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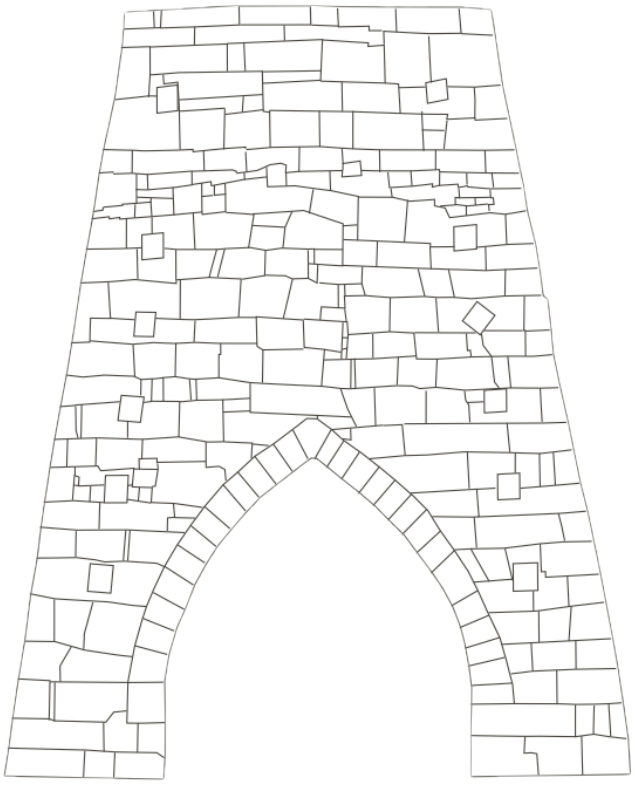
Research Report

The Johnson Report



Prepared by D. McCunn
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Background

Walter Michaels family worked in the East Canaan iron industry for many years. In his book "History of Iron Making" he mentioned the hiring of a consultant.

"*The Barnum also engaged a well known consulting engineer J. E. Johnson, to prepare plans for a new blast furnace, to operate on charcoal but to larger capacity than any previously built in this area. They would incorporate many of the improvements that had been developed and were in common use by the big blast furnace fueled with coke (coke is made from coal). They let contracts and started to build this furnace in 1918, but when financial difficulties overtook them and Barnum Richardson Company went into bankruptcy. The new furnace project came to a halt, and was abandoned*." - Michaels

Mr. William Wallace was the superintendent of East Canaan operations for the Barnum & Richardson Co. from 1911 until his resignation in 1918. He wrote in his Yellow Notebook:

"*At this time they employed a consulting engineer at an enormous salary to go over mines, furnaces, forges & everything. He, in his report, recommended that a General Manager be employed over all plants. This was done. [The new General Manager] was a brother-in-law of the consultant."*

"As soon as he landed he placed two brothers-in-law as Supt & asst Supt of Ore Hill & Weed Mines. It was like the blind leading the blind.

Neither the consulting engineer nor any of the rest knew what they were doing and got away with murder. The General manager knew nothing of furnace practice nor chemical plant either. Production went down, equipment became defective, etc. It was awful." – Wallace

Acknowledgment

The following text was taken from 47 scanned pages I received from Dick Paddock. Pages 20, 23, 42, 43 and 46 are missing. This document is a best effort transcription of those pages. The original documents were type-written but some portions of the original are not legible. In those cases the text has been edited for clarity. The original scanned document is available upon request.

David McCunn 2025

The Johnson Report

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SECTION 1 SUMMARY AND RECCOMMENDATIONS

SOURCES OF INFORMATION

The information herein contained was obtained by an examination of the company's plants at Lime Rock and East Canaan, and of the Ore Hill and Weed mines. The wood operations were not visited, but the wood situation was gone over with Mr. R. I. Barnum. Costs, figures, etc. were furnished by Mr. R. 1. Barnum and Mr. Richardson.

GETRAL CONDITIONS

These plants represent conditions which were out of date more than 20 years ago. They have survived on account of the reputation of Salisbury iron, which is one of the principal assets of the property. It will probably command a differential of several dollars a ton over coke iron for a long time to come. The growth of scientific knowledge in the foundry business tends always to reduce the differentiation special irons; and the best interest of the property will be conserved by maintaining the differential at a moderate figure. In the past the high differential, which has been obtained, has been of little sense fit to the company as most of it has been wasted in slack and inefficient management. The high earnings once made without much effort have tended to prevent the development of the property along modern lines.

THE WOOD SITUATION

The tracts of available wood land are scattered over a wide area, and were not visited. Mr. Barnun is, satisfied that there is a supply of wood obtainable within reach of reasonable freight rate

He has rejected certain tracts on account on their high content of chestnut. It is possible that the chestnut could be sold for tanning extract at a price which would pay for the cost of logging, and in that event these tracts should be acquired when they are within the reach of low freight rates.

Many tracts on the New York Central cannot be reached because this road will not cooperate with the New England to make low joint rates.

It is vital to the successful operation of retorts to have wood that has been seasoned at least a year and that is not too large in size. As soon as practicable, wood should be cut and piled to give a year's supply in advance. Then it Is delivered at the plant, over sized pieces should be thrown aside and split before they are charged.

