Austria-Hungary, Turkey, and Russia. The disaster created 196 widows and made 468 children orphans. Ten days later on December 16, 1907, 57 miners died in a mine explosion at Yoland, Alabama. Less than a year later on November 28, 1908 154 miners were killed at the newly opened Marianna Mine of the Pittsburgh-Buffalo Company, Marianna,Washington County. And on April 23, 1913 another 97 miners died at the Cincinnati mine of Monongahela River Consolidated Coal and Coke Company at nearby Finleyville, Washington County. All these mine disasters were caused by gas or explosive coal dust.

These "major" mining accidents caused by an acculumation of unsafe levels of gases (usually methane) or mine dust were shocking and sensensational events and attracted public attention; however, they were not the leading cause of death and injuries to coal miners. These disasters accounted for a small percentage of the total deaths. Fewer than 2,000 mine workers (1,954) in Pennsylvania were killed in the State's 64 major mining accidents between 1884 and 1945. Accidents caused by roof and rib falls, haulage accidents, and dangers from electricity posed greater daily health hazards to underground miners than death from the explosion of volatile mine gases or coal dust. The principal hazards to surface workers had to do with transportation, machinery, electricity, and falls. From 1913 to 1922

accidents killed 18,243 miners nationally at bituminous coal mines, a death toll ratio of 4.30 per thousand full time workers per year during this period. The percentage of fatal accidents during this single decade were fall of the roof and of coal - 50 percent ; mine cars and locomotives - 18.1 percent ; gas and coal dust explosions- 12.2 percent ; on the surface - 6.0 percent; electricity - 4.2 percent ; explosives - 3.7 percent; other causes - 3.6 percent; and falling into the shafts - 1.9 percent. [210]

The U.S. Geological Report of 1907 undertook a comparative study of mining accidents, casualties, and mine safety in the American and European coal industries. The study concluded the death rate from mining accidents in the United States was three times greater than that in England and Belgium, twice the rate in Prussia and almost four times the rate in France. American mines, according to the report, were inherently no more dangerous than contemporary European mines. The lower accident and fatality rates in Europe were due to safety legislation and rigorous enforcement. John Mitchell accepted the Geological Report's conclusion that "inadequate legislation and law enforcement more than any single cause was the essence of the safety issue." [211] Safety conditions and mining fatalities varied throughout the coal industry. He compiled fatality rates in the industry from 1907 and observed a strong statistical correlation between fatalities and the extent of unionization. He observed 2.47 fatalities per 1,000 miners in unionized states, 5.07 fatalities per 1,000 miners in partially unionized states, and a phenemonal 9.49 fatalities per 1,000 miners in non-unionized coal producing states. [212]

Mining Fatalities in European and Pennsylvania Mines Per 1,000 Employees

Nation/State	1891	1897
Austria	2.54	.95
Belgium	1.40	1.03
Germany	2.80	2.27
England	1.50	1.32
France	1.67	1.07
PA (Anthracite)	3.08	2.84
PA (Bituminous)	3.18	1.72 [213]

The human toll exacted by the coal mining industry during this era was staggering. The rise of underground explosions and increased fatalities and injuries prompted action by the union and public pressure. Some companies had unilaterally implemented their own safety practices at their operations by hiring their own mining inspectors. The prospect of losing their entire capital investment in a single explosion encouraged this new emphasis on mine safety. The H.C. Frick Coke Company, now a subsidiary of the U.S. Steel Corporation, began a safety program at their numerous facilities with the "catchy" phrase "Safety First, Quality Second, Cost Third." They trained rescue and first-aid teams that practiced continually honing their skills. The company also posted signs in English and five other languages throughout the mines and at the surface warning its workers of potential dangers.

Mining laws were passed by state legislators of coal-producing states beginning in the 1870s, and by 1920 an uneven collection of mine-safety laws existed across the coal-producing states . These laws were generally ineffective because they lacked meaningful enforcement provisions. Illinois and Pennsylvania, birthplaces of the nation's first miners' unions and the stronghold of the growing UMWA, were acknowledged as having the best safety laws in the industry, while West Virginia, largely nonunion at the time, was considered "the worst of the lot." State mining agencies with coal mine inspectors were created by coal-producing states. The bituminous coal mining inspection force was created by a legislative act passed in 1877 by the General Assembly of Pennsylvania. The act provided for the appointment of three mining inspectors by the governor. The bituminous coal region of Pennsylvania was originally divided into three districts and included thirty counties as nearly equal in size as possible. Five of these counties (Crawford, Erie, Forest, Potter and Warren) ceased to produce coal while three other counties (Bedford, Greene and Somerset) became active producers. [214] Pennsylvania's mine inspectors duties were to visit and inspect the state's mines to insure that they were safe for workers and mining. Each mine inspector was empowered by law to enter and inspect the mine and its machinery at all reasonable times day and night. He was also charged with determining the causes of mine accidents and was permitted to conduct investigations and issue subpeonas to discover the cause of the mining accidents. Each inspector was independent acting according to his own

judgment since there was no immediate superior to see if he was enforcing existing mining laws. He was required by law to report the results of his inspections to the Secretary of Internal Affairs. [215] Pennsylvania's state legislature in 1915 granted state mine inspectors in the bituminous region a life tenure. The act was not applicable to anthracite-mine inspectors who were still required to undertake periodic examination administered by the state. As Pennsylvania's coal industry expanded the number of mining inspectors was increased from three inspectors between 1878 and 1880 to 30 inspectors after 1915. A long-standing complaint of some miners was that state mine inspectors were political appointments and therefore they were subject to operators' influence which resulted in lax law enforcement.

The United States Bureau of Mines (BOM) was established by an Act of Congress on July 1, 1910, formed as a result of the rash of serious mining tragedies during the first decade of the twentieth century and especially the high death toll in 1907, when the coal industry recorded an appalling 3,242 death that year nationally. [216] The agency's mandate from Congress was "the investigation of the methods of mining, especially in relation to the safety of miners." [217] The new Bureau had no real power beyond gathering information. Joseph A. Holmes, the first director of the United States Bureau of Mines, undertook numerous experiments to reduce mine accidents and fatalities especially those explosions caused by coal dust and the improper use of explosives in the mine. Mine dust was a serious hazard for dangerous explosives, especially in winter when the air and the mine are dry. A variety of explosives were used in mines without much regard to safety. The Experimental Mine and Explosive Testing Center was constructed by the United States Bureau of Mines on a large tract of land located near Bruceton, thirteen miles from Pittsburgh on October 11, 1911. Sufficient ventilation was required to prevent the accumulation of methane gas and to remove coal dust in the mine atmosphere. A variety of safety measures instituted by the agency included the use of explosives and electrical equipment that had to pass certain safety tests and approval by the U.S. Mine Safety and Health Administration. [218]

The United States Bureau of Mines noted that the high death rate in American mines was not due entirely to the natural hazards inherent within the industry. The agency estimated

conservatively that at least one-half of all annual deaths could be prevented if proper precautions were undertaken by the coal operators. The fatalities per 1,000 full time workers in American and European mines by 1920 indicated that American mines were still more unsafe than European mines. The average rate of 4.08 deaths per 1,00 full times workers in the United States was more than three times the rate of 1.13 deaths per 1,000 in British mines. Coal mining was still one of the nation's most hazardous occupations. Nearly 2,000 miners were killed annually while non-fatal injuries runs between 50,000 to 150,000 per year during the 1920s. [219] An estimated 72,000 more miners would die in accidents until the passage in 1952 by Congress of the next significant mine safety law. The Federal Coal Mining Act for the first time established minimum safety standards that coal companies were required to meet. The BOM inspectors were permitted to inspect mines, but until the passage of this act could only recommend safety practices to operators not enforce safe mining practices.

Daily Life in the Company-Owned Town

The coal companies played a dominant role in the everyday life of the mining community. Each company had practically absolute control over its employees and their families' personal lives in a manner that was virtually impossible in any other type of community in the nation. Miners were always vulnerable to pressures from the company and were increasingly unhappy with this control over all aspects of their daily lives both in the "patch" town and at the mine. The company town, company store, and non-legal tender (scrip) were all introduced as practical necessities, but these necessities over time were used by some coal companies to gain economic and political control of their isolated and captive labor force. Muriel Earley Shephard wrote in her classic study of daily life in the Connelleville coke district, *Cloud by Day*, "They lived on feudal islands in the county but were not of it." [220] Neither the miner nor his family had the same rights or protection accorded most American citizens under the Constitution. Since many coal towns were located in rural and unincorporated villages, all political power was controlled by coal

companies which owned and operated the mining village as their own private feudal fiefdom. A former miner recalled this absolute political control of the mine superintendent noting that "he (the coal company superintendent) was mayor, council, big boss, sole trustee of the school, truant officer, president of the bank, in fact he was everything." [221] The miner who rented his house in these unincorporated villages had no basic right to control it . The company constable needed no search warrant to enter the house at any time of the day. Miners who rebelled and struck jeopardized losing their homes. There were always some miners and their families, in one coal field or another, living in barracks erected by themselves or by the union after they were evicted by the coal company after striking. Scholars have condemned this economic and political control exerted by the coal company as "a great anomaly in the midst of the free country." [222] Priscilla Long, author of *Where the Sun Never Shines,* observed that "in the land of the free the company town was isolated, remote, and anything but free." [223]

The coal company employed a variety of private police to enforce their laws, including the dreaded Coal and Iron Police of Pennsylvania. A Tioga County miner discussed this control of his daily life telling members of the State Commission of Pennsylvania in 1882 that "the (mine) superintendent makes all the laws and those who are in his employ must abide by them." [224] Miners rented their houses on the condition that they sign a lease agreement which could usually be terminated with only five days' notice. The lease permitted the company to evict them automatically when they ceased for any cause whatsoever to work for the coal company. Some leases, signed by miners as a condition of their employment, allowed company officials to enter the house at any time of day or night without prior notice. A typical lease, issued by coal companies and signed by most miners, stated"the company shall at all times have the right to enter the house to find and eject any improper or suspicious persons." [225] The United States Department of Labor concluded in 1917 that "A housed labor supply is a controlled labor supply." [226] Striking miners and their families were routinely evicted from their rented houses by the coal companies. Strike activities caused so many evictions of workers and their families between 1898 and 1919 that the

UMWA was forced to spend more than $16 million for their relief by constructing temporary housing - either barracks or tents and providing food. [227]

The monopoly held by the company in housing was maintained by the ubiquitous company store with its notorious reputation for high prices, high interest rates, and inescapable debt caused by the extensive use of scrip. Most miners disliked the company store, derisively calling it "the pluck me" or "grab-all" store. [228] Miners resented the store for three principal reasons: prices were usually inflated in comparison to prices charged by independent retail stores; their supplies were deducted from their wages, called "check-offs" before they received their pay; and trading with the store was often compulsory. If a miner did not purchase sufficient merchandize from the store, he was punished with immediate dismissal, or assigned one of the dangerous or poorer paying jobs underground. Coal companies hired managers to operate their stores and they were expected to make a handsome profit. A miner from Bradford County told a State Commission investigating alleged abuses in the mining industry in 1882 that "the employees in and about the mines where I work are compelled to deal in the company store, and have to pay a very high price for their goods." An Allegheny County coal miner told an investigator from the same commission that,"if we do not deal in the company store we are not wanted at the mine, and are given a poor place to work. The company store system is a blot on the liberties of this country, and should be the concern of all whether in or out of the mine." [229]

The Pennsylvania Bureau of Industrial Statistics conducted a survey in 1883 showing prices consistently higher in company stores than those goods stocked at neighboring stores.

Prices of Goods in Company Store and Independent Retail Store

Food stuff	Company store	Independent store
Flour per barrel	$8.00	$7.75
Corn Meal	$1.50	$1.25
Butter per pound	$0.35	$0.30
Bacon per pound	$0.40	$0.10

Ham per pound	$0.13	$.11 -.12
Cheese per pound	$0.20	$.16 -.18
Tea per pound	$.60 - 1.00	$.25 -.75
Coffee per pound	$.28 -.37	$.25 -.30 [230]

The practice of exploiting miners with excessive prices at the company store was not a practice limited to the coal companies of Pennsylvania. The General Assembly of Ohio appointed a committee to investigate a miners' strike in the Hocking Valley, Ohio in 1884, reported similar exploitive practices as those encountered in Pennsylvania. Goods sold at the company store were uniformly priced higher than similar goods avaliable in neighboring cash stores. [231]

The UnitedStates Census Bureau conducted an investigation of the coal industry in western Pennsylvania after a series of particularly violent strikes in 1910-1911. The study revealed that "many mine operators make a considerable profit by renting houses and selling merchandise to their employers." [232] The study investigated the earnings the coal companies. They found store profits accounted for on average about one-quarter of the companies' total annual revenue.

Coal Companies Profit from Coal and Store

Company	Coal Sales	Store Sales	Percent of Earnings
Keystone C&C Co.			
Arona	$331,126.88	66,566.90	20.1
Claridge	$206,528.67	56.694.34	28.4
Keystone Shaft	$250,903.38	50,938.00	20.3
Jamison C&C Co.			
Jamison No. 1	$304,576.22	91,445.21	30.0
Jamison No. 2	$448,611.59	95,071.51	21.3
Jamison No. 3	$244,391.69	83,178.19	34.0 [233]

Scrip was a certificate issued by an employer in lieu of cash wages, usually redeemable only at the company store. The use of coal scrip was another controversial feature of the company store. Its use was connected with the extension of credit and this practice often kept employees perpetually in debt to the coal company. Some coal companies paid their workers in coal scrip instead of American legal tender. Scrip was contemptuously called "bogus" money, "flickers," "drag," "clacker," and "chicken feed" by discontented miners. Coal scrip was paper or metal substitutes issued by coal companies and usually redeemable for goods and supplies only at the company store. The first scrip was issued in paper coupon form, hence the name. Scrip was later issued in brass, copper and aluminium denominations of coins including nickels, dimes, quarters, and half-dollars and as paper money corresponding to legal-tender denominations. Rural isolation and poor roads into many mining communities made it difficult to get money transported on a regular basis to pay miners and so scrip was introduced as a substitute to pay them. It was first used in the bituminous coal fields during the 1880s and 1890s in the isolated mining communities of West Virginia and Kentucky. Mine owners did not give up its use when transportation improved and the money supply increased. West Virginia and Kentucky were the principal coal-producing states that used scrip extensively although mining companies in Virginia and western Pennsylvania used it. The H. C. Frick Coke Company issued scrip called "Frick Dollars" during the Panic of 1873 when cash was scarce to pay their employees in the Connellsville district. This practice was later extended in western Pennsylvania especially by coke operators in Fayette County. There were at least sixty mines in Pennsylvania issuing scrip as a subsitute for legal tender to their workers during this period. [234]

The use of coal scrip, like that of company housing and the company store, began as a necessity, but over time it became a dreaded curse for miners and their families, and was heartily condemned by them. The miner or a family member could draw scrip in advance of payday by visiting the payroll office, often located at the company store, to see if the company owed the miner money; if so, scrip was issued and accepted at the company store for food, clothing,mining supplies, and other vital essentials. The store manager would subtract these charges called "check-offs" from the miners take-home pay. Many families

ran out of money before payday since wages were meager. Some company store managers would encourage workers to make purchases on credit at the store. This debt was deducted from future wages; so by payday, they owed money to the company. Some debt-ridden miners on pay day found three x's on their pay stub meaning their wages went directly to the coal company to pay off their store debt. Its use was a hardship because it forced them to shop exclusively at the company store where prices were generally higher than at neighboring independent cash stores. It created a perpetual and vicious cycle of continual poverty. Once indebted, miners and their families were prevented them from quitting their oppressive jobs in search of alternative employment in the city or at a neighboring mine without paying up. Some local retail stores located near the mine accepted coal scrip carrying large signs in their stores stating "We cash scrip but at a discount." There were two sets of prices in these independent stores, cash and scrip, with the later discounted from ten to fifteen percent. Some unscrupulous shop keepers discounted it by as much as forty percent. They took the discounted scrip to the company store and redeemed it for cash at face value. Proponents of the scrip system argued that it enabled miners to supply the necessities of life for their family without asking for the charity of friends and neighbors.

Coal companies' practices of inflating store prices, obligatory patronage of their store, and the use of scrip were divisive and acrimonious activities. Discontened miners did not passively accept these clearly exploitive practices. They staged wild cat strikes accompanied with periodic violence that prompted numerous state and federal government investigations. The General Assemblies of both Pennsylvania and Illinois mandated in 1891 through statutes passed in 1891 prohibiting the ownership of the company store by the mining company. The statutes were passed as an attempt to minimize this continual exploitation of mine workers by coal companies at the stores. These statutes, however, were so loosely written that coal operators were easily able to circumvent them. Pennsylvania law forbade mining companies to operate stores at their mines, but the law did not prevent them from organizing subsidiary companies. The company store was operated by a stock company whose stock was owned by the coal company. The Union Supply Company of the H.C. Frick Coke Company was established as a legally separate entity from the company's

mining and coking operations. The firm operated 63 stores in Fayette and Westmoreland counties by 1900.

Coal Companies and Subsidiary Companies That Operated their Company Stores

Pittsburgh Coal Company	Federal Supply Company
Westmoreland Mining Company	Kiski Supply Company
W.J. Rainey Company	Rainey Supply Company
Pgh. Termininal RR and Coal Co.	Mutual Supply Company (Allegheny County)
	Sumner Supply Co. (Washington County)
Bethlehem Mines Corporation	Services Stores Corporation
H.C. Frick Coke Co.	Union Supply Co.
Berwind-White Co.	Eureka Stores Co.
Rochester & Pittsburgh Coal Co.	Mahoning Supply Co.
Jamison Coal & Coke Co.	Underwood Supply Co. (West Virginia)
	Hannastown Supply Co. [235]

Drive to Organize and the Founding of the United Mine Workers of America

The deteriorating conditions in the mines and life in the "patch" towns during the last quarter of the nineteenth century made bituminous coal miners increasingly angry, fraustrated and desperate men. Immigrant miners and their sons worked long hours underground at low wages, with little hope of any meanful mprovement in their status. Mary "Mother" (nee Harris) Jones (1830-1930), the charismatic and legendary labor organizer and friend of coal miners, repeatedly proclaimed to them "to pray for the dead and fight like hell for the living." [236] She was a brave and outspoken union organizer who was known to her antiunion enemies as "the most dangerous woman in America" and to coal miners as the "miner's angel" and the "Joan of Arc of American labor." Mary Harris Jones was born in Cork, Ireland and immigrated as a child with her family to the United

States via Canada during the 1840s. She worked as a school teacher in Michigan and was a proficient dress maker in Chicago until her marriage to George Jones, an iron molder, in 1861. Her husband and four children died in a yellow-fever epidemic in Memphis, Tennessee in 1867. She became active as a lecturer for the Knights of Labor during the depression of the 1870s and as a Populist agitator during the 1890s. Mother Jones supported the miners' causes in their strikes and protests against coal companies over low wages, long hours and unsafe working conditions throughout the coal fields of Colorado, West Virginia and western Pennsylvania from the 1890s until her death. She told coal miners that "I am not looking for office, I am looking for your interests and your children's interest." She celebrated her hundredth birthday on May 1, 1930 and died of old age on November 30, 1930. She was buried in a miners' cemetery at Mount Olive, Illinois. Several years before her death she asked to be buried at Mount Olive with the Virden martyrs. She wished to "sleep under the clay with these brave boys." [237] These coal miners were massacred in a violent union-management battle at Virden, Illinois in 1898. The Chicago-Virden Coal Company imported 180 African-American strikebreakers on October 10, 1898. The next day some 40 miners were wounded and seven were killed during a bloody battle with hired strikebreakers and private police in Virden. The Progressive Miners erected an imposing granite monument to her memory that was formally dedicated on October 11, 1936. An estimated 50,000 miners attended the dictation of her monument and stood in silent tribute to the "miners' angel."

Miners were extremely militant industrial workers and were involved in some 709 strikes nationally between 1887 and 1894. These strikes involved 675,128 strikers, representing about eighty percent of the entire labor force. [238] Terence V. Powderly, after being ousted as president of the Knights of Labor in 1893, remarked why he believed miners were such militant workers who were able to endure lengthy strikes:

> In strikes, coal miners have always shown the most sublime fortitude and greatest endurance. From all I have witnessed, and from my studies of strikes, I am impelled to say that the miner can endure hunger and privation until the front of stomach and

> his spinal column are about ready to lean on each other for support. The reason for this is that it requires the most heroic type of manhood to seek a living in the mine, and he who has the courage to make that step in the dark each day, which every miner does, must be made of the good stuff, must be endowed with great patience and capable of enduring privation and want. [239]

Miners had organized themselves in a number of unsuccessful miners' labor organizations since the formation of the Bates' Union, Schuylkill County in the 1840s. Coal miners were represented by two national and competing labor organizations during the 1880s. The Knights of Labor had a broad-based membership policy that made it an eclectic labor organization. Farmers, small merchants, artisans, and all types of manual, semi-skilled and skilled workers were all welcomed into local assemblies. President Powderly placed little stress on immediate demands for wages and hours and generally opposed strikes; instead under his leadership the Knights advocated producers' cooperatives, trust regulation, currency reform, and the abolition of child labor. Powderly hoped to establish amicable labor-management relationships on a basis of cooperation and arbitration. Some miners departed from the Knights during the 1880s because they felt the Knights could not meet their particular social and economic demands. They wanted to establish a distinctive miners' union that could address what they believed were labor conflicts unique to their occupation. They were also unhappy with the Knights of Labors' preference for arbitration and were dismayed by Powderly's opposition to strikes. He was opposed to the use of the strike as a labor, on the grounds that it was an acceptance of the wage system. Powderly had withheld the support of the national organization for strike activities of the trade assemblies. He once remarked, "I shudder at the thought of a strike." Powderly continued to advocate cooperatives as the essential step towards the end of what he considered "that curse of modern civilization - wage slavery." Disenchanted miners from Illinois, Indiana, Ohio, Pennsylvania, West Virginia, Iowa and Kansas met at Indianapolis on September 12, 1885. They formed the National Federation of Miners and Mine Laborers that was later renamed the Miners' National Progressive Union in 1888. The union subsequently joined

the new American Federation of Labor, founded in 1886 with Samuel Gompers as its first president. The National Trade Assembly Number 135 was formed by the Knights as a rival miners' union the following spring. Both organizations aggressively competed against each other to recruit unorganized miners. The two rival miners' unions fought four years of disastrous internecine warfare for the allegiance of miners. The coal operators benefited from their bitter rivalry. The mine owners knew that it was only a matter of time until the disputes among the miners would destroy both organizations. The Miners' National Progressive Union represented 10,000 miners and had $139,000 in its treasury, while the District Association represented 15,000, most of whom were workers in the coke fields of Pennsylvania. [240] Officials of the rival miners' unions realized by 1889 that their continuous bickering was destructive to the general welfare of miners and worked only in the operators' interests. Coal operators were unwilling to grant fair and minimum prices and refused to negotiate with the leadership of the two competing union organizations. John McBridge, president of the National Progressive Union, noted in December, 1889: "the discordant and demoralized state our forces were in, together with their weakness financially, seemed to court the destruction of conciliatory methods and invite a conflict with operators which could not but end in loss and disaster to us." [241] The worsening conditions in dealing with hostile coal operators prompted delegates from the competing unions to meet in Columbus, Ohio in January, 1890 to bring about conciliation and cooperation and put an end to this disastrous in-fighting. Bitter and acrimonious disputes ensued among the 325 delegates during the next few days, but out of this conflict the delegates were able to set aside their long-standing differences and formed the "one and indissoluble" United Mine Workers of America on January 25, 1890. [242]

The new union had about 20,000 members out of some 255,00 miners and mine laborers in the nation. Workers in the anthracite region of northwestern Pennsylvania were disillusioned with the idea of forming a formal, region-wide union. They were involved in union organizations since the formation of the Bates' Union, Schuylkill County in the 1840s. Anthracite miners and mine laborers were unorganized by the UMWA until the strikes of 1900 and 1902 when Mitchell convinced them to join the miners' union.

The UMWA functioned as an AFL affiliate although the UMWA charter had provision for at first allowing its two benefactors to retain some of their essential features and administration. The UMWA was an industrial union embracing both skilled and unskilled workers, unlike Gomper's American Federation of Labor, which was organized exclusively as a craft union that represented workers by trade or craft rather than by industry. UMWA leaders, like John Mitchell, fought against the craft union principle as the exclusive basis of organization and instead established the right of mine workers to organize as an industrial union. The UMWA, like the Knights, opened its doors to all workmen regardless of skill, nationality, or race, from the youngest trapper-boy to the skilled and experienced machine undercutter. The UMWA was affiliated with the A.F.L. beginning in 1890 and with the Knights of Labor until the union severed all ties with the fading Knights of Labor at their 1895 annual convention.

The delegates adopted the credo of "United We Stand, Divided We Fall." The miners' constitution has been frequently ammended but the preamble stands as it was adopted in Columbus, Ohio on January 25, 1890, asserting the following:

> There is no truth more evident than that without coal there could not have been such marvellous social and industrial progress as makes present-day civilization. Therefore, we have formed the United Mine Workers' of America, for the purpose of the more readily securing the objects sought, by educating all the mine workers in America to realize the necessity of union of action and purpose, in demanding and securing by lawful means, the just fruits of our toil. [243]

The newly unified union elected John B. Rae of central Pennsylvania its first president ; W.H.Turner of Ohio, vice president; and Robert Watchorn, of Pennsylvania, secretary-treasurer. The salaries of the officers were as follow: for president, $1,000 per year; vice-president , $900 ; and secretary-treasurer, $1,000. Rae was born in Scotland and worked in Scottish coal mines as a boy. He was elected master workman of the Miners' Trades Assembly of the Noble and Holy Order of the Knights of Labor in 1886. The delegates also

elected four men to constitute the national Executive Board. The first National Executive Board of the UMWA consisted of Patrick McBryde of Pennsylvania, William Scaife of Illinois, R.F. Warren of Ohio, and W.C. Webb of Kentucky. [244] The locals were grouped into districts and subdistricts, defined by state boundaries and by geographical boundaries of individual coalfields. Jurisdication over immediate daily affairs of miners in the various coal fields was delegated to district unions. The local districts were independent with the right to elect officials, hold conventions, establish policies, and negotiate labor agreements within the district. The American coal fields were divided into 21 districts with each district required to supervise the activities of local unions within its geographic district. Pennsylvania was divided into five districts: District 1, Anthracite, Pennylvania; District 2, Central Pennsylvania; District 3, Low Grade, Pennsylvania (Greensburg Field); District 4, Coke Regions, Pennsylvania; and District 5, Pittsburgh District, Pennsylvania. Mining Districts 6 to 21 were Districts 6, 7, 8, 9, 10, Ohio; District 11, Indiana; District 12, Illinois; District 13, Iowa; District 14, Missouri and Kansas; District 15, Colorado, Washington and the Territories; District 16, Maryland; District 17, West Virginia; District 18, Virginia; District 19, Tennessee and Kentucky; District 20, Georgia and Alabama; District 21, Texas, Arkansas and the Indian Territory. [245]

The UMWA Constitution clearly articulated the diverse social and economic demands and greviances of mine workers throughout the coal fields during the last quarter of the nineteenth century:

1) to secure earnings "fully compatible with the dangers of our calling and the labor performed,"
2) to establish a system of payment in "lawful" money,
3) to establish safe mining practices,
4) to demand the eight-hour-work day,
5) to provide education for miners' children,
6) to seek favorable legislation for the protection of miners' health and welfare,

7) to use all honorable means to maintain peace between ourselves and employers; adjusting all difference, as far as possible, by arbitration and conciliation, that strikes may become unnecessary." [246]

Two days after the formation of the UMWA, convention delegates voted to assess members' wages to build a fund to aid miners "who are locked out or on strike." President-elect John B. Rae, John McBride-retiring leaders of the rival miners' unions with Samual Gompers, president of the AFL on January 27, 1890, together repeated the union's credo : United We stand ; divided we fall." The United Mine Workers of America were far from united and their influence covered very little of America in 1890. The UMWA was founded in the depression decade of the 1890s, a difficult time for recruitment drives of new members to the fledgling union. The new miners' union remained a small and ineffectual labor organization during its first seven years. Coal demand nationally had slackened during the depression years and many miners found themselves either unemployed or underemployed working three or four days each week. There were about 20,000 members in the UMWA in 1892; from 1893 to 1896, years of sharp economic depression, membership was reduced to fewer than 10,000 dues-paying members. [247] Coal miners had withstood a number of severe wage reductions imposed by coal operators between 1890 to 1896. A sympathetic economist commenting on how these wage cuts adversely impacted the daily lives of miners noted that " no one at all familar with (these) conditions will deny that the miners' earning had reduced below the living point. Everywhere poverty and degradation were manifest." [248] The union observed signs that the depression was ending by 1896 and a national strike was called for Independence Day, 1897 under the direction of John Mitchell, the young charismatic vice-president of the union. Some 150,000 miners, one-half of the labor force in the bituminous coal industry, responded to his call for a nationwide shutdown. [249] The strike lasted three months and paralyzed coal production in the northern coal fields, but the strike failed in the newly developed southern Appalachia Fields of West Virginia, Kentucky and Alabama. The strike was a landmark event in mining history and in the growth of the UMWA.

Northern coal operators from western Pennsylvania, Ohio, Indiana and Illinois recognized the UMWA as the collective bargaining agent for their membership and negotiated an interstate collective contract with the miners' union for the first time in 1898. Miners were granted the eight-hour work day in union mines. The UMWA had at last secured a major victory for its membership and their victory excited many unorganized miners to join. Membership in the UMWA swelled from 11,000 to 33,000 members within the next few years.

The newly formed UMWA represented about 20,000 members, mostly native-born Protestant Americans or English, Irish, Welsh, and Scotch immigrants in 1890. The UMWA constitution, written at the convention, conscious of the changing social composition of miners, prohibited racial, religious, or ethnic discrimination. Miners of diverse ethnic and racial composition were organized in the same locals, and in theory all were eligible for local and national union offices. The labor force of the industry was increasingly composed of unskilled immigrants from the polyglot nations of southern and eastern Europe ever since the 1880s. The original English, Welsh, Scotch and Irish miners saw their numbers decline with the influx of Italian and Slavic (Polish, Lithuanian, Russian, and Slovak) workers. The UMWA leadership generally adhered to a non-discrimination policy although strong ethnic, religious and racial tensions continued to exist among the rank and file. The United Mine Workers had an excellant record of organizing African-American workers. There were five African-American delegates to the UMWA founding convention and R.F. Warren, an African-American miner from Ohio, was elected to serve on the union's first National Executive Board in 1890. By 1900, an estimated 20,000 African-Americans miners were members, approximately one quarter of the union's members. Much of this success belonged to a small but dedicated band of African-American organizers, few of whom have left written records. In 1907 the UMWA became one of the first American labor unions that allowed Asians to be members. Asian immigrants had faced severe discrimation in the mines and usually found work at the lower paying surface jobs such as sorting coal in the tipple.

John Mitchell, the powerful and dynamic president and organizer of the UMWA from 1899 to 1908, repeatedly preached to them "the coal you dig is not Slavish coal, or Polish coal, or Irish coal. It is coal." [250] Miners who were proponents of racial equality within the union often stated, "we're all the same color when we come out of the mine." Mitchell had experienced the suspicions and prejudices that existed among various ethnic and racial groups while a miner at Braidwood, Illinois. Bigotry and racism was endemic in the mines and the coal towns as repeated pleas by the UMWA for racial and ethnic harmony to unite miners were often ignored. Strong prejudices among mine workers was rampant with expletives such as "greenhorn," "cheese-eater," "hunky," polack," "dago,""harp," "wop," and "nigger" heard in the mines and the coal towns. The typical English-speaking miner looked down on the new immigrant miners whether consciously or not. Prejudices and dissension among union members was apparently rampant prompting UMWA President John McBride to address the membership in 1893, " The internecine strife occasioned by religion and nationality has prevented your officers from effecting local organization and in many instances has disrupted those already established cannot afford to harbor or countenance such a spirit of bigotry and intolerance." [251]

Coal operators from the principal northern soft coal states of western Pennsylvania, Ohio, Indiana, and Illinois formed the Central Competitive Field. This organization anticipated the possibility of benefiting from industry-wide unionization. They hoped that standardizing cost of production through a union contract signed by all operators would reduce existing competitive wage instability and bring order out of the increasingly competitive industry. These operators saw the new miners' union as providing a mechanism for standardizing mining costs, reducing competition, and establishing a wage scale acceptable to miners. The union would also act as an enforcer of the contract, disciplining miners who staged wildcat strikes or reneged on agreements, and would also organize mines of recalcitrant operators who refused to bargain collectively. Coal operators hoped this new relationship with the UMWA would improve the productivity and profitability of their mines.
F.L. Robbins, Chairman of the Pittsburgh Coal Company, an original member of the Central Competitive Field and one of the nation's largest independent coal companies wrote

Mitchell in 1904 that "with honest, conservative men at the head of labor organization the liability of having trouble is decreased and it is a safer method of settling wage questions than dealing with the rank and file of employees." [252]

The early period of cooperative collective bargaining between the coal operators of the Central Competitive Field and the UMWA could endure only as long as a major portion of the industry operated on the closed shop principle. The locus of production and economic power in the bituminous industry by the turn of the twentieth century began to shift slowly from the Central Competitive Field to the newly opened non-union mines of central Appalachia. The coal industry was developing in the rural and sparsely populated mountainous region of southern West Virginia, eastern Kentucky and the coal fields farther south in Tennessee and Alabama. The ability of the UMWA to successfully organize miners in these coal fields would shape the continual viability of interstate union contracts and the economic strength of the UMWA in the immediate future.

John Mitchell (1870-1919) was born on February 4, 1870 in Braidwood, Illinois, the son of John Mitchell, a Scotch-Irish Orangeman and Martha Mitchell. He was orphaned at an early age and at the age of ten worked in local mines near Braidwood. He joined the Knights of Labor when he was 15 and with the collapse of the Order took out membership in the United Mine Workers of America. He was elected vice-president of the UMWA in 1897 and was responsible for leading the successful 1897 strike. Under his aggressive leadership and the return of prosperity the miners' union was involved in a number of strikes and work-stoppages to protest low wages, long hours, and unsafe working condition. Mitchell reported to delegates in the annual 1898 miners' convention that the union had actively participated in 260 strikes of which 160 were won, 29 compromised, 36 lost and 35 still pending. [253] He was elected the fifth president of the miners' union at the age of twenty-nine at the 1899 annual convention and served in this capacity until his resignation in 1908. The union led organizing drives west of the Mississippi and brought union protection to miners in parts of Colorado, Montana, Missouri, West Virginia and Wyoming. The UMWA also signed union contracts for the first time in the coal fields of Alabama, Kentucky, Tennessee, West Virginia and other

states. In 1900, the UMWA organized only about 8,000 of the nearly 150,000 miners employed in the anthracite coalfields. Anthracite miners of eastern Pennsylvania were organized after the 1900 strike and "the long strike" of 1902. As the winter of 1902 approached President Theodore Roosevelt intervened on October 16 and appointed a commission to mediate an end to the bitter strike The strike was called off by President Mitchell and the UMWA on October 21. The Roosevelt Commission awarded the anthracite miners a 10 percent wage increase on March 22, 1903. Roosevelt felt compelled to intervene in the coal strike because mine owners refused an offer of arbitration and the real possibility of anthracite fuel shortages in northern cities. Coal was so scarce during the anthracite coal strike of 1902 that the price of anthracite had risen to $30 a ton, by the time Roosevelt forced a settlement of the strike. Anthracite miners reached an agreement with operators after a six-month strike, firmly establishing the UMWA in the anthracite coal region of eastern Pennsylvania.

The union under Mitchell's leadership attained a membership of 173,000 and a treasury of nearly one million dollars in 1903. Canadian miners in the provinces of Nova Scotia, British Columbia and Alberta, were organized by the UMWA in 1905 and consequently the official name of the miners' union became the International United Mine Workers of America during his tenure. Mitchell was a strong advocate of trade unionism. The essence of trade unionism, according to Mitchell, was collective bargaining, which gave workers economic bargaining equality with management because it rid them of fear, raised their efficiency and established their citizenship in the new industrial order. When Mitchell resigned in 1908 as UMWA president because of ill health, the union reported an international membership of 330,000 dues-paying miners and was by far the largest and most powerful union in the nation. [254] He became a free lance writer and popular lecturer on labor problems and in 1914 Mitchell was appointed Commissioner of Labor for New York state, and later was appointed Chairman of the State Industrial Commission. Mitchell died at the age of 49 in 1919. A memorial to him was designed by Peter B. Sheridan of Hazleton and stands on the Courthouse Square in Scranton, in the heart of the anthracite region. Mitchell was responsible for organizing anthracite workers during

the strikes of 1900 and 1902 and was an extremely popular labor leader in the hard coal region. A popular song, *Be Sure and Stick to Mitchell,* was dedicated to him:

Be sure to stick to Mitchell boys
Your faithful president
For he's the one who won for you
The gain of ten percent
He made Truesdale, Baer, and Morgan
Come down from the high stand
And arbitrate with the working man
Who holds the winning hand. [255]

The Bituminous Coal Industry, World War 1 and the Coal Strike of 1919

The pinnacle of the bituminous production in Pennsylvania and the United States was reached during the Great War.[256] Coal and coke in both domestic and European markets were needed in iron and steel mills, for railroad locomotives, for ships transporting troops to Europe, electrical generators, home and commercial heating, and to meet the needs of European allies. In World War 1, bituminous coal furnished 69.5 percent of the nation's total energy, a mark never attained since. Soft coal miners produced 579,385,820 million tons nationally in 1918 alone. Throughout the Great War, often at the insistence of the Wilson administration, coal and coke companies were continuously asked to increase their production to meet this new energy demand. Abandoned and idled mines were reopened and dozens of new shafts were dug in an attempt to satisfy this insatiable demand for coal. The price of coal per ton on the commercial market had remained relatively stable between 1900 and 1916, averaging about $1.07 per ton. Compliance by the coal industry saw the average price of a ton of

coal rise from $1.34 in 1916 to $2.26 in 1917 and $2.58 during the last year of the war. The price of coal peaked at $3.75 per ton in 1920 while coal prices plunged to $2.89 per ton during the depression year of 1921.

The high price per ton of coal increased output as owners of idle and abandoned mines reopened their mines. Wartime inflation of coal prices and company profits saw an increase in the number of mines, mine workers and production. There were 5,818 bituminous mines in the United States in 1910 and 8,921 mines a decade later. The number of mine workers rose by about 100,000 nationally while output rose by 162 million tons between 1900 to 1918. Bituminous coal output nationally increased by 77 million tons alone during America's involvement in World War 1. The great demand for coal combined with its raising price per ton brought enormous profits and prosperity to hundred of coal companies during the brief boom years between 1917 and 1920. At least 90 percent of 1,234 corporations reported an average net income increase from 16 to 26 percent of invested capital, before payment of federal taxes, and from 9 percent to 17 percent after payment of federal taxes between 1917 and 1921. [257]

Pennsylvania, as the nation's leading producer of bituminous coal, shared in the coal and coke boom of the period. It produced 42 percent of the entire United States coal production in the five-year period from 1912 to 1916 and 36 percent in the five-year period from 1917 to 1921. [258] Pennsylvania's all-time high production, for both bituminous and anthracite coal, was attained in 1918, when some 276.6 million tons were extracted from mines employing some 329,904 miners. That year was also the historic high for coal production in the nation by a single state. The anthracite region extracted a record high 100,445,299 net tons employing about 148,226 miners in 1917 while the state's bituminous industry peaked the following year as 177 million tons of coal were extracted by 181,678 miners. Bituminous production peaked nationally in 1918 when 579,385,820 net tons were extracted. Pennsylvania's own soft-coal production of 177,217,294 net tons accounted for 30.82 percent of the total production. The war time boom made the coal industry the largest employer in Pennsylvania, and second in terms of capitalization and value of products, by 1919.

Status of the Coal Industry of Pennsylvania in 1919

	No.of Establishments	Capitalization	No. of Employees	Value of Product
Anthracite	254	$433,868,039	147,372	$364,084,142
Bituminous	1938	$648,626,800	154,992	$362,973,952 [259]

The Democratic Wilson Administration moved to stabilize coal production and improve working conditions in the coal industry to insure continual production and to forestall any labor disputes in the coal fields during the war. Congress passed the Lever Food and Fuel Control Act in 1917 to insure industrial production and maintain labor peace during the duration of the war. The Lever Act granted the President power to establish maximum prices for coal. The Federal Fuel Administration was a massive bureaucracy created by the government to insure fuel production and maintain labor stability. Dr. H.A. Garfield, the elder son of former President James Garfield, was appointed its first director. The agency negotiated the Washington Wage Agreement with the UMWA and coal operators in October, 1917. The agreement gave an increase of 10 cents a day for pick-mining rates, a 14 cent raise to day laborers and monthly company men, and a 15 percent boost in yardage, dead rate and room turning rates. The Washington agreement bound the UMWA not to renegotiate the contract before the war officially ended or until April 1, 1920, whichever came first. [260] Strikes were forbidden under the agreement and all labor disputes in the industry were subject to arbitration by the war Labor Board or Federal Fuel Administration. United States involvement in the war brought more than a year of labor peace in the bituminous coal fields.

