

GAS LIGHT

BY FREDERICK MOORE BINDER*

DURING the period before the Civil War, material change in urban living was rapid. From the installation of central heating and plumbing in public buildings and private homes to the construction of waterworks, the metropolitan centers of the new nation threw off the attire of colonialism and clad themselves in the fashion of modern progress. Not the least of these civic improvements was gas light. The glow of whale oil lamps in street and dwelling was to become only a memory in the large American cities by the end of the Civil War.¹ Illuminating gas, made from large quantities of bituminous coal and carried through miles of pipe to thousands of private and public lamps, transformed the dark, sleeping cities into islands of light and activity.

The British led the field in this significant improvement. While the dull glow of New Bedford whale oil cast long shadows in Philadelphia's streets and flickered in common room and kitchen of her inhabitants, London boasted of four gas companies manufacturing the new light from British coals and supplying over sixty-one thousand private and seventy-two hundred public lamps. By 1832 the London Gas Light and Coke Company, consuming twenty thousand chaldrons of coal annually, piped its product through one hundred and twenty-two miles of main to furnish half of London's gas light.²

Near the turn of the century, in 1798, William Murdoch, after successful experiments with illuminating gas in his native Cornwall, was commissioned to light the Soho Works of Boulton and

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¹Fredrika Bremer, *The Homes of the New World; Impressions of America* (New York, 1854), I, p. 255.

²William Matthews, *An Historical Sketch of the Original Progress of Gas-Lighting* (London, 1832), pp. 143-146.

Watt.³ A few years later, in 1802, Europe witnessed public demonstrations of gas lighting when LeBon in Paris and Murdoch in London gave exhibitions of this new illuminant during the celebrations of the Peace of Amiens.⁴ In that same year a young Englishman, Benjamin Henfrey, who had emigrated to Northumberland, Pennsylvania, patented a method of making gas light and demonstrated his "thermo-lamp" in Baltimore, Richmond, and Philadelphia. He proposed to illuminate these cities as well as all the Federal lighthouses.⁵ LeBon had used wood; Murdoch, coal; Henfrey, coal and wood. Differing in the utilization of raw material, the experiments had one thing in common: they were regarded as impractical, and they collapsed as commercial enterprises for lack of financial support.⁶

These demonstrations, nevertheless, did succeed in stimulating further laboratory experiments here and abroad. In the United States David Melville of Newport, Rhode Island, produced "hydrogenous gas or inflammable air" from "pit coal" and burned it in a brilliant flame without smell or smoke.⁷ Melville persevered with his gas apparatus for nearly seven years, but, like Henfrey, was unable to convince anyone of its practicability. The distinction which Melville holds in the early American experimentation with illuminating gas is that he was the only one to manufacture gas directly and solely from coal.⁸ European methods of utilizing coal were familiar to scientists of this country, but the great commercial value of this mineral which abounded in the United States seemed to be unknown to most Americans. Dr. Thomas Cooper of Philadelphia had complained of this in 1816 in the following words:

Indeed, there is one reason for introducing gas light here which does not exist in England; in that country, the precious article coal, the foundation of all manu-

³ William Murdoch, "An Account of the Application of Gas from Coal to Economical Purposes," *Abstracts of the Papers Printed in the Philosophical Transactions of the Royal Society of London From 1800 to 1830* (London, 1832), I, 1800-1814, p. 295.

⁴ G. T. Brown, *The Gas Light Company of Baltimore, A Study of Natural Monopoly* (Baltimore, 1936), pp. 10-11.

⁵ Thomas Cooper, *Some Information Concerning Gas Lights* (Philadelphia, 1816), p. iii; *Eighth Census, Manufactures*, p. clxxii.

⁶ G. T. Brown, *The Gas Light Company of Baltimore*, p. 11.

⁷ *Niles' Weekly Register*, VI, May 21, 1814, pp. 198-199.