As long as the principal ore mine is near Millerton, on both the New York Central and the New England Railroads, it is a great misfortune that the retort plant was not built there and the furnaces moved to that location.

IRON ORE SUPPLY

THE ORE HILL MINE

This mine has been operated for a long time. The workings are now 200 or 300 feet below the surface, and the slope extends down still further. Ore ls present at the lowest levels but not now being worked.

Heisting and Power Plant

The ore is hoisted in a skip running on a track in the slope. The hoisting and power plant are old, but fairly well adapted to the purpose. The method of getting the coal to the power plant is expensive.

The Mine Workings

This mine was formerly worked through a shaft, the pillar supporting which was robbed and the mine was thereby on used to cave to some extent. This has greatly hindered the working of the mine in recent years. It is now operated through a slope following the dip of the rocks, its upper end being about 30 degrees and its lower end flattening off to 15 or 20.

Quality of the Ore

The ore in the upper levels is only fair, but in the lower levels now being worked, is of good quality. With proper mining and washing a much higher-grade product could be obtained than has been supplied the furnaces in the past. The ore supply appears to be ample for several years to come.

Mining Methods

Examination of the mine itself and of the maps did not indicate any comprehensive scheme of mining adapted to extract the ore with the least expense. There are too many drifts standing open, and no plan appears to be in use for robbing without driving drifts.

I recommend that a man familiar with mining similar ore bodies in Virginia be employed to make an examination of the mine for several weeks, and to recommend methods whereby the cost of operation may be reduced.

Air drills should be installed as the ore in the lower levels is hard and can only be drilled by hand, with great waste of labor.

Ore washer

This is of the type known as a "cylinder washer". I do not regard it as being best adapted to clean the ore thoroughly, but the results in removing clay balls appear to be fairly satisfactory, nevertheless. The ore is not properly rinsed and this is very objectionable. This defect could be eliminated at a small expense by using the water from the pit sump for rinsing purposes.

WEED MINE

This lies several miles to the north of Ore kill, in the same geological horizon. The mine was formerly operated as an open pit, and in the bottom of this pit a slope has now been sunk and

workings turned off at two levels on the strike of the vein. The prospect of developing a fair-sized body appears to be good.

Heisting and Power Plant

These are more modern and better arranged than at Ore Hill

Ore Washer

This is similar to that at Ore Hill, but better arranged. An air compressor and drills are badly needed on account of the hard character of the ore. Steam drills are now in use, but are very objectionable.

The Ore Situation in General

It seems probable that the Ore Hill Mine alone can supply the requirements of the furnaces for several years to come. If this be true, the wisdom of developing the Weed Mine at the present time is doubtful.

Analyzing the Ore

As soon as a laboratory in installed, each car load of ore should be sampled and analyzed as a check on the mine operations, and as a guide to operating the furnace.

Other Ore Possibilities

It is understood that the market for Salisbury iron could be largely increased if the phosphorous in the ore could be lowered. This could probably be done economically by purchasing a small quantity of "Harmony" ore from the Port Henry nines. It could be necessary to arrange about freight rates, and to try the ore out in small quantities to see whether it would work with the other ore before adopting this as regular practice, but there is much reason to hope that it would be entirely successful.

BY-PRODUCT CHARCOAL PLANT

The retort portion of this plant is of the best and most modern construction. The apparatus for the distillation and evaporation of the by-products is of an uneconomical type, and will require more steam than the modern type which should have been installed. This will increase the fuel consumption of the plant. The returns to be obtained by rectifying the alcohol and selling the finished product would probably justify the installation of apparatus for that purpose, and would increase the profits of the operation.

There are many details involved in operating a retort plant which require the supervision of an experienced man, and such a man should be obtained for this position. There are certain construction details, not yet settled, which should be decided by the operator of the plant.

Fuel Supply

An estimate of the fuel requirements of the by-product plant should be made, and a pipe line provided for carrying the mite gas from the blast furnace to the retort plant, to supply Its requirements as far as possible. The question of water supply, which is vital to good recoveries of by-products in the plans, a hold also be carefully investigated.

BLAST FURNACES

There are two furnaces at East Canaan, with a joint capacity of 225 tons a week. These are of the very oldest type. The method of filling them is calculated absolutely to prevent successful working, except with extravagant fuel consumption. The top of the smaller furnace is entirely open; the top of the larger one is closed part of the time by a flap valve. Bells should be installed on both furnaces, and all the gas saved. This will involve the removal of the hot blast stove from the top of the smaller furnace to the ground level, and will permit the filling of the furnaces in a rational manner, which should result in large fuel economy.

Some minor rearrangements nay be required at the bottom of the furnaces.

The larger furnace requires to have Its hearth relined, and should probably be relined throughout before blowing in.

LABORATORY

A laboratory should be installed, and a chemist employed to make analyses and physical tests of the iron, to assist in the control of the retort of the by-product plant, to analyze the ore and to assist in the successful operation of the car-wheel foundry.

GRADING OF THE IRON

The iron should be subdivided into more grades than at the present. These should be determined by analysis and physical test, as well as fracture, and great care ahold be taken to pile only similar iron together, so that shipments to any one customer can be duplicated.