Inflation nationally ran at nearly fifty percent between 1917 and 1919 and rose an additional twenty percent in 1920 alone. From 1914 to 1919, the average annual earning

of employed workers increased 87 percent, but their purchasing power had only increased 5 percent during this same period. Miners' wages of 1917 had not kept up with wartime inflation. The U.S. Bureau of Labor Statistics reported in 1919 that an average American family needed an annual income of $2,243 for an acceptable standard of living, at a time when the income of an average miner was $1,194. [261] Angry and militant miners expressed their demands for wage increases at their international convention held in September 1919, by voting for a 60 percent increase in tonnage and yardage rates, a six-hour day and a five-day week. They had patriotically supported the war effort and proudly asserted they had "mined the tons (of coal) that beat the Hun." American labor unions, with the exception of some left-wing socialist groups and William Haywood's Industrial Workers of the World, had overwhelmingly supported the government's war effort against the Central Powers. Samuel Gompers, president of the AFL, fully supported the war effort and cooperated with the Wilson Administration wherever possible. President Wilson placed AFL and UMWA representatives on national planning committees established to provide efficient allocation of scarce materials for war production.

The IWW, that never had more than 70,000 members, was a peculiar combination of socialists, syndicalists and anarcharists who challenged the existing labor-management relationship. They saw this conflict as a revolutionary class struggle. The "Wobblies" stressed the organization of workers that trade unions had usually ignored agricultural workers, immigrant factory workers, longshoremen and lumbermen.

The Industrial Workers of the World (IWW) was formed on June 27, 1905 at Brand's Hall in Chicago by a diverse group of 200 political radicals and trade unionists including Daniel DeLeon, Eugene Debs, Lucy Parsons (the widow of one the Haymarket Square martyrs), "Mother" Mary Jones, and William "Bill" Haywood. It membership was drawn primarily from four groups: the Western Federation of Miners (founded in 1893), the Socialist Party of Eugene V. Debs, the Socialist Labor Party of Daniel DeLeon, and a group of radical unionists. The enthusiastic gathering that launched the nationwide IWW, like the Knights of Labor , organized skilled and unskilled industrial workers and women,

African-Americans, and all ethnic groups into "One Big Union" as an alternative to the conservative craft-oriented AFL

William D. "Big Bill" Haywood (1869-1928), the dominant leader of the new radical union, had worked as a cowboy, miner, and prospector. Haywood was the former president of the Western Federation of Miners which was the backbone of the new union. He declared the aims and objects of this new radical organization was "... to bring the workers of this country into the possession of the full value of the product of their toil." The IWW emphasized revolutionary programs including abolition of wage system and industrial unionism. The Wobblies strongly protested American intervention in the European war and dismissed the war and American involvement in the european conflict as simply a capitalist conspiracy. When IWW members refused to support American participation in World War 1, they were branded as traitors by the government. Federal and state officials suppressed IWW publications and union halls were shut down during the war. The federal government in June, 1917 indicted the top leadership of the IWW under a number of wartime espionage laws. One hundred IWW members were tried in Chicago before Judge Kenesaw Mountain Landis in 1918 for opposing American involvement in the war effort. All defendants were found guilty. A series of government raids and additional legal prosecutions under various criminal syndicalist statutes following the war lead to the crippling of the union as over 150 IWW members were jailed after these court cases. The IWW never recovered from these aggressive attacks on the organization by the federal government and soon faded from the national scene as an effective radical labor organization during the 1920s. [262]

Angry miners appealed to Harry A. Garfield in vain for an increase in their wages to offset rising costs in 1918. Garfield emphatically refused their wage demands asserting the 1917 agreement bound the UMWA not to renogotiate its terms until the war was officially ended or until April 1, 1920, whichever came first. John Llewellyn Lewis, who succeeded John P. White in 1919 as International President of the United Mine Workers of America, was pressured by the rank and file to call a strike. The general miners' strike was called to coincide with the national steel strike. In September 1919,

the employees of the U.S. Steel Corporation walked out in a drive for union recognization, to win an eight-hour day and to obtain an "American living standard" from the company. The militant battle cry of the mostly immigrant steel workers was "eight hours and the union." The average work week in the steel industry was 68.7 hours in 1917. A typical unskilled steel worker earned on average about $1,400 per year, while government statistics estimated the minimum subsistence for a family of five was $1,575. William Z. Foster (1881-1961), founder of the American Communist Party and a three-time presidential candidate, led the steel workers' strike for union recognition. The drive was brutally suppressed by the hostile steel companies after a lengthy and often bloody four month strike. [263]

The 1919 national coal strike was the first of many strikes that President John L. Lewis called during his long and often tumultous forty-year tenure as union president. President Wilson opposed the proposed strike asserting that the pending miners' strike was "not only unjustifiable but unlawful" and demanded Lewis withdraw his strike call. [264] Wilson sent William B.Wilson, his Secretary of Labor, to negotiate a new coal contract with the UMWA to avoid the impending strike. Congress created the United States Department of Labor on March 13, 1913, "to foster, promote and develop the welfare of the wage earners of the United States, to improve their working conditions and to advance their opportunities for profitable employment." William B. Wilson (1862-1934), after serving in Congress, was appointed the nation's first Secretary of Labor by President Woodrow Wilson. W.B. Wilson served continuously in this position from 1913 to 1923. Wilson was a former coal miner and a secretary-treasurer of the UMWA from Tioga County, Pennsylvania. William Bauchop Wilson (1862-1934) was born in Blantyre, Scotland, on April 2, 1862, the son of Adam and Helen Nelson Wilson. He worked at the mines at or near Arnot, Tioga County, Pennsylvania beginning in 1871 at the age of nine. Wilson was a "half member" of the Miners' and Laborers' Benevolent Association at the age of 11 in 1873. A road side historical marker erected by the Commonwealth of Pennsylvania on U.S. Route 15 on October 29, 1948, south of Blossburg identifies the farm home of William B. Wilson. [265]

Secretary Wilson met with John L. Lewis, William Green, secretary-treasurer of the UMWA (Green was later elected president of the AFL) and Thomas Brewster, president of the Coal Operators' Association. The C.O.A. was formed in 1917 by the northern coal operators of the Central Competitive Field although control of this owners' organization passed from union operators to nonunion operators during the 1920s. Negotiations at this meeting quickly collapsed and a national strike call was issued by Lewis for November 1, 1919. A government injunction was issued against the United Mine Workers leadership and Lewis was pressured by the government to cancel the national strike call of November 8. Lewis called off the work stoppage, telling the press " I will not fight my government, the greatest government on earth." [266] Angry and independent-minded militant miners simply ignored Lewis's call to return to the pits and continued their strike that had curtailed nearly 75 percent of the national's coal production. Although Lewis was the leader of the militant miners' union, he was himself no political radical. He was a long-time Republican who was fundamentally a conservative and cautious man who was fearful of radical "doctrinaires" and "insurgents" in labors rank. He believed in competition and conflict in the market place as the basis of a free society. The strike to Lewis was not a weapon of class struggle but simply a viable union tool in the capitalist system. Unions were seen by Lewis as the reverse side of the corporate coin. Both the union and the corporation shared similar functions - one organized sales and goods and the other organized labor. The government granted a 14 percent increase but the miners refused this offer and continued their strike for higher wages. The coal miners' strike, unlike the Great Steel Strike of 1919, was successful. It was called to a halt in mid-December after a two year settlement was signed in New York City in March 1920. The new contract gave union "tonnage men" a 34 percent wage increase while "day men" received a 20 percent daily wage increase.

The bituminous coal industry appeared to both coal operators and miners as a healthy and robust industry as the decade of the 1920s commenced. The war-time experience clearly demonstrated to the world the essential role bituminous coal played in the functioning of the modern and complex industrial society. As Frank Keeny, West Virginia

UMWA president, observed, "coal makes civilization possible." [267] "The Miner," a poem written by Berton Bailey exclusively for *Coal Age* , 1918 clearly states the invaluable and prominent role the miner and the coal industry had played in the recent war in defining the modern industrial society :

Grimy, and caked with dust of coal he stands,
Grasping his pick with his mighty hands;
The arbiter of destiny and fate.
Greater by far than the king or potentate.

Shops may not run except at his behest,
At forge and blast his strength is manifest.
The rolls that rumble and the sheer and screams
And all the million miracles of steam.

Depend on him for fuel that will turn
The wheels that urge them and the belts that churn.
Guns that will shatter fortresses of steel,
Ships that will plow the waves on steady keel. ... [268]

A rosy vision of the future of the coal industry was held by most miners and the leadership of the UMWA. "King Coal" and "Queen Coke" had played an essential role in the economic development of the United States in the past and the present, and they believed it would surely play a similar role in the immediate future. The UMWA celebrated its thirtieth anniversary in 1920 and John Llewellyn Lewis was recently elected its ninth president. The following nine men served as presidents of the UMWA between 1890 and 1960: John B. Rae (1890-1891), John McBride (1892-1894), Phil H. Penna (1895-1896), M.D. Ratchford (1897-1898), John Mitchell (1899-1907), T.L. Lewis (1908-1910), John P. White (1911-1917), Frank J. Hayes (1917-1918) and John L. Lewis

(1919-1960). Lewis presided over the largest and most powerful labor union in the nation representing 50.9 percent of all coal miners by 1920. [269] The union successfully negotiated for its membership an eight-hour work day, a forty-hour week, a standard daily wage for "day workers," a standard tonnage rate for underground production workers, and secured promises of improved safety conditions in the mines. [270]

The apparent prosperity and the prognosis of continual economic growth of the industry engendered during World War 1, however, was illusionary as the bright vision of future prosperity began to fade during the 1920s. The war-time euphoria had masked a fundamentally "sick" industry. The problem of overproduction was not caused exclusively by demand during the war but had its origins in the pre-war years. Overproduction and decreased demand for coal were becoming the curse of the industry as early as the 1890s. The bituminous coal industry had expanded production nationally by 10 fold from 50 million tons annually in 1880 to 568 million tons in 1920. Pennsylvania's bituminous coal production had experienced similar growth with output rising from 16.5 million to 166.9 million tons during this forty year period. Production increases during the Great War had simply exacerbated an already overdeveloped industry. The UMWA and bituminous coal companies would have to address the fundamental problems of too many miners mining too much coal that would pervade an increasingly volatile industry following 1920.

ILLUSTRATIONS

Number 1 Wilputte by-product coke oven
Number 2 Semet-Solway by-product coke oven
Number 3 Chemicals derived from the by-product oven
Number 4 By-product coke plant operation
Number 5 Manual extraction of coke from the beehive oven
Number 6 Rectangular coke oven
Number 7 Lower Connellsville district

Number 8 Coal Expansion in Greene County
Number 9 Covington coke extractor
Number 10 Location of J & L captive mines
Number 11 Company Housing
Number 12 Company Housing
Number 13 Coal mines on the Monongahela River
Number 14 Pittsburgh Coal Company properties
Number 15 Coal Company Hierarchy (Consolidation Coal Company)
Number 16 Harrison undercutting machine
Number 17 Electric haulage locomotive
Number 18 Carbide lamp

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Coke Plants built by the H.C. Frick Coke Co. in the Connellsville Coke region

Frick (Novelty)		1871
Henry Clay		1871
Adelaide		1888
Brinkerton		1901
Chambers		1902
Bitner		1904
Shoaf		1904
Smiley		1904
York Run		1904
Hopwood		1906
Collier		1907
Phillips		1907

Mines	Date Closed or Abandon	
1870-1879		
Star		1878
Ferguson		1880
Fountain		1881
Home		1881
Foundry		1888
Furnace		1888
1890-1899		
Spurgeon	1882-1892	
Washington	1882-1892	
Hazlett		1893
Anchor		1896
Morrell		1898
1900-1909		
Great Bluff		1900
Strickler		1900
Uniondale		1900
Sterling #1		1902
Diamond		1903
Mutual #2		1903
Rising Sun		1903
Wheeler		1903
Bessemer		1905
Mount Hope		1908

1910-1919		
Alverton #2 (Mayfield)		1910
Bridgeport		1910
Henry Clay		1910
Mullen		1910
Summit		1910
Hopwood		1911
Tip Top		1911
Franklin		1912
Southwest #4 (American ,Warden)		1913
Chambers		1913
Monastery		1913
Painter		1913
Sterling #2 (Jimtown)		1914
Charlotte (Scottdale)	1910-1914	
Clarissa	1910-1914	
Empire (Bethany?)	1910-1914	
Pennsville	1910-1914	
Tyrone	1910-1914	
Boyer		1917
Buckeye		1917
Byrne (Love)		1917
Eagle (Sherrick)		1917
Morgan		1917
Rist		1917
Veteran		1917
Marietta	1910-1918	
Coalbrook		1918
Jackson		1918
Rainey (Fayette)		1918
Valley		1918
Spring Grove		1919
White (Globe)		1919
1920-1929		
Enterprise		1920
Fort Hill		1920
Calumet		1922
Southwest #3 (Tarrs)		1922
Adelaide (Cupola)		1923
Baggaley		1923

Continental # 2 (Newcomer)		1923
Mutual #1		1923
Southwst #2 (Alice)		1923
Stewart # 1		1923
Acme		1925
Hecla #2 (Trauger)		1925
Juniata		1925
United #2 (Central)		1925
Continental #2		1926
Dorothy		1926
Lemont #1		1926
Oliphant		1926
Wynn		1926
Grace (including Moyer)		1927
Mammoth #1		1927
Redstone (Brownfield)		1927
Whitney		1927
Elm Grove		1928
Hecla #3		1928
Mayer		1928
Paul		1928
York Run		1928
Brinkerton		1929
Hecla #1 (Southwest)		1929
Marguerite (Klondike)		1929
Mount Pleasant (Carpentertown)		1929
Cora (Shannon)	1921-1931	
Dexter	1921-1931	
Mahoning (Mahaney)	1921-1931	
Percy (Johnson ?)	1921-1931	
1930-1939	1921-1931	
Mount Braddock		1930
Standard (Shaft and Slope)		1931
Hostetter (Lippincott, Jamison #21)		1931
United #1		1933
Revere		1934
Southwest #1 (Morewood)		1935
Bitner		1936
Saint Vincent		1936
Myers		1937

Lemont #1		1937
Trotter		1938
1940-1949		
Davidson		1940
Crossland		1941
Leith		1942
Lemont #2		1942
Oliver #3		1944
Oliver #4		1944
Phillips		1944
Youngstown		1948
Clare (Jamison 20)	n.d.	
1950-1959		
Shoaf		1951
Smiley		1951
Continental #1		1954
Leisenring #1		1954
Kyle		1954
Leisenring #2		1957

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Native Born	5,316,685
Foreign Born	985,250
Native White -Native Parents	3,729,093
Native White -Foreign Parents	1,430,028
Foreign White	928,543
Non-White	160,451

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The list below identifies most of the ready-made prefabricated companies in the nation:

Aladdin Redi-Cut Houses, Bay City, Michigan, 1906-1987
Armco, Hamilton, Ohio
Bennett Homes, North Towawanda, New York , ca. 1930
Gordon-Van Tine, Davenport, Iowa, ca. 1910-1941.
Harris Home,Chicago, Illinois, ca. 1912-1930.
E.F. Hodgson Portable Homes, Dover Massachusetts, ca. 1892-1970.
Lewis Built Homes Company , Chicago, Illinois.
Lewis / Liberty Manufacturing Company , Bay City , Michigan,1914-1973.
Mershon and Morley, Saginaw, Michigan, 1899-1926.
Montgomery Ward and Company, Chicago, Illinois 1912-1931.
Norwood Sash and Door Company, Wood, Ohio, ca. 1917.
Radford Architectural Company, Chicago, Illinois, ca. 1903-1920.
Sears, Roebuck and Company, Chicago, Illinois, ca. 1908-1940.
Standard Homes Company, Washington, D.C.
Sterling System Homes, Bay City, Michigan, 1915-1971

[139] A.F. Brosky, "Indianola Pumps Water from the Allegheny River Wells and Treats its Sewage by Bacteria and Chlorination," *Coal Age*. Volume 20, Number 1, September, 1921.

[140] Lou Athey, *Kaymoor : A New River Community* (Washington, D.C.: National Park Service, 1986) p. 32.

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[142] Ibid p. 67.

[143] Mack H. Gillenwater, *Cultural and Historical Geography of Mining Settlements in the Pocahontas Coal Fields of Southern West Virginia, 1880-1930* (University of Tennessee Dissertation, 1972) p. 91.

[144] Howard N. Eavanson, *The First Century and a Quarter of American Coal Industry* (Pittsburgh : Privately printed, 1942) p. 418.

[145] Priscilla Long, *Where the Sun Never Shines* (New York : Paragon Press, 1989) p. 57.

[146] Edward T. Devine, *Coal : Economic Problems of the Mining, Marketing and Consumption of Anthracite and Soft Coal in the United States* (Bloomington, Illinois : American Review Service Press, 1925) p. 50.

[147] Priscilla Long, *Where the Sun Never Shines* (New York : Paragon Press, 1989) p. 121.

[148] Ibid p. 120.

[149] *Commonwealth of Pennsylvania Report of the Department of Mines of Pennsylvania* (Harrisburg : C.E. Aughinbaugh, State Printer, 1912) p. 29.

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Mary Ann Kleeck, *Miners and Management* (New York : Russell Sage Foundation, 1934) p. 179

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[152] Richard Bissell, *The Monongahela* (New York : Rinehart and Company, 1952) p. 153.

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[153] Sylvester K. Stevens, *Pennsylvania: Titan of Industry* (Volume 3) (New York : Lewis Publishing Company, 1948) pp. 613-614.

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[155] *The Story of Pittsburgh* (Pittsburgh : First National Bank, 1920) np.

[156] Mary Ann Kleeck, *Miners and Management* (New York : Russell Sage Foundation, 1934) p. 181.

[157] John H. Jones, "Government Regulation of Coal Prices," *Coal Age*. October, 1914.

[158] Bruce T. Williams, and Michael D. Yates, *Upward Struggle : A Bicentennial Tribute to Labor in Cambria and Somerset Counties* (Johnstown, PA : University of Pittsburgh, 1976) n.p.

[159] Edward T. Devine, *Coal : Economic Problems of the Mining, Marketing and Consumption of Anthracite and Soft Coal in the United States* (Bloomington, Illinois : American Review Service Press, 1925) p. 176.

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[162] Tommy Ehraber, "King Coal," *Pitt Magazine*. Volume 5, Number 1, February, 1990.

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[164] Priscilla Long, *Where the Sun Never Shines* (New York : Paragon Press, 1989) p. 138.

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[167] *Commonwealth of Pennsylvania Report of the Department of Mines of Pennsylvania* (Harrisburg:C.E. Aughinbaugh, State Printer, 1912) p. x.

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[171] L.B. Smith, "Handling Mine Waters," *Coal Age*. Volume 10, Number 27, December, 1916.

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[179] Donna M. Ware, *Green Glades and Sooty Gob Piles* (Crownsville, MD. Maryland Historic Trust , 1991). p.122.

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181 John N. Boucher, *Old and New Westmoreland* (New York : American Historical Society, Inc. 1918) p. 279.

182 Howard N. Eavanson, *The Pittsburgh Coal Bed : Its Early History and Development* (New York : American Institute of Mining and Metallurgical Engineers, 1938) p. 40.

Preparation Plants in Western Pennsylvania 1890s

County	Number of Plants Having Washers	Number of Washers	Kind of Washers
Allegheny	8	5	Diescher
		4	Stutz
		3	Endres
		1	Slush
Fayette	1	1	Stutz
		1	Waverly Coal Co.

183 *Coal Age*. June 1, 1912.

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196 McAlister Coleman, *Men and Coal* (New York : Farrar & Rinehart, Inc., 1943) p. 121.

197 John Brophy, *A Miner's Life* (Madison : University of Wisconsin Press, 1964) p. 45.

198 Priscilla Long, *Where the Sun Never Shines* (New York : Paragon Press, 1989) p. 50.

199 George Korson, *Coal Dust on the Fiddle* (Hatboro, PA : Folklore Associates Inc., 1965) p. 229.

200 Ibid p. 47.

201 Ibid p. 47.

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Principal Bituminous Coal Mining Disasters in Pennsylvania between 1884-1945

Date	Mine	Operator
1884-Feb 20	West Leisenring	Connellsville C. & C. Co.
1885-Oct 27	Youngstown	Youngstown Coke Co.

1888-Nov. 3	Kettle Creek	Kettle Creek Coal Co.
1890-June 30	Hill Farm	Dunbar Furnace Co.
1891-Jan. 27	Mammoth	H.C. Frick Coke Co.
1897-Mar. 27	Berwind	Berwind-White Mining Co.
1898-Sept. 23	Umpire	Umpire Coal Co.
1899-July 24	Grindstone	Redstone Coal & Coke Co.
1899-Dec. 23	Sumner	Pittsburgh & Erie Coal Co.
1901-June 10	Port Royal No. 2	Pittsburgh Coal Co.
1902-March 6	Catsburg	Mon River Consolidated C. & C. Co.
1902-July 10	Rolling Mill	Cambria Steel Co.
1903-Nov. 21	Ferguson	Dunbar Furnace Co.
1904-Jan.25	Harwick	Allegheny Coal Co.
1905-April 27	Eleanora Shaft	Rochester & Pittsburgh Coal Co.
1905-July 6	Fuller	Taylor Coal Co.
1905-Oct. 13	Clyde	Cylde Coal Co.
1905-Oct.29	Hazel Kirk No. 2	Pgh. & Westmoreland Coal Co.
1905-Nov. 15	Braznell	Braznell Coal Co.
1906-Oct. 24	Rolling Mill	Cambria Steel Co.
1907-Aug.17	Sonman Shaft	Sonman Shaft Coal Co.
1907-Dec. 1	Naomi	United Coal Co.
1907-Dec. 19	Darr	Pittsburgh Coal Co.
1908-Nov. 28	Rachel/Agnes	Pittsburgh & Buffalo Co.
1909-Jan.25	Orenda	Merchants Coal Co.
1909-April 9	Eureka No. 37 Upper	Berwind-White Mining Co.
1909-June 23	Lackawanna No. 4	Lackawanna C. & C. Co.
1909-Oct. 31	Franklin No. 2	Cambria Steel Co.
1910-Feb. 5	Ernest No. 2	Jefferson & Clearfield C. & C. Co.
1911-March 22	Hazel	Pittsburgh-Buffalo Coal Co.
1911-July 25	Sykesville Shaft	Cascade C. & C. Co.
1911-Nov. 9	Adrian No. 1	Rochester & Pittsburgh Coal Co.
1913-April 23	Cincinnati	Mon River Consolidated C. & C. Co.
1915-May 24	Smokeless No. 1	Smokeless Coal Co.
1915-July 30	Patterson No. 2	United Coal Co.
1915-Aug. 31	Orenda No. 2	Merchants Coal Co.
1916-Feb. 11	Ernest No. 2	Jefferson & Clearfield C. & C. Co.
1916-March 30	Robindale	Conemaugh Smokeless Coal Co.
1917-March 13	Henderson No. 1	Henderson Coal Co.
1918-Aug. 7	Harmar	Consumer Mining Co.
1920-June 2	Ontario	Ontario Gas Coal Co.
1920-July 19	Renton No. 3	Union Collieries Co.

1920-Aug. 9	Maryland Shaft	Maryland Coal Co. of PA
1922-Feb. 2	Gates No. 1	H.C. Frick Coke Co.
1922-March 20	Dilltown No. 1	Dilltown Smokeless Coal Co.
1922-Nov. 6	Reilly No. 1	Reilly Coal Co.
1924-Jan. 26	Lancashire No. 18	Lancashire Coal Co.
1924-July 25	Gates No. 1	H.C. Frick Coke Co.
1925-April 26	Hutchinson	Westmoreland Coal Co.
1926-Feb. 3	Pgh. Terminal No. 4	Pittsburgh Terminal Co.
1926-Aug. 26	Clymer No. 1	Clearfield Bituminous Coal Co.
1927-April 2	Mine No. 53	Ellsworth Collieries Co.
1928-Feb. 20	Kinloch	Valley Camp Coal Co.
1928-May 19	Mather Collieries	Picklands, Mather, & Co.
1928-Aug. 9	Hillside	Tunnell Smokeless Coal Co.
1928-Aug. 15	Irvona No. 3	Irvona C. & C. Co.
1929-March 21	Kinloch	Valley Camp Coal Co.
1933-Sept. 11	Oakmont	Hillman C. & C. Co.
1937-March 28	Kramer	NW Mng. & Exchange Co.
1938-Jan. 12	Harwick	Harwick C. & C. Co.
1940-July 15	Sonman E	Sonman Shaft Coal Co.
1941-June 30	Kent No. 2	Rochester & Pittsburgh Coal Co.
1944-June 7	Emerald	Emerald C. & C. Co.
1945-March 12	Crucible	Crucible Steel Co.

210 Edward T. Devine, *Coal : Economic Problems of the Mining, Marketing and Consumption of Anthracite and Soft Coal in the United States* (Bloomington, Illinois : American Review Service Press, 1925) p. 232.

The worst mining disaster in the Connellsville coke district occurred at the H.C. Frick Coke Company ' Mammoth Mine. On January 21, 1891, 109 miners were killed at this mine at Mount Pleasant, Westmoreland County. The accident was caused by an explosion of gas and dust.

George H. Ashley, *Bituminous Coal Fields of Pennsylvania* (Harrisburg : Department of Forests and Water, 1928) p. 195.

Some accidents and deaths in the mines were probably caused by carelessness on the part of miners. The principal causes of fatal mine accidents in 1928 were roof falling (60 per cent), carelessness in the moving of coal from the rooms to the surface tipple (20 per cent) and gas and dust explosions (10 per cent), while the remaining 10 percent were caused by miscellaneous accidents including falls down shafts or slopes, and electrocution.

211 William Graebner, *Coal-Mining Safety in the Progressive Period : The Political Economy of Reform* (Lexington : The University Press of Kentucky, 1976) p. 118.

212 Ibid p. 139.

213 Harold W. Aurand, *From the Molly Maguires to the United Mine Workers : The Social Ecology of an Industrial Union 1869-1897* (Philadelphia : Temple University Press, 1971) p. 43.

214 Frank Hall, "Pennsylvania Bituminous Mine Inspectors Given Life Tenure of Offices" *Coal Age* Volume 12, 1915.

The first district comprosed parts of Washington, Westmoreland, Fayette and Allegheny counties; the second district comprised the counties of Beaver,Warren, Mercer, Crawford, Erie, Lawrence, Forest,Venango, Clarion, Jefferson, Indiana, Armstrong, Butler and part of Allegheny. The third district comprised the counties of Cambria, Blair, Huntingdon, Center, Clearfield, Elk, Cameron, Mckean, Potter,Clinton Lycoming, Tioga, and Bradford.

215 Harold W. Aurand, "Mine Safety and Social Control in the Anthracite Industry," *Pennsylvania History*. Volume 54, Number 4, October, 1985.

Alexander Trachtenberg, *The History of Legislation for the Protection of Coal Miners in Pennsylvania* (New York : International Press, 1942). p. 200

216 Michael Workman, *The Fairmont Coal Field: Historical Context* (Morgantown, WV : Institute for History of Technology & Industrial Archaelogy, 1992) pp. 97 -98.

Annual Report of Mining Activities, 1979, (Harrisburg : Department of Environmental Resources, 1978) pp. 94-95.

Two major accidents occurred in Pennsylvania in 1907: The Naomi Mine of the United Coal Company at Fayette City, Fayette County on December 1, killed 34 miners. The tragedy was caused by an explosion, although few miners died from the blast itself. Most died from the rapid spread of black damp - a mixture of lethal gas - which causes chocking and death by suffocation. The second disaster happened at the Darr Mine of the Pittsburgh Coal Company, near Jacobs Creek,Westmoreland County, which claimed 239 lives on December 19.

217 Bruce T. Williams, *Coal Dust in Their Blood : The Work and Lives of Underground Coal Miners* (New York : AMS Press, Inc. 1991) p. 109.

Alexander Trachtenberg, *The History of Legislation for the Protection of Coal Miners in Pennsylvania* (New York : International Press, 1942).

Trachtenburg's study, first published in 1917, is the most complete study covering nearly a century long struggle by miners for protective legislation in the coal industry.

Harold W. Aurand, Mine Safety and Social Control in the Anthracite Industry," *Pennsylvania History*. Volume 54, Number 4, October, 1985.

The first Federal coal mine inspection law was adopted by Congress in 1941.

218 *Pittsburgh : 50th Anniversary of the Engineers' Society of Western Pennsylvania* (Pittsburgh : Cramer Printing Company, 1930) pp. 229-230-23.

Charles Enzian, "Rock-dusting at Berwind-White Mines Costs Less than One Cent per Ton," *Coal Age*. Volume 30, Number 2, July 1926.

John E. Miller "Permissible Explosives" *Coal Age* Volume 16, Number 6 , August 7, 1916.

219 Walton H. Hamilton and Helen R. Wright, *The Case of Bituminous Coal.* (New York : MacMillan Company, 1926) p. 76.

220 Muriel Earley Sheppard, *Cloud By Day : The Story of Coal and Coke and People* (Pittsburgh : University of Pittsburgh Press, 1991 (reprint)) p. 110.

221 David Allen Corbin, *Life,Work, and Rebellion in the Coal Fields : The Southern West Virginia Miners 1880-1920* (Urbana : University of Illinois Press 1981) p. 10.

222 Lola M. Bennett, *The Company Towns of the Rockhill Iron and Coal Company : Robertsdale and Woodvale, Pennsylvania* (Washington, D.C. : National Park Service, 1990) p. 1.

223 Priscilla Long, *Where the Sun Never Shines* (New York : Paragon Press, 1989) p. 82.

224 Ibid p. 80.

225 Anna Rochester, *Labor and Coal* (New York : International Publishers, 1931) p. 99.

John L. Lewis, *The Miners' Fight for American Standards* (Indianapolis : Bell Publishing Company, 1925) pp. 174-175.

226 Margaret Mulrooney, *A Legacy of Coal : The Company Towns of Southwestern Pennsylvania* (Washington, D.C. : National Park Service, 1991) p.9.

227 Ibid p. 26.

228 John Enman, "Coal Company Store Prices Questioned : A Case Study of the Union Supply Store, 1905-1906"*Pennsylvania History*. Volume 41, Number 1974.

229 *Annual Report of the Secretary of Internal Affairs* (Harrisburg : Lane S. Hart, 1884) pp. 337-338.

A check-weighman from Allegheny County told the same commission that "the employees are required to patronize the company store to a certain extent and although you are not told to do so, by not doing so an excuse for discharge will soon be found. If a miner didn't buy sufficient merchandize from the store he was punished. He was assigned the worst job in the mine."

230 *Annual Report of the Secretary of Internal Affairs* (Harrisburg : Lane S. Hart, 1884) pp. 337-338.

231 Andrew Roy, *A History of the Coal Miners of the United States* (Westport,CT : Greenwood Press, 1905, reprinted 1970) p. 236.

232 Priscilla Long, *Where the Sun Never Shines* (New York : Paragon Press, 1989) p. 123.

Alexander Trachtenberg, *The History of Legislation for the Protection of Coal Miners in Pennsylvania* (New York: International Press, 1942) p. 182.

233 Alexander Trachtenberg, *The History of Legislation for the Protection of Coal Miners in Pennsylvania* (New York : International Press, 1942) pp. 183-184.

Donohoe Coke Co.			
Donohue	$153,636.33	85,625.33	55.7
Latrobe - Connellsville			
C.& C. Co.			
Saxman	$105,511.28	18,108.60	17.2
Superior No. 1	$111,678.65	21,148.69	18.1
Superior No. 2	$10,625.86	2,794.13	26.3

[234] Donald O. Edkins (compiler), *Edkins' Catalogue of Coal Company Scrip* (New Kensington, PA : The Catalogue Committee of the National Scrip Collectors Association, date unknown) pp. 138-151.

[235] Gordon Dodrill, *20,000 Coal Company Stores in the United States, Mexico and Canada* (Pittsburgh : privately printed, 1971).

John K. Gate, *The Beehive Coke Years : A Pictorial History of Those Times* (Uniontown, PA : Privately Printed, 1991).

[236] Linda Atkinson, *Mother Jones : The Most Dangerous Woman in America* (New York : Crown Publishers, Inc. 1978).

Dale Fetherling, *Mother Jones: The Miners' Angels* (Southern Illinois University Press, 1974).

[237] Dale Fetherling, *Mother Jones: The Miners' Angels* (Southern Illinois University Press, 1974) p. 16.

[238] Priscilla Long,*Where the Sun Never Shines* (New York : Paragon Press, 1989) p. 335.

[239] Jim Steiner, "The Noble Order of the Knights of Labor," *Mining Artifact Collector*. Fall, 1989.

George Korson, *Coal Dust on the Fiddle* (Hatboro, PA : Folklore Associates Inc., 1965) p. 393.

[240] David J. McDonald and Edward A. Lynch, *Coal and Unionism : A History of the American Coal Miner's Union* (Silver Spring, MD : Cornelius Printing Company, 1939) p. 23.

[241] Harold M. Watkins, *Coal and Men : An Economic and Social Study of the British and American Coal Fields* (London : George Allen & Unwin Ltd., 1934) p. 166.

[242] Andrew Roy, *A History of the Coal Miners of the United States* (Westport, CT : Greenwood Press, 1905, reprinted 1970) pp. 271-272.

[243] Mildred Biek, *The Miners of Windber : Class,Ethnicity, and the Labor Movement in a Pennsylvania Coal Town 1880s - 1930s* (Northern Illinois University Dissertation, 1989) p. 293.

Andrew Roy, *A History of the Coal Miners of the United States* (Westport, CT : Greenwood Press, 1905, reprinted 1970) p. 278.

244 David J. McDonald and Edward A. Lynch, *Coal and Unionism : A History of the American Coal Miner's Union* (Silver Spring, MD : Cornelius Printing Company, 1939) p. 23.

245 David J. McDonald and Edward A. Lynch, *Coal and Unionism : A History of the American Coal Miner's Union* (Silver Spring, MD : Cornelius Printing Company, 1939) p. 25.

246 Keith Dix, *What's A Coal Miner to Do? The Mechanization of Coal Mining* (Pittsburgh : University of Pittsburgh Press, 1988) p. 116.

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Bruce T. Williams, and Michael D. Yates, *Upward Struggle : A Bicentennial Tribute to Labor in Cambria and Somerset Counties* (Johnstown, PA : University of Pittsburgh, 1976) n.p.

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248 Priscilla Long, *Where the Sun Never Shines* (New York : Paragon Press, 1989) p. 154.

249 Ellis W. Roberts, *The Breaker Whistle Blow* (Scranton : Anthracite Museum Press, 1984) pp. 73-75.

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Ellis W. Roberts, *The Breaker Whistle Blow* (Scranton : Anthracite Museum Press, 1984) p. 79.

251 Priscilla Long, *Where the Sun Never Shines* (New York : Paragon Press, 1989) p. 163

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Retrenchment, Decline, and the Mechanized Mine, 1920-1945

Introduction

The 1920s was characterized by most contemporary American economists as a period of great expansion for the American economy. A leading contemporary economist, at the end of the decade, confidently asserted that the American economy was currently entering into an era of "permanent prosperity." The prosperity decade predicted by economists was not shared by a variety of industries including the nation's bituminous coal industry. The industry was recognized by many as "a mighty sick industry" in an otherwise expanding and robust economy. The 1920s was an economic and social catastrophe for both union and nonunion miners, the United Mine Workers of America, and the nation's coal companies. The demand for coal during and immediately following World War 1, and the attendant high price of coal, led to a great expansion in production capacity.[1] The industry's economic prospects took a turn for the worse during the 1920s. Demand which had been artificially inflated during the brief war years began to level off after 1920. The American bituminous coal industry that had experienced nearly three decades of phenemonal growth was entering into a prolonged crisis of overproduction. Government and private coal commissions identified this "overdevelopment" and "overexpansion" of the industry as the principal causes of the coal crisis of the 1920s and 1930s. Since 1850 coal output in each passing decade had practically doubled. The United States Bituminous Coal Commission (1920) and the Brookings Institute (1926) noted the productive capacity of the American bituminous coal industry at over 800 million tons per year although the maximum annual production never exceeded 579 million tons (1918). By 1926, the capacity of American mines stood at one billion tons, although the demand for coal was half that. Soft coal sales reached nearly 569 million short tons in 1920. But except for 1926 sales were below the 1920 figure throughout the 1920s. Employment in the American coalfields peaked in 1923 when the industry employed over 862,00 men and boys. A popular story told in the mining camps, during the period, addressed the fundamental problems plaguing

the industry. A miner's son asked his mother, "Why don't you light the fire? It's so cold." "Because we have no coal. Your father is out of work, and we have no money to buy coal.""But why is he out of work, Mother?" "Because there's too much coal." [2]

The bituminous coal industry had developed over a century and a half without a coherent long-term economic plan, and according to historian James P. Johnson, had become "a splintered and competitive industry that could not find a means to save itself through industrial self-government." [3] The industry was characterized by great seasonal and annual irregularity, recurrent violent labor difficulties, unrestrained competition with uncontrolled prices and speculation. These problems were collectively called the "Chaos of Coal" within the industry. The severe economic decline in the industry during the 1920s and 1930s were also exacerbated by new competition from alternative fuels like oil, natural gas, and hydroelectricity. The industry was operated with both union and nonunion mines which created a wide wage differentiation within the industry. As long as there was the potential of an over-supply of coal, some form of regulating price and production seemed necessary to effect stability in the industry. Many leading coal companies decried these problems and the lack of a stable pricing system, although the industry as a whole was unwilling or unable to find adequate remedies to these problems.

Coal Production in the United States

	Bituminous	Anthracite	Total	Percent Increase / Decline	Mines
1920	568,667	89,598	658,256	1910-1920 - 31.2%	8,921
1925	520,053	61,817	581,870		7,144
1930	467,526	69,385	536,911	1920-1930 - -18.45	5,891
1935	372,373	52,159	423,532		6,315
1940	460,772	51,485	512,257	1930-1940 - -4.6	6,234
1945	577,617	54,934	623,551		7,033 [4]

These apparent structural weaknesses were not adequately addressed by management, the UMWA, or the federal government during the 1920s; instead the "sick" bituminous coal industry witnessed increased interregional competition between union and nonunionized operators in a shrinking market. These harsh economic realities fundamentally transformed existing relationships between management and workers in the bituminous coal industry. The Great Depression of the 1930s simply worsened conditions in the industry but the depression did not create these inherent structural short-comings, all of which were left unresolved during the 1920s. Government intervention and regulation of the industry permitted a temporary revival of the industry between 1933 and 1945 and the revival of the miners' union.

The bituminous industry of the United States entered a period of decline following World War 11 that continued during the 1950s and 1960s. King Coal was soon replaced as the nation's principal sources of energy-first by petroleum and then by natural gas. Output and employment declined in Pennsylvania's soft coal industry as many traditional coal markets disappeared. The large coal companies survived by embracing mechanized mining practices following the Second World War in an attempt to remain competitive with oil and natural gas. Tens of thousands of small and medium size coal companies were forced into bankruptcy or were acquired by large firms.

The Challenge to "King Coal" from Alternative Sources of Energy

Coal had replaced wood as the nation's principal energy source by the 1880s and its dominance among fuels in the United States was unchallenged until the 1920s. From 1901 to 1905 coal (bituminous -70.7 percent and anthracite -18 percent) supplied 88.7 percent of the energy needs compared to domestic oil - 6 percent, natural gas - 3.2 percent and water power - 2.1 percent. [5] Oil's commercial history began with the gusher brought in by "Colonel" Edwin Laurentine Drake (1819-1880) at Titusville, Pennsylvania, on August 27, 1859. Oil markets grew as production of crude oil production increased by sevenfold between 1900 and 1920. Its principal usage was gasoline for automobiles; and kerosene as

an illuminate, as well as for cooking and home heating. Gasoline replaced kerosene as the oil industry's principal product by 1920. The natural gas era dates from the 1880s when it was used for heating furnaces and making steam at iron and steel works, and heating kilns at glass factories. The industry was limited to factories in Ohio,West Virginia and Pennsylvania.

This new competition was a subtle and a long-term trend as fossil fuels incremently began eroding coal's market share since the 1880s. Although competition from natural gas and oil was beginning to be felt in the industry, coal still provided the nation's principal source of energy. Coal produced 68 percent of the total fuel consumption in 1924 (bituminous 56.9 percent, anthracite 11.1 percent), while oil provided 21.6 percent (domestic 19.4 per cent and imported oil 2.2 per cent); natural gas provided 5.2 percent and water power provided 5.2 percent. [6] Bituminous coal's share of the energy industry declined to 55 percent in 1930, 48 percent in 1940, 39 percent in 1950, and 26 percent in 1960. [7] This challenge to coal from these alternative fossil fuels accelerated following World War 11. The proportion of energy supplied by bituminous coal dropped from nearly 60 percent to approximately 45 percent between 1940 and 1950. Petroleum's market share rose from about 17 percent to 23 percent during this decade, while natural gas generated 23 percent of production, up from 12 percent in 1940. [8] Petroleum (1952) and later natural gas (1962) eclipsed it as the nation's premier energy source.

UMWA leadership and the rank-and-file during the 1920s still believed in "King Coal." They accepted explicitly the 1890 preamble to the Constitution of the United Mine Workers of America that stated "There is no truth more evident than that without coal there could not have been such marvelous social and industrial progress as makes present-day civilization." John L. Lewis was elected the ninth UMWA president on New Year's Day, 1920 and declared throughout the 1920s to coal miners that "when we control the production of coal we hold the vitals of our society in our hands." [9] Most coal miners still saw themselves as "the creators of all wealth and power." These competitive fuels might chip away at the market share of the coal market; they could not replace coal as the dominate fuel, at least not in the immediate future.

