DORRANCE COLLIERY FAN COMPLEX
South Side of Susquehanna River
at Route 115 & Riechard Street
Wilkes- Barre
Luzerne County
Pennsylvania

HAER No. PA-61

HAER,
PA,
40-WILB,
5-

PHOTOGRAPHS
REDUCED COPIES OF MEASURED DRAWINGS

Historic American Engineering Record
National Park Service
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ADDENDUM TO
DORRANCE COLLIERY FAN COMPLEX
along the Susquehanna River
Wilkes-Barre
Luzerne County
Pennsylvania

HAER No. PA-61

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
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HISTORIC AMERICAN ENGINEERING RECORD

ADDENDUM TO
DORRANCE COLLIERY FAN COMPLEX

HAER No. PA-61

Location: Wilkes-Barre, Luzerne County, Pennsylvania

Dates of Construction: 1880s, 1908, c. 1930

Builder: Lehigh Valley Coal Company

Present Owner: Dorr Corporation of Pagnotti Enterprises

Present Use: Dormant

Significance: The Dorrance Colliery's mine fan complex spanned the history of the colliery. The oldest fan, an 1883 cast iron and wood Guibal, is the last known survival of the most common type used in the anthracite region. Its 35-foot diameter span, while not unique, was the largest of the fans found in the coalfields. Not only was the fan in good condition, it still was connected to its original power source—an 1883 horizontal slide valve steam engine. In addition to the Guibal fan, the Dorrance fan complex housed two other fans and the remains of their steam engines. One was a 1908 28-foot Dickson-Guibal fan powered by a Corliss steam engine, the other a c. 1930 Duplex Conoidal fan and Corliss steam engine. The Dorrance fan complex—its fans, engines and buildings—represented the technological development of mine ventilation. The complex was identified as the most complete mine ventilation system in the anthracite region.

Historian: David Salay

I. INTRODUCTION

In 1983 the entrance gates leading into the Dorrance Colliery in Wilkes-Barre, Pennsylvania, hung askew on broken hinges. The breaker, stripped of its machinery, stood rusting and unused. Scavengers and vandals had looted and damaged most of the colliery buildings. Fires had damaged the breaker, coal pockets and a number of other buildings. Neglect and the weather had added their adverse affects. The Dorrance Colliery, like the anthracite industry, was only a shadow of its former greatness. An industry that had been a major factor in America's industrial revolution was more history than reality. Beginning in the 1920s a combination of economic and technological factors eroded the market for anthracite. The tragic Knox Mine Disaster in 1959 flooded the mines throughout the northern coalfield and all but ended mining in the Wyoming Valley. Closed after the flood, the Dorrance Colliery now stood silent, a neglected monument to the fortunes of the anthracite industry.

The Dorrance Colliery is located on the Susquehanna River in Luzerne County, Pennsylvania. In 1983 the property encompassed 22.34 acres of land in the City of Wilkes-Barre, only a block from the Luzerne County Courthouse. Built by the Lehigh Valley Coal Company in the 1880s, it had been acquired by the Dorr Corporation, the real estate division of Pagnotti Enterprises, after the Knox Mine Disaster of 1959.[1] Although the colliery buildings were in poor condition, the site itself had value as the last developable real estate in Wilkes-Barre. The Dorr Corporation paid taxes on the land until 1977 but not on the buildings.[2] While the land belonged to the Dorr Corporation, the buildings became the property of Luzerne County in lieu of unpaid taxes. In 1983, city and county governments began negotiating payment of the taxes with Pagnotti Enterprises.

Resolution of the unpaid taxes became more critical when David Rowland, a Mountaintop, Pennsylvania contractor, offered to buy part of the site to construct a 120-bed nursing home.[3] Rowland signed an agreement in March 1983 with the Dorr Corporation to purchase almost seven acres of the colliery. The sale was contingent on approval of zoning and sub-division permits and a resolution of the tax questions. Prompt action was requested and received. In late March, the Wilkes-Barre School District, the City of Wilkes-Barre and Luzerne County reached an agreement with the Dorr Corporation on the Dorrance taxes. The Corporation agreed to pay all taxes due on the land, with interest and penalties, in exchange for ownership of the buildings free of taxes. As part of the settlement, Dorr agreed to demolish all of the small buildings at the site on or before June 30, 1983 and dismantle the breaker and boiler house and stack by May 29, 1984.

In April, the City Planning Commission approved the zoning changes to accommodate a nursing home. The city provided further assistance for the Dorrance Colliery project. In early April, Wilkes-Barre Community Development Corporation Director James Conahan applied for a federal Community Development block grant to make improvements to the site (sidewalks, street repairs, lighting and sewer lines).[4] The grant was awarded in June. At the same time, Rowland announced plans to fund his $7 million project, in part, with an Industrial Authority bond issue. These federal funds would have to be committed by July.

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[1] Lehigh Valley Coal Company to Dorr Corporation, February 13, 1963, Luzerne County Deed Book 1515, 423-430.
[2] "Nursing Home Eyed on Dorrance Colliery Site," *Citizens' Voice*, March 30, 1983, 10, 32.
[3] "Nursing Home Eyed on Dorrance Colliery Site," *Citizens' Voice*, March 30, 1983, 10.
[4] "City Eyes Funds to Improve Colliery Area," *Citizens' Voice*, April 14, 1983, 3.

Because federal funds were involved in the project, the law required a review of the historical significance of the site and its structures. Burt Logan, Executive Director of the Wyoming Historical and Geological Society (WHGS) and David Salay, Director of the Anthracite Museum Complex (AMC), were invited to visit the site. They found that the removal of machinery and fires had damaged the integrity and historic value of the coal breaker. All of the other buildings, except one, had no interest. But tucked in one corner of the property, almost hidden from view by trees and brush, stood a complex of buildings that housed the colliery's mine ventilating fans. This complex of three buildings connected by airshafts represented a remarkable historical and technological find.

The Dorrance Colliery's mine fan complex spanned the history of the colliery. The oldest fan, an 1883 cast iron and wood Guibal, is the last known survival of the most common type used in the anthracite region. Its 35-foot diameter span, while not unique, was the largest of the fans found in the coalfields. Not only was the fan in good condition, it still was connected to its original power source—an 1883 horizontal slide valve steam engine. The fan and engine alone would have marked the Dorrance fan complex an important industrial site. But there was more.

In addition to the Guibal fan, the Dorrance fan complex housed two other fans and the remains of their steam engines. One was a 1908 28-foot Dickson-Guibal fan powered by a Corliss steam engine, the other a c. 1930 Duplex Conoidal fan and Corliss steam engine. The Dorrance fan complex—its fans, engines and buildings—represented the technological development of mine ventilation. The complex was identified as the most complete mine ventilation system in the anthracite region.

After the fan complex's importance was identified, Project Directors Logan and Salay obtained permission from Pagnotti Enterprises to document the site and to determine the feasibility of preserving the mine fans and steam engines. James Tedesco (president), Louis Pagnotti III (chief engineer) and Tom Conners (real estate agent) of Pagnotti Enterprises gave both their official and personal support to the project. Their approval was contingent on the city's granting an extension of time required for the demolition of the fan complex. City Attorney Carl Frank not only approved the request but also added his support for the effort to preserve the fan complex.

The Project Directors also obtained the approval of the Pennsylvania Historical and Museum Commission (PHMC) administration and WHGS Board of Directors for the project.[5] In mid-May the Bureau of Historic Preservation, a division of the PHMC, awarded a $7000 grant to underwrite the costs of the survey. With funding secured, they contacted Dr. Robert Kapsch, Director of the National Park Service's Historic American Building Survey-Historic American Engineering Record. Dr. Kapsch approved HAER involvement and Eric Delony, Chief Architect, Historic American Engineering Record (HAER), added his expertise and energy as project advisor. On Delony's recommendation, Marion Dombroski and John Bowie, AIA, were hired to direct the field survey and prepare measured drawings. A staff of volunteers was recruited to assist with the field recording.

Prior to the field team's arrival on site, two tasks were undertaken. AMC staff, under the direction of Joseph Grego, AMC Construction and Maintenance Supervisor, cleared the brush and trees that had all but encapsulated the buildings. Three days were required for site preparation. The site and buildings were photographed using color slides and 35mm black and white film.

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[5] "Move Afoot to Save Dorrance Pump, Fan," *Citizens' Voice*, June 20, 1983, 16; "History of Coal Reviewed," Wilkes-Barre *Sunday Independent*, June 26, 1983, 20.

In June 1983, Dombroski and Bowie, led a survey team composed of staff and volunteers from the WHGS and AMC: Margaret Bakker, Annie Bohlin, Frank Grauman, Elizabeth Jewell, Lynn Kesselman, Mary Ann Landis, Mike Levine, Rob Lewis, Burt Logan, David Salay, and Joe Sgromo. During two, long hot days the complex buildings and machinery were measured. In addition, Thomas McCarthy, PHMC Chief of Construction and Planning, served as field surveyor, and Pierce Bounds volunteered his services as a professional photographer. The first products of the fieldwork, measured drawings and photographs, were approved by the HAER staff and submitted to the Library of Congress in 1984.

Preliminary archival research conducted at the outset of the project helped verify the historical value of the site. Fieldwork at the colliery provided additional information on everything from equipment manufacturers to construction techniques. This and subsequent research provided the basis for the photographic captions and measured drawings notes. While sufficient information was found to provide an overview of the history and function of the colliery's fans, a number of questions remained. Before a final report could be submitted further research was necessary.[6] Annie Bohlin, Frank Grauman, Mary Ann Landis, Frank Landis, Burt Logan and David Salay continued the archival research.

Archival research was hampered from the outset by missing records. The Lehigh Valley Coal Company records were destroyed in a fire several years before the project began. Pagnotti Enterprises had many subsurface mine maps but drawings of the Dorrance Colliery surface structures had been misplaced or destroyed. Gaps in the Buffalo Forge Company's record of the Duplex Coindal fan they manufactured for the colliery also proved frustrating. The company had microfilmed all of their engineering drawings, including those of the of the Dorrance fan. Unfortunately, the film was not checked before the originals were destroyed. After processing, it was discovered that the film of the Dorrance Colliery fan had been ruined. The drawings did not exist in any format.[7]

Research in printed accounts also produced mixed results. Prior to 1870, newspapers carried detailed accounts of the improvements made at local collieries. During the 1870s and 1880s, the quality and quantity of the newspaper coverage of mining operations declined. News of mining accidents and disasters were provided in detail, but improvements to the collieries received little or no comment. By the turn of the century, newspapers focused on national events. There is no newspaper coverage of the new fan house built in the 1930s. The same is true for the Pennsylvania Bureau of Mines Inspectors' Annual Reports. There are detailed descriptions on the construction of the first two fans and the mines associated with them. By the 1920s, however, specific information on colliery improvements is not included in the printed reports. The mine inspectors' field notes have disappeared or could not be located. They are reported to have been lost in the Hurricane Agnes Flood.

At the same time, the researchers added to their knowledge of mining techniques and mine ventilation technology in the Wyoming Valley. Useful information was located on the history of The Lehigh Valley Coal Company. Earlier data was checked and verified or corrected. A search was made

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[6] "Dorrance Colliery Information Sought," *The Tribune*, Scranton, Pa., September 5, 1983, 18; "Dorrance Colliery Artifacts Sought for Museum," Wilkes-Barre *Sunday Independent*, September 4, 1983; "Dorrance Colliery Memorabilia Sought," *Citizens' Voice*, September 3, 1983, 11.

[7] Earle VanDenBerg, Consultant, Engineering Division, Allis-Chalmers, to David Salay, May 15, 1984.

for people who had worked at the colliery. While few respondents were found who worked in the fan house, those interviewed added a personal perspective on its operation.

Within months of the project's completion, the Dorrance Breaker was demolished. All of the surface buildings—except the fan complex—were leveled. The Dorrance Colliery site was prepared for future development and the nursing home was built. The fan complex was retained—the last survival of its kind and a memorial to a great industry.

This report is the result of the effort of many people and the cooperation of local, state, and federal agencies. We would like to thank all who supported this project: the officers of Pagnotti Enterprises; the directors, staff and volunteers of the Historic American Engineering Record, the Pennsylvania Historical and Museum Commission, and the Wyoming Historical and Geological Society; and officials of the City of Wilkes-Barre and Luzerne County. We also would like to thank Marion Dombroski, John Bowie, and Pierce Bounds for their patience and extra effort.