COMPARISON OF PRESENT AND REACHABLE COSTS

The question of the survival of this plant depends upon the cost at which it can produce its product. This depends upon the price and quantity of raw materials used.

Ore Costs

With the improvement suggested, the ore should be delivered at the furnace at $3.50 per ton. Better costs than this have been obtained under similar conditions.

Charcoal Cost

I have assumed the common cost of 5 cents a bushel for the charcoal delivered to the furnace.

Charcoal Consumption

By better preparation of the ore and improved filling, the charcoal consumption should be reduced from 145 to 115 bushels.

Total Cost

The labor and expense will be reduced from the present figure by steady operation. On this basis we have a reasonable coat of $16.85 per ton as against a present coat of $29.03.

Earnings

If the iron can be sold for 320.00 a ton, this will yield= profit of 93.00 per ton, which on 12,000 a year would be 336,000. It should be possible to obtain $23.00 for the iron, which would correspond with earnings of 372,000 a year.

FOUNDRIES

These are located at Lime Rock, a mile and a half from the railroad. There are two - one for car-wheels, and one for gray iron castings. Both the buildings are old, of obsolete construction, and entirely without modern equipment for economical work. The cost of trucking the material to and from the railroad station amounts to $4,000 to $6,000 a year, probably more. The location of the plant off the railroad makes it difficult to obtain a sufficient supply of labor, while the labor consumption is extravagant on account of the lack of adequate facilities. The foundry should eventually be moved to East Canaan so as to consolidate the operations at that point.

A fairly reliable estimate indicates a present cost of 130,000 for a suitable foundry, completely equipped. savings in labor and haulage arising from this would amount to $20,000 to $25,000, which added to the profit on the present foundry would make an attractive investment, but one which should not be made at the present time on account of the high cost of construction.

ORGANISATION

As a survival of old conditions, the organization of the plant is top heavy, and an extravagant portion of the earnings goes to pay unnecessary salaries. This condition should be removed by eliminating unnecessary men and obtaining one or two technically trained men to take charge of the manufacturing end of the business.

SOURCES OF INFORMATION

I visited the plant and property of this company on October 9th to 11th inclusive. I did not examine the sources of wood supply as these are scattered over a wide area and would require extensive study which I understand has already been put upon them by Mr. R. I. Barnum. The figures of costs, etc., herein after given, were furnished by the officers of the company.

I examined the Ore Hill Mine, going through a large proportion of the openings, also the Weed Mine, going through all the openings. I examined the charcoal plant at East Canaan, now under construction, and obtained such information as I could exam concerning the details of the plant not yet erected. Besides the two blast furnaces at East Canaan and the one at Lime I also examined the wheel foundry and the gray iron foundry at Lime Rook.

SECTION II GENERAL CONDITIONS

This concern must be considered a survival of conditions once widespread, but extinct for twenty years or more in other districts. One of the most valuable assets of the company is the high reputation for special purposes which Salisbury iron has always had and still retains. At the same time, the advance in chemical knowledge has greatly diminished the advantage of such irons because many of the results desired can be obtained by mixing cheaper irons of suitable analysis and melting them with a proportion of steel scrap. For some purposes, however, this

process does not give the desired results and there still remains, and will probably always remain, a sufficient demand for high grade irons, to produce a differential in price between them and ordinary coke irons. The effect of the increased knowledge of iron metallurgy, however, is to reduce the demand for these special irons by narrowing their field and this in turn reduces the differential which such irons can hope to command as against ordinary irons.

On account of its high reputation, Salisbury iron has been able to maintain its differential for a much longer period than most irons, but foundries, under stress of competition, are feeling the high cost of using such materials more and more, and will find methods to eliminate all excessively high-priced products from their mixture, even at the expense of quality, if need be. If, however, the differential be reduced to a moderate figure, it will probably always be possible to market a fair tonnage of such material.

On account of the maintenance of the high selling price, there has been until recently no attempt to lower the cost of manufacture, and the property has realized very little benefit from the high differential obtained for its product, most of the differential being wasted in expensive methods of manufacture, and the net profit per ton being no greater than that on many cheaper irons. Careless also in regard to manufacturing 3005, and the exhaustion of the local charcoal supply, have, in fact, probably run the cost of manufacture up, while the differential was simultaneously dropping, so that the profits of the operation have been largely reduced, if not wiped out. The indifference to savings with his habitual in highly prosperous concerns has taken a strong hold on most of the staff operating the property, and has been a strong factor in bringing gout the present conditions. It has also operated to shut the works off from knowledge of what the rest of the world was doing, and has resulted in stifling any effort to improve conditions. Within the last few years, it is evident that Mr. J. Sarnun has been striving to bring about more business-like conditions, but he has undoubtedly been heavily handicapped by his long personal acquaintance with many of the staff of the company who have grown old in its service, and his consequent inability to affect all the improvements desired