Decline in Demand and Usage for Bituminous Coal

A more immediate cause of concern to the bituminous coal industry was the slackened demand for coal and coke from traditional markets during this period. High coal prices and new technologies encouraged a trend toward economy in fuel consumption by consumers of coal and coke. Ironically, the consumption of bituminous coal in the mines of Pennsylvania declined. Mines consumed 1.9 percent of their total production in the generation of power and heat in 1915, while their coal usage at the mine declined to .07 percent in 1929. This reduction was caused by the introduction of electricity in mines and their own energy conservation programs after 1900. Electrically powered machinery, used in hauling coal, undercutting and blasting coal, had replaced coal steam-powered machinery in the larger mines. [10]

The periodic coal shortages through strike activity, wild-cat work stoppages, and increasing coal prices, especially between 1918 and 1923, stimulated a long-term energy-saving program by the principal coal users. Bituminous coal sold for only $1.12 per ton as late as 1910 and between 1916 and 1922 the price per ton more than doubled. [11] Railroads, electric power plants, iron and steel companies, manufacturing industries, and domestic users were the major consumers of bituminous coal. The industry produced 443,492,000 tons in 1915, and the principal coal consumers, in order of significance were as follows : industrial establishments (including electric utilities) - 36 percent; railroads - 27.5 percent; coke manufacture - 14 percent; household - 12.4 percent; export - 4.2 percent; bunker coal (used by steam driven ocean liners) - 2.7 percent; used at the mines - 2.2 percent; and gas manufacture - 1 percent. [12]

Railroad locomotives were major consumers of coal since the origins of the railroad industry . Railroads consumed about 135 million tons of bituminous coal, nearly one-quarter of the nation's total consumption at its peak just after World War One. Many large railroad companies operated their own "captive" mines to supply their huge demand for steam coal for their locomotives. The volume of rail transportation continued to grow from 1918 through 1929 but more efficient designs in steam locomotives reduced their coal usage by almost 30 percent during this period. An average locomotive consumed 174

pounds of coal per 1,000 freight ton-miles in 1920, 125 pounds in 1929, and 121 pounds in 1933. The conversion to diesel locomotives after World War 11 ended the reign of coal-fired steam locomotives and with it a 135 million ton consumer was gone.

Coal usage by electric utilities in the production of electrical energy was reduced by 48 percent per kilowatt hour of electricity generated between 1919 and 1928. By 1900 electricity was applied to railroading and was used to power coal-mining machinery. Utilities used on average 3.2 pounds of coal for each kilowatt-hour of electricity generated in 1919, 1.76 pounds in 1928, 1.42 pounds of coal in 1937 and less than .08 pounds of coal in 1952. [13] The production of electric power increased about three fold between 1920 and 1940.

This trend in fuel efficiency continued in the production of iron and steel as production increased from 1904 to 1929 although manufacturers reduced their consumption of both coal and coke. The number of tons of coal used per gross ton of iron and steel was reduced from 2.01 tons in 1904 to 1.85 tons in 1914 and 1.41 tons in 1927. Coke was the principal mineral fuel in iron and steel production since the 1880s and the amount of coke required to make a ton of pig iron was reduced from 1.6 tons in 1860 to 1.2 tons in 1890, 1.0 in 1920, and 0.9 in 1940. [14] The continual shift of coke production from the beehive coke oven to the by-product oven was a major source in the reduction of coal and coke by the steel industry. This transition was most pronounced in the United States with the start of World War 1. By-product ovens, introduced during the 1890s, were more efficient users of fuel. Pennsylvania produced 61.1 percent of the nation's coke production as late as 1915, and beehive coke ovens in western Pennsylvania produced 54.2 percent of the nation's coke. [15] A majority of coal used in beehive coke production came from the famous Pittsburgh seam of western Pennsylvania and northern West Virginia. [16]

The growth of the beehive coke industry in southwestern Pennsylvania was spectacular but its own decline was even more striking. Beehive coke ovens produced 40 percent of the nation's coke in 1920, 6 percent in 1930 and 5 percent in 1945. The beehive coke industry of the famous Connellsville district hit its peak in 1918 when 38,986 ovens produced 18,135,000 tons of coke valued at $117,000,000. [17] The number of beehive

ovens in this coke district declined after this peak period from 15,333 ovens in 1925 to 7,393 in 1930 and 4,355 in 1935. Fewer beehive coke ovens were in operation in 1927 than operated in the district during the 1880s. The amount of coal used for coke production in the antiquated beehive coke ovens of Pennsylvania between 1915 to 1929 decreased from 32,498,000 tons to 7,308,000 tons.

The H.C. Frick Coke Company, the largest beehive coke producer in the United States, reported only 25 beehive coke plants in operation on December, 31, 1929. The plants, located in Fayette,Washington, Greene, and Westmoreland counties, had only 9,324 ovens including 2,261 inactive ovens. [18] There were only 71 beehive coke plants with 13,012 ovens in the nation in 1936 and beehive coke production was usually restricted to boom periods.[19] A quarter of the annual production of coke production in the United States was produced in by-product ovens ovens in 1912 ; 60 percent in 1920 ; 94 percent in 1930; and 95 percent by 1940. Raw coal, not coke, was increasingly shipped from the coalfields by river barges directly to the steel plant and converted to coke in the by-product batteries of ovens. The hauling of coal by railroads between 1915 and 1929 was reduced as river shipments on huge barges almost trebled during this fourteen year period.

Beehive and By-Product Coke Production in the United States

U.S. Year	By - Product Ovens Coke (Net Tons)	Beehive Ovens Coke	Total Coke Production	Percent Production By - Product Ovens	Beehive Ovens
1920	30,833,951	20,511,092	51,345,043	60%	40%
1925	39,912,159	11,354,784	51,266,943	78%	22%
1930	45,195,705	2,776,316	47,972,021	94%	6%
1935	34,224,053	917,208	35,141,261	97%	3%
1940	54,014,300	3,057,800	57,072,100	95%	5%
1944	66,627,381	6,990,308	73,617,689	90%	10% [20]

The increasing acceptance of the by-product coke oven by steel corporations diminished the need for beehive ovens and high-quality Connellsville coal. The trend in the coking industry from beehive coke to by-product coke is clearly shown by the following figures:

	1893	1923	1937
Beehive coke produced, net tons	9,464,730	19,379,870	3,156,300
By-product coke produced, net tons	12,850	37,957,664	49,205,798 [21]

The change in coking process from beehive to by-product ovens resulted in a complete change in the location of the coke industry. Beehive coke was produced near the mine where the ovens were located. The acceptance of the by-product ovens, located at the steel plant and not at the coal field, ended the competitive advantages that the Connellsville district had enjoyed for generations in three distinct ways:

1) By shifting most of the coke industry out of the Connellsville area to steel producing centers all over the country.
2) By further encouraging the subsitute of non-Connellsville coal in coking through provisions of greater latitude in the coking process.
3) Indirectly, by exposing the steel industry to the geographical attraction of other supplies of coal and coking than those of the Connellsville area. Shifts in the steel industry have been important in terms of the market situation for the regions coal. [22]

The Department of Mines of Pennsylvania wrote an obituary for the production of coke in the beehive coke oven in its 1929 annual report:

> Bee-hive coke production is rapidly becoming a lost art as the advantages of by-product coke manufacture are so apparent that it is only a question of a short time until the banks of abandoned bee-hive ovens scattered throughout

the coke region will be the only symbol remaining of what was once the leading industry of southern Pennsylvania. [23]

Many beehive coke plants were abandoned as demand for coke decreased and remained unused except for brief periods of unusually high demand for coke. Homeless families moved into the deserted ovens during the Depression and established legal residences so they could draw their relief checks. The increased demand for coke in the steel industry during World War 11 witnessed a temporary revival of the moribund beehive coke industry as abandoned ovens were repaired or entirely rebuilt and placed in operation. The annual beehive coke capacity in 1944 was 22 percent higher than 1940 and accounted for 10 percent of the nation's coke production. The expansion of by-product and beehive coking capacity increased production and enabled the industry to meet essential wartime requirements in the steel industry for metallurgical fuel. This economic revival was essentially the "last hurrah" for the venerable beehive oven as coke production was negligible nationally after the conclusion of the war. Jones and Laughlin Steel Corporation's Aliquippa Works, Beaver County was making coke in beehive ovens as late as 1948. New coke oven construction in the United States after 1920 was almost exclusively by-product coke ovens. These coke ovens were more efficient producers of metallurgical coke. They produced high-quality coke and also recovered gas and other valuable chemicals lost in the earlier process. A major exception to this long-term trend was the construction of a battery of 264 beehive coke ovens at Lucernemines, near Homer City, by the Rochester & Pittsburgh Coal Company of Indiana County. The ovens were constructed at a cost of $2 million in 1952. [24] High quality coke produced at this plant was sold and used in local blast furnaces. The coking plant was operated by the R & P Coal Company until 1957, when the facility was sold to Shenango, Inc. The coke ovens operated continuously until the Department of Enviromental Resources of Pennsylvania forced their permanent closure in October, 1972. The owner's of the beehive ovens were simply unable to meet strict air quality standards established by the state. Similar beehive coke operations at Shoaf, Fayette County and at Alverton, Westmoreland County were

closed during the 1970s by DER . The beehive coke plant at Shoaf, Fayette County was one of the last major producer of beehive coke in the United States. The H.C. Frick Coke Company constructed this beehive coke plant in 1902. The Shoaf facility, located about seven miles south of Uniontown,was later owned by the Menallen Coke Company which shipped its last railroad cars of beehive coke to market in March, 1972. The owners of these coke ovens attempted unsuccessfully to modify their beehive ovens to comply with the stringent air quality standards established by DER of Pennsylvania.

The economies of Westmoreland and Fayette counties, based almost exclusively on coke production from beehive coke ovens since the 1880s, saw the closing of mining and coking operations after 1945. This permanent economic downturn was as devastating to the region's economy as the Great Depression. Fayette County had a higher percentage of unemployment and persons on welfare than the state or national averages. The population of the county declined by 25 percent between 1950 and 1970, from 200,909 to 154,667 as former miners left the county in search of employment.

The Bituminous Coal Industry of Pennsylvania during the 1920s and 1930s

Pennsylvania employed more miners than any other coal producing state in 1920. There were 184,168 bituminous workers and 149,117 anthracite workers, accounting for 43 per cent of all coal miners in the United States. West Virginia was second with 105,000 workers while Kentucky and Illinois were third and fourth. [25] The number of coal miners in the Commonwealth shrank to 174,989 while production dropped to about 185 million net tons by 1945 (the 1945 figures are combined anthracite and bituminous totals). Pennsylvania's soft coal industry had employed more than 100,000 workers continuously from 1903 to 1943, but the industry employed fewer than a hundred-thousand workers (99,942 employees) for the first time in 1944. [26] In 1931 for the first time since 1904 bituminous coal output in Pennsylvania fell below 100 million tons.

Pennsylvania producers, as a group, had not held their own against rival producers in competing coal fields. The Commonwealth had averaged more than 35 percent of the

bituminous coal market share from 1890 to 1920 although its average market share nationally shrank to about 25 percent during the 1920s. The center of the American bituminous coal industry was the Appalachian fields extending from northern Pennsylvania, across Ohio, West Virginia, Kentucky and Tennesse into Alabama. Coal resources located in the interior and western coal fields were of poorer quality. Pennsylvania,West Virginia, Illinois, Kentucky and Ohio mined about four-fifths of the nation's total production in 1923 while the coal states of Pennsylvania and West Virginia extracted almost one-half of all bituminous coal.Pennsylvania's coal production experienced a fairly gentle decline after 1921, but during the 1930s the downward trend became more pronounced. [27] Pennsylvania's national share declined from 36 percent in 1912 to 26 percent in 1931 as output dropped from approximately 173 million tons in 1923 to 96.8 million tons in 1931.Twenty-four counties in Pennsylvania mined coal between 1918 and 1939 although Allegheny, Cambria, Clearfield, Fayette, Greene, Indiana, Somerset, Washington and Westmoreland counties were the principal coal counties (Illustration 1-2- Production by Counties). Five adjacent counties in southwestern Pennsylvania - Fayette, Washington, Allegheny, Cambria and Westmoreland accounted for about 70 percent of the state's total production by 1920. Pennsylvania production was 19.6 percent less in 1929 than in 1918 (the all-time production peak), and 17.4 percent less than in 1913. [28] Seven of the eight leading counties produced less coal during this period. Fayette, Washington, Cambria and Allegheny counties suffered declines of about 12 percent between 1917 and 1929 while Westmoreland County's decline of 38.7 percent was the largest. Greene County, which had the largest coal reserves in the state during this period, was the sole exception as output increased from about 900,000 tons in 1917 to 6.2 million tons in 1929. The original coal deposits in the county were estimated at more than 9 billion tons. Greene County was part of the Pittsburgh district but annual production in this rural county was modest until the 1920s. The coal deposits of eastern Greene and eastern Washington counties was nearly identical geologically with the Connellsville district. This coal has sufficient carbon content to make good coke. The rich Pittsburgh seam that underlies Greene County from Ruff's Creek District east to the Monongahela

river, south through Jefferson to Muddy Creek, and continuing south towards the state line had been opened for coal exploration since 1900. Steel companies, including U.S. Steel, Crucible Steel, Inland Steel Corporation and Picklands, Mather and Company, purchased coal lands in the county around this period and constructed a number of large "captive" mines with accompanying mining communities. The county produced more than a million tons annually between 1918 and 1945. [29]

Shifts in American Bituminous Coal Production

STATE (Million Net Tons)	1912-1916	1917-1921	1922-1926
PA	811	788	703
Ill	304	394	342
OH	146	200	155
WV	373	418	559
VA	42	48	59
KY	103	156	250
TN	31	29	27
MD	22	18	12
IN	86	127	113 [30]

Bituminous coal production in the non-union coal states of West Virginia and Kentucky made remarkable gains in contrast to Pennsylvania's declining industry. These two southern Appalachia mining states produced less than 11 percent of the nation's coal in 1895 in contrast to Pennsylvania's 37.1 percent. West Virginia's (23.7 percent) and Kentucky's (10.1 percent) proportions of the nation's soft coal production rose to 33.8 per cent while Pennsylvania's percentage declined to 26.7 percent in 1925.[31] West Virginia permanently displaced Pennsylvania as the leading soft-coal producer during the 1930s. The coal-producing states, in descending order of importance, mining more than 10 million

tons in 1940 were West Virginia, Pennsylvania, Illinois, Kentucky, Ohio, Indiana, Alabama and Virginia.

Some of the principal causes put forth by mining experts to explain the decline of the once flourishing coal industry in Pennsylvania during this period were: 1) the competition of soft coal from southern coal fields which, encouraged by preferential rates, had been able to ship coal beyond the boundaries of their natural markets ; 2) the competition of such other sources of energy as fuel oil, natural gas, and electric power; 3) increasing efficiency in coal burning and in the use of fuel; 4) previous overdevelopment in mine capacity; 5) curtailment of demand as a result of the Depression; 6) lower production costs in southern fields. [32] A variety of remedies was proposed to stop this erosion. However all these programs were generally ineffective in reversing this downward spiral. All indices of the activity of the industry with the exception of capital investment,- value of products, number of mines, total employees, total compensation, and tons produced were lower in 1930 than in 1923.

Decline of The Bituminous Coal Industry in Pennsylvania

	1923	1930
Value of Products	$ 453,003,200	$209,274,3000
Capital Invested	443,516,8000	473,695,000
Number of Mines	1,617	785
Total Employees	189,226	128,905
Total Compensation	314,807,1000	140,982,700
Tons Produced	172,158,436	121,384,040 [33]

Coal Companies' Response to Their Declining industry

Both union and nonunion coal operators employed a variety of strategies to maintain their market share in an ever-shrinking and increasingly competitive market. Mergers of coal

companies and informal pools were formed to control and limit production and establish consistent and long-term stable tonnage rates. These methods had been used since the 1890s by coal operators but were generally ineffective. The price per ton of coal plunged from a historic high of $3.75 per ton in 1920 to $1.78 in 1929. A number of large coal companies were firmly established through consolidation by the 1920s. Coal production was increasingly concentrated in larger mines. Class 1 mines, those producing 200,000 tons or more annually, accounted for 31.5 percent of total coal production in 1922 and 65.2 percent of the nation's output in 1929. But no single company produced more than 5 percent of the entire coal production nationally. The industry, in sum, was increasingly concentrated into fewer and larger coal companies concentrated in larger miners, but no one firm or group of firms was dominant. Nationally 12 percent or 553 bituminous coal operators produced 79.7 percent of all bituminous coal in 1929; the 17 largest operators produced 19.9 percent of the total tonnage. There were 218 coal producers nation-wide who produced half a million tons or more in 1929. These large producers mined 59.8 percent of the total bituminous coal production of about 534 million tons in 1929. [34] The 17 largest coal operators mined nearly 20 percent of the nation's bituminous coal and each operator mined more than three million tons of coal annually. Ten of these operators sold their coal and coke on the commercial market while the remaining seven companies operated "captive" or "consumer" mines. Chicago, Wilmington, and Franklin Coal Company, Consolidated Coal Company, Island Creek Coal Company, New River and Pocahontas Consolidated Coal Company, Old Ben Coal Company, Peabody Coal Company, Pittburgh Coal Company, Pocahontas Fuel Company, W.J. Rainey Company and Stonega Coal and Coke Company were the ten largest commercial coal companies in 1929. Five of the seven captive coal operators were steel corporations: H C. Frick Company, Tennessee Coal, Iron and Railroad Company and the United States Coal and Coke Company - U.S. Steel, parent company; Bethlehem Mines Corporation -Bethlehem Steel parent company; and Vesta Coal Company -Jones and Laughlin Steel, parent company. Superior Coal Company -Chicago and Northwestern RR, parent company and

the Union Pacfic Coal Company -Union Pacific RR, parent company were the largest captive mines owned by railroad corporations.

Six of the largest seventeen coal operators in the nation operated mines and coke plants in the bituminous coal fields of Pennsylvania. They were the Consolidation Coal Company, Pittsburgh Coal Company, W.J. Rainey and Company, Bethlehem Mines Corporation, H.C. Frick Company, and Vesta Coal Company (subsidiary of Jones and Laughlin Steel Corporation). [35] There were 1,300 coal operators in Pennsylvania in 1930. One hundred operations produced more than 200,000 tons annually and accounted for nearly 80 percent of the state's total bituminous coal production. There were 25 corporations with annual production exceeding more than a million tons while the ten largest corporations had annual production over 2 million tons and each employed more than two thousand workers. Pittsburgh Coal Company was the largest employer (11,485) while the H.C. Frick Coke Company was the leading coal producer in the state (12,878,579 tons). The ten largest bituminous coal companies and counties with mining operations in Pennsylvania in 1930 were as follows:

Company	Counties with Mines
H.C. Frick Coke Co.	Fayette/Greene/Westmoreland
Pittsburgh Coal Co.	Allegheny/Fayette/Washington/Westmoreland
Vesta Coal Co.	Washington
W.J. Rainey, Inc.	Fayette/Greene/Washington/Westmoreland
Westmoreland Coal Co.	Westmoreland
Pittsburgh Terminal Coal Corp.	Allegheny/Washington
Rochester and Pittsburgh Coal and Coke Co.	Clearfield/Indiana/Jefferson
Bethlehem Mines Corp.	Cambria/Indiana/Westmoreland
Hillman Coal and Coke Company	Allegheny/Fayette/Somerset/Westmoreland
Berwind-White Mining Company	Somerst/Cambria [36]

This concentration of bituminous coal production nationally and within Pennsylvania was neither a monopoly nor an oligopoly in the classical business sense. The bituminous coal industry still remained a fiercely competitive industry, unlike the anthracite coal industry, which had established a coal monopoly. The anthracite region of northeastern Pennsylvania was controlled by a small number of railroad companies, known simply as the "Companies" - Delaware, Lackawanna & Western; Delaware Hudson; Lehigh Valley; Reading; Erie; New York; Ontario & Western; Lehigh & New England; Central Railroad of New York and the Pennsylvania RR. These railroad companies owned and controlled about 75 to 80 percent of all anthracite mined and 90 percent of future supplies in 1923. The bulk of anthracite extracted from these mines was sold directly to retailers or consumers through their own selling departments, affiliated selling companies or contract commissioners. The remaining anthracite output was produced by over one hundred relatively small producers, known as the "Independents in the trade." [37]

Large corporations mined a majority of the bituminous coal and coke, and employed a majority of workers, but they simply couldnot dictate production tonnage or maintain or "fix" the price of coal throughout the industry. Small or medium size companies did not disappear; in fact, their numbers simply continued to increase throughout this period. There were 4,612 companies operating 6,057 mines producing 534 million tons in the United States by 1929. These small and medium-size mines posed a constant threat to price stability in the industry. C.E. Lesher, editor of *Coal Age* , in 1921 addressed why he believed the bituminous coal industry was unable to form a monoply:

> So easy is the coal of access and so easy is the initial work of opening a mine that every period of unusual demand, in which prices rise more than a few cents above the cost of production, find many entering the business. Having your own coal mine is almost as simple as having a war garden. Raising hogs, cotton, and corn are no more competitive than bituminous coal. [38]

Coal mining, unlike other extractive industries, still remained essentially a labor and not a capital-intensive industry. A new coal operator required very little capital to establish a mining operation. The drift-entry mine required no machinery to open and its maintenance cost was small. There was also a surplus of unskilled immigrant labor that was paid a low piece-rate by the ton to mine coal. The mine could be opened quickly if demand for coal and prices per ton rose and could be easily closed if demand and tonnage rates were small. High quality bituminous coal was still dispersed over a wide physical area located in six principal coal fields in the United States. High quality bituminous coal was located in Pennsylvania and mined in more than two dozen counties. None of the large-scale coal companies in the state had operations in more than four counties at one time. The ability to impose some form of monopolistic control within the industry in order to establish minimum coal prices and regulate production either from within the industry or from the government was not forthcoming during the 1920s. Controls on the splintered industry were finally imposed by the federal government during the first New Deal.

A second distinctive trait of the industry that made it such a cut-throat industry was its operating simultaneously with union and nonunion mines. Journals as diverse as the *New Republic* and *Coal Age* asked "Can coal continue two-thirds free (unionized) and one-third unfree (unorganized)." [39] The unorganized southern coalfields acted "like a pistol pointed at the heart of the union" during this entire period. [40] Unionism prevailed in the Pittsburgh District and northern portion of Pennsylvania, in the Broad Top coal field, and in Illinois, Indiana, and Ohio. The union prevailed in parts of West Virginia - Fairmont Field until 1925; Kanawaha Field until 1924; and New River Field until 1922. These states had been strongholds of unionism ever since the formation of the Central Competitive Field by northern coal operators after the 1897 strike. A second smaller region of unionism was the South Western Interstate Field, lying between Iowa and Northern Texas and consisting of Arkansas, Kansas, Missouri and Oklahoma. North of the South Western Interstate was the organized the Iowa coal field and in the south was the partially organized state of Texas. Union fields were also located in Wyoming and Montana in the Rocky Mountains. [41]

The predominant non-union areas in western Pennsylvania were the Connellsville Coke District, Irwin Gas Region, Greensburg, Latrobe and Ligonier Area of Westmoreland County and the Somerset-Meyersdale Field in Somerset County. The coal fields of Southern Appalachia that developed since the 1880s increasingly operated nonunion mines. Coal production had been insignificant in these fields in comparsion to the northern coal fields until this period. The high demand for coal and the high price per ton of coal during the Great War prompted local operators to expand their production. The war had brought on overproduction because of demand and these nonunion Southern operators did not reduce their output as demand for coal diminished in the 1920s.

The recent coal boom of World War 1 and 1919 and 1920 was soon becoming a vague memory. The continual decline of coal prices from the historic high of $3.75 a ton in 1920 to $1.78 a ton in 1929 prompted coal operators to slash wages and increase hours of work to remain competitive and solvent. A variety of variables was used in calculating the actual operating cost of mining coal including royalties, operator association dues, compensation insurance, taxes, power used at the mine, and labor. Labor costs represented from 60 to 70 percent of the total cost of producing each ton of coal. They accounted for 69.3 percent of the operating cost in the union-operated mines in the Pittsburgh District; 65.6 percent in the nonunion mines in Pocahontas, West Virginia; and 67.7 percent in the union mines of central Illinois in 1918. These economic realities made it increasingly difficult for the older northern unionized mines in the Central Competitive Field, which paid higher wages, to compete effectively and to maintain their market share against nonunion operators in a shrinking industry. Union operations reduced production and wages and laid off workers in an attempt to remain economically solvent. Paradoxically as union operators reduced their production non-union Appalachia operators continued to increase their production. Their labor costs were less and therefore they had an economic advantage even in a shrinking market.

The nonunion operators of western Pennsylvania and Southern Appalachia according to union coal operators had an unfair competitive edge in the production and sale of coal throughout the period. They paid lower wages, produced superior quality coal, and

received favorable railroad freight rates from the railroads. The Southern Appalachia Coal Fields, unlike Pennsylvania's own sagging coal industry, increased their coal production throughout the 1920s. Coal production increases from this region were so large that they more than offset the declining production in Pennsylvania, Ohio, Indiana and Illinois The division between coal mined between union and non-union companies was about two-thirds union coal and one-third nonunion coal in 1922-1923. West Virginia produced 23.7 percent of the nation's bituminous coal production while Kentucky produced 10.1 percent in 1925. Some 42 percent of all bituminous coal workers and 32 percent of all coal miners worked in nonunion Southern mines by 1929. [42]

Percentage of Bituminous Coal Mined by Principal States

Year	PA	WV	KY	OH	IN	ILL
1895	37.1	8.4	2. 4	9.8	2.9	13.1
1905	37.5	11.9	2.6	8.1	3.7	12.2
1915	35.6	17.4	4.83	5.0	3.8	13.2
1925	26.7	23.7	10.1	4.9	4.2	13.1 [43]

Coal companies employed a variety of strategies to remain competitive and profitable in a declining and over-developed industry. The collapse of the war boom and the crisis of overproduction and declining coal prices pushed coal operators into a fever of competitive cost-cutting strategies. Overcapacity brought on cut-throat competition that forced many companies into receivership and bankruptcy. Mass unemployment of miners began with the collapse of the coal market in 1923 when 1,745 mines closed throughout the nation squeezing at least 85,000 miners out of the industry between 1920 and 1923. [44]

The reduction of labor costs became the coal operators' point of attack to remain competitive. They attempted to decrease wages and increase the daily hours of work throughout the 1920s. A number of union owned mines began experimentation with mechanical loaders (led by the Pittsburgh Coal Company) in an attempt to reduce their labor

costs, although mechanizing coal loading was not a major factor in solving the problems of high labor costs during the 1920s. By 1920 60.7 percent of all coal was mechanically undercut by electric machines but less than 1 percent (.3 per cent) of all coal was mechanically loaded nationally. [45]

Practically all bituminous coal was shipped as run-of-mine coal throughout the nineteenth century unlike anthracite coal. "Rashed coal" is unpure and unmarketable coal, mixed with clay, slate, shale, or other foreign substances. Anthracite coal was sorted into at least nine different sizes at the breaker before delivery to market. Most anthracite coal was used for domestic home heating, stores, factories and the like. In contrast, the largest consumers of bituminous coal were railroads, factories, coke ovens and electric and gas producing plants. [46] Some larger firms attempted to improve the quality of the coal that they shipped to market during the 1920s. Coal operators, facing keen competition in a shrinking market, believed that improving the quality of their coal would make it easier to sell. Cleaning coal upgraded its quality and heating value by removing or reducing the amount of pyritic sulfur, rock, clay, and other ash-producing material. Coal washing equipment was installed at many mines to enhance the marketability of coal. Consumers were increasingly insistent upon the best quality of coal. The demand for most types of coal was decreasing overall, but consumer demand for certain size coal was increasing. Slack (fine) size coal was in demand as fuel with the development of new steel furnaces after the First World War. These furnaces used small pieces of coal that could not be hand cleaned, so coal operators were required to construct cleaning plants to market high quality slack coal.

Companies constructed elaborate and expensive preparation or cleaning plants during the 1920s hoping to attract a broader market for their coal and offset the declining demand for coal. Before the construction of the large preparation plants raw, run-of-the mine coal was roughly screened and sized in tipples. Coal was then dropped into railroad cars below for shipment to market by railroad or by river. Coal screening in the tipple was inefficient. There were no loading booms and no facilities for removing impurities in the coal. The treatment of coal was resumed by larger coal companies in the Pittsburgh district and throughout the bituminous fields during this decade. Several cleaning facilities were also

constructed in eastern Ohio by the Hanna Coal Company and at the Pursglove Coal Mining Company in Northern Virginia. There were 25 cleaning plants operating in the Pittsburgh District in 1938. [47]

Company	Mine	Year started	Capacity Ton per Hour
Humphrys C. & C. Co.	Greensburg	1929	50
Clinton Block Co.	Imperial	1928	299
J. & L. Steel Corp.	Hazelwood	1930	300
J. & L. Steel Corp.	Aliquippa	1912	80
Keystone C. & C. Co.	Salem	?	150
Saxman C. & C. Co.	Latrobe	1927	50
Buckeye Coal Co.	Nemacolin	1929	700
Carnegie-Illinois Steel Co.	Clairton	1931	800
Jamison C. & C. Co.	Hannastown	1931	350
Pgh. Terminal Co.	Coverdale No. 8	1931	500
Acme Coal Cleaning Co.	Avella	1933	300
Deep Vein Connellsville Co.	Brier Hill	1929	200
Hillman C. & C. Co.	Naomi	1933	100
Lincoln Gas Coal Co.	Lincoln No. 1	1928	250
Panhandle Mining Co.	Midway	?	?
Washington Coal Co.	Tyler	?	?
Pittsburgh Coal Co.	Champion No. 1	1928	700
	Champion No. 2	1936	100
	Champion No. 3	1927	300
	Champion No. 4	1929	450
	Champion No. 5	1929	450
	Champion No. 6	1933	400
Westmoreland Coal Co.	Magee	1938	275
Westmoreland Coal Co.	Hutchinson	1931	300

All these preparation plants facilities, except the Jones & Laughlin plant at Aliquippa, Beaver County, were constructed during the 1920s and 1930s. Raw run-of-the-mine coal was cleaned, screened,washed and dried in the preparation plant. Cleaned coal of different sizes and properties could be blended by the coal company to meet specific consumer requirements at the preparation plant. The preparation plants of this era had the capacity to

clean and wash from 50 to 700 tons of coal per hour. Since the construction of the preparation plant was costly to construct, coal operators often washed and cleaned coal for a fee from their competitors' neighboring mines. The Acme preparation plant, near Avella, Washington County and the Champion Preparation Plant Number One of the Pittsburgh Coal Company near Imperial, Allegheny County cleaned and washed coal from more than one mine. Coal from Pittsburgh Coal Company's Westland, Montour Number 4 and Margerun Mines were cleaned and wetted at this preparation plant. [48]

Coal was transported to the surface in coal cars that stopped at the rotary dumpers, designed to empty each car with mininum coal breakage . The dumped coal is feed into the preparation plant. Raw coal passes over and through special screens which accurately separate large coal from the smaller sizes. The larger coal passes over combination picking tables and shaker screens where slate and impurities are removed. The finished large pieces of coal of this screening process is then ready to be loaded for transport to market. Small size coal passes through another mechanical cleaning units,where the rock, slate, bone coal and pyrites are removed. At some preparation plants coal is also cleaned. Coal cleaning consisted of the following steps; 1) crushing or breaking the coal, to prepare it for the washing process ; 2) sizing, to separate coal into different dimensions, both to match the specifications for the various washing devises and to meet market requirements. 3) washing, to remove impurities from coal; 4) drying coal, to remove excess moisture prior to shipment to market. There were no universal standards in the bituminous coal industry as to the degree of cleanliness, trade names, and sizes as found in the anthracite industry as late as 1940.

Coal preparation consisted of two inter-related processes - sizing and cleaning. Coal was sorted according to size by putting it through a series of different size screens at the preparation plant. Cleaning coal involved the separation of impurities by either hand picking by the miners underground as they loaded the coal or by mechanical cleaning at the surface. The underground mine foreman checked the loader's wagon to insure these impurities were indeed removed. The introduction of mechanical loading machines, during the 1920s, made it necessary for more surface preparation of coal to separate impurities.

Coal impurites were hand-picked from the coal in the tipples which was then shipped as run-of-the-mine coal. Picking and shaking screens were found in more elaborate tipple where the coal was shipped to market as different sizes or as mixed sizes. The elaborate and expensive preparation plant screened coal from rock and other impurities including a mixture of rocks, slate, shale, boney coal, and coal dust. There were four general sizes of coal in the bituminous industry by 1925 although the size and name of coal was not standardized in the industry during this period: 1) slack, everything less than 3/4 inch; 2) nut, 3/4 to 1 1/4 inches; 3) egg, 1 1/2 to 4 inches; 4) lump, everything over 4 inches. Their measurements indicated the diameter of the screen openings used to separate coal. Steam coals, especially those used as bunker coal in ships, in locomotives, and in stationary boilers, were all usually cleaned and sized.

Some coal was washed to alter its chemical composition by reducing its high ash and sulfur content. Coal used in the production of metallurgical coke that had high ash and sulfur contents was washed to reduce their high content. [49] Effective washing could reduce sulphur content by as much as 50 percent depending upon the efficiency of the washer and the chemical properties of coal. [50] Coal was treated with oil, calcium chloride, or other chemicals to minimize dust and prevent it from freezing while in transit to market by rail or by river barge.

The Berwind-White Coal Company of New York constructed two cleaning plants in western Pennsylvania during the 1920s. The company's first preparation plant was constructed at Eureka Mine Number 37 in 1926. A second cleaning plant was contructed at Eureka Mine Number 40 ,Windber by Roberts & Schaefer Company of Chicago in 1928. The three story building was a reinforced-concrete tipple and cleaning plant costing about one-half million dollars (Illustration 3-Preparation (Cleaning) Plant).

Charles Enzian, a graduate of Lehigh University, served as president and general manager of the Liberty Coal Corporation of Kentucky before his appointment as chief engineer of the Berwind-White Mining Company. Enzian explained why the firm constructed these costly cleaning plants during the 1920s:

> The economic conditions of the bituminous coal industry which have existed in the past and no doubt will exist in the future, require exceptional alertness on the part of the operator to create additional demand through the improvement of the product from the mines so that he may be insured of retaining the market already supplied and a reasonable hope of gaining new markets. [51]

The United States Bureau of Mines noted that 7.8 percent of Pennsylvania's coal output was mechanically cleaned and ranked behind Alabama, Washington, and Colorado in percentage of mechanically cleaned coal in 1929. The tonnage of coal cleaned in the United States in 1936 (13.9 percent) was double the amount cleaned in 1932. [52] The growth of mechanical cleaning of coal in Pennsylvania paralleled that in the nation as a whole.

The Percentage of Coal Mechanically Cleaned

	1927	1936	1940
U.S.A	5.3	13.9	20.9
PA	4.2	19.6	23.6 [53]

Workers' Responses and the National Coal Strikes of the 1920s

The UMWA, under the leadership of their fiery president John L. Lewis, was the most powerful union in the United States by 1920. Lewis (1880-1969) was the most important leader in the history of the union and for the next forty years would lead the miners' union until his voluntary retirement in January, 1960. His parents had migrated from the coal-mining district of South Wales, and settled and married in Lucas, Iowa in 1878. Lewis was born in this small southern Iowa mining town on February 12, 1880. He attended the public schools in Lucas and at the age of 17 entered a local mine and worked with his father and brother. He was a mule driver and worked 10 hours a day receiving $1.60 daily. Lewis had a varied career in the coal, copper and silver mining industry throughout the

West before working as a coal miner in the coalfields of Illinois, where he began his rise in the miners' union bureaucracy. He served as pit committee boss in 1909 and was chosen by Illinois miners in 1910 as their state legislative representative for District 12 of the UMWA. He secured the passage of the workmen's compensation and a series of mine safety laws in Illinois. Samuel Gomper, the AFL president, who was impressed by Lewis's organizational abilities appointed him a field and legislative representative for the union in 1911. UMWA President White appointed him chairman of the resolution committee at the union's 1916 annual convention. Lewis served as a union statistician and as a manager of *The United Mine Workers Journal* before his election in 1919 as the ninth president of the United Mine Workers. [54]

The union, like coal operators, was becoming an unwilling victim of an ailing industry during the 1920s. President Lewis and the UMWA were becoming prisoners of events, rather than the shapers of economic events throughout the decade. Lewis wanted to raise wages so as to force operators to mechanize the industry. He believed the more efficient, high wage union mines would force the less productive and less mechanized southern operators out of business. The union was unable to address and solve the intense interregional and interfirm competition and this inability to address these issues made the union increasingly impotent in stopping the slide in the average price of a ton of coal and subsequent wage reductions. The nation's most viable and powerful union was a shattered and decimated labor organization by the end of the 1920s.

The national coal strike of 1922 became inevitable when coal operators and the union could not agree on a scale of wages to replace the expiring 1920 Washington Contract. Coal operators had campaigned vigorously since 1920 to maintain their high profits and to reduce the economic gains made by the union during the 1919 strike by rolling back wages and hours to the lower wage standard established in 1917. Some union operators expressed the view that the Central Competitive Field interstate bargaining structure should be immediately dissolved, but most executives of the coal companies were content simply to reduce wages and hours to the lower 1917 wage structure.

John L. Lewis asserted "We have tried to bring the mine owners into wage conference and now we are going to strike, " and with that declaration the first UMWA strike of the 1920s was called on April 1, 1922. [55] Lewis called this strike "the Verdun of Organized Labor." The union was optimistic that their strike action would succeed because of their victory in the 1919 strike. Some confident union leaders boldly asserted to their membership that "before the snow flies, we will win." [56]

The strike was the first defensive struggle of the decade by the UMWA to maintain the $7.50 day wage it received for its membership in the 1919 strike. The strike followed the expiration of the 1919 contract on March 31, 1922. Both union and nonunion mines of the anthracite and bituminous fields of Pennsylvania were effectively shut down for the first time in the state's history. Some 6,000 mines nationally were closed and the U.S. Department of Labor estimated 610,000 of the nation's 795,000 coal workers were on strike and manning the picket line by the first week of August, 1922.

Union organizers actively enlisted support from non-organized miners especially in District 2, Pennsylvania, including the counties of Somerset, Cambria, Clearfield, Center and the Broad Top semi-bituminous coal region. Union operators in District 2 produced 72 percent of the region's coal in 1920, but in 1921 they mined only 62 percent of the total. [57] In 1922-1923 the division of coal production was about two-thirds union and one-third nonunion and by the summer of 1925 coal production was 50-50. [58] The rapid growth of coal tonnage in the nonunion fields made it increasingly difficult for the union to maintain higher wages for their membership. For example, production increased by 48.6 percent in Kentucky and 8.3 percent in Virginia in nonunion mines. [59]

John Brophy (1883-1963), District Two president, was convinced that if the union-led strike of 1922 was to succeed in western Pennsylvania the support of non-union miners was essential. Brophy was the son of a Lancashire miner, born in St. Helens, England, in 1883. He had a limited formal education since he entered the mines when he was barely 12 and worked in a number of mines at Carolltown, Greenwich, and Nanty Glo, Cambria County. He was elected a union checkweighman from the South Fork mine and was subsequently elected local secretary. Brophy was elected District 2 president in 1917 and

served in this position until 1928. A centerpiece of his tenure as district president was his five point miners program, a detailed program of what the union needed to do to insure the future prosperity of their membership. He played a prominent role with President Lewis in the formation of the Committee for Industrial Organization (CIO) in 1935.[60]

Union leadership of District 2 issued a strike call to all non-union men from their strike headquarters at Cresson, Somerset County. Organizers distributed 20,000 copies of the union-sponsored paper *Penn Central News* in the non-union coal fields of Somerset County, parts of Cambria County around Johnstown, and the Black Lick field north and west of Nanty Glo, Cambria County. They circulated pamphlets stating the following call: "To All Non-Union Mine workers: STRIKE! QUIT WORK! THIS IS YOUR FIGHT! LEAVE THE MINE! BRING OUT YOUR BUDDIES!" [61] They circulated cards throughout the non-union "patch" towns declaring "Non-Union Towns are Towns of Fear!" because "Non-union miners have lived in Fear! Fear of the Boss-Fear of the Spies and Spotters-Fear of Gunmen and Coal and Iron Police-Fear of the Blacklist-Fear of Evictions." [62] This appeal to "Join the Union and Quit Being Afraid of the Boss" was successful as non-union workers deserted the mines and manned the picket lines. The strike spread quickly into the heart of the non-union counties of Somerset and Cambria counties and the Connellsville coke district of Pennsylvania. They joined the strike to protest working and living conditions around Windber, Somerset County. Miners from the St. Michael Shaft mine of the Berwind-White Mining Company, Cambria County were the first nonunion mine in the district to strike as more than 200 miners walked to South Fork, the nearest town, to sign up with the union. This was the deepest bituminous shaft entry mine in the Commonwealth during this time, located in the vicinity of the famous South Fork Hunting and Fishing Club and the South Fork Dam. The mine, located in Adam Township, was built circa 1908 and operated continuously until it ceased production in 1958. [63]

The Berwind-White Coal Mining Company and the Rockefeller-controlled Consolidation Coal Company were the principal non-union mining companies in Cambria and Somerset counties. The Consolidation Coal Company was incorporated on March 9, 1860, by an act of Maryland's Legislature, when the Frostburg Mining Company, the Ocean Steam Coal

Company and the Mount Savage Iron Company in the Georges Creek Region of Maryland combined their interests to form this new corporation. The company was not incorporated until April 19, 1864. The delay was due to the Civil War. Consolidation Coal Company opened its first mines in the semi-bituminous Georges Creek coal field of Maryland in 1864. The firm developed a close business relationship with the Baltimore and Ohio Railroad, between 1876 and 1906, during which time the two companies monopolized the production and distribution of the soft coal industry in Maryland. The Interstate Commerce Comission held an investigation of this business relationship and concluded in 1906 that this relationship was a business monopoly. The Baltimore and Ohio Railroad was ordered to sell its fifty-two percent interest of coal securities back to the Consolidation Coal Company. The company expanded its regional coal operations beyond Maryland during the first decade of the twentieth century. The company acquired interests in the Fairmont Coal Company, West Virginia, and the Somerset Coal Company, Somerset County in January, 1903. The Fairmont Coal Company was itself created by the consolidation of twenty smaller coal companies. The company owned 37 mines, 1,060 beehive coke ovens, stores and company houses. The company produced about 3.8 million tons in 1902 when acquired by the Consolidation Coal Company. The company opened a number of mines and constructed the company towns of Gray, Acousta, Jenners and Bell, in Somerset County. Consolidation Coal entered the eastern Kentucky coal field in 1909 by acquiring 30,000 acres of coal and surface lands in Johnson, Martin and Lawrence counties. The Rockefeller family purchased thirty-eight percent of the firm's securities and acquired controlling interests of the firm in 1915. John D. Rockefeller Jr. controlled 72 percent preferred stock and 28 percent common stock of the company by 1928. By the 1920s the Consolidation Coal Company was one of the largest coal operators in the nation, having mining facilities and coal reserves in Pennsylvania, West Virginia, Maryland and Kentucky. The company operated simultaneously both union and nonunion operations, and owned 300,000 acres of coal land with reserves of more than 1,800,000,000 tons. The Baltimore based corporation completed its first 70 years of operation and operated 22 mines in four states in 1934.

