COKE

A TREATISE ON THE

MANUFACTURE OF COKE AND OTHER PREPARED FUELS

AND THE

SAVING OF BY-PRODUCTS

WITH SPECIAL REFERENCES TO THE METHODS AND OVENS BEST ADAPTED TO THE PRODUCTION OF GOOD COKE FROM THE VARIOUS AMERICAN COALS

BY

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PREFACE TO SECOND EDITION

The first edition of Coke was issued by The Colliery Engineer Company, of Scranton, Pennsylvania, in the year 1895 and was the first treatise on this growing and important industry published in the United States of North America. This edition was exhausted over one year ago.

In the great progress of industrial manufacturers so manifest in the United States, this interval of nine years since the appearance of the first edition has retired some of the former methods in the manufacture of coke, and introduced many new ones. This advance in the progress of the industry has been induced by the large increase in the demand for coke, arising from the expansion in the use of steel and iron in architectural construction, as well as in railroad supplies. In the manufacture of these materials, a pure quality of coke fuel is an imperative necessity, and with the consequent large demand on the best coking coal fields, it has become necessary to extend coking operations outside these fields to regions possessing coking coals of a lower grade, requiring, in most cases, cleansing from the two principal impurities, slate and sulphur, by the modern processes of crushing, classifying, and washing.

This necessary preparation or cleansing of coals for coking has been an inviting field for mechanical experts in which to devise machinery for this special purpose. It has also impressed the necessity for studying the several conditions in which these foreign matters are found in coals, so that proper machinery could be devised to meet the several conditions necessary for eliminating slate and sulphur.

This department of the coke industry has, during the past decade, made commendable progress, especially in the preparation of the coal for introduction into the washer, in disintegrating the lumps of coal to certain sizes, and in the classification of the crushed product as it is being conveyed into the washers. This important auxiliary in the manufacture of coke enables the lower qualities of coals to be utilized in the production of an acceptable metallurgical fuel.

In addition to this coal-cleansing auxiliary in the coke industry, an additional element has been introduced, meeting the conditions of some coals low in bituminous matter—dry coals—in a fairly satisfactory manner. These dry coals, low in fusing matter, could not be made to produce the best possible product in the usual open beehive coke oven. To meet these exceptional conditions, the retort coke oven has been introduced; it is made in several types, but the different types have one element in common—the retort or closed-chamber principle, which affords a quick heat and permits the utilization of the small content of volatile matter in these dry coals.

The large cost of these retort coke ovens, with the additional expense of the apparatus for saving the by-products of tar and ammoniacal liquor, has prevented their general introduction. In addition to the large cost of installation, a retort-oven plant requires a supply of coal for a long period to cover the investment in the plant of ovens. Only certain localities can assure this supply of coal, and unless the conditions of the manufacture will bear the railroad freight charges necessary to continue the coal supply, when it has to be obtained outside the immediate limits of the coke plant, a retort-oven plant is impracticable. In situations where water transportation can be secured, with its moderate freight rates, the coal supply can usually be secured for long periods.

The use of the by-product tar in roofing and other applications, with its anticipated use as a bonding element in the manufacture of briquets, will enhance the value of this by-product.

In the first edition, the conditions were submitted that compelled the writer, in 1875, then General Mining Engineer of the Cambria Iron Company, to the study of the physical properties of blast-furnace coke. At that time the blast furnaces of this company were supplied mainly by coke made from native coals in Belgian ovens located at the works in Johnstown. This home-made coke failed when the expansion of the steel industry required the smelting of the Lake Superior iron ores in the production of Bessemer pig iron. The furnaces became hot above and cool below, and the general manager, the late Hon. Daniel J. Morrell, requested an investigation of the cause or causes of the inefficiency of this coke fuel in the blast-furnace work.

Chemical analyses failed to disclose the trouble, as the native coke was found to be much purer than the celebrated Connellsville. This result came as a disagreeable surprise, causing a general search of authorities on fuels for light on this matter, but without helpful results. After a careful examination and study of the principal blast-furnace fuels, anthracite coal, charcoal, Connellsville and Johnstown cokes, it became evident that as chemical investigation had failed to disclose the value of these fuels, it must be determined by physical research.