SECTION III THE WOOD SITUATION

The company's tracts of available wood land are scattered over a wide area and could not be visited without the expenditure of more time than the conditions warranted. Mr. R. M. Barnum has been investigating this situation carefully and should be able to obtain reports from competent timber cruisers as to the quantity of timber on the different tracts, cost or logging it, etc. Mr. Barnum outlined to me the course he had been pursuing in regard to this matter. He is satisfied that there is a supply of wood obtainable at freight rates which permit its utilization, so that the wood supply is assured for the output desired for many years to come. Mr. Barnun told me that he had condemned certain tracts on account of their high tenor of chestnut. Chestnut is being very largely used as the source of supply for tanning extract, and I would strongly advise an investigation as to the prices which may be obtained for it for that purpose. If these prices are such as would pay for the cost of delivery on cars, it would probably be very desirable to take tracts in nearby locations, even though they contained a considerable quantity of the wood log the whole tract, sell the chestnut, and utilize the hardwood for charcoal manufacture. This a matter of policy which on not be determined, except after careful investigation.

It seems that there are large tracts of wood within relatively short distance along the lines of the New York Central Railroad, which are practically out of reach because that railroad and the Central New England Railroad will not cooperate to make as low rates for a given distance as the latter will make for the same distance on its own lines. This bars out certain valuable tracts of timber. It would seem desirable to make stronger and more persistent assault on the Traffic Department of these railroads to compel them to put in effect reasonable joint rates, even appealing to the Interstate Commerce Commission, if necessary.

Mr. Barnum advised me that they considered $4.25 the out-side figure for wood delivered at East Canaan, and that they were getting some wood at a lower price than this. I have used this figure in subsequent calculations.

A matter of vital importance in the successful operation by-product charcoal plants is that the supply of wood shall conform to two requirements.

First: - That it has been in store a year.
Second: - That it be not too large.

If the wood be not thoroughly seasoned and the individual pieces are too large, much harder firing of the retorts is required and they are very much more apt to be burnt, while the temperature control is8 much more difficult, and the yields of by-products is apt to be smaller. It may be impossible to obtain a suitable supply of properly dried wood for the starting of this plant, but the wood operation should be organized on such a basis as to keep a year's supply ahead at all times, and the inspection should be so strict as to absolutely reject over-sized pieces. Then the wood is being repiled in the yard for storage, over-sized pieces may be thrown aside and split on a saw down to the size required. This can easily be done, and the expense is insignificant in comparison with the benefits in the operation of the process. These are matters which should receive careful attention at the present time, so that a suitable supply of wood may be provided for the retorts at the earliest possible moment.

In view of the difficulty of securing low joint rates on two railroads and the location of the principal ore deposit of the property near Millerton, the intersection of the Harlem Division of the New York Central and the Central New England Branch of the New York, New Haven, & Hartford, it was probably a lamentable mistake not to locate the charcoal plant at Millerton, since the coat of rebuilding the furnaces in that location would have been only a small fraction of the expenditure on the retort plant, and in view of the other changes now being made in the furnace plant, would have cost relatively little. The ore could have been hauled on a switch charge with a savings = 35 cents a ton, or by proper arrangement, the freight on the ore night have been eliminated altogether by the construction of a short spur track from the mine to some suitable site in close proximity to both railroads. This would have given many advantages in the shipment of finished products, and would have made available many tracts of timber which it may be impossible ever to reach under present conditions.

On account of the heavy investment now being made in the retort meet this plant, it is probable that nothing can now be done to situation.

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SECTION IV IRON ORE

IRON ORE SUPPLY

THE ORE HILL MINE

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HOISTING AND BOILER PLANT

The ore is hoisted by a skip running on the slope track. This skip automatically dumps at the top of its travel into a secondary skip, running approximately at right angles to the first for about 100 feet. This second skip dumps onto the grizzly which feeds the washer. This is a rather awkward operation, but the secondary skip is operated by the engineer who operates the main skip, and as there la no other important expenses involved, this operation does not add anything to the cost of producing the ore. The hoisting engine is a single cylinder engine of old, but of fairly good design, which is geared to a shaft on which two rope drums are clutched independently. They also have independent brakes, so that either can be hoisted while the other stands still or runs backways under the pull of the skip. There are four horizontal tubular boilers, and the coal consumption does not appear to be excessive for the work done, although the method of bringing the coal up to the boiler house is awkward and expensive. It all has to be dumped through the very low trestle on which the ore is shipped out, and hauled around by teams. This expense could have been avoided by a little more careful design of the main skip. which could have been made to hoist the coal from a hopper beneath the main railroad track, which crosses it, to the head frame, but this provision was not made, and cannot be made now without considerable expense.

THE MINE WORKINGS

The mine in the course of its long life has been operated by various managers; it is stated by the present manager, Mr. Perkins, that his predecessor had a shaft down not far from the present slope and that when pressed for ore, he robbed the supporting pillar of this shaft, causing the ground to break, and increasing very greatly the difficulty of keeping the mine open and the expense of taking the ore from it

After going through the mine, I saw nape of it which have been made from time to time.

A slope has been sunk in the southern end of the open pit which runs about north-north east approximately down the dip of the ore. Its angle at its upper end is about 30 degrees. There are rolls in it at one or two points, and its bottom and flattens off onto a lower slope, probably not over 20 degrees.