II. THE ANTHRACITE REGION

The story of the Dorrance Colliery and the fan complex is the story of coal, specifically anthracite or hard coal. Anthracite is a rank of coal characterized by its glassy, jet-black color.[8] It is composed of from 85 to 93% carbon and less than 11 or 12% of volatile material, the average being around 6 % (3% oxygen and 3% hydrogen). Although it is difficult to ignite, once lit anthracite burns with great heat. The heat value of anthracite, measured in BTUs is 13,600 per pound of coal. This compares to 4500 BTUs for peat, 6500 for wood, and 13,850 for high volatile bituminous from Pittsburgh. Anthracite has a specific gravity of 1.39 to 1.61, which means that it is compact and massive. In sum, anthracite is a slow burning (little oxygen), high caloric (large percentage of carbon), clean burning (few impurities) coal leaving little ash. It was an excellent industrial fuel and the ideal domestic fuel in the nineteenth century.

The United State's supply of anthracite, or hard coal, is concentrated in a 484 square mile area in northeastern Pennsylvania. The anthracite region is divided into four geological fields. The Southern Field (Schuylkill), the Western Middle Field (Mahoney Valley including the towns of Ashland, Centralia and Shamokin), the Eastern Middle Field (Hazleton Plateau), and the Northern Field (Lackawanna and Wyoming valleys including the cities of Scranton and Wilkes-Barre).

The Dorrance Colliery is located in the Wyoming Valley in the southern part of the Northern Field. The Wyoming Valley is approximately 55 miles in length and six miles broad at its widest point and contains about 198 square miles.[9] Shaped like a crescent, the ends taper to the north and south. The valley is a broad, fertile plain formed by the Susquehanna River, which has a width of from 800 to 1200 feet in this region. Wilkes-Barre borders the southeast edge of the plain. Behind it a series of low hills rise to the mountains. North of the river, the mountains arose from the plain without foothills. James

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[8] See *Analyses of Pennsylvania Anthracite Coals* (Washington, D.C.: Government Printing Office, 1944); Peter Roberts, *The Anthracite Coal Industry* (New York: The Macmillan Company, 1901), 3-4; James Macfarlane, *The Coal-Regions of America* (New York: D. Appleton and Company, 1875), 7-8.

[9] A. DW. Smith, "Report on the Anthracite Region," in *A Summary Description of the Geology of Pennsylvania*, Volume III, Part I (Harrisburg, Pa.: Board of Commissioners, 1895) 1918, 1946-47.

Macfarlane, described the valley in 1875 as "the largest and finest of the anthracite coal-basins" and the "only portion having any pretensions to beauty."[10]

Underlying this broad valley are rich coal seams. The coal measures, the distance from the surface to the bottom of the deepest coal seam, had a thickness of 1800 feet in the Wyoming Valley.[11] As reported by A. DW. Smith for the Geological Survey of Pennsylvania:

> The Wilkes-Barre division is easily the most important of all the areas into which we have divided the Northern field; it is the largest, the basin reaches its maximum depth, it has the greatest thickness of coal measures, the largest number of coal beds, and the thickest coal beds; hence its original coal contents was in excess of any of the other divisions and the large proportion which still remains to be mined is still more in excess.[12]

The original coal reserves of the Northern Field were estimated at 6100 million tons.[13] Up to 1884, Luzerne County produced 13,383,000 gross tons (41% of all the anthracite mined). By 1921, 931 million tons of anthracite was mined in the Northern Field. In 1945 the total mined was 2511 million tons and reserves were estimatcd at 2553 million tons.

This coal was found in the twenty-five coal seams of the Llewellyn Formation, of which ten mineable veins underlay the Dorrance Colliery.[14] In much of the Wyoming Valley the coal seams are relatively flat veins or have gentle pitches of ten to twenty degrees. South of the Susquehanna River where the Dorrance Colliery was located, however, anticlines (bell-shaped folds in the strata) are numerous. Dips of 20° and 30° are common but pitches of 40° and 50° are not unknown. A number of seams outcropped on the mountainside or in the valley itself. It was these outcrops that first supplied the settlers with coal.

III. THE LEHIGH VALLEY COAL COMPANY

Knowledge and use of anthracite in the Wyoming Valley dates from the 1760s.[15] John Jenkins' 1762 map of the Wilkes-Barre was the first written record of Pennsylvania coal. The Gore brothers, blacksmiths in Wilkes-Barre, began experimenting with coal to fuel their forge that same year. Visitors to the valley were quick to note the "fine, light, lustrous coal which rubbed leaves no smut on the hand and burns without any bad smell."[16] Attempts to exploit these resources soon followed. Abijah and John Smith were the first to ship Wyoming Valley to market. Their first efforts met with limited success but they persisted, shipping 220 tons in 1812.

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[10] Macfarlane, *Coal-Regions*, 13.
[11] Smith, "Report on the Anthracite Region," 1986.
[12] Smith, "Report on the Anthracite Region," 1983.
[13] For the following, see George H. Ashley, *Anthracite Reserves* (Harrisburg, Pa.: Department of Internal Affairs, 1945), 2-6, 8, 10-13.
[14] Smith, "Report on the Anthracite Region," 1983, 1985

[15] Samuel H. Daddow and Benjamin Bannan, *Coal, Iron, and Oil* (Pottsville, Pa.: Benjamin Bannan, 1866), 108-12; Howard N. Evanson, *The First Century and a Quarter of American Coal Industry* (Pittsburgh, Pa.: Koppers Building, 1942), 138-39, 143-44; and *The Story of Anthracite* (New York: The Hudson Coal Company, 1932), 21-29.
[16] Evanson, *American Coal Industry*, 140.

Although little used outside of the coal fields before 1820, anthracite gained wide acceptance as the ideal fuel for smelting iron, home heating and powering steam engines by the late 1840s and 1850s. In fact, until about 1845, whenever the Pennsylvania coal industry was mentioned in papers, magazines or book, only anthracite was meant.[17] Historian Alfred D. Chandler has claimed that anthracite was the key to America's industrial revolution.[18]

Production and use of anthracite grew rapidly. In 1840 production was about a million tons a year increasing to 8 million tons a year by 1860.[19] In 1875 the Commissioner of the Second Geological Survey of Pennsylvania wrote

> By far the most important and the best-known coal in this country is anthracite. It is the universal fuel for domestic use in the United States, in preference to all other kinds of coal . . . .[20]

As the demand for anthracite increased, mining companies were formed to exploit the mineral wealth found in and around Wilkes-Barre. In 1883, when the Dorrance Colliery began operation, there were 47 collieries in the Wyoming Valley and total anthracite production was almost 38 million tons.[21]

The history of The Lehigh Valley Coal Company and the Dorrance Colliery begins with Asa Packer and the Lehigh Valley Railroad.[22] Coal, iron and railroads offered seemingly unlimited opportunities in mid-nineteenth century Pennsylvania. Amassing a small fortune building canal boats for the Lehigh Coal and Navigation Company and then as an independent boat builder, Asa Packer became a successful businessman and mine operator by 1850. As he watched the industry grow, Packer soon realized the advantage of railroad transportation over canals in transporting coal from the mines of northeastern Pennsylvania. In 1851 Packer began construction of the first section of his railroad, the Delaware, Lehigh, Schuylkill and Susquehanna. Soon renamed the Lehigh Valley Railroad, the 46-mile line was completed in 1855. The Lehigh Valley connected the coalfields around Mauch Chunk with

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[17] Evanson, *American Coal Industry*, 138. In 1850, two-thirds of the coal produced in the United States was anthracite (Bureau of the Census, *Mines and Quarries, 1902* [Washington, D.C.: Government Printing Office], 1905, 668).

[18] Alfred D. Chandler, Jr., "Anthracite Coal and the Beginnings of the Industrial Revolution in the United States," *Business History Review*, vol. XLVI, no. 2 (Summer 1972), 141-81. A writer for *Harper's Magazine* stated, with some exaggeration, that in 1857 there were "probably but few persons in this 'land of the free' who have not, at some time or other, enjoyed the novelty and the genial warmth of an anthracite fire." ("Coal, and the Coal-Mines of Pennsylvania," *Harper's Magazine*, Vol. 15 [September 1857], 451.)

[19] Smith, "Report on the Anthracite Region," 1916.

[20] Macfarlane, *Coal-Regions of America*, 7.

[21] Commonwealth of Pennsylvania, Department of Mines and Mineral Industries, *Anthracite Division 1961 Annual Report* (Harrisburg, Pa.: np, 1962), 10. [Hereinafter cited as *Bureau of Mines Reports*.] See also See also *Bureau of Mines Reports*,

[22] See Jules I. Bogen, *The Anthracite Railroads: A Study in American Railroad Enterprise* (New York: Ronald Press, 1927), chapter 5 on the Lehigh Valley Railroad; Milton C. Stuart, *Asa Packer, 1850-1879: Captain of Industry; Educator; Citizen* (Princeton: Princeton University Press, 1938); and Burton W. Folsom, Jr., *Urban Capitalists: Entrepreneurs and City Growth in Pennsylvania's Lackawanna and Lehigh Regions, 1800-1920* (Baltimore: Johns Hopkins University Press, 1981) 118-21.

Easton, Pennsylvania, an outlet to eastern markets. With success came expansion. The Lehigh Valley Railroad pushed into the developing coalfields to the west and north to the Wyoming Valley.

Before railroads arrived in the Wyoming Valley geography and competition hampered exploitation of its rich coal resources. The valley was isolated from eastern markets by distance and the lack of a good water outlet. The Susquehanna River was largely unnavigable and flowed to the Chesapeake Bay rather than to the rich markets in Philadelphia and New York. An attempt at canal building, the North Branch Canal, proved unsuccessful. Competition, from the Delaware and Hudson Coal Company to the north and coal operators in the Schuykill and Lehigh valleys to the south, also hindered exploitation of the coal resources in the Wyoming Valley.

The success of two local railroads and the wealth of coal around Wilkes-Barre interested other rail lines in the Wyoming Valley. In the 1860s, the Lehigh Valley Railroad joined four other major railroads, and a number of smaller lines, in hauling Wyoming Valley coal. While expanding their trackage, the railroads also acquired vast tracts of coal lands. An 1868 Pennsylvania law permitting coal companies to merge, and allowing railroads to expand their landholdings encouraged this development. The Lehigh Valley Railroad was quick to take advantage of this law. As with other railroads, the LVRR sought to reduce competition and to "insure a traffic for each of our branches in addition to that to be expected from other sources."[23] On January 11, 1869 the stockholders approved the action of the Board of Directors to purchase "stock in coal companies, etc., a controlling interest in large tracts . . . to furnish us with a coal tonnage equal to that now moved from these regions."[24]

Action followed this resolution. The Lehigh Valley Railroad soon purchased over 7000 acres, including property in Yatesville and West Pittston, and in Plains and Wilkes-Barre townships. In addition to these purchases, the railroad leased 2340 acres in the Wyoming Valley by 1875. To further reduce competition and assure the railroad a steady supply of coal, the LVRR also bought outright or an interest in a number of other coal companies. In Luzerne County the Directors acquired the entire capital stock of the Humboldt Coal Company (5828 acres) and Luzerne Coal & Iron Company (760 acres), a controlling interest in the Mineral Spring Coal Company, and all available stock in the Franklin Coal Company, [25]

Having acquired extensive coal lands it became incumbent on the company to do something with them. Robert Sayre, Superintendent and Engineer of the Lehigh Valley Railroad Company, wrote to Asa Packer on May 10, 1870, that the "large amount invested in coal lands and leases with the interest and royalty accumulating" made action necessary.[26] Sayre first outlined three approaches for developing these coal interests. He then recommended joint ventures with independent coal operators to divide the expense.[27] Sayre even offered to resign his position and "go to mining coal" If the company accepted his

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[23] D. G. Baird, comp., "A Statement of Some of the Important Matters That Have Entered Into the History of The Lehigh Valley Coal Company From Its Inception To and Including the Fiscal Year Ending June 30, 1906" (1907), Pennsylvania State Archives, MG 274, Lehigh Valley Railroad Collection, carton 63, 2.
[Hereinafter cited as Baird, Statement of Important Matters.]

[24] Baird, Statement of Important Matters, 2.

[25] Baird, Statement of Important Matters, 2-6. They also acquired a controlling interest in the Coal Ridge Coal Company, Locust Mountain Coal and Iron Company (Columbia and Northumberland counties), New York and Middle Coal Field Railroad and Coal Company (Columbia County) and all available stock in the Delano Land Company (Schuykill County).

[26] Baird, Statement of Important Matters, 6.