In this investigation it became evident that two principal requirements were demanded in blast-furnace fuel: hardness of body and fully developed cellular structure; the first property to resist the dissolution of the fuel, in its passage down the furnace, from the attack of hot carbonic-acid gas, and the second to assure its rapid combustion and calorific energy in the melting zone of the furnace.

The hardness of the body of the coke was determined in the usual way. The cellular space was determined by accurately cutting inch cubes, weighing them dry and in water, and equating conditions to determine the cell space in the body of the cokes. The home-made coke was condemned from its lack of hardness of body, while the Connellsville became the standard of blast-furnace fuels from its hardness of body and full cell development.

The author believes that he was the first to originate this course of investigation of blast-furnace fuels. Some criticism followed the early results of these investigations, but the fact of priority in it has not been questioned. During the meeting of the American Institute of Mining Engineers, at Roanoke, Virginia, in June, 1883, Mr. Fred G. Dewey, Washington, District of Columbia, a representative of the National Museum, in submitting a paper on the "Porosity and Specific Gravity of Coke," said: "So far as I am aware, the credit of the first systematic investigation of the physical properties of coke belongs to Mr. John Fulton, Mining Engineer of the Cambria Iron Company."

In a recent publication on the chemistry of coke, being the "Grundlagen Der Koks-chemie" by Herr Oscar Simmersback, translated and enlarged by W. Carrick Anderson, M. A., B. Sc., of Glasgow, Scotland, it is submitted in the introduction: "Upon the physical properties of coke, experiments were carried out first of all by Americans. In 1875, John Fulton, then manager* of the Cambria Iron Works Company, at Johnstown, Pennsylvania, discussed the variable action in the blast-furnace fuels containing the same quantity of carbon. This variability he ascribed to the difference in their physical condition, anthracite, coke, and wood charcoal being, as he showed, characteristically unlike in structure." (Iron, 1884, No. 602; Berg-and Hüttenmannische Zeitung, 1844, p. 526.)

The author appreciates that in this wide field of research there remains very much to be disclosed, but he trusts that this contribution may be helpful, especially in a practical way, to those interested or engaged in this large and expanding industry—the manufacture of coke.

In the preparation of this second edition, the author has necessarily drawn from various sources, and due acknowledgment of such help has been given in the text whenever it has been possible to do so. He is laid under many obligations to the several publications of the United States Geological Survey, especially in the valuable "Twenty-Second Annual Report, 1900–1901, Part 3, Coal, Oil, Cement;" and to the very comprehensive annual volume, "The Mineral Statistics of the United States." Correspondence and requests with this important department of the government have always received prompt, accurate, and courteous responses.

*At the time noted above by Mr. Anderson, Mr. Fulton was the General Mining Engineer of the Cambria Iron Company; subsequently he became General Manager.

To Mr. James M. Swank, General Manager of the American Iron and Steel Association at Philadelphia, he is indebted for valuable statistics and helpfulness in the chapter on Briqueting.

Mr. J. V. Schaefer, formerly engineer of the Link-Belt Machinery Company, of Chicago, but now of the firm of Roberts, Schaefer & Co., Engineers, Chicago, Illinois, has contributed largely to chapter III, on the preparation of coals for coking, especially on the treatment in the Lührig washer.

Messrs. Stein and Boericke, Metallurgical Engineers, Primos, Delaware County, Pennsylvania, have contributed much matter on the treatment of coals by crushing and washing, in preparation for coking.

The Semet-Solvay Company, of Syracuse, New York, has contributed drawings and statistics showing the size, product, and cost of the Semet-Solvay retort coke oven.

Dr. F. Schniewind, of New York, has furnished many drawings of the Otto-Hoffman and other retort coke ovens and statistics of its work.

Mines and Minerals, a monthly journal, published by the International Textbook Company, Scranton, Pennsylvania, has been largely drawn upon for matter that has been used in several chapters of this edition.

Extracts have also been made from several volumes of the transactions of the American Institute of Mining Engineers.

Valuable help has been cheerfully afforded by the several inventors of coke ovens, disintegrating machinery and washeries, as well as from managers of coking establishments.

In the full chapter on "Briqueting in Europe and America," the reports of the United States consular service have been largely utilized in presenting and illustrating this young industry.