⁸ G. T. Brown, *The Gas Light Company of Baltimore*, p. 12.

facturing, is in universal use and esteemed as it deserves. Here, we know not yet its value. We do not use it all in the form of coak [*sic*] for our iron furnaces; we hardly know the use of it even for our steam engines; it forces its way very slowly into our stoves and houses; we use none of the coal for our vessels; and in fact it is to the generality of our people a substance whose great value is experimentally unknown. Whatever tends to bring it into public estimation will be a public benefit: for the seat of wealth and influence will ultimately be placed in every civilized country, there where canals centre and coals abound.⁹

Baltimore claims the distinction of being the first American city to build a gas works. Long familiar with James River and English bituminous, Baltimore, ignoring English methods, did not manufacture gas directly from coal, but from tar or pitch, the common distillate of pine knots. This procedure was patented in 1816 by Dr. Charles Kugler, a Philadelphia merchant and self-styled scientist. In this process, the melted pitch flowed into a red-hot retort and was reduced to its gaseous state.¹⁰ When used on a commercial scale the gas was piped from the retort to the storage tank or gasometer, which was little more than a great cup inverted over a tank of water. From the gasometer, the product was drawn off into the mains and found its way to the consumer. This method was demonstrated on a small scale at Peale's Museum in Philadelphia. That same June, in 1816, the Museum's famous collection of wonders moved to Baltimore under the direction of Rembrandt Peale, the son of Charles Willson Peale. Kugler's gas apparatus was offered again to the public, this time with spectacular success. Carbureted-hydrogen gas (methane) from wood tar caught the imagination of some prominent Baltimore citizens, among them the editor of the *Federal Gazette*, William Gwynn. Both Rembrandt Peale and Gwynn gave the demonstration considerable publicity. Within a week a small group of local capitalists had been induced to form the Baltimore Gas Light Company. City Council was petitioned immediately for a franchise and a contract to light the city with gas.¹¹

⁹ Thomas Cooper, *Gas Lights*, pp. vi-vii.

¹⁰ *Ibid.*, p. 139.

¹¹ G. T. Brown, *The Gas Light Company of Baltimore*, pp. 12-20.

During the first few years of its existence, the Baltimore Gas Light Company fought a losing battle for capital and a more satisfactory method for making gas. Tar had proven too offensive and costly. The combined filth, odor and pecuniary loss forced a reorganization of the company's stocks and physical plant. An English engineer designed new equipment and adopted bituminous coal as the raw material for the manufacture of the illuminant.¹² By the eighteen thirties the company was doing a profitable business and consuming large amounts of bituminous coal.

Philadelphia had watched the Baltimore experiment with interest and detached amusement. Not more than a year after the close of the War of 1812 a letter had been received by the city's government from a James M'Murtrie. Fresh from a sojourn in England, M'Murtrie claimed to have perfected an economical process for the manufacture of light from "stone coal gas." The City Councils appointed a joint committee of four to investigate "the effect and economy of gas-lights." The committee accomplished nothing, and by 1819 perished in official idleness.¹³ Philadelphia had resisted Henfrey, ignored Melville, rejected M'Murtrie and scorned Kugler. The Committee of Councils, moreover, seemed oblivious to Dr. Thomas Cooper's famous observations on gas light, which recommended Pittsburgh or Liverpool coal as the only raw materials for manufacturing pure, bright illuminating gas on a large scale.¹⁴

Meanwhile, New York and Boston, following Baltimore's example, had established gas works. New York experimented with several materials and had decided on rosin, the distillate of turpentine. Boston used imported soft coals, chiefly from England. Rosin gas was added to equalize the illumination as different kinds of soft coals yielded varying qualities of gas.¹⁵

For many years Philadelphia blinked in the reflections of her northern and southern neighbors. Not until 1833 was another committee appointed by Councils. Almost immediately opposition threatened to defeat the renewed efforts. Some contended that ex-

¹² *First Annual Report of the Trustees of the Philadelphia Gas Works*, 1836, Preface. Referred to hereafter as *Annual Report, PGW*; *Report to the Select and Common Councils of the City of Philadelphia by the Committee on Lighting the City with Gas*, 1833, p. 5.

¹³ *First Annual Report, PGW*, 1836, Preface.

¹⁴ Thomas Cooper, *Gas Lights*, p. 15.

