REPORTS ON IRON ORE MINES AND PROSPECTS

IN THE VICINITY OF COVINGTON, VIRGINIA

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ca 1942

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ORE RESERVES LIGNITE MINE-ALLEGHANY ORE & IRON CO.

Ore Reserves Lignite Mine-Alleghany Ore & Iron Co. #14

The Ore reserve estimates of the Lignite Mine are based on exposures of ore, old churn drill holes and diamond drill holes sunk during an exploration campaign carried on between November, 1941 and March, 1942. A total of 1,000,000 tons of ore averaging over 42% Fe were proved with a probability of 750,000 tons in unexplored areas additional.

Location

The Lignite mines are located in the south end of Botetourt and the north end of Craig Counties. They adjoin the Fenwick mine to the south and the Trediger lands to the north. The total length of outcrop is about three miles of which 3500' has been worked by old pits, 4000' is unexplored and the center mile and one-half has been proved to be valueless.,

The former site of the washer is connected to the Craig Valley branch of the C. & O. Railroad with a standard gauge track over which irregular shipments of metallurgical ore have been made since the mine closed down.

History

The Lignite mine was first developed by the Alleghany Iron Corporation in 1896. In 1907 the Lukens Steel Company purchased the property and actively operated it until 1923. A total over 1,000,000 tons has been mined. During the last few years of operation, the ore averaged 45% Fe with 21% insoluble.

The mine was opened up by three open pits, the Big and Flatwood pits at the south, and the Farrow Bank pit about 2 miles to the north. During the last years of operation a considerable tonnage of ore was mined from underground operations down the dip from the Big Pit operation. The total length from outcrop to bottom level in this area was 1,000 feet.

The ore in the Farrow Bank area was siliceous near the outcrop and consequently this area has not been developed nor explored to as great an extent as the south end of the mine.

Geology and Ore Estimates

The Lignite ore occurs in a syncline pitching towards the northeast. Only the northwest limb of the syncline with a dip towards the southeast has been commercial. In the Big Pit area folding has produced two minor folds so that three open pits were worked across the strike. The recent exploration was confined to developing the ore northeast of the Big Pit area and down the dip from the Flatwood. Exploration north of the Fleetwood was confined to sinking three shallow test pits. The area between the Flatwood and Farrow Bank pits was explored by a number of holes, none of which contained ore in commercial quantities.

The estimate was made from cross-sections of the orebody with the density assumed 18 cubic feet per ton. The results are shown in the accompanying table. It should be noted that the stripping ration in part of this area will probably be too great to permit economical open pit operation even with modern low cost methods. It is conservative to estimate that 700,000 tons can be economically mined by open pit work.

Probable Ore

South of the Big Pit area to the Fenwick line, adjoining the Big Pit on the southeast and between the Big Pit and the explored portion of the Flatwood area is a considerable area which is known to contain ore but which has not been included in the proved ore reserve. Undoubtedly a large part of this can be mined. It seems conservative to estimate that there is a probable reserve of at least 250,000 tons of ore in this section.

North of the Farrow Bank pit there is a length of 3000 feet of unexplored outcrop which probably contains a considerable tonnage of open pit ore. The last explored section on the north shows 370 tons of open pit ore per foot of length of outcrop. Three test pits and several surface exposures of ore indicate that ore continues into the Trediger property to the north. Estimating that 2,000 feet of this length will contain 250 tons per foot of ore, we would have a probable reserve of 500,000 tons. The drill holes in this area and a tunnel driven through the ore below the Farrow Bank pit indicate that the ore at depth is not as siliceous as the outcrop so that the prospects of additional ore in this area seem quite attractive.

ORE ESTIMATE - Lignite Mine

FLATWOOD

Soft Surface				Sandstone			Mineralized SS			Ore		
Sec.	Dist.	Area	Volume	Dist.	Area	Volume	Dist.	Area	Volume	Dist.	Area	Volume
	125		2,323-							100		885-
4870		18582									8855	
	400		4,357-	200		493-				400		2,167-
5340		3202			2465						1980	
	500		5,763-	500		2520-	250		1,877-	500		2,195-
5920		19850			7936			7511			6800	
	650		11,067-	650		4295-	650		2,953	650		3,661-
6680		14202			5289			1575			4465	
	125		1,775-	100		528-	100		157-	100		446-
	125		1,574-	100		791-	100		380	100		320-
5340		12596			7905			3800			3200	
	500		8,111-	500		3960-	500		2,828-	500		2,460-
5920		19850			7936			7511			6640	
Approach			100									
Total Volume			35,270			12587-			8,296-			12,135-
Total Cu Yds			1,406			466-			307			
Total Tons												674,000

Farrow Bank

							Sand in Ore					
	100		368-				100		94-	100		414-
11800		3680						945			4140	
	390		2,377				190		179	390		1,977-
12250		8512									6000	
	450		2,088-	225		506-	225		485-	450		3,206-
12730		14100			2250			1800			8250	
	100		1,410-	100		225-	100		180	100		825-
Total Volume			6,243-			731-			938-			6,422-
Total Cu Yds			231-			27-			32-			
Total Tons												357,000

REPORT ON THE LIGNITE IRON MINES

C. M. Weld

Low Moor, Va.

Jan. 29, 1912

Notes on the Lignite Iron Mines

Alleghany Ore & Iron Co.,

Craig & Botetourt Counties, Va.

I visited the Lignite Mines of the Alleghany Ore and Iron Co., on the afternoon of Jan. 25th, coming over the divide from Fenwick. Mr. J. W. Stull, Gen. Supt., piloted me over the property and showed me every courtesy.

The Lignite property lies North-East of the Fenwick property of the Low Moor Iron Co., adjacent to and having its S. W. boundary in common with the N. E. boundary of Fenwick.

The Ore is Oriskany brown iron ore. The Oriskany measures are found as synclinal trough with a N. E. to S. W. axis. The N. W. leg of this trough, dipping to the S. E., is traceable practically throughout the property, a distance of about three miles. The opposite and covering S. E. leg is not nearly as conspicuous, having been only occasionally located. It would appear that whereas the N. W. leg dips rather gently towards the S. E., the S. E. leg stands at a high angle and is no doubt in places overturned. The natural consequence is that the S. E. Crop-line is comparatively narrow and has been very generally concealled by float from the neighboring rocks.

No workable ore-bodies have been found on the S. E. crop. Four workable ore-bodies are situated on the N. W. crop, as follows:

(1) Beginning at the S. W. end, near the S. W. boundary of the property, is a Hill;

(2) A few hundred yards East of A. Hill is a group of extensive open cuts known as the Mountain Cuts.

These extend for a distance of a couple of thousand feet along the crop-line.

(3) About one thousand feet from the N. E. end of the Mountain cuts we find the Flat Woods Cut, a single cut extending for about 1000'.

(4) About one and a half miles N. E. of the Flat Woods Cut is a small cut known as the Fairbank Cut.

A small cut was opened between the Flat woods and Fairbank Cuts but was abandoned. There are no workings beyond (i.e. North East of) the Fairbank Cut. This latter lies a couple of hundred yards North of the camp.

I am notaware of the Oriskany measures occurring anywhere on the property except as the single trough described above. As we have seen, this trough has been traced a distance of somewhere about 3 miles, and has a width of from a third to a half a mile or more, appearing to widen out towards the N. E.

(1) A. Hill

The conditions on A. Hill correspond closely with those on the Low Moor Co's. Klondike Hill immediately to the S.W. A. Hill is a little lower than Klondike but has caught the same gentley rolling back fold of Oriskany ore-bed. This is nearly conformable with and encrusts the S. E. Side of the hill and rolls back so as to hug the Summit for about half way back to the N. W., where it finally goes off into the air. The N. W. side of the summit and all the country behind (i.e. to the N. W.) exhibits the underlying rocks.

A few shallow open cuts were opened on the summit of the hill but the ore was found to be thin and the flint was quickly laid bare.

Along the S. E. flank of the hill the ore-bed gradually assumes a steeper dip till it finally plunges beneath the surface and under the valley. A long open cut has been worked along this first crop. This is now idle, tracks having been withdrawn. It is said the ore was not exhausted but was found to be of rather inferior grade.

Just as the open cuts on the summit of A. Hill correspond with the Low Moor Co.'s Klondike workings, so does the cut along the S. E. flank of A. Hill correspond with the Low Moor Co.'s No. 9 open cut. The ore beds on the two hills are closely similar in attitude, as also apparently in character, and there can be no doubt as to their being one and the same horizon. The boundary line between the Fenwick and Lignite properties passes down the deep hollow between the two hills. This hollow has been denuded of ore-bearing measures, the abundant iron-bearing float which appears there having rolled down from the adjacent hill tops on either side.

(2) The Mountain Cuts

I attach a rough plan of the mountain cuts. It will be understood that this is a mere sketch and is drawn to no scale.

Immediately north of the long cut which I have designated on the plan as (b) there is a third hill, similar to the Klondike and A. Hills, but somewhat lower. In fact this difference in height is just enough to have resulted in the removal of the gently rolling back fold which still partially encrusts the Klondike and A. hills. Thus the crop of the ore bed first appears along the lower S. E. flank of the hill only, and this crop is in line with the open cut along the S. E. flank

of A. Hill and with the No. 9 open cut of the Low Moor Company.

I devoted some attention to this matter for the reason that it has been suggested that the big Mountain Cut lead has not been identified on the Low Moor Co.'s Fenwick property and has possibly not as yet been discovered. The only basis for this suggestion has been that the lead where found on the Fenwick property is neither as thick nor of as high a quality as the Mountain Cut. These differences are no more however than what one encounters almost daily in dealing with Oriskany ore-bodies. Still greater differences often occurring within much shorter distances on what are unquestionably the same ore-bodies. My study of the structural conditions, which after all are the only sure guides in such a case, have convinced me that the Low Moor Co.'s No. 9 Cut, the cut on the S. E. flank of A. Hill, and the big Mountain Cut, are on the same lead of ore.

Referring to my sketch plan of the Mountain Cuts, it will be seen that there are three cuts, which I have designated as (a), (b), and (c). In the cross - section constructed along the line A-B, I have attempted to express the structural conditions, which have reduplicated the same ore lead so as to make it appear as if there were three leads instead of one. I may add that this section is confirmed by a long drainage tunnel (1700') which has been driven from near the drill-hole shown as being in mountain sand, under cut (c) to the N. E. end of cut (b).

Cut (a) is on what may be termed the true out-crop of the ore-lead. This appears to be in line with the Flat Woods Cut about 1000' to be N. E. The N. E. end of cut (a) still carries ore, as does the S. E. side. The work was abandoned

temporarily however, as the stripping was getting heavy and cheaper ore could be won elsewhere. At the S. W. end, the ore pinched out.

Cut (b) is on an over-thrust fold which has brought the ore-vein back to the surface once more. This fold may possibly terminate about at the S. W. end of cut (a), this being the reason why cut (a) pinches out. From that point westward cut (b) may be said to represent the true crop-line.

Large supplies of ore are still available from cut (b). At the S. W. end a slight disturbance has led to some confusion in following the ore, and it was believed that the ore body had pinched out. This does not seem to be necessarily the case however, and further development may lead to the continuation of the cut in this direction. The present face at this end is some two to three hundred yards distant from the N. E. end of the open cut on the S. E. flank of A. Hill. There is much ore still left in the bottom of cut (b) and along its S. E. side, which can be taken with a steam shovel with not too heavy stripping. At the N. E. end the vein is seen at the point which I have marked as "not prospected", but has not been opened up.

At the time of my visit one steam shovel was working in cut (b), taking alternately stripping and ore.

Before leaving Cut (b) I may refer to a body of ore which was found underneath the foot wall flint. This I am told proved to be a mere pocket of very limited extent in any direction. It is probable that the descending mineral-bearing solutions found a small crack or fissure in the flint-bed at this point and made their way through this fissure to a slight extent, depositing

their burdens underneath.

Cut (c) is on the crest of a subordinate anticlinal arch. This arch was first discovered in the drainage tunnel referred to above. It was then developed by drilling and finally stripping was started. Its crest has a cover of 15 to 20 feet of waste for a length of perhaps 300 or 400 feet; beyond this extent, it plunges both to the N. E. and to the S. W. It is thus rather a buckling as it were, in the shape of a flat half-melon, rather than a true arch. One shovel is busy today in cut (c) partly on waste; while a second shovel is starting in to strip from the N. E. end (from the cut approaching cut (b), and going S. W.).

Considerable drilling has been done in the territory between cuts (b) and (c) and the ore bed has been discovered underneath, but with a cover of about 80'. Some drilling has been done to the South of cut (c). On my sketch plan I show the approximate relative position of the two most significant holes. One of these has caught 16' of ore at a depth of 211'-227'. Cap-rock began at about 150'. The other situated a few hundred feet to the East, appears to have been in the underlying sandstone practically from the start. The S. E. crop line must therefore lie somewhere between these two holes, somewhat as indicated in the sketch.

The quality of the ore taken from the various cuts described above has been according to report uniformly good. The ore from cut (a) was much lower in manganese than that from cuts (b) and (c).

The three steam shovels are all of the Bucyrus make. The shovels are served by 6 narrow-gauge dinkeys, and small ore cars carrying about 5 to 7 tons each. A narrow gauge railway of

about 2 miles in length with grades up to 6% and sharp curves connects the workings with the camp, and with the washer which lies about half a mile further to the South of the camp.

(3) The Flat Woods Cut

This is a single cut, about 1500' long and bearing N. E. to S. W. It appears to be in line with cut (a) of the Mountain cuts and is about 1000' distant.

This work has been temporarily abandoned and the tracks partially withdrawn, though there is much ore still left in the bottom and along the S. E. side. The S. W. breast also shows ore; this breast was stopped chiefly on account of water flowing in from the neighboring ravine.

The ore from this cut was of very fair quality and I understand carried some manganese - in this respect differing from the (a) Mountain Cut with which it lines up.

A number of drill holes South and South-East of the Flat Woods Cut are said to have shown thick ore.

(4) The Fairbank Cut

I did not visit this cut. I am told that the ore-lens is good as to quality but very much shorter than the ore bodies to the S. W., being only some 200 feet long. It trends N. E. - S. W., lining up approximately with the Flat Woods Cut 1-1/2 miles distant.

A Thew Automatic Shovel operates the Fairbank Cut, being served by one narrow gauge dinkey locomotive.

It is out of the question for me to attempt any estimate of the ore still available from the Lignite Mines. My trip was a hurried one and no maps or plans were placed at my disposal. Such distances as I have given above are all guess work.

Mr. Stull informs me that, whereas, Mr. D'Invilliers estimated some years ago that there were there still five million tons of ore on the property. It is his opinion that three millions would cover it all very generously today.

There can be little doubt but that there are still large quantities of ore available; very roughly perhaps several hundred thousand tons may yet be taken with a steam shovel and a further million or more tons by underground methods. This at least I may say without hesitation, that while the bulk of the cheap ore has been removed, the Lignite property is still a valuable one; certainly one of the best in this vicinity.

The present rate of output is said to be about 7000 tons of washed ore per month.

The Washer

All railway tracks above the washer are narrow-gauge, there being probably not less than three miles of such tract on the property with maximum grades on the main lines up to 6%, and sharp curves. The crude ore is brought down from the various cuts to the washer in small jimmies holding from 5 to 7 tons each. The heaviest of the seven locomotives weighs 27 tons.

Three jimmies may be spotted at a time over the crude-ore bin. From this bin the ore travels over a bumping screen, all over-size going to a crusher and all under-size going to two pairs of steel logs. Revolving screens follow the logs and the crusher and all material over two inches goes to the picking belt. It will be noted that the material passing through the crusher is not washed by the logs; it is rinsed in the screen but discharges onto the picking belt with a good deal of mud and clay still clinging to it.

Everything through the 2" revolving screens is elevated to a series of classifying screens and is sized and distributed as follows:

2" - 1-1/2"	- Am.	Concent.	Co.	Eccentric	Jig.	Single	compt.
1-1/2" - 1/2"	"	"	"	"	"	"	"
1/2" - 1/4"	"	"	"	Differential	Jig	three	compt.
1/4" - 3/64"	"	"	"	"	"	"	"

Through 3/64" is wasted.

The differential jigs operate their plungers by means of a cam and spring, thus getting a retarded settling. Fresh water is fed in on top of the plunger and is admitted below round the plunger as this rises; this feature still further contributes to the retarded settling. These jigs are said to do excellent work.

The washed ore is discharged from bins into standard gauge, C. & O. R'y cars, the spur track from the main C. & O. line being about one-third of a mile long.

C. M. Weld

Low Moor, Jan. 29th, 1912.

Allegheny Ore and Iron Company
Lignite Mine

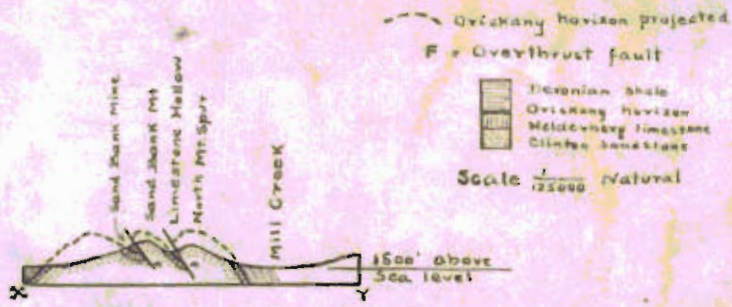
Section on Line A-B

Sketch Plan of Mountain Cuts with Cross-Section

No Scale

× indicate position of steam shovels.

Jan 25th, 1912



GEOLOGICAL CROSS SECTION ON LINE X - Y

LOOKING NORTH EAST

SKETCH-MAP TO ACCOMPANY REPORT ON

D.S. COOK'S NORTH MOUNTAIN PROPERTY

BOTETOURT AND ROCKBRIDGE COUNTIES, VIRGINIA

SCALE 1/125000 - 1" = APPROXIMATELY 2 MILES

NOTES ON THE CRANE EXPLORATION

CRAIG COUNTY

C. M. Weld

Low Moor, Va.

April 25, 1912

COPY

Notes on the Crane Exploration
Craig County, Virginia.

On April 19", Mr. D. A. Karr, Supt., at the Fenwick Mines, visited the explorations now being conducted on a portion of Major Anderson's land in Craig County, Virginia. The following notes are based on his report made to me.

The tract under exploration lies some 10 to 12 miles West of the Craig valley branch of the C. & O. R. R., and about 17 miles by road West - South-West from Fenwick. From this description it would appear to be situated somewhere along John's creek on the S. E. side of Potts mountain. The work is being conducted by Mr. Porter Clark under the direction of a Mr. Hancock, mining engineer, on behalf of the Crane Valve people. The option held by the latter expires next June, with the privilege of renewal for an unknown period. It has been the intention to devote $10,000 to the work of prospecting; of this about $7000 is said to have been spent to date.

It appears that the explorations lie on both sides of a N. E. to S. W. valley, the ore croppings representing the two edges of a synclinal trough about 1800 feet across. All the successful explorations have been on the S. E. side, where the ore crops boldly at several points, dipping to the N. W. Only 3 or 4 drifts were put in on the N. W. side of the valley and these were barren.

On the S. E. side there are 14 or 15 drifts and 26 drill holes. The drifts have encountered ore from 14 to 24 feet thick, over a total length of crop line of 1500 to 2000 feet. The greatest depth below the crop cut by any of these drifts was about 30 feet. Of the 26 drill holes/ 16 found ore, with an average thickness of 16 feet, overlaid by an average 30 feet of cover. Mr. Karr reports that decidedly the best ore appears in the original croppings, the vein turn-leaner with depth.

Mr. Hancock is said to have estimated a tonnage in sight to-day above the drifts of half a million. My estimate for the ore developed from the crop line down to the lowest drifts, treating the figures given above generously, would be:

$$\frac{2000' \text{ long} \times 19' \text{ av'ge thick.} \times 50' \text{ deep}}{27} = 70{,}000 \text{ tons.}$$

(Signed) C. M. Weld

Low Moor, Va.

April 25, 1912.

REPORT ON BRECKENRIDGE COVE AREA

C. M. Weld

Low Moor, Va.

May 31, 1912

E. C. Means, Esq., Pres.,

Low Moor Iron Co. of Va.,

Low Moor, Va.

Dear Sir:-

On April 25", I handed you a description of the Brackenridge Cove explorations, based on a report made to me by Mr. D. A. Karr, superintendent of our Fenwick mines. I myself visited Brackenridge Cove on May 24", accompanied by Mr. Karr. Mr. Porter Clark, who is in charge of the exploratory work, received us hospitably. I now beg to hand you the following report, based on my own observations, and would ask you kindly to substitute this present report for the previous one.

I attach two figures. Fig. 1, shows the position of Brackenridge Cove in relation to New Castle, Barbours Creek, etc. It is included in a tract of 16,495 acres belonging to Major W. A. Anderson and others, and described as lying on Potts, Fork, and Bailey's (Bald) mountains and on waters of Barbours Creek, in Alleghany County, Va.

The Cove is situated on the headwaters of Cove Branch, a tributary of Barbours Creek, far up on the flanks of Potts mountain. Spurs from Potts mountain enclose the Cove on the South and East, while the main ridge borders it on the N. W. Cove Branch breaks out of the Cove on the S. E. side. The general elevation of the floor of the Cove is 2,350 ft. above sea level. The elevation at Barbours Creek P. O. is about 1300.

The distance from the Cove to Barbours Creek P. O. in a bee-line is six miles; by road the distance is about twelve miles. A railroad line to connect with the Craig Valley branch line of the C. & O. R. R. would have to follow the waters of Cove Branch and Barbours Creek, and would be not less than twelve miles in length.

The exploratory work, while being conducted by Mr. Porter Clark, is under the direction of Mr. David Hancock, consulting mining engineer, Potter Bldg., Birmingham, Alabama. Mr. Hancock's principals are the Cranes of the Crane Co. of Chicago. I am told that the Cranes' option on Major Anderson's property expires this coming June, but is subject to renewal for an unknown period; further, that it has been the intention to devote $10,000 to the exploration of the iron ores of the property, of which $7000 to $8000 has been spent to date.

I find that a small roughly canoe shaped synclinal basin of Oriskany measures occupies a part of the floor and flanks of Brackenridge Cove. I show the outlines of this basin on Fig. 1, and again on a larger scale on Fig. 2. The latter figure also represents a rough sketch of the explorations. The basin is completely surrounded by the underlying Clinton sandstones.

The Oriskany ore-bearing horizon crops boldly along a portion of the S. E. leg of the basin, showing ore at many points. This stretch of crop line has been the chief seat of exploratory work. Three drifts were put in on the N. W. side, where Oriskany measures cropped out, but all three were barren. Nowhere else in

the Cove has the mineral showing on the surface, as far as discovered, encouraged exploration.

On the sketch map, Fig. 2, I show seven drifts, with their records, along the S. E. side; also one shaft and eight drill holes. There has been sunk a total of 14 drill holes on this side, but I have sketched in and given the records for only the more significant ones. There are 15 other drill holes, at various points in the Cove, all barren; some stopped in slate, others passed through barren Oriskany measures to flint. The thirtieth hole was in the process of drilling on the day of my visit, being located in the center of the basin, near Cove Branch; it was then down about 30 ft. in slate.

Fig. 2, tells the story of the explorations. It will be seen that the good and thick ore caught in Drift A, and by drill holes in its neighborhood, pinches out within 300 ft. to the S. W. It has not been traced northwards. At Drift D two veins come in with clay between; evidently there is a slight over thrust fault here. At Drift E there is only one vein, eight feet thick. This vein about holds its own to the S. W. end as shown by the drifts and shaft, but drill holes 6 and 8, a little down hill from the line of drifts, were barren. The great thickness of ore measured in Drift F is due to the flat position of the vein at that point.

In general Mr. Clark tells me that the richest ore has been found directly on the crop; that all ores found in the drill holes were leaner than the surface showings.

I am told that Mr. Hancock estimates about half a million tons of ore proved up by the present explorations along the S. E. side of the basin. I am at a loss to reasonably account for such an estimate. The deepest drill hole in ore (No. 1) encountered 12 ft. of ore at a vertical depth of 200 ft. If we assume for the moment that the entire 1800 ft. explored, can be said to have been proved to carry ore to a vertical depth of 200 ft. or say 230 ft. to allow full measure to the crest of the outcrop, (this would be 460 ft. on the vein assuming an average dip of 30°) and that the average thickness has been shown to be 15 ft., then we shall arrive at an estimate of something less than half a million tons. A glance at the explorations as recorded on Fig. 2, will show however how altogether untenable the above assumptions are.

Treating the actual results of the explorations in a most generous mood, I arrive at an estimate of approximately 60,000 tons. Treating then with stricter conservatism, I arrive at half this figure, namely 30,000 tons. I should say that the present work would justify an <u>outside</u> estimate of not more than 50,000 tons of ore in sight.

To get this ore to market Mr. Hancock proposes to build a narrow gauge railroad from the Cove, for a distance of about three miles, to the Eastern point of the spur which bounds the Cove on the South; there to construct a gravity plane of a couple of thousand feet more or less in length descending to the

bed of Cove Branch; from which point a standard gauge railroad will be built to the C. & O. R. R. at Barbours Creek Station.

I consider the ore so far proved up in Brackenridge Cove as totally inacessible from a commerical point of view, and I am inclined to believe from present indications that not enough ore will be found on this portion of the Anderson property alone to ever warrant the heavy expenditures which will be necessary to market the ores.

There is a "front vein" on the property, so indicated on Fig. 1, which, while more accessible and I believe of better promise than the Cove ores, has so far not been explored. This vein lies only a little way inside (N. W. of) the Anderson-Dickerson line, and since it dips to the S. E. would therefore soon pass out of the Anderson and into the Dickerson lands when followed on its dip. There is a broad crop line on the Anderson side of the of the line however, suggesting the possible existence of a considerable tonnage of cheap open cut ore at that point. I regard it as unfortunate that at least a portion of the time and money which has been devoted to the Cove explorations was not expended in the direction of proving up the possibilities of this "front vein."

I was told that it was at the instance of Major Anderson that the Cove was selected for exploration, it having been reported to him some years before by a Mr. Hannah, now deputy county clerk, I believe, for Botetourt Co., that at least one million tons of shovel cut ore existed on that portion of the

property. Mr. Hannah based his report on a very few superficial explorations.

Should at some time in the future the "front vein" be proved to be of sufficient value to warrant building the necessary railway approach, plant, camp, etc. for the marketing of its ores, then the Cove ores would perhaps justify the necessary extension of transportation facilities for their extraction. In other words, in my opinion, the "front vein" must be shown to be good enough to carry the entire expense of railway approach to that point, plus the camp, washer, etc. In such an event, the Cove ores could probably bear the expense of the necessary railway extension from the "front vein" territory, upwards; but they could not share in carrying the cost of plant, etc.

Under any conditions, other than the above, where the "front vein" must constitute the real asset and the Cove be merely an accessory, I do not consider that the Cove ores as developed to-day possess, or are likely to possess, any potential value. In the meanwhile, the ores of the "front vein" are certainly more worthy of exploration than those of the Cove.

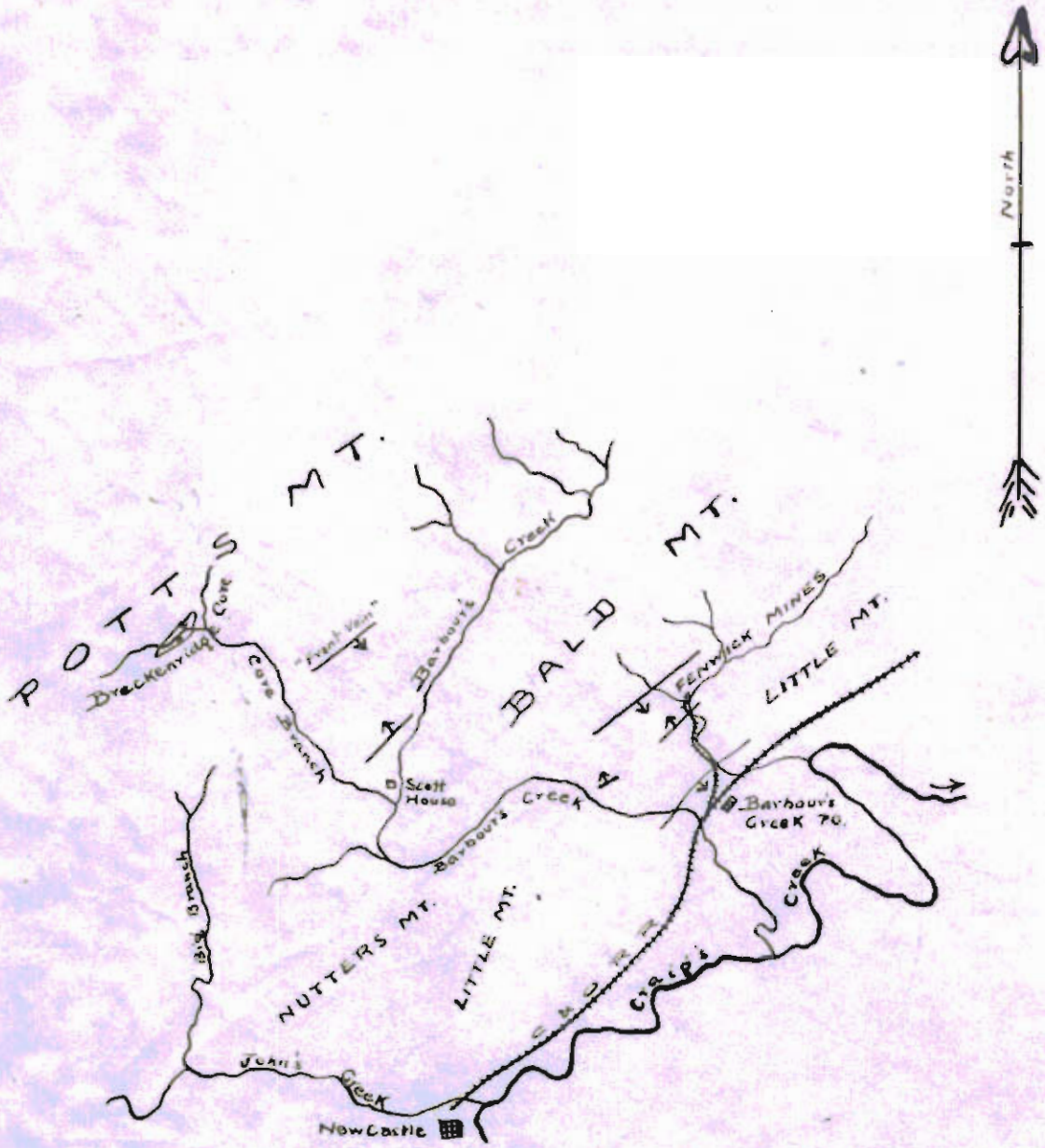
Respectfully submitted,

(S) C. H. Weld

Low Moor, Va.