Sincere thanks are returned to the many others who have so kindly contributed to the matter in the pages of this second edition.

JOHN FULTON.

Johnstown, Pennsylvania, January 1, 1905.

PREFACE TO FIRST EDITION

The manufacture of coke in the United States of North America began in a feeble way with four small establishments in the year 1850. During the 30 years following, the progress of the industry was rather slow, but from 1880 to 1892 it made rapid advances, showing in the latter year 261 establishments, using 42,002 coke ovens and producing 12,010,829 tons of coke, valued at $23,536,141 at the ovens.

In the year 1869, coke outranked charcoal for use in blast furnaces; and in 1875, it surpassed anthracite coal. Since the latter date, it may be said that we fully entered into the era of coke. It is also evident that this coke fuel is destined to retain this leading place of usefulness in metallurgical operations, and its increase is destined to accompany the expansion of the iron and steel industries.

In considering the present condition and future requirements of the coke-making industry, with its paramount value in the manufacture of iron and steel, it appeared that a volume embracing the principles and practice of the manufacture of coke would prove of permanent value to those engaged in these correlated industries. Its publication is regarded as the more needful at this time on account of the efforts being made to introduce the modern types of retort coke ovens, with their auxiliary apparatus for saving the chief by-products—tar and sulphate of ammonia—from the gases expelled in coking, and thus supplementing the profits in the coke industry.

In the United States, the manufacture of coke has hitherto been confined mainly to localities affording the best qualities of coking coals. It required little skill to make excellent coke from such good coals, but with the large expansion of the production of coke, and the gradual exhaustion of the areas of the prime coking coals, compelling the use of the secondary qualities of coking coals, a thorough study of the merits of the several kinds of coke ovens now being offered is regarded of the most important interest.

In this volume, the papers on the manufacture of coke that have been published in The Colliery Engineer and Metal Miner, have been recast and carefully revised. They give the several methods of coking, with the results obtained, for the consideration of those interested in this industry.

The author feels that very much remains to be learned in this department of industrial art, but trusts that this initial volume will suggest matter that will lead to an accelerated advance in useful knowledge along the several sections embraced in its pages.

The work has been undertaken with a feeling of the difficulty of doing it the justice its importance deserves. But, in this respect, the author trusts that some truth has been gleaned under the conditions of the old adage that "necessity is the parent of invention."

In the 20 years' experience of the author, in his official position of General Mining Engineer and General Manager of the Cambria Iron Company, he has been required to study the manufacture of coke in its elements of quality and cost. The extensive operations of this company in the different sections of the Appalachian coal region, by several methods of coking, afforded desirable opportunities for investigation and for the comparison of results.

In the year 1875, the coke made at the works at Johnstown, in Belgian coke ovens, failed to meet the furnace requirements. The management requested an investigation of the cause or causes of the inefficiency of this fuel in blast-furnace work. It appeared at first to be an easy task to ascertain the nature of the defect or defects in this coke. It was assumed that a chemical analysis would disclose the whole matter, but, contrary to expectation, it did not; it showed the coke to be very pure, with much less ash than the Connellsville coke, and with marked exemptness from other injurious elements. The result compelled an expansion of the method of investigation, as the chemical method alone would not reveal the cause.

A study to devise a method for the physical examination of the coke was then entered upon, which, after many trials, resulted in developing a plan that disclosed the main cause of the failure of this coke for blast-furnace use—its want of the principal requirement, hardness of body. From the softness of the body of this coke, much of it was wasted in the upper section of the blast furnace by dissolution in the bath of the ascending carbon-dioxide gas, thus lowering the temperature at the zone of fusion, and disarranging the regular operations of the workings of the furnace.

These early methods of testing the physical properties of coke were very crude and open to criticism, but the urgency of necessity, it is believed, has ultimately disclosed accurate methods of determining the true value of coke for metallurgical uses, the practical results in furnace work sustaining the reliability of these determinations.

It has become evident in the manufacture of coke from the secondary qualities of coking coals, that from the nature of the requirements of quick and high-oven heat to secure the hardest-bodied coke possible from such coal, the retort type of coke ovens will have to be used.