The Berwind-White Coal Mining Company was formed in 1874 when the four Berwind brothers of Philadelphia - Charles, Edward, John, and Henry and retired Judge Allision White formed a partnership. White was a Philadephia businessman and a former partner of the White and Linge Coal Company. Charles F. Berwind, the principal leader of the firm, entered the coal trade in 1861 at the age of fiveteen. He was employed as an office boy for Robert Hare Powell, a Philadelphia coal merchant. In 1869, Berwind founded his own company named Berwind and Bradley. The company dissolved and in 1874 Charles Berwind and his brothers formed a partnership with Judge Allison White. The Philadephia-based company opened its first mine, Eureka Number 1, in Houtzdale, Clearfield County in 1874. The company operated eleven mines and owned coal lands in Clearfield and Jefferson counties by 1885. The following year the partners incorporated as the Berwind-White Company, with Charles F. Berwind, president, Edward J. Berwind, vice-president, Fred Owen, secretary, and Judge White, treasurer. The company's annual production exceeded 3 million tons by 1892. The firm had established a steamship bunker coal business with the U.S. Navy valued at 2 million tons annually by 1903. The firm had contracts with the principal steamship lines of New York giving the firm a virtual monopoly of the trans Atlantic steamboat bunker coal market. [64] The company owned and operated vessels for coal transportation to Panama and other ports. They operated docks at Superior , Minnesota, for the Great Lakes trade and at New Port News,Virginia and South Amboy, New Jersey for overseas coal shipments.

The firm expanded its mining operations into rural Somerset County by acquiring 60,000 acres of coal lands from local farmers during the 1890s and opened Eureka mine 30 in September, 1897. The firm founded Windber, the name being a transposition of the syllables in Berwind, constructed as a model industrial community to serve as Berwind's headquarters for their extensive coal-mining operations in the region. Windber was laid out in 1897 and incorporated as a borough on July 2, 1900. Berwind-White erected 13 Eureka mines Numbers 30 through 42 around the new corporate town and acquired two shaft mines named Maryland 1 and 2 near St. Michael and Wilmore, Cambria County, respectively. Eureka Numbers 30 to 42 extracted coal in the "B" seam or Lower Kittanning

seam (mines 30, 31, 32, 33, 34, 35) or the "C" Prime , or the Upper Kittanning coal seam (mines 36, 37, 38, 39, 40, 41, 42). Eureka mines 35, 36, 37, 40 and 42 all operated into the 1950s. Between 1897 and 1962 the 13 drift entry mines of the Windber region produced over 150 million tons of coal. The company shipped coal to market on the South Bend Branch of the Pennsylvania Railroad. The company's expansion continued during the next two decades and by the advent of the First World War, Berwind-White Mining Company had acquired coal lands and opened new mines in Westmoreland and Cambria counties in Pennsylvania, and in Kentucky, Virginia and West Virginia. It was one of the largest independent coal companies in the nation by the 1920s, maintaining corporate offices in Philadelphia with sales offices located in New York, Philadelphia, Chicago, Baltimore, and Boston with shipping piers at Newport News and Norfolk, Virginia, Philadelphia, PA., Baltimore, MD., New York harbor, Duluth, MN and Superior,WI in 1945. Most of the firm's coal was sold to ocean-going steamships as bunker coal and to the New York city transit service. The company had a lucrative contract to supply coal to the Interborough Rapid Transit Company, New York City. This coal was an excellant fuel used for manufacturing, steamship and railroad use. The firm called its coal: Berwind's Eureka Bituminous, Berwind's Standard New River and Berwind's Standard Pocahontas. The Berwinds integrated their diverse and wide-spread coal businesses by forming a variety of subsidiary companies to mine its coal, supply its miners with goods and services, and ship its coal to market. The New York based company operated the New River Consolidated Coal Company, the Port Rico Coal Company, the Kentland Coal and Coke Company, the Windber Electric Corporation, the Atlantic Coal Company of Massachusetts, Herminie Land Company and the Eureka Supply Company by 1945.

Union and nonunion coal companies immediately mobilized and fought back attempting to break the strike and curtail the power and influence of the aggressive and powerful miners' union. The strike was both bitter and violent from the start. There were violent confrontations throughout the coal fields of Pennsylvania, West Virginia and Utah between militant nonunion and union miners and hired police forces employed by the coal

companies. Nineteen strikebreakers were killed in retaliatation for the murder of two strikers by mine guards at Herrin, Illinois on June, 1922.

Coal companies possessed an arsenal of resources at their disposal to break the strike. Spies and paid informants were used to infiltrate union meetings to obtain information on union strategy. Strike-breakers (called "scabs" or "rats" by miners), including local farmers, transient workers and African-Americans were immediately imported to work the idled mines. The companies ordered local county deputies, commissioned by the county, and paid by them to be stationed at the mine to protect scab workers and prevent vandalism of mine property by striking miners. The eviction of miners and their families from their rented company houses was a common practice. The lease was terminated automatically whenever a worker ceased to work for the coal company. Coal and Iron Police were used to remove the striking miners and their families from seventeen mining towns in Cambria and Somerset counties alone by the first week of June, 1922 - Conemaugh, Biuman, Holsopple, Ralphton, Acosta, Jerome, Ankeny, Macdonaldton, Kiel Run, Pretoria, Blough, Gray, Bell, Husband, Revloc, Twin Creek and Windber. Miners and their families spent the harsh winter of 1922-1923 living in ramshackle tarpaper shacks, tents or crudely constructed barracks. [65] A striking non-union miner at Maryland No. 1 Shaft of the Berwind-White Mining Company reported his eviction: "They made us move out. They threw our furniture out onto the street if you tried to organize. They had what you would call pussyfoots (Coal and Iron Police) riding horses, and if you would get four or five men in a group and try to organize, they would come and break it up." [66]

Coal companies of Pennsylvania had their own personal police force, known as the Coal and Iron Police, legally recognized by the state of Pennsylvania. This industrial police force was created by two statutes passed by the General Assembly of Pennsylvania in 1865 and 1866. The General Assembly passed a legislative act in 1865, "authorizing any corporation owning, or using, a railroad, in this state the right to petition the governor may designate as policemen with powers to arrest and incarcerate." The second statute, passed in 1866, authorized "corporations owning and operating mines and steel mills in this state to apply to the governor to commission such persons as the corporation may designate as policemen

with powers to arrest and incarcerate." [67] This police force was the primary law-enforcement agency used primarily by coal and railroad companies in the anthracite coal region. Its presence permitted the anthracite coal and railroad companies to exercise both social and military control of the area. The police had been employed to suppress the Irish secret militant society, the Molly Maguires, during the 1860s and 1870. These men were recruited from the ranks of the unemployed or former policemen and were hired by strike-breaking detective agencies for their ability to use rifles and blackjacks. No special training was required for these police, and a fee of one dollar per commission payable to the state of Pennsylvania qualified them to carry the Coal and Iron Police badge and a variety of weapons - rifles, 38 Colt pistols, black jacks and billy clubs.

They were used regularly in the bituminous coal fields of western Pennylvania since at least the 1922 strike. Miners contemptuously called them "Cossacks," "Pussy-footers," "Company Men," and "Yellow Dogs." [68] Cossack was a generic term used by most industrial workers to describe state troopers or paramilitary police organizations used by management to suppress strikes or to spy on union activities. Coal miners, like steel and railroad workers, saw them as simply common gunmen, hoodlums and adventurers. This private police force provided a variety of essential services for their employers. They patrolled the company town, evicted striking miners from company housing and enforced their private laws in the "patch;" recruited, imported and protected strike-breakers, and provided security for mining property against violent attacks on coal property from strikers. They were hated and feared for their excessive brutality and lawlessness in their vigorous attempts to suppress strikes and maintain control in the company town. The violence they provoked led often to counterviolence from the miners.

Deputy sheriffs and Coal and Iron Police were conspicuously active during the strike. The coal companies of Fayette County alone hired 2,500 deputy sheriffs to protect their property and evict miners. There was one deputy for every twelve striking miners in the county. [69] These private guards cost the coal companies about $5.60 to $9.00 per day in Fayette and Greene counties. *Coal Age,* the principal coal mining weekly journal, reported the strike with weekly articles published between April and October, 1922. It reported on

April 13, 1922 that , "in the Uniontown area many plants are being enclosed by barbed wire and hundreds of special deputees have been sworn in to guard mine property." Violence between deputy sheriffs and non-union miners broke out at numerous mines in Fayette and Westmoreland counties as striking miners destroyed company property at the mines. The *Penn-Central New* reported on the numerous violent confrontations between striking non-union miners and hired company police in District 2 in 1922. The following excerpts are typical of the repressive tactics employed by coal companies to suppress the strike in the coal region:

> Charles Dias, after helping five miners evicted from the Vinton Collieries Company at Claghorn, Indiana County on May 8, was beaten up by two Coal and Iron police while on the station platform. He was hammered over the arms and head with a club and blackjack, denied a doctor, was driven down the railroad track at a revolver point (sic).
>
> Tony Lilko, at Berwind No. 38 mine, while helping a comrade evicted from a company house, was arrested for "trespass;" two guards beat him up and added the charge of resisting officer; he was taken by the company store boss to a neighboring town where a justice was found to hold Lilko on the charges.
>
> At Kelso on June 7 three women and one man were arrested by a parade of fourteen deputies and guards, armed with guns and clubs, fined $25.50 to $39.00, each and jailed in Somerset on refusing to pay; charges "disorderly;" they had been picketing.[70]

The Harding Administration attempted to mediate a solution to the strike as it spread throughout the coal fields and acts of violence between labor and management escalated. The Administration was fearful of a coal shortage during the up-coming winter. President Harding ordered miners and the operators "to resume mining operations at once and then

adjust their differences in joint conferences." Harding had threatened to use government force if the strike was not immediately resolved. Coal was still the nation's main energy provider, and a coal shortage from a prolonged strike would cripple transportation, communication, home heating, and industry throughout the nation. The strike had already cut weekly coal production between 4,000,000 to 6,000,000 tons. Coal reserves had fallen from over 63,000,000 to approximately 22,000,000 net tons, the second lowest reserve on record. Nonunion operators in the South, West Virginia and Pennsylvania were unable to meet the national demand for coal.

Union leaders, coal operators, and government officials met in Cleveland throughout the summer and on August 15, 1922 a new labor contract was negotiated and signed. The contract ended the great strike of 1922 after four and a half months. The agreement maintained the economic gains acquired by the UMWA since the 1920 agreement. Some 45,000 union mine workers in District 2 and 500,000 miners in other parts of the country immediately returned to the mines. John L. Lewis proclaimed the strike a complete victory for the miners although the nearly 70,000 nonunion miners who had so passionately supported and participated in the strike were excluded from the labor settlement. Brophy and other union organizers harshly criticized Lewis and their union for their abandonment of the new union recruits from Cambria and Somerset counties following the Cleveland settlement.

The management of Berwind-White Coal Company was traditionally a virulently anti-union firm and refused to sign a union contract with its workers. The company resorted to any methods needed to suppress their workers' drive for union representation during the strike. Some miners, accompanied by their families,went to New York City to picket the company's office. The firm had a lucrative contract to supply coal to the city's subway system. John F. Hylan, mayor of New York City, concerned by these noisy demonstrations, appointed a five member committee, chaired by David Hirshfield, to investigate the mining and living conditions of Berwind-White coal towns. The committee travelled to Windber and called a number of meetings to investigate conditions experienced by striking miners and their families but the firm boycotted all the committee's hearings.

Commission members visited the firm's numerous mines and company towns around Windber and recorded the inhuman and depressing conditions. The company had evicted the strikers and their families who resided in make shift "tent towns" that sprang up at the end of the company towns. Their diets were poor and hygienic conditions in these make-shift tent towns were simply appalling. The commission released their report in 1923, declaring that miners worked and lived in settings "worse than the conditions of the slaves prior to the Civil War." [71]

W.J. Lauck , of the United States Immigration Commission, attributed the following characteristics to southern and eastern Europeans workers' in 1911: "when aroused the Slavic races have demonstrated their inclination to follow their leaders to any length, but in the normal life of the coal fields the miners of recent immigration are usually tractable and easily managed, and are imposed upon without protest. This temperament would give the impression of subserviency to their employers and to older workers." [72] His views were shared by coal operators and some leaders within the UMWA. The striking immigrant miners' militant and unified action during the strike destroyed forever the pervasive belief that these immigrants were passive and malleable workers. A majority of the workers in the Eureka and Maryland mines of the Berwind-White Mining Company were immigrants from southern and eastern Europe. There were only 411 American workers in a labor force numbering 2,894 in January, 1922 at their mines. These foreign-born nonunion miners from District 2 felt betrayed by union officials after they had so passionately supported the union's strike call. They continued the strike for union recognization with little overt union support until miners' delegates from Somerset County met in Johnstown on August 14, 1923 and called off their 17-month strike. [73] They were forced back to work under similar conditions that had prompted them to strike. These militant immigrant miners remained demoralized and unorganized until the next major organization drive by the UMWA in 1933. [74]

Brophy spoke on behalf of these unorganized immigrant miners before the United States Coal Commission in Washington, D.C. in 1923. He identified six demands of the striking nonunion men as follows: 1) collective bargaining and the right to affiliate with the union;

2) fair wage; 3) accurate weight of the coal they mined; 4) adequate pay for "dead work;" 5) a system by which grievances could be settled in a peaceful and conciliatory spirit by the mine committee representing the miners and a representative of the operator; 6) their rights as free Americans against the state of fear, suspicious and espionage prevailing in non-union towns and against a small group of operators controlling life, liberty, and the pursuit of happiness of a large number of miners. To put an end to the absolute feudal control of these coal operators. [75] Most of these demands were guaranteed to union miners but did not apply to the nonunion miners of District 2 or other miners employed by nonunion coal companies.

The U.S. Coal Commission which Brophy had testified before was also known as the Harding Commission. This commission was yet another in a series of government commissions established to examine the ailing American coal industry. [76] The federal government had proposed some sixty laws, commissions, or investigations of the bituminous coal industry between World War One and the New Deal. Public concern with the violence engendered by the recent strike had prompted its establishment on October 10, 1922 "for the purpose of securing information in connection with questions relative to interstate commerce in coal, and for other purposes." [77] President Harding appointed a seven man commission to undertake a comprehensive investigation of the industry and to recommend procedures for the industry's reorganization. The Commission was essentially a fact-finding body and during the next eleven months scrutinized all phases of the bituminous coal industry in the major coal fields in the East and Midwest. This voluminous study was followed by a second and third extensive government survey investigating conditions in the coal fields in 1947 and 1980. [78]

The Harding Commission issued a massive four volume study comprising 800,000 words on September 22, 1923. The study consisted of a series of reports on various phases of the mining industry and provided a detailed portrait of all facets of the industry during the 1920s. [79] The Commission conclusions, adopted by unanimous vote of the commissioners, rested on two broad principles: 1) coal is a public utility, a public necessity, affected by a public interest, and its mining, transportation, and distribution is

therefore subject to supervision and regulation by the federal government; and 2) the main responsibility for solving the problem of the industry must rest on the industry itself; "not through governmental coercion but through the enlightened self-interest of producers and consumers. The real remedy is to be sought; and the coal industry can reform itself from within." [80] John Hays Hammond, Chairman of the Harding Commission, suggested four areas of improvement to make the industry a more rational and profitable business: 1) development of machinery "to replace the irksome and solititary operation of hand loading," 2) improved control of underground operation, 3) improvement in the work of the individual, 4) and standardization of equipment. [81] The Commission's recommendations on what ailed the industry and possible solutions were generally ignored and summarily dismissed by the union, the coal operators, and the federal government. Many of their recommendations were later implemented during Roosevelt's first New Deal.

The two-year Cleveland Agreement expired on April 1, 1924 and the international officers of the UMWA, coal operators, and government officials met in Jacksonville, Florida. Both management and the UMWA were aware of the two salient facts now confronting the industry: it was capable of producing twice as much coal as the nation could consume and there were twice as many miners as were needed in the industry. Nevertheless the UMWA insisted on maintaining the wage scale of $7.50 established in 1920 and maintained in the 1922 Strike. The Jacksonville Interstate Joint Agreement signed in New York by the Central Competitive Field operators maintained the 1920 wage scale and served as the basis for coal agreements signed in other bituminous coal fields including those fields in the southwestern states. The contract stated simply in two paragraphs that the Cleveland Agreement, signed on August 20, 1922 and expiring on April 1, 1924, would be carried forward and that district and subdistricts then in effect would be extended without any further negotiations. The three-year Jacksonville Agreement was signed on February, 1924 and was effective until its expiration on April 1, 1927. There was the belief by the union that high labor wages would stabilize the industry without government intervention because the high wage scale of $7.50 a day would close down high cost and unprofitable mines.

The UMWA Journal and most union miners hailed the agreement as the best contract ever negotiated with the coal operators of the Central Competitive Field. They were elated and after its ratification, by a vote of 164,858 to 26,253, chanted "we got a three-year contract; next time we'll make it five." [82] Herbert Hoover, Secretary of Commerce, who helped to successfully mediate the Jacksonville Agreement, called the agreement "the most constructive development in the bituminous industry for years" and declared later:

> The coal industry is now on the road to stabilization. The benefits lie not only in the position of coal to consumer at lower prices than have been attained at any time since the beginning of the war. The gradual elimination of high-cost, fly-by-night mines is bringing about a greater concentration of labor upon a smaller number of mines, the increase in days of employment per annum, and thus a larger return to the workers. The inherent risk in the industry will be decreased because the efficient and stable operators will no longer be subjected to the type of competition that comes when those mines that exist only to take advantage of profiteering periods. [83]

Coal operators, under the new contract, agreed to keep wages at $7.50 a day base pay for company men and $1.80 per ton on piece-rate. This rate was considerably higher than the prevailing wage-scale paid workers in the nonunion coal fields. The contract, in essence, simply maintained the status quo of the previous miners' contract, which was a "small miracle" considering the rapidly deteriorating state of the soft coal industry since 1923. Coal prices had declined by 40 percent since 1922 while the number of unemployed mine workers rose by 80,000. Some union operators followed suit and renewed contracts according to the 1920 scale while the union operators in the Kanawaha region of West Virginia refused to sign the union contract and attempted to operate their mines as open-shops. [84] They refused to accept the union agreement, contending they could not compete with the nonunion Mingo, Logan,Williamson, Pocahontas, New River, and eastern Kentucky regions. The ten coal fields of West Virginia were Panhandle, Kanawha,

Fairmont, Upper Potomoc, Elkins, Gauley-Greenbrier, New River - Winding Gulf, Pochahontas, Williamson and Logan. The Kanawha Field is located in Boone, Logan, Kanawha, Putnum, and Mason counties while the Fairmont Field is located in Barbour, Preston,Taylor, Harrison, Marion and Monongalia counties (Illustration 4 - West Virginia Coal Fields). Coal companies in Colorado, Utah, Texas, Maryland and Virginia were already operating 100 percent nonunion mines at this time. The southwest mining region, once a stronghold of unionism, had begun to break up by 1924. The Jacksonville Agreement was signed by one-fourth of the mine owners in Oklahoma although the union was not represented in the larger mines in other southwestern states. [85] This breakdown of collective bargaining happened in spite of strong resistence by the UMWA. The inability of the union to organize these areas and establish collective bargaining between northern and southern operations made the future success of the union precarious.

Some Central Competitive Field operators, who had voluntarily and in good faith signed the three-year Jacksonville Agreement, asked Lewis and the UMWA for an immediate wage cut before the first year of the contract was fulfilled. Union operators faced with overproduction and falling coal prices during the postwar years sought to reduce operational costs, especially those of labor. They blamed their economic difficulties on the relatively high wages paid union miners in their mines. They declared that their signing of the agreement was a grave economic mistake and demanded that the union accept a six dollars a day wage for its members. They asserted that without these concessions more union mines would close. The UMWA power had been centered in the Central Competitive Field of western Pennsylvania, Ohio, Indiana and Illinois since 1897, when John Mitchell signed the union's first collective bargaining contract. The UMWA had successfully organized most mine workers in these states by 1924. All miners of western and central Pennsylvania were unionized except for the the following districts: Clearfield, Cambria, Somerset, Myersdale, Indiana, Latrobe, Connellsville, Youghiogheny and Westmoreland. All of northern West Virginia, except the Upper Potomoc field, as well as the Georges Creek field in Maryland were unionized. Virginia was unorganized and only a small section located in northern Kentucky had union representation. The balance of the Appalachia

region through Kentucky, Tennessee, and Alabama was nonunion. [86] The nonunion operators were paying as a rule lower wages, some as low as the 1917 level. The table below compares the different wage scales for underground and surface workers and clearly demonstrates that union operators were economically handicapped in competing with nonunion operations.

Average Wages of Daymen in Union and Non-Union Miner in 1920

	Union	Non-Union		Union	Non-Union
Blacksmith	$7.57	$6.36	Bratticeman	$7.42	$5.96
Carpenter	$7.14	$5.04	Doortender	$4.48	$4.26
Engineer	$7.29	$5.97	Driver	$7.47	$6.22
Fireman	$6.95	$5.41	Pumpman	$7.14	$5.53
Stableman	$6.07	$5.07	Timberman	$7.52	$6.26
Laborer	$6.55	$4.58	Tracklayer	$7.35	$6.09
Miscellaneous	$6.74	$5.37	Laborer	$7.16	$5.08
			Miscellaneous	$7.46	$5.99 [87]

Labor costs accounted for as much as two-thirds of the total cost of mining a ton of coal. This economic advantage meant nonunion coal companies could produce coal at lower costs, sell it at a lower price and open more new mines while union operators were permanently closing some of theirs and dismissing miners. Competition from nonunion southern coal eventually forced union operators to break their union contracts and cut wages.

President Lewis, the union's national leadership, and the rank-and-file were all politically and philosophically committed to maintaining the Jacksonville Agreement. Although the efforts of the union to organize tminers in the South failed in 1921, Lewis embarked on his

"no backward step" program. Lewis told a newspaper reporter in May, 1923, that "the union miners cannot agree to the acceptance of a wage principle which will permit his annual earnings and his living standards to be determined by the hungriest unfortunate whom the nonunion operators can employ." [88] Lewis' firm policy of "No-Backward-Step" regarding demands for wage concessions was strongly endorsed by union miners at their annual convention in 1924. Lewis insisted upon the retention of the $7.50 base rate in the Central Competitive Field and noted that if a wage reduction was granted to the coal companies by the union "the non-union crowd would simply make another cut in the wages of their miserable workers and the same relative condition would continue." [89] Lewis refused and informed the coal companies that the union would not renegotiate the contract until its expiration in 1927. He was contemptuous of coal companies and their managerial skills accusing them them of "being incompetent, inefficient, backward, lazy and disunited." [90] Lewis was a firm believer in the natural law of survival of the fittest and argued that the future economic prosperity and stability of the coal industry was possible only if the industry operated with fewer mines and fewer miners. Strict adherence to the higher wages of the Jacksonville Agreement would force inefficient coal operators to put the management of their mines on a more efficient basis, to consolidate their operations and close unprofitable mines, and to install labor-saving machinery, especially the new mechanical coal-loaders. The union believed high union wages would drive inefficient coal companies into bankruptcy. The uncompromising and intransigent position taken by Lewis and unanimously supported by the rank and file of the UMWA was fraught with danger in this period of severe economic decline. Lewis expressed his own sense of deep apprehension to a newspaper reporter when he stated that "we expect losses, perhaps heavy losses, but we are confident of victory in the end." [91] "In light of Lewis' refusal to revise the Jacksonville agreement," historian Irving Bernstein noted, "the operators set about the systematic destruction of the union." [92]

The Jacksonville Agreement was first abrogated by Rockefeller's Consolidation Coal Company and the Bethlehem Steel Company in the coal fields of northern West Virginia in July, 1925; daily wages were reduced to $6.00 a day. The successful "Open Shop" drive

by these companies in West Virginia was immediately followed by the Mellon-controlled Pittsburgh Coal Company which announced the following month that it would operate on a strictly nonunion basis. This Pittsburgh-based coal company, founded in 1899, was the largest coal company in the world at this time. The firm operated over 100 mines employing some 17,000 union workers in Pennsylvania, Ohio and Kentucky. [93] Management, as members of the Central Competitive Field, had honored all union contracts it signed with the UMWA since its formation. The prominent Mellon banking family of Pittsburgh, led by Treasury Secretary Andrew W. Mellon and his brother Richard, acquired 25 percent of the company's stock in 1924 and controlled the board of directors of the firm. [94] The new Mellon management believed the firm could not continue to effectively compete with rival nonunion coal operators especially those from West Virginia, Kentucky, Tennessee, Virginia and Alabama. Their solution was to crush the union. Management rejected the Jacksonville Agreement unilaterally and on August, 1925 posted notices at their mines that wages were reduced immediately to $6.00 a day and all mines would operate on a nonunion basis.

James D.A. Morrow, president of the Pittsburgh Coal Company, in an open letter to striking employees, clearly stated the producer's intent to operate their mines on the "Open Shop " principle, "Don't believe any story that this company is going to sign up with the union on April 1 or any other time. This is not true and has been put out to scare you and make you unhappy. We will never sign a scale with any union again. We will always have open-shop mines. We will never run any mine any way but shop open." Morrow was a former executive of the Joy Manufacturing Company and left to become vice president of sales for the Pittsburgh Coal Company. He was soon promoted president of the company, a position he held for 14 years until his return to Joy Manufacturing in 1940. [95] William G. Warden, Chairman of the Board of Pittsburgh Coal Company, testifying before a Senate Committee in 1925, was asked why the firm locked out its striking workers. He answered simply that "We were losing money. The firm had operated under a deficit for seven years in the decade after World War One." [96]

While Consolidation Coal Company and Bethlehem Steel Company were able to break the union at their West Virginia mines easily, Pittsburgh Coal Company spent three long years fighting the union. The company's losses in 1924 approximated about 10 cent per ton on all coal mined. [97] The struggle changed the financial status of the firm as the company went out of business, on paper, to avoid being sued for breach of contract by the union, and reorganized itself. This was a terribly expensive and destructive fight and started the company on a twenty-year period of no dividend payments to stock holders, as large arrearages accumulated on its perferred stock and made merger a logical step in the near future.

Pittsburgh Coal Company prepared for a violent amd protracted conflict with their union miners by doubling the number of its Coal and Iron Police, importing African-Americans from the South and white strikebreakers to mine coal, and obtaining a federal injunction restricting the number of pickets at their mines. Strike breakers were regarded by striking union miners as "bums and thugs." African-American miners were employed chiefly in three southern coal-producing states during the 1920s: more than 25,000 in West Virginia (most worked in the southern counties), some 17,000 in the Birmingham district of Alabama, and nearly 10,000 in Kentucky (most in the western Kentucky field). About 3,500 worked in the coal fields of Virginia and Tennessee. [98] Striking white miners called the "scab" African-American labor force "Roanoke niggers" because many were recruited by Pittsburgh Coal Company from this Virginia city and the surrounding rural comunities.

Coal companies had imported thousands of African-Americans from the South as strikebreakers throughout the strife-ridden 1920s. African-American workers were recruited from the South and lured North by the promise of high wages. "Scabs" or "blacklegs" were derisive terms used by union workers to describe workers who refused to join the the union and instead replaced them in the mines. A UMWA organizer lamented "Next to a scab, the lowest form of human life is an oilburner salesman." [99] Racism combined with the hatred of scabs frequently led to violence in the coal fields. A popular union song of striking miners during the 1920s clearly expressed their hatred and contempt of "scab" labor: "Just like a mule, A goddam fool, Will scab until he dies." [100] African-

Americans constituted fifty percent or more of the nonunion miners in a number of Pittsburgh Coal Company mines; they made up to one-third of the nonunion labor force at the mines of Pittsburgh Terminal Coal Company and other mining companies in southwestern Pennsylvania by the mid 1920s. Strike-breakers did not produce much coal because many were simply unskilled at mining. Some contemporary miners were racists and called them "niggers," "cotton pickers," "blackbirds" and other expletives. Veteran miners believed that management brought them to the mines not to mine coal but to humiliate and "to break their hearts" by showing them that anyone could mine coal, "even niggers." Some companies built barracks and tents to house their strikebreakers and segregrated strikebreakers according to race. This area of the "patch" was referred to as "scab hill" after the strike.

Pittsburgh Coal Company mines were reopened on an open-shop basis three months later with wages reduced by 33 percent. Management slashed wages an additional 20 percent in 1927. The destruction of the union by the Pittsburgh Coal Company did not bring economic prosperity as it lost more money in 1925 and its deficit crawled up to $2,175,000 in 1926. [101] The inability of the Pittsburgh Coal Company to make a profit was shared by other union mines. Income and tax returns from coal companies during the 1920s showed more firms reporting no net income with each passing year between 1920 and 1925.

Income and Tax Returns of Bituminous Coal Companies

Years	Returns	Firms Reporting Net Income	Firms Reporting No Net Income
1920	1234	1152	82
1921	1234	503	731
1925	3650	1065	2585

1928	2705	863	1842
1929	2469	934	1535 [102]

Returning former union miners of the Pittsburgh Coal Company were forced to sign a "Pocahontas" labor contract better known as the "yellow-dog contract," as a condition of their employment. They were called yellow-dog contracts because supposely only a "yellow-dog " would sign one. The contracts signed by miners as a condition of their employment stated "I am not now a member of the United Mine Workers and I enter this employment with the understanding that the policy of the company is to operate a nonunion mine and would not give me employment under any other condition." [103] Their use was criticized and despised by all miners and the UMWA. One miner clearly voiced this sentiment stating: "This Yellow Dog Contract, knocks a man out of his citizenship rights. A man hain't (sic) got no protection under it. He can be kicked out any time like a yellow dog. Under the contract which I signed if I get fired I can be forced to move out of my house inside of an hour." [104] Labor injunctions were also used by coal companies during the 1920s especially in the 1925 and 1927 strikes.[105] Millions of dollars were spent by the UMWA to have them struck down as unconstitutional. Miners who refused to work in the nonunion mine found themselves fired and their families forceably evicted from their rented houses. The UMWA spent nearly $8 million dollars to support these evicted miners and families by providing money to erect temporary housing, including wooden barracks and tents near the "patch" towns. The barracks were constructed very crudely out of tongue- and grove board and were not insulated. [106]

A primary cause for the decline of the UMWA during the 1920s was the union's inability to organize the expanding southern coal fields. Northern union operators had been urging the union to organize these regions ever since the 1890s, but unionization attempts in the expanding southern fields were sporoadic and generally ineffective. The wage scale of Jacksonville Agreement of 1924 was well above the prevailing rates in the non-unionized coal fields. Southern coal operators paid their workers lower wages and these savings permitted them to undersell their coal in the shrinking commercial coal market and to

acquire more coal lands. The capacity of coal stood at one billion tons in 1926, the nation demand was half of that. The nonunion mines had seized almost half of the market. Lewis accused these nonunion operators of perpetuating a system of either feast or famine in the coal industry, noting that the coal operators of Logan County, West Virginia were "practicing economic feudalism as the operators governed by terror and peonage of workers, a regime of private government backed by an army of mercenaries." [107] The shift of coal production from northern union fields to southern nonunion fields was continuing at a steady pace throughout the 1920s. The demands for wage and hourly concessions by union coal companies were motivated by genuine economic distress and not simply motivated by corporate avarice for increased profits.

The Pittsburgh Coal Company strategy to transform their operations from a union to a nonunion producer was copied by rival union coal companies in Pennsylvania, Ohio and West Virginia. Company after company followed Pittsburgh Coal's lead and by Christmas of 1925 almost 100 coal companies and some 110 union mines in Pennsylvania and 50 mines in West Virginia had rid themselves of union representation. The Inland Collieries Corporation, a subsidiary of Bethlehem Steel Corporation, the Youghiogheny and Ohio Coal Co., Paisley Coal Co. of Ohio and the Rochester & Pittsburgh Coal Co. of Indiana, County all decided to run their mines as nonunion operations. These companies represented some of the largest coal operators in Pennsylvania and neighboring states. The principal objective of these companies was not simply to extract temporary wage concessions from the union but to operate their mines on a nonunion basis. Some Central Competitive Field producers honored the Jacksonville Agreement until its formal expiration on April 1, 1927. Frank E. Herriman, president of the Clearfield Bituminous Coal Corporation, regarded the 1925 wage agreement with the union as "legally and morally binding" and honored the contract until its expiration. [108] This company operated a number of mines at the company towns of Rossiter, Barr and Commodore, Indiana County. Union operated companies, which honored the Jacksonville Agreement until its expiration, thereafter refused to recognize the UMWA as a bargaining agent for their miners and demanded significant wage and hour concessions from them.

There had been closures of numerous unprofitable mines and companies ever since 1923, although not in sufficient numbers to decrease the over-capacity of coal to an appreciable extent. Numerous union mines began to close during 1925-1926 because operators could not mine coal profitably at $2.04 per ton and compete with nonunion southern coal operators. Unemployed union miners were forced to find work at nearby nonunion mines or moved south to find work at non-nion mines which were operating at the lower 1917 wage scale. Individual UMWA locals held selective strikes between 1925 and 1927 in a futile attempt to stop the erosion of union-operated mines in western Pennsylvania. The UMWA spent more than seven million dollars during 1925 and 1926 largely to conduct selective strikes at mines where the Jacksonville Agreement had been abrogated. The UMWA scale committee authorized local districts to make local agreements for its members with individual companies. The union scale of $7.50 was a memory by 1926 as this daily rate was maintained only in Illinois, although Illinois locals accepted day rates as low as $5.00 per day with the expiration of the Jacksonville Agreement.

The union accused Andrew W. Mellon of Pittsburgh Coal Company, Charles M. Schwab of Bethlehem Steel Company and John D. Rockefeller Jr. of Consolidation Coal Company of conspiring to destroy their union mines located in Pennsylvania, West Virginia, and Ohio. They called upon Herbert Hoover, Secretary of Commerce, to intervene and stop this apparent union-busting activity reminding him, "you sanctioned the Jacksonville Agreement, now back it up." [109] The government did not intervene and by this inaction had tacitly condoned the union-busting activities of the coal operators.

The UMWA leadership called for the obligatory general strike on April 1, 1927 under the slogan "no backward step" with the formal expiration of the three-year Jacksonville Agreement. [110] The strike call initiated one of the most bitter and prolonged labor disputes of the twentieth century which continued until October, 1928 when the strike was officially declared over. Despite the Jacksville Agreement of 1924 which quaranteed miners a wage of $7.50 a day few union mines were still operating under this agreement in Pennsylvania, Ohio, Indiana, and Illinois when the union called for the strike of 1927. The union was driven out of New River,West Virginia after 1922, Colorado in 1922,

Kanawha, West Virginia and western Kentucky in 1924 and northern West Virginia in 1924-1925. Most operators in western Pennsylvania, Ohio, Oklahoma, Arkansas, Maryland and Iowa all discarded their union contracts and operated nonunion mines after 1925. [111] This strike, unlike the 1922 strike, was doomed because no coal shortages in the nation would determine the course of the strike. The nation's coal needs could be easily filled by production from the nonunion southern coal fields. The division between union and nonunion coal production was about two-thirds union production and one-third nonunion production in 1922-1923. [112] The share of the nation's coal output from nonunion mine operations increased from about 28 percent in 1919 to about 60 percent in the summer of 1925. The traditional northern unionized fields of Pennsylvania, Ohio, Indiana, and Illinois lost about forty-four million tons of yearly production from 1924 and 1927. By 1926, for the first time in about 30 years, nonunion mines in the Pittsburgh district produced more coal than union mines. The nonunion fields of southern Appalachia increased their production by 57 million tons during this same period. [113] A southern Ohio coal operator reminded his striking union miners that "the mines of West Virginia are today working full time filling your orders while you have no work. These mines could take care of their trade and also all the trade formerly held by the Ohio mines." [114]

The strike, from the very outset, was especially violent as some 200,000 union miners left the pit on April 1, 1927. The strike involved as many as 100,000 miners in western Pennsylvania who effectively closed down all mining activity in Pennsylvania. The nonunion miners south of the northern West Virginia fields were not affected by the strike. The union-busting coal operators were victorious by employing similar strategies they had used during the 1922 strike. The operators used dismissal, blacklisting, "yellow-dog" contracts, sheriffs' deputies, injunctions, importation of "scab" labor, private security police, and state and federal troops to suppress the strike. Pittsburgh Coal Company, H.C. Frick Coke Company, Bethlehem Mines Corporation and Pittsburgh Terminal Railroad Company, for example, employed the notorious and hated Coal and Iron Police to protect their properties and intimidate striking miners and their families. Company coal police wielded all the powers of public police officers in the state. Governor John S. Fischer,

(1927-1931) a former executive of the Clearfield Bituminous Coal Corporation, Indiana County, and a close personal friend of the Mellons of Pittsburgh Coal Company issued so many Coal and Iron Police commissions during the strike period that angry union leaders complained that they were running amuck in the coal mining regions of western Pennsylvania. Fisher issued four thousand commissions and permitted hundreds of uncommissioned men to wear the Coal and Iron badge during his term.[115] The coal company paid one dollar for each commission payable to the Commonwealth between 1871 and 1929. There is no record of a commission having having been revoked during this entire period. Hearings before the Committee on Interstate Commerce as documented in *The Conditions in the Coal Fields of Pennsylvania,West Virginia, and Ohio* in 1928 observed:

> [The coal and iron police] are all very large men; most of them weighing from 200 to250 pounds.They are all heavily armed and carry clubs, usually designated as "blackjacks." Everywhere the committee visited they found victims of the coal and iron police who have been beaten up and still carrying scars on their faces and rough treatment they had received...[116]

The use of a private police agency by the coal operators of Pennsylvania was not a unique phenomenon. The Baldwin-Felts Detective Agency played a similar role for the coal operators in the coal fields of Virginia and West Virginia. William G. Baldwin and Thomas L. Felts established the Baldwin-Felts Detectives Agency in Virginia and the agency was subsequently incorporated during the 1890s. Mine guards were ostensibly hired by coal companies to break strikes, spy on miners, maintain order in the company towns and evict striking workers from company-owned housing. Baldwin-Felts gunmen were involved in the infamous 1921 Matewan Massacre, Matewan,West Virginia. The West Virginia State Police was not established until 1919. A West Virginia law passed in 1933 prohibited the employment of private police by coal companies, and the law helped bring about the

inevitable demise of the Baldwin-Felts Detective Agency in 1935. The mine guard system was formally abolished in West Virginia until the administration of Governor Holt in 1937.