¹⁵ *Report of the Committee on Lighting the City with Gas*, pp. 3-6.

plosions, fires, and loss of life would result from the use of dangerous "flammable air." Other citizens, aroused over the prospects of a "constant digging in the streets," contamination of water mains, and the pollution of the rivers from the residue of the works, argued that ". . . no reservoir will be able to contain the immense fetid drains from such an establishment, to the destruction of the immense shoals of shad, herring and other fish with which they abound."¹⁶ New Bedford whale oil interests baited the newly-formed committee with an offer to sell oil to the city on a five year contract for eighty cents a gallon, a price well below the market value. Public consumption of whale oil compared with private use was trifling. The Committee on Lighting the City with Gas interpreted the overture for what it was—an effort to halt the construction of a gas works—and promptly rejected the proposal.¹⁷

Protests of the Philadelphia citizenry were combated in a well-organized campaign. Fire insurance rates in New York, Boston, and Baltimore had not been raised for homes using the new illuminant. In fact, it was argued, gas light was far less dangerous than candles or oil lamps. Charges of explosion were scoffed at in testimonial letters from the mayors of New York and Boston. Philadelphians were invited to think hard on the great blessings of the new light in comfort, convenience, economy, and morality. For, in the last instance, it was not overlooked that public gas lights would aid the City Watch on its nightly rounds. The advantages of a gas works were crowned finally by the comforting opinion of leading medical men. Instead of becoming a menace to health, the fumes from the works ". . . would have a tendency to correct or destroy atmospheric miasmata [*sic*] which produces epidemic disease."¹⁸ Since this included the dread cholera, the committee must have felt that with this final stroke it had administered the coup de grace to further deprecation.

Bituminous coal was to be the source of Philadelphia's new light. A survey of the existing gas works in the East convinced the committee that soft coal was the most economical material available.¹⁹ One bushel of bituminous coal would yield one and a

¹⁶ *Ibid.*, p. 32.

¹⁷ *Ibid.*, p. 36.

¹⁸ *Ibid.*, pp. 29-30, 44-47, 49-50, 53-58.

¹⁹ *Ibid.*, p. 9. Cooper had said the same thing nearly twenty years before. Thomas Cooper, *Gas Lights*, p. vi.

quarter bushels of coke, one quart of tar, and four gallons of ammoniacal liquor, all marketable commodities. This was not all. The coal was to be Pennsylvania bituminous. Philadelphia's example would institute a great demand for Pennsylvania gas coals, internal improvements would be expanded, and great profits would accrue to the commonwealth and its citizens. The appearance of Pennsylvania economic sectionalism is not unusual, for this was an era of growing faith in the future of the state to become the fountainhead of American economy.²⁰ Editorials and articles written by Pennsylvanians indicate this belief, and one can find it reflected also in reports by the State Legislature. In 1832 the Pennsylvania House Committee on Agriculture digressed from its immediate province to say: ". . . And it is to the minerals, and particularly to her coals, that this state is to be indebted for that preeminence in wealth, population and power, which is to distinguish her future career."²¹ This faith endured throughout the middle period, but it was twenty years before western Pennsylvania gas coals would find the means of cheap transport and supply the markets of the seaboard.

The Committee on Lighting the City with Gas also had been carried away by its own optimism regarding the quick, profitable sale of the by-products of distillation. Coal tar and ammoniacal liquor were regarded as nuisances in England and on the continent until the sixties.²² There was little demand for coal tar in Europe until chemists developed "aniline colours," of which Perkins' Mauve, discovered in 1856, was the first. The Glasgow Gas Works poured coal tar over coke for more rapid combustion under the retorts. In England small amounts were used to preserve timber, or naphtha was extracted from it and applied as a solvent for India rubber.²³ American shipbuilders experimented with coal tar in place of pine pitch, but found it unsatisfactory as a waterproofing material. The market was so limited that the Philadelphia Gas Works stored much of it in large tanks in their yard to await new applications for this annoying by-product.²⁴ Small amounts of ammoniacal liquor or ammonia water were purchased by chem-

²⁰ *Report of the Committee on Lighting the City with Gas*, pp. 9-10.

²¹ *Pennsylvania House Journal*, II, 1832-33, p. 452.

²² George Lunge, *Coal-Tar and Ammonia* (New York, 1916), III, p. 1046.

²³ *Ibid.*, I, pp. 18-20.

²⁴ *Thirteenth Annual Report, PGW*, June 20, 1846, p. 6.

ists for practically nothing and used in the manufacture of ammonium chloride or sal-ammoniac. There was some information regarding chemical fertilizer in the late forties, and the liquor, when combined with sulphuric acid, yielded the compound, ammonium sulphate. It was not until after the Civil War, however, that ammonium sulphate was applied in large amounts as fertilizer.²⁵ It was true that coke, the third product of distillation, did have a market, but even this was limited for a number of years. Gas works burned much of it as fuel under the retorts to manufacture more gas, and the Philadelphia company noted that coke also was used to feed their office stoves and stationary steam engines. The rest was peddled in the open market at prices varying from six to twenty cents a bushel.²⁶ But coke competed with anthracite in the home and factory, and it was not sold in large quantities until its use in the iron industry was established in the eighteen sixties.