The dip of the strata is given by the local official as out 30 degrees, but I should judge the present workings were very much flatter than this, only 15 to 20 degrees. The principal work going on, while I was there, was retimbering some of the upper levels which were being crushed by the weight

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QUALITY OF THE ORES

CONTINUING ON PAGE 24 of the original document

the remainder to the insufficient rinsing of the ore as later described. If the furnaces were supplied with ore of 46 or47 per cent as against 41, it would mean an important reduction in the quantity of ore required to make a ton of iron, and vastly more important reduction in the amount of impurity to be slagged at the expense of the charcoal consumed in smelting.

I did not attempt to make an estimate of the ore reserved in the mine, but it is perfectly obvious that there is enough in this mine to supply the requirements of the plant for many years to come. I understood from Mr. Perkins that the ore went on down to the lower levels and maintained its quality. If this be true, the question of an ore supply may be dismissed from consideration for 10 or 15 years at least, perhaps much longer.

MINING METHODS

From examination of the workings and from conversation with Mr. Perking and his son, and an examination of the mines, I was unable to discover that any very clear or definite plan of mine development or mining existed. It is absolutely certain from the number of drifts standing open that these are driven too far in advance of the time at which the ore they develop will be needed, with result of weakening the ground unduly and increasing the coat of the ore, both by the excessive number of drifts dug and the expense of maintaining them. The exact method of mining best adapted to these conditions could only be determined by a long and thorough study of the whole situation, by bringing all surveys up to date, and by making more comprehensive mays and cross-sections than any that I saw.

The general character of this ore deposit and of the ore itself is very similar to the brown ores which have been mined on a considerable scale in the mountains of Virginia for many years past. A system of mining has been developed there to meet these conditions, which has the net result of producing ore at less than two-third the ore cost given me by Mr. R. I. Barnum. A few men have been trained to this method of mining, so that they can operate these mines safely and economically. It would seem desirable to obtain a man of this type and have him spend a month or two in examining the general conditions, supplementing this by a survey, mapping the mine up to date, and then laying out a plan of working which could be carried along lines similar to those used in Virginia. If this is done, I would expect the coat of producing ore could be very materially reduced. It would probably be necessary to install a small air compressor and use air drills, since much of the ore la very hard and can only be drilled by hand with great and unnecessary expense. The introduction of air drills into similar mines in Virginia, where the labor costs were not much more than half what they are at Ore Hill, resulted in very decided economies. The proper method and time of installing these should be determined when the general survey of mining conditions is made.

ORE WASHER

The ore washer consists of a grizzly or screen of heavy bars for separating the fine ore and dirt from the course, a crusher for crushing the lumps, the washing cylinder proper and a secondary screen. The ore from the grizzly and crusher is sluiced into the washing cylinder through a trough

or launder. The washer was not in operation at the time of my visit as very little ore was being produced, and the washer was undergoing some minor repairs.

I do not like the cylinder type of washer since that has, in my experience, not been successful in breaking up lumps of clay, but is apt to roll them into balls and discharge them with the ore. This type of washer has very generally been discarded in the South where ore washing is carried on a large scale; the "log" washer (a large interrupted screw pushing the ore up the trough in which the screw works against a heavy current of water) is in almost universal use. At the same time, it must be stated that the ore I examined in the stock house seems to be fairly free from clay balls; it was, however, not well rinsed, the particles being covered with clay. It is a matter of very general experience that this film of clay affects the working of the ore in the furnaces much more seriously than its amount would lead one to expect, and the preparation of the ore could be decidedly improved by a more thorough rinsing. I noticed a good-sized stream of water being discharged from a sump in the old mine pit, which apparently was not being utilized; it is alight expense this water could be pumped up to the washer level to rinse the ore after it has been washed. This would, in my judgment, materially improve the suitability of the ore for the furnace and would not involve expensive changes to the ore washer, or appreciably increase the coat of operation.

WEED MINE

This mine lies in the same geological horizon as the ore Hill Mine. The mine has evidently been worked for a number of years as there is a large, open cut to show from whence the ore was taken. The ore became too deep to be worked in this manner any longer, and a slope was then sunk down the dip of the ore at an angle of about 30 degrees. This slope has gone down about 150 feet below the bottom of the old pit, and two-level shave been turned off from it, one from near the bottom, the other about 30 or 40 feet above the bottom. Drifts have been turned off northeast and southwest on these levels, those running to the southwest running only 75 or 100 feet, while those to the north east running twice as far. There ls good ore showing in these drifts practically throughout their length, but developments are too small to show conclusively what tonnage may reasonably be expected from the property.

HOISTING AND POWER PLANT

This is a more modern plant than that at Ore Hill. There is a double drum single cylinder hoisting engine of about the same type, but the machinery has been well set up and is adequate for its purpose. A small incline is provided which brings coal up from the level of the railroad in a way very much superior to that in use at Ore Hill.

THE ORE WASHER

On account of the small tonnage being produced and the work being confined to development, no ore was being washed at the time of my visit, but the washer was more modern and better arranged than that at Ore Hill. The washer is in the same building with the hoisting engine.