The United States Senate Committee on Interstate Commerce established an ad hoc special committee in 1928 to investigate charges that the John Rockefeller-controlled Consolidation Coal Company, General W.W. Atterbury of the Pennsylvania Rail Road, and the Mellon-controlled Pittsburgh Coal Company were "responsible for hunger and radicalism of the reddest kind in the mine fields." [117] This subcommittee (U.S. Senate, *Subcommittee of the Committee on Interstate Commerce Conditions in the Coal Fields of Pennsylvania, West Virginia and Ohio*. 70th congress, 1st Session, 1928) was one of the few congressional bodies to leave Washington and conduct its inquiry in the coal fields of the Pittsburgh District, Pennsylvania, West Virginia and Ohio. Commission agents visited numerous isolated mining communities and immediately described "the squalor, suffering, misery, and distress as a blotch on American civilization." [118] Senator Frank Goodling of Idaho visited a number of Pittsburgh Coal Company mine towns in western Pennsylvania, and reported that "women and children [are] living in hovels which are more unsanitary than a modern swinepen. They are breeding places of sickness and crime." [119]

The Commission's findings filled two immense volumes entitled *Conditions in the Coal Fields of Pennsylvania, West Virginia, and Ohio* which carefully documented the worsening conditions in the strike-torn mining communities of these regions. The dismal quality of daily life of miners and their families in western Pennsylvania was chronicled by newspaper reporters. Journalist Lowell Limpus of the New York *Daily News* visited the strike areas and reported in explicit terms the conditions he encountered:

> I have just returned from a visit to "Hell in Pennsylvania." I have seen horrible things there; things which I almost hesitate to enumerate and describe. ... I went into the coal camps of western and central Pennsylvania and saw for myself. We saw thousands of woman and children, literally starving to death. We found hundreds of destitute families living in crudely constructed bare-board

> shacks. They had been evicted from their homes by the coal companies. We unearthed a system of despotic tyranny reminiscent of czar-ridden Siberia at its worst. We found police brutality and industrial slavery....we unearthed evidence of terrorism and counterterrorism; of mob beatings and near lynchings; of dishonesty, graft, and heartlessness. ... The mine fields are a bubbling cauldron of trouble. If it boils over - and it threatens to do so-blood must flow freely and many lives pay the forfeit. [120]

UMWA membership fell from nearly 400,000 members to less than 100,000 during the first decade of Lewis's presidency. In 1928 President Lewis told a goverment committee established in Washington, D.C. to investigate the recent violence in the coal fields that "the bituminous industry is today in the worst state of demoralization it has ever known. In some regions the work day had been increased from eight to ten hours while wages were slashed to $2, $3, and $4 dollars a day." [121] Wages were less after the strike than they had been in 1924. Coal sold below actual production costs and miners wages plummeted to as little as $2.50 a day. The strike proved to be a complete disaster for the union and its consequences were much worse than anything Lewis could have ever imagined. The union was simply decimated as a result of the strike! The UMWA membership in the bituminous fields dropped from 386,000 members in 1920 - nearly two-thirds of all mine workers then employed - to about 84,000 or barely one-sixth of all miners employed in 1929. The Canadian membership in the UMWA fell from 20,600 to 12,900. [122] Seventy-one union mines alone between Connellsville and Brownsville employing about 20,000 workers, became nonunion operations by February, 1928.

Lewis and the UMWA executive leadership abandoned any attempt to maintain a national centralized wage policy for its membership when the strike finally collapsed in October, 1928. Individual districts were instructed by the UMWA to negotiate with individual coal companies the best possible contract for their membership. The UMWA bargained collectively for about 84,000 dues-paying members or less than 20 percent of the nation's bituminous miners. Agreements in Indiana and Illinois resulted in 18.7 percent wage cuts

while Ohio miners saw their wages reduced by one-third. The UMWA only remaining strength lay in the dissension-ridden Illinois and Indiana coalfields and in the anthracite districts of northeastern Pennsylvania. The Central Competitive Field as a bargaining organization was gone, never to return. Josephine Roche, president, manager, and the majority stock holder of the Colorado Coal Company, accepted union representation and signed a two-year wage agreement in 1928 with the UMWA. Most operators in Colorado opposed her policy of conciliation with the miners' union. Roche signed the contract with the UMWA covering about six hundred workers, for the purpose of "stabilizing employment, production and marketing through co-operative endeavor and the aid of science." [123]

Lewis' leadership was seriously challenged by both moderate and radical dissenters within his union, although he maintained control of the decimated union. Lewis was leader of the miners' union that lacked members, financial resources, and a coherent plan how to rebuild the scattered union. Union membership was less in 1930 than at any period since 1910 with 168,800 fewer union miners since 1920.

UMWA Membership and Coal Miners

	1910	1920	1930
Number of employees	613,924	733,936	621,661
UMWA Membership	226,000	373,800	205,100
Percentage Organized	36.8 %	50.9%	33.0% [124]

There was general dissatisfaction with Lewis' leadership by some union members after the 1922 strike, and the exclusion of nonunion miners in the contract. Events in the coal industry after 1925 made Lewis a vulnerable target from radical insurgents within the union. A coalition of communists, socialists, and moderate reformers all challenged Lewis's leadership in the UMWA presidential election of 1926. John Brophy posed the chief threat to Lewis's control of the union and discontented miners supported his candidancy for the presidency of the UMWA in 1926. The heart of Brophy's campaign

was the nationalization of the mines. Lewis defeated Brophy's "Save the Union " campaign by attacking him as a dual unionist and a Communist sympathizer. Opponents of Lewis charged the election results were fraudulent due to numerous irregularities in the vote count. This serious dispute eventually led to a split in the union with the creation of a rival miners' union. Miners in the important Illinois coal fields formed the Progressive Miners of America. Competing union leaders, including John Brophy, developed a variety of competing strategies to resurrect their decimated union after the strike. They demanded that the new Hoover Administration provide legislation to stabilize the industry while other reformers led by Brophy advocated nationalization of the coal industry as a feasible solution. Others proposed the creation of a labor political party and closer cooperation between anthracite and bituminous coal districts. All these reform proposals, however, met with little success as the industry continued its economic decline.

The anti-Lewis coalition split with in the UMWA over internal differences and disenchanted miners met in Pittsburgh at a convention in September, 1928. This Communist-led splinter group of radical miners formed the National Miners' Union with delegates from eleven states. The N.M.U. made numerous unsuccessful attempts to remove Lewis as president who was accused of both corrupt and ineffectual leadership. He was condemned for squandering union money and providing high paying patronage jobs for his friends who rarely entered nonunion territory to organize miners, but instead were content to spend their time in the union halls. The N.M.U. succeeded in organizing a few locals in Pennsylvania, West Virginia and Ohio. The organization was not interested in negotiating wage agreements because its sole purpose was revolution. The union was not willing to work within the framework of the UMWA. The leadership believed miners were ready for an immediate policy of violent confrontation and class struggle with the operators. An excerpt of the union's constitution asserts emphatically the class struggle basis of the union: "our organization declares that the interests of the employers and those of the workers have nothing in common... The history of coal miners ... is that of an incessant struggle between these two classes -the class struggle ... Our organization shall ever remain truly class-consciousness...and proceed as an organzation of the class struggle

for the abolition of capitalistic exploitation." [125] The N.M.U., in accordance with its principles of international class conflict, was affiliated with the Red International of Labor Unions. This Marxist controlled miners' union was responsible for numerous violent acts, including shootings coal officials and dynamiting their mining properties in Allegheny and Washington counties. The leaders of the N.M.U. were aware of the causes of the deplorable conditions miners were experiencing although the organization had no concrete economic solutions, except the use of violence and the overthrow of capitalism, to address the decline of the coal industry. The N.M.U. could claim two major victories during its brief existence. Their actions led to the passage of the Anti-Injunction Act (Norris-LaGuardia Act) of March 23, 1933. Senator George Norris of Nebraska toured the coal fields and spoke with miners and their families. Norris was touched by the sheer scale of the despair and poverty that he encountered and he was determined to improve the plight of the miners and their families. Norris sponsored federal legislation that made the "yellow-dog" contracts unenforceable in the courts, limited the power of courts to issue injunctions against labor, and asserted the right of labor to organize. The Anti-Injunction Act, served as a background to Section 7a of the National Industrial Recovery Act of 1933. It declared that "the worker shall have full freedom of association, self-organization, and designation of representation of his own choosing to negotiate the terms and conditions of his employment, free from employers interference in these or other concerted activities for mutual aid or protection." [126] The N.M.U also lobbied successfully for the elimination of Pennsylvania's Coal and Iron Police. The union rapidly faded away by the end of the 1930s.

FDR, The Great Depression and the Revitalization of the UMWA

The fragile bituminous coal industry virtually collapsed during the Great Depression of the 1930s. [127] The industry was devastated during the 1920s; but the nadir of the industry was reached in 1932, when prices, wages, output, and profits reached their lowest levels since the first decade of the twentieth century. Output nationally declined by 47 percent,

employment by 61 percent between 1918 with the low point in 1932. [128] This economic decline caused severe hardship to coal operators and miners alike. Bituminous coal output was reduced from 573,366,985 tons in 1926 to only 309,709,872 tons in 1932, the lowest annual production since 1904. This reduction in output witnessed the decline of workers employed in the bituminous coal industry from 593,647 to 406,380 during the same period. The average number of days worked annually declined from 215 to 146 days. Average hourly earnings of miners fell from 76 cents to 50 cents. Coal's share of the American energy market stood at 44.7 percent in 1932 while its share was 66.6 percent in 1919. The average price per ton of coal fell from $1.78 to $1.31 between 1929 to 1932.

Coal operators, like coal miners, were victimized by the competitive and vicious price wars of the 1920s and 1930s. The number of operating indepent mines in the bituminous coal fields declined by 2,500 between 1920 to 1935. Cut-throat competiton and decline in the average cost of a ton of coal drove thousands of coal companies going into receivership or bankruptcy. There were 6,070 coal mines producing 534,989 tons in 1929; in 1932 there was only 5,427 mines producing 309,710 tons. [129] Only 16 percent of 1,900 coal companies filing federal income taxes showed net income after taxes in 1932.

Bituminous Coal Mines

	Number of Mines	Percentage of Change	Production (thousands of tons)	Percentage of Change
1929	6,057	-27.4	534,989	
1930	5,891	-42.2	457,526	-12.6
1931	5,642	-38.1	382,089	-18.2
1932	5,427	-2.3	309,710	-18.9 [130]

Bituminous coal production in Pennsylvania was reduced to 142 million tons by 1929 - a decline of 35 million tons in comparison to its 1918 peak production of 177 million tons.

Employment in the industry was 135,272, a reduction of 46,000 workers since 1918. The surviving mining firms operated on a part-time basis open only three or four days a week.

The Great Depression hit the many isolated coal communities of western Pennsylvania especially hard and made life even more bleak. Unemployment and underemployment drastically reduced income and created severe hardships for the miner, his wife, and their children. The economic collapse of the soft coal industry can be easily measured but its impact in creating long-term human hardship and misery is more difficult to measure. Economic collapse deepened poverty and hunger in the coal fields as miners suffered a drastic curtailment of their wages, if they were still employed at all. The daily life of miners and their families in western Pennsylvania was never easy, but life was increasingly harsh as unemployment led to poverty and hunger in many company towns. "You didn't live then," one contemporary miner noted, "you just existed." Some years later another miner asked to describe the period, observed: "Well, there's one thing you can say about that time. We were all equal. Nobody had nothing." [131] "The fare of the workers and their dependents," Lewis wrote President Hoover in 1932, "is actually below domestic animal standards." [132] Governor Gifford Pinchot of Pennsylvania, in a letter to President Roosevelt in February 1933, clearly expressed the miner's economic despair in Pennsylvania " ... men were working there six and seven days a week who cannot earn enough to feed their families-working full time and not yet on relief." [133]

By 1933, over thirty-five percent of Pennsylvania's working population was out of work. [134] Unemployment in the coal-producing counties was even worse. Estimates of unemployment in Armstrong, Blair, Cambria, Cameron, Clearfield, Somerset, Washington and Westmoreland counties neared forty percent while unemployment in Dunbar, Everson, and Fayette City in Fayette County , for example counted unemployment rates as high as forty percent in 1934. [135] Most miners still lived in isolated and often drab private mining camps owned and ruthlessly controlled by the coal company; their "feudal rule" was strictly enforced by hired private security police. Evicted miners and their families lived in make-shift tents, coke ovens and other forms of accomodations that afforded them minimal shelter. Fannie Hurst, a New York journalist, visited the coal towns of America during the

1930s and painted a disturbing portrait of absolute despair and ugliness in these towns. According to Hurst's own writings "every aspect of their lives is ugly and unaesthetic...these people are living in shambles as children were reared under conditions that are shocking beyond description. ...Where human beings are living under conditions that generate hate, you can see that the seeds of revolt are being sown." [136] Many unemployed miners took to the road in search of work during the 1930s and when they could not find it returned home to the "patch." The following writings of contemporary coal miners gives a poignant vision of daily life and the sense of hopelessness and resignation that had overwhelmed them:

> I've tried all up and down the river and can't get work no place. At one time I was gone nine days but couldn't find anything. I got so tired being turned down I got sick and disgusted and came home. There ain't nothing a man can do these times.
>
> I've travelled 3,000 miles in the past ten weeks trying to find a job. But it ain't no use. There ain't no job any place.
>
> We find we are starving even at our work, as we can't get any food or money that we have sweated so hard to earn. ... We have no doctor. We have no hospital for our sick, no graveyards for our dead. We have gotten nothing to eat at this job for ten days. [137]

Coal companies had reduced hourly wages and the number of days their mines were opened. Many companies maintained the cost of rents on company houses that were at best dismal with few material amenities. Working miners and their families were still paying exorbitant prices for food and necessary mining equipment at the "pluck-me store." A number of studies were undertaken by private relief agencies during the 1930s comparing

prices charged at the company store and chain store. Prices charged for goods at the company store were consistently much higher than neighboring independent store prices. [138] Miners were paid twice monthly and from their meagre wages had to pay rent for their company owned house and buy household coal, company doctor, and school taxes, mining supplies, and buy food and clothing. The company checkweighman who weighed their coal was employed by the operators in nonunion mines, and he alone decided if the scales were accurate. Cheating or "shortweighting" the miners at the tipple's weigh station was a well-established custom employed by many nonunion companies since before the Civil War.

Bread was the principal food consumed daily by miners and during the Depression their lunch was often bread and coffee, called "coffee soup." The dinner menu for many mining families consisted of "bulldog gravy" made of flour, water, and some grease. They also ate "miner's strawberries" - beans - and for a variety white beans one day and red beans the next. A miners' "water sandwich" for the lunch - stale bread soaked in lard and water. [139] A miner described his family's menu, " We have been eating wild green ... Such as Polk salad. Violet tops, wild onions, forget me not, wild lettuce and such weeds as cow eat as a cow won't eat a poison weeds (sic)... " [140] Families with gardens enjoyed fresh vegetables. The sole aid to their economic plight was local charity, which was generally limited if available. The economic plight of the coal miners was not regarded as a problem for the nation as a whole. It would take the Great Depression to convince society that society as a whole was responsible for the care of those members unable to find adequate employment. The relief programs of the federal government under New Deal legislation were the concrete expression of this new idea.

Lewis told UMWA delegates in the lightly attended 1932 annual convention "Fear and hesitancy dominate American thought in industry and finance." [141] The coal industry was mired in the worsening depression and prospects for improvement in the immediate future were dim. The extent of the decline, and the chaos of the union's fortunes, and conditions of American miners was clearly addressed by President Lewis in the following speech:

> The United Mine Workers of America were driven from one field after another by the law of injunctions and the rule of gunmen; the right to collectively bargain for their wages was denied the mine workers and there was substituted the individual system of employment, in which the worker lost his right to belong to a union; wage rates were arbitrarily posted at the tipple; the right of mine workers to check their own coal was denied; wages were cut time and again and further cheated by the rent of the company houses and prices charged at the company store. The free hand which corporations thus exercised in labor relations was the chief cause for the increasing demoralization of the industry. [142]

Lewis delivered a radio speech on September 11, 1932 identifying the principal causes of the Depression as:

> Labor protests against further over-expansion of production facilities and asserts its opposition to employees being forced to carry the burden of fixed charges on the unneccessary investment involved in over-expanded industrial plants, labor seeks definitively to eliminate the manufacturer whose sole ability to remain in business is geared to pauperize wage rates and cutthroat sales prices. [143]

John L. Lewis believed prosperity would return to the United States when the following aims of organized labor were introduced: a shorter working day and week, the creation of a national economic council and the enactment of a national industrial code. Lewis was convinced that legislation that would stabilize the coal industry and require coal operators to recognize and bargain with all miners collectively was the only way to save the UMWA and save the coal industry. Lewis was re-elected president of the UMWA on January 31, 1933 and with his new mandate decided it was time to reorganize and revive his decimated union. He summoned his closest lieutenants to Washington, D.C. to plot a long-term strategy to recoup the union's devastating losses since the ill-fated 1927 strike. Lewis

planned the UMWA resurgence before Roosevelt had taken office or his administration had drafted the National Industrial Recovery Act. The reasons for his sudden decision to mount a major union-organizing drive at this time are still unclear but perhaps Lewis was emboldened by the recent election of Roosevelt in November, 1932.

The great depression hit America and the rest of the capitalist world in 1929. From 1929 to 1933 economic conditions worsened. Unemployment reached a peak in the winter of 1932-1933 at around 25 percent. The federal government did not systematically collect unemployment statistics. The practice of keeping accurate unemployment records was delayed until 1940. The Bureau of Labor Statistics later estimated that 12,830,000 persons were out of work in March 1933, at the bottom of the depression, about one-quarter of the civilian labor force of over fifty million. Approximately 28 million Americans were supported by some type of public or private relief.

Roosevelt swept the 1932 presidential election against incumbent Herbert Hoover by carrying 42 states and took office on March 4, 1933 and observed in his first inaugural address that "a host of unemployed citizens face the grim problem of existence, and an equally great number toil with little return. Only a foolish optimist can deny the dark realities of the moment." Roosevelt working closely with a Democratic Congress launched the First New Deal, a series of federal programs aimed at lifting the deteriorating American econony out of the Depression by dealing with high unemployment and farm relief. The Roosevelt administration sent 15 major legislative proposals to the Democratic-controlled 73rd Congress between March and June of 1933. All these proposals were adopted during this legislative session later known as the " First Hundred Days." The first New Deal legislation greatly extended the influence of the federal government in regulating many areas of the slumping economy. Government spending in federal social welfare rose by 500 percent between 1933 and 1936 ; increase in the federal deficit nearly doubled to $1.8 billion during this period.

Roosevelt and Congress implemented an assortment of legislation collectively known as the New Deal in an attempt to cope with the Depression. Congress established scores of new federal regulator entitites. Notable among them were: Agricultural Adjustment

Administration (1933-1942); Civil Works Administration (1933-1934); Civilian Conservation Corps (1933-1942); Farm Security Administration (1937-1944); Federal Emergency Relief Administration (1933-1937); Public Works Administration (1933-1939); and the National Recovery Administration (1933-1935).

The National Industrial Recovery Act, called the NIRA, passed by Congress on June 16, 1933 was one of the most significant pieces of labor legislation passed during the first New Deal. Roosevelt noted that "History will probably record the National Industrial Recovery Act as the most important and far reaching legislation ever enacted." [144] The NIRA was administered by the National Recovery Administration (NRA), directed by General Hugh S. Johnson (1882-1942) under the "Blue Eagle" symbol. Its essential purpose was to stimulate industrial and business activity by a series of agreements or codes, drawn up to govern each industry and to reduce unemployment. The NRA was based on the principle of self-regulation, operating under government supervision through a system of fair competition codes of fair practice concerning working conditions, wages, and business by dividing markets, boosting prices, and stopping wage cuts and lay-offs. The NIRA represented "the first serious and far-reaching attempt in peace time on the part of the Federal Government to regulate an industry that had been so committed to laissez-faire." [145] Under the NRA , 765 codes were drawn up by the government to regulate output, fix prices, reduce working hours, and increase wages in various industries including the coal and steel industries.

The coal industry in 1932 was ripe for unionization which came with the NIRA. Both coal companies and miners sought relief in any form. Production had declined by some 40 percent and many coal operators were bankrupt or on the verge of bankruptcy during the exceedingly competitive 1930s. Enormous capital values had been lost in the coal industry as many companies failed to survive. The Rockefeller family which owned 38 percent of the Consolidation Coal Company took a complete loss of their investment and retired from the coal business in 1932.

Lewis' union drive was initiated in the northern coal fields on Mitchell Day, April 1, 1933 at Blythedale, Fayette County when nearly 2,000 miners gathered to hear a call for

unionization and solidarity among the rank and file. Union miners had been granted the eight-hour work day in 1897, under the leadership of John Mitchell, who was called "the father of the eight-hour day." Mitchell Day, now called Miner's Day, is celebrated every April 1st as a contractual miners' holiday. Philip Murray, vice-president of the UMWA, was appointed by Lewis to lead the union drive in Pennsylvania and the northern coal fields. Murray, a Catholic Irishman, was born in Lanarkshire, Scotland, the son of an Irish immigrant miner. The family emigrated to Westmoreland County on Christmas Day, 1902. He worked as his father's helper in a number of coal mines, first in Scotland and later in western Pennsylvania. Murray was later employed at the Keystone Shaft Mine of the Keystone Coal and Coke Company, Westmoreland County. The lanky 18 -year-old Murray smacked a weigh boss suspected of cheating him and other miners on coal weight at the tipple. The company evicted Murray and his entire family from their company house and they were forced to live in a tent. Angry miners left the pits and refused to mine coal. The brief strike fizzled after a month when hunger forced miners back to work. Murray was personally escorted by company officials to the county border and told not to return. This action made him immensely popular with the rank-and-file and he rose rapidly in District 5 of the UMWA. Murray was an International Board member by 1912 and four years later was elected president of District 5 president. Lewis made him a vice-president in 1920 and during the next decade Murray was an invaluable ally and confident to Lewis.

On May 1933, Philip Murray spoke to 4,000 miners in Clymer, Indiana County and recruited 693 new union members who later organized mines owned by the Delano side of the Roosevelt family in the region. President Roosevelt's grandfather Warren Delano, and James Roosevelt, his father, were both members of the board of directors of the Consolidation Coal Company. Delano served as a company director from its founding until 1874 while James Roosevely was a director of the company from 1868-1875.Murray and other union activists had attracted 150,000 miners to the swelling union ranks by the end of 1933. Union organizers entered such former citadels of non-unionism as the Connellsville coke district and Somerset and Cambria counties, Pennsylvania. The Keystone State became the backbone of the new emerging UMWA.

This burst of union activity by the UMWA in early 1933 was both dramatic and unprecedented in the history of the American labor movement. Historian Leo Wolman asserted that "there was nothing in the annals of labor ... comparable to the dynamic burgeoning of the UMWA under the NIRA." [146] A contemporary song sung throughout the "patch towns" of western Pennsylvania reflects the miners' despair over the collapse of their union and the subsequent hard times, "We will have a good local in heaven, Up there where the password is rest, Where the business is praising our Father, And no scabs ever mar or molest." [147] Hunger and misery had stalked the dismal and often oppressive mining camps since the horrific union defeat in 1927 and these years of economic deprivation had intensified the miners' desire and need to band together. James A. Weschsler, a newspaper labor journalist of *PM* magazine, observed "to the miners the union was more than a collective bargaining association, it is the pillar of their hopes. As long as the union was preserved they are not serfs, they retain a glimpse of freedom and an awareness of potential power. The fortunes of the union are completely entwined with their own personal histories." [148]

The federal government, under Section 7a of the National Industrial Recovery Act, also legalized and guaranteed employes "the right to organize and bargain collectively through representatives of their own choosing, and shall be free from interference, restraint, or coercion of employees in the designation of such representation." [149] The union succeeded in getting a bill introduced in the U.S. Senate in 1928 that would guarantee the rights of workers to organize and bargain collectively. The bill drafted by UMWA General Council Henry Wehrum never made it out of the first congressional committe considering the bill. Section 7a put an official stamp of approval on collective bargaining between employers and their workers by the federal government. UMWA organizers, like other industrial labor organizers, saw its passage as the critical ingredient for the resurgence of their impotent union. Union memberships had declined in all unions sharply in the 1920s. American workers called the NIRA "Labor's Bill of Rights. " "From the standpoint of human welfare and economic freedom," said President Lewis, "we are convinced that

there has been no legal document comparable with it since President Lincoln's Emancipation Proclamation." [150]

The moribund and repressed American labor movement of the 1920s stirred to action under the impetus of the NIRA and other favorable pro-labor New Deal legislation. Reorganization of the American trade union membership soared as 775,000 workers flocked into numerous labor organizations - 500,000 in the AFL, 150,000 in independent unions, and 125,000 in the Trade Union Unity League (TUUL). [151] American trade unions membership, averaging only 3.3 million members in 1930, rose continually during this period, to 3.9 million in 1933, 4.7 million in 1936, 8.2 million in 1939, 12 million in 1942, and 13.6 million in 1945.[152]

The Bituminous Coal Code, under the NRA, represented "the first serious and far-reaching attempt in peace-time on the part of the federal government to regulate an industry that had been so committed to laissez-faire." [153] Bituminous coal operators were required under the code to abide by a Code of Fair Competition that called for 1) the maintenance of minimum prices and 2) elimination of unfair competitive practices. The Code had the force of law and was binding on all coal operators. A minority of coal companies refused to comply immediately with the NIRA and Section 7a because they doubted the law's constitutionality. The Code of Fair Competition was initially successful in the bituminous coal industry but code violations were increasingly frequent and complaints of cutthroat competition and unfair price fixing became more numerous. The Code was in force from October, 1933 to May, 1935 when the NIRA was abruptly struck down by the Supreme Court as unconstitutional on May, 27, 1935 in the Schechter Poultry Corp. v. U.S. (known as the sick chicken case). The Supreme Court ruled the NIRA unconstitutional on the ground that Congress had delegated to much authority to the agency. The court noted that the act was encouraging monopoly and creating cartels to the detriment of small businesses. The voiding of the NIRA ended the coal code of fair competition.

An angry Lewis stated that "we are living in a state of continuous crisis under the negative autocracy of five former corporation lawyers on the Supreme Court bench. Only industrial democracy can save America from a position of permanent social and economic

disequilibrum." [154] Lewis, with Congressman John Buell Snyder of Fayette County and Senator Joseph F. Guffy of Pennsylvania, wrote a new bill providing for the regulation of the bituminous industry similar to the recently voided Coal Code under the NIRA. The Bituminous Coal Conservation Act, commonly known as the Guffy-Snyder Coal Act, was passed by Congress in August 25, 1935. The new law, called coal's "Little NRA," was yet another attempt by the federal government to establish a balance between production and consumption in the coal industry. The Bituminous Coal Labor Board and the National Bituminous Coal Commission were created to administer production quotas, and price-fixing and labor regulations based on the NRA soft code. A 15 percent tax based on the market value of coal was levied on producers,with some 90 percent of the tax being remitted to coal producers complying with the code. The Guffy-Snyder Coal Act was jubilantly received by the unoin miners and by a majority of northern coal operators who remembered the ruinous competition in their formerly unregulated industry. The new act was strongly resisted by southern operators who successfully lobbied against it. James Walter Carter, president of the Carter Coal Company, began suit immediately to test the constitionality of the new law. The United States Supreme Court ruled the act unconstitutional in Carter v Carter Coal Company et al. in May 18, 1936. The majority decision asserted Congress had no power to regulate wages, hours of labor, and working condition in an industry not directly engaged in interstate commerce. Coal mining, according to the U.S. Supreme Court, is not interstate commerce but like manufacturing is a local business. [155] Lewis responded angrily again to the Court's decision stating "it is a sad commentary on our form of government when every decision of the Supreme Court seems designed to fatten capital and starve and destroy labor." [156]

The Guffey-Vinson Bituminous Coal Act was passed by Congress in 1937. The Act reenacted all the principal provisions of the outlawed Guffy-Snyder Act of 1935 with the exception of the wages-and hours clause. The act created a new code of fair competition for the bituminous coal industry. New federal regulations laid a revenue tax of one cent a ton on soft coal, and imposed on non-code coal producers a 19.5 percent penalty tax of the sales price. The Supreme Court upheld the act as constitutional. Associate Justice William

O. Douglas, who wrote the court's majority opinion, made the following astute observation regarding the recent tragic history of the bituminous coal industry:

> Labor and capital alike were the victims. Financial distress among the operators and acute poverty among the miners prevailed during periods of general prosperity. This history of the bituminous coal industry is written in blood as well as ink. [157]

Government intervention in regulating coal prices was successful in ending the destructive cut-throat competitive wars of the 1920s. One of the major causes of instability in the bituminous coal industry was overdevelopment made possible by the abundance of coal located over a wide geographic area. The inability of coal companies to regulate production and marketing and to control coal costs had made some form of external regulation inevitable. It is ironic that federal control over the bituminous coal industry came not because the industry was monopolistic but rather because the industry was not. The splintered coal industry was simply unable to find means to solve its problem of over-production through industrial self-government.

The American Federation of Labor was formed in December 8, 1886 in Columbus, Ohio and for years was guided by conservative and cautious leadership. President Samuel Gompers was the union's president until his death in 1924. William Green, UMWA Secretary-Treasurer, was elected AFL president following the death of Gompers in 1921. President Green, like his predecessor, was also a conservative and cautious leader *Fortune* magazine edition of December, 1933 noted that the AFL "has been suffering from pernicious anaemia, sociological myopis, and hardening of the arteries for many years." [158] The heart of the AFL was still craft unions, such as the carpenters and the machinists. The AFL leadership favored the continuation of craft or "horizontal" unions. Union membership in the United States in 1933 had reached its lowest point since 1920 and some labor leaders within the AFL favored organizing workers in industrial or "vertical" unions-unions which took in all workers in an industry. At the November, 1935 AFL convention in Atlantic City, David Dubinsky of the International Ladies' Garment

Workers, and Sidney Hillman of the Amalgamated Clothing Workers joined Lewis, John Brophy and other UMWA officials to organize American labor on an industry wide basis. They believed that the time was ripe for an all -out effort to organize mass production industries. Proponents of the new industrial union met immediately following the AFL convention to form the Committeee on Industrial Organization (CIO). The CIO was a conscious attempt, led by the miners' union, to organize workers employed in the mass-production industries. The new union headed by Lewis, included the leaders of the Amalgamated Association of Iron, Steel and Tin Workers, Mill and Smelter Workers, Federation of Flat Glass Workers, United Textile Workers, and other large unions joining the CIO throughout 1935. Lewis was vice president of the AFL but resigned in 1935. Conservative AFL leadership was opposed and felt threatened by the growth of industrial unionism and on August 3, 1936 the Executive Council of the American Federation of Labor suspended all CIO unions over a jurisdictional dispute. The expelled unions established a rival organization, the Congress of Industrial Organizations. The CIO, held their founding convention on November 14-18 , 1937, at the Islam Grotto, in Pittsburgh. John L. Lewis presided over the four day convention. The bitter conflict between the leaders of the AFL and CIO was essentially between craft versus industrial unionism. The subsequent CIO's organizing victories were seen as personal triumphs for the UMWA's John L. Lewis. The AFL and the CIO were competitive unions until their merger at a New York City annual convention on December 5, 1955.

Lewis was elected the first CIO president and supported Franklin D. Roosevelt in his 1932 and 1936 presidential campaigns against Herbert Hoover and Alf Landon. Lewis and the United Mine Workers contributed a half million dollars to Roosevelt's 1936 presidential campaign and the same amount going to the Labor's Non-Partisan League (LNPL). The LNPL was an independent political action organization created by the UMWA and other labor leaders as an independent political organization. The organization gave the miners' union and other participating unions the means to maintain their own political identity. Lewis refused to support Roosevelt in his bid for a third term in 1940. Lewis believed Roosevelt had not delivered on all the union's demands against the government. Lewis was

also concerned that organized labor was becoming to closely wedded to an increasingly conservative FDR and Democratic Party. Lewis backed Republican Wendell Wilkie's presidential bid in 1940. Lewis resigned his presidency of the CIO following the 1940 presidential election after he had failed to divert labor's support from Roosevelt to Wendell Wilkie. Philip Murray was elected the new CIO president and served from 1940 to 1952. Lewis took the UMWA out of the CIO in 1942.

The cry to "ORGANIZE" spread across the desolate mining villages from Pennsylvania as far south as the coal fields of Alabama where southern miners sang, "In nineteen hundred and thirty-three - When Mr. Roosevelt took his seat - He said to President John L. Lewis - In the Union we must be." [159] UMWA organizers constantly reminded West Virginia, Pennsylvania, Illinois, and Kentucky miners that "The President wants you to join the union" and "the law is on our side." "The old union is coming back, by God" was yet another rallying cry of union organizers.[160] Miners responded immediately and almost unanimously. Organizers went into such anti-union bastions as Mingo County, West Virginia and the Connellsville coke region of Pennsylvania. Van A. Bittner, a West Virginia mine organizer, reporting on the speed with which miners were flocking back to the union just a week after the passage of the NIRA, observed, "We expect to be practically through every mine in the state and have every miner under the jurisdication of our union by the first of the week." [161] John Brophy, in his autobiography *A Miner's Life*, noted that "within ninety days the industry was organized." There was no need to campaign; an organizer had only to see that he had a good supply of application blanks and a place to file them, and the rank and file did the rest. The fact that workers organized so quickly after 1933 was an indication of the general breakdown of the coal operators. They couldn't marshall sufficient strength to resist this crusade of organization that swept the nation." [162] Membership in the UMWA had quadrupled within a few short months after the passage of the NIRA. Miners joined the union in record numbers, as membership increased by some 300,000 in only one year. Philip Taft, in *Organized Labor in American History*, wrote that "it can truly be said the revival of the United Mine Workers of America was the greatest labor event in the short history of the National Recovery

admistration, an event which was to make possible the forthcoming labor revolution in the late 1930s." [163] The UMWA became the biggest and strongest of American labor unions virtually overnight. Much of the membership drive was completed by August 1, 1933 in every coal-producing region except the steel companies' "captive" mines.

The reorganized and vibrant UMWA won significant gains for its members in terms of wages, hours, and working conditions after 1933. No basic agreement had existed from April 1, 1927, until September, 1933 in the bituminous coal industry although some district agreements were signed in Indiana and all the states to the west. Seventy-two percent of bituminous coal production was nonunion with nonunion wages from $1.25 to $2.84 for a 9 to 10-hour work day. [164] The union concluded a new collective wage agreement in the former northern CCF region and in the non-union coal fields of West Virginia, Kentucky, and Tennessee on October 2, 1933. The concept of a single contract that would apply uniform wages and workings condition to all miners and employers in the industry was unheard of until the 1930s. Commercial coal operators signed five collective wage agreements with the UMWA between 1933 and 1939 that was applicable to all union miners and employers.[165] The first contract established minimum coal prices established at the 1929 level of $1.78 a ton. The object of the contract was to prevent the price-cutting and wage reductions which had characterized the industry in the 1920s. Most commercial coal mining companies accepted the NIRA because they felt that the new contract with the UMWA could act to stabilize and maintain a minimum price for their coal. This first agreement and subsequent contracts were all collectively called Appalachian Agreements, and unlike the pre-Depression era contracts signed between the UMWA and CCF operators, were very explicit contracts, detailing in specific terms the conditions of employment.

The first Appalachian Agreement, effective between October 1, 1933 and March 31, 1934, formed new arrangements for collective bargaining in the bituminous coal fields including coal operators from both the defunct Central Competitive Field and the nonunion southern Appalachian coal fields. This contract was a landmark agreement in the soft-coal industry, as it covered 340,000 miners - the largest number of workers ever included under

one agreement in American history. The agreement was the beginning of a new era in the task of stabilizating and modernizing the economic process of this basic industry. [166] Wage differentiation in the industry had existed between union and non-union mines since the 1890s. The new contract narrowed wage differences among the various coal fields and at last the UMWA could bargain collectively with both southern and northern coal operators. Daily wages were stabilized by establishing a minimum national wage of $3.40 a day: Northeast, $4.60; South, $4.20; Midwest, $4.57 to $5.00; Southwest, $3.75; Northwest, $4.00 to $5.63; Deep South, $3.40 to $3.84. [167] The agreement reintroduced the eight-hour day, a five-day work week, a forty-hour work week, the right of miners to choose their own checkweighmen, a dues checkoff, and abolition of child labor in the mines, and put in place policies for handling labor disputes. Some nonunion operators were recalcitrant and refused to operate their mines with union workers. The UMWA had led a strike against nonunion operators in Harlan County, Kentucky but by May, 1931 admitting defeat withdrew its strike action. Harlan County, Kentucky was referred to as "that little ugly running sore" by union organizers because the union fought one of the longest and bloodiest organization drives in this county. The Harlan County Coal Operators' Association was composed of staunch antiunion operators who ruled their mines and workers like feudal barons. They were successful in thwarting unionization attempts until July 19, 1939 when they finally signed the national UMWA contract.

The UMWA was once again a potent force in the coal fields and by 1934 the ranks of the union stood at about 400,000 dues paying members. The union was reestablished as the collective bargaining agent for coal miners under the first Appalachian Agreement. Each successive Appalachian contract signed with management by the UMWA between 1933 and 1941 improved wages and maintained the 40-hour work week. The 40-hour weekly schedule, eight hours per day and five day week, was established, and remained in force except for a few years during the Second World War. The average bituminous coal miner in the United States worked 60 hours weekly before 1898, reduced to 52 hours weekly during the period from 1898 through 1916, to 48 hours weekly between 1917 and 1932, and to 40 hours after 1933.

	Average Weekly Hours	Average Hourly Weekly	Average Weekly Earnings	Average Annual Earning
1935	26.5	$.74	$19.58	$957
1936	28.8	79	22.71	1103
1937	27.9	85	23.84	1170
1938	23.5	. 87	20.80	1050
1939	27.1	.88	23.88	1197
1940	28.1	.88	24.71	1235
1941	31.1	.99	24.71	1235 168

Coal miners were generally the lowest paid of all industrial workers in the United States. The ratifications of the Appalachian contracts increased their wages and miners' income became competitive with workers in the other extractive industries. It is difficult to calculate with any certainty how much these wage increases helped workers real income. Some coal companies simply offset their rising wages by increasing rents on company houses and the cost of foodstuffs and mining supplies in their company store. The passage of the first Appalachian Agreement was at least for the short term a festive time for overworked and underpaid miners who had endured a decade of decline in their income. Some 85,000 more miners nationally were working in 1935 than in 1932 - an increase of twenty four percent - while wages rose by 70 percent during this same period. The average annual wage of a miner was $677 in 1932 and $1196 by 1935. In the short term, the NIRA had satisfied the Roosevelt Administration's objective of putting people back to work and raising their real income.

Hourly Wages in Extractive Mining Industries

	1939	1950	Increase
Iron Mining	73.8 cents	1.51 dollars	103%
Copper Mining	67.9	1.60	136

Lead and Zinc Mining	68.3	1.56	130
Bituminous Coal Mining	88.6	2.01	126 [169]

UMWA Struggle with the Steel "Captive" Mines

The five Appalachian Agreements signed by the UMWA with management between 1933 and 1941 were confined to independent coal operators. These contracts negotiated by Lewis restored stability to the commercial bituminous coal industry although they did not include miners employed in "captive" mines. Coal was marketed in three ways by the 1930s. Independent mines sold their coal on contract to large consumers including railroads, factories, electric power plants and gas plants. Indepent mines also sold surplus coal on the open market to wholesale dealers that sold coal to retail dealers. The retail dealers in turn sold it to small consumers. "Captive mines" were owned by large railroads, coke and steel companies and utilities since the 1880s. These companies were principal consumers of coal and coke had acquired their own mines so they were not dependent on fluctuating market conditions. Captive mines controlled about 18 percent of the total coal production from 1913 through 1918 and more than a quarter of the total coal production (26.5 percent) from 1920 to 1929.

Captive Coal Mine Production and Precentage Share of National Market

	Production Millions of Net Tons	Percent of Total U.S. Production
1915	83	18.8
1920	113	19.8
1925	121	22.7
1930	117	25.0 [170]

Pennsylvania, West Virginia and Illinois had the largest concentration of captive mines. The steel companies of Pennsylvania produced 31.9 percent of the state's coal in 1924 (75.4 percent of the total captive coal production nationally). The captive mines of Illinois were owned by railroads and public utilities and accounted for 23.8 percent of the state's total coal production while West Virginia's captive mines were owned by steel companies and coke manufacturers and produced 12 percent of the total coal of the state in 1924. [171] Steel corporations operated 232 mines producing 51.6 percent of the total captive-mine coal in the United States in 1924. Bethlehem Steel Corporation (Industrial Collieries Corporation (mining subsidiary company with mines in Cambria, Indiana, Washington and Westmoreland counties), U.S.Steel Corporation (H.C.Frick Company with mines in Fayette, Greene, and Westmoreland and counties), Youngstown Sheet and Tube Company (Buckeye Coal Company with the Nemacolin mine, Greene County), Crucible Steel Company (Crucible mine, Greene County), Republic Steel Company (Clyde mines in Washington County and the Indianola mine in Allegheny County) and Jones and Laughlin Steel Corporation (Vesta Coal Company with mines in Washington County) were the principal steel companies in western Pennsylvania operating such coal mines. [172]

The steel firms were not interested in establishing industry-wide minimum coal prices since their coal and coke production was consumed internally. The steel industry had been a bastion of the open-shop tradition since the collapse of Amalgamated Association of Iron and Steel Workers at the Homestead Strike of 1892. Judge Ebert Gary of U.S. Steel once wrote "we do not confer, negotiate with, or combat labor union as such." Gary expressed in these few words the majority attitude held by steel companies towards trade unions since the beginning of the industry. William A. Irwin, President of the U. S. Steel Corporation, clearly voiced the majority position of the steel industry towards union representation of their miners stating that "as long as I live my company will never recognize the United Mine Workers." [173] Steel companies were opposed to unions, chargingthey were responsible for creating unnecessary antagonism between labor and capital. Charles M. Schwab (1862-1940), former head of the Carnegie Steel Company and later United States Steel Corporation and president of Bethlehem Steel Corporation since 1904 observed:

> It has always seemed a curious thing to me that people should talk about "conflict" between capital and labor. There is no conflict. It is human nature to want money. Capital wants money, so does labor. Where you see men, either as individuals or in groups, wanting more money, that's not conflict. The interests are identical. [174]

Steel management, like Lewis, saw the UMWA organization of their miners as an entering wedge for steel unionization. The Amalgamation Association of Iron and Steel Workers, affilialated with the AFL organized some 24,00 workers, or one-fourth of all steel workers in 1891. In 1931, the union had slightly less than 5,000 members, or about 1 percent of all steel workers. Steel management approved the wages and hours that commercial coal operators had accepted in the first Appalachian Agreement, but refused to recognize the miners' union or establish dues check-off. Check-off is a provision in a labor agreement whereby the operators are obliged to deduct union dues from workers pay and forward them to the union headquarters. Officials from the NRA and the UMWA met with steel companies representatives in late September 1933 in an attempt to persuade them to recognize the UMWA, although management refused to consider union recognization.