The year 1833 was one of investigation and persuasion during which the idea of a gas works was presented to the city. The following year the Councils appointed S. V. Merrick to visit London, the "Mecca" of gas light. A prominent engineer, Merrick, who later became President of the Pennsylvania Railroad, was instructed to tarry in Britain and then tour the continent. Paris, Brussels and Ghent were on his itinerary. Merrick compared the plants of Britain, France, and the new Belgium. He discovered that the continental works were of English origin and under English control.²⁷ When he returned to Philadelphia to design and build the gas works, Merrick corrected some of the construction errors he had observed in the foreign plants. Several years later, Merrick's successor, J. C. Cresson, visited England and reported, in a burst of civic ego and national pride, that the Philadelphia works were superior in engineering efficiency to those in Britain.²⁸

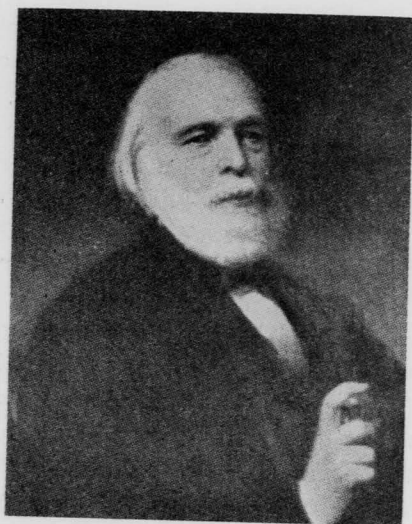
Bituminous coal was used in the British works. Merrick confirmed the committee's view that this was the only feasible and

²⁵ George Lunge, *Coal-Tar and Ammonia*, III, pp. 1045-1046.

²⁶ *Twenty-first Annual Report, PGW*, January 25, 1856, p. 10.

²⁷ *Report of the Committee on Lighting the City with Gas*, pp. 58-60 (from the *Report of S. V. Merrick on the Gas Works of Europe*, December, 1834).

²⁸ J. C. Cresson, *Report to the Trustees of the Philadelphia Gas Works*, August 8, 1845, p. 15.



SAMUEL V. MERRICK

*Courtesy the Philadelphia Gas Works,
Division of the United Gas Improvement Co.*

economical raw material for the manufacture of illuminating gas. A true son of Pennsylvania, he reported to Councils, ". . . that every material used in the fabrication of gas, will be the product of Pennsylvania labor," from the bituminous coal from which it could be made to the anthracite for heating the retorts and the lime for purification. ". . . And not a lamp will shed its rays over our streets," wrote Merrick, "which has not paid a tribute to the internal improvements of the state."²⁹ These bold, enthusiastic words indicate that Merrick was striving for effect and catering to Pennsylvania pride. A keen observer and competent engineer, he must have realized that anthracite would have been a costly fuel when the distillation of bituminous coal produced quantities of coke which could be used to heat the retorts in the common cycle of bituminous coal gas manufacture. Penned partially as propaganda, partially as prediction, the phrases were believed by many. The Philadelphia Gas Works was to be a proud monument to Pennsylvania resources and enterprise. Merrick, however, proved to be a false prophet. Although western Pennsylvania gas coals were given preference by the Philadelphia company

²⁹ *Report of the Committee on Lighting the City with Gas*, p. 61 (from Merrick's Report).

whenever possible,³⁰ high freight rates over the Public Works prohibited free use until the late eighteen fifties.³¹ Meanwhile, Virginia coal and later English bituminous were used.³² Cheap lime, derived from oyster shells raked from the beds of the Chesapeake or the shallow flats of the Delaware along the Jersey shore, furnished much of the purifying agent.³³ The fuel used to heat the gas coals was not Pennsylvania anthracite, but coke, the by-product of distillation of foreign or Virginia soft coals.³⁴