[27] Baird, Statement of Important Matters, 6-8.

recommendation. The Board of Directors chose not to do so. Instead, they appointed a special Committee on Coal Lands to tour their holdings in the Wyoming Valley. On June 14, 1870, the committee recommended

> That immediate steps be taken to organize a Coal Department and develop that portion of the property held by the Company under lease and on which they are bound to pay a minimum rent whether worked or not. That steps be taken to acquire a controlling interest in those properties in which the Company now hold a half interest or less and for which the purchase of the lease of the upper or Hillman vein in the Mill Creek Basin of the Hollenback property which could be developed in sinking a shaft to the lower veins on which the Company now have a lease, or probably by a slope from the outcrop at a small expense.[28]

The Lehigh Valley Railroad was in the coal business.

The Lehigh Valley Railroad acquired property under its own name and corporate standing until 1873. In 1873 Pennsylvania adopted a new constitution, effective January 1, 1874, with provisions that prohibited special legislation and required all corporations to fall under the general laws of the Commonwealth. Because the Lehigh Valley's charter did not include mining rights, the company wanted a corporation with a charter that would give it the power to develop its coal properties.[29]

In June 1872, the railroad purchased the charter of the Green Land Company from J. L. Seldridge and associates for $8515. The Green Land Coal Company had been chartered under the laws of Pennsylvania on May 29, 1871.[30] The rights obtained under the act of incorporation were

> To acquire lands by purchase, lease or otherwise, and to develop the same; may lease, sell, mortgage or otherwise dispose of such land, or any rights, easements or privileges therein; may construct all necessary buildings and fixtures for carrying on their business and for the accommodation of persons engaged in their employ, and may purchase, sell, transport and mine coal and manufacture iron and sell the same.[31]

The original charter of the Green Land Company provided for a capital stock of 100,000 shares at $50 per share with the right to issue additional stock in any amount necessary to carry out the objectives of the corporation. Thus, when the Lehigh Valley acquired the land company charter, the railroad had the right to purchase or lease up to 5000 acres of land and to construct the buildings and improvements necessary to carry on its business. This included the right to purchase the stock of other incorporated

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[28] Baird, Statement of Important Matters, 8-9.
[29] Baird, Statement of Important Matters, 11.
[30] Baird, Statement of Important Matters, 11; also D. G. Baird, comp., Corporation Book. Lehigh Valley Railroad Company, Including Subordinate and Affiliated Companies. Giving Brief Historical Information, Organization, and Details of Capital Stock and Funded Debt. Philadelphia: Secretary's Office, 1904. Pennsylvania State Archives, MG 274, Lehigh Valley Coal Company, Carton 4, Lehigh Valley Coal Company, 118-26. [Hereinafter cited as Baird, Corporation Book.]
[31] Baird, Corporation Book, 118; Baird, Statement of Important Matters, 13.

companies. A supplement to the charter, approved April 2, 1872, removed the restriction on the amount of acreage that could be acquired and provided

With the rights acquired through their new charter, the railroad transferred its coal lands to the Green Land Company.[32] The Green Land Coal Company was renamed The Lehigh Valley Coal Company in 1875. Even with a new charter and name change, it was still a wholly owned subsidiary of the Lehigh Valley Railroad.[33]

Under the direction of Robert Sayre, improvements to the coal lands had begun in 1871. New breakers were built or additions and improvements were made to old ones; shafts and slopes were sunk; and gangways and tunnels were dug.[34] The company invested heavily in land and improvements, production followed according. In an attempt to eliminate or reduce competition and to assure a steady supply of coal for the railroad to transport, The Lehigh Valley Coal Company also purchased coal directly from ten independent mining companies, including the great Coxe Brothers and Pardee collieries.[35] These investments in land and colliery improvements, and their contracts with independent operators, provided a steady source of freight and profit. The Lehigh Valley Railroad was a leader in the anthracite region by the 1870s.

The affairs of the corporation were well managed under Asa Packer and Robert Sayre's watchful eyes. But Packer's talents did not seem to carry over to the next generation. Packer died in 1879 and in 1884 his nephew, Elisha P. Wilbur, became president of the company. These were boom years for the anthracite industry. Production topped 52 million tons and was valued at over $85 million in 1893. Anthracite ranked second only to bituminous coal for any one mineral; iron was third and gold sixth.[36] But over-expansion, poor business decisions, labor relations problems and the Panic of 1893 soon brought the company to the verge of bankruptcy.[37] In desperation, the Directors turned to New York financier, J. P. Morgan. With Morgan's money came Morgan control. Elisha Wilbur and other Packer associates had to step down and the company entered another phase in its management. The Lehigh Valley Railroad and The Lehigh Valley Coal Company became part of J. P. Morgan's coal combination, one of seven railroad companies that controlled over 70 percent of all coal production.[38] The Morgan interests had made a wise investment. In 1901, the Wyoming District contributed 57 percent of the 67 million tons of anthracite sent to market.[39] Between 1883 and 1902, the Northern Field produced 50 percent of the coal shipped to market.

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[32] Lands in the Wyoming Valley transferred to the Green Land Company under this reorganization included the C. M. Rehrer River Tract (100 acres), M. E. Rehrer River Warrant (100 acres), Price and Longstreth lot (21 acres), West Pittston lands (761 acres), Turner, Brees & Carpenter lands (73 acres) and the properties held by the Luzerne Coal and Iron Company.

[33] C. A. Major, "Re: Events leading up to proposed reorganization of The Lehigh Valley Coal Company and general aspects of reorganization plan" (December 29, 1944), Pennsylvania State Archives, MG 274, Lehigh Valley Coal Company, Carton 4, 1-4. [Hereinafter cited as Major, "Reorganization of the Lehigh Valley Coal Company.]

[34] Baird, Statement of Important Matters, 265-66.

[35] Baird, Statement of Important Matters, 369-72.

[36] *Bureau of Mines Reports*, 1961, 10; Smith, "Report on the Anthracite Region," 1916.

[37] Folsom, *Urban Capitalists*, 136-37.

[38] Donald L. Miller and Richard E. Sharpless, *The Kingdom of Coal* (Philadelphia, Pa.: University of Pennsylvania Press, 1985, 286; Edward E. Hunt, et al, eds., *What the Coal Commission Found* (Baltimore: The Williams and Wilkins Company, 1925), 354-55.

[39] *Bureau of Mines Reports*, 1961, 10. See also *Mines and Quarries, 1902*, 676.

In 1903, The Lehigh Valley Coal Company's holdings were divided into four divisions: the Wyoming, Lehigh, Shamokin, and Schuykill. The Wyoming Division lands, which included the Dorrance Colliery, were valued at $1,244,087. After deducting royalties, depreciation and other expenses, the coal properties were assessed at a little over one million dollars.[40] Dorrance Colliery improvements were valued at $349,321 in June 1905.[41] By 1908 the Lehigh Valley had access to 43, 826 acres (24,709 acres of which were in the coal measures) which they owned outright and 16,553 acres of leased land (of which 12,671 were in the coal measures) with an estimated 742,394,000 tons of coal. Annual royalty payments on leased coal lands were almost $5½ million annually.[42]

Although the company was saved from economic disaster, it faced another problem in the twentieth century—the federal government's efforts to dismantle the trusts. In 1906 Congress passed the Hepburn Act. One of its provisions prohibited railroads from carrying commodities produced by themselves or by companies in which they held an interest. Under this act the Lehigh Valley Railroad was forbidden to haul the coal of The Lehigh Valley Coal Company, its wholly owned subsidiary.

There was little doubt that The Lehigh Valley Coal Company was a subsidiary of the Lehigh Valley Railroad. Although there was no written agreement, the Coal Company acknowledged that since November 1875 it had been required to ship all coal mined from lands it owned, leased or controlled exclusively on the Lehigh Valley Railroad. This understanding was formalized in October 1899.[43] The two were connected in other ways. The railroad funded the acquisition and development of coal lands, advanced money for colliery improvements, and underwrote deficits when The Lehigh Valley Coal Company could not pay its funded debt.[44] In fact, the railroad's paymaster paid the bills for the coal company supplies and wages.[45]

In an effort to forestall anti-trust litigation against the railroad under the Hepburn Act, the Lehigh Valley Sales Corporation was formed in 1912.[46] Stockholders of the railroad acquired ninety-seven percent of the Sales Corporation stock through a special ten percent dividend paid by the railroad. The Sales Corporation, in turn, entered a contract with The Lehigh Valley Coal Company to market the entire output of its coal. This "reorganization" did not fool anyone. The government proceeded with its anti-trust suit and in 1920 the United States Supreme Court ordered the dissolution of the inter-corporate relationship between the Lehigh Valley Railroad and its producing companies.[47] This ruling was largely ignored and the Coal Sales Corporation continued to purchase and market Lehigh Valley coal. When pressured to adhere to the court ruling, in 1924, the Lehigh Valley Railroad divided its interest in the Sales Corporation into as many shares of railroad stock that were outstanding. These "Certificates of Interest" were then sold to the railroad company stockholders at one dollar per share. (The Certificates

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[40] Baird, Statement of Important Matters, 18-20. The total valuation of The Lehigh Valley Coal Company was over $40 million dollars in 1906. This included $13 million in coal property and colliery improvements.
[41] Baird, Statement of Important Matters, 24.
[42] Baird, Statement of Important Matters, 262-64
[43] Baird, Statement of Important Matters, 374.
[44] Baird, Statement of Important Matters, 376-80. See also Eliot Jones, *The Anthracite Coal Combination in the United States* (Cambridge: Harvard University Press, 1914, 119-23.
[45] Baird, Statement of Important Matters, 415.
[46] C. A. Major, Reorganization of The Lehigh Valley Coal Company, 1-2.
[47] C. A. Major, Reorganization of the Lehigh Valley Coal Company, 2-3; Hunt, *What the Coal Commission Found,* 355-57.

sold on the open market for $30 a share.) In effect, the railroad shareholders still owned the mining company. This subterfuge did not work either. To force divestiture of the mining company stock from railroad company ownership, the government issued an injunction prohibiting payment of dividends in case of dual ownership. These restrictions were to remain in effect until 85% of the mining stock were independently owned. The company complied.

In 1928, the corporation adopted a reorganization plan to unify the Sales Corporation and the Coal Company.[48] A holding company was formed, the Lehigh Valley Coal Corporation, and its assets were exchanged with the public. One share of holding company stock was exchanged for one "Certificate of Interest" and one and one-fifth share of holding company stock was exchanged for one share of Sales Company stock.

The last corporate reorganization came in 1944. Because of financial difficulties the holding company formed a new corporation, the Northern Field Coal Company, which assumed The Lehigh Valley Coal Company's debt in exchange for certain considerations.[49] The new company was merged with the mining company, and renamed "Lehigh Valley Coal Company", eliminating the word "The." The ownership of the mining company was then divided between 250,000 shares of preferred stock held by the holding company and 189,000 shares of common stock held by the Girard Trustees.[50] By consolidating the company's debts and reducing the par value of the stock, the corporation created a capital surplus enabling them to escape their financial bind and pay dividends to their stockholders. The Dorrance Colliery remained part of the Lehigh Valley Coal Company until it was sold to the Dorr Corporation.

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[48] C. A. Major, Reorganization of the Lehigh Valley Coal Company, 2-3.

[49] The coal company had borrowed $12 million from the banks. To keep it out of bankruptcy, the holding company advanced $6 million secured in part from liquidating the Sales Company. The coal company then paid off the bank debt but owed the holding company almost $6 million dollars. Profits from the mining company went to reduce the debt but the holding company was concerned that they would lose their investment if the railroad went bankrupt before its bonds were paid in 2003.

[50] C. A. Major, Reorganization of the Lehigh Valley Coal Company, 3. The accountants did some creative bookkeeping. The 250,000 shares were 6% preferred stock at $10 par, reduced from $50 a share. The note was due January 1, 1955. This created a $7.5 million surplus which wiped out the deficit in the profit and loss column of the coal company and permitted it to legally pay dividends to the holding company. The common stock had a reduced par value of $10. This arrangement was to strengthen the coal company, which, it was believed, would benefit the assets held by the Girard Trustees and the holding company's investment.

CHART A

Organizational Changes: Lehigh Valley Railroad Company[51]

THE LEHIGH VALLEY COAL CO.

189,300 shares of coal company stock, $50 par, valued at $9,465,000, owned by the Company and pledged under a General Mortgages, dated September 30, 1903. On March 15, 1924, Court trustees this stock 1,212,160 of Interest to LVRR Company (that being the total number of of stock of the Railroad Company) upon payment of $1 per share.

