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**ONE HUNDRED YEARS OF  
AMERICAN COMMERCE**



*John Jay* —

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1795 - 1895

# ONE HUNDRED YEARS OF AMERICAN COMMERCE

CONSISTING OF

ONE HUNDRED ORIGINAL ARTICLES ON COMMERCIAL TOPICS DESCRIBING THE PRACTICAL DEVELOPMENT OF THE VARIOUS BRANCHES OF TRADE IN THE UNITED STATES WITHIN THE PAST CENTURY AND SHOWING THE PRESENT MAGNITUDE OF OUR FINANCIAL AND COMMERCIAL INSTITUTIONS

*A History of American Commerce by One Hundred Americans*

WITH A

## CHRONOLOGICAL TABLE

OF THE IMPORTANT EVENTS OF AMERICAN COMMERCE AND INVENTION WITHIN THE PAST ONE HUNDRED YEARS

EDITED BY

CHAUNCEY M. DEPEW, LL. D.

ISSUED IN COMMEMORATION OF THE COMPLETION OF THE FIRST CENTURY OF AMERICAN COMMERCIAL PROGRESS AS INAUGURATED BY THE TREATY OF AMITY, COMMERCE, AND NAVIGATION NEGOTIATED BY CHIEF JUSTICE JAY AND APPROVED BY PRESIDENT WASHINGTON IN 1795

IN TWO VOLUMES

VOL. I

*Illustrated*

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## EDITOR'S PREFACE

THIS volume illustrates the dignity of labor, the beneficence of liberty, and the triumphs of invention. It is an epic on the marvels of intelligent work. The wonders of the material development of the most remarkable of the centuries of recorded time are exhibited in this gallery of pen-pictures. They are the word-paintings of artists, each eminent in his own department of beneficent industry. It is an American story; but the United States is the most conspicuous illustration and example of the nineteenth century and its results. Peace and free institutions have furnished the opportunity for individual efforts. States constructed, cities founded, wildernesses settled, and vast populations prosperous in varied industries are the rich contributions of our country to the world's progress in the past hundred years. Capital and labor have caused and shared this creation of power and production, and this volume, which is an encyclopedia of industrial development for a century, written by business men, is appropriately dedicated to the business men of America.

C. M. D.

## PUBLISHERS' INTRODUCTION

THE evolution of an idea is always interesting. In submitting to the public this history of American commerce, an explanation of the causes in which it had its inception may most properly premise a review of the finished work. The present year marked for the oldest commercial paper in America, the "Shipping and Commercial List and New York Price Current," the completion of one hundred years of useful existence. In seeking some method of celebrating the centennial in a manner worthy at the same time of the paper and of the business interests of the country, the present idea was evolved. It was decided that in no better way could service be rendered to the American commercial community than by gathering together in compact form the interesting facts of its remarkable development. At first the intention was to present this history in a centennial edition of the paper, and upon this plan the work was begun. Then, as in the end, the plan contemplated the publication of one hundred chapters, written by one hundred men representing the great lines into which our trade and industries had been developed and specialized in recent years. The suggestion of such a work met with most generous welcome in the business world. Its need was recognized at once, and its novelty and value elicited eminent aid. The very success of the idea compelled the changing of the original plan. In the form of a newspaper publication the work would have lacked permanence and breadth of scope. It seemed almost unfair to interest representative men throughout the country, who would bring enthusiasm, ability, and experience to the work of describing the industries of the country, and then to place upon them limitations of space within which they could do justice neither to themselves nor to their subjects. Moreover, it was not solely as a newspaper centennial that the event was of importance; it had a deeper and more extended historical significance. Like the "Shipping and Commercial List" itself, the centennial to be celebrated was but the natural outcome of a great event in the history of our establishment as a nation.

In the year 1795 there was ratified by the Senate of the United States, and formally approved by President Washington, a treaty of amity, commerce, and navigation with Great Britain. This treaty, negotiated by John Jay, of New York, as envoy extraordinary, secured to this country a commercial liberty commensurate with its position of national independence, as recognized in the treaty of peace twelve years before. It conceded the actuality of the national existence, and implied conviction as to its permanence. Above all, it averted the almost certain disaster of a war, then imminent, between the two countries. The confidence it inspired in the business world by its recognition of this country as a treaty power, and

the immediate advantages it brought to our commerce, are shown in the fact that the foreign trade of the United States almost doubled in the single year following its making. Arranged at a time when the American people were smarting under a sense of bitter wrong inflicted by Great Britain, the many advantages obtained by the Jay treaty were not, at first, fully appreciated. Political partizanship attacked it blindly, and the great party then clamoring for an alliance with France denounced it fiercely. In its support, the calmer counsels of such great statesmen as Washington and Hamilton, representing the conservative and substantial elements of the nation, finally prevailed, and the treaty was adopted. Time has too fully demonstrated the wisdom of this action to make necessary a further discussion of the long-since-refuted arguments by which the consummation of the treaty was opposed. The era it ushered in was for the nation one of progress and prosperity unprecedented.