During the first fourteen years of its existence the Philadelphia Gas Works operated without Pennsylvania bituminous gas coals.³⁵ The valuable resource from the western part of the state had not found its way across the Alleghenies to the eastern cities in any appreciable amounts. Most of the coals used by the Philadelphia works to 1848 came from the Chesterfield mines of Virginia. New York, abandoning rosin, relied upon British coals which came by the "keel" as cargo equal to about twenty or twenty-four tons. The Brooklyn Gas Works by the mid-fifties was purchasing an estimated forty thousand tons of British coals per year.³⁶ New York supplemented her supplies with Virginia coals; and, when the Deep River mines of North Carolina were opened, some of this coal was shipped by way of Wilmington to the New York market.³⁷ Wilmington, North Carolina, seemed to ignore the gas coals passing through her port, and manufactured her illuminating gas from wood cut from the vast pine barrens of the Carolina coastal plain. The source was near and labor was reasonable. Wilmington, in the eighteen fifties, gloried in the title of the "cheapest lighted city in the United States."³⁸ About this time the Potts-

³⁰ *Eleventh Annual Report, PGW*, January 23, 1846, p. 10.

³¹ *Sixteenth Annual Report, PGW*, January 24, 1851, p. 17 (from the *Engineer's Report*).

³² *Thirteenth Annual Report, PGW*, January 20, 1848, p. 8; *Fourteenth Annual Report, PGW*, January 23, 1849, p. 6.

³³ *Fifteenth Annual Report, PGW*, January 18, 1850, p. 290; *Sixteenth Annual Report, PGW*, January 24, 1851, p. 16.

³⁴ *Second Annual Report, PGW*, January 19, 1837, pp. xix-xx; *Seventh Annual Report, PGW*, January 19, 1842, p. 4; *Eighth Annual Report, PGW*, January 19, 1843, p. 4; *Ninth Annual Report, PGW*, January 18, 1844, p. 217.

³⁵ *Sixteenth Annual Report, PGW*, January 24, 1851, p. 17.

³⁶ Notes: For the Executive Committee of the Westmoreland Coal Company, February 16, 1856, W. J. Palmer Papers, Colorado State Historical Society. A microfilm of this collection is deposited in the library of the Pennsylvania Historical and Museum Commission, Harrisburg, Pennsylvania.

³⁷ H. Waydell to W. J. Palmer, 1856, W. J. Palmer Papers, CSHS.

³⁸ *Miners' Journal*, July 2, 1853.

ville *Miners' Journal*, commenting on the cost of generating illuminating gas from pine wood, noted that a Washington dentist had taken out a patent which would light all the lamps in Norfolk for less than \$1 a night. This was to be commended, quipped the *Journal*, since it was even cheaper than moonshine.³⁹ Boston favored British and Nova Scotia coals, while some of the smaller eastern cities, among them Pottsville and York, Pennsylvania, Trenton, New Jersey, and Springfield, Massachusetts, used the more expensive rosin gas made from the distillate of turpentine.⁴⁰

The Chesterfield mines produced the best available Virginia gas coal. Since it varied in quality and was exceedingly liable to spontaneous combustion, it was considered inferior to the western Pennsylvania fuel.⁴¹ A shortage of Chesterfield coal in 1848 forced the Philadelphia company to buy large quantities of the higher-priced British bituminous. British Newcastle yielded nearly one-third more gas than Chesterfield, but the illuminative power was weak. Later a blend of Virginia, British bituminous, and cannel coals was tried with some success.⁴²

At mid-century the Pennsylvania Canal Commission reduced the rates on the Public Works, and Pittsburgh gas coals were shipped to Philadelphia for the first time in large quantities. More than half the coal used during 1850 came from the Pittsburgh beds. The native gas coal was put to use and carefully watched. Its high illumination eliminated the expensive addition of resinous material, but the company's engineer expressed disappointment in its other characteristics. The coke was not as free-burning nor the gas yield as large in volume as the British coals. Even so, it was the best coal used up to that time and the company deemed it prudent to secure as much as possible while the price remained reasonable.⁴³

The following year increased freight rates on the Pennsylvania Canal again interfered with the shipments of Pittsburgh coal eastward. The Philadelphia company reported to its stockholders, "The current trade on the State Canals not being favorable for obtaining large supplies of coals from Pittsburgh, very little has been de-