LEHIGH VALLEY COAL SALES CO.

On January 19, 1912, the LVRR Company declared a cash dividend of $6,060,800 with LVRR the stockholders to use that sum to subscribe Consolidation for stock of the Lehigh Valley Coal Sales Company, 121,600 shares with a par value of issued against $50, and a capital authorization of $10 million. Certificates There are now outstanding 196,028.7 shares stockholders and the par value has been reduced to $20, or of the shares $3,920,574.

LEHIGH VALLEY COAL CORPORATION

Incorporated June 29, 1928. One share of common stock exchanged for each Certificate of Interest of Lehigh Valley Coal Corporation and one and one-fifth shares of 6% cumulative preferred stock for each share of Coal Sales stock. The outstanding stock of the Corporation is 1,205,437 shares of common (no par) and 227,409 shares of preferred ($50 par), $11,370,450

NORTHERN FIELD COAL COMPANY

Created by the Lehigh Valley Coal Corporation. with their $5,7000,000 note assigned to it as follows: 250,000 shares of preferred stock ($2,500,000) and a 5% note for $3,200,000 due January 1, 1955.

LEHIGH VALLEY COAL COMPANY

As a result of the merger of THE Lehigh Valley Coal Company and Northern Field Company, the Lehigh Valley Coal Corporation will hold 250,000 shares of Lehigh Valley Company 6% preferred stock with a par value of $010 ($2,500,000) a 5% convertible note due January 1, 1955 ($3,200,000) for a total of $5,700,000. Girard Trust Company Trustees will hold 189,300 shares of Lehigh Valley

[51] Lehigh Valley Railroad Company, Office of the Secretary and Treasurer, New York, January 4, 1945. Pennsylvania State Archives, MG 274, Lehigh Valley Railroad Collection, carton 63.

common stock with a par value reduced to $010 a share for a total of $1,893,000.

IV. MINE VENTILATION

The Dorrance Colliery, as with all collieries, included the underground workings (the shafts, tunnels, slopes, and gangways commonly known as the mine), above and below ground transportation networks, and surface buildings. The surface buildings included support facilities for the miners—the shaft headframes, hoisting house, wash house, blacksmith's shops, mule and/or car barns and stables, hospital, and ventilating fans. Other buildings housed administrative functions for the mine superintendent and officials, engineers, draftsmen, salesmen, accountants and paymaster. Surface buildings also included what was often the most visible and noted feature of the anthracite region—the coal breaker. The breaker was the building that housed the coal crushing, cleaning and sizing equipment. The breaker, along with the coal pockets and weigh scales, were the processing and marketing end of the business. Every building was an integral part of the colliery operation.

None was more important to the miners—and the safety of the mining operation—than the fan house and mine fans. They provided fresh air for the miners and exhausted noxious gases through airshafts, and underground airways. The fan houses were altered and enlarged to house new fans and steam engines as the underground workings expanded and as lower coal seams were reached or more gaseous conditions were encountered. To understand and appreciate the Dorrance Colliery mine fan complex it is important to understand the problems with mine ventilation and the function of ventilating systems.

Mine Gases. Mine ventilation supplies fresh air for the men, and in earlier days animals, working in the mine and eliminates or dilutes noxious and explosive gases. [52] In addition to the normal constituents, mine air contains a number of impurities. Naturally occurring gases are the greatest danger. Other impurities include smoke and gas from blasting, the most dangerous being carbon monoxide (CO) and carbon dioxide (CO_2), and dust from mining operations and underground haulage roads. Men, animals and open flame lights produce carbon dioxide as well as using up oxygen. If not cleared from the mine or diluted these explosive and inflammable gases accumulate. If ignited the resulting explosion causes injury or loss of life and damage to the mine workings.

One of the most dangerous gases found in mines is methane (CH_4) or **firedamp** as the miner's called it. Methane occurs naturally in coal strata and can be found in pockets under pressure of up to 500 pounds per square inch. When struck by a miner's drill these "blowers" release a large quantity of explosive gas at the working face. Methane was one of the most dangerous gases because it is particularly volatile. A mixture of 5.5 to 12.8 percent of methane and air is explosive, or as little as two percent if coal dust is present. Another gas, **blackdamp,** is a residual gas left after partial or complete removal of oxygen from the air. When pure it contains 85 percent to 99 percent nitrogen and one to 15 percent CO_2. **Whitedamp**, or carbon monoxide, is noxious at .05 percent and is fatal at .2 percent. **Afterdamp** is a mixture of air, blackdamp, white damp, and CO_2. While a miner might escape death from an explosion, he could be suffocated by the afterdamp produced by the explosion.

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[52]F. Ernest Brackett, "Mine Ventilation," in Robert Peale, ed., *The Mining Engineers' Handbook.* (New York: John Wiley & Sons, Inc., 1918) , 1019-1022; W. M. Weigel, *Ventilating Equipment* (New York: McGraw-Hill, Inc. 1915), 1. See also *Reports of the Inspectors of Mines,* 1871, 56-57 and *Bureau of Mines Reports*, 1872, 55-58.

Coal mines can release large quantities of these dangerous gases. The gas present per ton of coal mined varies from about 15 to 8000 cubic feet. Of this amount, 50 to 100 percent can occur at the mine face, where the miner is working. The quantity of gas usually increased with the depth of the mine and where the coal seam was under an impervious covering of rock that does not allow it to dissipate upward.

Mine Ventilation Law of 1870. The need for adequate mine ventilation to remove or dilute gas generated an on-going discussion from the outset of the coal industry in Pennsylvania. Regular articles in the *Shenandoah Herald* and the annual reports of the mine inspectors made it clear that "An ample supply of fresh air is as important and vital to successful mining, as the sap is to the tree."[53] Explosions, mine fires and mine closings drew attention to the dangerous conditions in the mines. Although there was a debate over who was most to blame, careless miners or thoughtless mine owners and superintendents, all agreed that mine gases were dangerous to the health and safety of those working underground.[54] In 1869, the Avondale Mine Disaster killed 179 miners and highlighted the need for better legislation. A mining law had been passed shortly before the disaster but it applied only to Schuykill County, Pennsylvania. The Avondale Disaster encouraged the Commonwealth to extend the law to all anthracite counties. On March 3, 1870, the Pennsylvania legislature passed the anthracite Mine Ventilation Law.[55]

The law now regulated the amount of air required to prevent explosions and dilute the gases coming from the strata in coal mines. The Pennsylvania Mine Ventilation Law of 1870 required 55 cubic feet of air per second or 3300 cubic feet per minute for every 55 men.[56] (The volume of fresh air per man in cubic feet per minute in ordinary buildings is from five to 16.) In general, it was believed that mine air should not contain more than two percent of impurities which when mixed with 100 volumes of normal air has 20.6 percent of oxygen.[57] Because of the presence of coal dust and the possibility of blowers, some thought that this percentage should be even lower.

Not only was the volume of air and percentage of allowable impurities legislated but air velocities were regulated as well.[58] The effect a high velocity of air had on the health of the miners and on open-flame lamps was a concern. A velocity of five feet per second at usual mine temperatures was considered unhealthful for perspiring men. With four feet of air per second a candle flickers so that it is hard to see; at seven feet it is difficult to keep a miner's lamp burning and at 20 feet per second naked lamps cannot be used. Fifty feet per second produces a high wind. Engineers also preferred moderate air velocities because they were the most economical of power and in avoiding excess friction and high ventilating pressures.

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[53] *Bureau of Mines Reports*, 1880, 91.

[54] For example, *Bureau of Mines Reports* for 1871 (58), 1872 (30), 1879 (123), and 1883 (104). See also Anthony F. C. Wallace, *St. Clair: A Nineteenth Century Coal Town's Experience With A Disaster Prone Industry* (New York: Alfred A. Knopf, 1987).

[55] Alexander Trachtenberg's *A History of Legislation for the Protection of Coal Miners in Pennsylvania, 1824-1915* (New York: International Publishers, 1942) provides the best review of the development of mining law.

[56] *Bureau of Mines Reports*, 1875, 74. This was revised in 1891. The law then required 200 cubic feet per minute for every man working in the mine. (*Anthracite Mining Laws of Pennsylvania* [Harrisburg, Pa.: Department of Mines, 1948], 47) See H. M. Chance, *Report on the Mining Methods and Appliances used in the Anthracite Coal Fields* (Harrisburg, Pa.: Board of Commissioners for the Second Geological survey, 1883), 333 for how this was calculated.

[57] *Mining Engineers' Handbook*, 1021-24.

[58] *Mining Engineers' Handbook*, 1027.

The amount and velocity of air in the mines was one thing; getting it to where it was needed was another. Different systems were used to direct the air through the gangways and along all of the working faces. The old system was the single-entry, the same entry was used as both the intake and exhaust airway. It was inexpensive and adaptable to small mines but it was dangerous because air becomes impure after 100 yards.[59] The Mine Ventilation Law of 1870 prohibited the single entry system and work could not extend more than 60 to100 feet without cutting through the pillars to adjacent workings for air.[60] The standard system by the 1880s was the double entry, with two airways separated by at least 400 feet.

The Mine Ventilation Law also forbade the use of one air current to serve the entire mine.[61] The split system divided a mine into districts and ventilated it by separate air currents. The intake was usually divided into two sub-divisions at each level, or lift, and directed along the gangways opened on each side of the shaft. The passageways and workings on each side of the main gangway were divided in turn. This kept the foul air in one district from being drawn through any other. The split system was particularly important in gaseous mines where the return current in a district could contain firedamp.[62] Because the friction of the air against the walls is the greatest obstacle to ventilation, air splits had engineering advantages as well. In the split system air velocity and therefore the friction is reduced. The reduction in velocity also reduces the pressure consumed and lowered energy costs.[63] These were the principles and laws in place by 1880.

Even with the passage of the Mine Ventilation Law and the use of mine inspectors, accidents occurred. When the Dorrance Colliery began development in 1883, proper mine ventilation was still a critical need in the Wyoming Valley. This was made clear by the statistics the Bureau of Mines began keeping after 1870.[64] Some accidents were major disasters resulting in a number of deaths. Between 1871 and 1879 six explosions resulted in the deaths of five or more miners. Large explosions were only a small percentage of those that occurred in the mines. In 1875 alone there were 42 firedamp explosions in the district. One unfortunate mine accounted for eleven of them.[65] All explosions did not cause death. In the Hillman seam, "a large quantity of gas was left to accumulate, and ignited by workmen in traveling through the same to and from the surface, causing a terrible explosion, yet more by good luck than good management, no serious injury to persons was received."[66]

V. THE DORRANCE COLLIERY

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[59] Macfarlane, *Coal-Regions of America*, 99.

[60] *Bureau of Mines Reports*, 1876, 137-38; *Anthracite Mining* Laws (1948), 15-17; Mining *Engineers Handbook*, 1027.

[61] According to the law, "every mine having explosive gas . . . shall be divided into two, four, or more panels or districts, each ventilated by a separate split of current of air, and fifty persons shall be the greatest number that shall working any one panel or district at the same time,. . . ." *Bureau of Mines Reports*, 1876, 139-40. See also Chance, *Report on Mining Methods*, 327 and Roberts, *Anthracite Coal Industry*, 23.

[62] *Mining Engineers' Handbook*, 1025-26.

[63] Macfarlane, *Coal-Regions of American*, 101; Joseph J. Walsh, *Mining and Mine Ventilation* (New York: D.Van Nostrand Company, 1915), 122-23.

[64] Shortly after passing the Mine Ventilation Act, on April 5th, the Pennsylvania legislature passed an act to preserve mine records.

[65] *Bureau of Mines Reports*, 1875, 63.

[66] *Bureau of Mines Reports*, 1879, 122.

This industrial and corporate history is the framework for the development of the Dorrance Colliery and the mine fan complex in particular.

The Dorrance Colliery is located in northeastern Pennsylvania on the eastern side of the Susquehanna River in Wilkes-Barre. In geological terms it is situated in the Northern Anthracite Field. In economic and marketing terms it is found in the Wyoming coal district. In political terms it is located in the City of Wilkes-Barre in Luzerne County. At its peak the colliery encompassed 550 acres with mines extending under the Susquehanna River to include land on both the eastern and western sides of the river.