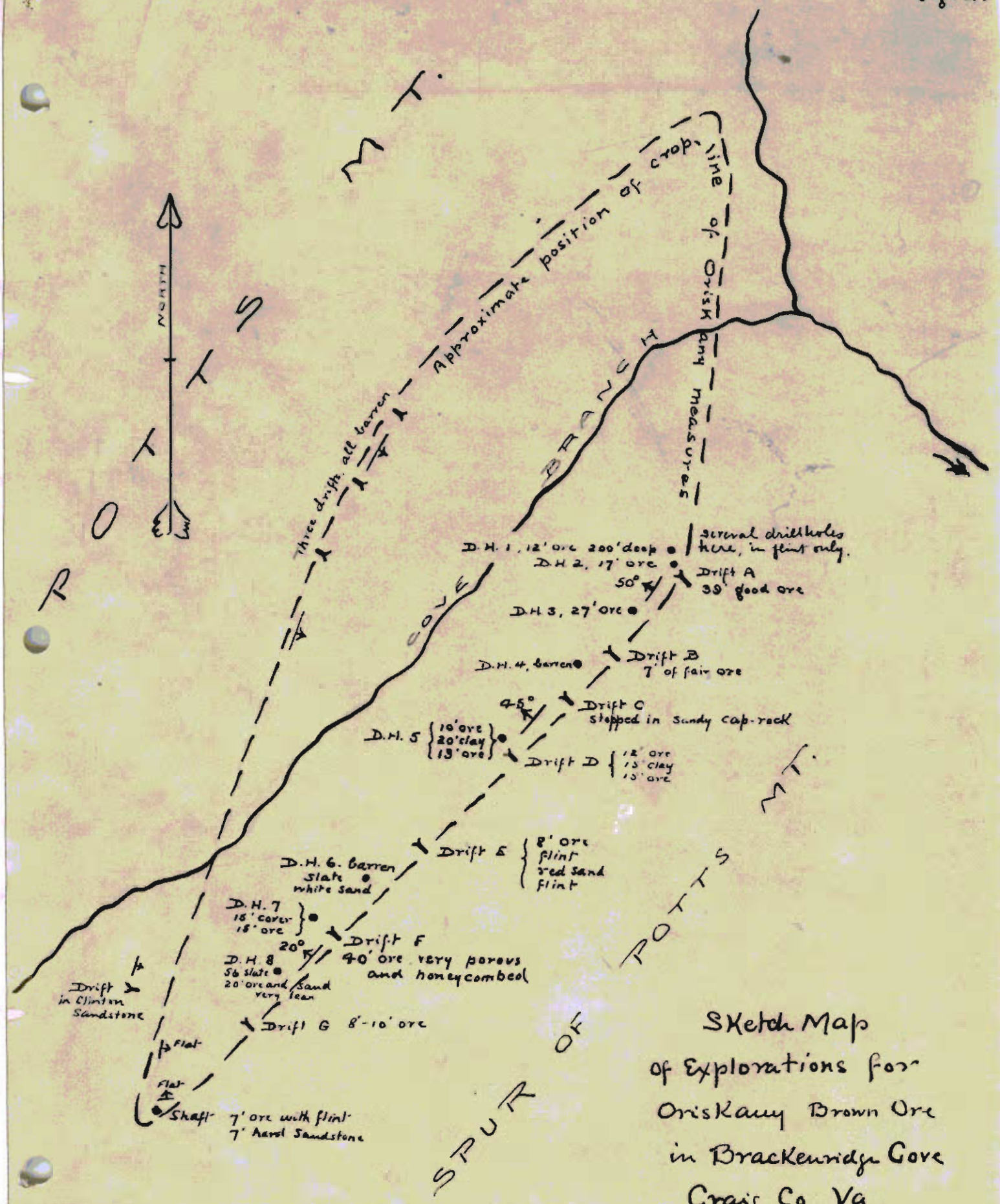
May 31, 1912

Fig. 1.



Sketch-Map Showing location of
Brackenridge Cove
With reference to New Castle, Barbour's Creek, etc.
indicates Oriskany crop-line, with dip.
Scale 1" = 2 miles

Fig. 2.



Sketch Map of Explorations for Oriskany Brown Ore in Brackenridge Cove Craig Co, Va.

Approximate scale, 1" = 300'

REPORT ON NORTHEASTERN PART OF

CRAIG COUNTY, VIRGINIA

C. M. Weld

Low Moor, Va.

Nov. 8, 1912

Mr. E. C. Means, Pres.

Low Moor Iron Co. of Va.,

Low Moor, Va.

Sir:

I attach a sketch map of the area in Craig Co. Va., lying between Potts Mountain and Craigs Creek, Lignite Mines and Johns Creek Mountain. I have traversed this area on three different occasions, as follows:

The first of these journeys (May 24th 1912) was made for the purpose of visiting the prospecting work then in progress in Brackenridge Cove (marked No. 1. on the map). I started from Fenwick and returned to Barbour's Creek depot. Incidentally I briefly examined some other outcrops and prospects on the way.

On the second occasion (Sept. 26, 1912) I rode from Jordan across Potts Mountain by way of the Fincastle Turnpike, passing Brackenridge Cove and the Scott House, to New Castle. On the following day, taking Mr. W. M. Echols (Craig Co. Surveyor) with me as guide, I examined the Peters Hill prospects, and thence re-ascended Potts Mountain where Mr. Echols showed me two other Oriskany outcrops and prospects which he regarded as the best in that district. I returned to Jordan by way of Paint Bank.

My third journey (Oct. 10, 1912) was made from Jordan directly across Potts and Bald Mountains into Fenwick. Again on the day following I traversed the territory S. W. of Fenwick as far as Johns Creek.

Some time before my visit to Brackenridge Cove I had visited the prospects on the J. Q. Dickinson land immediately West of the Fenwick boundary.

I have indicated on the sketch-map the approximate probable positions of the several Oriskany leads as these were traced out by me in the course of my traverses; also the points (by numbers) where Oriskany ore outcrops or indications were either actually examined by

me or were reported to me to exist.

The geological structure of this area is easily recognized. Along the line A-B (see sketch map) there are three successive anticlines with intervening synclines. The anticlines straddle Potts Mountain, Bald Mountain, and Little Mountain. On these mountains the underlying Clinton Sandstones come to day light. Along their flanks are found the Oriskany measures, while the Barbour's Creek, Fenwick, and Craigs Creek Valleys are occupied by the Devonian slates. The Fenwick syncline goes into the air at about the S. W. end of Bald Mountain, its S. W. end pointing towards a small synclinal wedge coming up from the S. W. between Nutters and Little Mountains. The Bald Mountain anticline finds its S. W. nose in Peters Hill, beyond which it plunges beneath the slates. At about the N. E. end of Nutters Mountain, the Bald Mountain and Little Mountain anticlines are practically one.

I believe these structural relations are clearly brought out on the sketch-map and in the geological cross-section shown in the lower left-hand corner. I am told that there is another Oriskany lead lying along the N. W. flank of Johns Creek Mountain and dipping to the N. W. I have not shown this on the map as I did not personally observe it, but its existence would be perfectly in accord with the structures shown and it therefore probably does exist. No ore prospects of promise were reported from that direction.

Following is a description of the points shown by numbers on the map, and a discussion of their probable commercial value.

I have already reported, under date of May 31, 1912, on the Brackenridge Cove explorations (No. 1.) The fairly extensive explorations had in my opinion revealed less than 50,000 tons of ore, in a highly inaccessible position, and I concluded that the deposit possessed no commercial value. Work has since been discontinued.

Points Nos. 2, 3, 4, 5, and 6 are on the same lead along the S. E. flanks of Potts Mt. No. 2. is a mere surface indication of the presence of the Oriskany measures, observed by me as I crossed the Ellis and Anderson 1015 acre tract coming down Potts Mt. towards Barbour's Creek. There is said to be a small showing of ore a mile or more to the N. E. on the Alum Springs 75 acre tract. No. 3 is on the Anderson land. This showing has already been described and discussed by me in my report on Brackenridge Cove (Page 5) under the designation of "Front Vein". While of no great promise in itself, I felt that this locality was more deserving of exploration than the Cove deposit, chiefly owing to its greater accessibility. Even here 8 to 10 miles of railroad would be required to market the ore, should any be discovered. No. 4 is a showing of ore reported to me as existing on the H. C. Wright 155 acre tract. I did not visit it because Mr. Echols advised me that the surface croppings there did not give as much promise as at the two points next to be described. Nos. 5 and 6 are on land belonging to the Mountain Lake Land Co. There are abundant croppings of "Cap-rock" at both points but the results of the small amount of prospecting work are discouraging, in as much as no ore was revealed underneath the capping.

In brief, all these points give little promise and are furthermore relatively inaccessible. Only No. 3 possesses some slight interest.

Points 7, 8, 9, and 10 are on the N. W. dipping lead lying along the N. W. flanks of Bald and Nutters Mt. Here again there is nothing so far discovered of any promise. No. 7 is a small showing of ore near Lone Rock on the Fork Mt. tract of land; No. 8 is on the J. W. Price 77 acre tract; No. 9 is on the P. S. Lewis 152 acre tract, and No. 10 is on the J. Q. Dickinson 92 acre tract. The small amount of prospecting done at the last three points met with no particular encouragement.

On my journey from Jordan to Fenwick across Potts and Bald Mts., I crossed this lead about on the cross-section line A-B; I was able to identify the Oriskany horizon but saw no ore.

I may add that this lead represents the S. E. limb of a syncline, a fact which according to the rule for Oriskany ore-deposits in the Alleghany-Craig district would probably preclude it from being ore-bearing to any commercial extent, since the S. E. limbs very generally stand at high angles of dip and are even not infrequently overturned. Such an attitude is unfavorable to the accumulation of an ore-body. At the S. W. end, near Peters Hill, the dip probably flattens out, but nothing of value appears to have been discovered even there (e. g. at points 9 and 10).

The property known as Peters Hill - No. 11 - lies at the S. W. end of the hill and on the nose of the Bald Mt. anticline. The ore prospects are in the Western portion of the J. L. Dickinson 1372 acre tract. The ore appears to lie in a thin capping over the crown of a low hill and along the S. E. flank. It also crops out along the County road on the North edge of the property, where it dips to the North. At one point 50 to 100 tons of ore of excellent quality have been dug, and at other points also the ore is of satisfactory quality. Everywhere however, one gets the impression that it is thin, an impression which could only be dispelled by a very considerable amount of successful exploration. The prospecting so far accomplished has been to a certain degree abortive.

My opinion regarding this property is that it probably deserves exploration. It is fairly accessible and there is opportunity for developing a good tonnage of open cut ore. The existence of this ore has not as yet been proved however, and the property as it stands today can only be regarded as a fairly promising prospect.

and for this reason would probably be worthless were it not for the fact that a local buckling of the measures appears to have produced locally flat dips. As it is, the several prospect openings give sufficient promise to encourage further exploration, particularly in view of the accessibility of this point. No. 17 is on the same lead with the Lignite and Fenwick No. 8 mines. This lead swings round to the N. W. of the Fenwick No. 3 mine, giving very scant exposures until it crosses the Dickinson boundary. Here it shows up once more with fairly abundant croppings and has been prospected at three or four points. While giving some promise, the vein appears on the whole to be thin.

I have described in the foregoing pages all the points known to me within the area under discussion, where Oriskany ores have been found. In general it may be said that the prospects are poor. I consider No. 16 most worthy of exploration especially perhaps in conjunction with No. 17. I am no doubt somewhat influenced in this opinion by the proximity of these two points to our present Fenwick operations, which would make their approach a less expensive matter than in the case of the other points. Aside from this consideration, Peters Hill - No. 11 - is probably the best prospect, but I do not regard even this as giving very great promise. Next after Nos. 11, 16, and 17 I should rank No. 3.

I may conclude with the general opinion that on the whole I should be inclined to look elsewhere than in this particular corner of Craig County for our future ore-supplies.

Respectfully submitted,

(S) C. M. Weld

Low Moor, Va.

Nov. 8, 1912

No. 12 is on the M. M. Walkins 205 acre tract. A couple of small cuts have revealed a thin bed of ore. Just to the N. E. an incomplete section can be seen in Johns Creek where my measurements were as follows:

Devonian:	Slate.	
Oriskany:	Iron-stained "Cap-rock"	18 ft.
	Gap (river-gravel)	101 "
	Yellow-white quartzitic Sandstone	97 "
Helderberg:	Thin-bedded muddy limestone	205 "
Clinton:	Sandstone.	

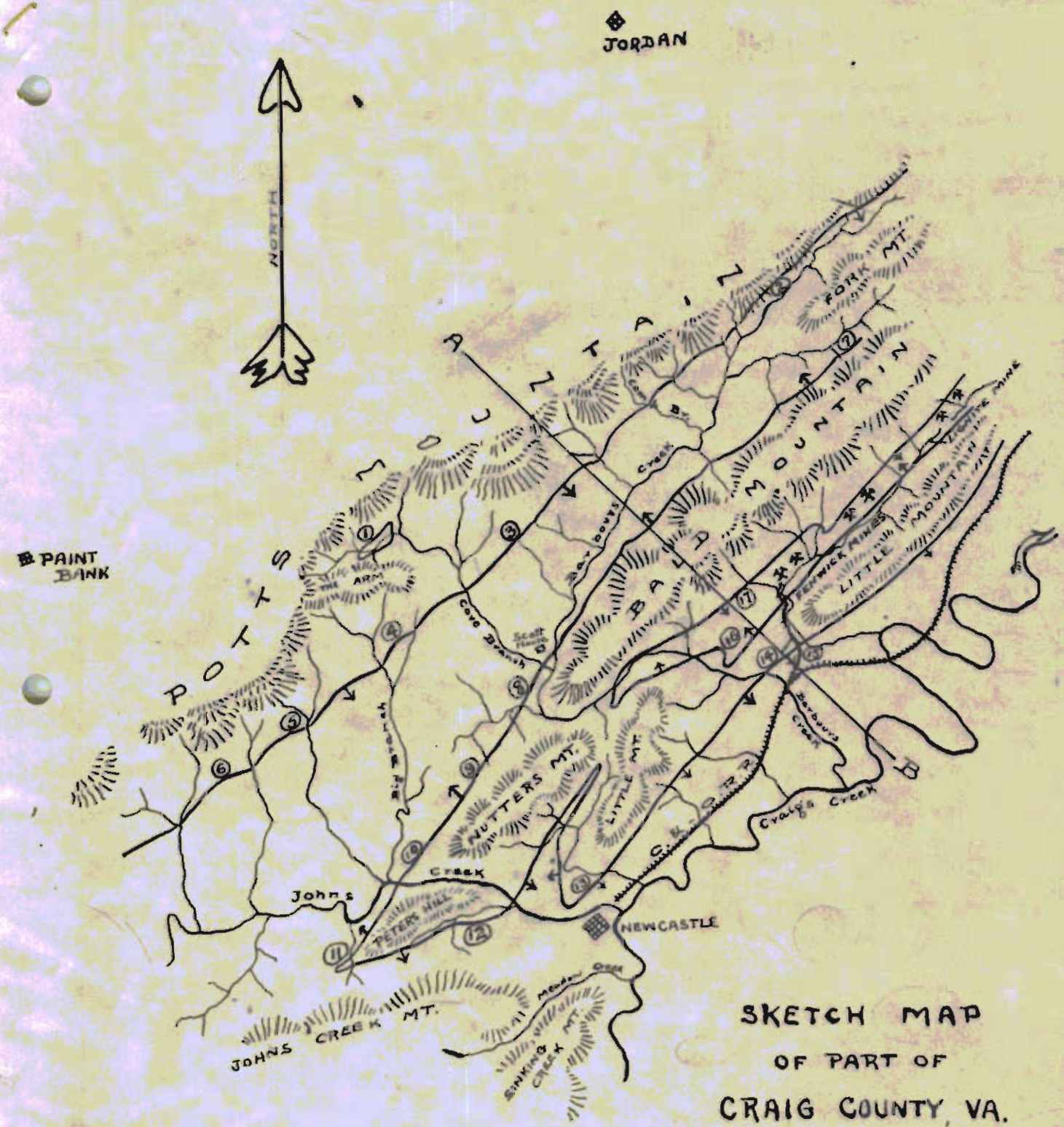
The ore-bearing horizon should occur immediatly beneath the "cap-rock". Unfortunately nothing could be seen in place at that point owing to the heavy accumulation of river-gravel. The measures dip to the S. E. at from 40 to 65 degrees from the horizontal.

No. 13 is a small prospect, of little promise, lying North of New Castle on the lands of the Craig City Improvement Co. A few wagon loads of ore were dug and shipped from here.

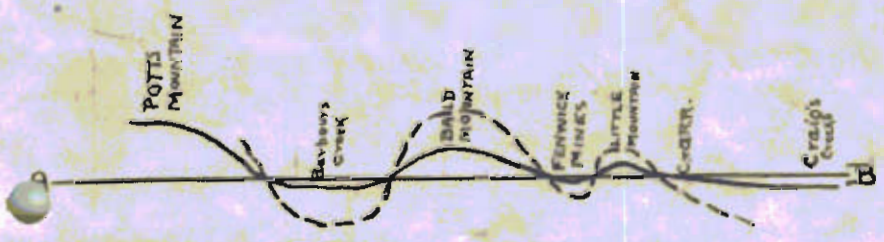
At Nos. 14 and 15 good exposures are had of the Oriskany measures but ore is practically absent. No. 14 is on the County road near Ripley's Mill and No. 15 is on the L. M. I. Co's railroad just below the Fenwick washer. In both cases the measures are thin and barren. Further N. E. a small railroad cut reveals the same condition of affairs.

The lead on which Nos. 13, 14, and 15 are situated is traceable for many miles to the N. E., in all probability being the same lead which passes close by the Roaring Run furnace and on which the Circle, Callie, and Wilton mines are working. At its S. W. extremity it appears to be worthless.

Nos. 16 and 17 are on J. Q. Dickinson land, being on opposing limbs of the Fenwick synclinal trough. No. 16 lies on the S. E. limb



SKETCH MAP
OF PART OF
CRAIG COUNTY, VA.
SCALE, 1" = 2 MILES



GEOLOGICAL CROSS-SECTION ON A-B
LOOKING NORTH-EAST
--- = Oriskany horizon.

= Oriskany Crop-line
②, ⑨, etc. = Ore prospects
⚒ ⚒ = Mines

NOTES ON THE JORDAN ORE LANDS
POTTS CREEK VALLEY
ALLEGHANY COUNTY, VIRGINIA

C. M. Weld
Low Moor, Va.
Jan. 18, 1912

NOTES ON THE JORDAN ORE LANDS

POTTS CREEK VALLEY

ALLEGHANY CO., VIRGINIA

L A N D S.

The lands in question are situated in Alleghany Co., Va. Very roughly they form a quadrangle of about 6-1/2 miles long by about 5 miles wide, the longer axis lying N.E.-S.W.

The S. W. boundary is a S. 45°E. line drawn through the Potts Creek P. O. and extending from the crest of Peters Mt. on the N. W. to the crest of Potts Mt. on the S. E. The N. W. boundary is the crest of Peters Mt. while the S. E. boundary is the crest of Potts Mt. Thus the area represents a complete section for about 6-1/2 miles of the Potts Creek Valley, from crest to crest of the enclosing mountains. Potts Creek meanders through the floor of this Valley in a generally North-Easterly direction.

The quadrangle described above would include something over 20,000 acres. Of this acreage:

-------- acres were in the P.V.M.&M. Co. lease to the L.M.I. Co.

-------- acres are owned in fee by the L. M. I. Co.

-------- acres belong to other companies and individuals.

To the first of the above I shall refer hereafter as the "leased land".

G E O L O G Y

Structural Features

We have seen that topographically the area under discussion consists of a great valley, bounded on the N. W. and S. E. sides by two mountainous ridges. Structurally the underlying measures of rocks likewise form a great valley or trough, with its axis parallel with that of the surface valley, and roughly conformable with the latter. Thus, along the two bordering mountainous ridges we find the older rocks cropping out and dipping towards the valley, where they plunge and disappear beneath younger rocks, these latter occupying the greater part of the valley proper.

Such a structural trough is known in geology as a syncline. The reverse, being an arch-like fold, is termed an anticline.

Just as the valley is not a perfect trough however, but presents many minor hills and ridges within its borders, subordinate to the main features but still conspicuous in themselves; so too the great structural trough has many minor alternating troughs and arches superimposed upon it, local crumplings and corrugations, warpings, bucklings, and small tight folds, the latter not infrequently resulting in small breaks where the measures have parted and slipped over one another (known as over-thrust faults).

Thus the older rocks, while occupying altogether the crests and higher flanks of the mountains, also reappear here and there within the valley where the crests of the minor arches have been

denuded by the wearing away of the younger rocks through destructive surface agencies.

Whereas a simple trough-like fold is, as noted above termed a syncline, as complex trough such as I have just described, being a great syncline including a number of small alternating snyclines and anticlines, is termed a synclinorium.

In short then, the section of Potts Creek Valley under discussion presents what is known in geology as a snyclinorium. The older rocks crop along the mountain tops and flanks and disappear beneath younger rocks in the valley, being revealed again here and there however where the latter have been worn away along the crests of the minor arches or anticlines of the latter.

It will be of interest to note that from July 1st to Nov. 23rd, 1911, there were handled and produced at the Potts Creek, "Jordan" mines:

22,916 tons of Waste and

67,790 tons of Crude Ore, which latter yeilded

29,355 tons or 43.3% of Washed Ore

The Washed Ore was 32.3% of the total amount of material

THE POTTS CREEK ORE LANDS.

General Remarks

Up to the present I have dealt on the whole with Oriskany iron-ore deposits in general, seeking to bring out their essential characteristics; in some instances I have referred more directly to the Oriskany deposits occurring on the Potts Creek Valley leased lands. Hereafter I shall refer wholly to these latter.

The leased lands include roughly 18000 acres. I have once or twice been asked what portion of these lands is underlaid by Oriskany ore-bearing measures. My answer must be, a very large portion, probably two thirds. Since however the obvious purpose of the question is to learn what portion of the lands may be underlaid by ore (not by ore-bearing measures), this answer, while literally correct, would be highly misleading.

We have seen that the ores in question always occur within the oriskany measures, and that it is for this reason that these latter have come to be known as the Oriskany ore-bearing measures. We have further seen however that only very small portions of the Oriskany measures are actually ore-bearing, and that these portions are by necessity at or near the crop. Thus it is only the crop and moderate depths below the crop that can be at any time regarded as potentially ore-bearing.

Therefore in considering what portion of a given tract of Oriskany ore land may be ore-bearing, we have to deal, not with the total portion underlaid by the Oriskany measures, but with the narrow ribbon of land as it were where the crop line of the Oriskany measures is known to exist.

By careful geological survey of the Potts Creek lands we have found that there are nearly 35 miles of Oriskany crop-line traversing these lands. If we assume the ribbon referred to above as averaging 200 feet in width, then 875 acres or about 5% of the total property is underlaid by potentially ore-bearing measures.

Statements of this sort are more commonly made in terms of tons however, rather than in terms of acres. The total feet of crop-line are multiplied by an assumed average thickness and depth and the result divided by a figure intended to represent the number of cubic feet in the ground required to produce one ton of washed ore; the quotient being the total ultimate possible tonnage, assuming that the entire Oriskany crop-line is commercially ore-bearing.

Of the 35 miles of Oriskany crop-line traversing the Potts Creek lands, roughly 20 miles lie along the mountain flanks, and 15 miles represent the minor arched folds denuded along their crests and therefore projecting through the younger rocks within the valley proper. If now we assume that these 35 miles represent a continuous bed of ore 15 feet thick and 200 feet deep, and divide the volume thus assumed by 27, we arrive at 20 millions for the total ultimate tonnage offered by these lands.

Such an estimate as this can be regarded only as a first rough figure, based on preliminary data, before any actual examination for ore has been undertaken. Its sole value would lie in determining whether or not such an examination would be worth while.

The Potts Creek lands have been examined throughout, the result being the elimination of all but between 8 and 9 miles out of

the 35, as barren of any surface indications of ore. Thus all but about one-fourth must be discarded at once, and we have left about 220 acres or about 1.25% as still possibly ore-bearing after the first examination. Our ultimate possible tonnage is likewise reduced to one-fourth, namely, 5,000,000 tons.

The next logical step is to e xplore the 8 to 9 miles of crop line which the surface examinations has shown to give sufficient encouragement to warrant exploration. This also has been done. Let us see with what result.

Jordan Mines and Explorations.

Detailed descriptions of the various cuts, drifts, drill holes, etc., must be left for an appendix, and only summaries given here. I will take up successively the Peters Mt. side, the Mill Ridge anticline, and the Potts Mt. side, beginning in each case at the S. W. end.

Wolfe Mine

An old shallow cut showed a small amount of ore. This was known as the Wolfe Mine. Later, 11 drifts were put into the hill-side below the oriskany crop line. Six of these encountered lean ore mixed with sand. Two stopped in slate. Three were barren to flint. The length of crop-line thus explored was about 3500.

Pipe, Ore, Pilot Knob, Upper Bennett.

Three small open cuts or groups of open cuts were known by the above names. All are situated on a back fold of the Oriskany measures, encrusting the mountain side and entirely isolated from the

main body of measures. About 175 tons of ore were hauled out in wagons, chiefly from Pipe ore, and the deposits thereby exhausted. Three exploring tunnels driven below the cuts proved barren. These workings and explorations cover about 3000' of crop line.

Lower Bennett.

The explorations at this mine covered a crop-line of about 2500' Some ore was hauled out in wagons and the deposit thereby exhausted. In addition to the open cut, there were eight drifts and 19 drill-holes, all of which failed to develop anything worthy of further exploration.

Bennett Branch to Myers Branch.

This stretch of crop-line, being about 5000', presented slight surface indications which led to prospecting by means of 12 drill holes and six drifts. No ore bodies were discovered.

Hepler.

This has been one of the productive Jordan Mines. About 4000' of crop line (including the No. 2 or Upper Hepler Mine) have been throughly explored by open cuts, drifts, and drill holes. There have been not less than 150 of the latter put down, with a total depth of about 7000'. Within this length of 4000' of more or less encouraging surface indications, two ore lenses were developed, which we may term the Hepler or Main lens and the Crowder lens.

The Main lens was about 450' long. It has been worked wholly by open cut to a depth of 75 to 100 feet below the original crop, and has yielded about 50,000 tons of washed ore. The stripping is now so heavy (that is to say, there is so much waste to

handle to uncover the ore on the level which is now being attacked) that should there be any ore at lower levels it will have to be won by underground methods. There are 4500 tons (in terms of washed ore) still remaining in sight on the present level.

Little is known regarding the possibilities here for deeper ore. If however, we assume that the lens will continue for its present length (400' on the bottom) to a depth of 200' and with an average thickness of 15', we arrive at an estimate in round figures of 40,000 tons. This is not "ore in sight". Perhaps one third of it might be classed as "probable" ore, and the b alance as "possible".

The Crowder lens was about 350' long, but much of it too sandy to be mined at a profit. There have been produced about 10, 000 tons, and there are possibly 5000 tons left, too badly mixed with silicous ore and sand however to be mined with a steam shovel, since it all has to be sorted over by hand before sending to the washer. The possibilities here for deeper ore are very limited.