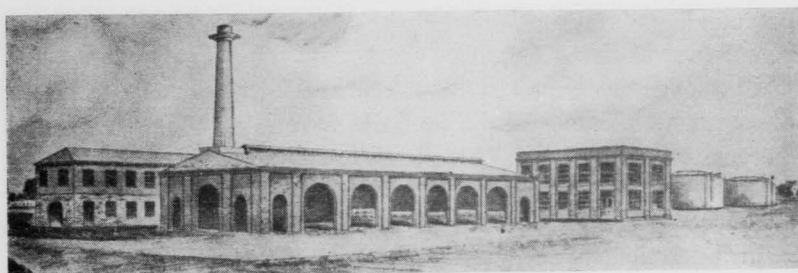
³⁹ *Ibid.*, March 5, 1853.

⁴⁰ *Ibid.*, March 16, 1850.

⁴¹ *Eleventh Annual Report, PGW*, January 23, 1846, p. 10; *Fourteenth Annual Report, PGW*, January 23, 1849, p. 8.

⁴² *Fourteenth Annual Report, PGW*, January 23, 1849, p. 9.

⁴³ *Sixteenth Annual Report, PGW*, January 24, 1851, p. 17.



MARKET STREET WORKS, 1835

Courtesy the Philadelphia Gas Works

rived from that quarter." A small amount was obtained, but Virginia and English coals once more made up the bulk of the gas works' purchases.⁴⁴ The company at this point seems to have abandoned hope that the superior Pennsylvania gas coal ever would become available in reasonable and dependable supply.

The growth of the Philadelphia company and consequently the consumption of coal had been little less than amazing. In operation only four years by 1840, the works supplied twenty thousand dwellings and seven hundred public buildings.⁴⁵ This was accomplished through the carbonization of less than five thousand tons of coal. By 1852 the Philadelphia Gas Works had become one of the largest, if not the largest, in the country, consuming over twenty thousand tons of coal annually.⁴⁶ Four years later this amount had more than doubled and was to redouble again before the end of the Civil War.⁴⁷ Twenty-five thousand tons supplied illumination for over two hundred thousand lamps in 1853. A decade later more than eighty thousand tons of coal were carbonized, and gas flowed through four hundred and fifty-one miles of main to furnish illumination for half a million lamps.⁴⁸

The price of gas to the consumer wavered between \$2 and \$3 per thousand cubic feet.⁴⁹ It would be unrealistic to suggest that the company, controlled by the City of Philadelphia since 1841, was

⁴⁴ *Seventeenth Annual Report, PGW*, January 29, 1852, p. 345.

⁴⁵ *Journal of the Franklin Institute*, XXXI, 1841, pp. 231-241.

⁴⁶ *Ibid.*, LV, 1853, p. 207.

⁴⁷ See *Annual Reports, PGW*, 1840-1865.

⁴⁸ *Twenty-ninth Annual Report, PGW*, January, 1863, p. 16; *Thirtieth Annual Report, PGW*, January, 1866, p. 16.

⁴⁹ See Sixteenth through Twenty-sixth *Annual Reports, PGW*, 1851 to 1861.

not making a profit. Nevertheless, during the fifties the officials complained of rising operating costs. Between 1852 and 1854 labor had increased its demands 18 per cent and bituminous rose in price 35 per cent.⁵⁰ Ammoniacal liquor and coal tar often went begging; whereas coke in Philadelphia as well as in New York, competing with the popular anthracite coal, found a slow market.⁵¹ The Philadelphia concern felt the rate pressures from the State Works and returned to the less efficient Virginia and more costly British coals. The latter soared to unprecedented heights during the Crimean War and the eastern gas works complained of the exorbitant British freight rates on coal. Now western Pennsylvania gas coal from Westmoreland County was greeted favorably, particularly in New York, provided it could be brought east by rail at reasonable rates.⁵²

Increased costs forced the Philadelphia firm to intensify its campaign against destructive spontaneous combustion which volatilized the coal stockpiles. At the same time the company began conducting experiments in efficiency to obtain the largest yield of gas and the greatest intensity of illumination with the least amount of raw material and labor.⁵³ Some consideration was given to a revived patent which produced "water gas" by applying steam to incandescent carbon. Dr. A. Gessner's discovery which generated illuminating gas from asphaltum was listed as an alternative. A French experiment with pure hydrogen and a platinum wick also was noted as a possibility. The company's engineer defended this novelty by remarking that it was not as "absurd and impractical" as the projects a year or two before concerning electric light.⁵⁴

Hard pressed during the Crimean War which placed them at the mercy of British carrying charges, uncertain of western supplies and disgusted with the low quality of gas coal from the South, Philadelphia seriously considered turpentine rosin or wood when obtainable at low price. A special apparatus was constructed from a "foreign patent." Wood gas was quite satisfactory, and it was found that under the control of the new retort one cord of ordinary fire wood gave off nearly twice as much gas as a ton of the best

⁵⁰ *Twentieth Annual Report, PGW*, January 25, 1855, p. 24.