The Lehigh Valley Railroad purchased the Dorrance site, the former Bidlack Farm, from Sarah Hunt in 1880.[67] This joined the parcels the railroad purchased in the Wyoming Valley soon after it was organized. As noted above, in the Wyoming Valley the company acquired the entire capital stock of the Humboldt Coal Company and Luzerne Coal & Iron Company, a controlling interest in the Mineral Spring Coal Company and all available stock in the Franklin Coal Company.[68]

In addition to these purchases, the railroad leased over 2000 acres in the Wyoming Valley by 1875 and continued to lease land as needed and as it became available.[69] Most of these were perpetual leases and only covered the sub-surface rights. In exchange for the right to mine coal they provided the landowner royalties on the coal mined at fixed prices, usually with a minimum annual payment. There were several reasons for leasing property rather than purchasing it outright. First, landowners who had acquired their land through inheritance would not sell but they would enter leases for mining their coal. Second, some parcels were too small to warrant the development of a colliery but could be attached to an existing colliery or consolidated with other leases to form one mining operation. Third, a number of leases covered coal lying under cities or towns, or under improvements that could not be disturbed. The cost of purchasing these outright would have been impossible or prohibitively expensive.[70]

The Lehigh Valley Coal Company acquired over 100 leases throughout the anthracite region by 1906.[71] Each lease was assigned to one or more of the company's collieries. Many of those considered "tributary" to the Dorrance colliery were for small plots located in or near the City of Wilkes-Barre and the Dorrance Colliery. [See Appendix I for a list of leased lands "tributary" to the Dorrance Colliery.] In fact, the colliery was named in honor of Colonel Charles Dorrance, from whom the Lehigh Valley Railroad leased important coal lands.[72]

The first task undertaken at the Dorrance Colliery was to sink a hoisting shaft with two lifts to haul men and coal in and out of the mine. This was sunk 602 feet to the Hillman vein by July. The Hillman vein was fourteen feet thick at this point but the miners extracted only eight and a half feet, leaving the rest to support the mine and surface structures. At the same time, a second shaft (No. 2), twenty-five feet by ten feet, was being driven 400 feet north of the hoisting shaft. It would strike the

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[67] Charles P. Hunt, et al to Lehigh Valley Coal Company, April 2, 1880, Luzerne Deed Book 219, 42-46.
[68] Baird, Statement of Important Matters, 2-6.
[69] Baird, Statement of Important Matters, 4.
[70] Baird, Statement of Important Matters, 125-26.
[71] Baird, Statement of Important Matters, 172-89, 262-64.
[72] "The Dorrance Shaft," *Wilkes-Barre Record*, July 3, 1883.

Hillman vein at a depth of 344 feet and would serve as the intake shaft.[73] While work on the No. 2 airshaft was underway, the hoisting shaft served as the air exhaust for the ventilating system.

The construction of these main intake and return shafts was one of the most important considerations in developing a ventilation system. If the sectional area was small, the velocity would be high and friction would consume a large part of the total pressure generated by the ventilating equipment. In 1883, as the Dorrance Colliery began development, H. M. Chance noted that the size of shafts was larger than in former years. He gave three reasons for this change: the greater depth required to reach the coal, to secure better ventilation because of the gaseous condition of these mines, and the preference for opening one large colliery rather than several small mines. The Dorrance Colliery fell within all of these parameters. In fact, Chance stated that "Some of the shafts now under contract are of extraordinary size, notably the Dorrance shaft of the Lehigh Valley Coal Company, 13'x52' . . . ."[74] He could have added that the length of the mine cars and the number of compartments in the shaft also determined shaft size. Sinking shafts was an expensive undertaking. In 1901 the cost of sinking a shaft through hard rock to a distance between 600 and 800 feet was from $5.00 to 8.00 a cubic yard and in shale and soft sandstone for $2.00 to $4.00 a cubic yard. Where alternate layers of soft and hard rock are found in the Wyoming Valley, the cost was between $3.50 and $4.00 a cubic yard.[75]

Because mine ventilation can be produced in number of ways, The Lehigh Valley Coal Company had several options in selecting a ventilation method when they began to develop the Dorrance Colliery. Mine ventilation can be produced by natural ventilation, a waterfall, steam jets, furnaces, or mechanical ventilators. By the time the Dorrance Colliery was developed, mechanical ventilation, or fans, was the primary system for moving air into and out of the mines.[76] A fan is a mechanical device that forces an air current through the mine by the rotating or reciprocating action of vanes or blades mounted to a central shaft.

As with mining systems and ventilation methods, The Lehigh Valley Coal Company had the choice of ventilating their mines by forcing or blowing air into them or by pulling or exhausting the air from the mine by creating a partial vacuum in the upcast shaft. With blowing fans haulage ways could be used as intakes only if doors were installed in the passageways to regulate the airflow. Because doors were inconvenient the main haulage road often was used as the outlet and foul air, explosive gases, powder, and smoke were forced through the gangway. This was particularly serious in gaseous mines because an explosion would force Afterdamp through the miners' escape route.[77] In the exhaust system, the foul air containing impure air and noxious gases passed through the upcast or outlet directly to the fan; pure air entered the mine by the main haulage ways. The benefits of exhaust fans were thought to override those of blowing fans. Most anthracite mine fans, including the Dorrance Colliery's, were exhaust fans drawing air from the mine rather than forcing air into the mine workings.[78]

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[73] "The Dorrance Shaft," *Wilkes-Barre Record*, July 3, 1883. In July the shaft for the second opening was already down 175 feet; the tunnel connecting the two was completed in October 1884.

[74] Chance, *Report on Mining Methods*, 60-62. See also Roberts, *Anthracite Coal Industry*, 23-24.

[75] Roberts, *Anthracite Coal Industry*, 25.

[76] Chance, *Report on Mining Methods*, 314-15

[77] Chance, *Report on Mining Methods*, 332

[78] *Mining Engineers' Handbook*, 1026-27; R. V. Norris (Wilkes-Barre, PA), "Centrifugal Ventilators," in *Transactions of the American Institute of Mining Engineers* (New York: Published by the Institute, 1905), vol. 35, 456; Chance, *Report on Mining Methods*, 331. Even so, blowing fans sometimes were used in emergencies, such as mine fires or explosions.

One disadvantage of the exhaust system was the chance that gas in the return current might cause an explosion that would damage the fan. Because of the danger, an exhaust fan was not positioned directly over the airshaft.[79] It was sited back from the shaft, away from the damp and dust of the mine, and an airway directed the flow of air to it. As a precaution against damage from explosion, the airway roof had heavy metal blast doors positioned directly over the shaft. If an explosion occurred, the force of the blast would be directed upward through these doors and not into the fan. Blast doors were included in the plans for the Dorrance Colliery fans houses.

In July 1883 work on the Dorrance Colliery was proceeding and William Patten, colliery supervisor, showed a reporter from the *Wilkes-Barre Record* the work being done. Patten believed that the fan and the building to house it would be working September or October.[80] Patten was mistaken. The first ventilating fan at the Dorrance Colliery went into service on April 24, 1884. According to a contemporary mine inspector, the fan produced "ventilation far in excess of their present need, although running but very slowly."[81] The Dorrance Colliery was to be no fly-by-night operation. The Mine Inspector noted with some satisfaction that the company "evidently is bent on securing the best kind of machinery, as well as insuring the highest known degree of safety for both men and property."[82] This was critical because as H. M. Chance reported in 1883, "In the Wyoming district, especially in the neighborhood of Wilkes-Barre, the best means of securing proper ventilation is the most important mining problem to be solved."[83] These precautions were necessary. In May 1883, just after the shaft was completed, an explosion of mine gas killed one man and fatally injured another.[84] Another firedamp explosion was reported in February 1884.[85]

Guibal Fans. The fan that The Lehigh Valley Coal Company selected for the new colliery was a 35-foot diameter Guibal.[86] Designed by a Belgium inventor, the Guibal became the most widely used fan in the anthracite region. It is a centrifugal, closed-running double outlet exhaust fan. Centrifugal fans draw the air from the mine into the center (shaft area) of the fan and, through centrifugal force and out to the circumference (blade tips) where it is discharged. The Guibal was one of the first centrifugal fans used in the anthracite region.

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[79] *Mining Engineers' Handbook*, 1024; *Keystone Mining Catalog*, (Metal and Quarrying Edition) 4th Issue (Pittsburgh, Pa.: Keystone Consolidated Publishing Co., Inc., 1924, 504.

[80] "The Dorrance Shaft," *Wilkes-Barre Record*, July 3, 1883. Patten was mistaken about other items as well. He told the newspaper that they did not plan to construct a breaker at the colliery because their coal was intended for local iron furnaces and lump coal could be processed in existing breakers. He added, "It may be that after a while a small breaker will be built to work up the fine coal to supply the city retail trade." Despite this pronouncement, the Bureau of Mines reported that a breaker was under construction in 1883 and began operation in June 1884, although little coal was mined because of problems in the mine. *Bureau of Mine Reports*, 1883, 111; 1884, 100.

[81] *Bureau of Mines Reports*, 1884, 100.

[82] *Bureau of Mines Reports*, 1884, 100.

[83] Chance, *Methods of Mining*, 307.

[84] "Exploding Mine Gas," *Wilkes-Barre Record*, May 5, 1883.

[85] *Engineering and Mining Journal*, February 9, 1884.

[86] The Dorrance Colliery management had several fan types from which to chose. Centrifugal fans are classified in one of four categories: Guibal fans, Capell fans, modern steel plate fans or high-speed or multi-vane fans. Weigel, *Ventilating Equipment*, 17-18; *Mine Engineers Handbook*, 1056-57.

Closed running means that the fan is encased in a housing that fits closely around the circumference of the fan so that the air can only enter into the center, shaft area. A close-fitting housing improved the efficiency of the fan by eliminating the re-entry of air behind each vane and by protecting the fan against exposure to wind. Open running fans (open around the whole circumference) had been common in the anthracite regions in the 1860s and 1870s. But open running fans waste a large amount of power by permitting a reentry of air behind each vane and through exposure to high winds. Chance reported that by the time the Dorrance Colliery began operation closed fans with Guibal characteristics had replaced most open running fans.[87]

The first Dorrance Guibal fan was a double outlet exhaust fan.[88] In a double outlet installation air drawn up the airshaft was divided by a pointed brick wall or air-split and entered both sides of the fan. Some fans were single outlet, having the air drawn into only one side. The inlet for the air was characteristically one-half the diameter of the fan wheel.[89] Exhaust fans, as noted previously, draw air from the mine rather than blowing air into it.

The Guibal fan was a remarkable development and soon became the most widely used of all mine fans.[90] The Guibal fan's characteristics included its:

1. large size
2. spiral casing or shroud
3. expanding chimney
4. shutter
5. cast iron frame
6. few blades
7. curvature and inclination of the blades
8. width of the blades.

The Guibal was the largest fan used in the anthracite region. Its 35-feet diameter was the largest sized fan used in the United States. When the 35-foot fan was installed at the Dorrance Colliery, it was one of the largest in use at the time. Chance wrote that in 1883 there were "yet comparatively few fans more than 20 feet in diameter, a very large number of 20 foot fans, and a still larger number of sixteen-foot fans are in use."[91] Although there were few fans less than 10 feet in diameter, a large number of the older 12 and 14 foot diameter fans were still being used in the anthracite region.

The spiral casing which enclosed the vanes was considered one of the most distinguishing features of the Guibal fan. This is what differentiated it from other fans. These casings differed in design and there was some debate on what was preferred.[92] The *Mining Engineers Handbook* divided them into two general categories: those with spirals of great length beginning to open out at or near the point of cutoff and short

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[87] Chance, *Methods of Mining*, 315.

[88] There are four general types of fan installations: single inlet exhausting, double inlet exhausting, double inlet blowing, and double inlet reversible. *Keystone Mining Catalog* , 504.

[89] Weigel, Ventilating Equipment, 18.

[90] *Mining Engineers' Handbook*, 1055.

[91] Chance, *Methods of Mining*, 323.

[92] Chance stated that there were three common forms in the 1880s: (1) a complete spiral, commencing at the throat (discharge) and expanding regularly throughout; (2) upper half circular with the spiral beginning about 180° opposite the throat, and (3) a three-fourths spiral with the spiral beginning opposite the lowest part of the fan, about 270° from the throat. Chance, *Methods of Mining*, 316.

spirals beginning some distance above or below the point of cutoff.[93] This guide recommended that the peripheral casing of centrifugal fans should be a logarithmic spiral but that a true or Archimedian spiral could be used without serious difficulty. Whatever the design, the casing had to be strong enough to withstand the difference in inside and outside pressure and resist wind stress. Wood casings were the cheapest to construct and were the first used but brick, and later steel, proved more durable. Besides which, wooden casings were too dangerous for use with gaseous mines. The Dorrance casing was brick and sheet metal.