Thus the Hepler 4000' of Oriskany measures, after thorough explorations, following up the original favorable surface indications, have yielded about 60,000 tons of washed ore, and contain from 9000 to 10,000 tons still remaining in sight. Over half of this latter amount however is too badly mixed with silicous ore and sand to be handled otherwise than by hand. There are about 13,000 tons of "probable" deep ore, and further limited amounts of "possible" deep ore.

Jordan Peters.

Occasional surface indications led to the exploration of about 3000' of crop line along this stretch of peters Mt.

From two old cuts there were hauled in wagons from 400 to 500 tons of ore fair in quality. In the immediate neighborhood of these cuts, two prospect drifts showed 17, and 35 feet of ore respectively. Out of nine other drifts and one cut distributed along the crop line, one found 10' of ore, another 7', and two others only 5' each. The other 6 were barren. In view of these discouraging results I should consider an estimate of a possible 25,000 to 40,000 tons of ore in the vicinity of the old cuts and three successful drifts as very generous. As the construction of 3-1/2 miles of difficult narrow-gauge railway would be required to connect this showing with the Heller Mine (the nearest outlet), it is very doubtful if this ore body has any ultimate net value.

Helmintoller Nos. 1 and 2.

The Helmintoller Mine No. 1 is a single small cut which has exhausted a small knob or pocket of ore. From here to Hilmintoller No. 2 the measures are traceable, though with scant indications, till one approaches the No. 2 Mine. This again is a single small cut, through a ridge of "cap rock" to a small body of ore underneath. Possibly 250 tons of ore were wagoned out from these two cuts jointly.

Five drifts and two shafts as well as a number of small pits were dug in the vicinity of the No. 2 Mine but all were barren with the exception of one drift, which found some lean mixed ore.

These cuts and explorations represent about 2,000' of crop-line. Since the locality is inaccessible to the present washer site and would therefore require a separate washing plant as well as a great length of railway, only a large tonnage of good ore "in sight" could be regarded as of any value. There is no indication

of the existance of such tonnage.

The above complete all the stretches on the peters Mt. side where surface indications have led to prospecting, developments or operating. We turn next to the Mill Ridge anticline, beginning with the Black Oak Ridge.

Black Oak and Bess

The stretch of 4000' Oriskany measures has been thoroughly explored by drill holes, drifts, shafts and open cuts. Three mines were opened and railroad lines built to them, these being: the Black oak mine, 3 open cuts; the Red Ore Mine, 2 open cuts and some underground work; the Bess Mine, one extensive open cut. These mines were all finally abandoned owing to the very lean quality of the ore produced by them. Before they were abandoned they produced about 70,000 tons of washed ore of very inferior quality. The explorations included probably over 400 drill holes of which 316, with a total footage of over 12700' exist today. There were 24 shafts with a total depth of 390', besides 9 shafts whose depth is not shown by the records and which have now fallen in and can not be therefore measured.

Wasp Nest

The Wasp Nest ridge, representing about 1500' of Oriskany crop-line has also been extensively explored and operated. Over 250 drill-holes were put down; of these 204 still exist outside the cuts, with a total depth of 7400' Nine open cuts have been worked and have been exhausted with the exception of three, which will presently be described. There have been produced about 95,000

tons of washed ore, largely of an inferior grade.

The three cuts just referred to as not exhausted are the following:

The Ailstock cut has a breast of fair ore in sight, but drill holes in advance of this breast give no encouragement. It is true that the early drill holes were reported as showing a thick body of ore in this territory, but later work done to check the first work, disproved the presence of this ore. On the basis of the present showing it would probably be fair to estimate that there are about 10,000 tons of ore still available from this cut, of which perhaps half will be of good quality and the balance of doubtful quality.

Grant's Cuts has been exhausted on the present level, but drill-holes have shown about 7000 tons of fair ore at a lower level.

Caldwell's cut has likewise been exhausted on the present level, while drill-holes here show 13,000 tons more or less which may still be taken at a lower level, this further tonnage being of doubtful quality.

In addition to these three cuts there is an area which has been drilled and where about 20,000 tons of ore have been blocked out, the ore being however of exceedingly doubtful quality. This we may call the Hinkle-Dixon area.

In short then the Wasp Nest Ridge may be summed up today as offering about 5000 tons of probably good ore and a further 45000 tons of ore of doubtful quality but accessible.

Kempers Branch

A few hundred tons of lean ore were wagoned out from a couple of small cuts on Kemper's Branch. Subsequently drilling has

blocked out about 20,000 tons of ore of very doubtful quality.

The explorations, which cover about 1200' of Oriskany crop-line, include 56 drill holes with a total depth over 2800'; 2 shafts, 1 drift and 2 cuts.

We now turn to the Potts Mt. side beginning at the S. W. boundary of the property.

Evans Branch to Salt Log Run.

A stretch of about 1500 feet of Oriskany crop-line is traceable by means of abundant "cap rock" float. Six tunnels and two small cuts, however, failed to reveal anything more than a very little sandy ore.

Salt Log Run to Paxton Branch.

This stretch of 3000' has not been explored, though examination shows occasional patches of lean "caprock" float. Exploration of far more encouraging areas East and West failed to encounter ore-bodies. For this reason, this particular stretch was not explored.

Paxton Branch to Flat Rock Hollow.

At several points within this distance of about 3200' fairly abundant surface indications were discovered. These were explored by means of seven cuts and five drifts, all of which were in sand with here and there a little thin mixed lean ore. No ore body was encountered.

Flat Rock Hollow.

Three drifts and one cut in this territory discovered ore.

This led to drilling, and during the summer of 1911, 47 drill holes were put down with a total depth of 2264'. The net result was the discovery of an ore-body containing about 15,000 tons of ore under an average cover of 44.5'. As the ore averaged only 20.8' in thickness, this cover would prohibit surface mining. Hence the mining costs would be high, and the locality is too inaccessible to justify constructing a railway for so small a deposit. The explorations covered about 500' of Oriskany crop-line.

Double Ridge

This has been the most productive of the Jordan mines, the total output having been about 110,000 tons of washed ore, from eight open cuts. The total length of the ore lens was about 1200' though not continuous, there being barren areas within this distance. Some tight folding and over-thrust faulting duplicated the ore lead thus increasing the available tonnage over what it would have been had there been but a single lead; at the same time reducing the original expectations based on the assumption that there was a single very wide lead, instead of a succession of narrower leads with barren areas between, as proved to be the case.

Probably over 250 drill holes have been put down in this territory. There are 179 still standing today outside the limits of the worked areas, with a total depth of over 7000'. The total extent of these explorations along the Oriskany line is approximately 1700'. This work has pretty well defined the limits of the ore-bearing body and makes it possible to estimate with fair exactness how much ore is still remaining in the ground. This I estimate to be: 18,000 to 20,000 tons of probably good ore, well

placed for mining; 5000 tons of easily available ore but of doubtful quality; 7000 tons of probably good ore but isolated in such a way as to make it doubtful whether or not it can be mined at a profit. Total 30,000 to 32,000 tons. There are no possibilities here in the way of deeper ore.

From Double Ridge eastward there are three Oriskany crop-lines, the two to the North being due to a subordinate anticlinal fold or arch. Of the following described prospects, the first three are situated on the most Northern line, the following three on the middle line, and the last two on the Southern line or back fold.

Tipple Knob

About 300' of Oriskany crop-line showing surface indications were explored by four drifts aggregating over 150' of tunnel work. All were barren.

Sugar Run.

A drift was driven under the Oriskany crop-line from the Double Ridge R. R., a few hundred feet east of the stable, and encountered a very little lean ore.

Gaines Mine

This was the first cut from which shipments of ore were made. A few hundred tons of rather inferior ore were shipped to the Dolly Ann Washer, some four or five drill holes were afterwards put down N. E. of this cut, with no success. A shaft, put down

through an exposure of "cap rock", about 1500' N. E. of the Gaines Mine discovered a small amount of siliceous ore. These explorations cover about 1500' of Oriskany crop-line.

East of Double Ridge.

Immediately East of Double Ridge about 500' of Oriskany crop-line were explored by one drift and 35 drill holes. Of the latter, two only encountered ore, its thickness being 5' and 16' respectively.

Cowbone.

The explorations at Cowbone covered a crop-line of approximately 2400'. They include 9 small cuts, 60 hand drill holes about 25 deep each, and 9 deep drill holes. A small body of ore was discovered, which has since been practically exhausted after yielding a few hundred tons of rather poor ore.

J. C. Smith Tract.

Immediately adjacent to the East Boundary of the Robinson 98 acre tract (belonging to the L. M. I. Co), a cut developed a little sandy ore. On the Robinson tract, two cuts and a shaft were made on the same area of surface showings, but failed to develop an ore-body.

Redman's Gap.

Some rather feeble surface indications near the road winding up into Redman's Gap were explored by two small cuts, with no favorable results.

Jordan Potts.

A small opening north of Nichol's Knob on the flanks of Potts Mt. developed a little lean ore, in a highly inaccessible position.

Review and Summary

The above described explorations and operations cover a total of about 44,700' or nearly 8½ miles of Oriskany crop-line; this being the entire portion of the grand total of nearly 35 miles which surface examination has shown to give any encouragement.

We have seen that all of the 8½ miles has been explored, first by drifts and prospect cuts; later by shafts and drill holes wherever the first work met with sufficient encouragement to justify the deeper work. A single exception to this is the 3000' stretch between Salt Log Run and Paxton Branch on Potts Mt., where scant surface indications exist, but no work has been done. Since however the indications seen along this stretch are far less abundant than the two immediately adjacent stretches to the East and to the West, where work has been done and has failed to develop results, this omission can not be considered as serious.

Of the 26 or more miles of totally barren Oriskany crop-line, much has been examined personally by me, while the balance has been carefully described to me by the former Jordan Mines superintendents and by others, and declared by them to be barren.

I therefore feel warranted in saying; (1) that the entire 35 miles of Oriskany crop-line have been examined; (2) that only 8½ miles have been found to give any surface indications, such as should properly lead to explorations; (3) that these 8½

miles (with the exception of the above referred to 3000') have been amply explored. These explorations include

70 drifts, with a total approach of 1103' and a total length under cover of 3620'

35 prospect cuts and pits.

46 prospect shafts, with a total depth of 855'.

1055 drill holes still standing, with a total depth of 42,130'. I estimate that not less than 250 holes have been worked out by mining operations. The grand total of drill-holes was therefore not less than 1300 with a total depth of 52,000 to 55,000 feet.

The net result of these extensive explorations has been as follows:

Ore bodies of sufficient size to lead to operation were discovered at 16 points. Of these 8 were quickly exhausted after yielding a total of about 1500 tons, or less than an average of 200 tons each. I include amongst these 8 the two Helmintoller mines, where there may be a small quantity of ore left but far from sufficient ever to justify the necessary development for its extraction.

Of the remaining 8 mines the history is as follows:

Jordan Peters has produced about 450 tons and has not been exhausted. I estimate that there may still be from 25,000 to 40,000 tons of ore at that point. Its quality is not of the best however, and its position is further more such as to make it extremely doubtful whether or not it could be taken without ultimate loss.

The Hepler mine has produced about 60,000 tons of generally good ore. There are left here about 4500 tons of probably good ore;

on the investment (which however I provide for roughly in the preceding paragraph) general office expenses, or damages paid on account of accidents.

A current royalty of 20¢ per ton has been charged. The minimum royalties have been such however, that there were at all times deficiencies to be made up, making the actual royalty per ton considerably greater. Thus to Jan. 1, 1911, $84,696 has been paid for royalty deficiencies, there having been produced up to that time only 276,518.9 tons of ore, whereas the minimum royalties called for 700,000 tons on the basis of 20 cents per ton. The deficiencies therefore amounted to 25 cents per ton.

The total operating costs on the basis of the lease were therefore $2.11. To this has to be added the above $1.10 for amortization of plant, provided the lease has terminated on Nov. 23, 1911.

Iron ore of the quality produced at the Jordan Mines is worth about $1.50 per ton on the present pig-iron market. It has at no time during the life of the lease been worth more than $1.85 per ton. It is apparent without further analysis of the figures that the lease has been a ruinous one.

There has been ample equipment provided for mining iron-ore up to the full amounts required by the minimum royalties in the lease. Unfortunately the large and high grade ore-bodies which it was confidently expected were contained in the leased tract did not materialize, and explorations as well as operations have consistently met with disappointment both as to the quality and the quantity of the ore. With a more moderate minimum it might still have been possible to make a better showing by con-

fining operations to the richer portions of the deposits, thus producing smaller tonnages but at the same time a more valuable ore. Under the conditions of the lease however the tendency was naturally to strive after tonnage, and the result, owing to the character of the ore-bodies, was serious deterioration in the quality of the product.

Had for example a product averaging 42½% in metallic iron been secured, this would have been worth from $2.00 to 2.30 per ton according to the state of the iron market. Now with a moderate minimum, whereby no deficiencies would be incurred under a reasonable output, the cost of this ore would not have been more than say $1.90 and there would have been something left over to at least partially take care of the interest and amortization charges.

The position today is that with a continuance of the former lease and with no very decided improvement in either the ore-bodies or in the iron market or in both, heavy losses would continue to be incurred. As we do not hope for any present great improvement in the iron market, and as we have become convinced that the ultimate limits of the ore both as to quality and to quantity have been pretty well defined, we find the conditions of the lease utterly impossible. In fact an improvement in the iron market alone would not suffice to relieve the situation, since the ore bodies will not permit the mining of the maximum requirements under any circumstances, unless materials so low in iron as to be no longer in the class of iron ore are mined and shipped.

The only relief lies in the reduction of the minimum royalty to a point where it becomes practically inoperative. Then mining may be confined to the ores of actual value, tonnage of out-put being disregarded, until these ores are exhausted. In this way reasonable profits may be temporarily made and the past losses partially wiped out.

C O N C L U S I O N

I have devoted many pages in these notes to a detailed description of the geological conditions under which the Oriskany brown iron-ore bodies are formed, and to commercial considerations attending their valuation, development, etc. My object in the first instance has been to show how it is quite possible that an area of so great initial promise as the Potts Valley leased lands may prove wholly disappointing; how geological conditions and surface indications only show what may be and are in no sense a proof of the actual existance of ore-bodies; and how and why these last may be wholly absent in a commercial sense even though every theoretical consideration argues their presence. In the second instance, it has been my purpose to outline the various considerations which must constitute a thorough study and examination of any Oriskany ore tract before an investment is made, or if once made, abandoned.

Following upon these general considerations, I have attempted to show (1) the great initial possibilities of the Potts Valley tract; (2) the actual results of the detailed and extensive examinations and explorations which have been made. That the results were out of all line with the possibilities is not so much a matter for astonishment as for disappointment.

I have shown that the land in question has been thoroughly examined and explored in accordance with the commercial considerations which I have set forth; furthermore, that every reasonable effort in other directions has been made to meet the terms of the lease.

Operation under this lease has been accompanied by actual loss practically from the start. Since no ores can be consider-

ed workable unless they can be won at some profit to the operator, the logical conclusion would be that the Potts Valley lands have at no time contained workable ore-bodies. If true at the beginning, it is ten fold true now, when such heavy total losses have been incurred that there can be no longer any hope of ultimately retrieving them.

Under less burdensome terms, there would have been several workable bodies of ore in the Potts Valley. In fact there are small amounts of ore still remaining which might be taken at some profit under a minimum royalty so moderate as to be practically inoperative. This could be done only by the Low Moor Iron Company, however, as the amounts are too small to warrant any other company putting in the necessary plant and equipment. The Low Moor Company has its plant and equipment already on the ground; while it cannot afford to continue to operate at a loss, it would no doubt gladly operate at some small profit till the remaining ores have been exhausted, thereby partially retrieving its losses.

Thus I conclude that, whereas the Potts Valley lands undoubtedly gave great initial promise, the results have proved that they at no time contained workable bodies of ore under the terms of the lease. There are small amounts of ore still remaining. Under a new lease, imposing moderate and reasonable terms, these remaining ores may be considered as workable by the Low Moor Iron Company, but they are not so for any other concern.

Low Moor, Va. C. M. Weld

Jan. 18, 1912.

REPORT

ON

THE CHARTER OAK LANDS

NEAR CLIFTON FORGE

ALLEGHANY CO., VA.

C. M. Weld
Low Moor, Va.
May 23, 1912.

E. C. Means, Esq., President,

The Low Moor Iron Co. of Va.

Low Moor, Va.

Dear Sir:-

Following upon your instructions, I examined the "Charter Oak" lands on May 3rd, under the guidance of Mr. J. Woodsun. I beg to submit my report herewith.

These lands comprise about 2400 acres, lying chiefly South of the City of Clifton Forge. The accompanying sketch-map will indicate to you their location and boundaries. I understand the present owner is Judge Geo. K. Anderson of Clifton Forge.

The geological structure and the approximate outcrop lines of the Clinton and Oriskany ore beds are shown on the sketch map. It will be seen that the leading structural feature is a great anticlinal arch which trends N. E. to S. W. about through the centre of the property. This arch is best seen along the Jackson River just above Iron Gate, where indeed there is a wonderfully perfect exposure revealing the entire geological column from the Medina sandstone up through the Clinton, Helderburg, and Oriskany, to the Devonian shale.

The arch is succeeded on the N. W. within the limits of the property by a synclinal trough. Both arch and trough, while having N. E. to S. W. axes, plunge to the N. E., the vertical drop along the crest of the arch being about 1000 feet in a horizontal distance of 2-1/2 miles, or roughly 7%. The effect of this pitch is that the Clinton ore horizon which is abundantly exposed towards the South West becomes buries as we follow it Eastward, only to be exposed again where cut by the Jackson River. The Oriskany crop-line persists along the S. E. edge of the property, but is found in only a portion of the property on the N. W. side of the big arch.

My examination was confined to the South West third of the tract, where Mr. Woodsun undertook to show me some exposures of Clinton fossil ore. Lack of time prevented our visiting the Merry Hill mine where the Oriskany ore was once worked. I have on other occasions briefly examined the exposures along the Jackson River.

The Clinton Ores

Mr. Woodsun and I did in fact trace the Clinton ore horizon for some distance and my observations enabled me to plan its approximate crop-line as shown on the sketch map. We failed, however, to see any exposures or openings where it was possible to measure the vein, although both shale and fossil ore were present in the float, the latter in occasional blocks up to 9" in thickness. There are many points where the vein could be cheaply explored and its true thickness revealed.

In the meanwhile, I wish to note that it is my present belief that there is only one Clinton vein, namely, that the so-called "shale ore" and "fossil" veins are not two separate veins, but are one and the same thing. This belief I am aware, is contrary to popular opinion. My reasons are that I found both "shale ore" and "fossil ore" float on the Charter Oak lands, the former being the more abundant, at exactly the same geological horizon throughout; that this horizon is exactly the same as that on which the tunnels of the Iron Gate fossil ore mines were driven; that according to Mr. Woodsun's testimony, one of these tunnels, namely A, started in black "shale ore" and passed from this into "fossil ore"; and that the records of Mr. E. J. Schmitz (see below) abundantly show the intimate association and apparent interchange of "shale" and "fossil" ore in the same tunnels.

The ore bearing horizon is marked by a massive bed of white quartzitic sandstone above and by a bed of deep purple sandstone underneath. The fossil ore in McGraw's gap occurs at this same horizon. I have yet to examine other sections of the Low Moor and adjacent properties to confirm this association. The vein is usually actually enclosed within a few feet of slate and clay, or at times siliceous limestone, lying between the white and purple sandstones just described.

I found that Mr. Woodsun was strong in the opinion that there are two separate veins, and cited the fact that at the Iron Gate fossil ore mines, on the East side of Jackson River, there were workings on two veins, the one lying 240 feet above the other. Both veins, he admitted, were overlaid by white quartzitic sandstone and underlaid by purple sandstone. I later confirmed this description by personal examination, but found the reduplication to be due to an overthrust fault, as indicated in section A-B on the sketch map. Therefore, this supposed proof of the existence of two veins was readily explained.

There can be no question but that the Clinton ore bed traceable through the Western third of the Charter Oak lands, is identical with the vein worked in the Iron Gate "fossil ore" mines. These mines were worked at two different times during the early nineties, the total period of operation being about 3-1/2 years. The ores were under lease from Judge Geo. K. Anderson at a royalty of 20¢ per ton. They were smelted at the Iron Gate furnace. Sixteen tunnels were driven on the vein from the West side of Jackson River and three

or four tunnels were worked on the East side. Various reasons are given for the final abandonment of operations.

E. J. Schmitz (Trans. Am. Inst. Mining Engineers, Atlanta meeting, October 1895) has given us a record of the vein section in some of the tunnels on the West side of the river. I have platted these sections on the attached sheet, as the most forcible method for bringing out the facts. A glance shows us that the best section, namely number 16, offers only 26 inches of ore (4" of shale ore and 22" of fossil ore) in a solid vein. This is at the portal of Tunnel K. At 130' in from the mouth, the vein has pinched down to from 3-1/2 to 6 inches of fossil ore (section 17). In tunnel P, there were 23 and 19 inches of ore, both fossil and shale, mixed through 45 and 34 inches of vein matter respectively, at points 20 and 40 feet from the entrance. The ore pinched out entirely further in. All the other sections are of less interest. The average for 18 sections (omitting numbers 10 and 18) shows 7" of fossil ore and 4" of shale ore, a total of 11" of ore, included in an average of 15" of vein matter. Many portions of the tunnels appear to have been barren.

I may again refer to the intimate association and apparent interchange between the "fossil" and "brown shale" ores which is so clearly brought out by the diagram of sections.

Schmitz's records certainly offer no encouragement for reopening the Iron Gate mines, and I have seen nothing on that portion of the property which I visited which would lead me to suppose that conditions would be any more favorable further to the West. The Clinton vein could be cheaply explored at a number of points and this perhaps should be done. Until it is done, no final opinion as to the value of the Clinton ore can be given. Inthe meanwhile, I consider

the prospects unfavorable and should be inclined to place the burden and expense of proving them to be otherwise upon the owner of the property.

The Oriskany Ores.

The Oriskany ore bearing horizon crops along the South Eastern boundary of the property, dipping towards the South East. About 8000 feet lie within the property lines at the South East end and it is here that the Merry Hill mine was operated and abandoned contemporaneously with the operation and abandonment of the Iron Gate fossil ore mines. This mine lies on the same lead and about 1-1/2 miles North East of the Callie mines of the Princess Furnace Company. From all I can learn its operation was not attended with success and it is not regarded as contributing materially to the mineral value of the Charter Oak lands.

I did not visit the old workings and am therefore not in a position to say definitely how far in my opinion further exploration for ore bodies would bejustifiable. The fact that the mine was worked and abandoned, however, is pretty good evidence that the Oriskany lead is here probably worthless.

The same lead crosses the Jackson River justabove Iron Gate and passes North Eastward through the Wilson Hill tract of the Charter Oak Lands, where there must be some 6500 feet of crop line within the boundaries of the tract. As far as I know this portion of the lead has yet to be explored. At the crossing of the Jackson River it gives no encouragement.

On the North West side of the Charter Oak property and outside its boundaries is situated the Alexander Mine, worked for a number of years, but now abandoned. The Alexander lead passes North Eastward for about 5000 feet of crop line through the Charter Oak property,

largely through low lying land occupied by the Jackson River, C&O RR tracks, etc.

This lead dips towards the N.W. It has not been explored and is not supposed to be worthy of exploration, except possibly for the first few hundred feet immediately across the boundary from the Alexander mine. To the South West from the mine, the lead swings round into the North and does not cross over into the Charter Oak tract.

Conclusion.

The Charter Oak lands contain both Clinton and Oriskany iron ore bearing horizons. Both horizons have been the seat of mining operations for some three to four years and were then abandoned. There are practically no explorations outside these mines, and their records offer no encouragement.

While the lands are probably deserving of further exploration, it would be my inclination in view of the circumstances to throw the burden and expense of such further exploration upon the owner. I do not consider the prospects sufficiently encouraging to lead your Company to undertake explorations; and without some present showing of mineral beyond the abandoned workings and occasional traces of the crop lines of the ore bearing horizons. I consider the property, particularly in the light of its past history, as innocent of any immediate mineral value.

Respectfully submitted,

C. M. Weld

Low Moor, Va.
May 23, 1912.

REPORT ON
THE MOORE & HAYNES TRACT
ALLEGHANY CO.
VIRGINIA

C. M. Weld
Low Moor, Va.
Mar. 30, 1912

REPORT ON THE MORE AND HAYNES TRACT
ALLEGHANY COUNTY, VIRGINIA.

This tract comprises 2279 acres, lying North-West of the City of Clifton Forge, in Alleghany Co., Va. The Southern point of the tract reaches the corporation limits of the city, while its North-West boundary lies along the flanks of Little Middle Mountain, from McGraw's Gap Eastward. The boundaries and other features maybe seen on the attached plan. The present owners are Messrs. John T. Delaney, M. B. Miller, and Crowder, all of Covington.

I have spent portions of the two days (March 14th and 26th) examining the openings made for iron-ore on this property. On my first visit I was accompanied by Messrs. Miller and Crowder. The following notes are the result of my examination.

Geology

If we divide the tract into two parts by drawing a N.E. - S. W. line through the Upper Dam on Smith Creek, we find that the portion lying S. E. of this line is occupied almost entirely by Devonian Slates. North West of our line we find Oriskany sandstones and limestones alternating with the slates, until we approach the extreme N. W. part of the property, where we encounter Clinton sandstones. The Helderberg limestone, which intervenes between the Oriskany bottom

Sandstone and the top of the Clinton is only feebly exposed at one point.

An excellent geological section can be obtained along Smith Creek; this will be seen reproduced on the attached plan, from the N.W. Boundary line in McGraw's Gap to the Upper Dam. Below the dam, nothing more is to be seen except slate.

The ore bearing measures included in the above are the Clinton and the Oriskany. The former exhibit the usual "fossil" vein, while the latter are seen at various points to contain bodies of brown ore at the usual horizon.

The Clinton "Fossil" Ore.

The vein is seen cropping in McGraw's Gap close to the N. W. Corner of the property. The strike is N. 35° E. and the dip is S. E., 60° from the horizontal. As will be seen from the attached plan, only about 1000' on the strike of the vein would be included within the boundaries of the property.

Two small tunnels have been driven on the vein, the one being about 20' vertically below the other. Measurements of the section as revealed by these tunnels give the following:

	Upper Tunnel	Lower Tunnel
Massive sandstone		
Thin bedded sandstone	5' 0"	5' 0"
Shale	3' 8"	4' 4"
Ochreous Shale	0' 5"	----
Fossil Ore	1' 2"	0' 6"
Limestone	----	0'10"
Ochreous Shale	1' 8"	0' 5"
Shale, about	30'	30'
Purple sandstone		

It will be seen from the above that the 14" of ore in the upper tunnel diminish apparently to only about 6" in a vertical distance of some 20', linestone coming in in place of the ore.

This occurrence of Fossil ore has no commercial value, being of academic interest only. The thin bedded sandstone in the above section is overlain by about 275' of massive sandstone. I made no attempt to measure the thickness of the underlying purple sandstone.

The Oriskany Brown Ore

The Oriskany measures include the usual members, these being, from top to bottom: (a) calcareous sandstone; (b) massive limestone including a persistent bed of flint; (c) quartzitic sandstone. Incomplete and rather unsatisfactory measurements taken at the Upper Dam gave thicknesses of about 30 and 60 feet respectively for (a) and (b). (C) appears to be some 30

to 40 feet thick, as indicated by the out-crop of Helderburg limestone on the S. W. side of the Creek about 500' above the dam.

Such ore bodies as have been found occupy the usual position above the flint bed in (b), with the impregnated and partially replaced calcareous sandstone appearing in the role of "Cap-rock".

On the attached plan I reproduce the geological section exposed along Smith Creek. This section is taken along a N. 75° W. line and is therefore not directly across the strike of the measures, which bear N. 35° - 40° E: the resulting distortion is not sufficient however to detract from the value of the section. This shows three anticlinal arches coming in between the point at the Upper Dam where the measures first appear from underneath the Devonian Slates to the point about 3000' distant to the N. W. where they go off into the air for the last time. Thus we have seven crop lines exposed in the Creek bed and as many opportunities for examining the ore bearing horizon for possible ore bodies. I may note that these crop lines are not persistent across the country however since the arches are for the most part so low that their crests become buried once more under the Slate hills a short distance away from the line of the Creek.

Of the seven crop lines just described, only three have offered sufficient surface indications to encourage exploration. These three, I have numbered (2), (3), and (4) on the map.

At (2) a short tunnel, some 20' in length was driven in a North Easterly direction into an outcrop of "cap-rock". At the end of this a 40' cross cut was driven to the N. W. to the flint. No ore body was discovered and the prospect is worthless. Some 1700' to the S. W. is a prospect (shown as (6) on the map) where some ore is reported to have been found, but which I did not visit. This is on the strike of (2), both being situated on the last or back fold of the ore bearing measures.