The opportunity to celebrate the centennial of our oldest commercial paper as well as that of our country's commercial progress naturally spurred us on to the highest possible attainment. It was determined to have nothing ephemeral or meretricious about the publication, and to make it, not a newspaper issue, but a standard book of reference, prepared under the best literary guidance and made with the best mechanical skill. The opportunity was in every way worthy of the undertaking, for in addition to the commemoration of commercial liberty there was demanded a permanent and authentic record of the results accomplished through this liberty. Properly produced, such a history of American commerce would not only do long-delayed justice to the memory of the patriots of one hundred years ago, but would appreciatively recognize the men who by their industry and genius have aided in the industrial advance of this country, and would provide for the present and the future a source of inspiring and stimulating knowledge of the grandeur of American achievement. It was to this end that this history of American commerce, as it now appears, was undertaken, and in this spirit the work has been carried on throughout. The incentive and the material were at hand, and the men whose influence had directed our commercial activities in the crowning years of the century were still here to aid in making the work authentic and complete.

These considerations were presented to Hon. Levi P. Morton, Governor of the State of New York, and to Dr. Chauncey M. Depew. Governor Morton at once accepted the assignment of "American Banking," and Dr. Depew generously consented to edit the entire work. From this time the success of the undertaking was assured. The merits of the plan impressed the leaders in other lines of industry, and the most generous coöperation followed. In choosing the men to contribute the various articles, the editorial committee, to whom was delegated the authority of selection, considered but one question: Was each fitted by ability and experience to represent the industry with which he was identified? No other question entered into the matter. Political considerations were especially avoided. The work was to be simply a magazine of facts collated by men who knew their significance, and made interesting with the vitality of actual experience,—a book about business, by business men, for business men,—a record of events in the departments of enterprise and production, with such reference to causes and conditions as should be necessary to describe intelligently those events.

If the need of such a history was understood before, it certainly became more impressive as the work upon the book progressed. For a century the commercial history of the United States had remained unwritten, and records such as the compiler of political and universal

history finds preserved for his reference, were not obtainable for a work of this character. They were scattered, incomplete and often conflicting, through every conceivable channel, from the old ledger entries of long-forgotten firms to the modern monographs in the files of periodical publications. The wisdom of dividing the work into one hundred chapters written by one hundred contributors now received corroboration anew. Upon no other plan could the data essential to the work have been gathered; nor by any other means could the publication have obtained that historical accuracy and standard of authenticity which a work of this kind must possess to have permanent value. No one historian, however industrious or versatile, could have written "One Hundred Years of American Commerce." Only by the coöperation of the leaders in every branch of industry treated could the desired results have been obtained, and it is here due to the writers of this book to state that, chosen as they have been from the ranks of the busiest men of to-day, they have still found time cheerfully and ably to coöperate for the patriotic purposes of this history of American commerce. In order that the reader may understand something of the plan upon which the work was written by these contributors, we quote from the first letter of suggestions sent out by the editorial committee in charge of the work:

"As to the character of the work. In the varied individuality of style, naturally resultant upon so many contributors, we hope to escape that dullness of machine-made history which keeps so many otherwise useful volumes unread. Therefore upon every contributor we would impress the fact that he should not sacrifice his personal style or preferences. It is not the encyclopedic knowledge of the pedant that the world wants to-day. It is the living acquaintance with men and things, causes and effects, that shall show what is and the promise of what is to be. The information that every successful man has of his own business is of greater value than the statistics of the records. In our work we desire to bring the man and the records together, and to have him show the meaning of the records in the light of his personal and practical knowledge. Is this to be a statistical or a descriptive work? is an important question that has been asked. Are the articles to be nearly all statistics, and is the progress in the various lines to be shown by figures or by words? The answer is that this is to be both a statistical and a descriptive work; but the statistics are to be subordinated to the description, or not used at all unless they are necessary to the description. Description without statistics would have no force; statistics without description would be meaningless to many. The union of the two in the hands of men who know the significance of the statistics they cite will give these articles their interest and weight. In dealing with branch or allied subjects pertinent to the article under discussion, contributors are recommended merely to summarize the cognate subject briefly and with special reference to its application. There are so many ramifications of every great industry that to attempt to follow more than the main story would be impossible. To conform to the centennial feature of the work, it has been decided to limit the number of chapters to one hundred. A history of 'one hundred years of American commerce, in one hundred chapters, by one hundred Americans,' has the ring of a slogan of success. And the men in charge of this work will keep constantly before their minds not only the making of the work, but the making it of such a nature that business men will not only *need* but *want* it. A strong, accurate, and true record, as well as an attractive one, is the aim."