⁵¹ *Seventeenth Annual Report, PGW*, January 29, 1852, p. 347.

⁵² Notes: For the Executive Committee of the Westmoreland Coal Company, 1856, W. J. Palmer Papers, CSHS.

⁵³ *Seventeenth Annual Report, PGW*, January 29, 1852, p. 347.

⁵⁴ *Ibid.*, p. 349; *New York Journal of Commerce*. Reprinted in *Cist's Weekly Advertiser*, February 13, 1850.

Pittsburgh coal.⁵⁵ The manufacture of wood gas at first was used to resist further increase in the price of coal.⁵⁶ But wood gas experiments continued and ten additional retorts were put into use in March, 1855.⁵⁷ By 1857 the engineer reported: "With the present relative prices of wood and coal in the Philadelphia market, the cost of making gas from the former is somewhat lower, but the difference is not sufficient to justify the immediate abandonment of the latter. Should a commercial change occur, by which the price of coals should be again advanced to the high point reached two or three years ago, there might arise important advantages to these works and its customers, from the ability to make the substitution of wood for coal."⁵⁸

Scientists in Philadelphia and New York had analyzed wood gas and had found its illuminating qualities equal to coal gas. The findings were not surprising, for the Philadelphia Gas Works was aware of three methods of gas manufacture. The first was from bituminous coal, employed by most large cities in the United States and abroad. The second, from wood gas, was used by several of the southern cities and by some towns in Europe. The third was the "water-gas" method in which steam was played upon incandescent carbonaceous material, such as turpentine rosin or coke. This latter method was still in the experimental stage, but it had been used in tests by the Northern Liberties Works of Philadelphia for a few weeks in 1860.⁵⁹ It was decided, however, that bituminous coal was still the most economical material to be used. Rosin cost no less and "water-gas" would need new equipment and perfection. Supplies of reasonably priced pine wood were even less reliable than bituminous coal as wood costs chiefly depended upon wages.⁶⁰

A basic force in the decision to continue to use bituminous was the increased supply of Pennsylvania western coals moving east over the Pennsylvania Railroad system. The City of Philadelphia, owner of the gas works, was a large stockholder in the line, thus freight rates could be discussed thoroughly under these circum-

⁵⁵ *Twentieth Annual Report, PGW*, January 25, 1855, pp. 4-23.

⁵⁶ *Ibid.*, pp. 23-24.

⁵⁷ *Twenty-first Annual Report, PGW*, January 25, 1856, pp. 17-18.

⁵⁸ *Twenty-second Annual Report, PGW*, January, 1857, p. 17.

⁵⁹ *Twenty-sixth Annual Report, PGW*, January, 1861, p. 18. (From the *Report of the Commission on Gas Works*).

⁶⁰ *Ibid.*, p. 19.

stances. Despite experimentation and investigation of other raw materials, western Pennsylvania bituminous, by 1858, not only had eliminated wood and "water-gas," but had replaced Virginia and British coals in Philadelphia.⁶¹

The Westmoreland Company, one of the great gas coal concerns, moved into the eastern market in 1855-56.⁶² On the eve of the Civil War this concern supplied fifty-eight gas works. Purposely seeking the eastern marts, it sent more coal to Philadelphia and New York than to Pittsburgh and the western cities.⁶³

With the beginning of the Civil War, Philadelphia made hasty purchases of foreign coal from the port of New York, since the city feared the curtailment of supplies caused by military demands on rail transportation.⁶⁴ The fears were unfounded, as western Pennsylvania gas coals continued to be moved into Philadelphia during the Rebellion. An inflated currency forced coal prices upward. In 1863-64 domestic bituminous was bringing \$11 to \$11.40 per ton, twice its usual cost.⁶⁵ The consumption of the Philadelphia works in 1864 had grown to ninety thousand tons, but even this amount, chiefly shipped from the Pennsylvania Gas Coal Company and Westmoreland mines, did not satisfy demand.⁶⁶