At (5) there is a small cut on the point of a ridge in some masses of ore bearing rock. These are so confused in their position as to lead me to believe that they are not in place but have moved down from some higher level. However, this may be, the ore seen, while good, is not abundant and is badly mixed with sandy material. I do not therefore consider this prospect encouraging.

Returning to Smith Creek and moving down stream from (2), we find both legs of the first arch apparently barren. The second arch appears as a small tight fold, faulted along the N. W. side. Here we find prospect (3), following a sandy stratum containing a very little ore, included within the "Cap-rock". No true body of ore has been discovered at this point.

Our next prospect down stream is (4), dignified on the

map by the appellation "Mine". Ore has in fact been mined from here and shipped to the Low moor furnaces, as seen by the record cited below.

The #(4) workings are situated on the N.W. leg of the 3rd and last arch. The measures dip to the N. W. at about 25° from the horizontal and strike N. 35° E. An upper tunnel follows the ore to the North East for about 130' and is said to have been stopped in ore. This has now fallen in and can not be entered. A lower tunnel, approximately parallel with the first but to the N. W. of it and some 12' vertically below, is about 60' long and terminates in a chute leading down to it from the upper tunnel. The lower tunnel is heavily lagged throughout, but where the walls could be seen, did not appear to have been in ore, but rather in a red sandy material.

The vein as worked in the upper tunnel is reported to have been about 20' thick. The ore was a soft yellow to purple ochreous material containing few lumps and much fine powder. I was able to examine this in a small exposure at the mouth of the upper tunnel, and obtained a sample which yielded in analyzing (dried at 212°F.) 40.76% metallic iron and 20.80% insoluble matter.

Thirty R.R. cars, presumably a total of about 900 tons, were shipped to the Low Moor Iron Co., at irregular intervals from May 5, 1906, to Jan. 14, 1908, the ore being wagoned out some three miles from the mine to the C. & O. at Clifton Forge. This ore was not washed. Indeed, it was of

such physical character that it could not have been washed without great loss. At the same time, I understand it underwent a certain amount of selection at the mine. The thirty cars gave an average analysis of 43.3% metallic iron (dried at 212°F.).

This interesting result would naturally offer considerable encouragement. Unfortunately practically nothing has been done to trace the vein of ore. To the North East a few shallow pits have been put down with totally inconclusive results. To the S. W. across the Creek, sufrace conditions would indicate that the ore is absent, but here again we have nothing conclusive. We know nothing in fact about this body of ore except that it has yielded nearly 1000 tons of soft clayey to gritty material carrying an average of 44.3% Fe. Being familar with the total lack of persistency of Oriskany ore bodies, we can only conclude that the results so far obtained justify some expense for prospecting. It is at present out of the question, to offer any estimates of tonnage, even on a "probable basis".

The S. E. Leg of the arch on which (4) is situated is well exposed at the Upper Dam and is obviously barren of ore. Here the measures dip beneath the Devonian slates for the last time and do not reappear on the property under discussion. About 4500' S. W. of the Upper Dam an old opening, from which a few tons of Oriskany ore were wagoned out many years ago, is seen on the Tatum land (marked (7) on the map). The Cap-rock exposed in the sides of the old cut strikes N. 35° E. and dips gently to the S. E. This opening

is probably on the strike of the Oriskany exposures at the Dam.

I am told that there are no openings on the property North East of Smith Creek except a single small cut at the extreme N. E. corner, about 1-1/2 miles distant and near Wilson Creek. I did not visit this.

Commercial Considerations.

Transportation.

It would require about 3 miles of railway to reach the "mine" (described as prospect #4) from the existing C. & O. R. R. tracks at Clifton Forge. Such a railway would have to follow the windings of Smith Creek, and while the actual difference in elevation between the two termini is only about 325' and would therefore entail an average grade of not more than about 2%, the valley of the Creek is for a great part of the way very tight. It is certain therefore that many cuts and fills would be encountered if sharp curves and grades are to be avoided. Only a large body of ore "in-sight" would justify the construction of a standard gauge branch railway, and a narrow gauge road could not be built cheaply. I would say the latter might cost from$25,000 to $40,000.

Water Supply.

Since Smith Creek has been appropriated by the city of Clifton Forge for its water supply, there is no available water on the property for washing ore except perhaps Wilson's Creek, which crosses its extreme North Eastern corner.

If all the ore discovered on the property is of the same physical character as that shipped to Low Moor, this would perhaps be no great misfortune. If on the other hand, Oriskany ores of the usual character should be encountered in bodies of workable size, the operators would be reduced to shipping the crude ore for many miles to some point where water would be available for washing.

Timber.

Timber of mining sizes, while not abundant, would probably be ample in quantity for mining purposes for some time to come.

Mining Costs.

As developed today, I do not see any great promise of finding ores on this property which may be won cheaply by open cut and steam shovel methods. However, this must be a matter for exploration to determine. At the present time there are no ore bodies "in-sight", whether surface or underground, and there is only one good prospect. Any expression of opinion therefore as to probably mining costs, must be postponed till explorations have perchance discovered an ore body. The same is true of estimates for plant and equipment.

Conclusions.

The Clinton Fossil ores on the Moore & Haynes Tract are of no value. The Oriskany brown ore measures have been superficially explored at several places and at one point there has been developed a prospect of some promise. Even at

this point however there is no ore "in-sight", nor can any estimate be made of "probable" ore. In fact explorations of any real significance and value are lacking.

I conclude that the property is of sufficient promise, as far as the Oriskany possibilities are concerned, to justify moderate expenditure, say up to $500 or $1000, for further explorations. This amount would not go very far but it would probably suffice to obtain results indicative of the wisdom or folly of going further into the matter. I anticipate that five to ten times the above amount would be necessary to finally put "in-sight" an ore body of sufficient dimensions to justify the requisite expenditures for plant and equipment. While far from being inaccessible, any ore bodies discovered on this property could not be cheaply approached and equipped, and the water question must ever be a serious one.

Respectfully submitted,

C. M. Weld

Low Moor, Va.

March 30, 1912.

Feb. 7, 1908

Mr. Jno. T. Delaney
Covington, Va.

Dear Sir:-

Replying to your inquiry as to the results shown by our records the analyses made of ore purchased by the Low Moor Iron Company from Mr. A. M. Stull, or from his lessees, said ore having been mined at and shipped from the tract of land adjacent to the city of Clifton Forge, known as the Moore and Haynes land. I beg to give you the following statement showing the dates of shipment, number of cars in which the shipment was made, and the percentages of metallic iron shown by analysis. Ore dried at 212:-

1906.	Car Number	Persentage Metallic Iron.
May 5	18260	45.200
7	50265	44.400
7	16667	40.600
8	17862	43.600
11	16143	44.600
11	50378	43.800
14	18099	44.400
14	17194	43.800
19	16720	43.600
19	17699	45.600
Sept.14	17781	44.000
Oct. 8	17328	43.800
1907.		
Feb. 1	17344	45.400
18	17128	45.000
18	16225	44.200
25	18372	43.600
March 25	17113	43.800
29	17462	45.600
July 26	16224	40.600
Aug. 5	17161	38.400
27	16000	38.400
Sept. 11	18056	45.200
11	17294	42.200
11	17224	45.800
23	17683	47.000
23	17620	48.000
Oct. 5	16398	43.800
15	17156	48.100
23	17632	45.200
Nov. 8	17685	52.600
Jan. 14	16291	45.000

There are thirty car loads in this statement. The average on the thirty car loads is 44.1/3%.

We trust the above will answer your purpose.

Yours truly,

THE LOW MOOR IRON COMPANY OF VIRGINIA.

S. G. Cargill,
Asst. Treasurer

The above analyses are based upon curde ore.

May 2, 1905.

REPORT OF JOHN W. STULL, as to Iron Ore Value of 2,200 acres of land owned by A. M. Stull and lying North of Clifton Forge, in Alleghany County, Virginia.

This property embraces the foot hills and South side of what is known as Gap Mountain, and extends North-east and South-west along these hills a distance of about three (3) miles and averages in width about one and a quarter (1-1/4) miles. The property extends to about the corporation limits of the town of Clifton Forge on the C. & O. Railway on the south side and is ideally located for mining. It embraces the famous Low Moor and Rich Patch leads of iron ore in Alleghany County, but on account of these leads passing through the property in low ridges, the outcroppings are not prominent. In recent months some prospecting has been done on the property, but one only of these openings has been extended sufficiently far to show what might be present in the way of Iron Ore. If these openings were extended and test pits driven at intervals along the two leads of brown ore, which are on the property, it is the writer's opinion that a considerable quantity of a good grade of ore could be developed. This prospecting should be done by an experienced miner at a cost of $500 to $1000. The vein of Fossil Ore on this property is of excellent quality, but the vein has not been sufficiently well prospected to justify an estimate of the quantity.

There is on the property an abundance of water for all mining purposes, and the ore leads could be reached with a railroad not longer than three (3) miles, with fairly easy grades.

The opening in ore referred to above shows an excellent grade of material, the vein at this point appears to be about 20 feet thick and has been opened for a distance of about 130 feet The ore is near the surface and could be easily mined at low cost.

WELD AND LIDDELL

Consulting Engineers

2 Rector Street

New York

REPORT

- on the -

MINERAL RECONNAISSANCE

- of the -

DOUTHAT SURVEY

ALLEGHANY AND BATH COUNTIES, VIRGINIA

- By -

C. Minot Weld
Weld and Liddell
Consulting Engineers

NEW YORK

April 5, 1926

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REPORT ON MINERAL RECONNAISSANCE OF THE DOUTHAT SURVEY ALLEGHANY AND BATH COUNTIES, VIRGINIA.

LOCATION AND DESCRIPTION

The Douthat Survey is situated in Bath and Alleghany Counties, near the northwestern border of the State of Virginia. It is an immence tract of land, stretching in a northeasterly direction for over 30 miles, with a width varying from four to eight miles. The gross area is approximately 102,000 acres; but this is cut down by numerous inlying adverse holdings, chiefly occupying the bottom-lands, to a net of roughly 87,000 acres.

Plate I, herewith attached, is a partial reproduction of the Monterey and Natural Bridge U. S. Topographic Sheets. The exterior boundaries of the survey are marked on this map, and neighboring towns, iron blast-furnaces, topographic features, etc. are clearly shown.

Plate II is likewise a map of the Survey, on a somewhat larger scale, and showing the adverse holdings above referred to.

TOPOGRAPHY

The great tract or Survey of approximately 100,000 acres lies in the heart of the Allegheny Mountains, and is typical of these mountains in its surface expression.

Warm Springs Mountain stretches almost unbrokenly along the northwest side, ranging N.E. S.W. and forming a long and comparatively narrow ridge rising from 3,500 to 4,000 feet above sea-level. Southeast of this huge rampart is seen a succession of smaller parallel ridges, with narrow valleys between. The streams following the valleys break through the ridges here and there, and so, crossing from valley to valley, finally make their way into the large valley of the Jackson and Cowpasture rivers. This last valley roughly marks the southeastern border of the Survey.

By far and larger proportion of the Survey is mountainous. Cultivable bottom-lands are pretty well represented by the 15,000 acres more or less of inlying adverse holdings.

The above-described topographical features may be clearly seen on Plate 1.

Oriskany Iron Ores

Contrary to the case of the Clinton ore horizon just described, the Oriskany iron-ore horizon, which is likewise notably persistent, finds its best development in Alleghany and adjacent counties of Virginia. A number of comercially successful Oriskany mines have been worked in these counties, and have then been the mainstay of a very considerable local iron industry.

One thing we must note at the outset however, and with emphasis, Whereas the horizon itself is exceedingly persistent, and frequently traceable for a great many miles, the commercial ore-deposits are very spottly and comparatively rare. The deposits are always found in very definite associateion with the horizon. It is therefore necessary first to locate the latter, but this is very different from finding an ore-deposit. After locating the horizon, we must then search for ore. We have only narrowed down our search.

We emphasize this matter because it has not always been recognized, and many more or less irresponsible estimmtes of Oriskany iron-ore have been made which were based on nothing more than finding and tracing the Oriskany sandstone.

Long experience with Oriskany ore is helpful to the prospector in that he learns to recognize certain conditions which do or do not suggest the possible presence of ore. These conditions have to do with the appearance and character of the capping, the position of the strata, the accompanying

topography, etc. We may perhaps be permitted to add that our own personal local experience as well as that of our assistant, has been brought to bear fully upon this investigation.

With these prefatory remarks, we will not pass on to a description of the oriskany iron-ores of the Douthat Survey.

The repeated folding of the geological horizons, described on an earlier page of this report and shown graphically on Plate III, has resulted in many miles of traceable crop-lines of the Oriskany horizon within the Survey. These crop-lines are indicated on Plate II.

A considerable amount of surface prospecting has been carried out in past years along these crop-lines. At one place, namely, along Pounding Mill Creeek in the so-called Iron Mountain Area (lying between Iron Mountain and Fore Mountain at the southern end of the property) a million or more tons of Oriskany iron-ore were mined previous to 1910.

We ourselves, while general superintendent of mines of the Low Moor Iorn Co. of Virginia (1911-1913) visited the Douthat Survey several times and reported on the Oriskany iron-ore showings as revealed by the mines and prospects just now referred to. As far as we have been able to learn no prospecting of consequence has been done since that time until the present investigation. For the purpose of this present investigation we began by a careful study of all the earlier work, followed by renewed visits to those localities which the said earlier work had indicated to be of some possible commercial interest.

We here take the liberty of including herewith and referring to a mpa prepared by us in August 1913 in connection with our report of that time on the Douthat Survey. This map is marked Plate IV. If you will compare this with our corresponding map of today, namely, Plate II, you will note a few but unimportant changes which have grown out of our further examination of the terreitory involved.

The various prospects, marked by yellow dots on Plate IV, may be grouped for discussion as follows:

1. Dry Run.
2. Iron Mountain
3. The lead following the S. E. flanks of Fore and Gap Mountains (the latter is designated as Little Middle Mountain on Plate II).
4. Chestnut Ridge and Brushy Mountain territory.
5. .Brushy Ridge and Mare Mountain.
6. Piney Mountain

Each group will be discussed below in turn. The group numbers are marked on Plate IV for easy reference as to general locality.

1. Dry Run.

This is a small trough of Oriskany measures lying N. E. of the town of Covington. There are a couple of prospects, showing little promise, in the vicinity of the Covington water-supply intake. This last would present an obstacle, which the prospects themselves do not justify an effort to overcome. The area is therefore discarded.

A short stretch of lead is shown crossing a corner of the Survey lying due north from the prospects just now referred to. This lead is revealed at a couple of points on the Warm Springs road, and again in Falling Springs Creek. It gives no particular promise.

2. Iron Mountain.

This area is the site of former mining operations and is of great interest. It will therefore be discussed at length in a separate chapter.

3. FORE AND GAP(Little Middle) Mountains.

The lead is traceable for seven or eight miles along the eastern flanks of the above mountains, crossing Smith Creek not far above the old Moore & Haynes mine. The 15 to 20 end surface openings scattered along this lead were examined by ourselves and reported on in detail in 1913; since which time no further work has been done. Nothing of probable commercial interest was seen by us, and the territory was reported as being of

very little promis. We have not therefore included it in the present investigations.

We may add that the More & Haynes mine was unimportant and was abandoned.

4. Chestnut Ridge and Brushy Mountain

When we examined the ore showings of this group of prospects 13 years ago, we found much that was interesting. We therefore re-examined it at this time, a preliminary investigation by our assistant being followed up by a personal inspection.

Much of the old work examined back in 1913 is no longer accessible, and no new work appears to have been carried out. At least we were not able to discover any. We did however run across a couple of old prospect holes which we had apparently missed in the thick brush in 1913, and which detracted somewhat from the encouragement felt formerly because they indicated in one case lack of depth and in the other case lack of continuity of the ore-showings.

Our present conclusion is that this territory offers possibilities; but, as far as can be seen today, not in a large way. The desirability of further prospecting is indicated, but the comparative inaccessibility of the district must be taken into account. It should particularly be noted that 12 to 13 miles of rather expensive railroad construction would be required to take the ores to market. Thorough prospecting therefore, to prove up a large tonnage of ore, would be a preliminary necessity.

Today's showings, as noted in the foregoing, do not suggest the presence of the large tonnages which the expense incident to development of transportation would require. Further exploration shoud proceed in two stages; First, enough additional surface work to indicate what chance there may be of the existence of large tonnages: next, the testing out of those chances, in case they appear to be favorable, by sub-surface exploration, as by drilling. Favorable completion of the first stage would only be indicative: it could not be conclusive.

5. Brushy Ridge and Mare Mountain.

Here again, as with group 4 just described, we were encourage by our examination of 1913, and so we revisited and re-examined the district.
Our present conclusions are exactly parallel with those just expressed with reference to group 4, with the additional notation that this group would require some seven miles more of expensive railroad construction thahnwould be required by group 4. In the matter of railroad, the two groups should probably be considered as a unit, in the hope that the two together might prove up enough ore to warrant building about 20 miles of railroad.

The present combined showings of the two groups do not offer any assurance of this last proving to be the case. They are both deserving of further study however.

6. Piney Mountain.

The lead following the southeastern flanks of Little Piney and Piney Mountains is exposed on the road from Bath Alum to Warm Springs and in a couple of old prospect holes. The showings are of no commercial interest.

PLAN OF EXPLORATORY CAMPAIGN

We have seen that three of the six groups enumerated are discarded as of no further interest to this investigation. The remaining three are worthy of consideration. (Iron Mountain, Chestnut Ridge, Brushy Mountain)

At the outset of this investigation we were confronted with the problem of how best to expend the definitely limited sum of money appropriated for exploration. Two possible courses were open to us:

(1) To spend the money in a very general investigation over the length and breadth of the Survey, tracing the Oriskany leads and endeavoring to show up as many points as possible where there might be a chance of finding ore; this may be called the promoter's point of view.

(2) To select one or more of the most promising localities and concentrate the expenditures there, with the view of endeavoring to locate and definitely prove up at least one ore-body of sufficient dimensions to justify an operation; this we may call the operator's point of view.

Largely influenced by the past history of the Douthat Survey, which has always been one of "glittering possibilities" but no definite tangible assets since the abandonment of Iron Mountain mines, we selected the second course as the more likely to return value for money expended. We may add that this selection was made in consultation with yourselves.

We applied ourselves therefore to a selection of the localities upon which to concentrate our expenditures. Obviously, these were the area represented by the groups 2, 4 and 5 described in the foregoing.

Of these three, number 2 (Iron Mountain) gave the greatest promise, and was by all odds the most accessible. For this last reason it might well be said that one ton of ore discorvered at No. 2 would be worth at least two tons at either 4 or 5. So we started our campaign by planning to explore No. 2 thoroughtly, hoping to reserve sufficient funds to carry explorations through the first state at number 4 and 5.

As work progressed, it became evident that we could profitably expend the entire available sum at No. 2. Upon reporting this development of the situation, we were given to understand that further funds might be requisitioned for surface explorations at 4 and 5 if considered highly desirable. After consultation with you however, we mutually agreed that purely indicative work at 4 and 5 was not sufficiently important to justify asking for more money, so we devoted all we had to No. 2, and succeeded in bringing our work there to a satisfactory completion.

The net result today is assreported above for numbers 4 and 5, and as reported in the next chapter for number 2.

IRON MOUNTAIN EXPLORATIONS

Iron Mountain was extensively mined a good many years ago by open cuts, and was abandoned with the practical exhaustion of the cheaply available surface ores. The old cuts may be seen today, and although badly fallen in, give evidence here and there of ore remaining in their bottoms. The tram and railway grades, connecting with the Low Moor Iron Co's Dolly Ann railway grade, and thence with the Covington furnace, are still in fair condition.

We had here therefore abundance proof of the existence of conditions favorable to the making of Oriskany iron-ore deposits, in a position where transportation could be rehabilitated at a reasonable cost.

What we had to find out was whether or not any important amounts of ore still remained in the ground, beneath the old open cuts or elsewhere.

For this purpose it was necessary to emplpy drills. It so happened that the Low Moor Iron Co. was about to suspend its operations. This made it possible for us to rent drills from the Low Moor Co. and to take over a number of their employes who were skilled in exploratory work of this character. More particulary we were able to secure the services of Mr. E. B. Burwell, mining engineer and geologist for the Low Moor Co., and place him in charge of our Iron Mountain explorations. Not long before, Mr. Burwell had completed an exactly similar campaign at the Old Rich Patch mines east of Low Moor.

We had two precussion drills of the type customarily used in exploring for Oriskany ore, on a Keystone and the other a Cyclone; together with crews, teams etc. We housed the men in the old Dolly Ann Camp. We also hired some extra hands for pit and trench work.

The explorations were started towards the end of November 1925, and concluded about the middle of February 1926. During this period we drilled 36 holes, totalling 2,640 feet; average depth per hole, 73 feet. Quite a little time was necessarily lost in moving the drills about, but we were fortunate in losing only a very few days on account of bad weather. Excluding time lost for bad weather and for long moves (but including short moves), the Keystone drill averaged over 26 feet daily and the Cyclone over 25 feet; and entirely creditable showing.

The detailed drilling record, showing material passed through in each hole, with analysis of ore, is given on the next page (blueprint).

Simultaneously we dug two dozen prospect holes and drifts, totalling 300 lineal feet of excavation. Detailed record of these is given on the page following the drill record.

RECORD OF HAND PROSPECTING

DOUTHIT SURVEY

No.	Nature	Extent	Material
1	Drift	53'	21' clay and ore, 12' wash ore.
2	Shaft	14'	4' clay and ore, 10' wash ore.
3	Pit	3'	3' foot wall clay and flint.
4	"	2'	2' foot wall clay.
5	"	4'	4' foot wall clay and flint.
6	"	12'	2' clay and ore, 10' wash ore.
7	Shaft	13'	13' ore.
	X-Cut	9'	6' ore, 3' foot wall clay and flint.
8	Pit	2'	2' Oriskany sandstone.
9	"	12'	11' hanging wall, 1' foot wall.
10	"	4'	4' ore and flint.
11	Shaft	12'	12' hanging wall.
	X-Cut	6'	6' hanging wall.
12	Pit	6'	6' hanging wall.
13	"	4'	4' foot wall clay.
Shaft in Cut 29		17'	17' filled material.
14	Pit	4'	1' clay and ore, 3' foot wall clay.
15	"	5'	2' clay and ore, 3' foot wall clay.
16	Drift	16'	16' barren vein material.
17	"	21'	15' hanging wall, 6' ore, stopped in ore.
18	"	50'	33' filled material, 17' ore, stopped in ore.
19	"	17'	8' fill material, 8' ore, 1' foot wall.
20	Pit	11'	11' ore, bottom on foot wall.
21	Winze	19'	12' true thickness of ore.
Pit in Cut 10		8'	8' ore, together with cut shows 13' ore.
Miscellaneous pits		6'	6' shale.
	Total	300'	

All this work, both drilling and hand-work, is shown on Plate V. The area included by Plate V. is outlined on Plate II.

Examining Plate V. we see drill-holes 35 and 36 at the left-hand end, not far from the Low Moor Iron Co's boundary. This was our last work, and was done in the hope of picking up the extension of a small ore-body formerly worked by the Low Moor Co. in its so-called Lineway mine. It proved abortive however, no ore being found. It is still possible of course that there may be some ore remaining under Cuts 1 and 3 up the hill to the south.

We put down two drill-holes, Nos. 33 and 34 behind Cut 10. These also proved to be barren, although we had previously found 13 feet of ore in a test-pit just under the floor of Cut 10. Drill-holes 1, 3, and 4 found some rather lean ore behind Cuts 11-12-13. Hole 2 was barren. The possibilities of this area are not exhausted.

Drill-holes 29, 30, 31, and 32 were put down to test out the N. W. dipping limb of the trough which splits off from the main trough as Iron Mountain is approached, goint S. W. This work was barren of results, but not conclusive. Hole 27, on the S. E. dipping limb of the anticline which splits off the trough just referred to, was likewise barren.

Further northeast, along the N. W. dipping limb of the main trough, we had far better results, finding continuous evidences of ore from Cut 20 to drill-hole 21. Details of drill-hole locations and

records, with analysis for this area, are all shown on Plate VI.

The ore-body thus proved up at this end of the Iron Mountain territory is as a matter of fact an important deposit of Oriskany iron-ore. From Cut 20 to drill-hole 5 it is evidenced by the old cuts and by our new test pits, this territory not having been drilled because of the difficulty of getting the drills to it. Roads for the drills could be build, but would have been costly. From drill-hole 5 to drill-hole 25 the ore is shown up in drill-holes and test-pits. Within this stretch only two completed wholes, namely, Nos. 10 and 22, were barren or nearly so; and only one, No. 5, was comparatively lean. All three of these holes encountered the ore horizon at some depth, and no doubt mark the limits of its downward extension. All other completed holes show ore of rather better than the usual grade.

An estimate of tonnage, made as shown in detail on Plate VII, accounts for 546,700 tons, with the probabilities not exhausted, particulary at the S.W. end. This, let us say, half-a-million tons is all above drainage and could therefore be mined without hoisting or pumping; and, as already noted, is better than the average grade of Oriskany ore. The total distance to Covington furnace is roughly six miles, with old railroad grades in existence for the entire distance.

It appears therefore that there exists at least one ore deposit in the Iron Mountain territory of commercial size and grade; sufficient in itself to justify rehabilitation of mines and transportation

In addition to this, there are other localities which deserve further exploration. The possibilities of Iron Mountain are not exhausted by this one favorable discovery.

C O N C L U S I O N.

We have outlines in some detail in the foregoing pages the methods employed by us in carrying out your valued commission to report on the mineral resources of the Douthat Survey. The results may be briefly summed up as follows:

The only mineral resources of primary importance are iron-ores. Sand and limestone are secondary.

There are two classes of iron-ore, namely, Clinton and Oriskany. The Clinton, although of prime importance in other districts, is not found in workable development in this part of Virginia. The reverse is true of the Oriskany.

The Oriskany horizon is traceable for many miles within the Douthat Survey. At only three places however do the surface showings suggest ore possibilities of commercial interest. Two of these (groups 4 and 5, see Plate IV) have been very inadequately explored in the past, and are so remote from transportation that large tonnages would have to be put in sight to justify exploitation. The third, No. 2 (Iron Mountain), was the scene of former rather extensive mining operations and lies within six miles of a blast-

furnace, with the old railroad grades still in fair condition. In deciding upon our exploratory campaign, we were chiefly influenced by the feeling that your present purpose could be served far better by one real immediately tangible asset than by any number of "glittering possibilities.". Iron Mountain offered a chance for the former; whereas any work done on group 4 and 5 within the means at hand could not accomplish more than indicative results, which might perchance offer the aforesaid "glittering possibilities" but could not possibly reach a stage where exploitation would be justified.

We therefore devoted all our resources to exploring the Iron Mountain tract. We are glad to be able to report that we have there put in sight an ore-body with a reasonably assured tonnage of over half-a-million, of better than average grade, all above drainage, and readily accessible. This does not exhaust the Iron Mountain possibilities for ore.

Beyond this, we call attention to the two areas designated as groups 4 and 5, namely, Chestnut Ridge - Brushy Mountain and Brushy Ridge - Mare Mountain, where the Oriskany iron-ore showings deserve further exploration at some future time.

The Iron Mountain ore-deposit reported above is of a size and character which warrants establishment of mining operations with rehabilitation of railroad grades, etc. In this connection it is proper to point out however that the commercial importance of

Oriskany ore is after all a local matter. This ore is at its best not a high-grade material, and cannot therefore stand the cost of transportation to distant points of consumption.

Reference to Plate I will show you the possible local consumers, namely, the local blast-furnaces. Of these, the Low Moor Iron Co. is by far the most likely customer. It is in fact not too much to say that the Iron Mountain ore find is of real importance to the Low Moor Company.

Other local furnaces which are now out of blast, but which have been active within the last five years are those at Iron Gate (Alleghany Iron & Ore Co.), Glen Wilton (Princess Furnace Co.) and at Goshen (present owners unknown). The Alleghany Iron & Ore Co. also owns a furnace at Buena Vista in Rockbridge County.

Somewhat further afield, but possible customers, are the furnaces of the Virginia Iron, Coal & Coke Co., with head offices at Roanoke, Va.; the West End Furnace No. at Roanoke; and the Russens Furnace near Lynchburg, Va.

- - - - - - - - - -

All of which is respectfully submitted.

WELD AND LIDDELL

By: C. M. Weld.

New York, N. Y.
April 5th, 1926

EXTRACT FROM REPORT ON THE DOUTHAT SURVEY

Extract from Report on the Douthat Survey

REVIEW AND CONCLUSIONS

From the mass of detail which I have presented in the foregoing pages, one point stands out conspicuously, namely the inadequacy of the exploration so far accomplished on the Douthat Survey. It is safe to say that no single portion of this huge tract has been conclusively explored, either positively or negatively, and one gets a feeling of hopeless scattering of effort. Definite and final conclusions regarding the mineral values of any portion of the tract are out of the question.

At the same time certain more or less definite impressions have resulted out of my brief survey of the property and these are probably worth recording.