The peripheral casing was close fitting around the fan increasing in a spiral until it reached a point near the chimney, as noted above. The use of an expanding chimney was based on the belief that the column of air drawn from the throat spreads to fill the chimney. The air thus met the atmosphere at a reduced velocity resulting in less loss of power than if projected against the atmosphere at the speed at which it left the fan blades.[94]

A shutter regulated the size of the opening so that it was just large enough to allow the air flow easily.[95] A shutter consisted of horizontal wooden strips bolted to thin iron bars that slid in curved guides. The lower edge formed an adjustable cutoff. Sometimes the lower edge was an inverted V-shape that could gradually cut off outflow from the passing vanes.[96] The reason for the shutter was simple:

> "When air is being discharged into the spiral casing from between two blades, the pressure is on the front of the blade. Now as the tip of the blade passes the point of cutoff the discharge of air is suddenly stopped, causing more or less shock, and a sudden removal of the pressure from the front of the blade. This condition tends to cause vibration injurious to the fan, and pulsations in the air.[97]

There was an additional need for a shutter. The point of cutoff at a fan throat was fixed for a given resistance or amount of mine air, but every change in resistance required a change of throat area. A flexible shutter could deal with these changes.

Guibal fans, like the one at the Dorrance Colliery, had a cast iron frame to support the blades. The Dorrance fan has three cast iron spiders, one on each side and one in the middle, all keyed to a large central shaft. Bolted to the spider, and to each other, is a framework of long metal bars. The outer end of each bar supports the blade while the inner end of the bar serves as a brace to strengthen another blade. Because it had ten blades the Dorrance Guibal framework was pentagonal in form. Guibal fans with six blades had a hexagonal spider and those with eight blades had an octagonal spider.[98]

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[93] *Mining Engineers' Handbook*, 1049; Weigel, Ventilating Equipment, 18.
[94] *Mining Engineers' Handbook*, 1049; Chance, *Methods of Mining*, 321-22.
[95] Chance, *Methods of Mining*, 320.
[96] Weigel, Ventilating Equipment, 19-20; *Mining Engineers' Handbook*, 1052-54. Chance claimed that there were few fans in the early 1880s built with an adjustable shutter and those that had them were seldom used. But he added that experiment and that once known a table should be made available that showed the best position of the shutter under different conditions could only accurately determine the best position of the shutter. Chance, *Methods of Mining*, 318-19.
[97] Weigel, Ventilating Equipment, 19.
[98] *Mining Engineers' Handbook*, 1052; Chance, *Methods of Mining*, 317; Weigel, *Ventilating Equipment*, 17-18.

Guibal fans had from six to ten blades. The Dorrance Colliery Guibal fan had ten blades attached to its 35-foot diameter frame. There were trade-offs with having more or fewer blades. The more vanes a fan had the less distance there was between the blade tips. This reduced reentrance and eddies but increased the area of surface exposed to friction.[99]

Fan blades or vanes may be planes or curved surfaces. The earliest fans had plane (flat) surfaces. Later forms adopted a forward or rear sloping surface to reduce friction. There was considerable debate on the advantages and disadvantages of the slope of the blade and on forward versus rear sloping blades. After a number of experiments the conclusion was that each form had certain advantages and some disadvantages. Forward curving blades facilitated the entrance of air from the intake and were more efficient but had the disadvantage of increasing eddies. Backward-sloping vanes, like those on the Dorrance Colliery Guibal fan reduced eddy currents at the tips but increased mechanical friction due to the higher rotational speed required for a given head. The Guibal was noted for the slight inclination of its blades. Guibal fans with six blades were set an angle of 60°; those with eight blades were set at 45°; and those with ten had an angle of 30°.[100]

A blade width equal to one-third (or a little less) of the fan's diameter was accepted practice in 1883. By 1915 these dimensions were calculated more technically. The *Mining Engineers Handbook* stated that to prevent excessive radial velocity the width was satisfactory when the cylindrical surface swept by the inner edges of the vanes equals the total inlet area.[101] When the vanes tapered, however, the width at the circumference should be 50 to 60% of the width at the outlet. Each blade on the Dorrance Colliery Guibal fan was 138 inches wide by 119 inches long, roughly ten feet by eleven feet.[102]

There was one other characteristic of Guibal fans: their slow speed. The Guibal fans used in the anthracite region varied in size from 16 to 35 feet in diameter, turning at 45 to 85 revolutions per minute. But the fans were constructed to run nearly double this speed in case of an emergency. Thirty tests on a number of fans showed peripheral speeds ranging from about 4000 to 5500 feet per minute. The larger fans turned relatively slower than the small fans. The Dorrance Colliery Guibal fan ran at 49 revolutions per minute.[103]

Guibal fans, like all centrifugal fans, are gauged by the air pressure they produce.[104] Pressure is measured from the air at zero velocity near the intake to the pressure of motionless air at the outlet. When there is air movement between the intake and outlet, pressure exceeds zero to zero measurement by the force necessary to produce the velocity. The ventilating pressure varies directly as the square of the velocity, or quantity of air, delivered. This is affected by the friction head, the decrease in the pressure of air current between the mine inlet and outlet. The total pressure required for circulating air is that necessary to overcome friction and produce velocity.

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[99] *Mining Engineers' Handbook*, 1055.
[100] Weigel, *Ventilating Equipment*, 18; Chance, *Methods of Mining*, 317-18; *Mining Engineers' Handbook*, 1050-51.
[101] *Mining Engineers' Handbook*, 1051.
[102] The planks used to construct the blades were one inch thick and seven and one-eight inch wide.
[103] Weigel, *Ventilating Equipment*, 20; *Bureau of Mines Reports*, 1896, 111-12.
[104] *Mining Engineers' Handbook*, 1031, 1033.

Ventilating pressure is measured by a "water gauge."[105] The water gauge is an open U-shaped glass tube partly filled with water. The tube is attached to a light wooden frame with a vertical scale between the legs of the U. One leg of the tube terminates in a horizontal brass thimble that is inserted in a hole in a partition between the intake and return airway and made airtight. The difference between water levels in the two legs, caused by the difference in air pressure on each side of the partition, is read on the scale. A low water gauge and a high volume of air indicated that the width of the airways was correct and that there was an economy in the expenditure of power. In the anthracite region the water gauge usually read between 0.25 and 6 inches. Chance reported:

> The water gauge (or in other words the ventilating pressure) rarely exceeds two inches. At a few collieries it runs up to three inches, but as a rule it is from half an inch to one inch and a half. The secret of the large quantity of air passed through some of the mines of the Wilkes-Barre district—two hundred thousand feet and more per minute—is in the small water gauge obtained by large airways, and the method now adopted at all collieries (when possible) of dividing the ventilating current into as many splits as possible.[106]

Centrifugal fans required from 3 or 4 horsepower for small fans working at the face to 300 horsepower for large fans ventilating a large coal mine. Because of their large diameter and slow rotational speed, Guibal fans were adaptable to direct engine drive. Anthracite engineers and mine superintendents preferred direct-connected engines to belts or gearing because of the latter's liability to breakdown. It was of great importance to have an engine that ran regularly without close watching and with little risk of breakage, and that could be quickly repaired or replaced in case of serious damage. In dangerous mines, two steam engines were sometimes installed with one kept in reserve for emergencies. A governor was recommended to regulate the speed in case an obstruction of the air current suddenly reduced the load on the fan.[107]

In 1883 George A. Parrish and W. B. Culver of Pittston manufactured the steam engine used to power the Guibal fan in the first Dorrance fan house. They also may have supplied the fan. An advertisement in the *Wilkes-Barre Record* (June 18, 1883) stated that the Pittston Engine and Machine Company manufactured direct-acting hoisting engines and ventilating fans up to 35 feet in diameter. The slide valve engine they delivered to the Dorrance Colliery had a single 30-inch by 60-inch cylinder with an 1896 Judson (Rochester, New York) governor added later. The engine was direct connected to the fan turning it 49 revolutions per minute and producing 180,501 cubic feet of air per minute. The fan ran twenty-four hours a day. Daily maintenance was minimal—checking and oiling the oil cups on the crossheads of the engine and the shaft bearings. On Sundays, a three-man maintenance crew gave the fan and engine a thorough review.[108] Maintenance and operation of the fan was critical; the safety of the 440 men working underground depended on its operation to provide fresh air and to remove dangerous, noxious gases.

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[105] *Mining Engineers' Handbook*, 1032. Chance thought water gauges were unreliable: "It is commonly placed in a hole in a stopping between the intake and return airway . . .and the hole luted with clay or otherwise made nearly airtight. Sometimes the stopping in which the water gauge is fastened borders directly upon the airway and in that case a current of air is flowing past, or directly against the mouth of the gauge, increasing or diminishing the reading by the suction or pressure due to the velocity. With very high velocities, this error may reach serious proportions." Chance, *Methods of Mining*, 324-26.

[106] Chance, *Methods of Mining*, 325.

[107] *Mining Engineers' Handbook*, 1055.

[108] Anthony Fluegel Interview, September 30, 1983. WHGS, Burt Logan.

In sum, the Dorrance Guibal fan was a large centrifugal fan with ten blades, an adjustable throat and point of cutoff, rectilinear backward sloping vanes and a double inlet. The Dorrance fan, like all Guibal fans, could move large volumes of air, from 100,000 to 300,000 cubic feet of air per minute. In engineering terms, the Dorrance Guibal fan had good efficiency, suitable for large volumes of air at medium water gages, from one to three inches. On account of its large diameter and slow rotative speeds the Guibal was adaptable to direct engine drive.

Patten's estimated cost of the 35-foot Guibal fan and fan house was $25,000, which seems a little high. The cost of fans varied, of course, with local conditions as well as with size, style and construction of course. In 1915, a 16-foot Guibal fan was estimated to cost from $2500 to $3500.[109] A 14-foot by 6-foot Guibal built by the J.W. Montgomery, Jeffrey Manufacturing Company in 1915 cost:

First cost, fob factory	$2500
Installation, with connection to mine	1800
Engine	1600
Engine house	600
Accessories (Installation of engine & connection)	500
Total	$7000

In 1889, a second ventilating fan was installed at the Dorrance No. 2 shaft.[110] This was a 30-foot diameter single-inlet Guibal fan with ten-foot blades that cost $14,187. This fan, too, was powered by a direct connected steam engine with a 30-inch by 60-inch cylinder. The Dorrance Colliery's two Guibal fans ventilated seventeen air splits in the underground workings. Together they circulated 312,000 cubic feet of air per minute (cfm) in the mine, providing an average of 700 cfm for each of the 440 men working in the mine.[111]

At the same time the colliery added a new device to supplement the water gauge in measuring the air pressure generated by the fan. The Mine Ventilation Law required colliery fans to have "recording instruments by which the speed of the ventilators or the ventilating pressure shall be registered for each hour, and such data shall be preserved at the colliery for future reference for a period of three months."[112] These were to give warning in case the fan ran too slowly and the ventilation became less than the minimum required. The Dorrance fans now used the newest machine available, a Williams' self-recording pressure meter and pressure alarm for mine ventilation. The Williams' self-recorder

> makes a record of all these variations and also by closing an electric circuit and ringing a bell or bells gives alarm when the pressure becomes lower than it is safe to have it. The bells are placed so that the engineer or officers can hear them. This instrument is preferred because

[109] *Mining Engineers' Handbook*, 1055.
[110] *Bureau of Mines Reports*, 1889, 104.
[111] *Bureau of Mines Reports*, 1902, 205; Baird, Statement of Important Matters, 272.
[112] *Bureau of Mines Reports*, 1891, 89.

> it records the essential part of the ventilation and gives alarm when this is dangerously affected. It needs no lubrication and very little attention, other than changing the chart once a week and winding the clock-work.[113]

This was the latest device on the market and its use at the Dorrance reinforces the impression that the Lehigh Valley management was attempting to secure the latest equipment.