The policy persistently observed has been studiously to refrain from interfering with either

the style or method of treatment by which each writer has stamped his own individuality upon his work. The editors have attempted no greater uniformity than that which was necessary to prevent extended and useless duplication in allied subjects. If, therefore, the reader of this book finds that its chapters are not always uniform in length or treatment, he is but noting the differences which must exist in literary work among one hundred men. In these very differences exists one of the most interesting and most effective phases of the history. In presenting the book herewith it is only necessary to add that each article bears the trade-mark of its quality in the signature of its contributor. When it is further recalled that actual personal knowledge covering from one half to two thirds of the century under discussion, and directly received but hitherto unpublished oral tradition concerning the remainder, are possessed by the majority of the relators, the present work has had sufficient testimony to its worth. The figures accompanying each article are such as are deemed the most authentic, and have been derived from every available source. In the frequent preference given to the reports of the United States census the writers have taken the stand that, however imperfect these may have been found in certain particular instances, they are still, taken collectively and with due regard to their official nature, the soundest basis for comparisons covering extended periods. Where particular trades have preserved their own records, and these have been considered reliable, figures have been based upon them, while in other instances special statistics personally compiled by the writer have been given. In all these cases the figures given are considered the most authentic by the writers, and this judgment by them must be the support for their accuracy.

The method pursued in dividing the work into its one hundred chapters so as both to comprehend and to distinguish all the great factors in the industrial activities of the country will be apparent upon examination of the Table of Contents. Beginning with great national interests, as banking and interstate commerce, the classification follows through the great corporate subdivisions of industry,—as the telegraph, ship-building, newspapers,—then through the products of the earth — as cotton, rice, and sugar — and our natural resources,— as mines, live stock, etc.,— and so on down through the long list of manufactures in which the genius of America has been shown, to the mercantile activities comprised under the various trades. The chapter numbered XCIX, "Other Industries," was introduced to provide representation for other more or less important industrial factors not elsewhere treated.

The editorial management of the history, under Dr. Depew, has been conducted by Mr. Thomas C. Quinn. Of the associate editors whose work deserves mention are Mr. Wesley W. Pasko, Mr. William Douglas Willes, and Mr. Charles Frederick Stansbury. Mention should be made also of the work of Mr. John Winfield Scott, whose wide acquaintance and patriotic labors did much toward making possible the final successful result. For the typographical excellence of the book-maker's art evidenced in this volume, credit is due to the De Vinne Press, to whose reputation for elegance and fine work little can be added. The art work of the history was placed in charge of the artist William C. Smith, of whose skill many of the portraits in this work give evidence. The engraving of the portraits drawn by Mr. Smith, as well as the reproduction of the other portraits, was done by the Gill Engraving Company. Words of recognition are also due to the L. L. Brown Paper Company, of Adams, Mass., for their care in the manufacture of the hand-made paper for the authors' edition of the history.

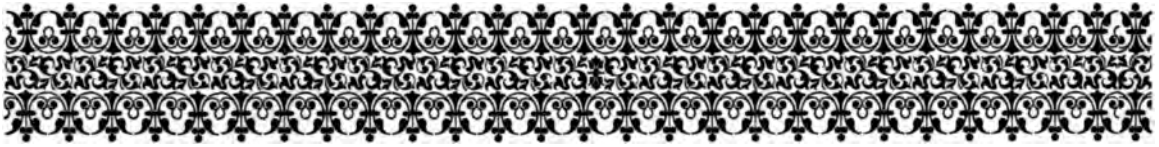
One result of the work upon this history which was not directly foreseen when the project was conceived has been the setting aside of December 19th as "Commercial Day," in honor of the centennial of American commercial liberty, and in recognition from year to year hereafter of the beneficent results of American industry and enterprise which this history of American commerce both demonstrates and commemorates. The idea of this celebration came to Dr. Depew through his editorial work on this history. His suggestion of Commercial Day has already been taken up throughout the country. The Chamber of Commerce and the Board of Trade of New York led off in the movement. In the resolutions passed by the Chamber of Commerce their leadership in the promotion of Commercial Day was most strikingly justified by allusion to the fact that it was the solid men of New York, as represented by the Chamber of Commerce one hundred years ago, who, uninfluenced by partizan clamor, came to the assistance of President Washington in securing calmer consideration for the Jay treaty. Commercial Day this year will be celebrated with a banquet in New York at Delmonico's, given under the auspices of the editors and contributors to this history of American commerce, and to which have been invited representative business men in all lines of industry and from all sections of the country. Chambers of Commerce and Boards of Trade throughout the country, following the example set by New York, will commemorate the day with appropriate exercises. From 1895, the centennial of American commercial liberty, will date Commercial Day, devoted to the interests of American trade and to renewing from year to year the vigor of our national patriotism and enterprise.

In the closing days of the work on this history the painful news of the death of Mr. Frederic Gunther was received. Only a few days before his death Mr. Gunther had revised the proof of his article on the fur trade for the history. This contribution from his experience will remain to testify to his ability and the success of his business career.

We must finally express our deep sense of obligation to the one hundred Americans who have coöperated in the production of this history, and to whose enthusiasm, experience, and ability it is a lasting monument. That our part has been done in a manner which shall be considered worthy of them and of the commercial interests of our country is the highest praise for which we hope.