We have seen that the property contains two classes of ore, namely Clinton and Oriskany. The points where the former have been opened up are far too remote from transportation for these ores to be regarded as possessing any but equally remote value, aside from any other qualifications they may or may not possess. I have therefore omited these altogether from consideration in my study of the property.

The Oriskany ores occupy well defined leads running practically the entire length of the property. For the purpose of study it has been convenient to group these into six divisions, the fir[illegible] and last of which, namely the Dry Run trough and the Bath Alum Springs trough, I have not examined. The remaining four may b[illegible] reviewed as follows:

B. I have no change to make in my former report on the [illegible] Mountain trough, except perhaps to give somewhat m[illegible]

ty, more particularly in those districts which I have lettered D and E and where there is some promise of open-cut ore. The results of this further prospecting must determine whether or not the necessary railroad construction should then be undertaken and these further points be opened up and equipped.

It will be seen that this plan of campaign involves a successive attack, taking up one point after another and not all simultaneously. While one point is being worked, another may be explored. The terms of lease should be based on this idea, allowing for a moderate minimum royalty and a number of relatively short periods, each carrying an option for the succeeding period. In this way the operator could go on or not according to the success or failure of his search for further ore.

Such a lease may very possibly not appeal to the owners, but it seems the only wise course for the lessee, unless or until the owner has himself accomplished far more thorough and conclusive exploration. In other words the property today is quite inadequately explored. There are certain points upon it worthy of further exploration. If the owner will do this himself, well and good; having done so, with success, he will be in a far stronger position to make a lease than he is today. If however he places the onus of further prospecting upon the lessee, he must recognize this fact in the terms of his lease. The lessee in such case should demand: (1) a reasonable period for preliminary prospecting at Iron Mountain, say not less than 6 months; (2) a moderate minimum royalty, based ont on the property as a whole but on the single portion of it which is immediately under operation; (3) a long time lease broken up into short periods, upon the termination of any one of which the lease may be abandoned with all rights for

it to the ore-showings on the North side of the divide between the Pounding Mill and the S. Fork of Smith Creeks. There should be some open-cut ores in this direction which would be a valuable supplement to the underground ores still remaining under the old Iron Mountain cuts.

C. The Gap Mt. lead, while not conclusively explored, gives very little promise of valuable bodies of ore.

D. In the Brushy Mt. - Chestnut Ridge territory, there is promise of a good body of underground ore on the East side of Chestnut Ridge, and of considerable amounts of open-cut ore along portions of No Man's Ridge. On the whole this territory hasbeen inadequately explored. Its approach would requir 12 to 13 miles of railway construction.

E. There are se good prospects, but wholly inadequately explored, fo pen-cut ores in the Mare Mt. - Brushy Ridge territory These ores would require some 7 miles of railway exte n beyond the Chestnut Ridge ores referred to under D

If the hase of the Douthat Survey were under consideration we should hav now a great deal more about it than we do today before any p ould be set upon it which would be reasonably free from g

Fr point of view of lease, the property may be more immediate ached. The first point of attack should unquestionably be itain, but even here some time must be given for further ing before the expense of rehabilitation is undertaken. prospecting meets with success, an operation could be st ron Mountain, and during its continuance vigorous pros ld be proceeded with on other portions of the proper-

removal of equipment etc.

The above is of course suggested merely as an outline or basis for negotiation. Many acceptable variations or modifications are conceivable. The main thing to keep in mind is that, while giving promise, the property is as yet vertually unexplored.

Certain portions of the property carry very fine bodies of timber. This additional resource would help pay for the railways necessary to reach the ore.

REPORT ON THE ROARING RUN IRON ORE PROPERTY

C. M. Weld

Low Moor, Va.

August 23, 1913

Low Moor, Va. August 23, 1913

Mr. E. C. Means, Pres. & G. M.

Low Moor Iron Co. of Va.

Low Moor, Va.

Dear Sir:

I have made two visits to what is known as the Roaring Run Iron Ore Property, on August 11th. and 21st.. both times under the guidance of Mr. G. B. Williams (Parr, Botetourt Co., Va.) who lives on the property in the capacity of agent and representative of the owner, Mr. Harry L. Horton of New York. Mr. Williams took me to see all such openings as had not fallen in and where in his opinion something of value and importance could be seen.

The property in question is situated in the N. W. part of Botetourt Co., Va., and comprises about 9500 acres, mostly mountains land. I attach a map showing its boundaries together with other features of interest, and its position relative to the Craig Valley Branch of the C & O R. R.

While studying this property I have had before me a printed pamphlet purporting to be a report on its mineral and other values, prepared in 1911 by William Russel Hinsdale, Consulting Engineer, of New York. Mr. Hinddale quotes a number of authors, both as to the Roaring Run and neighboring properties, the latter with the purpose of showing that this tract lies in the heart of an exceptionally rich iron country. He concludes, over his own name, that the property contains "more than 20 million tons of ore" immediately available for mining" with a further probable 10,000,000 tons, and unlimited possible tonnage. His figures for immediately available ore are based upon the results of 41 openings and other exposures of Oriskany and Clinton ore, all of which are serially numbered and described in detail on pages 42 to 47 of his report.

In the following description of the several points seen by me, I have used for the purpose of direct comparison Mr. Hinsdale's corres-

ponding serial numbers. My sketch-map herewith attached is based upon Mr. Hinddale's map, but considerable modified in certain respects, and giving some added information. I have furthermore omitted all but the more important and significant openings, and have given these the corresponding Hinsdale Serial numbers, as in my text.

Inspection of may map will show that there is one persistent lead of the Oriskany ore-bearing horizon passing entirely through the property. This is seen running along the S. E. side of the Horton ridges, striking N. E.-S. W. and dipping to the S. E., and is the same lead as that exposed at our Fenwick washer. It may be traced continuously thence through the Oriskany, Grace Ellen, Roaring Run, Princess and other properties, all the way to Iron Gat Gate and in fact beyond. Upon it are situated the Longdale Co's "Circle" and the Princess Co's "Wilton" and Callie" mines, these mines being approximately 2½ to 4 miles N. E. from the Roaring Run N. E. property line.

I have observed this lead at four points whithin the Roaring Run tract. Two of these points namely where it crosses Cole's Run and again where it crosses the turnpike North of Roaring Run, have not been opened up, and the surface showings are not encourageing. At the other two points are the openings described below.

7. This opening is situated just S. W. of the old Roaring Run charcoal furnace, at the point marked on my map. Hinsdale describes this as an "old furnace tunnel reopened in ore, 400' with incline 60', all in ore, vein 25' thick"; and credits the territory thus described with an estimated tonnage of 6,000,000. I entered the old tunnel, which has within recent years been reopened, for a distance of a couple of hundred feet and found it to intercept the top of some old work said to nonnect by a 60' incline with an old shaft to the S. E., through which ore was raised for use in the charcoal furnace. The vein dips S. E. at about 30 degrees from the horizontal. I can not say what the old work below the tunnel-level revealed, but in the tunnel the vein was thin and sandy, showing flint bands nearly to the hanging-wall sandstone. The same condition appears at the tunnel portal, where the vein

may be inspected by daylight. The ore on the dump is for the most part lean. I should give little if any credit to this showing.

#12. At this point, indicated by the same number on my map, Hinsdale reports a 60' tunnel showing 37' of Oriskany ore; and credits this together with two other openings, one on either side (namely Nos. 13 and 14) with 4,500,000 tons. The three openings cover a stretch of lead approximately 2000' in length. Nos. 13 and 14, at both of which 25' of Oriskany ore is reported to exist, were said to be fallen in and I did not visit them. At #12, I found the following conditions. At the end of a crooked adit tunnel which is chiefly in sand is 55' cross-cut, bearing N 40 degrees W. At the S. E. end of this latter is about 10' of clay-slate dipping to the S. E. Underlying the slate are seen a couple of narrow bands of sandstone, with clay between. The balance of the cross-cut is in loose lean sandy ore with at one point a considerable pocket of clay coming down from the roof. It is apparent that the clay-slate hanging-wall nowhere rises far above the roof and at the one point actually rolls down into it. No flint was encountered, the N. W. face being in loose sand with a little lean ore. In short this cross-cut never got far away from the hanging, did not anywhere reveal the foot, and contained nothing but loose very lean ore scattered through sand. The ore on the dump is lean. From what I saw at #12 I see no ground for crediting this portion of the lead with any tonnage.

There are four other openings given in Hinsdale's table as on this lead, all of which were reported to me by Mr. Williams as fallen in and not worth visiting. I take it that he took me everywhere to the best showings, in fact he admitted as much to me. Hinsdale credits this front lead with a total of over 10,000,000 tons of Oriskany ore. My impression on the other hand is strongly adverse to the existence of any real values in this lead. At least no values have as yet been proved.

At the same time we may admit that there are considerable portions inadequately explored or not explored at all. This last is true of that part of the property lying N. E. of Roaring Run and therefore nearest to the Longdale and Princess Mines, and it is still possible that values may lie in this direction if nowhere else.

Two more leads of Oriskany ore are seen, lying N. W. of the Horton ridges, with converging dips, forming in fact a trough. This trough is perhaps 1000' across where it enters the property from the S. W., but narrows towards the N. E. and finally cuts out altogether a little to the N. E. of Crawford's Run. It is interesting to note that the N. W. limb of this trough is the lead upon which are situated the Lignite and Fenwick Mines.

Hinsdale describes a total of 13 openings on the two limbs of this trough. I travelled its entire length but was taken to only three numbered openings, while observing several unnumbered ones and at the same time the general surface conditions.

Two of the numbered openings which I saw were on the S. W. end of the S. E. limb, on what is called Horton Mountain Junior. Here Hinsdale has recorded a total of 8 openings, showing an average thickness of over 20' of Oriskany ore, and giving a total tonnage estimate of 1,720,000. My observations follow:

I visited Nos. 39 and 40 (see map). Hinsdale has reversed these two numbers in his report. Correcting this error, Hinsdale has for #40 and 80' tunnel showing 40' of Oriskany ore. I found here a true cross-cut tunnel starting in basal Oriskany sand, passing for 35' through flint, and thence through 40' (Horizontal measurement) of rather siliceons ore striking N 30 degrees E. and dipping N. W. at 40-45 degrees. The tunnel heading is in rather rich cap-rock. The true thickness, that

is normal to the dip, of the 40' of ore-material is 27'. This is on the whole not bad-looking stuff; I should judge the ore on the dump would run a little under 40% Fe.

At #39, which is not 100' up the hill from #40, I found an open cut somewhat fallen in, which Hinsdale reports as 40' long and showing 40' of Oriskany ore. As this cut is directly across the top of the #40 cross-cut tunnel the two records are really duplicates. Here again the material laid out on the dump was rather good siliceons ore.

These two, namely Nos. 39 and 40, are the best openings on Horton Mountain Junior according to Hinsdale's report, and were all that Mr. Williams considered worth showing me. Hinsdale's other six openings average a reported thickness of 16'. This is undoubtedly horizontal measurement as I found such measurements to be the rule wherever I was able to check them up. Applying therefore the same angle of dip as I found to exist at No. 40, the true average thickness for these six openings would be 11'.

I conclude that along Horton Mountain Junior there is a vein of fair Oriskany ore with an average thickness of 10 to 15 feet, dipping at 40 to 45 degrees towards the N. W. I have no sufficient data on which to base an estimate of tonnage, but judge that there might be a hundred thousand tons or more of this ore, only a small proportion of which could be taken by open-cut. I fear that Hinsdale's estimate of 1-3/4 million tons is to be set down as manifestly absurd.

The Horton Mountain Junior ore is rather the most accessible on the property, and this fact in conjunction with the present not altogether unfavorable showing makes it the most worthy of further exploration. Such exploration would be absolutely essential before any expense for railroad approach be undertaken.

The remaining opening which I was shown on the trough of Oriskany ore was situated approximately at the point marked #41 on my map. Here Hinsdale reports a 60 feet cut showing 13' of Oriskany ore, estimated to offer 120,000 tons. I found a true cross-cut trench, revealing cap-rock, ore, and flint, all with a gentle dip to the S. E. The ore at this point is for the most part excellent. Its horizontal measurment as seen in the trench is indeed approximately 13', but its true thickness is between 4 and 5 feet. No estimate of tonnage whatsoever may properly be based on a single isolated surface exposure such as this.

Hinsdale's report shows two more openings on the N. W. limb, with 5 and 8 feet of ore respectively and likewise two more on the S. E. limb, each with 17' of ore. His total estimate of tonnage for both sides of the trough, including Horton Mountain Junior, is a little over 3,000,000. In my opinion, aside from a probable considerable tonnage on Horton Mountain Junior, the openings so far made warrant nottonnage estimates. While being shown only three of Hinsdale's numbered openings, I did pick up several unnumbered points where work had been done, with results sometimes abortive, at other thimes negative. At least one opening was positive in its evidence showing the absence of ore. I will not say that openings of this latter sort have been suppressed, but naturally they are not conspicuously brought forward, either in Hinsdale's report or to the notice of a visitor such as I.

In general my impressions of the ore possibilities of this trough are not altogether unfavorable. I believe some more prospect-

ing might justifiably be undertaken at the S. W. end both on Horton Mountain Junior and in the territory adjacent to #41. Towards the N. E. there is abundant cap-rock float at a number of points and in some cases conditions are such as to suggest the possible existance of some shovel-cut ore. The work done so far has not met with much encouragement, but it is largely inconclusive and should probably be supplemented by some better placed and more conclusive exploratory work. In the meanwhile there is no foundation for any estimated of tonnage. At three points abortive attempts were made to put down drill-holes with a shot-drill. I was told that each attempt failed upon reaching the Oriskany top sandstone horizon.

We now turn to the Clinton ore. The Clinton leads naturally approximately parallel the Oriskany leads. I have not attempted to trace them on my map, only showing the approximate location of points reported by Hinsdale.

I visited only one point where Clinton ore was to be seen. This is Hinsdale's #8, being near the Northern end of the Horton Ridge, and at the N. E. end of the Clinton trough; its dip is locally eccentric however, being very gently towards the N. E. Hinsdale says of this point: "bed of Clinton ore averaging 10' thick covering more than 35 acres (38 pits); 1,680,000 tons." There is indeed an abundant showing of Clinton red-shale ore. Its gentle dip causes it to be more or less conformably with the surface, thereby covering an extensive area with float. I was able at no point however, to check up the reported thickness of 10'. In an old cut from which ore had been dug for the charcoal furnace, the ore appeared to be much thinner than this though badly covered up. The pits had all fallen in.

I may say that I am skeptical about the thickness and also about the quality of this ore. It has the usual appearance of Clinton

red-shale ore and may possibly run 40% Fe., but it is my opinion that it will certainly not average any higher. No conclusion however may be reached regarding the commercial value of this deposit until it had been further prospected and fairly sampled.

Hinsdale records two more localities in the general neighborhood of #8 with 10' of Clinton ore and a joint tonnage of 170,000. I did not see these.

In fact I saw no other exposures of Clinton ore. I am told that there is no fossil ore on the property, the Clinton being all red-shale. There are three openings and exposures reported as on the N. W. limb of the trough, showing Clinton ore 15' thick and offering a joint tonnage of 5,210,000; also three openings on the S. E. limb, offering jointly 430,000 tons of 5' Clinton ore. Only one opening is reported on the S. E. side of the Horton Ridge, #29, with 70,000 tons of 5' Clinton ore.

Without further exploration and a very thorough sampling of these Clinton red-shale ore exposures, it is impossible to form an opinion as to their real commercial value. Even without such further exploration however Hinsdale's estimates of tonnage are very open to question. The length of the trough for which he gives an "immediately available" tonnage of nearly 7.5 millions is approximately 10,000 feet. A rough calculation shows that to arrive at such an estimate we have to assume a depth of not less than 500' on the slope for a continuous ore body 20,000 feet long (both limbs of the trough) and with an average thickness of 10'. Or the same depth must be assumed to account for his estimate of 5 million tons of ore on the N. W. limb alone, taking the average thickness throughout as 15'.

I have serious doubt from what I have seen of this Clinton red-shale vein elsewhere in this part of Virginia, of the existence

of 15' or even 5' of ore of good commercial value for more than very limited distances. Under the circumstances I can only say that whilewhile considering Hinsdale's estimates totally unfounded, it is possible that bodies of Clinton red-shale ore exist on this property which would be worthy of exploration, particularly in connection with the more promising Oriskany ores. Further exploration and thorough sampling can alone determine this question.

I was taken to see two points from which Clinton ore is reported, but which in both cases proved to something else.

Nos. 9 and 10 are close together and are on a pocket of brown ore in the Devonian Shale. Hinsdale credits these openings with 280,000 tons. They should be disregarded altogether.

At #16, Hinsdale reports a "shaft 40' deep intersected by a tunnel driven from the surface 60' showing vein 15' thick of Oriskany ore" and credits this showing with 3,000,000 tons. Williams, with more reason, claims that this is Clinton ore and has asked me to change Hinsdale's report accordingly. As a matter of fact this is a brown ore deposited along a fault in the Clinton sandstone. The fault bears N. 15 degrees W and is filled with gauge and two to four feet of good brown ore. Hinsdale's estimate of tonnage is, not to put too fine a point upon it, absurd. No estimate of tonnage is warranted by the present developments.

I have now reviewed all the more important mineral showings on the Roaring Run property either seen by me or reported by Mr. Hinsdale and others. My conclusions may be briefly summarized as follows:

(1) The presistent lead of Oriskany ore following the S. E.

feet

foot-hills of the Horton ridges is, as far as explored today, worthless; but there are portions still unexplored or inadequately explored which may be worthy of more attention. Hinsdale attributes over 10,000,000 tons to this lead.

(2) The trough of Oriskany ore behind the Horton ridge is credited by Hinsdale with over 3,000,000 tons. In my opinion present developments warrant no estimate of tonnage, but further exploration may well be undertaken at its S. W. end. At the same time the N. E. end should not be overlooked as there may be some shovel-cut ore in that direction, although explorations to date have not been encouraging.

(3) Hinsdale's estimate of 7.5 million tons of Clinton ore may rightly be treated with skepticism. There is no true fossil ore on the property, the Clinton being all red-shale, of rather doubtful quality, while at the same time occuring in unquestionably conspicuous amounts. No value can be placed on this ore until further exploration and thorough sampling has proved it to be available.

(4) The 3,000,000 tons estimate for prospect #16 is wholly unwarranted, although the fault-vein existing at that point is probably worth further investigation in conjunction with the other ores on the property.

In brief, the Roaring Run tract has in my opinion been grossly over-rated. There are nevertheless some points which hold out a certain degree of promise and may properly be further investigated. In the meanwhile no definite value can be placed upon the property, but I may say that on the whole it seems rather less deserving of attention than the average property in this part of Virginia.

All of which is respectfully submitted.

(Signed)
C. M. Weld

REPORT ON THE LONGDALE IRON MINES

C. M. Weld

Bow Moor, Va.

~~ca Sept. 25, 1913~~

Sept. 1911

E. C. Means, Esq., Pres.,

Low Moor Iron Co. of Va.,

Low Moor,

Va.

Dear Sir:

I visited the Longdale iron mines on Sept. 13th, accompanied by Mr. Arthur Bird and Mr. George Nettleton. We were very courteously received by Mr. Firmstone and were taken through the underground workings. The following note is based on information gathered during the visit.

The ore is Oriskany. The hanging wall where seen was in every case shale and its derivative clay; the foot wall was the usual flint. I saw no sandstone or cap-rock, the ore being a high grade limonite frequently massive, its sole gangue being clay. The absence of sand should make it possible to turn out a product running 46 to 48% in iron. I have no analyses indicating what other impurities the ore carries, but understand that the phosphorus runs well up round 0.8%.

We visited two mines, known as the slope and the shaft. The former lies to the north-east of the latter, on the same lead, with a barren zone between. The vein

dips to the south-east. The two lenses on which these two mines are situated are said to have yielded 1¾ million tons of ore.

Except at these two points Mr. Firmstone informs me that very little ore has been found on the Longdale property. A couple of small pockets have been worked out and abandoned. It appears to be Mr. Firmstone's conviction, after thorough examination, that the ore still remaining in the property is wholly represented by that now left in the shaft and slope mines.

Our attention was wholly devoted to the two mines and we visited each in turn. Mr. Firmstone kindly loaned me tracings of the mine maps, blueprints of which I attach herewith. The tracings have been returned. The first blueprint represents the shaft mine and the second, the slope. They are not intented to show the entire workings but only those portions blocked out and as yet not robbed. In short they are skeleton maps, prepared chiefly for the purpose of estimating the developed ore still remaining in the ground-that is the "ore in sight".

The Longdale Company's estimate of "ore in sight", based on these maps, is 500,000 tons. I learn that this figure was arrived at by multiplying the square feet of ore-bed, taken on the plane of the vein, by an assumed average thickness of 15 feet, and dividing by 15, this last figure representing the cubic feet in the ground which it is assumed will turn out one ton of washed ore. The square feet of ore-bed measured up must therefore have been

500,000

I have made a careful study of the mine maps and arrive at a total figure of 426,210 square feet of ore-bed. I gained the impression from what I saw, that 15 feet average thickness is too great. In the absence of any proofs or actual measurements in this direction therefore I prefer to assume an average thickness of 10 feet. As for the yield, I fail to see how 15 cubic feet in the ground can be made to produce one ton of washed ore, allowing for wastage in mining and washing. I have usually considered that one cubic yard in the ground will produce a ton of washed ore, but in the present case, owing to the massive character of the ore I am willing to assume that 20 cubic feet will suffice. My estimate for "ore in sight" is therefore

$$\frac{426,210 \times 10}{20} = 213,105 \text{ tons}$$

say <u>200,000</u> tons, or two-fifths of the Longdale Company's estimate. I believe I have made sufficiently clear why I cannot agree with their figure.

I show the rough details of my calculation on the blueprints, by which you will see that I credit the Shaft mine with 55,000 tons and the Slope mine with 145,000 tons.

It is highly probable that there is still undeveloped ore below the bottom car-levels of both mines. In both cases, however, it appears that the lenses are wedging out in depth. I have indicated this probable condition on the map of the

Shaft mine. Taking this fact into consideration, I estimate that it fairly safe to count on a further 65,000 tons of ore below the bottom of the Shaft mine, and perhaps 35,000 tons below the Slope mine. These further tonnages can readily be reached by sinking the shaft or extending the slope in the two cases, respectively.

The mines are in reasonably good condition throughout. It has been an unfortunate practice to drive the development work on the hanging wall side so that the drifts are generally partly in slate and clay, and often wholly so, a condition of affairs particularly hard on the timber. The drifts are standing fairly well to date but much of the timber will probably have to be renewed later. The mines make comparatively little water. The equipment, top and bottom, appears in good shape and well cared for. Drilling capacity is not very ample. I should say that an output of 250 to 300 tons crude ore per day for the two mines together ought to be maintained without difficulty. The work would be chiefly robbing, with some development below the present bottom car levels.

There is a dangerous broken cliff or ledge overhanging the Shaft mine. Further caving through robbing may bring this down but as far as I could see no machinery or plant would lie in the line of a fall except the narrow gauge railway.

The property is said to carry large supplies of mine timbers, tie timber and other small stuff.

About 4 miles of narrow gauge railway connect the

mines with the washer. This I did not have time to visit but was told that it comprises 4 pairs of steel logs with screens, picking table and spitzlutte for the sand; all said to be in good condition, which I am inclined to believe after seeing how well kept up everything else has been, including the railways. The capacity of the washer should be 200 tons washed ore per day and possibly more.

About 8 miles of narrow gauge railway, well laid and in good condition, connect the washer with the C. & O. Ry. at Longdale Sta. If ore were to be shipped out, trestles and bins would have to be built for the purpose, as all equipment of this sort today is arranged for incoming ore and coke, since the furnaces were located close by the washer.

A limestone quarry, about 2 miles below the washer, is said to have yielded rather dirty stone.

I conclude with a brief review of the above.

No ore is claimed for the Longdale property except that left blocked out and ready to be robbed in the two mines. I estimate the quantity to be 200,000 tons, with a possible further 100,000 tons not developed. The mines are in good condition and equipment apparently good throughout. The ore is high-grade with no sand or cap-rock. The hanging-wall is shale and clay, and the gangue is clay. A 46 to 48% product should be obtained. The washer is reported good for 200 to 250 tons. I see no reason why an output of 150 tons washed ore daily should not be quickly reached and readily

maintained. The washer lies about 4 miles below the mines and the C.& O. junction about 8 miles below the washer, all narrow gauge railway. Motive power and rolling stock are apparently ample and in good condition. If ore were to be shipped out, trestles and bins would have to be constructed at the C. & O. junction, namely: Longdale Station.

An annual output of 40,000 tons should be perfectly possible with very little new equipment. This would give the mines a 5 years life based on "ore in sight"; possibly two to three years longer if new developments succeed. I do not believe the ore should cost over $2.75 into C. & O. cars including a 25¢ royalty or depreciation charge. On the basis of this charge and taking only the "ore in sight" the mines may be regarded as worth $50,000.*

I am

Very truly yours,

C. M. Weld

* I give no credit for equipment as I consider that this will have little value when the mines are exhausted.

REPORT ON THE

IRON ORE MINES AT LONGDALE

OCTOBER 14, 1913

REPORT ON LONGDALE IRON MINES.

According to your instructions Messrs. D. A. Karr, P. H. McNulty and F. U. Humbert visited Longdale, our purpose being to examine and report on the mines, equipment, etc., with a view to possible operation by your company. Upon our arrival at Longdale Furnace on October 7th, we were cordially greeted by Mr. H. Firmstone, President of the Longdale Iron Co., who offered us every facility for our inspection of the property. Below you will find a review of the details which follow.

REVIEW.

Reviewing and condensing this report it appears that before actual mining can start, considerable timbering and cleaning up will be necessary in both mines, namely, the shaft and the tunnel.

FIRST.-The car levels must be retimbered. This may require six week's time and may cost $2290.00. When the car levels are in good order, the robbing rooms, (all of which have caved and there are no working faces open) will have to be opened. This work must be done cautiously. Some ore will be taken while opening up the rooms. The time required and amount and value of the ore extracted from the robbing rooms can only be determined as the work progresses. We should not expect to get an output of 3000 tons per month before five months after the car levels are retimbered.

Other costs preliminary to actual extraction of ore will be; raising tracks and constructing a tipple at Longdale station,

suitable for unloading from narrow gage cars to standard gage cars. This will cost about $1200.00. Also ten mules will be necessary. These will cost $2250.00.

The total costs preliminary to actual mining will therefore be about $5740.00.

No new machinery or equipment will be necessary. No difficulty is expected on account of water. Ventilation for the mines is well provided for. Timber may be secured on the property. The number of houses is sufficient. All property is in good condition.

The ore is Oriskany, generally massive and fairly hard, of good quality, and should average 45% Fe. Silica in the ore should be low because of the absence in the hanging of the usual Oriskany sandstone, clay and shale form the hanging walls in these mines. The foot wall is the usual flint.

An estimate of ore in sight shows 59,000 tons for the shaft and 165,000 tons for the slope. The total tonnage in sight is therefore 224,000. This tonnage may possibly be added to by development below the present car levels. Assuming an output of 3,000 tons per month from both mines, a life of four years may be expected for the shaft, and seven years for the slope. At the end of four years, it will be necessary for the slope to alone maintain the output.

The cost sheets boiled down, show that, mining 3,000 tons per month, the ore should be delivered at Low Moor, exclusive of royalty and central office charges, at a cost of not more than $2,195 per ton. Add 25¢ royalty and this becomes $2,445 per ton.

The total cost delivered to Low Moor for all the ore is $526,846.50. The value of 45% Fe. Ore we placed at $2.75 per ton.

224,000 (tons) x $2.75 - $616,000 - total value of ore.
Cost del'd to Low Moor 526,846.50 without royalty
89,153.50 margin without royalty.

Tons Royalty
224,000 x 25¢ - 56,000 total royalty.
33,153.50 margin with 25¢ royalty.

Average cost per ton - $2,352
Including royalty of 25¢ - 2,602

(Value per ton) (Cost per ton)
$2.75 - 2,602 - 14.8¢ margin per ton.
with 25¢ royalty.

Cost per ton
$2.75 - $2,352 - 39.8¢ margin per ton without royalty.

The narrow gage railway is in very good condition. There are but few rotten ties. Ample provision for maintenance is allowed in the cost sheets.

The washer with the exception of some few inexpensive repairs, pipe connections, etc., is ready for operating. Its capacity, 250 tons per day, is adequate.

Scarcity of labor caused the mines to close down. We were told that at present there are plenty of men in the vicinity who are anxious for work. About 100 men would be needed.

As a final word, I would say that the only difficulty which might arise to interfere with your company's operating the mines profitably would be the scarcity of labor.

DETAILS.

GENERAL INFORMATION:

We visited two mines known as "Shaft" and "Tunnel", both mines were closed down in 1911. 1-3/4 million tons of ore are said to have been extracted. The "Shaft" and the "Tunnel" lie close together. They are reached by a narrow gage railway which extends from Longdale Station to the mines, a distance of some twelve miles.

Both mines open up lens shaped veins of Oriskany Ore. The veins dip to the south-east, that of the shaft standing at a higher angle than the slope vein. Appearances indicate that both veins are pinching out rapidly below the car levels.