It is confidently hoped that the plans and statements of the actual work of these retort ovens, with and without apparatus for the saving of by-products, will prove helpful in enabling the coke manufacturer to make intelligent selection and application of the special type of oven best adapted to assure the best coke from the coal used in its manufacture.

Very much care has been given to the consideration of the best modern methods in the preparation of coals for coking, especially to the process of crushing and washing, for the elimination of slate and pyrites.

In the preparation of this work, the author has necessarily drawn from many sources, and due acknowledgment for such help will be given when possible to do so. He is laid under many obligations to Mr. Joseph D. Weeks, of Pittsburg, for extracts from his admirable reports for statistics of the manufacture of coke, and for the results of his recent visit to Europe. Mr. Walter M. Stein, metallurgist, Philadelphia, agent for the Siebel retort coke oven, has kindly contributed many papers on plans and work of coke ovens. Dr. F. Schniewind, of Cleveland, Ohio, agent of Dr. C. Otto & Co., has generously contributed very full information of the plan, cost, and work of the Otto-Hoffman oven. Mr. W. B. Cogswell, general manager of the Solvay Process Company, of Syracuse, New York, has kindly contributed plans and results of the working of the plant of Semet-Solvay coke ovens at his place.

The author is also placed under renewed obligations to Sir Isaac Lowthian Bell, of England, for plans of his Browney coke ovens, and for his admirable method of testing the resistance of coke to the action of carbon dioxide.

Mr. Henry Aitken, Falkirk, Scotland, has kindly contributed his plans and studies in his methods of saving by-products from beehive ovens.

The "Mineral Statistics of the United States," by Dr. David T. Day, of Washington, District of Columbia, has afforded much help in many ways; as have also the works of the Second Geological Survey of Pennsylvania, by Prof. J. P. Lesley, State Geologist, and his able assistants. Many valuable extracts have been made from the several volumes of the transactions of the American Institute of Mining Engineers.

Sincere thanks are returned to the many others who have so kindly contributed to the matter in the pages of this volume.

production since the ovens started working. At the Hanover colliery, Doctor Kassner, Doctor von Bauer, and others, are of opinion that this excess in the yield is due to the precipitation of volatile carbon, which is absorbed by the glowing coke in the last stages of the process. Notwithstanding the experiments of Kassner, many are skeptical on this point, and further investigations are to be made. The fact of this excess of the yield above the estimate is, however, well established.

The advantages claimed for these coke ovens are the surplus of gas unconsumed, the smaller space that they occupy, the low working expenses, and the absence of any smoke.

Lowe Coke Oven.—In response to a request for information about the Lowe oven, the following has been received from the inventor, Mr. T. S. C. Lowe:

NORRISTOWN, PA., July 14, 1903.

MR. JOHN FULTON, 136 Park Place, Johnstown, Pa.

Dear Sir:—Your letter of June 26, to Mr. Herbert Cutler Brown, of Los Angeles, has been sent to me with the request to write you concerning my new system of coke and gas production, and it gives me much pleasure to send you herewith an article recently published in the Progressive Age.

I have been much interested in your former publications, and if possible would be glad to furnish you with accurate tests of my system, but so far there have only been experimental plants built, the most important being that of the Jones & Laughlin Steel Company, and unfortunately it will take a longer time to get accurate information from that source than you will probably have before issuing your proposed publication, for the reason that it has been found necessary to let down heats to arrange some parts of the apparatus, increasing flue space and stack draft, as well as to arrange to prevent the indrafts of air caused by warping of door and other frames of the outer casing. This is easily done, as soon as they can shut down the ovens long enough to do the work.

These first ovens have been in operation 3 months, and it is desired to continue them, since it serves to give them information as to all the parts that are found defective, as you know in all new matters something will arise that can be bettered. The principle, however, works perfectly, and cannot be improved on, either in the production of a superior quality of coke, or the saving of the gases.

In about 2 weeks from now, however, we shall start up a new plant better arranged for making tests, at Rockaway Beach, Long Island, and if you think that your work will be delayed long enough, I shall be pleased to send you an invitation to go and see this plant operated, for I am sure it would be an interesting feature for your book, and afford just the information that is now needed more than ever concerning the production of metallurgical coke and gases suitable for open-hearth steel work, power, etc.