The story of the triumph of Pennsylvania gas coals in the eastern market is further evidence that transportation and utility do not exist in separate economic vacuums. The account of the Philadelphia Gas Works, while not intended to be interpreted as a conclusive example of utilization and experimentation, nevertheless can be employed as a model to show how American enterprise applied a basic resource to the material progress of the nation. In Pennsylvania the decade of the fifties was marked by an increasing number of requests for incorporation of gas works.⁶⁷ By 1862 the United States counted four hundred and twenty gas companies with a total capital investment of more than \$5,000,000.

It is obvious from the preceding pages that, although American

⁶¹ W. J. Nicolls, *The Story of American Coals* (Philadelphia, 1897), p. 354.

⁶² Coal Notes and Pocket Diary, 1856-1857, W. J. Palmer Papers, CSHS.

⁶³ *Twenty-seventh Annual Report of the Philadelphia Board of Trade*, 1860, pp. 117-118.

⁶⁴ *Twenty-eighth Annual Report, PGW*, January, 1862, p. 18.

⁶⁵ *Thirtieth Annual Report, PGW*, January, 1864, p. 4; *Thirty-first Annual Report, PGW*, January, 1865, p. 7.

⁶⁶ *Thirty-first Annual Report, PGW*, January, 1865, p. 7.

⁶⁷ See *Pennsylvania Senate Journals*, I, 1852 to 1855 and 1857 to 1860-1861.

gas companies burned large amounts of bituminous coals, not all their fuel came from the mines of Pennsylvania, nor has it been possible to determine exactly how much Pennsylvania gas coal was used by these works. On the other hand, it would not be an error to state that by 1860 Pennsylvania gas coals had begun to supplant foreign coals in the East and were firmly established in the Ohio and Mississippi valleys as well as in the Great Lakes region.

Pennsylvania gas coals found some competition in the West from Ohio, Indiana, and western Virginia bituminous, but as a source for illumination they were in great demand. During the drought of 1854 St. Louis found her stocks of Pittsburgh coal rapidly diminishing. There was little prospect of fresh supplies by water, and for a time St. Louis was plunged into darkness.⁶⁹ The St. Louis Gas Light Company purchased approximately fifteen to eighteen thousand tons of Pittsburgh gas coals annually.⁷⁰ The City of Pittsburgh maintained three gas works which had a combined yearly consumption totaling nearly twelve and a half thousand tons.⁷¹ From Cincinnati to Louisville, south to Memphis and New Orleans, and north to Chicago, Cleveland, and Erie, Pittsburgh gas coals found ready sale.

Pennsylvania bituminous coal, black brand or light, entered the urban centers of the United States and contributed to the welfare and progress of a youthful, energetic nation which, in its quest for convenience, comfort and material gain, successfully utilized one of the great treasures of nature.

⁶⁸ *Eighth Census, Manufactures*, p. clxxii.

⁶⁹ *Pittsburgh Gazette*, January 28, 1854.

⁷⁰ *Ibid.*, July 29, 1859.

⁷¹ *The Pittsburgh Quarterly Trade Circular*, I, October, 1857, p. 29.

RUSSELL J. FERGUSON

The Pennsylvania Historical Association has sustained a tragic loss by the death this past August of one of its most valued members, Dr. Russell J. Ferguson, Head of the Department of History of the University of Pittsburgh.

Dr. Ferguson was for many years one of the most active leaders in the management of the affairs of the Association. At the time of his passing he was serving as a member of the Council and as Book Review Editor of this journal. In the deliberations of the Association, Dr. Ferguson was always wise, practical, and farsighted. His enthusiasm and good humor, his sincerity and devotion to the historical interests of Pennsylvania, his scholarship and administrative skill will be sadly missed by his fellow-members. We remember him as one with whom it was always a pleasure to work; one who was always willing to give his energy and talent to advance the best interests of this Association; and one to whom we looked for leadership in the future. For the privilege of his friendship we are grateful. We can best honor him by our own increased application to the work of Pennsylvania history which he loved so well. To Mrs. Ferguson, who shared this interest and regularly accompanied her husband to the meetings of the Association, we extend our deepest sympathy.

PHILIP S. KLEIN