THE ORE.

The ore itself is generally massive and fairly hard. We were told that it is easily drilled. In the past, very little soft ore was encountered. The hanging wall is shale often altered to clay. The foot wall is flint. The veins are notably free from sand, the gangue being clay. The absence of the usual Oriskany sandstone is especially noticeable and very favorable for a low silicious ore. Mr. Firmstone states the ore has averaged at the furnace, 45% Fe., and 15% silica. One-eighth of this being lump, and seven-eighths washed ore. An average of 62.7% of crude ore was recovered from the washer.

Samples of the crude ore were taken by Mr. P. H. McNulty. These were analyzed by Mr. T. J. Quick. Location and results are as given below.

Samples not yet analyzed. Will supply later.

COPY.

LABORATORY.

COVINGTON, VA., Oct. 21, 1913

ANALYSES DRIED ORE:

LONGDALE ORES.

	Insol.	Fe.	Phos.	Mang.
Fan Tunnel	16.00	49.72	.63	.58
Store Level Slope	24.14	44.13	.58	.41
Bottom Car Level	12.56	51.29	.82	.59
Shaft 40 Level	4.80	58.24	.51	.39
120 Level Slope	7.99	58.46	.39	.43
90 " "	11.59	50.40	1.03	4.15
110 " "	1.60	58.46	1.37	.50
Shaft 60 Level	18.78	48.16	.60	.39
Shaft 80 Level	35.44	39.42	.35	.39
70 Level Slope	5.04	58.24	1.10	.46
Shaft 20 Level	38.62	36.96	.16	.20
Slope Bottom Car Level (Centre)	3.80	56.89	1.00	.39
Slope Bottom Car Level (upper end)	2.80	56.00	.66	1.40
Slope Bottom Car Level (nearest end)	25.78	40.76	.44	2.48

T. J. Q.

ORE ESTIMATE.

Referring to the report of Mr. C. M. Weld on Longdale I note that his estimate of ore in sight is 200,000 tons, whereas, Mr. H. Firmstone's estimate is 500,000 tons. Mr. Firmstone uses 15 cubic feet of ore in the ground to produce one ton of washed ore. Mr. Weld uses 20 cubic feet. In my estimate I use 20 cubic feet as I believe this to be closer to the actual footage than 15 cubic feet. Also, I assume an average thickness of ore of 12 feet as against Mr. Weld's 10 feet and Mr. Firmstone's 15 feet. I think a thickness of 10 feet is too conservative. My figures for area are taken from the blue prints attached to Mr. Weld's report.

ORE IN SIGHT - SHAFT MINE

(Area) (Thickness)
99900 x 12 - 65,940 tons
20

(Cubic feet per ton)
Allow 10% for waste in mining and lean spots.

(% recovered)
65,940 x 90 - 59,340 tons recovered
say - 59,000 tons recovered.

ORE IN SIGHT - SLOPE MINE.

(Area) (Thickness)
307,300 x 12 - 184,380 tons
20

(Cubic feet per ton)
say- 184,000 "

Allow for waste in mining and lean spots.

(% recovered.)

184,000 x 90 - 165,600 tons recovered
say - 165,000 " "

TOTAL TONNAGE IN SIGHT FOR BOTH MINES.

Shaft - 59,000 tons
Slope - 165,000 "
Total - 224,000 " in sight.

Indications in both mines suggest possibilities for more

ore below the present car levels. This can only be proved up by underground prospecting. Mr. Weld's report gives figures for this possible ore and I am willing to let them stand for what they are worth.

THE CONDITIONS.

The condition of the mines is such that it will require some time for retimbering and cleaning up before we could expect to extract any ore. At the shaft mine, the shaft is in good condition and ready for immediate hoisting. At the slope mine, the slope is in good condition and ready for hoisting. The car levels in both mines are in poor condition. Both car levels will need considerable retimbering and cleaning up before ore can be taken. Also in neither mine are there any robbing rooms which are safe to work. The robbing rooms have all been allowed to cave. The car levels and other openings in the mines with the exception of the robbing rooms are being kept up sufficiently only for passage, and ventilation. It is our general opinion that six weeks working two ten hour shifts will be necessary before the car levels are in a safe condition. In many places the car levels are driven in the hanging. This makes the task of retimbering somewhat difficult because of the tendency of clay and shale to swell when once opened to air. Even when retimbering is done most carefully, this kind of ground is liable to run in before the old timber can be replaced by the new. Six weeks to retimber the car level is our best prognostication.

Regarding the opening of the rooms, we must guess at the existing conditions and therefore guess on the time required to get an output. The ore has broken from the hanging and no doubt there is considerable hanging intimately mixed with the ore. It is very probable that in some places the mixture of the hanging with the ore has

rendered the ore commercially unworkable. The true existing conditions of the rooms can not be judged until a certain amount of cleaning up and timbering has been done.

OUTPUT.

We place the time necessary to get the robbing rooms in condition for operation on the basis of 3,000 tons per month washed ore at five months additional to the six weeks required for retimbering the car levels. Of course some ore will be won as the opening up of rooms is carried along. This amount is indefinite: we should get at least

500	tons	from	our	first	month's	work	on	the	rooms
1000	"	"	"	second	"	"	"	"	"
1500	"	"	"	third	"	"	"	"	"
2000	"	"	"	fourth	"	"	"	"	"
3000	"	"	"	fifth	"	"	"	"	"

MINE WATER

The shaft mine carries very little water. Pumping one and one-half hours in 24 is sufficient.

The slope mine has considerable more water than the shaft. We were told that pumping from three to four hours in 24 hours is necessary. The pumping system in both mines is the same. An air lift is generally used. A steam pump is provided for emergency and is run once a week to test its condition.

VENTILATION

Natural ventilation is said to be ample. Both mines are provided with fans. These were running at the time of our visit and the air was good. After the rooms are opened the air may not be so good as it was at the time of our visit; we should expect some difference but this should not be serious enough to greatly inter-

fere with operation.

SYSTEM OF MINING.

The system of mining followed is long wall retreating, with top-slicing and caving. The ore is top sliced in slices of 10 feet, shoveled into wheel-barrows and dumped into chutes connected with the car level. Cars are charged from the chutes and hauled by mule to the bottom of the shaft or in the slope to the bottom of the slope. In the shaft the cars are hoisted in the cage to the tipple where they are dumped on to flat lying grizzlies with two inch openings. The tipple men rake the ore over on the grizzlies and sort out the waste which is thrown into a separate chute for loading into cars. The thrus from the grizzlies are loaded into cars for washing. Any overs are shipped direct to the furnace. Large pieces are broken up by hammer. The same method of handling is also used at the slope except that the cars are hauled by cable up the slope. An attempt is made to sort the gangue and hanging wall (which often falls after a shot) from the ore underground.

Drilling, shooting, timbering and loading was all done by the company. Mr. Firmstone tells me that contracting was tried, but was abandoned because miners avoided difficult places, considerable ore was left in the ground, and more waste than was necessary came to the surface. In the event of your company operating these mines, we could try loading by contract, all other work on company time.

MINES, MACHINERY AND EQUIPMENT

Each mine has it own power house. Each power house has two boilers, two compressors and one hoisting engine. Only one boiler is kept in fire. There is also one fan at each mine.

There are twelve Sullivan 26 U. M. drills, 2 inch cylinders, 4-1/2" stroke. These would be ample for some time to come. The compressors have no difficulty in supplying air for the drills.

There are 40 mine cars. These are of wood, end dumping, 24 inch gage. The cars are very high for hand loading. They are suitable for chute loading and as most of the ore is loaded in this manner they should give no great drawback to the output. The mine rails are about 16 pounds per yard.

All machinery and equipment is in good working order.

THE WASHER.

The washer is a simple affair. There are four pairs of steel logs, four sizing trommels, 3/16 inch holes, four sizing screens, 20 M. and one spitzlutte. The washer has a capacity of about 250 tons washed ore per ten hour day. As the washer has been idle for two or more years it is not unlikely that some small repairs will be found necessary. When operated by the Longdale Company, it was run by electricity furnished from the furnace plant. Your company would operate by steam; there being amply boiler power. Water for the washer has always been abundant. It flows by gravity from a flume which taps a steam some distance above the washer. The flume is in good repair.

FLOW SHEET OF LONGDALE WASHER MINE.

RAILWAY AND EQUIPMENT

The railway is 36 inch gage. There is about twelve miles of trackage to keep up. The distance from the mines to the washer is about four miles. From the washer to the Longdale station is about eight miles. The rails are 35 pounds to the yard. Ties used are 6" x 8" face, 5 feet long. Mr. Firmstone values the ties at 25 cents each along side railway. The railway is in good condition and is being kept up. There appeared to be but few rotten ties. One long bridge over Cowpasture river has to be kept up. This is now in good repair.

The present arrangement of tracks at Longdale station is not suitable for unloading ore from the narrow gage cars to the C. & O. cars. There is a long trestle which provides for the unloading from the C. & O. cars to the narrow gage cars. To reverse the process of loading at this trestle would be more expensive than to raise the narrow gage tracks along the main line where the standard gage tracks run parallel, and where the iron was transferred from the narrow gage cars to the C. & O. cars. At present the narrow gage tracks are two feet higher than the standard gage tracks. To provide for unloading ore from the narrow gage cars into the C. & O. cars, will require a vertical height of twenty-four feet rail to rail. This means that the narrow gage tracks must be raised twenty-two feet. Say we raise on 3% grade for a distance of 600 feet and then 400 feet on a 1-1/4% grade. We could raise the track by filling (material is in bank close by) up to a height of nine feet, which means a 3% grade, 300 feet of fill. The balance 700 feet, will be raised by trestling. Timber for this trestling may be secured from the present trestle, which is 1100 feet long and maximum height

26 feet. 400 feet of the present trestle would be sufficient for incoming coal or other supplies. For cost of this change see under "Costs."

ROLLING STOCK - NARROW GAGE

The rolling stock is certainly ample. There are six narrow gage locomotives. Three of these are capable of hauling 50 tons of ore, and three can haul 175 tons of ore to the washer and 120 tons from the washer to the Longdale station. Four of these locomotives are ready for immediate use. The other two need slight repairs.

Eighty-five jimmies, 5 to 6 tons capacity, side dump, V shaped bottom, are said to be in good condition.

Forty coke cars, capacity ten tons, are available to haul ore from the washer to Longdale station.

Also there are 38 flat cars.

MACHINE SHOP.

The machine shop is located at the furnaces. It was run by steam furnished from the furnaces. There is a portable boiler which could be used to furnish power for the machine shop. The Longdale Company did practically all its own repairing. We did not visit the machine shop but were told that it is well equipped and ready for use.

TIMBER

Mr. Firmstone states that the Longdale Iron Company's property which has 23,000 acres has an abundance of mine timber, ties, etc. At the slope mine there is a saw-mill which is in good condition. It was installed primarily for squaring up mine timber. I understand it was used but little for this purpose.

The Longdale Company cut and hauled their own timber on company time. They kept four mules for timber hauling. Your company could probably arrange to contract for necessary mine and other timber.

LABOR, ETC.

The mines closed down in 1911 because of the scarcity of labor. It was found impossible to keep up an output sufficient for the Longdale Company's furnaces. There are two furnaces, both built of brick. The furnaces are located near the washer. Their capacities are said to be 80 and 60 tons. Most of the labor employed at Longdale came from Rockbridge County. At present stationary and locomotive engineers are available on the property. Also there are a few miners. Mr. Robinson, foreman for the Longdale Company, and now in charge of keeping up the mines informed us that there were plenty of men in Rockbridge County and in the vicinity who would be glad of work. The Rockbridge County line adjoins the Longdale Company's property.

To keep up an output of 90,000 tons per year, it requires 70 underground men, and 13 surface men. This does not include locomotive men, say four, - or trackmen, of six.

The total number of men required is about 100.

Wages ranged from $1.50 per day for common labor, to $2.00 per day for foreman and engineer.

HOUSES

Houses are sufficient and in good condition. Rents are at the rate of $1.00 per room per month.

At the mines there are as follows:

6 - 2 room houses
12 - 3 " "
14 - 4 " "
1 - 5 " "
7 - 6 " "
1 - 8 " " (Sup'ts House)
1 - 4 shanty
12 - 2 shanties
1 - Commissary

At the furnace there are 42 houses
At Longdale Station 6 "
At Longdale Quarry 10 "
At Settling Dam 8 "

COSTS

Raising narrow gage track.

300 feet grading on 3% grade		
500 yards at 30¢	$150.00	
700 ft. trestle containing 70,000B.M.		
knocked down and erected @$15.00/M. -	1050.00	
Total -	1200.00	1200.

Six mules needed for the mines		
Four mules for hauling timber	2250/00	2250.
Ten mules at 225.00		

Retimbering car levels in both mines
Six weeks of two ten hour shifts

One superintendent @	$ 5.00	per day
Ten timbermen @$1.50	15.00	" "
Two Foremen @ $2.00	4.00	" "
Four Tipplemen @ $1.40	5.60	" "
One Locomotive Engineer @	2.00	" "
One " Fireman @	1.50	" "
Office and Storeman @	2.00	" "
Six mine mules @ 80¢	4.80	" "
Total	39.90	" "

36 days @ 39.90	$1436.40	
4 Firemen 42 days @ 2.00	336.00	
1 Stable man @ 1.35	56.00	
120 Tons coal @ 2.50	300.00	
200 sets timber @ 80¢	160.00	
	2289.10	2289.10

Total expense before any ore is won 5739.10
Say 5740.00

	1st month after retimbering car levels	2d month's mining	3d month's mining	4th month's mining	5th months mining	After 5th month
Mines		Per ton.	Per ton	Per ton	Per ton	Per ton
Salaries	.25	.125	.084	.063	.042	.03
Labor	3.91	1.96	1.64	1.46	1.07	.90
Explosives	.20	.20	.20	.20	.20	.20
Fuel	.50	.25	.19	.125	.10	.09
Supplies	.15	.12	.12	.10	.08	.07
Timber	.30	.18	.18	.12	.12	.12
Engineering	.01	.01	.01	.01	.01	.01
N.G.R.R.	.43	.32	.296	.274	.15	.11
Teams	.48	.24	.16	.12	.08	.06
Analyses	.01	.01	.01	.01	.01	.01
Gen. Exp.	.05	.03	.03	.01	.01	.01
Telephone	.01	.01	.01	.01	.01	.01
Development				.01	.10	.10
Total	$6.30	3.455	2.930	2.602	1.982	1.72
WASHING						
Labor	.12	.09	.08	.07	.06	.05
Supplies	.01	.01	.01	.01	.01	.01
Fuel	.01	.01	.01	.01	.01	.01
Repairs	.02	.02	.01	.01	.01	.01
Total -	0.16	.13	.11	.10	.09	.08
Total Cost	6.646	3.585	3.07	2.702	2.072	1.78
Del'd L.M.	6.585	3.72	3.195	2.827	2.195	1.905
Output tons	500	1000	1500	2000	3000	4000

Let us see what the total cost to win all the ore will be based on an output of 3000 tons per month, each mine furnishing one-half the total output after the mines are in good order. 224,000 tons to be mined.

Costs delivered to Low Moor.

SHAFT

One-half preliminary costs 2870.00

250 tons @ 6.585 -	1646.25
500 " @ 3.72 -	1860.00
750 " @ 3.195 -	2396.25
1000 " @ 2.827 -	2827.00
Cost 1st 2500 tons -	11599.50

NOTE

When the ore is nearly worked out there is liable to be a reduction in output on account of there being fewer robbing rooms. I assume at this stage the ore will cost $3.00 per ton and that 20% of the total ore in sight will be mined under these conditions.

		Cost of 1st 2500 tons.
59,000 tons x 20% -	11,800 tons	
Say -	12,000 "	11,599.50
12,000 @ 3.00 -	36,000	36,000
44,500 @ 2.195 -	97,677.50	97,677.50
		$145,277.00

Total cost of 59,000 tons del'd L. Moor	145,277
Royalty @ 25¢	
59,000 x 25 -	14,750
Total cost including royalty.	160,027
Value of 45% Fe ore - $2.75	
59,000 @ $2.75 -	162,250
Margin	2,223

- - - - - - - - - - - - - - - - - -

The life of shaft mine is estimated at about four years.

SLOPE MINE

165,000 tons in sight	
1st 2500 tons	$11,599.50

See note under shaft - say 10% instead of 20%

Tons

165,000 x 10% -	16,500 tons	
16,500 @ $3.00 -		49,500.00
146,000 @ 2.195 -		320,470.00
Total		381,569.50
165,000 @ 25¢ royalty		41,250.00
Total cost -		422,819.50
165,000 @ $2.75		453,750
Margin		30,930.50

The life of mine is estimated at about seven years.

Respectfully submitted.

(signed) F. U. Humbert

Oct. 14, 1913.

To E. C. Means/ Esqu., President
and General Manager
Low Moor, Va.

REPORT ON THE PRINCESS FURNACE COMPANY

AND THE LONGDALE IRON COMPANY

C. M. Weld

Low Moor, Va.

Nov. 22, 1911

E. C. Means, Esq., Pres.

Low Moor Iron Co. of Va.

Low Moor, Va.

Dear Sir:

On Nov. 7th, 1911, I visited the mines of the Princess Furnace Co. at Glen Wilton. I was hospitably received by Mr. Curtis Claypoole, Gen. Manager, who personally conducted me through the mines, in company with Mr. Noyes, Supt. and Mr. Dillard, Mine Foreman. I beg to submit the following notes of my visit.

MAP

The accompanying map shows the two tracts of land owned by the Princess Furnace Company, together with the adjacent tract of the Longdale Iron Co. I have sketched in with probably fair accuracy the several mine workings and tunnels. Elevations, dimensions, etc. have all been taken from the Princess Furnace Co's. maps, which were placed at my disposal.

GEOLOGY

A single belt of Oriskany measures passes through the two tracts from North East to South West, dipping at varying angles to the South East. Its total length within the Company's lands is roughly 7250'. Of this distance about 2800' or roughly 38% has been found to be mineralized to a commercial extent and has been worked. The balance, I understand, has either been prospected and found worthless, or else offers no surface indications, such as to lead to prospecting.

The ore, being the usual type of Oriskany brown iron ore, occurs in three separate lenses, aggregating the 2800' in length described above. The foot wall is the usual flint, or at times a clay with scant flint. The hanging wall may be slate or clay; sandstone or cap rock; or else, as seen at several points on the lower levels, limestone. In one mine (the Wilton) limestonehas been found completely enclosed by the iron ore, forming "horses" in the vein.

The Clinton measures, carrying the fossil vein, must occur

higher up on the flanks of Rich Patch Mountain, paralleling the Oriskany measures. The fossil ore has however not been worked, nor has it so far as I know been discovered within these lands in a workable condition.

THE MINES

The three lenses referred to above have each been worked, both on the crop and underground. The three sets of workings are known from North East to South West successively as (1) the Callie Mine 2nd Incline; (2) the Callie Mine 1st Incline; and (3) the Wilton Mine. The first two are on the Callie Furnace tract and closely adjacent, being separated by only a couple of hundred feet of barren ground. The last, namely the Wilton Mine, is on the Princess Furnace Tract. Its North-Eastern extremity is 2300' distant from the South-Western extremity of the Callie 1st Incline. This intervening stretch is so far as known barren. To the south west, the Wilton extends to the Longdale boundary and has in fact been worked across the boundary, the lens being continuous with the ore body on which is situated the Longdale Co's Circle Mine.

I shall proceed to describe each mine in turn, taking them in the order given above.

The Callie Mine 2nd, Incline

The bottom car level of this mine is open today light at both ends, opening directly to the surface on the crop of the vein, at the North East End, and connecting with a cross cut tunnel, at the South West End. Its elevation is given as 1444'. The old open cut crop workings were about 250' vertically above. A block of ore of the following dimensions is still left above the car level, waiting to be robbed. The figures have been taken from the Princess Furnace Co's maps and only roughly checked by me. The great width of the ore on certain levels is due to a flat roll, accompanied by a slight overthrust fault.

	Height	Width	Length	Cubic Feet
Car level - 24' level	24	25	560	336.000
24' " - 48' "	27	45	260	315.900
48' " - 72' "	24	45	290	174.000
72' " - 84' "	13	40	340	176.800
84' " - 96' "	14	30	360	151.200
96' " - 108' "	12	15	180	32.400
			Total Cubic Feet	1,186.300

At 27 cubic feet of ore in the ground to produce one ton of washed ore, we have in this block 44,000 tons of ore, of which 15 to 25% has been removed by the development work. It will probably be fair to estimate 35,000 tons of ore in sight for this mine.

The ore lens on the bottom car level was 600' long. It is impossible to say how much deeper this ore may go. If a hundred feet, with an average width of 15' and maintaining its present length of 600' then there will be a further 33,333 tons or say 30,000 tons of washed ore available. If more than 100' there will be correspondingly more ore; if less, the above figure will be excessive. Again, the lens may expand or contract in length. In any event anew cross cut tunnel of considerable length or else a shaft, would be required to reach any further ore discovered beneaththe present bottom car level.

I believe it fair and safe to estimate a probable tonnage of 25,000 under this mine, with further possible tonnages.

The Callie Mine 1st Incline

The elevation of the lowest car level in this mine is given as 1494' or 50' higher than that of the Callie 2nd Incline. It is approached by a cross cut tunnel of approximately 250' in length. The old crop workings were 175' vertically higher up. Following are the dimensions of the block of ore left above the car level. As before/ I take my figures from the Princess Company's maps, having only roughly checked these personally, they are probably to be regarded as reliable.

	Height	Width	Length	Cubic Feet
Car level - 24' level	24	10	900	216.000
24 " - 36' "	12	10	730	87.600
36' " - 48' "	12	10	250	301000
48" " - 60" "	12	10	180	21.600
60' " - upwards	12	10	130	15.600
		Total cubic feet		370.800

At 27 cubic feet of ore in the ground to produceone ton of washed ore, we have in this block 13,733 tons, of which 15 to 25% has been removed by development work. I consider that we may safely estimate that there are not less than 10000 tons of ore in sight.

As regards the existance of ore below the car level, we are confronted with the same uncertainties as with the 2nd Incline Callie Mine, with the exception that here we find a new cross cut tunnel driven to the vein at a depth of 144' vertically below. This tunnel was nearly 500' long. Where it cut the vein, ore was found, but in no great thickness, being badly confused with sandstone and limestone. The veing would appear in fact to have been distrubed at this point by a crumpling movement, though not actually faulted. It was not driven on in either direction, nor am I satisfied that the true foot was encountered before work was stopped.

The ore lens on the bottom car level was 900' long. If we assume that it will continue with an average width of 10' and maintain the same length downto the new cross-cut level, then we have a block of ore containing (900 x 10 x 144) ÷ 27 = 48,000 tons. It would be untenable to regard this as ore in sight. We may fairly say however that there are 40,000 to 50,000 tons of probable ore at this point.

Under the circumstances I should not care to credit this mine with any probable ore below the new cross cut tunnel. There are of course further tonnages of possible ore however in this direction.

The Wilton Mine

The "Wilton" or "Big Bin" tunnel, with a length of about 1800' cuts the ore lens at an elevation of 1200'.

The upper or "shop" tunnel is 121' above this, while the old crop workings were 480' higher up.

There is a block of ore left above the lowest car level of the following dimensions. Again I have taken my figures from the Princess Furnace Company's maps.

	Height	Width	Length	Cubic Feet
Big Bin Tunnel-1st Level	12	7	600	50.400
1st Level 2nd "	12	14	400	67,200
2nd " 3rd "	25	15	400	150.000
3rd " 4th "	25	14	340	119.000
4th " 5th "	25	14	280	98.000
5th " 6th "	25	10	200	50.000
6th " 7th "	20	6	170	20.400
7th " 8th "	18	4	125	9.905
8th " Shop Tunnel	18	4	90	6.480
Shop Tunnel Upwards	12	4	40	1.920
Total Cubic Feet				572.405

At 27 cubic feet of ore in the ground to produce one ton of washed ore, we have 21,200 tons of ore in this block, or 17,000 tons after deducting a fair allowance for ore removed in development work. This is ore in sight.

It is again impossible to say how much ore may be counted on below the bottom level. Down to 60' above the Big Bin Tunnel level the ore lens was 1200' long. Below that point, it contracted rapidly on the South West end so that on the Big Bin Level it was only 800' long. Should it continue downwards for a hundred feet maintaining this length of 800' and a width of 10' there would be a further 30,000 tons. Under the circumstances I do not believe we should reckon on more than 20,000 tons of probable ore, with of course further tonnages of possible ore.

The probable ore would require either a new and very long cross cut tunnel or else a shaft.

Ore Estimates Review

We have seen that the following tonnages are offered by the three mines under discussion.

	Ore in sight	Probable Ore
Callie Mine, 2nd Incline	35,000 tons	25,000 tons
Callie Mine 1st Incline	10,000	45,000
Wilton Mine	17,000	20,000
	62,000 tons	90,000 tons

The ore in sight is blocked out and ready to take. Of the probable ore, one half would require new cross cut tunnels or else shafts.

I have omitted any reference to possible ore in the above table since it is out of the question to place any exact figure on this. We may however, gain a general idea of what the ultimate possibilities might be. If we assume for the moment that the entire 7000' more or less of Oriskany measures crossing this Company's land carry a 10' ore bed from about the average level to which I have reckoned the probable ore, down to the level of the James River, we shall arrive at the figure of approximately 500,000 tons. It is conceivable though improbable, that the ore may have formed even below the James River Level. On the other hand, it is extremely unlikely that with further depth, the Oriskany measures will be found mineralized to a commercial extent for their entire length, when down to the present levels they have been so mineralized for only about 35% of their length. Assuming that these measures will be found in depth, to carry workable ore bodies for 25% of their length, we calculate a possible tonnage of 125,000.

I think it probably fair to say that there may be 150,000 to 200,000 of Oriskany ore or the Princess Company's lands, beyond the ore-in-sight and probable ore, which I have included in the above table. I have shown that the ultimate possibilities could not exceed 500,000 tons. I frankly admit however, and should wish to have it so understood, that these last figures are mere guess work.

All this possible ore would require veryllong cross cut tunnels or shafts.

I do not know whether there is any workable Clinton ore on this property or not. I understand none has been discovered.

OPERATING CONDITIONS

The usual local methods were employed in mining the ore. The three mines jointly produced from 2500 to 3000 tons washed ore per month. I do not believe much better than this could be done without further extensive development of the probable ore. The mines are in fair shape.

The crude ore was brought down over a narrow gauge railroad in 10 ton cars to the washer, situated near the furnace on the C. & O. Railroad. The equipment appears to be in reasonably good condition. Compressor and rock drills are on hand.

I did not have time to visit the washer. I am told that this is of the simplest type, including only McClenahan Stone Steel Logs and I believe sand screens and picking belt.

Quality of the ore

My inspection of the ore in the mines would lead me to suspect its quality to be of inferior grade. Mr. Claypoole informed me that when running all local ores, a furnace yield of 42% could be maintained. More refined washing methods might possibly better this by one or two units. It was apparent to me however that the ore in the ground is not as free from sand as our Dolly Ann or Fenwick Ores. I should class it about with the Rich Patch Ores.

REVIEW

The Princess Furnace Co's three mines offer today approximately 62,000 tons of ore in sight and 90,000 of probable ore. There are a further possible couple of hundred thousand tons with ultimate possibilities of 500,000. This last I consider an extremely unlikely figure. It merely represents what there is room for should the entire measures contain workable ores down to the James River level.

The ore in sight is blocked out and ready to be taken. Half the probable ore and all the possible ore would require new cross cut tunnels or shafts.

The above is all Oriskany ore. So far as I know, no workable Clinton ore has as yet been discovered on the property though the measures cross it.

In quality, the Princess Company's Oriskany ore may be classed as medium grade, giving furnace yields, so it is claimed, of 42%. More refining washing processes might raise it one or two points.

The equipment is present and in fair condition for an output of perhaps 3000 to 3500 tons monthly. The three mines jointly have been producing from 2500 to 3000 tons. They are idle today.

All of which is respectfully submitted.

C. M. Weld

Low Moor Va.

Nov. 22, 1912

REPORT ON THE CIRCLE MINE

OF THE LONGDALE IRON CO.

GLEN WILTON, VA.

C. M. Weld

Low Moor, Va.

Nov. 7th, 1911 - Feb. 5, 1912

E. C. Means, Esq., Pres.,

Low Moor Iron Company of Va.

Low Moor, Va.

Dear Sir:

On Nov. 7th, 1911, I visited the mines of the Princess Furnace Company at Glen Wilton. I took the same occasion to examine briefly the adjacent "Circle" mine belonging to the Longdale Iron Company, Mr. Frank Mitchell, mine foreman, showed me over this mine. Unfortunately I had very little time and was therefore able to do no more than go through the Car-levels.

Attached to my report on the Princess Furnace Company's mines is a map which includes the Longdale Iron Company's Circle mine tract. The position of the mine may be seen on that map.