Captive mine owners had tried to inspire company loyalty in their employees by undertaking a series of paternalistic programs to improve their living conditions. Corporate paternalism was a conscious attempt to attract and maintain a stable and loyal labor force while discouraging the appeal of union organizers. Asssistant superintendent W.H. Glasgow of the H.C. Frick Coke Company asserted proudly to a newspaper reporter that "The welfare of the miner and other employees engaged in the mining industry, is the welfare of the industry," and further," ... We contend that the employees of the H. C. Frick Coke Company are the best treated and best satisfied coal and coke workers in the world. I know of nothing more conducive to the higher efficiency and uninterrupted service from working men than fair treatment and pleasing surroundings." [175] Many of the "model" industrial coal towns including Bobtown, Nemacolin, Mather, Muse, Richeyville, Vestaburg, Slickville and Daisytown, were constructed by steel companies in western

Pennsylvania after the 1890s. These communities provided large and clean homes, charged workers fair prices at the company store, and provided a variety of recreational activities for their workers. They sponsored baseball teams, and constructed playgrounds for their children, swimming pools and recreational halls. Their miners were usually paid higher wages than miners employed in independent mines. Some steel companies provided pensions for miners with twenty-five years service, relief programs in the event of unemployment, and compensation for families of miners killed or hurt in mining accidents. Work at captive mines was generally steady; and when it was not, a miner could receive relief from the company. [176] The U.S. Steel Corporation provided for its miners a pension program and an opportunity for them to purchase company stock.

Both government and mine workers rejected the steel companies' corporate paternalism for unionization. H.C. Frick Coke Company, Crucible Steel, and Weirton Steel all sponsored the company union, or "employment representaion plans", as the corporations preferred to call them. Company unions were formed as a conscious attempt by anti-union steel management to comply with the letter, yet evade the spirit of the mandate of Section 7a. The company union was sponsored and financed by the companies and these organizations maintained a facade of collective bargaining. They did not carry out real negotiations with their employers, and never went on strike. work council." H.C. Frick Coke Company, a subsidiary of the United States Steel Corporation and the unofficial leader of the captive coal operators, formed the Workmen's Brotherhood, supported by the local chapter of the Ku Klux Klan, and the Miners' Independent Brotherhood, whose leader spent his time writing the Commissioner of Immigration, Washington seeking ways to deport aliens. [177]

These company strategies to keep the union out of the mines were unacceptable and almost universally rejected by a majority of miners during the turbulent 1930s. Non-union miners rebelled and demanded union recognization by the UMWA. Miners from Fayette, Westmoreland and Greene counties, whose mines were the principal sites of steel-controlled mines, called a wild cat strike and left the pits in September, 1933 and did not return until early November. The H.C. Frick Coke Company, a subsidiary of the U.S.

Steel Corporation, as the unofficial leader of the steel companies became the focus of numerous violent confrontations. UMWA sympathizers fought pitched battles with company deputies in the Frick company towns of Grindstone and Maxwell, Fayette County for union recognization in the summer of 1933. Violence between miners and company deputies also flared at the Star Junction mine and the Colonial Number 1 mine in Fayette County. Striking miners shut down four H.C. Frick Coke Company and two Jones and Laughlin mines during the year as the strike spread to neighboring counties. Thirty thousand miners were on strike and by August, 1933 all Frick mines were idled. The violent confrontations in 1933 were unsuccessful, as the steel barons were intransigent in their virulent anti-union position. Attempts by Lewis, the UMWA, wild cat strikes by nonunion miners, and intervention by President Roosevelt all failed. The 1933 campaign to organize the captive mines was defeated, but the mine leaders and the rank-and-file were determined to try again.

Steel companies continued to thwart unionization efforts by the UMWA until World War Two. The coal and the steel industry were operating at full capacity filling war orders in 1941. The UMWA made another attempt to force the steel corporations to accept union recognization in the fall of 1941. Only Jones & Laughlin Steel Corporation of the twelve largest steel corporations would accept unionization of their mines at this time. The remaining steel corporations, employing about fifty thousand miners in southwestern Pennsylvania, refused a closed shop; instead they offered higher wages and hour concessions. Lewis called three wild cat strikes during the fall of 1941 and they all failed. The National Defense Mediation Board (N.D.M.B.) was established by the Roosevelt Administration in early 1941to facilitate war production by trying to prevent or settle difficulties between labor and employers. The N.D.M.B. panel, on December 7, 1941, granted union representation to all miners employed in the captive mines. Steel companies of southwestern Pennsylvania capitulated and accepted the unionization of their miners. [178] The unionization of "captive mines permitted the UMWA to negotiate a single contract for the entire coal industry except for a few small companies. These operations

were usually owned by formers miners who had saved sufficient money to buy or lease their own property or equipment.

Mechanization of Mining and Its Consequences to the Industry

Coal operators were determined to maintain higher coal prices obtained after 1933 while the UMWA was equally committed to maintaining the economic gains it had attained through the Appalachian Agreements. The average price of a ton of coal increased continually from $1.77 per ton in 1935 to $2.19 in 1941. The high prices for coal can be credited in part to the consent of most coal operators to maintain collective bargaining agreements.

Coal Price Per Ton / Production

	Average Price Per ton	National Production (net tons)
1935	$1.77	372,373
1936	1.76	439,088
1937	1.94	445,531
1938	1.95	348,545
1939	1.84	394,855
1940	1.91	460,772
1941	2.19	514,149[179]

Coal operators could no longer cut coal prices or cut miners' wages with impunity as had been their practice in the recent past. The agreements equalized wages and it was not possible for one company to undercut competitors with a low-wage policy. The editors of *Coal Age* clearly identified the new economic dilemma now confronting coal companies during the 1930s - "How to pay higher wages and yet reduce costs and how to work shorter hours and yet produce the same tonnage?" [180] *Coal Age* was the leading weekly

journal of the coal industry and a principal booster of mechanized mining. The rising cost in wages and the shortened work week forced coal producers to substitute machinery for high-cost labor. Many coal companies had previously regarded machinery and miners as interchangeable and they chose whichever was cheaper. [181] Lewis observed that "The American coal operators never would have mechanized their mines unless they had been compelled to do so...." [182]

The principal attraction of machinery for coal operators is that it lowered labor costs by reducing the size of the required labor force and increased productivity output per man per hour. The National Recovery Administration issued a report in November, 1933 estimating the average cost to mine a ton of bituminous coal at $1.58 in the Appalachian region. This cost was distributed as follows: mine labor at 93 cents; mine supplies at 22 cents; other expenses at 3 cents, royalties and compensation insurance at 15 cents, depreciation, taxes, and insurance at 11 cents and sales and administration at 14 cents. [183] A wide variety of factors account for differences in the costs of mining a ton of coal among firms and within bituminous coal fields. All the following factors affect the cost of mining a ton of coal: geological condition, degree of mechanization, wage-rate differential, type and method of mining (surface or underground mine opening), age of the mine, difference in length of work per day and week, difference in amount of coal preparation, age of mining equipment, depth of mine, rate of employee compensation insurance, state and local taxes, and amount of mine acreage being mined. [184] Labor was the principal cost in coal production and varied from sixty to seventy percent of the total expense for each ton of coal mined. Approximately 63 percent of all mine workers were "tonnage" workers in 1929. They were paid piece-rate based on the number of tons of coal mined daily or by the car load. Their wages comprised about 55 to 60 percent of total labor expenditure in the mine. The average output per man per day rose from 4.0 ton in 1920 to 5.3 tons in 1931, representing a 32.5 percent increase. This increase in productivity reflects the increased use of undercutting machines, mechanical loading of coal and general improvement in efficiency of the mining operation.

"Mechanization of mining" refers to both the removal of coal from the working face and the loading of the coal in mine cars for their removal by mules or motorized storage-battery or electric locomotives to the tipple or cleaning plant. [185] The degree of mechanized mining in the nation was not uniform. Coal was still undercut with picks and loaded by hand and hauled to the surface with draft animals in many Pennsylvania mines as late as the 1930s. Jessie Liotta, a coal loader from Braeburn, Westmoreland County, described the primitive work process still employed to extract coal in the mine. His poem was entitled "I Worked that Mine in '36":

> You'd go straight in, you'd sit in the coal car with your head way down.
> 'Course if you put it up you'd get it kicked off.
> You went in to where you had to work and you crawled out.
> You couldn't stand up; wasn't that high-
> Three foot of coal at the most.
> When you shoveled, you was on your hands, and knees,
> You worked on your own, you worked on tonnage.
> You made
> You got
> So you had to work.
> That was livin'. [186]

Some larger coal companies had employed mining engineers to test the feasibility of mechanizing the mining process during the 1920s. The undercutting machine had ushered in the beginning of the mechanized mining era of the bituminous coal industry during the 1880s. Union coal operators had embraced the use of mechanical undercutting machines as a method to reduce their labor costs and reduce the need for skilled workers who were often the most militant union miners. Coal, refuse, and miners were hauled to the surface with electric and battery-powered locomotives in the larger mines. The majority of coal was still loaded with shovels by unskilled loaders until the 1930s. Shoveling coal was the last

underground job to yield to machine operation. This was heavy and arduous work requiring many workers for increased production. Hand shoveling of coal was a major impediment in the application of "factory" methods to coal mining. [187] The managing editor of *Coal Age* wrote in 1921: "Mining [of coal] is still in a way a "cottage" industry, only the cottage is a room in the mines." [188] *Coal Age*, a weekly journal, was the leading trade journal of the period and a staunch promoters of mine mechanization. The introduction of a variety of mechanical loading machines represented a revolutionary step in the mining operation. One historian observed the significance of mechanical loaders over hand loading and how the use of these machines fundamentally changed existing mining methods stating:

> In loading more than in any other function, mechanization fosters an increased tempo of mine operation. It may indeed be said that the balanced cycle of underground operations is a concomitant of the post-world war mechanization of the loading process. To the extent that loading machines have replaced hand loading, bituminous coal mining must have become an industry in which many of the old craft traditions have had to be discarded. Each working face does not have its own loading machines; rather loading-machine crews have taken their place... as workers performing a specialized function in the larger process of mining . Ideally, a single working face is attacked in sequence by cutters, drillers and blasters, and loaders, each group working in close coordination with the others... The old routine (or lack of routine) has given way to a systematic planning of production with a closely supervised execution of the production process. [189]

A more systematic process to mechanize work in the mines was undertaken by coal companies during the mid-1930s in their frantic attempt to increase daily productivity and reduce higher union labor costs. Mechanical coal loaders were not widely used underground until this decade although mechanical loading equipment had been developed a half-century earlier. The terms "machine loading" and "mechanical loading" are used

interchangeably in this study. The first mechanical coal loading machine used in an American mine was the so-called Stanley Header that was designed to break down the coal from the seam as well as to load it. [190] The English designed machine was brought from England in 1888.[191] The Jones loader or "Coloder" machine was designed as a loading machine between 1893 and 1898 by the Pocahaontas Fuel Company in West Virginia. The company received a patent for the machine in 1902. These early experimental coal-loaders were unsuccessful and unpopular with coal companies for a variety of reasons. They suffered from a number of technical deficiencies and were subject to continual mechanical breakdowns. They were large and cumbersome machines which were difficult to move about from room to room within the mine. Manufacturers improved the quality of these machines during the 1920s. The physical size of the machinery was reduced and manufacturers made them more mobile by mounting them on caterpillar traction. Many coal operators were still indifferent to the improved mechanical loader. Miners were paid on a piece-rate basis and labor was both abundant and cheaper than investing in this costly machinery.

Mechanical loading equipment is divided into two basic groups; machines that virtually eliminate hand shovelling except for incidental clean-up and machines which reduce the amount of shoveling involved. Mobile loaders, scrapers and duckbills are in the first category while pit-car-car loaders and face conveyors fit into the second category. [192] These machines had various horse power reflecting their daily capacity.

	Horsepower	Daily Capacity (tons)	Factory Price
Conveyor	5-30	50-300	1,110-2000
Pit-car	1-5	15-25	$ 700-$1,500
Duckbill	15-30	50-300	1,500-2,500
Scraper	7.5-25	50-250	1,500-2,500
Mobile	22.5-50	100-800	6,500-13,500 [193]

The total tonnage of bituminous coal loaded by machinery in the United States was 52.3 percent by mobile machine, 23.5 percent by pit-car loaders, 2.4 percent by scraper loaders, and 21.8 percent by face loaders including those equiped with duckbills in 1935. The mobile loader was the most popular type of loader and 56.1 percent of all mechanically loaded coal was loaded with one of these machines by 1945. [194] Mobile loaders which were responsible for the elimination of hand loading originally involved two different types of machines. One machine consisted of a scoop which after being pushed into the coal pile was mechanically lifted and dumped into a car. Another machine added a pair of claws to the conveyor principle. The two claws were mounted on the lower end of a conveyor, were rotated by motor and reached into the coal pile on the floor and gathered it up and drew the coal on to separately motorized conveyors for delivery to the mine car. [195]

The scraper consisted of a bucket or scoop attached to an electric hoist. The scoop was dragged past the coal face dragging the coal to a side entry and into mine cars. The scraper loader tripled production in contrast to shoveling coal but the machine had several disadvantages. In dragging the removed coal along the floor it gathered up refuse including rocks, scrap metal, and fire clay. Costly cleaning facilities had to be erected by operators using the scrapers to remove these coal impurites. This was a major expenditure since less than 8.3 percent of all coal was mechanically cleaned in the nation by 1930. The use of scrapers was best applied to long-wall mining.

Pit-car loaders began to be used about 1925 and by 1931 were loading about 18 million tons of coal annually. These loaders were popular in Illinois where their numbers increased from less than 100 loaders in 1927 to 2,162 loaders in 1931. Pit-car loaders loaded nearly one-half of all the coal loaded by mechanical means in 1931. [196] This loader was a simple conveyor that rose like a ladder from the mine floor to the top of the mine car. The loader scooped coal from the floor to the bottom of the conveyor and the motor moved the coal forward until it fell into the car. The pit-car loader was difficult to move about from room to room within the mine. The Bureau of Mines reported 2,300 pit-car loaders and 500 mobile loaders were in operation in 1928 but by 1943 there were only 300 pit-car loaders and 2,500 mobile loaders in service. [197]

The duckbill loader (self-loading conveyor) is a shovel devise with a flared mouth which is attached to the end of a shaking conveyor. The duckbill is pushed under the piles of broken coal and the differential movement of the conveyor carries the coal backward from the loading head onto the conveyor proper. This loader was used principally by coal operators in Sweetwater County, southern Wyoming with three-quarters of all duckbills in the United States in 1938.

The Coloder Company of Columbus, Ohio, the McKinnley Mining and Loading Company of Fairmont, West Virginia, the Myers-Whaley Company of Knoxville, Tennesse and the Joy Manufacturing Company of Pittsburgh, Pennsylvania were the principal manufacturers of these coal - loading machines during the 1920s. [198] Joseph Francis Joy (1883-1977), founder of the Joy Manufacturing company, was born in Cumberland, Maryland. He was raised in a family of seven children and attended local school through the fifth grade. Joy was working at a nearby tipple as a slate picker at the age of 12. Joy held every mine job, from pumper to general superintendent, employed at a number of mines in Maryland and western Pennsylvania between 1895 to 1913. He was hired by Pittsburgh Coal Company, as a consultant engineer, to built an experimental coal - loading machine. The loader was tested at Pittsburgh Coal's Somers Number 2 mine at Pricedale, Pennsylvania, where under adverse conditions the machine performed poorly. This unsuccessful experience at Pricedale prompted Pittsburgh Coal to end their business relationship with him to develop a viable loading machines. He founded the Joy Machine Company of Pittsburgh in 1919 after he left the Pittsburgh Coal Company. In 1921, the company became a wholly-owned subsidiary of Joy Machine Company that was incorporated under Delaware law in 1921. The company worked with the Charleroi Iron Works to build different types of loading machines from 1921 to 1924 in Charleroi, Washington, County. The firm constructed a variety of mechanical loaders and a variety of mining machinery at its new facility at Franklin Plant Number 1, which opened on March 1, 1925. Machinery constructed included coal loaders (models 8BU, 11BU, 12BU, 20BU, and 30BU); shuttle cars (two and four wheel drive and steer) -models 32E, 42E, 60E-12, 70E-1, 5SC, 6SC, 7SC, 8SC, and 10SC; coal and hard rock continuous miners; mining

machine tracks (crawler mounted); timber setters (both track mounted and rubber-tired); post pullers; water sprays; and high speed drifting systems for hard rock tunnel driving.[199] The company founded by Joseph Joy is today the largest manufacturer of mining machinery in the world.

The name Joy became synonymous with the mechanical loader. Joseph Joy developed a variety of successful coal- loading machines that was used extensively in mines throughout the United States. Miners accustomed to hand loading coal called the Joy mechanical loaders the "man killers." Organized miners were able to block the introduction of mechanical loaders in their mines by refusing to agree to a wage rate for the loading machine operator. One miner clearly reflected the prevalent position that the machines took away jobs and undercut their wages stating "The machines have thrown miners out of work. I don't like to work with machines and would rather dig coal with pick and shovel by hand."[200] *Joy Days,* a popular mining camp ballad, clearly expressed the deep fear and apprehension felt by most hand loaders with the increased usage of these loading machines by coal companies :

Here is to Old Joy, a wonderful machine,
That loads more coal than any we've seen.
Just pick out the slate and lays up the track,
Get plenty of empties and hurries back.
Ten men cut off with nothing to do,
Their places needed for another Joy crew.
Fifty cars a day is the goal they have set,
With coal and slate together they will get it, I bet.
The bosses all smile to see Joy at work.
And keep him well oiled, he never will shirk.
He uses no shovel and neither a pick,
But with coal and slate together he loads a car quick...[201]

Thereafter, despite miners' protests and resolutions, loading coal by machines continued unchecked. A majority of coal companies were still hand loading their coal by 1930. The introduction of the mechanical loader was a gradual process that began modestly during the 1920s when some firms decided it was time to switch from hand loading to mechanical loading and grew substantially during the 1930s. There were 129 mechanical machines loading some 1,900,000 tons of bituminous coal, or .03 percent of all coal according to the U.S. Geological Survey in 1923. The percentage of coal loaded by machines tripled from 10.5 percent in 1930 to 31 percent in 1939 to 56.1 percent nation-wide in 1945 (Illustration 5 - Mechanical Loader)..

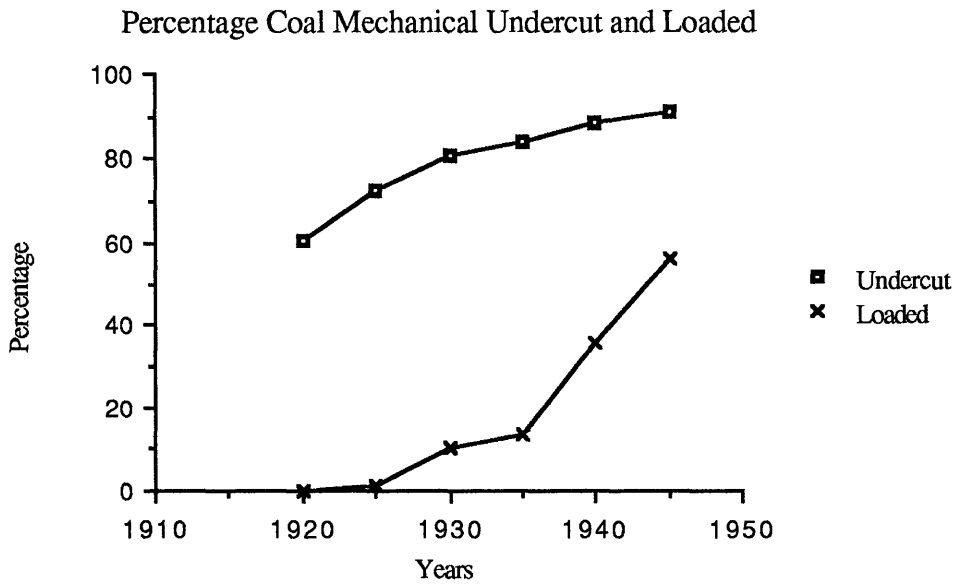
Percentage of Coal Undercut by Mechinery and Mechanically Loaded

		PA	WV	Ill
Machine Under Cut	1929	70.3	85.8	83.5
	1932	79.8	89.6	85.0
Machine Loaded	1929	1.4	1.5	11.8
	1932	2.4	.6	28.8 [202]

The United States Bureau of Mines reported this transition from hand loading to mechanical loading in 1938:

> It is well known that the proportion of underground output obtained by mechanical loading has been highest in the coal fields of the northern Rocky Mountains and the Middle West, where (high) wages combined with favorable seam conditions have stimulated the process of mechanization. In the last two years, however, market conditions and the trend of wage rates have tended to stimulate mechanization in the Appalachian region, and a large part of the sales of equipment reported by the eastern and southern fields. [203]

A variety of factors contributed to this expansion of mine mechanization in the industry after 1935: changes in the level and structure of wage rate, rising product demand and a consequent improvement in the earning prospects of the industry, and the availabilty of improved equipment adaptable to a variety of geological conditions.



UMWA leadership , unlike most miners who were fearful of their future livelihood with the introduction of mechanized mining, wanted coal operators to mechanize their mines by introducing more mechanical loaders. The union strategy was to raise wages, shorten hours of work, increase fringe benefits and improve working conditions for its membership, and this they believed was feasible only if the number of mines and miners was significantly reduced. The official position of the miners' union towards the introduction of machinery in the mine was, "We decided it is better to have a half million men working in the industry at good wages...than it is to have a million men working in the industry in poverty..." [204] President Lewis had been a long-term staunch advocate of mechanized mining since the 1920s and as late as 1947 asserted:

> The UMWA takes the position that the only way in which the standard of living could be increased ... would be by increasing the productivity and lowering the unit costs and utilizing the genius of science and the automatic machine... and the usage of power to do the work of human hands. [205]

Lewis told an interviewer in 1950 from *U.S. News & World Report*: that: "we are not trying to keep men in the mines just to retain jobs. It will be a millennium if men do not have to work underground but can all work in God's sunshine. That'll be a long time in coming, but we would be in favor of it." [206] Lewis viewed the principal purpose of the union as winning higher wages and lower hours in the mines and the membership dues payed by miners was to help the union leadership gain these goals in negotiation with coal operators. Opponents of mine mechanization called Lewis "the best salesman the machinery industry ever had." Locals had been able to block the introduction of mechanical loaders in the 1920s by refusing a wage scale for the loading machine operators or by negotiating restrictive work rules. Union miners who opposed the introduction of loaders during the 1930s did not have the same opportunity to express their opposition. Lewis had ignored traditional processes for ratifying labor contracts with management that had existed in the 1920s. He had purged all rank-and-file opponents during the 1930s and centralized the bargaining process and contract negotiations into his own hands. Lewis had used his constitional authority to revoke the charters of rebellious districts, subdistricts, and locals so that he could replace his opponents with loyal subordinates. Lewis had successfully created a monolithic miners' bureaucracy under his absolute control. A local union spokesman from Fredericktown, Washington County, summarized this usurpation of workers' control by Lewis in 1940 stating "Whereas, we feel that we should have more say as to the kind of contract that we have to work under; be it Resolved, that the International Convention goes on record in favor of a referendum of the membership before the contract is signed." [207] Job rights of miners were traded by Lewis and his inner circle of advisors in exchange for higher miners' wages, or at least the promise of higher wages for a

shrinking membership. Mechanization of mines that began in earnest during the 1930s created a series of new problems within the industry:

1) Mechanical loaders made work underground easier but the coal loaders required a smaller labor force. Fewer workers increased coal daily coal production .
2) The rapid undercutting machines worked in an environment with little improvement in ventilation. There was an increased level of dust in the mechanized mine. High concentration of dust exposed miners to higher risks of black lung disease and possibiabilty of mine exposions.
3)The pace of mining quickened in the mechanized mine. The once independent and primarily unsupervised miners now worked in a more regimented assembly line atmosphere underground. The company foreman was increasing defining the daily work day underground.

More and more coal diggers were laid off permanently as the tempo of mechanization increased. By 1945 UMWA membership had steadily dwindled while unemployment in the coal industry skyrocketed.

The whirlwind union organization drive directed by John L. Lewis since 1933 had successfully organized more than 90 percent of all miners in less than a decade. The UMWA achieved a guaranteed eight-hour day, a national wage agreement and the introduction of much needed safety legislation for its membership. Coal was mined in 31 states with production of 393 million tons of bituminous coal and 50 million tons of anthracite on the eve of World War 11. Pennsylvania produced nearly all the anthracite. This total of nearly 450 million tons represented about 4 tons for every man,woman, and child in the United States. Pennsylvania, West Virginia, Kentucky and Illinois produced nearly three-fourths of the nation's bituminous coal output. American involvement in World War 11, like the Great War, was an economic boom shared by the coal and coke industry. The average price per ton of coal rose from $2.19 to $3.06 nationally while

annual production rose by 63 million net tons between 1941 and 1945.[208] American coal miners were once again enjoying a full work week during the war years.

	Average Value Per Ton	Average Number of Days Worked	Tonnage Mined Per Man Per Day
1936	$1.76	199	4.62
1937	$194	193	4.69
1938	$1.95	162	4.89
1939	$1.84	178	5.25
1940	$1.91	202	5.19
1941	$2.19	216	5.20
1942	$2.36	246	5.12
1943	$2.69	264	5.38
1944	$2.92	278	5.67
1945	No Data	261	5.78

Mechanized loading, cutting, drilling, hoisting and coal preparation rapidly increased daily tonnage of coal but reduced the number of pick-miners and loaders required. The new machinery increased daily production, increased productivity per worker by reducing the size of the bloated labor force. The number of bituminous coal miners in Pennsylvania declined from 133,703 to 98,764 between 1930 and 1945. The reduction of the work force was a long-term and irreversible process, as the number of miners in the state decreased by almost 84 percent from 170,000 to about 26,000 between 1950 and 1980. In Pennsylvania, there were fewer bituminous coal miners employed in 1970 than in 1880.

The Bituminous Coal Industry in the Post War Decades

Pensylvania's bituminous coal industry after 1945 was a far different industry than the industry that had developed in the Monongahela Valley during the 1760s. From 1945 to 1960, while the national economy grew by 50 percent, coal production in the Commonwealth fell by 27 percent. [209] By the 1950s the state's production slumped as bankruptcies occurred with increasing frequency. Unsuccessful coal companies closed their mines, laid off their miners, and sold off their mining properties including the company-owned houses. Miners who had rented their homes for decades could now own them. Some companies sold the houses directly to individual buyers with miners having the first chance to buy them while other companies simply sold all their ral estate holdings collectively to a real estate investor who then resold the properties. A federal survey of mining families in 1947 found nearly 60 percent were still living in company-owned housing. The government survey also found the average company house was one-story four room frame house with a kitchen, a living room and two bedrooms. Few miners' houses of the period had closets, basements or indoor bathrooms. The President's Commission on Coal of 1979 found only 7 per cent of miners rented houses from the company while 74 percent owned their own houses (most were purchased from the company). The study noted 25 percent of all miners and their families lived in mobile homes, compared to only 5 percent of the general population. [210] Many former mining communities became incorporated towns or were consolidated by larger neighboring towns. Dozens of the former coal towns and villages dotting the landscape of western Pennsylvania have survived the collapse of the coal industry and today many remain viable communities generations after mining has ceased.

Pennsylvania's soft coal industry hit the skids during the 1980s when statewide production fell by 21 percent while coal production nationally increased by 19 percent. Employment in the industry dropped 61 percent reflecting lower production and productivity improvement. There were less than 14,000 miners in the state producing 68.3 million tons in 1989. The bituminous industry of Pennsylvania is now firmly controlled by

large corporations which have successfully mechanized the extraction of coal. These few large coal companies have restructured the state's coal industry through mechanization, mergers and acquisitions. For example, Pittsburgh Coal Company and Consolidation Coal Company had been losing money at a terrific rate since the 1930s before their consolidation on November 23, 1945. George Hutchinson Love, the new president of Pitt-Consol, was a coal company executive with over two decades of practical experience in the industry. He entered the coal industry as operator of the Union Collieries Company in 1926. He joined Consolidation Coal Company in 1943 and Union Collieries' properties were taken over by Consolidation in 1944. The new corporation was created, according to Love, because "We felt that if we could eventually build a company that could afford to close down the poorer properties and concentrate on the better ones, there was a chance to make something out of this industry. If coal was going to be competitive with other fuels, like oil and gas, you had no choice but to mechanize." [211] Pittsburgh Consolidation Coal Company (known as Pitt-Consol) operated 39 underground and 9 surface operations in Pennsylvania,West Virginia and Kentucky in 1945. [212] Pittsburgh Consolidation had assets of more than 100 million dollars with a net working capital of approximately 29 million dollars. 5 percent in 1940, 20 percent in 1945 and 25 percent in 1950. The three largest coal-producing companies during the 1980s were the Peabody Holding Company (6.4 percent), Consolidation Coal Company (5.2 percent) and Amax Coal Company (4.4 percent). These three companies alone produced 16 percent of the nation's entire coal production in 1981.

Pitt-Consol, like other successful coal companies that remained solvent in a declining industry and a highly competitive energy market, introduced continuous mining in a desperate attempt to make their industry competitive with oil and natural gas. The post-war mechanized mine made the industry more productive and cost effective by substantially increasing the daily productivity of a smaller labor force. There were fewer than one-half as many underground operations in 1973 (4,744 mines) as in 1950 (9,429 mines). Productivity per miner doubled from 5.78 tons per day to 12.83 tons per day between 1945 and 1960.[213] The efficiencies of individual underground mines of Pennsylvania differed greatly. Mechanized mines produced more than 20 tons while less mechanized mines

produced less than 1 ton in 1945. A survey of 622 mines in 1954 noted that 128 mines produced less than 3 tons per man / per day, 325 mines produced from 3 to 6 tons per man / per day, 125 mines from 6 to 9 tons per man / per day, and 44 mines over 9 tons per man / per day. [214] Almost 50 per cent of Pennsylvania's coal production of 91.9 million net tons of coal productioncame from fewer than one-half of one percent of the 888 operating mines in 1953. The more efficent mines used large-scale mechanized mining equipment that extracted coal in generally thick seams. The most productive mining operations in Pennsylvania by the mid-1950s were located in the southern parts of Armstrong, Indiana and Cambria counties. An average mechanized coal operation producing a million tons of coal annually, was at least a $10 million investment.

A bituminous coal miner in 1910 using a pick, shovel and black powder explosives could dig about three tons of coal-on-average-per day . By 1988, each American miner produced over 19 tons of coal while each surface miner averaged more than 46 tons per shift. By 1945 90.8 percent of all coal was mechanically undercut while 56.1 percent was mechanically loaded in the United States. Mine mechanization increased the capacity to produce more coal with fewer workers and furnished greater elasticity in operations by permitting operators to meet peak demands quickly. Mechanization of the mining process linking every operation, from face to the tipple, into a single continuous process was not fully implemented until the 1950s with the introduction of the continuous mining machine. The use of gathering-type mobile mechanical loaders of the 1930s had increased productivity, but the undercutting and removing of coal from the face still represented separate mining operations.

The Joy Manufacturing Company of Pittsburgh introduced the 3JCM-2 continuous mining machine in a public demonstration for the news media on December 14, 1948. This machine was designed, according to the manufacturer, to rip two tons of coal per minute out of a solid seam of coal. [215] Mechanical breakdowns and workers' resistence often rendered this production assertion an exaggeration; nevertheless, the machine greatly increased mining productivity. The continuous miner represented the culmination of a gradual process in the technological and social organization of the underground mine as a

work place. Coal is extracted in a sequence of steps in conventional mining. The giant continuous mining machine combined the separate functions of undercutting, drilling, blasting, and loading into a single process. Carbide cutting bits mounted in the rings of rotating cutting discs literally ripped coal from the face and then giant dual gathering arms swept the broken coal onto a conveyor that passed from the front of the machine to the rear where it was loaded into rubber-tired shuttle cars, or directly onto conveyor belts that transported it out of the mine to the tipple for processing. Water was sprayed on the cutting equipment and the coal face to reduce the extensive airborne dust. Each machine and its collateral equipment cost the coal company more than $250,000 in the 1950s (Illustration 6 - Mechanical loader). National data on coal mines employing this machinery was first compiled in 1950 when less than 1 (.8) percent of coal was mined with these machines (about 3.1 million tons) while 91.8 percent of coal was undercut by machine and 7.4 percent was cut by hand and shot from solid. Some of the earliest continuous mining machines were first introduced in Cambria County during the 1940s. Barnes and Tucker Company installed one of the earliest continuous miners at its Lancashire Mine Number 15 near Bakerton in 1949. A second machine with a rotary (or boring) type cutting head was installed at Mine Number 31 of Bethlehem Mines Corporation in Cambria County on November, 1950. There were 157 continuous mining machines in operation throughout the nation by 1951. [216] A decade later 27.4 percent of all coal mined nationally was extracted with these machines, while 67.7 percent was undercut by machines and less than 5 percent of all coal was mined by hand. Other machinery introduced in the post-war mechanized mine included the cutting knife, crawler-type loader, and the shuttle car. The cutting knife was a machine on wheels that had a sharp single blade that cut coal from the seam in either a vertical or hortizontal manner. The crawler-type loader picked up coal that was blasted from the coal seam and loaded it into cars hauled away by shuttle cars or on a conveyor belt. These machines are equiped with a steel canopoly that protect the operators from possible roof fall while working the mine face. These electrically powered machines break up the coal with large, rotating cutting drums studded with carbide teeth at the mine face, while gathering arms located behind the drum scoop the coal directly onto built-in

conveyors for loading onto waiting shuttle cars, which carry the coal to the mine conveyor system. The machine advances through the mine face by single cuts limited to the length of the machine which is approximately 20 feet as the machine proceeds through the coal seam, miners will install roof supports usually a combination of cribs, posts and "roof bolts." After the continuous mining machine removed coal from the working face, miners installed temporary supports by installing ten ton hydraulic roof jacks to provide roof support. The roof bolter and his buddy operates a roof bolting machine that drills holes, position bolts and tightens them in the roof. Steel roof bolts of varying sizes are installed using a special torque measuring wrench. The introduction of roof bolts was a major development in the evolution in mine safety. Roof bolts are long steel rods driven in the roof to bind weak, overlaying rock strata into a layer strong enough to support its own weight. The use of roof bolting provided elbow-room underground for both men and machinery. [217] Modern continuous mining machines can mine coal at the rate of 8 to 15 tons per minute in 1990.

The room-and-pillar system of mining was still the prevalent underground mining method of extraction. Underground coal is mined in rooms separated by walls or pillars left to support the roof by continuous miners. Long-wall mining is an alternative method of deep mining coal. This technique uses a steel plow or rotating cutting drum that passes back and forth across the face of the coal covering an area of 500 to 1,000 feet long. The loosened coal falls onto a conveyor belt and is removed from the mine. This method, unlike the room-and-pillar "continuous mining method" that it challenged following World War 11, involved the removal of the entire coal seam, or very large sections of it (Longwall method - Illustration 7). American use of longwall mining dates back to the first decades of the twentieth century when posts and cribs were used to support the wall adjacent to the long face. European coal operators began using this method extensively in their mines by 1900. A few American coal companies employed longwall mining during this period although the process was never enthusiastically embraced by a majority of bituminous coal operators until after the Second World War. [218] The mines at Vintondale, Cambria County, and the Maryland Shaft Mine of the Berwind-White Coal Mining Company used this underground mining method during the first decade of the twentieth century. Long-wall mining was

successfully employed at the Gateway Mine near Clarksville, Greene County and at Jones and Laughlin's Vesta Mine Number 5, Vestaburg, Washington County in Western Pennsylvania immediately after World War 11. Modern mechanized longwall equipment used today in the United States, powered supports and cutters, was largely imported from Europe during the 1960s.

Longwall mining is employed today to mine large blocks of coal where the seam is relatively flat and thick, and where the degree of surface subsidence is acceptable. Longwall mining can be accomplished using two methods. The first type uses a cutter called a plough. This mechanical mechanical devise has teeth positioned along the sides which cuts an average of six inches of coal per pass as it moves forth across several hundred feet of the seam. The loosened coal is then transported from the mine on a series of conveyor belts from the face. The second type of cutting machine is the rotating drum shearer. The metal shearer traverses the coal face cutting 30 inches deep into the coal. As the machine moves along a chain conveyor is used to support the newly formed roof. Moveable steel plates, called props or shields, supported by hydraulic jacks support the roof over the immediate work area, and as the miners works the machine deeper into the seam, the roof supports are advanced and the roof rock behind the supports are permitted to cave in. Long sections of coal, up to 700 feet, can be removed at a time without any pillars to support the mined-out region. The president of the Blue Diamond Company described the longwall extractve method and its superiority to other existing mining methods to his stockholders in the company's 1986 annual report :

> The longwall is a highly mechanized means of mining coal that has been greatly refined in the last five to ten years. It consists of a shearing machine, which hauls itself back and forth on a conveyor frame and cuts 30 feet of coal from a 700 feet face. Each longwall panel will be from 2,500 to 8,100 feet in length. The shearer and conveyor are both located under massive metal roof supports with hydraulic legs and most of the work is performed under these roof supports, greatly enhancing the safety of the work crew. On the longwall face, we are expecting

to mine six times as much coal, with a similar size crew, as on a continuous miner section. For this reason, the longwall should make a significant reduction in the mining cost per ton at Scotia. [219]

This method was more efficient than the wasteful room-and-pillar method. Engineers estimated that one-third to one-half of all coal in abandoned mines remains in the forms of pillars. Longwall mining offers coal companies the best method for improving daily productivity in underground coal mining by reducing the size of its labor force. A major drawback to longwall mining was the large initial capital outlay for the purchase of the machinery. In 1993 21 mines in Pennsylvania and a total of 112 mines in the United States currently employ longwall mining. [220] Underground coal production by mining techniques in 1990 were room-and-pillar with continuous mining machinery - 63 percent, conventional room and pillar - 7 percent, short wall - 1 percent, and longwall - 29 percent. [221]

Oil and gas production had been encroaching on the coal market shares since the 1920s but this trend had greatly accelerated during the post World War 11 period. The significant, but brief era of "King Coal," was coming to a close during the 1950s and 1960s. Its long-term position as America's primary energy source was successfully challenged by natural gas and petroleum as the increasing popularity of these fossil fuels lessened the demand for coal from traditional coal markets. Coal was surpassed first by petroleum in 1952 and subsequently by natural gas in 1964 as the nation's principal energy source. Automobiles, home heating and industry were the principal users of oil. The further expansion of natural gas as a viable and major energy source was handicapped until the construction of an extensive national network of pipelines. This competition made natural gas the choice for home heating and industrial markets. Natural gas exceeded coal as the principal source of energy in the United States in 1960 and four years later surpassed petroleum. [222]

The share of the energy market held by coal was eroded by these fossil fuels and by the continual shrinkage of traditional coal markets. Steam coal for railroad locomotives ended with a rapid change-over to diesel engines following the war. The steam coal market was once a 130-million ton a year market. The consumption of coal and coke by the steel

industry for the production of pig-iron and steel became stagnant with the decline of these industries. The steel industry also found more effective ways to utilize coke and therefore demand for bituminous coal and coke was reduced. Coke is still used in iron production, but most steel in the United States is made in electric furnaces. The principal users of Pennsylvania's bituminous coal in 1929 were beehive and by-product coke ovens -27.5 percent, general manufacturers - 20.0 percent, railroads - 19.5 percent, domestic use-15 per cent, and steel works - 10 percent. In contrast, the principal coal markets in 1981 were steam coal for electrical utilities - 55 percent; steel companies (metallurgical coal for coke production) - 20 percent; industrial and retail consumers (boilers and domestic consumers) - 8 percent; export (both steam and metallurgical coal) - 17 percent. [223]

Coal was extracted from the surface like quarry stone by coal miners since the 18th century. The scale of surface or strip mining increased significantly after World War 11. The decision to undertake surface mining is dependent upon the average thickness of the overburden and the thickness of the coal seam. Surface mining is employed when the coal seam is located less than 50 to 100 feet from the surface. "Area" mining and "contour" mining are the two principal methods of surface mining. Area mining is practiced when the coal seam is on relatively flat ground and consists of a series of cuts 100 to 200 feet wide, with the overburden from one cut used to fill the mined-out area of the proceeding cut. Contour surface mining follows the coal seam as it outcrops on steep and hilly terrain. Large-scale equipment enhanced the productivity of surface mining operations. The following list of surface mining equipment employed included: auger machine, bucket-wheel excavator, bulldozer, carryall scraper (or pan scraper), continuous surface miner, dragline excavator,walking dragline, front-end loader, thin seam miner. Surface mining involves a series of distinct steps from extraction to shipment to market. The first step is the removal of topsoil and surface rocks that are broken up by blasting and then removed by giant power shovels. The second part of the operation is the loosening and removal of coal and loading it for shipment. In the final step, coal is transported from the site, usually by truck to the preparation plant where it is sorted according to a variety of sizes, washed to remove impurities and then dried. The coal is now ready for transportation to a nearby

electric-generating plant or loaded onto railroad cars or by truck for transport to more distant local or foreign markets.