THE PUBLISHERS.

December 10, 1895.



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## CHAPTER XLII

# AMERICAN GAS INTERESTS

**A** CENTURY covers, with some margin, the history of gas-lighting, not alone in the United States, but in the world. Late in the eighteenth century, William Murdock of England, and Philippe Lebon of France, investigated the possibilities of the manufacture and distribution of illuminating gas distilled from bituminous coal. To which of these investigators should be accorded the merit of priority in the application of coal-gas to domestic purposes is one of the questions over which English and French authorities are still disputing.

The first recorded instance of the illumination of a house by artificial gas reported in the United States fixes the date at 1806. In that year David Melville, of Newport, R. I., lighted his house, and the street in front of it, with gas manufactured upon his premises. This was one year before the first public gas-lighting in England, but it was four years after a display made at the Soho factory of Boulton & Watt, and nine years after William Murdock lighted his premises in Old Cumnock with gas of his own manufacture. Melville improved his apparatus from time to time, finally patenting it in 1813. He introduced gas for the lighting of a cotton-mill at Watertown, Mass., and of a mill near Providence, and in 1817 employed it in lighthouse illumination. From this small beginning the gas industry in America grew at first slowly, and later, with the development of improved apparatus and the acquirement of more accurate knowledge of the physical laws involved, much more rapidly. In 1816 a company was chartered in Baltimore, Md. In 1822 Boston adopted gas-lighting. In 1823 a company was organized in New York City. In 1825, Brooklyn, New York, and Bristol, R. I., were lighted with the new illuminant. In 1835 the New Orleans Gas-Light Company was chartered. These were the pioneer companies in the United States, and the number grew until in the year 1859 there were, according to tables pre-

pared by the "American Gas-Light Journal," 297 companies, with a capitalization of \$42,861,174, supplying a population of 4,857,000 through 227,665 private meters.

From 1860 the growth of the business has been rapid, until in 1895 the capital invested is, approximately, \$400,000,000, and the annual output is, approximately, 60,000,000,000 cubic feet, supplying a population of 24,500,000, in 885 towns. The number of plants named by the authority for the above data (Brown's "Directory of American Gas Companies") is 999. Thus in thirty-five years the number of companies has increased almost three and one half times, the population supplied five times, and the capital invested almost ten times. It is probable that the sales of gas have increased twenty times. It has been impossible to obtain a record of the total sales for an earlier date than 1890.

While it is not possible to state the number of premises at present supplied throughout the United States, an idea of the multitude of people who in their homes and places of business enjoy the convenience and security of this modern illuminant may be gathered from the fact that in 1894 there were 134,447 premises supplied in the State of Massachusetts; and in the city of Philadelphia, for the same year, there were 153,546 premises supplied. There can be little doubt that there are in the United States to-day nearly 2,000,000 premises supplied with gas.

The history of the gas-works in Philadelphia may be taken as typical of the history of the earlier plants erected to supply gas; and this plant, being operated by a city, has records which are available for the scrutiny of the historian. Apparently the earliest attempt to secure gas-works in Philadelphia was made in 1815, when it was proposed to manufacture gas from wood. This attempt failed. In the winter of 1826-27 there was a proposition made

to erect works and light the city lamps with gas. This plan also failed. There was at this time a strong opposition on the part of certain Philadelphians, many of them men of high standing, to the introduction of gas, it being claimed that there was danger to life, limb, and health from the erection of gas-works and the distribution of gas. It was not until 1835 that an ordinance for the construction and management of gas-works was passed. This ordinance provided for the issuing of stock to the amount of \$100,000. It was estimated that the lighting of the entire city would require 20,000 burners, consuming an average of four feet per hour each. The works were completed early in 1836, and in 1837 distributed 17,000,000 cubic feet of gas. The gas was made from bituminous coal, and 6816 private burners and 301 public lamps were supplied. The growth of the business is shown by the following figures:

PRODUCTION OF GAS.

YEAR.	GAS MADE. FEET.	NUMBER OF CONSUMERS.	PRICE PER THOUSAND.
1840.....	56,410,000	2,393	\$2.25
1850.....	182,016,000	9,216	2.25
1860.....	639,578,000	41,200	2.25
1870.....	1,241,485,000	66,943	\$2.55 and \$2.30
1880.....	2,173,010,000	99,035	2.00
1890.....	3,311,995,000	134,555	1.50
1894.....	4,110,401,000	154,743	\$1.50 (3 Mos.) and \$1.00 (9 Mos.)

In fifty-four years the sales have increased approximately seventy times, the number of consumers about the same, and the number of burners from 6816, as given above, to nearly 2,000,000.