The crying need at this plant was for compressed air to operate the air drill a in the drifts. They were drilling with steam drills at the time of my visit, but this is horrible practice, not only

destructive of the men's health and ability to work, but of the timbers in the mine as well. If this mine is to be continued in operation, an air compressor and air drills should be provided. The drills should not be of the heavy tripod type now in use, but should be of the modern type of one-man drill. These are cheaper and more convenient in every way, and can do much more work in a day on account of their greater portability.

THE ORE SITUATION IN GENERAL

In consideration of the great lengths of drifts standing open in the Ore Hill and the strong probability that development has run too far ahead of mining, it has seemed to me likely that it would be good policy to drive this mine harder for the present and obtain the entire ore supply of the plant from it. A thorough examination of the mines should enable an estimate to be formed of the number of years it will supply the plant, and if this is much more than five, it seems doubtful whether it is good policy to operate two mines, both on such a small scale, with the consequent high cost. If sufficient output can be secured from the Ore Mill Mine, it might be the part of wisdom to shut the Weed Mine down until such time as it should be developed at a good rate to take the place of Ore Hill. one mine than from two. It would be very much cheaper to obtain ore from

ANALYSIS OF THE ORE

One of the recommendations hereinafter made is that a laboratory be provided and a chemist installed therein. This is essential to the successful operation of the property. When this is done, careful samples should be taken from each carload of ore received at the furnace and its analysis in iron, silica, manganese and phosphorous determined. This would be a check on the quality of the material that the mine is putting out, and would probably enable a suitable mixture to be made from the ore from one mine.

Some of these matters can only be determined after an investigation extending over several months, but present circumstances indicate that it would be very desirable to work along the e lines, if it is in any way possible.

OTHER ORE POSSIBILITIES

I understand from Mr. Barnum that a very large market for Salisbury iron could be obtained from the manufacturers of malleable casting in New England if the phosphorous could beheld to slightly lower limits. Vitherbee, Sherman & Compenyon Take Champlain have a very large tonnage of ore which alone makes an iron with phosphorous of about, l percent, while I understand Salisbury runs ,25 per cent and over. This is a Tory iron ore, and I believe it would be feasible to use small proportion of it in the mixture without increasing the cost of ore per unit of iron. It would be necessary to find tut freight rate could behind on this ore from Port Renty to East Canaan; this should be investigated.

I know Withebee, Therman & Company Tell and Son perhaps against in getting them interested in this outlet for them. It may be that the project is not feasible, but it will at least cost nothing to find out. If it be found commercially feasible, only small quantities of this ore should be used on the furnace until it could be seen we the: it worked well with the native ore. There is no particular reason to anticipate that it will not.

SECTION V BY-PRODUCT CHARCOAL PLANT

The charcoal plant in of the modern type, using steel retonte or ovens for the carbonization of the wood. 3h1sparh o2 the plans 13 at andard, has been built by the best tilders, nn inIcented on a suitable and artiaotory site.remards the zecotery and varining of the byproducts, the plans adopted are by no means the most modern or the most economical.

In the beat installations what are known as "mlbipleellecta" are used, and the steam is used two or three times, so as rasponding reduotion in the requirements for boiling and for further in modern distillation plants, apparatus is used oh produces refined alcohol and acetone at one operation. It is not certain that the size of your plant could justify the acquisition of such apparatus, but the differential between. a price paid for crude alcohol and that paid for refined is very much greater than the coat of refining, and in general it pays to refine on a much smaller scale than is generally believed. he large refining interests cultivate the idea that refining is exceedingly difficult and expensive but there is not very much justification for it.

I was not able to get very complete information as to the apparatus to be installed in your plant, but Mr. Zubbard told me that it was all leingle etect apparatus, using the ateamonly once, and that the alcohol was not to be relined but sold in the crude state. It is very certain that the fire t in serious mistake, and it is not improbable that the second is also. It seems to be too late to do anything to rectify these mistakes at the present time, though it may be worthwhile to consider refining. the alcohol later.

There are a good many details about the successful operation of a retort plant which are of vital importance to its commercial success. These details are known only to men who have actually operated these plants, and in my judgment such a man should be secured for superintendent or this operation. Certain minor details of construction oar only be decided on too sasis of praotioni experience. For instance, contain detrilo us to the method of trawing the cotorta have not teenaotaled, and the conatruenion on ot be finina unit dai svazy important taotor in the elegagaful dharacion plants has been decided. It would be well to have the judgment of a man who has operated plants in settling this question.

FUEL SUPPLY

Efforts should be made to find out how much fuel is required for the operation of the distilling plant, on the basis of the apparatus already purchased, end the requirements for firing the retort a themselves. Provision should be made for piping the surplus gas from the blast furnaces over to the retort plant, and pains should be taken to conserve all of thing as possible and the expense for fuel can thereby be largely reduced.

The question of water supply for the retort plant should be carefully investigated and provision should be made for re-cooling the water and using it over, if necessary. It is claimed by some of the local men at East Canaan that the flow or the stream will be entirely inefficient for cooling during the dry seasons. The alcohol can only be recovered from the gases by using an ample supply of cooling water on the condensers and whatever is needed to supply this must be done, or heavy logs will result. The flow of the stream at the time of my visit was excellent and the water in the district was said to be low at that time, so that there may be no necessity for

recooling this supply of water, but definite information should be obtained before the question becomes an urgent one.