Surface mining was not a practical mining method until large-scale excavation equipment became widely available around 1915. Indiana and Illinois were early strip-mining states although less than 1.5 percent of all coal was surface mined during the 1920s. The percentage of coal mined by surface methods increased steadily with each successive decade after the 1920s from 4.3 percent in 1930, 9.4 percent in 1940, and 23.6 percent in 1950. By 1975 approximately one-half of the 640 million tons of coal produced nationally was mined by surface removal methods. There are numerous advantages of surface mining over conventional underground mining that account for its increasing popularity with coal operators: it is faster, less expensive, and generally a more efficient method of mining. This method requires a smaller labor force and is safer than underground mining. Mechanized surface mining removes from 80 to 100 percent of the coal in the seam while conventional underground mining recovers between 40 to 60 percent. An acre of coal with a three feet thick coalbed produces approximately 5,000 tons by surface mining whereas a similar size area yields 3,300 tons or less in deep mining. The output per man per day in a strip operation was double that of an underground miner in 1960. An average worker in a surface coal operation produces 22.93 tons per day while an underground miner averages 10.64 tons per day. Surface mining is a safer mining method because there is little danger to workers from poison or explosives gases, collapsing roofs, and haulage accidents, which are all major causes of underground mine fatalities and injuries.

Surface mining has a number of drawbacks including the inability to mine coal in inclement weather. Furthermore, the process can create severe environmental damage by destroying the natural vegetation of the mined area. The harmful effects of surface mining include disruption of ground water and surface draining regimes, ponding of water to form breeding grounds for insects, creation of potentially hazardous slopes and cliffs (high walls) and unstable spoils piles. The General Assembly of Pennsylvania passed the Pennsylvania Bituminous Coal Open Mining Conservation Act in 1945. It was one earliest and most comprehensive surface-mine reclamation laws to deal with the harmful

environmental impact of this mining method. The act established standards that surface-mine operators had to adhere to in the restoration of land after mining was completed. The Pennsylvania Assembly enacted in 1963 a more stringent law requiring the restoration of surface-mined land to resemble the contour of the land prior to its being strip-mined.

Surface or strip miningbegan in the anthracite region of Pennsylvania during the 1880s and by the next decade this type of mining had expanded around Eckley and extended east to Sandy Run and west near Jeddo, Ebervale, Japan, Oakdale and Harleigh. Strip mining accounted for about 1.5 million tons, representing about 2.5 percent of all anthracite mined in 1925. The Pennsylvania Bureau of Mines did not keep precise records of surface mining before 1932, but by 1964 55 percent of all anthracite was stripped mined.

In contrast, surface or strip mining in the bituminous coal fields of Pennsylvania began during the late 1930s. The Pennsylvania Department of Mines first reported surface production statistics in the bituminous coal fields in 1939. Some 2.7 million tons of coal was surface-mined in comparison to 89 million tons mined underground. The Pittsburgh coal seam, located in Allegheny, Fayette, Washington and Westmoreland counties were the first counties surface mined in Pennsylvania. After 1940 surface mining increased from 5 percent in 1940, 20 percent in 1945 and 25 percent in 1950.

ILLUSTRATIONS

Number 1 Production in Counties of Pennsylvania
Number 2 Production in Counties of Pennsylvania
Number 3 Layout of a Preparation Plant
Number 4 West Virginia coal fields
Number 5 Mechanical coal loader
Number 6 Continuous mining machine
Number 7 Longwell mining

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The relative supply of energy by various sources in 1931 were: bituminous coal 48.6%, anthracite 7.9 %, natural gas 8.6%, water power 8.5%, imperial oil 1.4%, and domestic oil 25.0%. American coal (anthracite - 5.4% and bituminous - 45%) supplied less than half of the energy in the United States by 1937.

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The chart below identifies the principal energy suppliers and percentage of the market share each fuel held between 1920 and 1944:

	Bituminous	Anthracite	Petroleum	Natural Gas	Hydro
1920-1924	69.7	11.4	9.3	4.7	4.9
1925-1929	67.9	9.3	11.4	7.0	4.4
1930-1934	61.6	9.3	14.1	10.2	4.8
1935-1939	59.2	7.4	16.3	11.9	5.2
1940-1944	59.1	6.0	17.4	12.4	5.1

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3 million tons or more 17 producers 19.9 % U.S. Commercial Total
1 million tons or more 70 producers 22.9 % U.S. Commercial Total
500,000 to 1,000,000 131 producers 17% % U.S. Commercial Total

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There were 23,900 miners in Fayette County, of whom several thousand were employed at union mines.

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The chart below, from Heber Blankenhorn's study, reflects the ethnic diversity of the miners employed by the Berwind-White Mining Company in their mines in Somerset and Cambria counties:

	January 1, 1922	January 1, 1923
American	411	507
Slavish	753	275
Polish	495	264
Hungarian	545	358
Italian	415	179
German	37	40
Scotch	25	17
Austrian	35	13
Welsh	6	7
French	3	1
English	23	20
Irish	4	9
Rumanian	47	24
Scandinavian	6	3
Spanish	23	90
Belgian	1	2
Serb	0	3
Croat	17	7
Lithuanian	40	20
Greek	2	17
Mexican	6	15
Porto Rican (sic)	0	1
Macedonian	1	2
Turk	0	1
Bulgarian	1	1
Canadian	0	1
Total	2,894	1,877

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The returning miners issued the following bitter resolution at the conclusion of their 17-month unsuccessful bid for union representation:

Whereas: The long strike of almost seventeen months in the coal fields of Somerset has been terminated and...

Whereas: we recognize the circumstances making necessary the temporary abandonment of our fight against the coal operators for Union recognization, and realize that the feature of the strike to secure our demands was not due to any defects in the principles of unionism, but rather by the brutal tactics and tremendous financial strike of the coal companies, as well as to the weak mindedness, selfishness and un-Americanism of strikebreakers who took our jobs, and reaped the benefit of the wage increases which not they, but we and the union were means of securing from the coal operators of Somerset County.

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Second Appalachian Agreement April 1,1934 to March 31, 1935 later extended to September 30, 1935
Third Appalachian Agreement October 1, 1935 to March 31, 1937
Fourth Appalachian Agreement April 1, 1937 to March 31, 1939
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INTERAGENCY RESOURCES DIVISION
NATIONAL PARK SERVICE

1. NAME OF PROPERTY TYPE: Extractive Facilities

11. DESCRIPTION

The extractive facility property type includes a broad array of both surface and underground resources associated with the extraction and processing of bituminous coal and coke production. The physical resources of this property type range in size and complexity from an eighteenth century mining facility consisting of little more than a drift entry into the side of a hill, to the mid-nineteenth century extractive facility consisting of a wooden tipple, a loading platform, small storage shacks for mining supplies and a mule barn, to the twentieth century site including a diversity of both surface and underground resources including a tipple/preparation plant, hoist house, lamp house, bath house, boiler house, motor barn, blacksmith shop and coke ovens at a coke plant. Large commercial mines had underground workings ranging in size from 1,000 to nearly 100,000 acres. For example, the Maple Creek Mine of the United States Steel Corporation on the Monongahela River between New Eagle and Monongahela City, Washington County had underground coal reserves of approximately 17,000 acres of Pittsburgh coal seam situated in four townships of Washington County. The Renton Mine mined 100,000 acres of coal lands in Allegheny County while the Shannopin Mine, mined 7,500 acres of its nearly a 13,000 acres of coal reserves in Greene County. This represents a 20 year coal reserve with existing mining techniques.

There was no need for surface structures and buildings during the eighteenth century when pioneer coal pickers simply removed coal with picks and shovels that outcropped at or near the surface. Coal pickers were forced to follow the seam underground when most surface coal was exhausted by the first decade of the nineteenth century. Simple hand tools - picks, shovels, and augers - owned and maintained by coal miners were used to remove coal from the seam. The rudimentary power underground was supplied by miners, dogs, horses or mules. The number of surface structures needed for mining and storage was still negligible. A typical extractive site of the 1860s consisted of a coal tipple, a loading

platform, small storage shacks, and a mule barn. These buildings and structures were usually constructed of wood and located close to the mine entry. The coal tipple was the central structure located at all extractive sites but the smallest seasonal "fly-by-night" operations. The tipple was a large wooden tower-like structure located near the entrance to the mine or if coal was transported by water it was usually located overlooking the river. The structure was called a tipple because after the coal was shipped to the surface in wooden coal cars it was weighed by the weighmaster, and each car was "tippled" or " dumped" into the top of the structure. Raw coal was weighed, and sometimes sorted into different sizes and cleaned before shipment to market by river or railroad. The average life of a wooden tipple was estimated at about twenty years and to prolong the life of the tipple, a wood preservative such as carbolineum was used. Associated with the tipple were scales, run-of-the-mine conveyor belts, and the tippleman's shack which provided shelter for the tipple operators including the weigh master, the dump operator and at least one man to handle and inspect the mine cars.

Significant technological and organizational changes in the industry, and the introduction of electricity in the decades following the 1880s led to the growth in the number of surface resources at a typical coal and coke extractive facilty. A variety of factors determined the exact configuration of the surface resources located at a particular extractive site: the type of mine entry, whether the facility manufactured coke; the physical size of the operation; and the date when the facility was in operation. There are three kinds of underground mines- drift, slope, shaft - and the type of mine entry employed to extract coal was dependent upon the terrain and other factors. Some mines had more than a single type of entry. Drift mines are used to develop coal seams exposed in hillsides or the coal seam outcrops on the side of a mountain. Miners tunnel into the hill removing coal as they go. A drift-entry mine, unlike a slope - or a shaft-entry did not require a hoist house since there was no need to haul coal, miners or material to and from the mine. Small drift-entry mines employing natural ventilation did not require mechanical ventilation, therefore there was no need for the construction of a fan motor house to contain the mechanical fan(s). The use of electricity to operate undercutting machinery, haulage trolleys and underground lighting required the

construction of a power house, boiler house and sub-generator shop to produce electricity and convert it to operate mine machinery, the electric fan, and to provide power at the company town. Mines that did not use electricity or purchased their electrical power did not require these buildings.

An extractive facility after the 1880s included all or only a few of the following buildings and structures: ventilation fan house, mule stable (either surface buildings or underground), tipple/preparation plant and scales, hoist house, supply house(s), repair sheds, blacksmith shop, machine or motor barn, carpenter shop, cap and powder houses, lamp house, mine office, power station, boiler room, substation, wash house and perhaps coke ovens. These buildings and structures were constructed of wood, brick, stone and increasingly with concrete and steel after 1900. Concrete was a new building material used during the twentieth century in the construction of the tipple/preparation plant, fan house, underground mule stables, shaft entry and haulage ways. The wooden tipple was replaced with the steel tipples at a number of coal operations. Each of these extractive buildings or structures ranged from the four-foot square for the cap and magazine buildings to the machine repair shop measuring more than 150 feet in length and 100 feet in width. The principal buildings or structures located at a large coal and coke extractive facility included:

The hoist house was located in all shaft entry and some slope entry mines. It was usually a one-story brick or masonry building with a slate, shingle or cement tile roof. Steam or electric hoisting machines, with numerous smaller electrical motors were located in this building to haul coal, waste, and miners in a cage from the mine to the surface and back. An average building measured about 25 by 40 feet. The hoist house was located near the power house and often the functions of the two building were combined in one larger building.

The head frame was a metal structure located next to the hoist house and power house. It contained a large bullwheel and cables used to raise and lower the cage(s) or skip(s) in the concrete lined shaft after 1900. An average cage or elevator circa 1920 handled 15 to 20

men. A typical shaft mine of this period ranged from 100 to 1,000 feet, but some mines are as much as 1,500 feet deep.

The boiler house, power house and electrical substations were usually brick buildings with a variety of roof materials including shingle, tile, slate or cement tile roofs. The buildings were constructed to generate and distribute electrical power used at the mine to operate machinery including undercutting machines, haulage locomotives, and provide lighting and communication in the mine. Electrical substations were constructed of brick or concrete and were used to house electrical transformers. At the substation the electricity produced at the power plant was converted to a usual direct-current of 250 volts for machines and 500 volts for electric haulage locomotive (circa 1918).

Cap and powder magazine structures were used to store detonating caps and explosives. Explosive caps used by miners in blowing coal off the working face after the seam was undercut were stored in the cap building while the powder magazine stored black powder or dynamite. These were the smallest buildings located at a typical bituminous mine in Pennsylvania. Each structure measured about 4 by 4 feet. They were constructed of concrete blocks, corrugated metal or bricks, with brick, stone, and concrete foundations. The standard door of the powder magazine was three thicknesses of 7/8 inch hardwood boards covered on the outside with no less than 1/2 inch of steel or boiler plate. The flat roofs of these structures were made of asbestos boards, corrugated metal or poured concrete. The structures were usually constructed at some distance from the mine for safety and often they were constructed into the side of a nearby hill.

The fan house was constructed of brick or cinderblock, with a flat, corrugated metal roof, to house the electric fan used to keep fresh air circulating in the underground passages. The fan enclosed in the fan house located at the surface continually exhausted air up a shaft from the mine below. Fresh air was drawn into the mine through other openings.

The lamp house was constructed in larger mines that used a large number of electric miners' lamps and safety gas lamps. Lamps were left with the lampman by miners after each shift to be charged, repaired and stored in the lamp house. The building was usually a small brick or wooden building with a slate, asbestos shingles or cement tile roof. The lamp house was often part of the foreman's office or washhouse in smaller mining operations. Miners who worked in non-gassy mines used open flame carbide lamps as late as the 1950s (for example, miners at Loyal Hanna Mine Number 6 at Cairnbrook, Somerset County used carbide lamps between 1914 and the closure of the mine in 1958). A lamp house was not constructed at these non-gassy mines.

The mule barn or stable was constructed to shelter draft animals including mules, ponies, and horses that were used to haul coal to the surface coal tipple. The size of this wooden building with a tar-papered roof was dependent on the number and type of draught animals used at a particular mine. The building was located underground in most shaft mines and in some deep slope mines. The animals remained underground and were moved to the surface when the animal died, needed medical care or during an extended labor strike. This practice was ruled illegal when Pennsylvania passed legislation prohibiting this practice in 1965.

Machine shop or motor barn was constructed for the maintenance and upkeep of mining machines, haulage locomotives, and mine cars. Each mine that employed mechanical machinery had its own motor barn for repair and maintenance of machinery and equipment. Small mines that lacked any mining machinery had a small blacksmith shop where hand tools were sharpened and draft animals were shoed.The building was usually brick with roof trusses made of wood. The interior walls were stucco-covered lath. The roof was covered with asbestos shingles, slate or cement tile. Motor barns were constructed underground in some large shaft mines. The duties and services provided by the mine's blacksmiths and carpenters were performed in this building in larger mines.

The wash house or bathhouse was constructed by some coal operators to relieve the miners' wives of the necessary and tedious task of bathing their husbands each evening. By 1920 Pennsylvania law required the construction of a bathhouse whenever a demand was made for them by any ten men whose work was done in wet places. The physical size of the washhouse varied in terms of the number of miners the building served. The washhouse was constructed of brick or concrete with a slate or asbestos shingle roof. The floor of the whole building was concrete after 1900. The washroom was divided into rooms in term of their functions-locker room, toilet room and showers.

A variety of small buildings or warehouses were located at most mines to house oil and sand. These warehouses were often wood-frame buildings with asphalt or asbestos shingle roofs or corrugated metal roofs. These buildings were usually located at the railroad siding. Goods for the company store and mining supplies were unloaded and stored in the warehouses.

A coal washer or preparation plant did the identical functions of the nineteenth century tipple although it also cleaned and washed coal. A majority of bituminous coal was shipped to market as run-of-the-mine coal without much surface preparation until the 1920s. Large impurities were usually removed underground by loaders but little coal processing was done at the surface. The expansive and costly preparation plants were constructed by large coal companies beginning in the 1920s in an attempt to attract a broader coal market in a declining industry by selling higher quality coal. They were large poured-concrete buildings costing as much as a million dollars each. The preparation (wash) plants constructed during the 1920s and 1930s had the capacity to clean and wash from 50 to 700 tons of coal per hour. Cleaning coal upgraded the quality and heating value of coal by reducing or removing sulfur, rock, clay, and other ash-producing matter. The cleaned coal was transported via a conveyor belt to a room where coal of different sizes and properties were blended together to meet particular consumer requirements. The coal was then dried and ready for shipment to market.

Some preparation plants were constructed as an integral part of a single extractive facility (Mine 40, Somerset County and Mather Mine, Greene County) while other coal companies erected their preparation plant in a central location to clean and wash coal for a number of their own mines, and often competitors coal for a fee (for example, the Pittsburgh Coal Company's Champion Plant Number 1, near Imperial, Allegheny County).

Most buildings and structures were located on the surface but in a few cases buildings and structures were constructed underground. Mine engineers who constructed the surface mine complex built the mule barn and machine repair shops underground in some shaft mines and in some deep slope mines. Machine shops were constructed underground to service and repair a diversity of power tools and machinery. Electric and battery locomotives, electric-and air-compressed undercutting machines, and mechanical loaders were all repaired by machinists and blacksmiths in fully stocked shops underground. Construction of underground repair facilities saved the coal company time and money by servicing equipment underground. When the mine was closed and the shaft sealed the repair shops with machinery and tools were abandoned and left intact underground.

The purpose of some coal mines was the extraction of coal for the conversion into coke at the mine site. A typical coke plant would require most of the same structures and buildings located at a conventional mine but would also include coke ovens and a large reservoir for water used to quench the hot coke. The coke-making process was designed to burn off the volatile matter in coal without letting the fire destroy the carbon. Coke is the solid product resulting from the destructive distillation of coal. This is done by carefully restricting the amount of air in contact with the burning coal. There were two principal methods of coke production in Pennsylvania before 1860. The earliest coke production process was known by a variety of names -"coking in coke-fires," on "coke-hearths,""in ricks,""racks" and "on the ground." In this method coke was produced by the controlled combustion of coal piled in large mounds covered with turf in the open air. Part of the coal was burned to supply the

heat for converting the remaining coal into coke. Iron masters of western Pennsylvania used this coking method until the adoption of the wide-spread use of the beehive oven.

The beehive coke oven was so named because the dome-shaped interior of the oven is shaped like a beehive and lined with heat-resistant refractory fire bricks and tiles. It was first constructed near Connellsville during the 1830s. The beehive oven was an arch-roofed circular, brick room with an opening at the top and at the front of the oven. The ovens varied in their interior sizes in their diameter and height although accepted dimensions by larger coke producers including the H.C. Frick Coke Company were 12.5 feet inside diameter, and 7 to 8 feet clear height. The dome is spherical and springs from the circular wall at about 1.75 feet above the floor. There is a circular hole at the top of the oven called the "tunnel head" or "eye" which could be covered with a metal lid. Flames and smoke from the burning coal is expelled into the atmosphere from this opening. Coal is dumped through the "eye" and spread evenly on the floor to a depth of 2 or more feet. The front opening of the oven, through which the coke was discharged, is nearly sealed with bricks while the coal was burned. The space between the lining and the outside walls is filled with waste bricks and other material to prevent, as far as possible, the loss of heat to the exterior. The brick beehive oven subsequently became the universal method of coke production in the state and nation until the twentieth century. About 88 percent of all iron produced in the United States used metallurgical coke made in these ovens from 1871 to 1919.

Beehive coke ovens were constructed in batteries arranged in single rows called "banks," or in double rows called "blocks" located close to the entry of the mine. Rows of beehive coke ovens were often constructed into the side of a hill. The number of ovens at a coke plant ranged from a couple dozen ovens to continuous banks including as many as 900 plus ovens in the larger coke production sites (Star Junction, Standard Works, and Trauger). Some large coke operators in order to avoid excessive waste in time and power in charging a single long block of ovens built several shorter parallel blocks, each block generally having about 100 ovens.

The beehive ovens, concentrated in the compact Connellsville coke region, produced nearly 100 percent of all coke used as blast furnace fuel in the nation until 1893, and as late

as 1910 produced 83 percent of all metallurgical or "met" coke. Between the early 1890s and the outbreak of the European War, annual coke production in the United States more than quadrupled. Production rose from less than ten million tons annually to more than 46 million tons in 1913. Two alternative coke-producing ovens were developed after the 1890s which challenged the supremacy of the venerable beehive coke oven. They were the rectangular oven and the by-product or retort oven.

The rectangular oven also known as the Belgian, or Mitchell oven was a variation on the beehive oven. The oven was invented in Belgium in the late nineteenth century. These ovens made coke in a similar manner to beehive coke, but each oven was larger than the conventional beehive oven. The standard beehive oven was about 12 feet in diameter and about 7 feet high while the rectangular oven measured around 30 feet long, 4 1/2 feet to 5 feet wide and 8 1/2 feet high. The rectangular oven's larger interior space permitted each oven to produce 5 1/2 tons of coke with each charge as compared to 4 1/2 tons per charge in an average beehive oven.

The new design of the rectangular oven abandoned the circular shape and the single door of the beehive oven. The rectangular oven, unlike the beehive oven, was designed to be mechanically loaded, levelled and unloaded. Each oven had a door at either end for the mechanical removal of coke and therefore such ovens were constructed in single banks.

The first bank of rectangular ovens was constructed at Mt. Braddock, Fayette County in the winter of 1905-1906 under the directorship of T. J. Mitchell, superintendent of W.J. Rainey Company. The experimental rectangular oven was 30 feet long, 4 feet wide, and had a vaulted crown. This prototype oven proved successful after a number of technical problems were resolved. W.J. Rainey Company was the major user of these ovens in the Klondike and Connellsville coke districts in Western Pennsylvania.

The by-product or retort coke oven represented a revolutionary new coke-making technology designed by engineers in England, Belgium, and Germany during the 1880s. A by-product coke oven was defined as "one in which the gas evolved by distillation of the coal, in externally heated air tight ovens, is withdrawn and saved." These ovens, besides producing excellent metallurgical coke, were designed to capture and recycle the chemical

by-products of the coking process. The principal products saved in the original oven besides coke are gas, ammonia, light oil, and tar. These recycled gases and chemicals became the foundation of the chemical and plastics industries of the United States after World War 1.

The first by-product coke in America was made by the Semet-Solvay Company in a small battery of 12 ovens built at the Solvay Soda Ash Works, Syracuse, New York in December, 1892. There were numerous manufacturers of by-product coke ovens and their designs changed over time; therefore, design and size specifications were not standardized. H. Koppers Company, Semet-Solvay Company, Wilputte, United Otto, and Otto-Hoffmann were the principal by-product oven manufacturers. A coke battery is made up of scores of individual ovens which average about thirty-six to forty feet in length from front to back, up to 20 feet high, and 18 inches in width. The ovens were usually constructed in batteries containing fifty or sixty units, with the largest plants having 600 or more ovens. Each oven was a steel chamber surrounded by flues and lined with silica brick. About eight tons of coal were fed from the top of each oven into each oven by a charging machine and then fired from 17 to 24 hours, depending upon the type of coke required. While coal was burned on the inside in the beehive oven, the coal in the by-product oven was burned from gas on the outside. When the coking process was completed, a ram operated from a car at the rear forced the coke onto a cooling platform. Coke was quenched with water and was now ready to be loaded onto cars and shipped to the blast furnaces. Gas from the oven was transferred to a by-product house where it was cleaned and by-products were obtained. The oven had a coking chamber, from which the gases from the heated coal were drawn through uptake pipes into water-sealed collecting troughs. The gases were then drawn through a series of condensers and scrubbers from which the various by-products were deposited.

The by-product coke ovens grew in popularity after the 1890s. Five large by-product plants were constructed on the Monongahela and Ohio rivers in the steel mill towns of Clairton, Monessen, Hazelwood, Aliquippa and Midland during World War One. U.S. Steel began construction of the Clairton By-Product Coke Works in 1916. This facility was open in 1917 making it the largest by-product facility in the nation. By-product coking began replacing beehive coke coke production during World War 1. This success

fundamentally shifted coke production from the coal field to the steel mill town and after the war the Connellsville region's beehive coking industry gradually was phased out. New coke oven construction in the United States after 1920 was limited almost completely the by-product oven.

111. SIGNIFICANCE

The extractive facility property type includes resources significant between 1740 and 1945 under a variety of areas of significance and National Register Criteria A, B, C, D (see also Registration Requirements). Significance was evaluated in comparison to other extractive properties located in the four principal bituminous coal fields of Pennsylvania (see also Methodology).

Resources in the extractive facility property type are significant under Criterion A in association with Pennsylvania's foremost extractive energy industry between 1740 and 1945. Resources in this property type are associated with prominent events, activities, and development of the coal and coke industry. In 1899 the United States passed Great Britain in coal output, and was the largest producer and consumer of coal in the world. The beehive coke industry peaked between 1910 and 1920 when there were about 300 coke plants in Fayette County, which had the greatest number. Pennsylvania was the leading coal and coke producing state in the nation during this entire period. The coal and coke industry was the largest employer in Pennsylvania, second in terms of capitalization and value of products in 1919. The Commonwealth was home to a number of significant technological innovations in the industry including the continuous miner, a machine which combined the separate mining processes that characterized the conventional mining method into a single mechanized operation, and the electric coke extractive machine.

Some of the earliest commercial mines in the nation were developed in the period between 1760 and 1800 including the Coal Hill mine, located on Mount Washington, Pittsburgh. The coke industry developed first in Fayette County, Pennsylvania and the state was the leading coke manufacture and developer of coke-making technology for more than a

century. Beehive, rectangular and by-product coke ovens were all constructed and used in Pennsylvania to produce high grade metallurgical coke for the state and nation's iron and steel industry. The by-products by the burning of coal in the by-product oven helped create the modern chemical and plastics industry of the United States during the 1920s. The Commonwealth was the home to some of the earliest coal corporations (Westmoreland Coal Company and Penn Gas Coal Company) and after the 1880s some of the largest and most important coal and coke companies in the nation including the Pittsburgh Coal Company, Berwind-White Mining Company, and H.C. Frick Coke Company.

The extractive facility property type includes resources significant under Criterion B for their association with individuals who made important contributions to the development of the bituminous coal and coke industry of Pennsylvania between 1740 and 1945. A variety of individuals including Isaac Meason, Mordecai Cochran and his nephews, James and Sample Cochran, Joseph F. Joy, H.C. Frick and T.J. Mitchell played significant roles in the establishment, promotion, and growth of the coal and coke industry in Pennsylvania and the United States. Meason, an influential ironmaster and lawyer from Fayette County, was one of the earliest users of coke in western Pennsylvania. Meason made coke at his Plumstock Iron Works on Redstone Creek, located nine miles east of Brownsville, Fayette County using the "rick" method in 1818. Mordecai Cochran and his nephews James and Sample, of Dawson, Fayette County were pioneer coke producers near Connellsville during the 1840s. They constructed some of the state's earliest beehive coke plants in the compact Connellsville coke district in the decades before the Civil War. After the war the Cochran family, owners of the Washington Coal and Coke Works, constructed Star Junction, just south of Perryopolis in 1893. This coke plant was one of the largest beehive coke complex in Pennsylvania. Joseph F. Joy, a Maryland-born miner and inventor, was responsible for designing a variety of mechanical coal loading machines and the continuous coal miner. The introduction of this machinery invented or improved on by Joy transformed the coal industry of Pennsylvania and the United States from an essentially labor intensive industry into a highly mechanized industry. Joy founded the Joy Manufacturing Company of Pittsburgh (now Joy Technologies) which is one of the largest

manufacturers of coal mining equipment in the world. The company produces a variety of mining machinery including mechanical coal loaders, coal and hard rock continuous miners, mining machine tracks (crawler mounted), timber setters (both track mounted and rubber-tired); post pullers; water sprayers; and high speed drifting systems for hard rock tunnel driving. Joy Manufacturing introduced the 3JCM-2 continuous mining machine on December 14, 1948. The machine combined the separate mining processes of cutting, drilling, blasting and loading into a single operation and at last competely mechanized mining. Two workers operating this machine could extract coal from the seam at a rate of 12 tons of coal a minute in 1950. Joy Manufacturing and Lee-Norse of Charleroi, Washington County were two of the most important manufacturers of continuous mining machinery.

H. C. Frick,who was born in the village of West Overton in the heart of the famous Connellsville coke district, founded the nation's largest coke manufacturing company in 1870. The company introduced a number of technological innovations at their various coal and coke facilities in Fayette and Westmoreland counties. The firm began a modernization program shortly after 1910 changing from pick-and-shovel operations by introducing air powered coal punchers to undercut coal, compressed air locomotives and electric cutting machines underground. Frick company engineers introduced the first electric mechanical coke extractor to its coke plants in Fayette County. Hand drawing the coke from the hot oven was the hardest job at the coke plant. The work was laborious and the number of ovens drawn daily was restricted by the number of workers. The Covington Machine Company of Covington, Virginia manufactured the first practical coke drawing machine. The machine was first installed at Continental Mine Number 1 in early 1906. This machine consists of two parts: an extractor for drawing the coke out of the oven, and a conveyor for screening and loading coke into the water. The wide-spread use of this machine increased the daily productivity at the beehive coke plants by reducing the number of coke drawers required to remove coke from the beehive ovens. Thomas Jefferson Mitchell, superintendent of the W.J. Rainey Coal Company was the chief proponent of the rectangular coke oven and under his supervision the first bank of rectangular ovens was

constructed at Mount Braddock, Fayette County. This Cleveland based coke company, founded by W.J. Rainey (1833-1900), was the chief competitor of the H.C. Frick Coke Company in the Connellsville coke district.

The extractive facility property type includes a variety of resources significant under Criterion C for their engineering and architectural importance. Many important engineering accomplishments within the industry were developed in Pennsylvania in the design, construction, and operation of equipment and structures. These changes were significant in transforming an essentially labor intensive, inefficient and unproductive industry into a mechanized, efficient, and highly productive industry. These changes resulted in a decline in mine employment with the introduction of electric undercutting machines, mechanical loaders, continuous mining machines, the mechanical electric coke drawing and loading machine. Some extractive sites were important for the introduction of new technology or methods of mining. Some of the earliest continuous mining machines were first introduced in Cambria County during the1940s. Barnes and Tucker Company installed a continuous miner at its Lancashire Number 15 mine near Bakerton in 1949. A second machine with a rotary (or boring) type cutting head was installed at Mine Number 31 of Bethlehem Mines Corporation at Nanty Glo, Cambria County on November, 1950 .

The extractive facility property type includes resources significant under Criterion D for their archaeological importance. These include undisturbed archaeological remains may provide a better understanding of the development of the coal and coke industry in Pennsylvania by providing information on mining technology, about the size and configuration of mining and coke complexes from an earlier era. Archaeological remains may shed additional information on the daily lives of miners at work in the past.

1V. REGISTRATION REQUIREMENTS

CRITERION A

Area of Significance: Industry

To be eligible for registration a resource must have a strong association with the coal and coke industry. It must have been involved in the extraction and processing of coal and/or the manufacture of coke between 1740 and 1945. Resources which played important roles in shaping significant events, developments and activities in the technological,business and production history of the state and the nation's coal and coke industry will be eligible. Coal and coke resources that are eligible under other Criteria and Areas of Significance will generally be eligible under Criterion A in the area of Industry.

Area of Significance: Social History

To be eligible for registration a resource must have a strong association with important events, activities and developments in the social, particularly labor history of the Pennsylvania and American coal and coke industry between 1740 and 1945, including the organization and management of workers, such as major strikes, and organizing drives of different coal miners' unions.

Integrity:

A large number of mining buildings and structures at extractive facilities have been demolished since the conclusion of World War 11 and the decline of the industry in the Commonwealth. Nominated resources do not have to retain all or even most of the original buildings and structures found at a typical extractive facility in order to be eligible under Criterion A. Many extractive buildings, especially the hoist house, power house, machine

shop, and bath house have been converted for commercial and social usages and been altered or "modernized" by the new private owners. Additions or alterations that do not mask the original design and feeling of the buildings are acceptable. New roofs and gutters, pointed bricks and blocked windows with cinder block blocks or glass blocks are acceptable alterations. The removing of walls and the attachment of prefabricated buildings such as "Butler" buildings or aluminum sided buildings to enlarge the building would usually make the building noncontributing. The partitioning of the interior of the building with walls creating a number of smaller rooms or partitioned cubicles would make the building ineligible for nomination. These changes are unacceptable because these changes have fundamentally altered the physical size of the building and caused a loss of integrity.

Buildings and structures significant under Criterion A that are associated with events that made significant contributions to the coal and coke industry of Pennsylvania must retain much of their historic *design* and *feeling*. It is important that the form and function for which the extractive buildings or structures are important be readily apparent. Structures and machinery should represent the functions for which they are important. The historically important functions, design and layout of a nominated coal mine or coke facility should be apparent.

The principal indicator of the probability of remaining resources at a coal and coke extractive site is often the year of its closure. The mines located at the the former communities of Marianna, Westland, Clyde, Bobtown, Newfield, Muse and Ellsworth, which closed during the 1970s and 1980s, are the most intact resources displaying a high degree of integrity. The former H.C. Frick Coke Company's coke plant at Shoaf, Fayette County was the last beehive coke operation in the United States. Shoaf opened in 1904 and ceased coke production in 1972. The Shoaf facility has some of the best preserved beehive ovens in western Pennylvania and rivals those in Bretz, West Virginia, already listed in the National Register.

Pennsylvania was once the nation's largest coal and coke producers in the nation but the industry went into decline after 1945.. Many Pennsylvania mines fell on hard times and were unable to compete in a changing energy market. Mine operators discharged their

workers and then simply abandoned hundreds of extractive coke and coke properties after departing from the industry. These resources, usually located in isolated areas, were abandoned and left to the ravages of nature and vandalism. Some sites were acquired by strip mine operators who completely razed the surface site and began the removal of the remaining underground coal pillars. Local citizenry, residing near the abandoned mines, have placed political pressure on regulatory agencies to remove these decaying and often hazardous buildings and structures but these pleas were at first ignored. Since the 1970s agencies such as the Department of Environmental Resources of Pennsylvania (DER) has begun to systematically raze many of the deteriorating resources especially coal tipples. These structures, unlike other extractive resources, are potentially hazardous structures and are not feasible for alternative industrial uses. Large buildings, like the hoist house, bath house and machine shop were easier to convert for alternative industrial or commercial uses. Many of these buildings were acquired and converted by private owners for commercial usage. In some cases an entire former extractive mining facility has been acquired and transformed for industrial uses. For example, the extractive complex of the former Indianola Mine of Republic Steel at Indianola, Allegheny County has been preserved intact and converted for usage as an industrial park.

Buildings and structures must retain their predominant *materials* and their historic *settings*. Settings of the extractive coal and coke extractive property facility generally include a nearby coal mining community. However, resources of the facility property type can be eligible for nomination even if the coal community is no longer extant.

Buildings and structures must have integrity of *location*.. Buildings and structures moved after their period of significance will not be considered eligible unless they retain their setting and their position relative to other contributing resources on the nominated property. For example, the metal headframe used at the shaft entry Leisenring Mine Number 2, Leisenring, Fayette County was removed from the abandoned mine and reassembled at the United States Steel Corporation's Maple Creek Mine in Washington County in 1957. The

Maple Creek Mine is located on the south bank of the Monongahela River and approximately eight miles upstream from the Clairton Coke Plant. This resource could be deemed eligible because it was being used for its original function at another extractive site, that is, transporting men and materials underground in the cage.

CRITERION B

Area of Significance : Industry

To be eligible for registration under Criterion B a resource must be associated with an individual who has made an important contribution to the historical development of coal and coke industry in Pennsylvania or the United States between 1740 and 1945. The individual must be closely associated with important events, activities or development such as:

The management of a major coal and coke company in Pennsylvania;
the invention or establishment of significant innovation in the coal and coke industry;
leading development of a major coal or coke producing region in the Commonwealth; the development of forms of business organization.

Integrity:

Integrity of *association* is highly important for buildings or structures that are significant under Criterion B. Such buildings or structures must have strong association with the significant individual. The resource should be associated with the person's period of achievement, unless it is the only extant property known to be associated with the person's life. If more than one property is associated with the person's period of accomplishments, the resources should be compared to determine whether they represent different aspects or phases of a person's productivity.

Buildings and structures eligible under Criterion B also must retain much of their historic *design, materials, feeling, setting* and *location* as outlined under Criterion A above.

CRITERION C

Area of Significance: Architecture

Coal and coke facility resources may be eligible for the National Register under architecture for their importance in the development of a distinctive industrial vernacular style of extractive structures and buildings constructed between 1750 and 1945.

Area of Significance: Engineering

Coal and coke facility resources may be eligible for the National Register under engineering for their importance in the design, construction and operation of equipment, structures and buildings between 1750 and 1945. Some extractive facilities were constructed by prominent engineering companies of the period. For example, W.G. Wilkins Company of Pittsburgh designed the H.C. Frick Coke Company's coke plants at Shoaf, Bitner and Yorkrun in Fayette County around 1904. The Loyal Hanna Coal and Coke Company of Philadephia employed S.E. Dickey & Company, Civil and Mining Engineers of Johnstown, to design and construct Mine Number 6 at Cairnbrook, Somerset County in 1912. Some engineering firms also constructed significant structures at some mines. The Columbia Bridge Company of Pittsburgh constructed a 826 ton steel viaduct, measuring 1,080 feet in length, to transport semi-bituminous coal from the mine portal to the steel tipple at the Orenda Mine Number 2, Boswell, Somerset County in 1900. This was the largest such structure in the world.

Integrity:

Buildings, structures and machinery eligible in the area of engineering must display the engineering design, construction or method of operation for which they are significant. Thus they must retain much of the *design, materials* and*workmanship* for which they are being nominated. For example, a coal tipple nominated for its handling and sorting of coal into various sizes and cleaning of coal for market must retain much of the screens intact and processing machinery. Parts of the original buildings, structures and machinery may have been altered through replacement by more equipment, or additions to the originals; such alterations should not obscure the design, construction or method of operation for which the resource is being nominated. For example, many hoist houses were originally designed to use steam engines to haul men, coal and waste to and from from the mine. Electrical motors were later installed to accomplish this task. This alteration is acceptable. Buildings, structures and machinery should retain their integrity of *location.* In particular, machinery will not be eligible if moved to a location isolated from other machinery, buildings and structures immediately involved in the operation of the machinery. Machinery will also not be eligible if moved to a setting substantially different from the original setting.

CRITERION D

Area of Significance: Historic-Non-Aboriginal

The above or below ground remains of coal and coke extractive facilities may be eligible for listing on the National Register under Criterion D for the information they may yield about past technology and machinery used in mining bituminous coal and manufacturing coke, about the layout and scale of the facilities, and about the daily lives of coal miners who worked at these facilities between 1740 and 1945.

The analysis of remains of coal and coke production machinery and buildings can assist in understanding how coal and coke was extracted and processed. Remains of buildings

and structures can also provide information on the scale and the exact layout of these resources. Foundation remains, for example, can show how buildings or structures were located relative to each other in order to bring coal to the surface and process it for transport to market. Through the datings of such remains, the physical expansion or contraction of the extractive facility over time can also be understood. In addition, below ground remains of workers' artifacts can provide information about work-place health, safety, clothing, diets and culture.

Integrity:

Archaeological remains must have integrity of *location*. Physical remains cannot have been moved from their historic locations. The immediate setting should have little or no surface disturbance. Integrity of location is a particular problem with coal and coke extractive property types becauses resources that might potentially be eligible under Criterion D may have been disturbed by strip mining since this mining method became popular in Pennsylvania after World War 11. This method usually remove all surface resources and destroys all archaeological remains.

Archaeological remains must have integrity of *association*. The remains must be conclusively identified as associated with a particular extractive facility company, and if possible, with a particular building or structure in the facility. This association can be made through the use of written record especially mining maps held by state and federal mining agencies, local oral history informants, or archaeological excavation. The remains must be also identified conclusively as to their type and function.

1. NAME OF PROPERTY TYPE: Mining Communities

11. DESCRIPTION

The coal mining community was an important component of the bituminous coal and coke industry of Pennsylvania although it was not an integral part of the actual production process. Therefore it is possible to find an extractive facility without the accompanying mining community. They were constructed by coal companies to provide shelter for their workers if none existed near the mines. A mining complex that was not located in an isolated area or located near a source of housing would not require the construction of such a community. A brief definition of a coal mining community is "any community which has been built wholly to support the operations of a single company, in which all homes, buildings, and other real estate property are owned by that company, having been acquired or erected specifically for the benefit of its employees, and in which the company provides most public services." Mining communities were not randomly built but were established solely by geological considerations. They were developed as nearly instant creations adjacent to the mining operation in order to minimize the walking distance of the miners to work in the mine or in the coke yards. The miners' houses were built close to the mine entry to minimize travel time and the amount of land to be developed. It was recommended that the work site be no more than fifteen minutes walking distance from the town, or thirty minutes by "dependable transportation."