Very sincerely yours,

T. S. C. LOWE.

New Lowe Coke-Oven and Gas-Making System.*—This new process of gas making has now passed the experimental stages, and it is a proved fact that a superior, hard, heavy, smokeless fuel, fully equal to the best anthracite, can be made in any locality in the

*By John Haug in the Progressive Age, April 1, 1903: further information upon this new process will be furnished by the author at or from his office, 536 Bourse Building, Philadelphia, Pennsylvania.

world, from cheap soft coals, and while doing this a larger volume of gas is saved than by any process heretofore practiced. This coke, sold under the name of "Lowe anthracite," has been tested for all purposes for which anthracite has been employed, and in no instance has it proved inferior, but in many cases far superior to the natural anthracite. To devise a system to accomplish this has required, on the part of the inventor, an immense amount of work and study and the possession of an unusual amount of scientific knowledge. To create a perfect system required, first, a thorough study of the older methods. The old beehive system was found to produce a good hard metallurgical coke, but, as a rule, the yield is only from 50 to 60 per cent. of the coal employed, all the rest going off in volatile form. It was noticed that, when care was taken to admit air in the best proportions for securing high heats, the coke was harder and better and the yield of that oven was greater than when this care had not been exercised. The reason for this slight increase in the weight of coke was found to come from the deposit, on the upper portions of the charge, of carbon dissociated by the high temperatures from the heavy hydrocarbons. Under the best conditions of beehive coke making, more than 50 per cent. of the combustible gases escape from the tunnel head of the oven unconsumed, which of course accounts for the immense volume of black smoke always arising from coke ovens operated in this way. It was this knowledge of what was going on at the different stages of coking under this system, as well as the knowledge of what kind of coke would give the best results in blast furnaces, cupolas, and for domestic and other uses, that showed the necessity of a radical change in this most important line of industry.

Without going into the various stages of how he arrived at his final conclusions, it is evident that Professor Lowe has devised a system of coke and gas making that is of considerable interest.

The first requisite was to retain all the valuable features of the beehive ovens, whereby the coal is coked by reflected heat from the arches of the ovens; second, to maintain continuously the highest possible degree of heat that the best brickwork would stand without injury, that all of the heavy hydrocarbons might be deposited in solid form during their passage upwards and through the hottest part of the coke; and third, to save all combustible gases not needed in keeping up the necessary heats.

If fairly good coke could be made in the old way without actually burning more than half the gases arising therefrom, it was certain that, with a properly constructed apparatus by which the ovens are never cooled while charging coal or discharging coke, and where the air admitted for burning gases comes in at from 2,000° to 3,000° temperature instead of cold air as in the old system, it would be easy to figure that a much larger percentage of the gas arising from the coking coals could be taken away unburned, and either enriched and sold as illuminating gas or employed for metallurgical heating and power purposes without carbureting. But this required an entirely new construction, and the plan was adopted which resulted in the ovens being heated by internal combustion taking place directly over the coal to be coked.

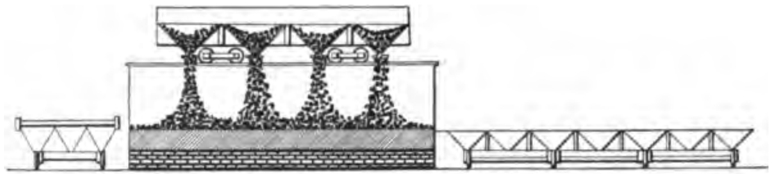
In following out this idea, Professor Lowe has devised a series of ovens *a* built within a single steel casing, all having connecting flues *b*, with large regenerator chambers *c* at each end of the battery of ovens, and also a steam generator *d* and stack *e* at each end connected by flues *f* and *g* to the superheaters, as shown in Fig. 31.

To properly heat a large plant under this system requires about a week, but after the heats are once established the operation is very simple, and, so far as the brickwork and apparatus generally are concerned, there is no reason why they should not last 10 to 15 years without repairs. Blast furnaces often run from 7 to 10 years without closing down for repairs, and their work is much more severe than that of coke ovens.

Under Professor Lowe's system, a much deeper charge of coal is thoroughly coked in 24 hours than in the beehive oven in 48 hours.