The history of one of the earlier companies, the New Orleans Gas Company, shows a similar growth. In 1836 the output was 7,300,000 cubic feet at \$7 per thousand; in 1840 the business had grown to 20,075,000, at \$7 per thousand. In 1850 the sales were 53,562,000, at \$5; in 1860, 132,418,000, at \$4.50; in 1870, 238,468,000, at \$4. The panic of 1873 was very severe on general business in New Orleans, and a full recovery was not made until after 1880. The gas sales in that year were 230,296,000, at \$2.70. Between 1880 and 1890 the candle-power of the gas, which had, previous to that date, been about 16.5, was raised to thirty-three candles, and the consumption fell away until in 1890 it was 181,497,000 feet. This falling off is due to the great increase in the candle-power of the gas. In total illuminating value the gas sold in 1890 was equal to

363,000,000 cubic feet of the gas sold in 1880. The New Orleans Company is one of the few at present in the enjoyment of a legal monopoly.

The first movement toward furnishing a supply of gas to the city of Cincinnati was based upon a communication written by John Towne, a resident of Pittsburg, Pa., under date of September 7, 1827; but it was nearly ten years later—April 3, 1837—when seven public-spirited citizens procured a charter for the purpose of making and vending gas. Though they made active efforts to induce capitalists to advance the funds, and even secured coöperative pledges from the city, all their efforts were unavailing, and four years were consumed in fruitless endeavor. In the spring of 1841, a young Englishman, John S. Conover, appeared upon the field, and after much earnest effort induced the municipal council to pass an ordinance, on the 16th of June, 1841, granting to him and his associates the exclusive use of the city's streets for the purpose of laying mains, and also granting him certain contract privileges in the way of supplying gas to public lamps. He then purchased the charter of the company previously organized, and proceeded to comply with his contract obligations. While blessed with untiring energy, he possessed but little capital, and had a very hard time getting construction under way and fighting off the ceaseless attacks of councilmen. He finally assigned to John H. Caldwell, a capitalist of New Orleans, a half-interest in the undertaking, and with the capital advanced by Mr. Caldwell was enabled to turn gas into his mains on or about January 1, 1843. Two years later he died at Bedford Springs, Pa. John H. Caldwell then succeeded to the presidency and assumed the management of the company. The capital of the company was nominally \$100,000, though probably not half this sum had been expended in building the works and laying about six miles of mains. The price then charged for gas was \$3.50 per 1000 cubic feet. December 1, 1846, the price of gas was reduced to \$3, and January 1, 1854, to \$2.50. The company had, January 1, 1847, 546 meters and 192 public lamps in use, supplied through 32,487 feet of main pipe from two to eight inches in diameter. Dry meters were first introduced in July, 1847. By January 1, 1848, the number of meters was 738, with 289 lamps; and the largest "send-out" in one day, 88,600 cubic feet. Clay retorts, imported from Belgium, were introduced in December, 1861, and exhausters in October, 1863. The following table represents the growth of the enterprise:

## PRODUCTION OF GAS IN CINCINNATI.

YEAR.	CUBIC FEET.	CONSUMERS.	LAMPS.
1845.....	7,947,300	561	181
1850.....	33,039,900	1,593	486
1855.....	71,359,200	4,401	1,220
1860.....	157,216,200	7,560	2,102
1865.....	245,441,200	9,893	2,780
1870.....	355,449,000	12,247	3,328
1875.....	577,244,000	13,000	5,042
1880.....	518,336,000	13,828	6,957
1885.....	751,278,000	16,601	7,488
1890.....	1,076,780,000	20,978	9,676

The capital has been gradually increased, as extensions demanded, to its present requirements of \$8,500,000, with market value of \$17,000,000. The price of gas has been periodically reduced from the initial price of \$3.50 to the present price of \$1 per 1000 cubic feet.

Gas-lighting in the city of New York has increased at a rapid rate. Efforts to obtain accurate data from some of the larger companies failed to elicit a response. It is safe to assume, however, that the output for the year 1894 was, in round numbers, 12,000,000,000 cubic feet.

In the first days of gas-lighting in America the material used was almost exclusively soft or bituminous coal. In some Southern cities rosin and pine-wood were used, and during the war these materials were very largely employed in towns which were unable, owing to the blockade, to obtain coal. The gas made from soft coal had an illuminating value of approximately fifteen to seventeen candles, and was considered a brilliant illuminant in the earlier days, when comparison was made with whale-oil lamps and tallow dips. But the advent of kerosene-oil and the improvement in oil-lamps marked the commencement of an era of higher candle-power, and, by creating a new factor in the competition for urban lighting, promised to reduce the rapid growth of the gas business. While its convenience and safety would, in the face of any oil competition, insure gas a large share of the lighting business of cities, the quality of gas supplied in 1870 could not, at 1870 prices, compete on the basis of cost per unit of light with the oil-lamps of that day, and its value as a cooking and apartment-heating fuel had not been demonstrated. Its prospect was somewhat dimmed. At this crisis in its history a Frenchman, Tessie du Motay, and an American, Professor T. S. C. Lowe, of aeronautic fame, were independently experimenting in the manufacture of gas by the dissociation of steam in contact with incandescent carbon. The result of these experiments was the