SECTION VI BLAST FURNACES

There are two of these at East Canaan, located at a short distance apart - one, No. 1, has been making about 125 tons a week - the other, No. 3, about 100 tons. These are a survival of almost the earliest type of blast furnaces used in this country, with a few modern improvements.

The stone stacks are lined with fire brick and the tuyeres are of modern construction, being made of copper and renewable in the standard way. The furnaces are blown with warm blast. The hearth jackets are of cast iron, water cooled. The cinder is drawn off at an opening which is stopped with clay.

The furnaces are filled with barrows, but the method of filing is absolutely preposterous. It has been recognized for probably 200 years that the stock mint be distributed asymmetrically in the stack of the furnace and that filling it one side, or in any other way irregularly, results in the worst possible condition in the hearth; in greatly-increased coal consumption; reduced output, and probably irregular quality of iron. If an experienced man were given the task of deranging the work of a furnace which was running satisfactorily, the first thing he would do would be to install on one side.

Both these turnades are filled exactly in that way. All of the material is dumped at one point and this can only mean that all the lumps ze dom one side, and all the finen down the other. This is an unspeakable condition, and if commercial operation is to be obtained, must not be tolerated for a moment.

The type of filling at the two furnaces is the same, but the construction of the two tops is different. No. I furnace has nothing on top of the furnace proper, except a sort of draft stack to carry off the flame. The gas is taken off below the top and carried down to the bottom of the furnace where it is used to fire the stoves and boilers; the top is closed by a flap valve to force the gas down - when a charge is to be put in, the flap is raised.

On No. 3 furnace there is no valve of any kind; the stove is built on top of the furnace structure, immediately over the charging opening, and the gas from the furnace mixing with air at the furnace top came up through the stack in a flame. This makes it impossible to control the temperature in the stove, and wastes all the gas not used for heating the blast, which is probably only about on a-tenth or the total.

The tops of both furnaces should be sealed with a bell in the way which is now standard for all furnaces of whatever size, and the material should be dumped in at three or more equally distant points around the circumference of the top. To do this in the case of the No. 1 furnace will involve only the installation of the bell, and the tearing out of the flame stack, which will then be entirely unnecessary.

On the smaller furnace, No. 3, it will involve transferring the hot blast stove from the top of the furnace to the ground and installing a pipe to take the gas down to it.

The surplus gas from both furnaces should have a fuel value equivalent at least to that of 5 to 10 tons of coal, and this should be piped to the retort plant to tire the retorts and boilers. The pipe need not be heavy, and its cost will be insignificant in comparison with the value of the coal saved.

The arrangement of the tuyeres at the bottom of the furnace may require alteration as a result of this change in the filling, but this will not be a matter of great expense, and may not be necessary. The slag should be dram off through a water-cooled opening like a tuyere, since this can be done without taking the blast off the furnace, while now the furnace has to be stopped every time the slag is tapped. This also is a matter of small expense. I estimate that $1,00 should be sufficient to change the No. 1 furnace, and that As, co should be sufficient to change No. 3 in these particular. These are only rough guesses, rather than estimates, but in any even the amount of money required is not large.

My understanding is that the boilers for driving the blowers of the No. 3 furnace have been separately fired with coal. This, of course, is a preposterous condition, and the piping of the gas, as suggested, will permit firing this boiler with gas, with small additional investment.

The No. l furnace requires some repairs. The hearth must be relined complete before the furnace can be started, and while the local superintendent thought it was not necessary to reline the shaft, I consider it very doubtful whether the money saved by not doing this is a good investment. The lining looked very rough and irregular, and not adapted to produce the snoot and uniform working essential to economical results. This will probably cost $2,500, but this is not to be considered as a capital investment, only as a normal part of operating expanse which must be incurred every few years.

I would not recommend any radical changes to these furnaces at this time other than these.

LIME ROCK FURNACE

The furnace at Lime Rock is practically identical with. No. 3 at East Canaan, but on account of its location entirely off the line of the railroad, it cannot be operated at a coat within 32.00 or 33.00 of that of the East Canaan furnaces, and it cannot, therefore, be considered as having any commercial value.

SECTION VII LABRATORY

The development of scientific knowledge in the metallurgy of iron has been great in recent years, and this with the necessity of a uniform product from the foundry has made it essential that its raw material, pig iron, should be not only good, but uniform in grade and quality. This means to the furnace that the composition of each lot of iron made must be known definitely, since grading by fracture in more coceptive in charcoal iron than in any other and is practically obsolete, even with poise irons. There is, therefore, a double need for socirate knowledge of the icon being shipped to each customer ore over, even when iron has the same analysis, it varies very greatly from oast to on at in physical strength and in some properties, which can be determined by analysis only with the tasteut difficulty.

So most these conditions, a laboratory should be installed, no the practice should be introduced of a noting test bara from the metal of each gaot and breaking these on a simple tooting machine which on be a part of the laboratory equipment.