The earliest bituminous coal mining communities in Pennsylvania were constructed during the 1850s. These communities were constructed throughout the four principal bituminous coal regions, located in more than 30 counties in Pennsylvania. A majority of the surviving former coal mining communities found today were constructed between 1880 and 1920, which was the boom period of the industry. New mines and coking facilities were rapidly opening in unsettled rural and remote townships throughout Western Pennsylvania during this period. The large railroad companies, like the Pennsylvania Railroad and the Baltimore & Ohio Railroads, built branch lines to transport coal and coke

from the isolated new mining villages. The railroad expansion, after the 1880s, permitted the opening of isolated mines in a number of coal-rich counties in central and western Pennsylvania. The introduction of railroads into such counties as Armstrong, Cambria, Indiana and Somerset created a long-term coal boom in these counties. Coal and coke became principal industries and employers in these counties. The Connellsville coke district communities were begun after 1870 when the economic success of the coke industry was assured. These communities, like neighboring coal communities, were constructed as a necessity because the majority of the new mines and coke plants were remote from existing towns and villages. The lack of housing and essential services in these isolated locations forced operators to construct them to attract a labor force. They were usually unincorporated, but parts of a larger incorporated municipalities.

These communities was regarded by coal companies as simply part of the general investment in the mining enterprise. The extractive facility and the coal mining community, including both residential and non-residential building, were considered a declining asset with a definite and limited life determined by the amount and quality of coal accessible at a particular site. They were an instant creation and once the supply of coal was depleted, the settlement was usually abandoned. The mine engineers, who designed the extractive facility, served as architects in their construction with the greatest economy possible. For many years, mine engineers were unable to conclusively predict with any precision the lifespan of the mine. Consequently coal communities were considered temporary settlements to be abandoned when the seam at the mine was depleted. Few new mining communities were constructed in Pennsylvania after World War 1.

The coal mining community was created as a single-industry town whose layout was determined by a number of factors: local geologic location and physical setting (whether the site was a narrow valley or an open plateau area), location with respect to other towns, size and probable life of the extractive facility, classes and nationalities of workers and the conscientiousness of the operator in community planning. The communities provided shelter and necessary services including water, retail and medical services, a school, church(es) and perhaps a social center to attract and maintain an increasingly immigrant

labor force. These mining communities of Pennsylvania varied widely in their setting, layout and services they provided workers and their families. They were usually constructed from simple designs with minimum attention paid to any sense of aesthetic qualities of town planning that could foster a sense of community. Construction materials were selected in accordance to the premise that mining at this site was a short-term enterprise. Other factors that may have affected construction materials was availiabity and adaptability of material, original cost, cost of maintenance, the amount of capital available, and existing statutory requirements of the township or borough government.

The spatial size of the coal mining community was dependent on the number of workers employed at the mine and the number of coke ovens. Most miners' dwellings were quick and inexpensive to construct and were usually erected by coal company employees or by a local contractor. Small coal and coke operators created mining communities consisting of a short row or two of dwellings. The houses were extremely primitive consisting of little wooden shacks constructed quickly of inexpensive materials and located near the mine entry. The wooden houses consisted of two rooms that had no insulation, indoor plumbing or electricity. The shacks typically became run down with holes in the roof and broken down porches. The community had absolutely no social or cultural amenities and was extremely drab and isolated place. A small frame company store suppling food stuffs and mining equipment was usually the only non-residential building in these small communities.

These small, cheaply built communities existed throughout the coalfields of Pennsylvania but they were not by any means the only type of communities. Miners' community and their housing varied between towns and within each town. A majority of the exteriors of most miners' houses of Pennsylvania were clad in clapboards, weatherboards, or boards-and-battens (primarily hemlock, poplar, locust, and oak), usually nailed directly to the frame often without sheathing other than paper. The houses were built from locally obtained lumber, with the exception of prefabricated houses,which were imported by rail from manufacturers after 1890. The exteriors of some of the wooden houses were whitewashed or painted with cheap barnboard paint - lead gray, dull brown, or drab-red

while the interior surfaces were given one rough coat of lath and plaster. Roofs were usually gable or hip and were made of composition board (the most popular roofing material), slate, shingles or one of a variety of artifical materials available. Flooring was a single layer of knotted or split board, permitting cold air through the holes, and was generally carpetless. Few houses were constructed with cellars, and houses sat directly on the ground or were propped on stilts a few feet from the ground. They were generally constructed without electricity, water, and indoor plumbing. Electricity was used in mines for lighting and operating undercutting and haulage locomotives machinery after the 1880s but few houses were originally wired for its use before 1900. Light was usually provided by candles and kerosene lanterns, and the coal stove found in the kitchen was used for cooking and for home heat. A primitive system of flues and grates circulated warm air to the upstairs bedrooms. The miners' houses were usually cold and drafty because they were uninsulated. Most houses had no piped water. Water for cooking and bathing came from outside pumps or hydrants in front of the houses, with one unit located every 75-100 feet. Bathtubs or showers were seen as a luxury items and were generally not found in most company-owned workers' houses.

A minority of housing, estimated at about five percent of all company housing nationally, was constructed of brick, tile, or stone (for example brick houses at Ellworth,Washington County, and Boswell, Somerset County and brick and block housing at Commodore, Indiana County). The coke plant at Carpentertown, near Mount Pleasant was the only community surveyed in the Connellsville coke region constructed completely built of brick. These two-family brick houses have four rooms to a side, two upstairs and two down.

There was a variety in the size of dwelling units constructed within each community. Some miners and their families called the mining town the "patch." The origin of this term is obscure. For economic reasons, there was a tendency by the coal company to construct rows of uniform dwellings for their workers. This practice gave these towns a drab and monotonously similar style of architecture. Coal operators constructed single, double and multiple dwellings. Single family houses and duplexes consisted of three, four, or five

rooms. A typical four-room one-floor miner's house had a living room, kitchen, and two bedrooms while a typical two-story six-room house had a parlour, kitchen and living room on the first floor and three bedrooms on the second floor. Two-family semi-detached dwellings were usually two-story buildings with four rooms a side, two upstairs and two down,with a parlour and kitchen on the ground floor and two bedrooms upstairs. Eight-or ten-room double (semidetached) houses were the most popular housing design in the numerous company towns constructed in Fayette and Westmoreland counties by the H.C. Frick Coke Company. Multiple family housing, including three or more family-sized units constructed before 1900,were originally barracks-style row houses erected to house single miners. Boarding houses and hotels were built at various communities to house single or transient workers or provide rooms for visiting company officials. The boarding house rented rooms, and provided meals and laundry service for miners. Overcrowding was common in most communities because of a lack of dwellings. Many families took in single miners as boarders as a means to supplement their meagre income.

Coal companies, since 1880s sent agents to Europe to induce workers from the polyglot nations of southern and eastern Europe to come to the thriving coal fields of Pennsylvania. Railroad companies ran "immigrant trains" daily from the seaboard to the hundreds of new mining communities of western Pennsylvania. Mining communities resembled a congress of many nationalities and religious groups. Evidence suggests that most mining communities were socially stratified by race, ethnicity, and by occupation. This segregated settlement patterns represented conscious attempts by some coal companies to fan and maintain Old World racial, ethnic, religious and political antagonisms and thereby keep their workers divided. There were marked differences in the quality of the residences for management and labor within most mining communities. The communities were segregated although not all the following patterns of segregation existed in all mining communities. First was an area in the community occupied by members of the mine's supervising personnel -the "bosses" -who were usually Americans or of the so-called "Anglo-Saxon" stock. They lived in the best houses if they resided in the community at all; often they resided in a nearby town away from the dirt, grime, and smoke of the village. Management

row was often constructed near the mine so officials would be near in case of an emergency. In other communities, management housing was determined by proximity to the company store or other public building. Management housing for the superintendent, foremen, company-store manager, payroll clerk and other office personnel was called "bosses' row" or "silk stocking row" by workers. The houses were generally larger and more sturdy in construction than regular workers' houses. The houses were furnished with furnaces, complete indoor bathrooms, and hot and cold running water. The houses were often of individual design, in sharp contrast to the monotonous sameness that characterized workers' houses. The houses had elaborate porches and were landscaped with lawns, trees, and shrubbery. The mine superintendent's house, always the largest and most ornate house in the community, was often surrounded by elegant trees and well-kept grounds. Some companies permitted their superintendents to build the house of their choice and in some cases permitted him to purchase the home. The superintendent of the Crucible Mine, Greene County, owned by the Crucible Fuel Company, lived in a fourteen-room house, surrounded by a tennis court and a swimming pool.

Ethnic, racial, and class differences separated miners in the community according to European immigrant, African-American, and native born Anglo-American groups within the community. A second segregated area included white miners of American, "Anglo-Saxon," or "Northern European stock." The English-speaking immigrants constituted a majority of early miners and residents of the coal towns until the 1890s. The new non-English speaking miners, from southern and eastern Europe, called them "Johnny Bulls." This group occupied somewhat better and commodious houses as compared with foreign-born white southern and eastern European. Members of these ethnic groups included Slavic people of eastern Europe and Italians, Hungarians, and Greeks. Slavic people are divided into groups based on their languages and include Poles, Czechs, Slovaks, Russians, Croatians, Slovaks, Serbs, Slovenes, and Ukrainians. These ethnic groups often resided apart in distinctive areas within the community called "Siberia,""Dago Hill," "Russian Hill," and "Hunkytown." African-Americans occupied the lowest rung of the social and economic ladder in the company town. Their housing was often mere shanties and was

usually located some distance from the other workers' housing. Relatively few African - American miners were employed in western Pennsylvania before 1925. During the bitter conflict over the Jacksonville Agreement many coal companies including Pittsburgh Coal Company and Pittsburgh Terminal Coal Company-determined to operate their mines on a non-union and basis imported African -American from neighboring southern states to replace striking union miners.

Some coal companies constructed a number of non-residential buildings besides the obligatory workers' houses. These buildings and structures were erected to provide the commercial, educational and religious needs of workers and their families because most communities were isolated with poor roads connecting them to neighboring towns. Miners did not own automobiles and trolley service often did not extend out to the community, and even if it did, miners and their families were simply unable to afford the fares. Virtually all mining communities had a company store which like housing was constructed as a convenience for their workers and their families in order to supply them with everyday neccessities and mining equipment and tools. This reality made the company store or commissary the commercial and social heart of the community. It provided all the daily material necessities of life in the isolated community as miners' and their families were dependent upon it for their food supplies in both good and bad times. Workers paid their bill for the company doctor, usually about one dollar a month, and received their mail at the store. All stores stocked and sold food-stuffs and a variety of mining equipment. Coal miners, unlike most other industrial workers, were responsible for providing and maintaining their own tools and mining supplies. The store stocked a variety of tools including black powder or dynamite, caps, miners lamps and fuel for carbide and oil wick lamps, squibs (fuses), electric exploders, picks, shovels, flints, and machine oil.

As in housing, there was a great variety in the physical size and architectural style of the company stores. They were custom-built for each mining community except for imported prefabricated stores. The buildings varied in size from single to three story buildings constructed of wood, stone and brick with slate, shingle or tar paper roofs. Clapboard siding was the dominant exterior for wooden buildings. Small stores, usually constructed

of wood, sold basic food items, such as groceries and meats, and also mining tools and supplies. The larger stores were similar to a conventional retail department store found in a larger town or city. These spacious stores were often three stories with different functions on each floor: the first level was used for the storage of goods, the second level for retailing and offices, and the third floor exclusively for offices. The larger stores sold a greater variety of goods including furniture, clothing, plumbing, hardware, and building supplies. If the item desired by the miner was not in stock, the store manager could special order it. Many stores employed an "order" boy who delivered store goods locally if miners were unable to shop. The larger company stores operated ice cream parlors and soda fountains. Some stores provided additional services including laundry, millinery, and gristmill.

Some operators provided for the educational, religious and leisure needs of miners and their families with the construction of a school, church and community center. The schoolhouse was usually a frame building made of a simple design and contained one to five rooms depending on the number of students. It was heated with a coal stove in each room. Children were required to attend school only to the eighth grade before 1920 and thus coal operators did not have to erect a high school. Catholic, Eastern Orthodox Greek and Catholic and a variety of Protestant denominations were found in a majority of the company-controlled communities. Each building often served more than one denomination and religious services were often segregated. African-American were usually not permitted to attend services in any white church so they constructed their own church in the African - American section of the community. Mine workers raised the money to build the churches in most communities while the company contributed the lots and in some rare cases provided funds for their construction. Some of these churches were elaborate and extensive buildings that rivaled the churches in larger neighboring towns and cities. Churches were important in the lives of workers outside the mines, especially for eastern and southern European immigrants and African-Americans. Ethnic churches perpetuated Old World languages and traditions through their services, meetings, and festivites. Recreation for miners and their families was closely connected with church activities such as weddings, christenings, and religious festivals.

A community arcade or amusement building was found in some larger coal towns (for example Cedar Grove, Mather, Muse, Marianna) and served a variety of social and leisure purposes. The community building was a multi-purpose building including a drug store, an ice cream parlor, a bowling alley, pool and billiard tables, a dance floor, a movie theater, and a gymnasium. There were sleeping rooms upstairs for visiting mine officials or unmarried administors. The community building because of its diverse function was usually a large building with dimensions averaging 50 feet in width and 100 feet in length. These buildings were constructed of wood (usually clapboard) or brick and often included an attached front porch.

Some larger independent coal companies and "captive" mine operators in Pennsylvania began the construction of a number of well-designed, planned model industrial communities after the 1890s. There was a conscious attempt by a few enlightened coal operators to improve the quality of life of miners and their families in contrast to life in earlier coal mining communities known for their drabness and monotony. The model coal community was designed and constructed as a fully integrated community by urban planners or architectural firms employed by the coal company. In sharp contrast, the earlier coal communities developed in an ad hoc fashion with additional construction proceeding according to demand. A western Pennsylvania coal operator interviewed in 1916 described the rationale of this new corporate paternalism by stating "If you would make your business a success, you must get good service from your workmen; and if you would get good service from your workman, you must make it worth their while to serve you."

A typical miner's house in these model communities was better constructed and larger than in other mining communities. Each house included indoor plumbing, electricity, spacious porches, closets and a basement. Each model community was constructed with a variety of social and instititional buildings besides the obligatory houses and company store. Non-residential buildings included churches, a hospital, library, movie theater, and a community center. Most of the streets were wide and paved and some were tree-lined. The designers of these new towns consciously provided leisure activities for miners and their families by building playgrounds for children, swimming pools, and dance halls.

The company towns of Slickville (Cambria Steel Company of Johnstown), in Westmoreland County, Nemacolin (Buckeye Coal Company of Ohio, a subsidiary of Youngstown Sheet and Tube Company), in Greene County, Mather (Picklands, Mather & Company of Cleveland, Ohio), in Greene County and Indianola (Inland Collieries Company, a subsidiary of the Inland Steel Company), in Allegheny County, were examples of mining communities reflecting this new practice of corporate paternalism. These communities were constructed by coal companies that were usually subsidiaries of steel companies that opened between 1900 and 1920. Some railroad companies also constructed model comminities, for example the community of Commodore, Indiana County.

Coal or coke produced at these "captive mines was consumed by the parent company. Independent coal companies also constructed "model" mining towns including Windber (Berwind-White Mining Company), in Somerset County, Jenners (Consolidation Coal Company) in Somerset County and Star Junction (Washington Coal and Coke Company), in Fayette County.

A number of manufacturing companies of prefabricated houses provided coal companies with an alternative method of construction by 1890. For a few thousand dollars per house a coal company received floor plans, pre-cut lumber, nails, paint, doors and light fixtures all shipped by rail to its mining site. A variety of companies were involved in the catalogue-house business although the "big six" were Sears, Roebuck & Company, Montgomery Ward & Company, Gorden-Van Tine of Davenport, Ohio, and three companies located in Bay City, Michigan - Aladdin Company, Lewis/Liberty Manufacturing Company and Sterling System Homes. These firms and their competitors manufactured a complete line of pre-assembled industrial housing, hotels, banks, churches and bunk houses that could be purchased, shipped by rail and reassembled at the new mining sites. The prefabricated town could be put up without relying on skilled labor because no framing was required. This provided coal operators with an opportunity to construct quality and diverse styles of housing for their workers at an economical price. The Inland Steel Company constructed Indianola, Allegheny County and the Ford Colliery Company of Detroit constructed Bairdsford, Allegheny County from imported prefrabricated houses.

The boney pile, also known as the slate, ash heap, or gob pile, was a prominent part of the landscape of most mining towns. The refuse pile was a by-product of the extractive mining process. It was created by discarding shale, slate, and low-grade (bone) coal which was removed daily with coal. Over time these refuse heaps became small mountains that towered over the community

Many mining communities have endured long after coal and coke production ceased in Pennsylvania. By the 1950s bankruptcies in the industry occurred with increasing frequency. Unsuccessful coal companies closed their mines, laid off their miners, and sold off their mining properties including the company houses to private investors. Miners who had rented their homes for decades could now own them. Some companies sold them directly to individual buyers with miners having the first chance to buy while other companies simply sold all residential and non-residential buildings collectively to a real estate investor who then resold the properties. The integrity of the surviving former company houses and non-residential buildings varies considerably between and within former coal mining communities. Few houses retain all of their original appearance. Some houses are still wood clapboard dwellings with the original double-hung windows and composition board roof. The wooden single or double privy, cow stable, and coal bin are still extant in the rear of many houses (for example Cairnbrook, Somerset County and Smock, Fayette County). A majority of houses have been physically altered and refurbished by the owners who purchased the houses directly from the coal company or from a real estate company. The clapboard has been resurfaced with aluminum or with vinyl siding. New shingles have replaced the composition board roofs and fuel efficient windows have replaced the single pane double-hung windows. Some houses have been physically enlarged with the addition of rooms especially the addition of a bathroom, enlarged porches, single or double garages. Some owners have also purchased two-family dwellings and converted them into single family dwellings.

Non-residential buildings especially the company store and community center, have been converted and altered by new owners if the buildings have no been razed. They have been converted into a variety of commercial uses by the new owners. Former company stores

have been converted into karate and judo parlors, apartment buildings,food markets, machine shops and beer gardens. Community centers have been converted into apartments or small manufacturing facilities. The altered buildings have been remodeled or "modernized" by the new owners with the installation of new windows, doors, floors and new roofs. The open interiors in many cases have been divided into partitioned cubicles.

As Margaret Mulrooney summarized in a *Legacy of Coal*, most coal mining communities in southwestern Pennsylvania shaed the following five fundamental characteristics:

1) Each town was financed, built, owned, and operated by only one company. Unlike other single towns,the primary employer was also the primary landholder. In this dual capacity, the company determined not only the economic character of the community, but added the social, political, and cultural character as well.
2) Houses in these towns tended to be two-story, wood-frame structures, whether detached or semi-detached, with four or six rooms per dwelling.
3) There was a clear hierarchy of architecture in each town that segregated management from labor and reinforced ideas of ethnic and occupational segregation.
4) Houses within a given community were remarkably similar in style and materials since construction was charried out as cheaply as possible.
5) Coal towns shared a similarity in spatial arrangement. In almost all cases, the location of the mine site and its associated buildings received primary consideration while housing took a secondary role. Nevertheless, housing was always located near the work site to minimize travel time.

111. SIGNIFICANCE

Coal mining communities include resources significant between 1850 and 1945 under a variety of areas of significance and National Register Criteria A, B, C, and D (see also Registration Requirements). Significance of these resources was evaluated in comparision to similar other properties within the coal producing districts of Pennsylvania. There was

no attempt to compare housing in Pennsylvania to coal mining communities located in neighboring bituminous coal producing states such as Ohio, Virginia, or West Virginia.

Resources in the coal mining communities property type are significant under Criterion A in association with the social, ethnic and racial heritage and community planning and development of the coal mining communities in Pennsylvania from 1850 to 1945. Resources in this property type are associated with prominent events, activities and development in the social, particularly labor history of the Commonwealth and the American bituminous coal and coke industry, including major strikes and organizing drives of coal workers' unions. For example, many mining communities were the centers of the labor movement and sites of violent confrontation between workers and management. Attempts by non-union miners to organize themselves in the UMWA began in the community. Strike action for union recognition was a prevalent theme in District 2 between 1919 and 1933. Unorganized immigrant miners staged an unsuccessful 17-month strike for union representation during the prolonged and violent 1922 strike. Miners employed in the "captive" mines owned by steel companies also struck for union representation after 1933.

The mine community was also the site of racial and ethnic tensions between miners. Some coal operators of Pennsylvania imported African-American workers as strikebreakers during the numerous walk-outs or strikes. This conscious company policy was responsible for inciting racial tensions and hatred among workers especially during the long and protracted strikes of 1922 and 1927-1928. Some contemporary white veteran miners, both native-born and European immigrant, were racists who believed management had brought African-Americans to the mines not to mine coal but to humiliate them and "to break their hearts" by showing them that anyone could mine coal,"even niggers." Striking white miners called the "scab" African-American labor force "Roanoke niggers" because many replacement workers were recruited from this Virginia city and surrounding comunities. The coal company constructed barracks, shanties and tents to house strikebrealers and segregate scab workers according to race. This part of the village was called "scab hill" after the strike. This housing was often used to house miners following the end of the strike.

Coal communities, besides housings also contained commercial buildings, especially the company store that was the commercial and social center of the community. Some communities included a variety of institutional buildings, including churches, that were significant in the ethnic history of the community. The churches were usually constructed with private funds collected by workers on property donated by the coal company. Churches played an essential role in the daily lives of workers outside the mines, especially for eastern and southern European immigrants and African -Americans. These groups had replaced English-speaking miners as the principal labor force in the bituminous coal industry of Pennsylvania since the 1890s. Ethnic churches perpetuated Old world languages and traditions through their services, meetings, and festivities. Recreation for foreigh-born miners and their families was closely connected with church activities such as weddings, christenings, and religious festivals.

The coal mining communities property type includes resources locally significant under Criterion B for association with individuals prominent in important events, activities or developments in the Pennsylvania and the United States coal and coke industry. Some individuals were important because of their role in introducing new mining technology to the industry including H.C. Frick, Joseph Joy, James and Sample Cochran and W.J. Rainey. John Brophy and James D.A. Morrow and others men were significant because of their role in labor and management conflicts within the industry and in organizational changes in how coal companies operated.

The coal mining community propery type includes resources locally significant under Criterion C for their architectural importance. A majority of coal mining communities including both residential and non-residential buildings constructed between 1880 and 1920 represenented vernacular architecture. The corporate offices or banks of the coal and coke located at the community or in a nearby town or city often represented significant exaples of particular high style architecture or represent the work of locally prominent architects who designed them. The corporate office of the Ellsworth Colliery Company in Ellsworth was a Georgian-style two-story red brick building. The H.C. Frick Corporation constructed two offices at Broadway and Walnut Avenues, Scottdale,Westmoreland County in 1880 and

1904 representing high style architecture. testmCoal owners of the large out-of-state mining corporation that came to dominate the industry after the 1890s were usually absentee owners. Most did not reside in the company town instead they employed a mine superintendent to represent their financial interests. A few large coal mines were still locally owned and controlled. The local owners constructed elaborate home possessing distinctive architectural styles at the mining community or at a central location near their extractive facilities. James Cochran, a pioneer coke operator of Fayette County constructed a ten-room Queen Anne-Victorian style house on Railroad Street, Dawson, Fayette County in 1890. The house has two ornate brick chimneys extending through the gable ridge of the roof while a third chimney rises above the east facade. Behind the Cochran residence stands a two-story carriage house with an ornate gable roof. A second Cochran house is located on Griscom Street. Philip Cochran (1849-1900), his son, was the president of the Washington Coal &Coke Company, Brown & Cochran Coke Company, Cochran Coal & Coke Mining, Dawson Bridge Company, and the First National Bank of Dawson. The Washington Coal &Coke Company opened the Star Junction coke plant in 1893 and the mining community of Star Junction, lying on the periphery of the Connellsville district, at the height of the coke industry. This was one of the largest coke plants in the world with more than 900 beehive coke oven. The Washington Coal &Coke Company constructed a the First National Bank of Dawson in Dawson in 1897. The two-and-one-half story brick building has a three-story conical-roofed turret that extends above a stone arched entrance. A number of gable dormers insect with a slate covered hipped roof. After the death of Philip Cochran, Sarah Boyd Cochran, his widow, constructed a palatial thirty-five room stone English Tudor mansion, set on a hill 600 feet above the Youghiogheny River near Dawson between 1911-1913. The mansion was subsequently called Linden Hall, named for the linden trees that Mrs. Cochran imported from Germany. Daniel B. Zimmerman, a Somerset County native, was a pioneer commercial coal operator, cattle dealer, and agriculturalist in the county. He was president and owner of the Quemahoning Coal Company that operated a number of mines and communities at Ralphton, Rockwood, and

Zimmerman in Somerset County. Zimmerman constructed a spacious Georgian-style mansion in 1915-18 at Somerset, near the corporate office of his coal company.

Some planned communities were constructed by prominent architectural and engineering firms. For example, the mining community of Mather, Greene County was constructed by Baton & Elliott of Pittsburgh, consulting and contracting mining engineers.

The coal mining community propery type includes resources significant under Criterion D for their archaeological importance. These resources include the remains of housing and other non-residential buildings including the company store, churches and community center. There are few coal mining communities extant that were constructed during the period between 1850 and 1880. Archaeological remains of undisturbed sites of these former communities may provide significant information about the daily lives of coal miners and managers, including their diet, standard of living, clothing, amusement, ethnic traditions and religious beliefs.

1V. REGISTRATION REQUIREMENTS

CRITERION A

Area of Significance: Social History

To be eligible for registration a coal mining community resource must have a strong association with important events, activities and developments in the social, specifically labor history of the Pennsylvania and the United States bituminous coal and coke industry between 1760 and 1945, including the organization and management of workers, such as major strikes and organizing drives of miners' unions.

Area of Significance: Ethnic Heritage, including European and African-American

Coal mining communities are eligible for listing on the National Register under ethnic heritage if they strongly represent the religious practices, cultures, and social gatherings of ethnic groups, including eastern and southern European immigrants, and African-Americans residing in the coal mining communities and employed in the adjacent underground coal mine and coke plant between 1850 and 1945.

Area of Significance: Community Planning and Development

Coal mining communities are eligible for listing in the National Register under community planning and development if the resource offers a good illustratation of a coal or coke company's effort to build a community for its workers and management personnel, including providing for educational, religious, residential, social and/or commercial needs of their employees.

Area of Significance: Industry

Coal mining communities significant under Criterion A in other areas of significance will also generally be eligible in the area of industry.

Integrity:

Buildings and structures significant under Criterion A must retain much of their historic *design* and *feeling*. The historic layout of a coal mining community should be readily apparent. Destruction of substantial parts of blocks or streets of the coal mining communities would make those portions of the community ineligible under Criterion A as part of a historic district. It is significant that the form and function for which the residential and non-residential buildings or structures were constructed in the community should be

readily apparent. For example, it should be apparent that the company store was designed for a commercial function although the store front and roof may have been altered or changed from their original appearance.

Buildings, both residential and non-residential, must retain their predominant historic *material* and historic *setting*. Setting does not have to include the surviving coal and coke extractive facility.

Buildings, both residential and non-residential, must have integrity of *location*.. Buildings moved after their period of significance will not be considered unless they retain their setting.

CRITERION B

Area of Significance : Industry

Coal and coke mining community resources eligible under Criterion B in the area of industry must be associated with an individual(s) that made an important contribution to the history of the coal and coke industry in the state or nation between 1740 and 1945. The individual(s) should stand out among his or her peers in association with important events, activities or in the management of a major coal or coke company; significant technological innovations in the state or national coal and coke industry; manufacture of significant coal or coke by-products in the state or nation; or the development of a principal coal or coke company or coal and coke producing region.

Area of Significance: Social History

Resources in the coal mining communities eligible under Criterion B in the area of social history must be associated with individuals who made an important contribution to the labor history of the coal and coke industry in the state or nation between 1740 and 1945. The individual(s) should stand out among his or her peers in association with important

events, activities or development in the organization of miners formal institutions such as the United Mine Workers of America in the state and nation.

Integrity:

Integrity of *association* is highly important for buildings or structures that are significant under Criterion B. Such buildings or structures must have strong association with the significant individual. The resource should be associated with the person's period of achievement, unless it is the only extant property known to be associated with the person's life. If more than one property is associated with the person's period of accomplishments, the resources should be compared to determine whether they represent different aspects or phases of a person's productivity.

Buildings and structures eligible under Criterion B must retain much of their historic *design, materials, feeling, setting* and *location* as outlined under Criterion A above.

CRITERION C

Area of Significance: Architecture

Coal communities may be eligible in the area of architecture if they include buildings that represent or are outstanding examples of the evolution of vernacular architecture in local coal mining communities. They may also be eligible if they are locally outstanding examples of nationally popular high style, or of the work of locally prominent architects between 1850 and 1945. A majority of coal communities in Pennsylvania were hastily constructed by coal companies using local materials and employing company employees or local contractors. Most of the dwellings and non-residential buildings represented no particular school or style of architecture. The architecture is best described as vernacular. A

minority of these communities were contructed from prefabricated materials ordered by the coal company from a variety of manufacturers companies specializing in this type of industrial housing. The prefrabricated house represents a particular trend in the evolution of industrial housing that was popular nationally as a method of constructing inexpensive housing that appealed to workers who wanted a home but could not afford traditional housing. The model coal mining communities constructed by captive coal companies and large independent coal companies were constructed by local architectural firms between 1890 and 1920.

Corporate mining offices, banks and the private homes of coal and coke owners located at the mine site or in a neighboring city were often constructed by prominent architects and represented examples of high-style architecture including Queen Anne and Georgian Revival styles and vernacular architecture peculiar to the region.

Integrity:

Coal mining communities eligible for the National Register under Criterion C in the area of architecture must retain the characteristic style or type of architecture for which they are being nominated. These characteristics include *design and workmanship*, of architectural style or type. Most of the community buildings and housing is vernacular architecture and does not represent any prominent high style. The original exterior of a majority of miners' houses were constructed of wood clapboard. Their exterior has been been altered, first by coal companies who applied asphalt siding over the original clapboards during the 1920s and 1930s and then by the private owners who acquired them from the coal companies. Aluminum and vinyl sidings were added on the exterior of the houses private owners beginning in the 1940s. This exterior re-siding does not disqualify these houses from contributing to architectural significance providing that other changes have not fundamentally altered the basic shape and size of the dwelling. Additions or alterations to non-residential buildings including the community hall, company store or church is

acceptable but these changes should not obscure the architectural styling and workmanship for which they are being nominated.

Buildings and structures included in this property type that are significant under Criterion C must retain their historic *feeling*. It is important that the form and function for which the buildings or structures are significant must be readily apparent.

Buildings and structures nominated or contributing to nominated districts must have integrity of *location* and *setting*.

CRITERION D

Area of Significance : Historic-Non-Aboriginal

The above or below ground archaeological remains of coal mining communities may be eligible for listing on the National Register under Criterion D for the information they may yield about the size, construction and layout of miners' and managers' houses and other social and institutional buildings constructed between 1850 and 1945; and also about the daily lives, cultures and religious beliefs of the residents of a specific coal mining community during a definable time period. Below ground remains of pottery, glass, and other household artifacts, may lead to a better understanding of the diets, standard of living, clothing, amusements, ethnic traditions and religious belief during the period that the community was occupied. Archaeological remains of buildings and communities may indicate the size, construction and layout of buildings and their evolution over time. The physical expansion or contraction of communities could be dated in part through such investigation.

Integrity

Archaeological remains, particularly below ground remains, must have excellent integrity of *location*. The physical remains cannot have been moved from their original historic locations. The immediate setting should have little or no surface disturbance.

Archaeological remains must have integrity of *association*.. The archaeological remains must be conclusively identified as being associated with a particular coal mining community, and if possible with the particular buildings, including dwellings, company store, church, school or community hall, formerly found in the community. This association can be established through the use of written records including Sanborn Map Company fire insurance maps, county histories, local oral history informants, or records kept at state and federal mining archives. The archaeological remains must also be conclusively identified as to their type or function, for instance, remains should be identified as the foundation of residential houses or of miners or management or social or institutional buildings including company store, amusement center, hospital, movie theater, or as household artifacts used by the miners' and their families or management personnel.

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Section G. Geographical

The multiple property nomination of historical coal and coke extractive property type and coal mining communities property type in Pennsylvania include both surface and underground resources located in Pennsylvania and in operation between 1760 and 1945. Coal seams are found in nearly every county west of the Allegheny mountains and are also located in several outlying coal fields east of the mountains. Bituminous coal has been mined commercially in more than 30 counties of Pennsylvania since its discovery by fur trappers, pioneers, and explorers during the second half of the eighteenth century. Coke was manufactured in western Pennsylvania since the 1830s.

Bituminous coal deposits are located in a number of irregularly shaped fields in the western half of the Pennsylvania and in a few coal fields in the northern part of the state bordering New York. Bituminous coal underlies some 14,200 square miles of Pennsylvania or approximately a third of the physical area of the state. The bituminous coal regions of Pennsylvania include the following principal coal fields: 1) Main Bituminous Field - Allegheny, Armstrong, Beaver, Blair, Butler, Cambria, Cameron, Center, Clarion, Clearfield, Clinton, Elk, Fayette, Greene, Indiana, Jefferson, Lawrence, McKean, Mercer, Somerset, Venango, Washington, Westmoreland counties; 2) Broad Top Field - Bedford, Fulton, Huntingdon counties; 3) North-Central Fields (five small fields) - Bradford, Lycoming and Tioga counties; 4) Georges Creek Field - Somerset County.

The coal and coke historic context and field survey did not represent all the coal producing counties instead was restricted to the principal coal producing counties of Allegheny, Bedford, Cambria, Fayette, Greene, Huntingdon, Indiana, Somerset, Washington and Westmoreland. These counties were located in three of the four principal coal regions of Pennsylvania. North-Central Fields of Bradford, Lycoming and Tioga were not included in this list. This restriction of coal - producing counties of Pennsylvania to these counties does not restrict the inclusion in the National Register of Historic Places from the North-Cental Fields or other coal producing counties not included in the context - for example, Armstrong, Butler, Clinton, Clearfield, Jefferson etc.

Section H. Summary of Identification and Evaluation Methods

METHODOLOGY

The multiple property nomination of coal and coke sites in Pennsylvania includes the historic physical remains of this significant extractive industry from 1740 to 1945. The nomination was prepared by the Bureau for Historic Preservation of the Pennsylvania Historical and Museum Commission with funding provided by America's Industry Heritage Project. The industrial survey was conducted by Carmen P. DiCiccio, who also prepared the coal and coke multiple property documentaion form.

The project began in September, 1991. The first phase was the complilation of a comprehensive coal and coke bibliography for the writing of a historic context of the multiple property documentation form entitled the *Bituminous Coal and Coke Resources of Pennsylvania, 1740-1945*. Diverse sources were consulted including state and federal government documents and maps, American Industrial Heritage Project's published and unpublished reports, PHMC reports, dissertations and master theses, general and scholarly books on the industry. Information gained from on-site investigations and previous surveys was also incorporated in writing the context. Local informants at the individual site played an essential role in providing written and oral history about the community and the extractive facility. Retired miners were essential in the identification of the extant buildings and structures at the abandoned mines and in identifying archaeological remains. Long-term residents also provided maps, photographs and other written materials permitting an accurate reconstruction of how the community and extractive facility was originally laid out and had evolved over time.

The historic context was completed in June, 1993. The state's bituminous coal and coke industry was divided into four distinct historical periods: The Emergence of Coal in the Age of Wood, 1740-1840; Transportation, Iron, and Railroad as Impetus for the Expansion of the Coal and Coke Industry, 1840-1880; The Golden Era of King Coal, Queen Coke, and Princess Steel, 1880-1920 ; and Retrenchment, Decline and the Mechanized Mine, 1920-

1945. The exact dating of these historical periods is not definitive because the principal processes that characterized each period as distinct were gradual and incremental and often did not conform to any artifical historical time models. Nevertheless, each historical period used in the context was based upon a number of recurring themes in the evolution of this prominent extractive industry: technology employed, commercial uses of coal and its byproducts, transportation systems employed to distribute coal and coke to market, changing social composition of its labor force, and creation and expansion of new industries associated with the industry. Two principal property types associated with the coal and coke industry were developed from the context ; Extractive facilities property type and Mining Communities property type including residential and non-residential buildings.

Another phase of the research was the assembly of existing field surveys on the coal and coke industry sites which had been identified in the Commonwealth's historic resource surveys and other sources. Pennsylvania Historic Resources Survey files included on-site field surveys in a number of coal-producing counties including Washington, Greene and Tioga. The surveyor also examined published and unpublished coal and coke surveys of the nine county AIHP project region. These two sources were used to generate a list of extant coal and coke resources for on-site visits.

A list of potential resources for possible nomination was assembled from on-site investigation and the resources noted in the preceding paragraph. The following criteria were applied to select resources for possible nomination:

1. integrity of the site
2. historical significance
3. architectural significance
4. technological significance
5. association with prominent person(s)
6. significance in labor history
7. significance in ethnic and/or immigration history

The following former coal and coke resources in western Pennsylvania are listed in the National Register:

Property County

Marianna Historic District - Washington County
Brier Hill - Washington County
Windber Historic District (Mine 40) - Somerset County
Minersville Coke Ovens - Huntingdon County
Robertsdale - Huntingdon County

All these nominated sites were field visited to get an understanding of the quality and quantity of these sites. The quantity and quality of surface resources in the coal and coke industry has declined continuously with the passage of time but there remains significant surface buildings and structures to tell the story of this significant industry. The field visits to selected abandoned coal and coke sites in the coal producing counties of southwestern and central Pennsylvania identified surface resources that varied in terms of their quality and quantity. The physical remains of these extractive sites varied from only archaeological remains to pristine abandoned facilities that included all the buildings and structures required to mine coal, maintain mining, and transport the fuel to market. The sole legacy, beside the housing in these communities indicating its past mining history, were the large slate refuse dumps. Many are overgrown with vegetation and the dumps are not always visible. More coal and coke mining communities were found extant than coal and coke extractive resources.

The list below identifies 31 former coal and coke resources from eight principal counties located west of the summit of the Alleghenies in western Pennsylvania for possible nomination to the National Register of Historic Places. This short list is not to be regarded as comprehensive but simply a starting point for future site nomination. There are probably additional resources found in other coal - producing counties that were not field visited by

the surveyor (for example, Armstrong, Beaver, Bedford, Blair, Butler, Jefferson, Lawrence and Mercer counties.)

Counties	Operator	Company Town
Allegheny County		
Montour 10	Pittsburgh Coal Company	near Library
Indianola	Indianola Inland Colliery	Indianola
	Republic Steel Company	
Newfield	Newfield By-Product Fuel Company	Penn Hill
Cambria County		
Maryland Mine 2	Wilmore Coal Company subsidiary of Berwind-White Company	Wilmore
Colver	Ebensburg Coal Company	Colver
Lancashire No. 15	Barnes & Tucker Company	Bakerton
Revloc	Monroe Mining Company	Revoloc
Fayette County		
Ralph	H.C. Frick Coke Company	Ralph
Leisenring Mines 1 & 2& 3	Connellsville Coke & Iron Company H.C. Frick Coke Company	Leisenring
Shoaf	H.C. Frick Coke Company	Shoaf
Allison Mines 1 & 2	W.J. Rainey Company	Allison
Greene County		
Mather	Picklands, Mather & Company	Mather
Shannopin	Shannopin Coal Company Jones & Laughlin Company	Bobtown

Nemacolin	Buckeye Coal Company of Ohio	Nemacolin
Indiana County		
Lucerne	Rochester & Pittsburgh Coal Company	Lucernemines
Heilwood Mines 1 & 2	Penn-Mary Coal Company	Heilwood
Somerset County		
Orenda Mines 1 & 2	Merchant's Coal Company Davis Coal & Coke Company	Boswell
Loyal Hanna Mines 6 & 7	Loyal Hanna Coal & Coke Company	Cairnbrook
Jerome	Hillman Coal and Coke Company	Jerome
Washington County		
Vesta 4	Vesta Coal Company Jones & Laughlin Steel Company	Daisytown / Richeyville
Vesta 5	Vesta Coal Company Jones & Laughlin Steel Company	Vestaburg
Mine 51	Ellsworth Company Ellsworth Collieries Company	Ellsworth
National Mine 3	H.C. Frick Coke Company	Muse
Clyde Mines 1 & 2& 3	W.J. Rainey Company Clyde Coal Company	near Fredericktown
Westmoreland County		
Slick Mines	Cambria Steel Company	Slickville
Valley Camp	Valley Camp Coal Company	Valley Camp
Forbes Road	Jamison Coal & Coke Company	Forbes Roads
Frick Corporate Offices	H.C. Frick Coke Company	Scottdale
Alverton Mines 1 & 2& 3	H.C. Frick Coke Company	Alverton
Beehive ovens	Carnegie Coal Company	near Ardura

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