development of the water-gas systems that bear the names of the distinguished inventors—the cupola-retort system of Du Motay, and the generator-superheater system of Lowe, the most important of all inventions affecting the manufacturing of gas. The experiments of Tessie du Motay, as well as of Lowe, were carried on in the United States, and the development of the water-gas system is purely American. The first plant of any magnitude under the Tessie du Motay system was erected for the Municipal Company, of New York City, by the Continental Iron Works, of Brooklyn, N. Y. Under this type may be included the Jerzmanowski and Wilkinson processes. In all processes of this type the non-luminous water-gas is generated in cupolas, carbureted with oil vapor, and passed through retorts externally heated, the gas thereafter being condensed and purified, as in coal-gas and other water-gas systems.

The Lowe process, covered by patents dated 1872 and 1875, may be regarded as the basis of the modern water-gas system. It covers, broadly, the use, in connection with a generator in which non-luminous gas is made, of a superheater, or fixing-chamber, fired by internal combustion, the combustible being the gases which are formed during the process of "blowing up"; that is, during and from the passage of air through the fuel in the generator. This air is blown through the fuel—hard coal or coke—at a high velocity, for the purpose of raising the fuel to a condition of incandescence, fitting it to dissociate the steam admitted during the gas-making period. The Lowe process further covers the introduction of oil or other enriching substances into the non-luminous gas, and the fixing of this oil by passage through the super heater. The first Lowe apparatus was erected at Phenixville, Pa., in 1873. A short time later one was erected by the inventor himself at Conshohocken, Pa., and a third, also by him, at Columbia, Pa.

The modern water-gas apparatus is undoubtedly the double superheater or improved Lowe, a development of the Lowe idea by the United Gas Improvement Company, the owners of the Lowe patents (now lapsed) for the greater part of the United States. Many modifications of each of the two water-gas systems have been made and patented by their inventors, but none of these have been of sufficient importance to command special attention or to overshadow the original inventions. After several years of neglect or bitter antagonism on the part of the coal-gas interests, the water-gas processes obtained a firm footing, and since 1880 the intro-

duction of water-gas has been rapid. In 1880 there were in operation approximately 12 plants of the Tessie du Motay type, and approximately 75 plants of the Lowe type. By 1890 the number of Du Motay plants in operation had grown to 30, and the number of Lowe plants to 260. At this writing it is estimated that there are in operation 40 plants of the Tessie du Motay type and its modifications, and 350 plants of the Lowe type and its modifications. There are about thirty-five companies operating water, oil, and combined plants of various forms, included in the above estimate. Every city in the United States of over 400,000 inhabitants uses water-gas, wholly or in part; and all but six of the cities of over 50,000 population by the 1890 census have water-gas plants.

It is to be noted that among the largest water-gas plants in the country are the Tessie du Motay plants in New York City and Baltimore, and the Lowe plants of Boston, Providence, Chicago, and the Twenty-fifth Ward Works, Philadelphia. It is probable that at this date seventy per cent. of the illuminating gas manufactured in the United States is water-gas, and by far the greater volume of this is made under the Lowe process. Among the modifications of the Lowe apparatus, but covered by the Lowe type, are the Granger-Collins, Hanlon-Leadly, Springer, Flannery, McKay-Critchlow, Martin, Pratt and Ryan. These are all of the generator-superheater type, variously modified according to the ideas of the inventors.

There are several points of advantage in the operation of a water-gas plant, each of which had its weight in the argument that finally persuaded so many coal-gas makers to adopt the water-gas process. In its influence on the extension of the use of gas, the particular point of advantage was the candle-power. Water-gas is sold of candle-powers varying from twenty-two, for a probable minimum, to thirty-five candles in Pensacola, thirty-three in New Orleans, and thirty in New York, with a probable average throughout the country of twenty-five to twenty-seven candles.

Americans are peculiarly fortunate in the quality of gas supplied them. There is probably not five per cent. of the gas manufactured and sold in England that is above seventeen candle-power, and some of the English companies are chartered to supply gas at as low as fourteen candle-power. When we remember that, with few exceptions, the large cities of this country are supplied with gas of above twenty candle-power, and that the far greater part of the gas supplied to them is twenty-five

candle-power and above, while, with rare exceptions, the smaller cities (above 25,000 inhabitants) are supplied with gas of twenty to twenty-five candle-power, we can see how much more illumination the American is getting per 1000 cubic feet of gas bought than is his English cousin. In the matter of impurities in the gas the American is equally fortunate. The English law allows twenty grains of sulphur in forms other than sulphureted hydrogen, and three grains of ammonia, per 100 cubic feet of gas. The average of sulphur per 100 cubic feet of gas sold in the United States is certainly not above twelve grains, and the ammonia may be truly said to be a mere trace. A long series of analyses, extending over a period of ten years, in one of the largest cities of the country, has shown the gas to contain, approximately, ten grains of sulphur per 100 cubic feet, with practically no ammonia. The superiority of American coals, and the pride that the American gas-engineer has in the quality of his product, are sufficient explanations of the smaller quantity of impurity in the American gas than in the English gas.