Mine Expansion, 1890-1908. Good ventilation to provide fresh air, clear away dust and dilute or remove dangerous gases was particularly important in the Dorrance mines as the workings expanded. In 1894 the Pennsylvania state mine inspector offered a warning and praise, stating that the colliery's "workings across under the Susquehanna River are exceedingly dry and dusty. The greatest need for care is to prevent accumulations of fire damp, for a large quantity is unceasingly evolved, but in this they have hitherto been successful."[114]

The expansion of the mine during these years was impressive and gives an indication of the growing need for more ventilation. Between 1889 and 1908 the underground workings at the colliery included the Abbott, Bowkley, Hillman, Five Foot and Snake Island veins. In 1902 "A rock plane has been started, to be driven on on [sic] an angle of eighteen degrees, from the Baltimore to the five foot seam; plane is eight feet high and eighteen feet wide. A rock tunnel driven through the measures 372 feet long from the Hillman to the Abbott seam."[115] There were problems however. Gas accounted for 10 percent of the fatal accidents and 14.4 percent of non-fatal accidents in anthracite mines between 1890 and 1899. Gas was an even greater danger in Luzerne County and caused a higher percentage of the mine accidents in Luzerne County:[116]

1892	44.64%
1893	70.45%
1894	22.85%
1895	43.75%
1896	34.77%
1897	38.88%
1898	56.75%

A 1901 survey of the anthracite industry concluded that

> *In the Wilkes-Barre district, where a large quantity of gas prevails, the problem of securing proper ventilation is the most important one to be solved by the operators. Such a quantity of gas is met with here that two airways are sometimes opened, one on each side of the gangway, and, after they are driven, they are left for several months before chambers are opened, so as to drain off the gas.*[117]

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[113] *Bureau of Mines Reports*, 1891, 89-90.
[114] *Bureau of Mines Reports*, 1894, 131.
[115] *Bureau of Mines Reports*, 1901, 206
[116] Roberts, *Anthracite Coal Industry*, 162.
[117] Roberts, *The Anthracite Coal Industry*, 87.

These problems were found in the Dorrance mines. In 1901, when rock planes were being dug, the West Hillman plane gave off so much gas that it had to be closed until the intake airway was enlarged. The size of this enlargement is not stated but the shaft may have been expanded from 25 feet by 10 feet to 25 feet by 14 feet. When completed, the quantity of air at the face was increased from 55,000 cfm to 75,000 cfm.[118]

Despite the gaseous conditions, the development of the Dorrance mines continued and the work was impressive. In 1903 the Mine Inspector reported that the

> Hillman vein slope extended 654 feet into the basin forth of cemetery anticlinal. Tunnel finished from Abbott to Snake Island—Middle plane level. Tunnel commenced on Upper level to same vein. Tunnel is being driven from Hillman to Five Foot vein, 232 feet. New slope started from lower Bennett gangway to reach the basin below Slant slope. New inside slope started to work river warrant—Hillman vein. Preparations are being made and work started to sink main hoist shaft from Baltimore to Red Ash, also second opening rock slope for same. . . . New concrete cribs have replaced the old wooden ones in both hoist and ventilating shafts.[119]

In 1904 work included

> Baltimore shaft extended 100 feet, will be continued to the Red Ash vein; No. 13 rock slope for second outlet Red Ash development, extended 460 feet; No. 6 rock slope driven 350 feet through Mill Creek anticlinal,
> will be continued to Bennett vein basin; No. 9 slope in Bennett vein sunk 1,080 feet; No. 10 slope in Bowkley vein sunk 210 feet; No. 12 slope in Hillman vein river warrant extended 900 feet; No. 7 tunnel, Bennett to Cooper vein, completed, 115 feet; No. 5 tunnel, Hillman to Snake Island, finished, 125 feet; No. 8 tunnel, Hillman to Five Foot, completed 160 feet; No. 10 tunnel, second opening, completed 455 feet; No. 1 tunnel, Hillman to Bowkley, driven 165 feet and being continued to the Abbott vein; No. 13 tunnel, Hillman to Abbott, driving, 170 feet; . . .[120]

Similar work was reported in 1905, 1906 and 1907.[121]

Because of the gaseous conditions in the Dorrance workings, closed safety lamps were used in most areas. Existing airshafts and ventilating fans reached their limit and parts of the mine were closed.

> Owing to the large accumulation of gas in the Baltimore vein which the old fan was unable to pull out, the company found it necessary to stop work in that part of the mine until the new air shaft is completed . . . .[122]

A new airshaft and fan were needed.

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[118] *Bureau of Mines Reports*, 1901, 206.
[119] *Bureau of Mines Reports*, 1903, 277-78.
[120] *Bureau of Mines Reports*, 1904, 233.
[121] *Bureau of Mines Reports*, 1905, 245; *Bureau of Mines Reports*, 1906, 281; *Bureau of Mines Reports*, 1907, 217.
[122] "Big Fan Installed at Dorrance Colliery," *Wilkes-Barre Times Leader*, July 29, 1908, 1.

To deal with the problems, work began on a new 13 by 25 foot airshaft (No. 4) to the Baltimore seam in December 1907.[123] On July 28, 1908, the *Wilkes-Barre Record* reported that the shaft had reached 410 feet and was progressing nicely.[124] It had taken
4100 railroad cars to haul the 123,000 cubic feet of rock that had been hoisted to the riverbank where it was being used as fill. The newspaper noted that the contractor was pushing the work so that the company could mine coal from the Baltimore vein to supply the expected winter demand. A fire in the airshaft that October highlighted the problems faced by the company but did not halt work.[125] The shaft was completed on October 29—650 feet through solid rock. The Wilkes-Barre newspapers, in announcing the completion of the shaft, bragged that contractor Isaac Thomas, of Dorrenceton, had completed one of the "quickest shafting jobs on record."[126]

Dickson-Guibal Fan. With the completion of the No.4 shaft in 1908, the company added another fan.[127] A 28 feet by 7 ½ feet Dickson-Guibal fan and Corliss steam engine were installed over the new shaft to provide ventilation for the mine workings at the lower level.[128] The Dickson-Guibal was an all-steel double inlet centrifugal fan manufactured by Allis-Chalmers Company. Air drawn up the No. 4 shaft was divided by the brick air split and drawn in to the inlet on each side of the fan. The curved surface of the hub deflected the air into the blades where it was spun to the tips and up and out the stack. The Dickson-Guibal fan had twelve curved steel plate blades enclosed on the outside by annular steel disk or cheek plates. The blades were riveted at their center by two angles that connect them to the steel plate web fastened between the two halves of the double conoid of cast iron forming the hub. The inner corners of the blades were supported by round iron rods.

The single eccentric, four-valve Corliss steam engine that powered the fan had a 24-inch by 48-inch cylinder with a Judson governor. A Mine Inspector claimed that the Dickson-Guibal produced 300,000 cubic feet of air per minute (cfm) at three inches on the water gauge.[129] The inspector may have combined the ventilating capacity of two fans. A later reports state that the Dickson-Guibal revolved at 69 revolutions per minute and provided about 141,000 to 146,000 cfm.[130] Two fans operating, with a third in reserve, would have produced over 300,000 cfm.

Other major changes to the fan complex were underway.[131] In 1908 work began on a new fan house and drift in preparation for moving the1883 35-foot Guibal fan to ventilate the Hillman vein. During 1908 and 1909 concrete and steel supports were added to the No. 1, No. 2 and No. 3 airshafts. In 1909 the new fan house and airshaft were completed and the 1883 Guibal fan and steam engine were moved from the No. 1 airshaft to the No. 2 airshaft, its present location.[132] The new airway had a brick

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[123] "New Valley Shaft," *Wilkes-Barre Times Leader*, December 9, 1907, 13. This issue erroneously gave the dimensions as 13 by 40 feet. There seems to be a difference of opinion on the starting date for this shaft. The July 29, 1908 issue of the *Wilkes-Barre Times Leader* claimed work began four months previously—in April.
[124] "Big Fan Installed at Dorrance Colliery," *Wilkes-Barre Times Leader*, July 29, 1908, 1.
[125] *Wilkes-Barre Times Leader*. October 23, 1908, 12.
[126] *Wilkes-Barre Times Leader*, November 11, 1908, 12; *Bureau of Mines Report*, 1908, 220.
[127] *Bureau of Mines Reports*, 1908, 220.
[128] The patent numbers for the fan are 1,138,083; 1,166,659; and 1,781,166.
[129] *Bureau of Mines Reports*, 1908, 220.
[130] *Bureau of Mines Reports*, 1927-28, 131; *Bureau of Mines Reports*, 1929-30, 142.
[131] *Bureau of Mines Reports*, 1908, 220.
[132] *Bureau of Mines Reports*, 1909, 258.

air-split and large ventilating doors that could be opened or closed to direct air to one or both sides of the fan. Both doors could be closed, and airflow cut off, when the Guibal was held in reserve. The brick fan house had two small rooms or air locks to separate the fan room from the outside. Access to the fan, for oiling the bearings, was through the airlock. Airlocks were necessary because of the air pressure generated by the fan. The 1883 Guibal fan remained in operation until the 1930s when a new fan house and fan were installed. The 35-foot Guibal fan was then maintained in reserve for emergency use until the mine closed in 1959

After 1909 expansion of the colliery buildings and mines continued. A new boiler house, concrete hospital, powder house, engine house, and office building were some of the surface improvements. Underground work included new tunnels and rock planes, back silting of old workings began, and new headings.[133]

During this period, up to 1929, the Dorrance colliery had four fans, all Guibal fans; each fan was powered by a separate steam engine. One was 35 feet in diameter, two were 30 feet in diameter, and one (the Dickson-Guibal) was 28 feet in diameter: [134]

35 feet	49 rpm	180,522 cfm
30 feet		Emergency
28 feet	63 rpm	146,660 cfm
30 feet		Emergency

When one fan was on line, the other one was held in reserve. Once a week the auxiliary fans were tested and the primary fans were given a rest.[135]

It is clear from reading the statistics on mine disasters that these fans were needed. Of 109 mine disasters killing five or more miners between 1870 and 1950, gas explosions or mine fires caused 76.[136] Two of these disasters occurred at the Dorrance Colliery. On October 7, 1895, a fire boss leading mining engineers through abandoned workings with open flame lights set off an explosion that killed seven men. Thirty years later, on August 3, 1925, ten men lost their lives in an explosion.

Duplex Conoidal Fan. In the 1930s, expansion of the underground workings, and perhaps, the age of the Guibal fans, required additional equipment and modifications to the ventilating system. In 1936 a brick airway was constructed to connect both the Baltimore and Hillman fan houses with another fan house. Large ventilating doors on the west side of the brick ventilating shaft now blocked air from entering the Guibal fan and directed it up the airshaft to the new fan.

This New Fan House had a rectangular brick engine room and sheet steel fan casing and chimney. The fan house contained a 1936 Buffalo Forge Company single inlet Duplex Conoidal exhaust centrifugal

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[133] *Bureau of Mines Reports*, 1911, 282-83; *Bureau of Mines Reports*, 1913, 246-47; *Bureau of Mines Reports*, 1914, 254; *Bureau of Mines Reports*, 1915, 240.
[134] *Bureau of Mines Reports*, 1927-28, 131; *Bureau of Mines Reports*, 1929-30, 142.
[135] Communication from retired Mine Inspector Roger Howell, April 22, 1983.
[136] Untitled typescript mss., 1-3. Author's collection.

fan and Corliss steam engine.[137] The Duplex Conoidal fan differed from other centrifugal fans. It had a disk fan attached to the inlet to draw air into a centrifugal fan.

Propeller or disk fans have vanes (either plane or curved surfaces) set obliquely to the plane of rotation, like a windmill.[138] They generally have from 5 to 12 vanes, with the vanes set an angle of from 30° to 50°. The Dorrance Colliery's disk fan was fourteen feet five inches in diameter and had twelve sheet steel blades. The blades were fastened to a hub on the shaft and braced on the back to prevent deflection. The suction was created by the difference in pressure on the two sides of the wheel resulting from the change in the velocity of the air. The speed of rotation of disk fans, from 4 to 12 feet in diameter, was 4200 to 8000 feet per minute. Although considered compact and convenient, disk fans were not believed to be as efficient in producing pressure as centrifugal fans. Their efficiency was rated at between twenty and forty percent, although when work in producing velocity is included the efficiency may have reached 70 percent. In 1915 disk fans were chiefly used for low mine resistance, or in combination with a centrifugal fan like the Dorrance Colliery's Duplex Conoidal fan.[139]

Unlike the mine's centrifugal fans, disk fans, were placed directly in the airshaft. A brick wall, built up to the casing surrounding the disk fan's blades, forced the air current to pass directly from the airshaft through the disk fan. At the Dorrance Colliery the casing had a concrete base and sheet steel partition. Air pulled up the airshaft by the disk fan passed though a stator and into the Duplex Conoidal's six foot by twelve foot single inlet centrifugal exhaust fan.[140] The air was then vented out the chimney. Many disk fans did not have an expanding chimney to reduce the velocity of the discharge. This was not the case with the Duplex Conoidal fan. The fan house's sheet metal casing and expanding chimney were patterned on the Guibal design. With the completion of the New Fan House and installation of the Duplex Conoidal fan, the Dorrance Colliery fan complex was complete.