A laboratory will also he needed in the proper conductor the by-product charcoal plant. This is contrary to the opinions of some charcoal-plant operators, but the bainees of their practice in itee if justifies the contrary opinion.

The ore, as already mentioned, should be analyzed day by day as a check upon the mine, and as a guide to the operation of the furnace.

For all these purposes, a laboratory and chemist are required. They should also be of use in standardizing and improving the practice in the our-wheel foundry, especially if this be moved to adjoin the other words. It may be aid that it is practically impossible to operate a plant of this type to the best advantage without a laboratory, and provision should be made to have one in operation men the chemical plant and furnace start.

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SECTION VIII THE GRADING OF THE IRON

LABORATORY

SECTION IX COMPARISON OF PRESENT AND REACHABLE COSTS

ORE COSTS

CHARCOAL COST

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blast furnaces were not explained to me in detail, but as the charcoal plant should earn a handsome profit on its investment at a price of 5 cent a per bushel of charcoal, and as this price is used in similar plants, I have taken it as the basis in figuring the pig iron costs.

CHARCOAL CONSUMPTION

The quantity of charcoal used per ton of iron, according to the cost figures for the last run furnished me, was an average of 145 bushels for the two furnaces. This is an extravagant fuel consumption, due in part to lean and improperly prepared ore, but probably due in e much greater degree to the unspeakably bad method of filling used. With charcoal of a quality under control, with ore properly prepared and not to clean, and with a proper filling system, the consumption of charcoal should not exceed 115 bushels.

TOTAL COST

With costs reduced, the operation should be carried on continuously, in fact, this is essential to any sort of screenful operation; this will greatly reduce the labor cost and the "expense".

I have, therefore, prepared the following comparative table of present and reasonable costs at this plant:

COSTS TABLE

PRESENT	Reachable
Ore	
Charcoal	
Repairs	
Labor	
Expense	
Total	

The left-hand column, giving the present costs, is based on figures furnished me at the plant; the right-hand column on figures which I think should readily be obtained.

EARNINGS

If this can be done and the iron can be sold at a price of $20.00 per ton at the furnace, it will give a profit of $3.00 per ton. The better preparation of the ore and filling of the furnace should increase the output to about 12,000 tons per year, with constant running, and $3.00 on this would make a prof-it of 136,000 per year for the furnaces, entirely independent of the profit on the chemical plant and the foundries. This, considering the small actual value of the investment represented by the furnaces and ore mines, must be considered satisfactory. by maintaining the selling price of the iron at the very reasonable figure of 323.00, corresponding about with the ordinary price at which southern iron of poorer quality are sold, these earnings would be doubled.

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SECTION X FOUNDRIES

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each way every day. This is done by power trucks, but the total expense of handling and transferring this material at the railroad station is $4,000 to $6,000 a year, and there is no compensating advantage whatever. On the contrary, the inefficiency of the men, on account of having no modern facilities to work with, is not improbably equal to twice as much m OTe* difficulty in securing a sufficient supply of moulders is undoubtedly due to the isolated community in which the men have to live.

The wheels made in the wheel foundry have enjoyed an excellent reputation and commend a sufficient differential to make their production profitable if this be done on economical lines. The fact that the gray iron foundry has more business offered than it can take care of indicates that that business also could be done at a profit if it were handled properly, and not over-loaded with this transportation and excess labor charge. by recommendation, therefore, would be that the foundry business be moved to East Canaan and established in a suitable building to be constructed at East Canaan, adjacent to the furnaces and charcoal plant, so that the whole operation can be under the charge of one organization and one competent technical superintendent.

A tentative estimate prepared for present conditions by the Hooper Falkenau Engineering Company for a foundry of a daily capacity of 100 wheels and 10 tons of gray iron castings, indicates a cost of $130,000.

The present cost of all building materials and equipment is exceedingly high and it la not necessary to incur this large expenditure at the present time. The foundries are, or should be earning money in their present location under present conditions. They may be continued in operation as long as this condition last, but if it is desired to maintain the foundry end of the business permanently, then it is absolutely necessary to con-sider the installation of a modern foundry on the line of the railroad. I estimate that the labor coats in such a foundry would be reduced 25 percent over what they are in the present foundries, and as these two payrolls are about 11,200 a week, this would make a saving of about 9300 a week, or $15,000 a year. This, added to the w6,000 or 36,000 to be saved by the elimination of hauling, would pay 10 or 18 per gent on the Investment, on the basis of the above estimate, and with the in-proved quality and quantity of work which could be turned out added to the present profit, should sake such a foundry a decidedly profitable investment. At all events, whether a new foundry be built or not, it seems certain that no money mat ever should be expended on improvements on the foundries at Lime Rock.

SECTION XI ORGANIZATION

In consideration of the small size of this plant, the organization must be considered as excessively top heavy. The number of employed in the office and of foremen and superintendent is entirely out of line with the volume of business done and with the requirements of the conditions. It is impossible to maintain an organization of this size without making a heavy draft on the income of the business. A thorough reorganization ahold be affected on the general principle of employing a far high-class men, and putting them indirect charge of enough departments to keep them busy.

November 9, 1916