GEOGOGY

The Circle mine is on the same Oriskany lead which traverses the Princess Furnace Company's lands, striking N.E. to S.W. and dipping about 40° to the S.E. at this point. The ore lens is continuous with that of the Wilton mine adjacent to the North east, and has been worked for 750' southwestward from the boundary on the upper or No.1 car-level. Beyond that point no ore has been found, but it has not been proved that there is none. From the south-west breast on the No.1 Car-level, which is barren, to the southern boundary of the property, on the strike of the vein, is approximately 1500'. An interesting feature of this mine is the appearance of limestone at several points along the bottom level. East of the junction of the No. 2 tunnel with this car level two bodies of limestone, each about 8 to 10 feet thick, were cut through and the ore encountered once more on the further side. At the south-west end, the breast was stopped in limestone after cutting through about 3 feet

of this material. No attempt was made in any case to pass around the limestone, so that it is not known today whether this simply occurs as "horses" within the ore or whether it occupies the entire vein; nor is it known what its vertical extension may be. Examination of the contact surfaces between the limestone and ore convinced me that the former exists as residual unchanged masses within the ore horizon. It is of course highly probable that with greater depth the limestone masses will become more and more abundant within the ore horizon, till the ore gives way to limestone altogether, at a depth where the replacement effects of mineral-bearing surface waters have no longer been operative. What that depth may be is mere guess work; it would of course vary locally with differing local conditions. But the presence of the limestone is strongly suggestive that the mine is beginning to approach the depth where ore may no longer be hoped for.

I may note that limestone "horses" were found at some of the lower levels in the Wilton mine.

Tunnel No. 2 encountered the vein at a point slightly in front of or geologically speaking above its proper position as projected downwards from the upper levels. This is no doubt due to a slight over thrust fault, lying somewhere between the two car levels. So little development has been made in this block of ground that the position of this fault has not been uncovered, but its existence should increase rather than decrease the quantity of available ore.

I am not aware of any Clinton ore having been discovered on the Longdale Iron Co.'s tract. At best there could not be much of it.

THE MINE-ORE ESTIMATES

The upper or No. 1 car level is approached by a cross cut tunnel about 450' in length. This car level is 750' long and its elevation is given as 1448' above sea level. For 410' south westward from the northern boundary the ore has been robbed down to the 24' level. Higher blocks of ore are standing above the balance of the distance. I estimate the ore left above No. 1 car level to be as follows:

Length	Slope Height	Angle Thickness	Cubic Feet
180	213	10	383,400
55	180	10	99,000
25	147	10	36,750
30	110	10	33,000
50	73	10	36,500
410	36	10	147,600
	Total Cubic Feet		736,250

At 27 cu. ft. in the ground to yield one ton of washed ore this would represent 27,270 tons, from which we should deduct say 15% for ore removed in development, leaving a net 23,180 tons of washed ore above the No. 1 car level.

I take my figures from an ideal section prepared for the Longdale Iron Company. I see by this section that the Company's estimate for the same block of ground is 60,000 tons. This would appear to have been arrived at by assuming an average thickness of 12' and taking 15 cu. ft. in the ground to yield a ton of ore. The last figure I consider untenable. The ore is good, better I should say than that seen in the Wilton and Callie mines and more massive, but it is still full of clayey and sandy spots and losses both in mining and washing are

bound to be heavy.

When estimating the ore in the Longdale Company's mines at Longdale, I conceded a reduction in my customary figure of 27 to 20 cu. ft. in the ground to produce one ton of washed ore, as the Longdale mines present an unusually clean and massive ore. In the present case however, it is my conviction that the figure 27 should be used to arrive at a safe estimate.

The No. 2 cross cut tunnel is roughly 1250' long and at an elevation of 1358, or 90' vertically below No. 1. The No. 2 car-level has been driven North Eastward to the Company's boundary and south westward to limestone. I do not consider however that the latter necessarily cuts off the ore, as two belts of limestone were passed through going to the North-east and ore was found again beyond. The total length is 587'.

A 24' level has been driven above the No. 2 car-level for its entire length and about 48' beyond it to the south-west. This latter did not encounter the limestone which stopped the car heading. These two levels are on what I have described as the front or upper bed of ore, the reduplication being due to a thrust-fault. In estimating the ore I shall treat it as lying in a single bed throughout and we shall thus be on the safe side. The faulting could not have increased the available tonnage to any considerable extent and on the other hand will possibly increase the losses in mining due to complication of the vein.

A single slope connects the two car levels; otherwise practically no further work has been done in this block of ground. I estimate it to contain the following tonnage.

587' long	X 150'	slope height	x 10'	av'ge. thickness		880,500
160' "	x 150'	" "	x 10'	"	" x 1/2	120,000
		Total cubic feet				1,000,500

The last is the triangular block included in a line drawn from the No. 1 S.W. heading to the No. 2 S.W. heading. Dividing by 27 and deducting say 10% for ore removed by development, we arrive at a total tonnage of washed ore of 33,300.

Here again I have taken my figures from the Longdale Company's section. The latter's estimate for this block is 80,000 tons. It is apparent that this was reached by assuming an average thickness of 12' and taking 15 cu. ft. to the ton of washed ore, as before.

Below the No. 2 car level a small amount of ore has been blocked out by the extension across the boundary of the Wilton Mine "Shop Tunnel" car-level. The slope height of this block is 60' and its length 240'; with an average thickness of 10' and 27 Cu. ft. to the ton of washed ore, I find this block to contain 5333 tons.

All the above may be termed "ore in sight". What may be hoped for in the unexplored ground to the south-west of the present levels or beneath them is of course wholly uncertain. I find an estimate given on the Longdale Company's section of 68,000 tons below No. 2 car level down to the level of the Wilton Mine, Big Bin Tunnel. We must keep in mind two facts however bearing upon such an estimate: (1) The Wilton Mine was barren at the boundary from 60' above the Big Bin Tunnel level downwards; (2) The limestone present in the vein on the No. 2 level (described on a previous page) gives us a hint that we are approaching the downward limit of the ore.

The No. 2 level is 158' vertically above the barren S. W. end of the Wilton Mine Big Bin Tunnel level. 98' of this lies above the lowest point where ore was found at the boundary from the Wilton side. Since the average dip of the vein would appear to be 37°30', the 98' would

represent a slope height of 160'. In estimating the "probable ore" I propose to reckon with this slope height for a distance of 200' S.W. from the boundary and thereafter with less generous distances below the No. 2 Tunnel. Further I shall include 50 vertical feet below the triangular block lying between the S.W. extensions of Tunnels Nos. 1 and 2 included in the "ore in sight". Since the S.W. breast of No. 1 Tunnel is barren, I do not propose to reckon on any "probable" ore S.W. of that point. My results follow:

200' long	x 160'	slope height	x 10'	thick -	320,000 cu. ft.
100' "	x 120'	" "	x 10'		120,000 " "
250' "	x 85'	" "	x 10'		212,500 " "
185' "	x 85'	" "	x 10'		157,250 " "
				27)	809,750 (29,990

Or say 30,000 tons of "probable" ore. The greater part of this ore would require a new and very long cross-cut tunnel or else a shaft; or else could best perhaps be taken out through the Wilton Mine Big Bin Tunnel.

When we attempt to estimate the "possible" ore on this property we enter the realms of pure guess work. I calculate roughly that the ultimate possibilities, on the assumptions that the lead is mineralized throughout its length and down to a depth equal to the James River level, would be approximately 500,000 tons after deducting the ground already worked or included in my estimates for "ore in sight" and "probable" ore. Both my assumptions would of course be untenable. It is probably fair to say however that there <u>may</u> be a couple of hundred thousand tons of ore further than that included in the other figures.

<u>REVIEW</u>

There is a single Oriskany ore lead traversing the Circle

Mine property, in a N. E. to S. W. direction and dipping about 40° to the S. E. Its length within the property is 2250'. This lead has been worked and developed through two long cross cut tunnels situated near the North Eastern boundary of the property. The ore lens thus approached is continuous with that of the Wilton Mine immediately to the N. E. and has been driven on for 750' South-westward from the boundary, where it pinches out on the upper or No. 1 Tunnel level. The lower or No. 2 Tunnel has not been driven so far to the S. W. and has stopped temporarily in limestone. Very little work has been done between Nos. 1 and 2 tunnels.

I estimate the ore still available from this property as follows:

"Ore in Sight"	
Above No. 1 Tunnel level	23,180 tons
Between No. 1 and 2 tunnels	33,300
Between No. 2 and the Wilton Mine encroachment	5,333
Total "ore in sight"	61,813 tons
"Possible" ore	30,000

"Probable" ore, say 200,000 tons

Or say, 60,000 tons "ore in sight"; 30,000 tons "probable" ore; and 200,000 tons "possible" ore. With the exception of 55,000 tons of the "ore in sight" the greater part of this ore will require new cross-cut tunnels or else shafts, or else maybe approached through the Wilton Mine of the Princess Furnace.Co.

OPERATION

The circle mine has been idle since early Spring of 1911. At that time the monthly output amounted to about 1500 tons. The crude ore as brought out through the No. 1 and No. 2 Tunnels, was let down

over a gravity plane, to the Princess Furnace Co.'s narrow gauge railway. From that point it was hauled from the Longdale Company by the Princess Furnace Co. at the following charges per ton of washed product.

6 ¢ for transportation

10 ¢ for washing

3 ¢ for compressed air, which was supplied to the Circle Mine by the Princess Co.'s Compressor.

Total - 19 ¢ per ton of washed ore. C. & O. cars took the washed ore from the Princess Washer to Longdale.

Respectfully submitted

(signed) C. M. Weld

Low Moor, Va.

Feb. 5, 1912.

This report was long delayed in preparation. All figures apply to the date of examination. The mines have recently been started up again.

REPORT ON THE IRON ORE PROPERTIES

of the

LOWMOOR IRON COMPANY.

C. M. Weld,
New York, N. Y.

May 1911.

C O P Y

E. C. Means, Esq. President & general Manager.

Low Moor Iron Company.

Low Moor. Va.

Sir:

In accordance with your instructions of March 20th, I have made a careful study of the iron-ore lands of your Company with the purpose of arriving at an approximate estimate of the probable tonnages of ore contained therein. I beg to submit herewith my results.

I accompany this report with a number of geological maps and cross-sections, which it has been necessary to prepare as a basis for the estimates. These are detailed under the descriptions of the several properties.

With reference to these drawings, I desire to point out that several have been worked up by me from rather scant surveys and all include many features which have, of necessity, been sketched in from field observations. I do not pretend therefore to vouch for their accuracy, but I believe them to be relatively approximately correct, and at least sufficiently so to warrant the approximate figures based on them.

You will of course understand that in many cases the geological boundaries have been drawn in, not from actual surface croppings (which are naturally more often absent than present), but according to the positions which can be reasonably argued for them from such evidences as do appear on the surface. The lines of the cross-sections are, of course, largely imaginary, necessarily so when projected to depths below the workings. In such matters the

imagination must play its part, guided as far as possible by evidence and after that by experience and judgment. I have no doubt that when the ore-beds have been fully explored and the last word has been said, my plans and sections may be found faulty in many details. Those possible faulty details, however, will not affect the broader consideration involved, or vitiate the approximate conclusions which I propose to draw.

I have attempted to be as brief as possible, consistent with clearness, but it has been a large subject. I present a short summary of my findings on the last two pages. I am anxious, however, that you should follow through with me my methods of arriving at my results, in the hope that you will become a partner in my conclusions, or at least a sympathetic critic. I beg therefore your patience and a careful study of the entire report.

GENERAL GEOLOGY

The geological horizons involved are the following:

DEVONIAN	Romney Shale
SILURIAN	Oriskany (Monterey) formation
	Lewistown (Helderberg) limestone.
	Clinton (Rockwood) formation.

The iron-ores included in the above fall into two general classes, viz. the Oriskany Brown-Ores, and the Clinton Red Ores. There appears to be an isolated occurrence of brown-ore at the base of the Lewistown limestone (at the Robinson mines near the S.W. boundary of the Jordan property) but this has no economic importance.

THE ORISKANY BROWN-ORES

GEOLOGY. The Oriskany measures have before been considered as consisting essentially of sandstone. Early observers placed the ore-bearing horizon above the Oriskany sandstone and regarded the ore-beds as original. Late observers have described the ore-bodies as replacements "mainly of the Helderberg or Lewistown limestone, but also of the adjacent beds of the Oriskany" (E.C.Eckel,U.S.G.S.Bull.#285 - 1905 - p.184) and again "in the Lewistown limestone. Above them is the Oriskany sandstone or Romney shale and below them the cherty middle portion of the Lewistown limestone" (E.C.Hardey,U.S.G.S.Bull #380 - 1908 - p.247).

My observations have led me to refer the ore-bodies wholly to the Oriskany measures. I include with these measures certain limestones and occasional shales which have before been indifferently ascribed to either the Oriskany or the Lewistown, without any real apparent attempt at exact demarkation. My guide section has been that at Iron Gate, measured in 1905 by E. O. Ulrich and presented by both Messrs.Eckel and Harde in the U.S.G.S.Bulletins referred to above. I have personally confirmed this section and give it below:

Devonian.

Romney black shale		Very thick	
Oriskany			
(a)	Calcareous sandstone	50'	
(b)	Siliceous limestone with many beds of chert	54'	
(c)	Blue-gray limestone with sandy beds in upper part.	65'	
(d)	Quartzitic sandstone with two shaly beds	40'	209'

Lewistown

Thin bedded shaly limestone shales. 322'

Clinton

Sandstones, Etc.

In my work I have followed Mr. Ulrich in placing the line between the Oriskany and Lewistown at the base of the (d) sandstone. At Iron Gate old cuts in ore prove the ore horizon to lie at the base of the (a) calcareous sandstone.

This standard section has proved a satisfactory guide in every case observed by me. While there are naturally wide local variations, I have in every case been able to trace a reasonable correlation, which has cleared up the confusion I was at first put to by the apparent reduplication of the limestone horizons, a reduplication which has no doubt led to the difference of opinion amongst earlier observers with regard to the locus of the Oriskany ore-bearing horizon.

I ascribe therefore to the Oriskany formation the following members:

(a) being a top sandstone, which may vary from a few feet to as much as 50 feet, or be wholly absent. This sandstone is often limey, appears rusty or deeply iron-stained, is sometimes re-cemented to a hard highly ferruginous "cap-rock", at other times is soft and loose with a leached appearance.

I find closely associated with this, a coarse gray fossiliferous limestone, varying from 0 to perhaps 40 feet in thickness. My observations indicate that the limestone and sandstone are more or less complementary to one another, and either or both are subject to replacement by iron-ore bodies.

Thus, above (b) which is a limestone containing very abundant chert or flint in noddules and bands, and below the black shale, we may find rusty calcareous sandstone, coarse gray limestone, or iron-ore; or any two of these or even all three.

Next below (b) Mr. Ulrich records a "blue-gray limestone with sandy beds in upper part". I have observed this limestone beneath the cherty horizon at no other point; though it is possible that the limestone found in association with the ore beds in some of the Low Moor underground workings may have been from this horizon. In appearance it resembles closely the coarse gray limestone just described as frequently occuring with the top (a) Sandstone.

The (d) quartzitic sandstone is everywhere present, though at one point, namely Fenwick, it is only 2½ feet thick, between two shales. Elsewhere it attains great thickness, up to 200 feet, and serves as a useful guide to mark the Oriskany off from the Lewistown limestone underneath.

The Lewistown or Helderberg limestone is generally thin bedded and shaly, though this is not always the case. At Jordan for example, the stone-quarry on the hill (on the narrow-gauge railroad to the Hepler mine) is in the Oriskany limestone, while the quarry on the main C.&O.R.R. line is in Lewistown; yet the two stones resemble each other closely. The successive horizons are perfectly clear however, there being no opportunity for deception through faulting. This section is further confirmed by the very satisfactory exposures in Robinson branch at the upper end of the Jordan property. At Low Moor, on Fork Run above the old mines office, the lower quarry was in Oriskany while the upper quarry was in Lewistown limestone. Here the difference in appearance of the two stones is sufficiently marked to suggest at once different horizons. The present active quarry at Low Moor is in Oriskany limestone

I have said that there are wide local variations in the several Oriskany and other members. These are due in part to eccentricities in deposition and in part to slight time breaks and resulting unconformities both before and after the Oriskany period and probably during the period as well. However the correlation which I have found possible is on the whole exceedingly satisfactory, considering the extent of territory involved. I give below without further comment, sections measured and recorded by me at six different and widely separated points. The letters (a) (b) etc., refer to the Ulrich section, to indicate the proposed correlation. I have at times abbreviated sandstone to S.S. and limestone to L.S.

FRENICK WASHER.

Shales

Oriskany		Feet
(a) Weathered sandstone with mixed ore & clay		30
(b) Cherty limestone		10
Shale	10	
(d) Sandstone	2½	
Shale	6	18½

Lewistown

Thin bedded shaly L.S.	30	
Heavy bedded limestone	200	230

LOW MOOR WASHER

Oriskany		Feet
Red surface soil	5 ±	
(a) Rotted & stained SS	15 ±	
Red soil and clay	20 ±	40 ±
(b) Whitish soil with much chert		10 ±
Sandstone	28 ±	
Sandy shale	2 ±	
(d) Sandstone	55 ±	
Sandy shale	10 ±	
Sandstone	25 ±	120 ±

Lewistown

Thin bedded limestone exposed	15 ±

DOLLY ANN

Black Shale	Feet
Oriskany	
(a) Yellow sandstone	10-20
Ore	12
(b) Chert	1- 6
(d) Sandstone	20-50
Lewistown	
Siliceous limestone, only top exposed	

DUNLAP CREEK

Half mile above McDowell Station

Black Shale	Feet
Oriskany	
(a) Old cuts showing ore etc. on dumps	
(b) Cherty limestone	20
(d) Heavy quartzitic S.S.	200
Lewistown	
Thin bedded muddy limestone exposed	15

JORDAN

Composite section as seen in L.S. quarries and under R.R. bridge

Shales

Oriskany			
(a) Sandstone	8		
Coarse gray L.S.	30	38	
(b) Limestone with much chert		20	
(d) Sandstone		18	
Lewistown			
Coarse gray limestone	25		
L.S. with much chert	16		
No exposures	15	56	
Quartzitic S.S. only top exposed			

JORDAN

Robinson Branch near Potts Creek

Shales

Oriskany			
(a) Sandstone	5		
Coarse gray L.S.	30	35	
(b) Siliceous limestone with much chert		45	
(d) Sandstone		18	
Lewistown			
Thin bedded siliceous L.S.	11		
No exposures	13		
Siliceous L.S. with much chert	25	49	
Quartzitic sandstone		8	
No exposures	65		
Coarse gray limestone	50		
L.S. with much chert	10		
No exposures	90	215	

Clinton Sandstone

THE ORE BODIES. We have now to return to and more particularly consider the top Oriskany member, which we have seen to be the ore bearing horizon.

The Brown Iron-Ore occurs within this horizon as replacements, at times of the limestone and at times of the calcareous sandstone. The bodies take the form of beds, sheets, and tabular lenses, frequently of great length along the trend of the rocks which they have replaced. In thickness, they vary from little or nothing up to 20 or 30 feet; occasionally they attain still greater thickness. The depth below the surface to which they may hope to be followed has as yet been nowhere determined. I will refer to this point again.

Their genesis may with little doubt be ascribed to meteoric waters which have taken into solution the iron of the frequently pyritiferous overlying black shales. These solutions percolated with some freedom the calcareous sandstones and limestones of the top Oriskany member but were retarded or wholly arrested by the comparatively impervious flinty horizon (b). Under these conditions the waters dropped their burdens and ore bodies were built up, either in pre-existing cavities or by metasomatic replacement, always somewhere within (a) and therefore above the flint horizon. While not necessarily persistent even for short distances in any of their dimensions they follow as a rule so closely the enclosing bedded rocks that they may properly be termed ore beds.

It is certain that ore beds formed in this way may exist at least as deep as the ground water level. At Longdale, the ores have been worked to a vertical depth of 500 feet beneath the outcrop, though at this depth they are still above the valley bottom, and have been reached through long tunnels. At Fenwick, Mine No.8, a cross-cut

from the new winding shaft has caught the vein in its full strength at over 100 feet below the creek bottom.

It has appeared impossible to formulate any rules governing the probable loci of ore bodies within the top Oriskany member. We have seen that this last may consist of sandstone, limestone, or iron-ore, or any two or even all three of these materials. Numerous points have been observed where under apparently favorable conditions there is no trace of ore, sandstone alone or else sandstone and limestone comprising the entire horizon. A study of the large number of drill-holes which have been put down on the Jordan property exhibit the following extreme variety of conditions:

1. (a)- i.e. the top Oriskany member - is wholly absent, the shale lying directly upon (b), i.e. the cherty limestone.
2. (a) is represented wholly by sandstone and limestone.
3. (a) is represented wholly by sandstone or cap-rock or both.
4. (a) is represented wholly by iron-ore.
5. (a) included sandstone or caprock or both with an underlying bed of ore, the ore resting upon flint.
6. The ore bed is on top, next to the shale, with sandstone between it and the flint.
7. The ore bed has sandstone or caprock or both above it, and sandstone beneath, the last lying on flint.
8. There are two veins of ore, intercalated with three beds of sandstone; or either the top or bottom sandstone, or both, are absent.

In short, the ore bed, where present, lies sometimes at the top next to the shale; preferably perhaps on the bottom, upon the flint; often at some middle horizon; occasionally at two horizons. Shale, caprock or sahdstone may form the hanging wall; sandstone or flint the foot-wall. At times (a) is represented wholly by ore, and frequently ore is altogether absent.

ESTIMATE OF TONNAGE - QUALITY. It is worth while devoting time to a consideration of all these facts if only to arrive at some conception of the difficulties attending any attempt to estimate the probable tonnages on iron-ore lands which include many miles of crop-line of an ore bearing horizon of this description with but comparatively few developments or workings. Thus, ore beds cropping strongly at the surface have been known to pinch out at unreasonably shallow depths. On the other hand there is good reason to argue that leached and barren outcrops may lead to valuable ore bodies at greater depths. Again, swells and pinches on the trend of the ore beds are the rule. Rarely in fact can the miner foretell with any certainty when a good breast will pinch out or a lean breast come in strong once more.

The only logical method to reach a fair estimate of the total probable tonnages of ore on the lands in question is without doubt to calculate the total area of ore bearing horizon presented, lying within the probable effective ground-water zone; to deduct from this those portions known from observation to be in all probability barren; to multiply the remainder by a reasonable tonnage figure per unit of area; and then to consider and if advisable reduce the result to reach a figure believed to be conservative, largely in the light of results already yielded by those portions of the lands formerly or at present under operation.

This method has necessitated first a careful geological study and mapping of all the lands under examination. My maps and cross-sections accompany this report and the calculations based thereon will be presented below. The areas of ore-bearing horizon are given in square yards.

The tonnage figure per unit area, which in this case will represent the tons per square yard of ore bearing horizon, requires some consideration. The ore beds vary in thickness from nothing up to 25 or more feet. Anything less than four or five feet would hardly be workable however. Since then all thinner portions must be left out (a fact to be considered in making the arbitrary reductions) we may say that the thickness of all ore included in our calculations varies from 5 to 25 feet. I consider that 9 feet would be a fair average thickness. This would mean 3 cubic yards per square yard of ore bearing horizon, or 6 tons, at 2 tons per cubic yard. Ordinarily two tons in the ground should yield 1 ton of shipping ore, allowing for losses in mining and washing. To further increase the conservatism of my figures however, I propose to increase the ratio to 3 to 1;,then each square yard of area of ore bearing horizon may be considered as offering two tons of shipping ore.

It is beyond the scope of this report to consider the quality of the ore. It goes without saying that to be workable, the beds must be not only of sufficient thickness but must yield ore of a grade which after washing will be acceptable to the blast furnace man. Thus our arbitrary reduction must be such as to eliminate not only the probable actually barren portions of the ore bearing horizon, but also those portions where the ore is either too thin or too lean to work, and which are therefore equally barren from a commercial point of view. The following summary of analyses of shipments from the three active properties during the month of March will give a good idea of the standard character and quality of the ore.

Property	Cars	Iron	Insoluble	Manganese
Fenwick	105	44.13	23.60	1.018
Dolly Ann	71	42.93	25.19	0.511
Jordan	146	43.81	21.81	1.361

The arbitrary reduction presents perhaps the greatest difficulty in our problem. No general figure for application to all the cases under consideration can be selected as the conditions are variable. Each case will have to be considered separately according to its merits and information regarding the yield of ground already worked will be of special value as a guide and basis for comparison. In making such a comparison however we have to remember that the areas first worked are invariably those where the croppings have given the best promise from the start; and we are to include in our estimates many miles of crop-line which give little or no special promise at the surface. It would nevertheless be illogical to exclude the barren crop lines since the absence of ore at the surface does not by the very nature of things argue its absence at depth; in fact if anything the reverse may be true. Still, a further uncertainty is thereby introduced. This question will further be handled in the detailed estimates for the several properties.

THE CLINTON-RED ORES

These ores are original deposits lying in definite beds of great persistence within the Clinton measures. They are identical with the Clinton hematite ore beds well known throughout the Appalachian province from New York to Alabama and variously termed red-ore, fossil, dye-stone, oolitic, etc. In Virginia they have

attained only a very subordinate development.

On the Low Moor properties two horizons within the Clinton are ore-bearing; the upper vein is known locally as the "fossil" or "shale" ore, and the lower as the "block" ore. The latter, while reported up to 4½ feet in thickness, appears to have been found everywhere too siliceous to be of any present value. The former has been prospected at a number of points and was worked for five years at the Horse Mountain Mine near Low Moor, where it was 15" to 24" thick. This mine yielded 85,000 tons of good ore at a reasonable cost.

It is possible to trace many miles of crop-line of the "fossil" ore, particularly on the Low Moor and Jordan lands, by means of croppings, supplemented by occasional ancient shallow crop-workings and prospect trenches. In all recent developments however this possible source of ore has been practically neglected. Reliable data therefore on which statements may reasonably be based regarding quality or quantity are so insufficient as to render such statements of very little value.

I must then dismiss the Clinton measures with the brief opinion that they offer mineral resources distinctly worthy of more consideration than they have been given in the past. The principal ore-vein is traceable for many miles, often perfectly accessible to mining operations; and has yielded at one point eighty five thousand tons of good ore at a reasonable cost. Investigation and prospecting should unquestionably be undertaken. In the meanwhile these ores can not in any sense be measured up, but must be recorded simply as offering further resources of unknown though possibly very considerable value.

THE FENWICK MINES

Maps and Sections.

Property map, scale 1" = 100 poles.

Mines map, in 3 sheets, scale 1" = 200'

Vertical cross-sections, 1 sheet, scale 1" = 200'

Description. The Fenwick property includes for a stretch of approximately three miles both edges of a N.E. to S.W. trough of Oriskany measures. Immediately adjacent on the N.E. and on the N.W. leg of the same trough lies the Lignite Mine of the Alleghany Ore & Iron Co., which has been exceedingly productive.

Beginning at the N.E. end of the property, the trough is a simple one, as indicated by the cross-sections on the lines J-K and G-H. The N.W. leg has already been the scene of considerable mining at shallow levels and is now the site of Mine No. 8, where a new shaft and cross-cut have caught the vein in its full strength at over 100 feet vertically below the creek level, and 600 feet on the dip below the original croppings (see section on line G-H). There is every promise of the existence of several hundred thousand tons of ore in the single stretch from Mine No. 8 to old Mine No. 2, below the car levels; a portion of this ore has already been blocked out but practically none has been robbed. Above the old car levels the ore has been removed.

On the S.E. leg drill-holes and old workings have proved the existence of ore, but comparatively little work has been done. This leg stands in a more nearly vertical position than the N.W. leg.

The simple trough extends from the N.E. boundary for a distance of roughly 10,500 to the S.W. The ore-basin then widens out and

develops into a double trough, the intervening anticlinal coming to the surface in the old shovel-cut. In this latter the crown of the fold is clearly seen, dipping both N.W. and S.E. and plunging to the S.W. Beyond the shovel-cut (to the S.W.) the basin may again be regarded as a simple trough as far as surface indications go, but much wider than before and with probably a rolling bottom. The No. 3 slope workings lie to the S.E. and South of the Shovel Cut and are now swinging round the S.W. nose of the anticline to the West side of the old cut.

If we consider the Shovel-Cut workings as representing a double crop-line, there have been worked to-day approximately 1.7 miles of outcrop, including certain apparently barren portions. This 1.7 miles has yielded 550,000 tons of ore, the excavations having nowhere gone more than some 200 feet down on the ore and generally much less. Thus the ore-horizon has so far yielded about 325,000 tons per mile of outcrop, without bottoming the ore.

Estimates. A careful calculation of the area of the ore-bearing horizon for the entire Fenwick property from the crop-line down to the probably effective ground water level, and eliminating those portions already worked out, gives a result of a little more than 1,000,000 square yards, or 2,000,000 tons of ore at 2 tons of shipping product per square yard of ore-bearing horizon. This calculation includes 7¼ miles of crop-line; the tonnage per mile is therefore 275,000 - as against 325,000 tons per mile taken from the workings to date without anywhere bottoming the ore.