The development of the water-gas process came at a time peculiarly fortunate for the American gas industry, which was just then threatened, as stated above, by cheaper oils and improved lamps. A few years after the invention of the water-gas processes, and during their development, the electrician appeared on the field as a competitor for the business of city illumination. The effect of the appearance of the new light on the value of gas shares was disastrous. The general introduction of water-gas, however, checked the fall in prices and enabled the gas-man to hold his own. The high candle-power of the water-gas made it a cheaper illuminant, unit of light for unit of light, than the incandescent electric lamp; and while the introduction of electricity doubtless retarded the growth of the gas business, it did not succeed in reducing the sales, or even entirely stopping their extension. The fright that the electric light gave gas-men has resulted in good to the companies and to the consumer. Many gas managers believed that their sole refuge from the storm would be in the cultivation of other uses for gas than that of illumination. This idea resulted in the development of the gas-stove for cooking and heating, and of the gas-engine and many other mechanical devices for the utilization of gaseous fuel. This branch of the business has grown enormously within the last ten years, and there are now gas companies supplying, during portions of the year, fifty per cent. of their product for fuel purposes.

This is a field in which electric energy has so far been unable to compete; and the rapidity of its growth, past and present, indicates that it will soon be the larger branch of the gas business. In the field of illumination, electric invention and the improvement of oil-lamps have made great advances in the last decade, and have threatened again to give the gas industry a close fight for supremacy in this branch of its business. In this crisis, invention again helps the industry of which I write, making its method of illumination so much cheaper than the incandescent electric lamp or the kerosene lamp that it is apparently only a question of a brief period until—except for special work—gas will be used almost exclusively for illumination wherever gas mains are laid. This new factor is the Welsbach lamp, the invention of Auer von Welsbach, of Vienna. It develops an illuminating power of twenty candles per cubic foot. This means that five feet of the gas will give a light of 100 candle-power, making the illumination, from a given quantity of gas, from six to seven times greater than could be obtained with the best burners known to the art thirty years ago. The Welsbach invention has so cheapened gas-light that it may be said—on the question of cost per unit of illumination—that it has no competitor but the heavenly bodies.

The convenience with which the electric arc is lighted and extinguished gives it an advantage over gas, even with the Welsbach burner, for the illumination of streets, large railway-stations, etc.; but even in these places the Welsbach light is making progress in competition with electric light. The rapidity with which the use of this burner has grown within the past two years is one of the wonders of the history of gas-lighting. It is estimated that there are now in use, approximately, 1,000,000 Welsbach burners in the United States, and it is believed that the sales for the year ending June 30, 1896, will aggregate 1,500,000 burners.

For many years "gas logs" and gas-heating stoves have been in use in a limited way. Neither have met the popular requirement, either from an effective or an economic view. About 1890 a combination gas-heater and steam-radiator, the invention of Q. S. Backus, of Philadelphia, was brought to the attention of gas companies and the public. For three or four years it met with indifference, and in many instances open hostility, on the part of gas managers. During the past year, however, it has rapidly grown in favor, and at present the demand for these heaters exceeds the supply. It is by far the most economical of any of the inventions for heating

by gas that have yet been offered to the public of which the writer has knowledge.

The history of the gas-lighting industry in the United States would not be complete without a reference to the standing of the companies in the communities in which they operate, their relation to the municipalities, and the trend of legislation affecting them. In the early days of gas-lighting monopoly franchises were commonly granted to companies agreeing to stated and generally easy conditions. The industry was regarded as hazardous, and legislators, anxious to secure for their constituents the possible advantages of the modern system of illumination, found that capital could be tempted into the untried field only by the offer of a special concession. This ordinarily took the form of a franchise, exclusive for a term of years estimated to cover the time of development, and a period of profitable operation in which to earn interest on the investment for the life of the franchise. The right to use the streets and continue the business of supplying gas was not ordinarily made to terminate with the exclusive clause of the franchise. A few years of experience demonstrated the safe and profitable character of the business, and capital becoming more willing, legislation became more exacting. Exclusive franchises were less readily granted, and conditions as to price and quality and amount of investment were attached, and the right of municipalities to interfere in the conduct of the business of established companies was asserted. This tendency has grown with the century, until in its closing years exclusive clauses are almost unknown, and many Western cities are attempting to fix the price at which gas shall be sold within their boundaries. Franchises are now commonly granted for a term of years, the right to charter other companies being reserved, and conditions as to price and quality of the gas supplied being attached.

A number of attempts on the part of councils and legislatures to fix prices at which gas and electric light shall be sold and the business of the common carriers conducted have of recent years been the subject of judicial investigation and decision. The tendency of these decisions is to limit the power of regulation to the fixing of a reasonable rate, the adjective "reasonable" being construed to be a rate that should not result in the depreciation of the value of the property of the company affected. There is every reason to believe that gas companies, in common with railroads and other corporations serving the public, will be protected in their right to earn an interest that shall be commensurate

with the investment, and with the risks of the business.