From four to twelve of these ovens are built in each battery. Therefore, in a four-oven plant, one oven is discharged and recharged every six hours; in a six-oven plant, every 4 hours; in an eight-oven plant, every 3 hours; and in a twelve-oven plant, one oven every 2 hours. The greater the number of ovens in one battery, up to eight or twelve, the more evenly are the heats maintained, although most excellent results have been obtained in a four-oven apparatus.

In order that the reader may understand how the gas is saved by this system when it is impossible to do so in the beehive oven, we would state that the heating of the Lowe ovens and taking off gases therefrom are alternating operations, while the coking process is continuous. The gas arising from the coking coals is burned under the arches of the ovens and over the coking coal, by the admission of the highly heated atmosphere from one of the regenerators, say, for 30 minutes, and the combustion of these gases is completed while passing from the last oven into and among the brick checkerwork of the regenerators at the other end, and the last heats are taken up while passing through open iron checkerwork in entering the stack, say, for 30 minutes; then the stack valve is closed, and water being sprayed over the piled cast-iron work, large volumes of steam are generated, which, while passing through the checkerwork brick, is so highly superheated that it does not in the least check the coking operations of the coal; and while this steam passes along from one oven to another through the series of flues, it not only carries with it the volatile hydrocarbons being given off in immense quantities, but the steam itself is decomposed while coming in contact with the heavier hydrocarbons and the flocculent carbon in the form of lampblack or soot, when passing through the highly heated brickwork.



Cross-Section

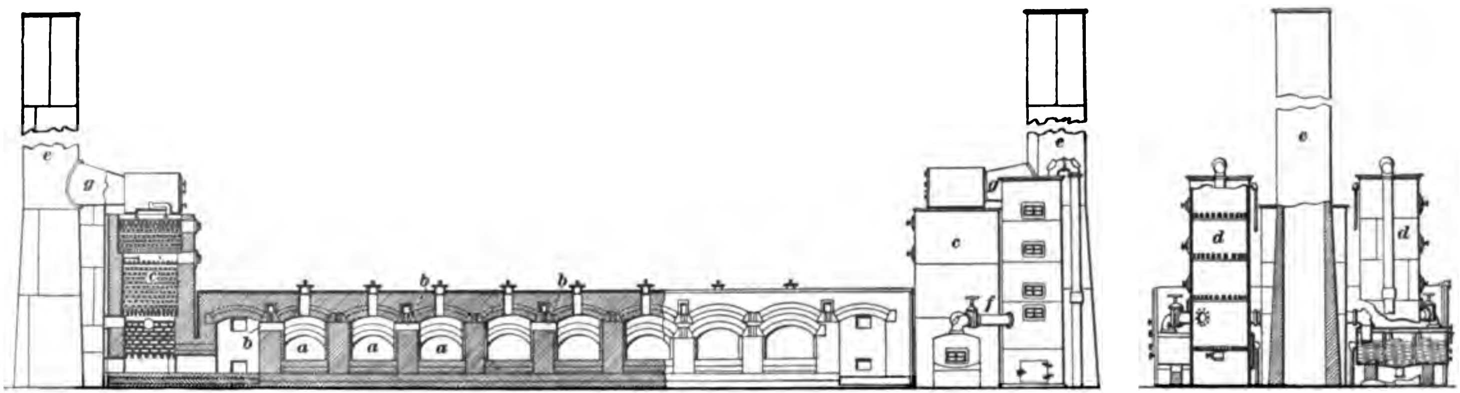


Fig. 31. Longitudinal Section Through Ovens, Regenerators, and Stack, With Cross-Sections Through Oven Showing Charging Hoppers