The history of the Dorrance Colliery mirrored that of the anthracite industry. The expansion of the colliery during the early 1900s kept pace with the growth of the industry as a whole. But problems were becoming evident. Although anthracite production reached a peak in 1917 when over 100 million tons was mined, bituminous coal and coke replaced anthracite as industry's fuel of choice by 1910.[141] During World War I, anthracite production could not keep up with demand and consumers turned to other fuels. The increased availability and low cost of oil, electricity and natural gas eroded the domestic market for anthracite. Even bituminous coal, despite its reputation as a dirty, inefficient fuel undercut the domestic market for anthracite because of its lower cost. Labor strife and prolonged strikes in the anthracite region during the 1920s added to the coal industry's problems. Anthracite production fell from 89 million tons in 1920 to 69 million tons in 1930. The decline in production continued during the Depression, hitting a low of 46 million tons in 1938. World War II brought a brief resurgence in anthracite production. Anthracite output reached a high of 64 million tons in 1944, but declined steadily when the war ended.

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[137] "No. 36 Super Duplex Mine Fan," Buffalo Forge Company Drawing A-65656, October 18, 1936.
[138] Weigel, *Ventilating Equipment*, 13-16; *Mining Engineers' Handbook*, 1057-58.
[139] *Mine Engineers Handbook*, 1057-58. See also U.S. Government, Bureau of the Census, Special Reports: William M. Steuart, ed., *Mines and Quarries, 1902* (Washington, D.C.: Government Printing Office, 1905, 295, 668-69.
[140] Patent numbers for the Duplex Conoidal fan are 1,138,083; 1,314,049; 1,166,659; 1,341,882; and 1,781,165. Information on the Dorrance Colliery Duplex Conoidal fan comes from field observations and Buffalo Forge Company blueprints A-65656 dated October 5, 1936 and October 18, 1936.
[141] *Bureau of Mines Reports*, 1961, 10-11.

Not only had markets for anthracite evaporated, the industry had turned from deep mining to strip, or surface, mining.[142] "By the 1950s the sight of weary, dirt-encrusted middle-aged men straggling home after a shift in the few working deep mines was already a curiosity."[143] In 1950 total anthracite production was 46 million tons; five years later it had fallen to 26 million tons.[144] The end of deep mining in the Wyoming Valley came at 11:42 AM on January 22, 1959.[145] Pennsylvania Coal Company miners working in the Knox Mine north of the Dorrance Colliery broke through the rock separating the mine from the Susquehanna River. Twelve miners lost their lives as water poured into the underground workings. Despite an effort to dam the flood, water soon inundated all of the mines of the Northern Field. Within one-week anthracite coal production fell 94,000 tons a week. The Dorrance Colliery closed its underground workings, as did all of the collieries in the Wyoming Valley. 7500 miners lost their jobs in the anthracite region. A year later, in 1960, anthracite production was less than 18 million tons.[146]

In 1963 the Lehigh Valley Coal Company sold the land on which the Dorrance Colliery stood to the Dorr Corporation for $104,000. Dorr was the real estate division of Pagnotti Enterprises, a mining company. [See Appendix II for description.] This deed conveyed to Dorr Corporation "all improvements thereon, including the breaker known as 'Dorrance Breaker', boiler house, other accessory buildings, and all equipment relating to same," including the fan complex. In 1983, as part of the settlement of overdue taxes, Pagnotti agreed to demolish the ruins of the coal breaker and other structures. A nursing home replaced the Dorrance Colliery.

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[142] *Bureau of Mines Reports*, 1961, 10-11.
[143] Miller and. Sharpless, *Kingdom of Coal*, 320.
[144] *Bureau of Mines Reports*, 1961, 11.
[145] George A. Spohrer, "The Knox Mine Disaster: The Beginning of the End," *Proceedings and Collections of the Wyoming Historical and Geological Society*, Vol. 24 (Wilkes-Barre, Pa.: Printed for the Society, 1984), 125-45.
[146] *Bureau of Mines Reports*, 1961, 11. In 1990 total anthracite production was a little more than 3 million tons of which only 415,518 tons came from underground mines.

APPENDICES

I. LEASED LANDS TRIBUTARY TO THE DORRANCE COLLIERY

Leased parcels which contributed to the Dorrance Colliery operation included the:

Miner, Kulp and Chase lease, acquired through the Wilkes-Barre and Seneca Lake Coal Company on January 2, 1871 and subsequently purchased on March 31, 1875. The land included 54.6 acres in the City of Wilkes-Barre and had an estimated 1,200,000 tons of coal. The annual minimum royalty was $5000 and
the lease ran to the coal was exhausted.[147]

Charles Dorrance, *et al* lease was acquired through the Luzerne Coal and Iron Company on March 16, 1871. The lease encompassed 487 acres in Kingston Township, Luzerne County with estimated coal reserves of 11,700,000 tons. The annual minimum royalty was $22,500. The lease ran to the exhaustion of coal.[148]

George H. Butler lease located in Kingston Township, Luzerne County. The lease was signed on April 11, 1881 for contains 39.1 acres with an estimated 1,100,000 tons of coal. The annual minimum royalty was $1000. The lease ran until the coal was exhausted.[149]

Emily L. Wright lease was dated July 1, 1882 for 168.5 acres in the Borough of Kingston. The coal reserves were estimated to be 5,300,000 tons. The annual minimum royalty was $16,825 and the lease ran to the exhaustion of the coal.[150]

Ruth Ann Conyngham lease was made December 26, 1882 for 37.5 acres in the City of Wilkes-Barre with an estimated coal reserve of 298,000 tons. The minimum annual royalty was $3000. The lease ran to the exhaustion of coal but only for coal above the Baltimore vein.[151]

Frank Heime lease was made on April 2, 1883 for 30.6 acres in Kingston Borough for an estimated 600,000 coals. The annual minimum royalty was $3115. There was no provision for cessation of mining.[152]

Mary B. Reynolds lease was made July 15, 1883 for 18.4 acres in the Borough and Township of Kingston with a coal reserve of 500,000 tons. The annual minimum royalty was $1825. The lease ran to the exhaustion of coal.[153]

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[147] Baird, Statement of Important Matters, 172.
[148] Baird, Statement of Important Matters, 175.
[149] Baird, Statement of Important Matters, 176.
[150] Baird, Statement of Important Matters, 181.
[151] Baird, Statement of Important Matters, 183.
[152] Baird, Statement of Important Matters, 177.
[153] Baird, Statement of Important Matters, 178.

Lawrence Myers lease was dated July 15, 1883 for 39.1 acres in the Borough and Township of Kingston. It had an estimated reserve of 1,200,000 tons. The annual minimum royalty was $4000. The lease ran to the exhaustion of coal.[154]

Charles D. Foster lease was made on February 1, 1884 for 9.3 acres in the City of Wilkes-Barre with an estimated 150,000 tons of coal. The annual minimum royalty was $1380. The lease ran to the exhaustion of coal.[155]

A. T. McClintock lease, March 1, 1889, was the renewal of a lease made on December 1, 1867; the lease expired on December 1, 1912 for one acre of land in the City of Wilkes-Barre with an estimated 25,000 tons of coal. There was no provision for a minimum annual royalty and the agreement ended on December 1, 1912[156]

L. D. Shoemaker lease was made on April 3, 1889 for 100 acres in the Boroughs of Dorranceton and Kingston for an estimated coal reserve of 3,200,000 tons. The annual minimum royalty was $10,000. The lease ran to the exhaustion of coal.[157]

Sarah H. Johnson lease was entered November 2, 1890 for 2.3 acres in the City of Wilkes-Barre with an estimated 38,000 tons of coal. The annual minimum royalty was $346.50. The lease ran to the exhaustion of coal.[158]

Charles D. Foster lease was made on November 26, 1890 for 1.5 acres in the City of Wilkes-Barre with 25,000 tons of coal. The annual minimum royalty was $255.75. The lease ran to the exhaustion of coal.[159]

Mary D. Derr *et al* lease was made December 28, 1903 for 1.8 acres in the City of Wilkes-Barre. No estimate of the coal reserves was made. The annual minimum royalty was $306. The lease ran to the exhaustion of coal.[160]

Wilkes-Barre Gas Company lease, dated December 15, 1904, was the renewal of a lease originally signed on April 1, 1869. The lease contained 4.5 acres in the City of Wilkes-Barre with an estimated coal reserve of 59,000 tons. There was no annual minimum royalty. The lease ran to the exhaustion of coal.[161]

Pennsylvania & New York Canal and Railroad Company lease, dated December 12, 1909, was for the coal in the old North Branch Canal from the City of Wilkes-Barre to Mill Creek, 16.2

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[154] Baird, Statement of Important Matters, 179.
[155] Baird, Statement of Important Matters, 184.
[156] Baird, Statement of Important Matters, 182.
[157] Baird, Statement of Important Matters, 180.
[158] Baird, Statement of Important Matters, 186.
[159] Baird, Statement of Important Matters, 185.
[160] Baird, Statement of Important Matters, 188.
[161] Baird, Statement of Important Matters, 187.

acres. No estimate of coal reserves was available. The Lehigh Valley Coal Company guaranteed payment of all taxes in lieu of royalties. The lease ran to the exhaustion of coal.[162]

Many of these leases were for small plots located in or near the City of Wilkes-Barre and the Dorrance Colliery. All those listed above were "tributary" to the Dorrance Colliery or the Dorrance and one of its sister collieries.

[162] Baird, Statement of Important Matters, 189.

II. DORRANCE COLLIERY DEED DESCRIPTION. SALE OF THE PROPERTY BY THE LEHIGH VALLEY COAL COMPANY TO DORR CORPORATION.

BEGINNING at a point in the low water mark of the Susquehanna River said point being a point in the easterly line of T. J. Rehrer (Charles Dorrance) River Warrant and being also the northwesterly corner of lands now or late of the J. W. Hollenback Estate and the northeasterly corner of premises herein conveyed; Thence along the line dividing lands of Hollenback, aforesaid and lands of grant South 39° 20' East 184 feet, more or less, to a corner said corner being also the northwesterly corner of Hollenback Cemetery and the northeasterly corner of Wilkes-Barre City Cemetery; Thence along the said lands of the City Cemetery South 35° 38' West 510 feet, more or less, to a point said point being also the northwesterly corner of City Cemetery aforesaid; Thence along said City Cemetery and along the center of a private road South 36° 52' East 912 feet, more or less, to a set stone corner in the westerly side of North River Street; Thence along North River Street South 52° 54' West 463 feet, more or less, to a point in line of the southerly side of Reichard Street; Thence along the southerly side of Reichard Street and premises conveyed to C. F. Goeringer and Rueben H. Levy by deed dated December 3, 1953 the following two courses and distances viz: North 56° 00' West 234 feet, more or less, and South 66° 50' West 423 feet to a point in line of lands now or late of Pennsylvania Central Brewing Company; Thence along said Pennsylvania Central Brewing lands and crossing Water Street and along lands now or late of Wilkes-Barre Gas Company, also crossing lands of the Lehigh Valley Railroad Company and lands now or late of Wilkes-Barre Railroad Company North 30° 20' West 585 feet, more or less, to a point at low water mark of the Susquehanna River being also a point in the easterly line of the T. J. Rehrer (Charles Dorrance) River Warrant; Thence along said River Warrant and the low water mark of the Susquehanna river the following five (5) courses and distances, viz: North 43° 23' East 32 feet, more or less, and North 27° 10' East 297 feet, more or less, and North 51° 30' East 528 feet, more or less, and North 23° 33' East 418 feet, more or less, and North 55° 30' East 174 feet, more or less, to the place of beginning; Containing 22.34 acres, more or less. BEING all or part of the following conveyances, Sarah A. Hunt et al to Lehigh Valley Coal Company by deed dated April 2, 1880, recorded in Luzerne County Deed Book 219, Page 42; William H. Sperring et ux to Lehigh Valley Coal Company by deed dated April 3, 1880, recorded in Luzerne county Deed Book 219, Page 46; Joseph H. Everett et ux to Lehigh Valley Coal Company by deed dated April 10, 1880, recorded in Luzerne County Deed book 219, Page 110; Alfred W. Fellows et ux to Lehigh Valley Coal Company by deed dated March 14, 1891 recorded in Luzerne County Deed Book 298, Page 503.[163]

[163] Luzerne County Deed Book 1515, 423-30.

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