Gas companies, because of their commonly enjoyed monopolistic privileges, either actual only, or actual and assured, and because of the fact that their commodity is taken as wanted from a maintained supply, and paid for after use, have been generally subjected to the suspicion of the unthinking, and charges of extortion have been common in the public prints. This feeling on the part of citizens and officials that gas companies were getting more than their deserts, and the belief that there are fabulous profits to be earned in the gas business, have resulted in some instances in the acquisition of gas property by municipalities. The example set by the city of Philadelphia, which in 1841 took over the gas-plant, and has since continued it as a branch of the city government, was followed later by Wheeling, W. Va.; Richmond, Va.; Danville, Va.; Charlottesville, Va.; and Hamilton, O.

The result of municipal ownership and management of gas properties has not encouraged other cities to acquire works. It has been amply demonstrated that it is better for the municipality and better for the citizens that the gas-plant should be conducted by private enterprise. With the single exception of Hamilton, O., there has been no recent instance of the erection or purchase of a gas-plant by a municipality in the United States. The Hamilton works were erected about 1890.

American gas literature contains but few books. The American contributions have consisted principally of papers read at gas association meetings. Many of these papers have been of the highest order, but for our more formal literature we have been dependent upon Europe. There are three periodicals devoted to the gas industry at present published in America. In the order of their age they are the "American Gas-Light Journal," of New York; "Progressive Age," of New York; and "Light, Heat, and Power," of Philadelphia. For the purposes of the American gas-man they are more valuable than the journals published abroad.

The commercial importance of the gas industry is indicated by the amount of money collected from sales of the products of gas-works. While accurate figures are not obtainable, enough information is at hand to indicate that the receipts for gas sold in the United States amounted in 1894 to between \$70,000,000 and \$75,000,000. It is probable that the receipts for residuals of gas manufacture amounted to an additional \$5,000,000, making the total receipts

for the products of gas companies \$75,000,000 to \$80,000,000.

In the first years of gas-lighting—indeed, up to about 1870—lime was the purifying agent of gas manufacture, to the exclusion of every other material. Since 1880, however, the use of oxide of iron as a purifying agent has become popular, and to-day it is probable that more than three fourths of the gas purification in the United States is effected with this material, with a reduction in the cost, and without the nuisance attending the removal of the spent lime.

The American gas business is to-day entirely independent of foreign countries. The New York Gas Company, incorporated in 1823, made its first gas from oil, using rosin later, and in 1860 was distilling English coals for the manufacture of its product. Most of the earlier companies imported the material from which their gas was made from England. Ultimately the opening of American mines furnished them with a bituminous coal that for gas-making purposes has no known superior. In water-gas manufacture America took the lead through invention, and will probably continue to hold it, because of the fact that the materials from which it is manufactured, anthracite and petroleum, found in the United States, are superior in quality to the products of any other country. Meters and clay retorts were originally imported from England and from the continent of Europe. At present American meters and American retorts have no superiors. For many years cannel-coal, for the enrichment of coal-gas, was brought from Scotland and Australia. Beds of cannel equal to any in the world have since been found in the United States, and cannel-coal has been shipped in quantity from America to Europe.

It cannot be said that the business of gas manufacture in America has been made by any man or set of men, or any corporation or set of corporations. Gas is peculiar in that it must be manufactured in the vicinity in which it is used, and, as a rule, local enterprise is responsible for the erection of the local plants. There has been, of late years, a tendency to the formation of what are known as "parent" companies; that is, companies controlling and operating a number of plants, situated in different parts of the country. Of these the best known are the United Gas Improvement Company and the American Gas Company. Such combinations of capital have in them nothing of the objectionable characteristics of the much-abused "trust." Prices cannot be kept up by such combinations. The gas for each city's

use must be made in, or close to, that city, and local conditions control the prices. The tendency to-day is toward further concentration in the ownership of gas properties, and there can be no reasonable doubt that such concentration as has taken place up to this date has resulted in good to the investor and to the consumer, chiefly through the introduction of improved processes and apparatus, and the employment of more skilful management.

This is intended to be a history; prophecy is foreign to the purpose of the publishers, and the limit set for the story of the gas business has been passed. Otherwise it would be interesting to speculate on the future of this great industry—the producer and the distributor of the cheapest lighting and heating agent of the present, and possibly of the future. After passing through the recent financial depression with practically no shrinkage in the volume of its business, it finds itself to-day in what

promises to be the most prosperous year of its existence, with new and superior appliances for manufacture and utilization to guarantee it a still more prosperous future. "More, better, and cheaper light" will be the demand of the dawning century; and, as in the nineteenth, so we have every reason to believe in the twentieth cycle, gas will fill that demand to the profit alike of its manufacturer and its consumer.

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*Emerson M. Miller*