It is believed that in the larger batteries of ovens, for every 30 minutes the gas is burned in the ovens, the gas-recovering period can be extended to 40 minutes; thus, over 57 per cent. of all the gas arising from the coking coals is saved, in addition to all the water gas that the more solid and condensed portions will produce by their admixture under these high heats, leaving no tar to be provided for. In fact, the inventor's aim has been to convert everything about the coal into either a high grade of coke or gas in a combustible form. He says that, in apparatus making tar, it is always at the expense of good coke and large volumes of gas, and there could be no better illustration of this than in the results obtained in distilling coal in the ordinary gas-house retorts, for there they get tar in such quantities that the gas engineer is continually hunting better methods of burning the tar, either under retorts or steam boilers. The quality of Lowe-oven coke is much superior to that of gasworks coke. The writer is now superintending the erection of a number of Lowe coke-oven plants, on both the Pacific and Atlantic coasts. The largest battery of ovens yet built is that at the Jones & Laughlin Steel Company's plant at Pittsburg. They are built inside a gas-tight steel casing, having a ground space for the ovens and superheaters of 40 by 80 feet, and contain eight ovens, each 6 feet 6 inches wide by 38 feet in length. Each oven will take a charge of coal weighing 16 tons. The brick required for this battery of ovens was about 500,000, including the regenerators and checkerwork, but it is found that in future construction this can be considerably reduced without impairing the efficiency of the ovens.

The steel company has built a large gas holder, and gas mains are being laid to their various open-hearth steel furnaces. This gas will either mix with or supplement the natural gas of which their supply is now so short and the price so high that they have been compelled for a number of years to make producer gas to help them out—which is both troublesome and expensive. These ovens were designed to be ready to go into regular operation some time in April, 1903.

A test of the ovens in producing coke was made about the middle of January, principally to settle the questions: (1) concerning the ability to thoroughly coke so thick a mass of coal (30 inches) and at the same time produce a satisfactory quality of coke; and (2) to ascertain whether or not the coke could be discharged from ovens of this size and length without piling up in the ovens. Much to the surprise of all, the coke pusher designed for this purpose discharged the entire mass of coke in a solid block, without the least stoppage or hitch.

These were two very important points to a concern whose coke production was 3,000 tons daily, and who planned to increase that output to 4,000 tons. To make 4,000 tons of coke daily in beehive ovens would require the maintenance of fully 1,800 of them, and as it required one man to three ovens, it would mean a force under the old system of 600 men daily, as it is nearly all hand labor. By this new system, fifty men will be amply sufficient to do all of this work, leaving 550 to go into other more useful branches.

While making the short test of the ovens, it was difficult to ascertain the exact increase in percentage of coke, but enough was shown to satisfy Professor Lowe that the increase over the beehive yield would be fully 20 per cent., and that about 15,000 cubic feet of mixed coal and water gas would be saved per ton of coke made; or 60,000,000 cubic feet of gas while producing 4,000 tons of coke, which, counted at selling rates of natural gas (10 cents per 1,000) per equal number of heat units, would amount to $6,000 daily. This, with the 800 tons daily of pure, solid carbon saved in the coke, and the labor of 550 men, is sufficient to give any large concern like this a great advantage over its competitors.

The time consumed in discharging coke from the ovens and recharging the coal, and quenching and loading the coke into cars, is estimated, under favorable conditions, to require for each oven about 2½ minutes. The coke, as it is discharged from the ovens, drops into an immense cage capable of holding 13 tons of coke, the cage itself weighing 6 tons. This is picked up by a traveling crane operated on an elevated railway, and run to a tank of water in which it is immersed for about 15 seconds. It is then lifted out, and by the time the cage is swung round over a car, the internal heat in the coke has so driven out all the moisture that the coke is much drier than when quenched with hose in the old and tedious way. To see this cage with its load handled by this machinery one would think it had but a feather's weight.

An advantage in handling coke in this manner is that there is no waste in the form of breeze, as in the case of the beehive ovens, where it has to be pried out with bars, and consequently broken up considerably.

The coke pusher is an admirable piece of machinery, and was designed by W. B. Hasbrouck, who at present has charge of the Lowe coke-oven construction work, while W. Larramie Jones, of the Jones & Laughlin Steel Company, was, I believe, the originator of the new method of handling and quenching the coke by machinery. It is certain that they are taking a great interest in this new system, and it will not be surprising if in time it will supersede, not only all their beehive coke ovens, but the entire coke-making systems the world over.

Beehive By-Product Oven.—During the past few years efforts have been made to use the beehive, or round, coke oven in the saving of by-products. The results thus far have not been assuring. Some of them have exhibited considerable ingenuity, but the section of this oven is not the true form of a retort It is undoubtedly much more economical in first cost than any of the standard