While I believe the above figure of 2,000,000 will in all probability be ultimately reached, I prefer to arbitrarily cut it down to 1,500,000 tons, or practically 200,000 tons per mile of

out-crop. This I consider a conservative estimate in the light of what the property has done and is now doing. There are to-day roughly 100,000 tons blocked out.

THE LOW MOOR MINES.

Maps and Sections.

Property and Mines map, with Geology, scale 1" = 45 poles.

Geological Cross-Sections, scale 1" = 45 poles.

I experienced some difficulty in securing a satisfactory map of this property and was forced in the end to adjust some of the land boundaries so as to effect a closure, and to largely sketch in the railroads, creeks, workings, etc., from field notes. Furthermore the scale is unfortunate, but results from my having to work from a surveyor's plat of the old deeds. I do not claim therefore more than very approximate accuracy for the map presented herewith. Such as it is however it is useful for the purpose in hand.

Description. A brief word regarding the geological section will be to the point. I find on the Low Moor property that the limestone at the top of the Oriskany measures is locally strongly developed and to the apparent exclusion of all traces of ore-bodies. Thus at the limestone quarry there are some 35 feet of fresh coarse gray limestone separated from the Devonian shale by only a few feet of rusty sandstone, and with practically no trace of ore. Immediately South West of the limestone quarry however caprock and ore begin to appear, and in the section back of the washer the limestone is absent or reduced to a few feet of clay. Up Fork Run, above the old mines-office, the limestone appears again, and the dumps of several

of the shafts show limestone.

Thus on this property we find evidences of the co-existence of the ore-beds and the limestone, though as a rule the latter disappears with the appearance of the former. In short, the limestone, sandstone, and ore-bodies of the top Oriskany horizon supplement each other in a rather irregular manner. The sandstone is probably never wholly absent however, while either of the other two, or at times both, may be absent. I have found many evidences of the same condition of affairs on the Jordan property.

The sandstone at the base of the Oriskany is well developed. In the section behind the Washer, I measured roughly 120 feet. Underneath this there are good exposures at several points of the Helderberg (Lewistown) limestone, particularly in the hollow to the West of and across Karnes Creek from the Washer, and in the upper quarry on Fork Run.

Structurally the Low Moor geology presents a rather complex problem. At the S.W. end, where the property abuts with the Rich Patch Company's property, the structure consists of a fairly simple trough-like basin. Along Fork Run however a rather strong cross-fold has brought to the surface a number of additional strike-folds, which plunge once more to the N.E. At the same time the valley widens out very considerably, ultimately merging on the N.W. side into the great valley occupied by the Jackson River. The S.E. leg of the basin if fairly continuous throughout the property, being disturbed only along the Fork Run section by an overthrust fault. The latter is of the scissors type, playing out towards the N.E. and becoming more profound to the S.W.

No mining is in progress to-day on this property. The old cuts,

tunnels, and shafts are shown approximately located on the accompanying sketch map. These yielded during some 25 years of operation 967,640 tons of shipping ore. The workings represent roughly 2.4 miles of crop-line; the yield per mile of crop-line was therefore 403,000 tons.

Estimates. I have calculated as accurately as possible under the circumstances the total area of Oriskany ore-bearing horizon offered by this property, down to the probable effective ground water level, and find this to be 1,066,781 square yards. I have excluded from this figure all that area known as Limestone Hill, where is situated the limestone quarry, and the adjacent areas to the South, since there are there no evidences of ore (with the single exception of the ore reported to have been found in the railroad ditch near the old church). I have however included all the sites of the old workings. At two tons of shipping ore per square yard, we arrive then at an estimate of 2,133,562 tons. Deducting from this the 967,640 tons already mined out, we find that there are left in the property 1,166,000 tons.

The total crop-line is 10.4 miles. The old workings covered only 2.4 miles of this; therefore our present estimate of 1,166,000 tons is spread over 8 miles of crop-line, giving 145,750 tons per mile of crop. When we consider that the former workings yielded 400,000 tons per mile of crop, we may believe that the present estimate of ore left in the property of say a round million tons is sufficiently conservative, without the application of any further reduction.

THE DOLLY ANN MINES.

Maps and Sections.

Mines map, in 3 sheets, scale 1" = 200'

Vertical cross-sections, 1 sheet, scale 1" = 200'

I attempted to prepare a property map for Dolly Ann, but was forced to give it up as the surveyor's plats from the old deeds proved to be hopelessly confusing. My mines map, described above, has for its base a plan of the Iron Mt. Railway in its early allignment. To this I have tied the plan of the present underground workings and a plat of the drill-holes; also a plan of the abandoned Lower Lineway Mine, which however was quite innocent of cardinal points and therefore was somewhat difficult to orient. Everything else has been sketched in from field notes, including the railway S.W. of the store-office, the washer, and all old workings. I make no apology for my map, nor do I make any claim for its accuracy. I believe it to be approximately relatively correct however, and when taken as a sketch-map, it is useful.

Description. There are several parallel folds and separate troughs of the Oriskany measures on the Dolly Ann property. At the N.E. end and North of the railroad, a shallow fold barely pushes its nose across the line from the Iron Mt. tract; the old Bull Pen cuts were on this ore-bed. South-East of the railroad lies a strong sharp fold, likewise coming in from the Iron Mt. Tract, but extending for 8500 feet to the South-West; this trough has been the scene of extensive mining both above and below ground and includes the present producing workings. Again to the North of the railroad, and about

on a line bearing North from the store-office building, we find the N.E. end of a wide double synclinal, extending thence South Westward beyond the limits of the property. Large abandoned open-cut workings are seen here. The intervening anticlinal of this double fold plunges shortly and develops into an overthrust fault, while a new fold heads in on the S.E. side across the creek; this last ultimately merges with the main trough. A study of the four vertical cross-sections should help to make clear the above-described rather complex structure.

The geological section at Dolly Ann reveals some 10 to 20 feet of yellow sandstone underlying the shale and overlying the ore-beds. The latter rest on chert. I understand that in some of the old workings, limestone was found associated with the ore, as at Low Moor. At one point, fresh limestone with abundant chert, the usual foot-wall of the ore, is seen in outcrop underlaid successively by quartzitic (Oriskany base) sandstone and siliceous (Helderberg-Lewistown) limestone. Clinton sandstone is conspicuous on the mountain sides. Thus the section is complete, with probably the Oriskany limestone poorly developed.

Mining operations at Dolly Ann to-day are wholly underground, but the ore was formerly dug from extensive open cuts. Since 1887 there have been produced about 785,000 tons of shipping ore; records do not go back of 1887. It is probable that the total output of the property has been some 850,000 to 900,000 tons. It is difficult to estimate with any accuracy the length of crop-line which has been worked, but a fair figure would be something under three miles. We may safely say that the mines have so far yielded approximately 300,000 tons of shipping ore per mile of crop-line.

Estimates. I have calculated from my sketch map and cross-sections, as accurately as the circumstances will permit, the area of the ore-bearing horizon from crop-line down to the probable effective limit of ground water, and eliminating all those portions already worked out, I find a probable area of 380,000 square yards, which at 2 tons per square yard should yield say 750,000 tons of shipping ore. Since the crop-line included in this calculation is 4.5 miles, my estimate calls for a yield of 166,000 tons per mile of crop. We have seen that the ground already worked has yielded approximately 300,000 tons per mile of crop-line. It would appear therefore that my figures are probably sufficiently conservative as they stand.

THE JORDAN MINES.

Maps and Sections.

Property and Mines map, scale 1" = 1000'

Vertical cross-sections, scale 1" = 1000'

Description. The Jordan property includes a great North-East to South-West trough of the Oriskany measures, 3 miles across at the South West end and widening out to the North East. Throughout, the trough is corrugated into a number of minor folds; in its narrower part however the corrugations become more pronounced, Mill Ridge representing a huge corrugation which has brought up the underlying Clinton measures and has developed an overthrust fault along its North West side. The nose or North East prolongation of this anticlinal is the locus of a number of mines including the Bess and Wasp Nest.

The next anticlinal to the North West has again brought the

Clinton measures to the surface, but to a lesser degree. Here the Oriskany upper horizon appears to be barren of ore and has its limestone well developed. The Robinson Mines on this anticlinal are at or near the base of the Helderberg (Lewistown) limestone.

The anticlinal lying immediately North of the town of Jordan likewise exhibits a practically barren Oriskany upper horizon, but with its limestone well developed. Of the two quarries in this locality, the upper on the Hepler narrow gauge railroad, is in Oriskany limestone, while the lower, on the C. & O. R. R. is on Helderberg stone.

The North West and South East edges of the trough exhibit apparently continuous ore-bearing measures for great distances, associated with minor folds. All the interior anticlinals plunge beneath the slate towards the North East. The North West edge swings round the end of Peters Mt. by the Helmintoller mines, trending North East again only after crossing Cast Steel Run.

A study of the maps and sections will serve to make clear the geological structures underlying this property.

The geological section is complete and in some cases typical. Two examples have been given and discussed on a previous page of this report.

The Jordan mines have been in operation something over four years and have yielded nearly 290,000 tons of washed ore.

Estimates. The Jordan property presents more difficulties than the other three properties in connection with attempts to estimate its probable resources of iron-ore because the areas and stretches of crop-line involved are much greater and far less developed. I find

that there are 28.6 miles of probably productive crop-line. This figure excludes all those portions seen to be barren, such as the Robinson Branch and Boiling Spring anticlinals; also the Pipe-ore to Upper Bernett area; and, of course, all inlying foreign ownerships. A calculation of the square yards of ore-bearing horizon down to the probable effective limit of ground water gives 4,036,107 which multiplied by two gives 8,072,214 tons, or 281,546 tons per mile of crop-line.

This figure per mile of crop-line exceeds that calculated for any of the other three properties owing to the fact that the topography unquestionably permits deeper ground water action. However if there is to be any error in my calculation, I much prefer it to be on the side of conservatism, and I shall therefore nearly cut the above figure in half, because so much of the crop-line entering into the calculation has been so far either entirely neglected or only very superficially examined.

Taking then the expected yield of shipping ore per mile of crop-line to be 150,000 tons, we have a total estimate of ore for this property amounting to 4,290,000 tons, or 4,000,000 tons after deducting the tonnage already mined.

REVIEW.

Four properties have been exmained, namely Fenwick, Low Moor, Dolly Ann, and Jordan. These contain iron-ores of two sorts, Oriskany brown-ores and Clinton red-ores.

The latter have been so little developed that no measure can be given of their resources. They are distinctly worthy of inve[illegible]

gation; for the present however they must be recorded simply as offering potential supplies, possibly in very considerable amounts, in addition to the brown-ores described below.

The Oriskany brown-ores have been worked for many years on these properties. The following table summarizes the information and estimates presented in the foregoing pages.

	Yield to date. Tons.		Estimated tons remaining.	
Property	Total	Per mile of outcrop.	Total	Per mile of outcrop.
Fenwick	550,000	325,000	1,500,000	200,000
Low Moor	967,640	400,000	1,000,000	145,750
Dolly Ann	850,000	300,000	750,000	166,000
Jordan	290,000	-----	4,000,000	150,000
Total	2,657,640		7,250,000	

A comparison of the second and fourth columns of this table will suggest the conservatism of my estimates of brown-ore still left in the properties under review, namely a total of 7,250,000 tons.

All of which is respectfully submitted.

(signed) C. M. Weld

New York;

May 25, 1911.

BRIEF HISTORICAL SKETCH OF THE

LOW MOOR COMPANY OF VIRGINIA

FROM JULY 5, 1873 TO DECEMBER 31, 1923

THE LOW MOOR IRON CO. OF VA.
KAY MOOR, W. VA.

COPY

BRIEF HISTORICAL SKETCH
OF THE
LOW MOOR IRON COMPANY OF VIRGINIA
From
JULY 5, 1873 to DECEMBER 31, 1923

The Low Moor Iron Company of Virginia was organized under a chart granted by the State of Virginia July 5, 1873.

The first two years of the Company's operations were occupied in making surveys and prospecting for iron ore by drifts, pits, shafts and mining some five thousand tons of fossil ore. The regular opening of the several veins of Hematite ore, preparatory to a large business, commenced in 1875. From that date to 1880 the business of the company was confined to the mining and shipping of high grade iron ore.

The original holdings of the company were iron ore properties, 4117½ acres located in Allegheny County, State of Virginia, two miles south of Low Moor; Low Moor being located on the waters of Jackson River and the main line of the Chesapeake & Ohio Railroad four miles west of Clifton Forge, Virginia.

The present holdings, owned or leased, include Iron ore mines, furnace plants, limestone quarries and coke ovens in the State of Virginia, consisting of 21904 acres; and coal mines and coke ovens in the State of West Virginia, consisting of 5396 acres, making a total of 27300 acres.

IRON ORE MINES:

Low Moor Mines began producing ore in 1875. This ore was shipped over the Chesapeake & Ohio Railroad in ten and fifteen ton, four wheel "Ore Jimmies" to Quinnimont, West Virginia, and was smelted in the Quinnimont Furnace, then leased by J. H. Bramwell. This continued until 1880 when the company began smelting their own ores. These mines were operated continually until 1898 when part of them were abandoned on account of the ore being exhausted and an excessive amount of water which did not allow an economical operation. The fossil ore was mined from 1905 until 1910. The above mines produced 1,067,189 tons of ore.

Stack Mines, Dolly Ann and the Iron Mountain lease were acquired in 1893. Stack Mines is located on the main line of the Chesapeake & Ohio Railroad ten miles west of Covington and was operated until 1910, producing 305,472 tons of ore. This mine was abandoned on account of washer being destroyed by fire and not enough ore in sight to rebuild. Dolly Ann and Iron Mountain were operated jointly, both being located on a branch line of the Low Moor Railroad two and six miles east of Covington. The Iron Mountain lease expired in 1900 and Dolly Ann was abandoned in 1921 on account of the ore being exhausted. While these mines were operating they produced 897,239 tons of ore.

Fenwick Mine was acquired in 1899 and is located in Craig County on branch line of the Low Moor Railroad, one and one-half miles north of Barbours Creek, Barbours Creek being on Craig

Valley Branch of the Chesapeake & Ohio Railroad, 22 miles southwest of Eagle Mountain. This mine is still producing and is said to be the best iron ore mine in the State of Virginia. Has produced 938,560 tons of ore and has, blocked out, ready to be extracted, 1,000,000 tons.

Rumsey Mine was acquired in 1900, replacing the Iron Mountain lease, and was located on a branch line of the Low Moor Railroad, four miles west of Covington. Owing to the low grade of ore produced at this mine, it was only operated two or three years, producing 90,180 tons of ore.

Jordan Mines was leased in 1906 and was located on the Potts Valley Branch of the Chesapeake & Ohio Railroad, seventeen miles south west of Covington. This mine produced 615,092 tons of ore, the lease expiring in 1920.

The Longdale Mines were leased in 1914 and were located on a branch railroad of the Longdale Iron Company, eleven miles east of Longdale Station, Longdale Station being on the main line of the Chesapeake & Ohio Railroad, two miles east of Clifton Forge. These mines were operated until 1919, producing 101,432 tons of ore. They were abandoned on account of the ore being exhausted.

The latest venture of this company, in the mining game, is that of leasing the Rich Patch Property, located four miles south of Low Moor. This is considered a very good property and should produce an iron ore mine equal to any in the state.

The above mentioned mines have produced ore both from open cuts and underground, however, the present workings are principally underground. The system of underground mining used has been that of the top-slicing and caving method. At first the flooring was made with tree tops and brush, but Mr. Hungerford, then the mining engineer, conceived the idea of laying this flooring with eight and four foot cord wood and this is the practice used today.

The first washers used were the round pole chute, gravity type, and no attempt was made to save the fine ore. This was followed by the "Barrel Washer" and the "Log Washer" using jigs to clean and save the fine ores. A very expensive washer was built at Jordan Mines, consisting of crushing plant, vertical log washers, picking belts, jigs and recrushing plant, which demonstrated beyond a doubt that to put the low grade Virginia ores on a commercial basis, it is necessary to go to fine grading.

At the present none of the ore mined is washed, but is delivered to the furnace plants in the crude state. However, every precaution is taken in the mining to pick out all foreign matter.

LIMESTONE:

The Low Moor Quarry began producing stone in 1881. At first it was like all other quarries, that is it was an outside

quarry, but later it was made an underground quarry on account of the over burden. It is said by some to be the original underground limestone quarry of the world, but the possibility of this is rather remote, however, it is the original underground limestone quarry of the United States. This quarry has produced 2,140,611 tons of stone.

Panther Gap Quarry was acquired in 1909 and is located on the main line of the Chesapeake & Ohio Railroad two miles west of Goshen, Virginia. This quarry has only been operated as the supply demanded, producing 18,291 tons.

Quarries were operated at Jordan and Longdale in connection with the mining and produced 3,370 and 12,135 tons respectively.

COAL MINES:

In 1899 a large tract of valuable coal land was acquired in Fayette County, State of West Virginia, located on the waters of New River and the main line of the Chesapeake and Ohio Railroad, fifty miles east of Charleston, West Virginia.

The first coal mined by this company was in the Fayette Mine. This mine was operated until 1902 and at that time sold. The tonnage record for this mine has been misplaced.

Kay Moor Mine No. 1 was opened in 1900 and has operated from that date to the present time with only one serious

shut-down--September, 1914 to the Spring of 1915--producing 2,947,112 tons of coal and is known today as one of the best mines in the New River Field.

Kay Moor Mine No. 2 was opened in 1903, replacing the Fayette Mine. No. 2 has run "off and on" from that date to the present time, producing 562,088 tons of coal.

COKE OVENS:

In 1881 built 135 twelve-foot Bee-hive, hand drawn ovens, at Low Moor and, in 1900 built 25 twelve-foot Bee-hive machine drawn ovens. In 1916, built 100 fourteen-foot Bee-hive machine drawn ovens, replacing the original 135 ovens. The tonnage records on coke manufacture at Low Moor from 1881 to 1902 have been misplaced, however, since that time the record shows that 579,649 tons have been manufactured.

In 1898 a block of 50 twelve-foot Bee-hive machine drawn ovens were built at Covington and were operated until 1919, producing 207,238 tons.

Began building ovens at Kay Moor in 1900, but they were not completed until 1915 and, at the present time have 202 Bee-hive machine drawn ovens and, since they have been operating, have produced 974,261 tons of coke.

FURNACE PLANTS:

The Company operates three blast furnaces, known as "A", "B" and "C" furnaces. "A" and "B" furnaces are located

at Low Moor and"C" at Covington, Virginia.

"A" furnace was completed in 1880 and blown in on its initial blast October 11, 1880. Since then it has operated intermittently, producing to October 18, 1923--the date of completion of its last blast--862,336 tons.

"B" furnace plant was completed in 1887 and blown in July 28, 1887. It went out of its last blast June 25, 1919, having produced 898,131 tons of iron.

"C" furnace was acquired in 1893, but was not put into operation until April 25, 1895. It had produced up to December 31, 1923, 543,457 tons and is in blast at the present time.

All of these furnaces to begin with were hand filled furnaces, the raw materials being wheeled from the stock piles by hand in two wheel buggies, hoisted to the top of the furnace on a cage, and distributed by hand into the furnace bell. About 1904 this method of filling was replaced by the automatic dump skip hoists, the raw materials being transferred from stock pile to skip pit in cars.

In 1920 "C" furnace was rebuilt and equipped with a bucket hoist for filling and motor haulage for transferring raw materials from stock bins. This is the most modern practice for filling, the advantage over the skip hoist being that the materials are more uniformly distributed in the furnace.

The operation of a furnace is an intermittent process, the life of a particular blast being from nine months to three years. At the completion of each blast the furnace must be relined, so that at no time have more than two furnaces been in blast at one time.

Since the beginning of furnace operations, there have been only two periods of idleness, the first period for seven months from September 15, 1914 to April 21, 1915, the second period for 19 months from March 21, 1921 to November 6, 1922.

In connection with the furnaces, it is interesting from an historical standpoint to note that the Low Moor furnaces served as a market for the first slack coal shipped out of the New River Field. This slack was made near Thurmond at a mine operated by Mr. Berry, the slack being screened out over gravity pole screens.

STATISTICS:

The following are some statistics on consumption of raw materials

Furnaces:	Ore	Coke	Limestone	
	5,297,821	3,399,555	2,524,953	tons.

Were these tonnages loaded into Chesapeake & Ohio equipment, it would require a train 34,180 miles long to haul the ore, one 21,934 miles for the coke and one 16,290 miles for the limestone. It would require 2,244 Chesapeake & Ohio engines

of the Chesapeake type to move these trains.

The total iron produced is 2,303,294 tons, a train equivalent of 14,859 miles requiring 460 locomotives.

The aggregate ore, limestone, coal and coke production is as follows:

Ore	4,025,164 tons
Limestone	2,156,116 tons
Coal	3,509,200 tons
Coke made	1,782,821 tons

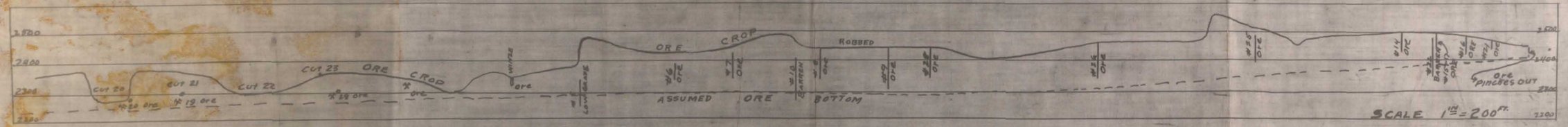
It can be seen that the ore consumption exceeds the production over 1,000,000 tons. This deficit has been supplied by foreign ores, the greater part coming from the Lakes.

Given Mine #16 and Cornfield Mine #25

These two mines 6 and 2 miles respectively north of Paint Bank in the Potts Creek Valley were drilled in 1914 and from the blueprint showing location and logs of holes, estimates were made by Pomeroy C. Merrill in 1942.

Given mine 59,000 tons open pit ore
56,000 tons underground ore

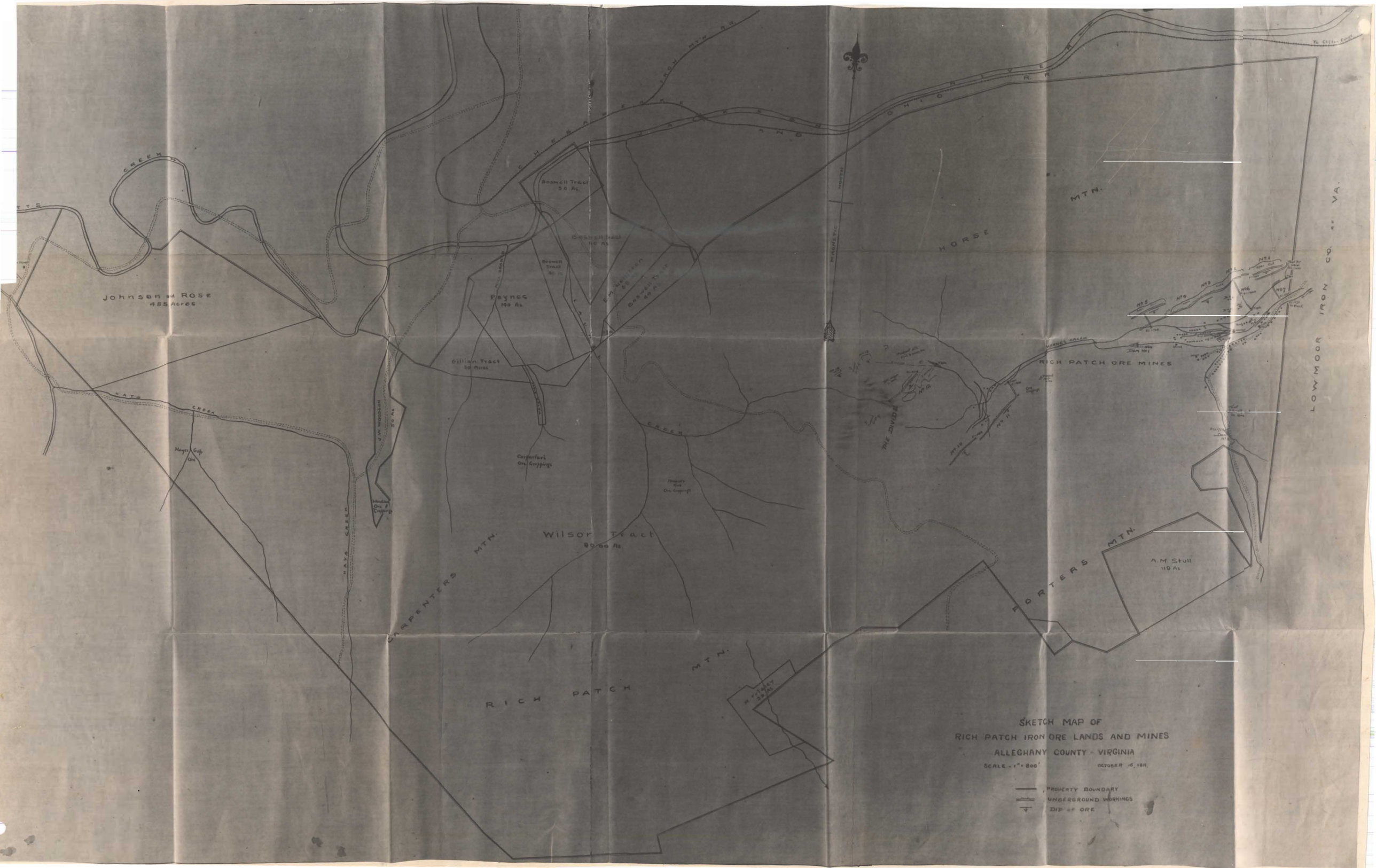
Cornfield mine 40,000 tons underground ore.



VERT. WIDTH	HORIZ. WIDTH	SLOPE DIP	DIST.	LENGTH	AVGE. THICK.	TON FACTOR	TONS PROBABLE
35	35°	61	100	8	18		2,700
130	35°	227	100	10	18		12,600
125	36°	213	100	10	18		11,800
105	36°	179	100	10	18		10,000
60	36°	102	75	10	18		4,200
30	37°	50	140	10	18		3,800
55	37°	91	85	10	18		4,300
80	37°	133	100	10	18		7,400
85	38°	138	100	10	18		7,600
80	38°	130	100	10	18		7,200
75	39°	119	100	10	18		6,600
45	39°	71	100	10	18		4,000
30	40°	47	100	10	18		2,600
65	40°	101	100	11	18		6,200
65	41°	99	100	13	18		7,100
75	42°	112	100	15	18		9,300
100	43°	146	100	17	18		13,800
165	44°	238	100	20	18		24,400
145	46°	202	100	20	18		22,900
135	46°	188	100	20	18		20,900
130	47°	178	100	20	18		19,700
140	48°	189	100	20	18		20,900
165	49°	219	100	20	18		24,200
150	50°	235	100	20	18		26,000
150	51°	193	100	20	18		21,400
140	53°	175	100	20	18		19,400
150	55°	184	100	20	18		20,300
150	57°	175	100	20	18		19,900
145	59°	169	100	20	18		19,200
140	60°	162	100	18	18		16,200
115	62°	130	100	15	18		10,900
100	64°	111	100	13	18		8,000
110	66°	121	100	12	18		8,000
125	68°	135	100	12	18		9,000
145	70°	154	100	12	18		10,200
155	70°	165	100	12	18		11,000
150	70°	160	100	12	18		10,600
140	70°	149	100	12	18		9,900
145	70°	154	100	12	18		10,300
200	70°	212	100	11	19		12,300
165	71°	175	100	10	20		8,700
120	71°	137	100	10	21		6,000
110	72°	116	100	10	21		5,500
115	72°	121	100	10	21		5,700
120	73°	125	100	10	21		5,900
115	73°	120	100	10	21		5,700
107	74°	111	100	10	21		5,300
90	74°	93	100	8	21		3,500
70	75°	72	100	6	21		2,300
40	75°	41	100	4	21		800

Total 546,700

ESTIMATE OF ORE AT UPPER END OF IRON MTN TRACT


SKETCH MAP OF
RICH PATCH IRON ORE LANDS AND MINES
ALLEGHANY COUNTY - VIRGINIA
SCALE - 1" = 800'
OCTOBER 15, 1914
PROPERTY BOUNDARY
UNDERGROUND WORKINGS
DIP OF ORE
MAGNETIC NORTH
Johnson and Rose
485 Acres
Boswell Tract
58 Ac.
Boswell Tract
110 Ac.
Boswell Tract
40 Ac.
Boswell Tract
40 Ac.
Paynes
140 Ac.
Gillian Tract
50 Acres
J.W. Woodson
50 Ac.
Wilson Tract
89.60 Ac.
A.M. Stull
119 Ac.
Tract
39 Ac.
Carpenter's Ore Croppings
Hayes Gap
Ore
Hayes Creek
Carpenters Mtn.
Rich Patch Mtn.
Porters Mtn.
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Rich Patch Ore Mines
Haynes Creek
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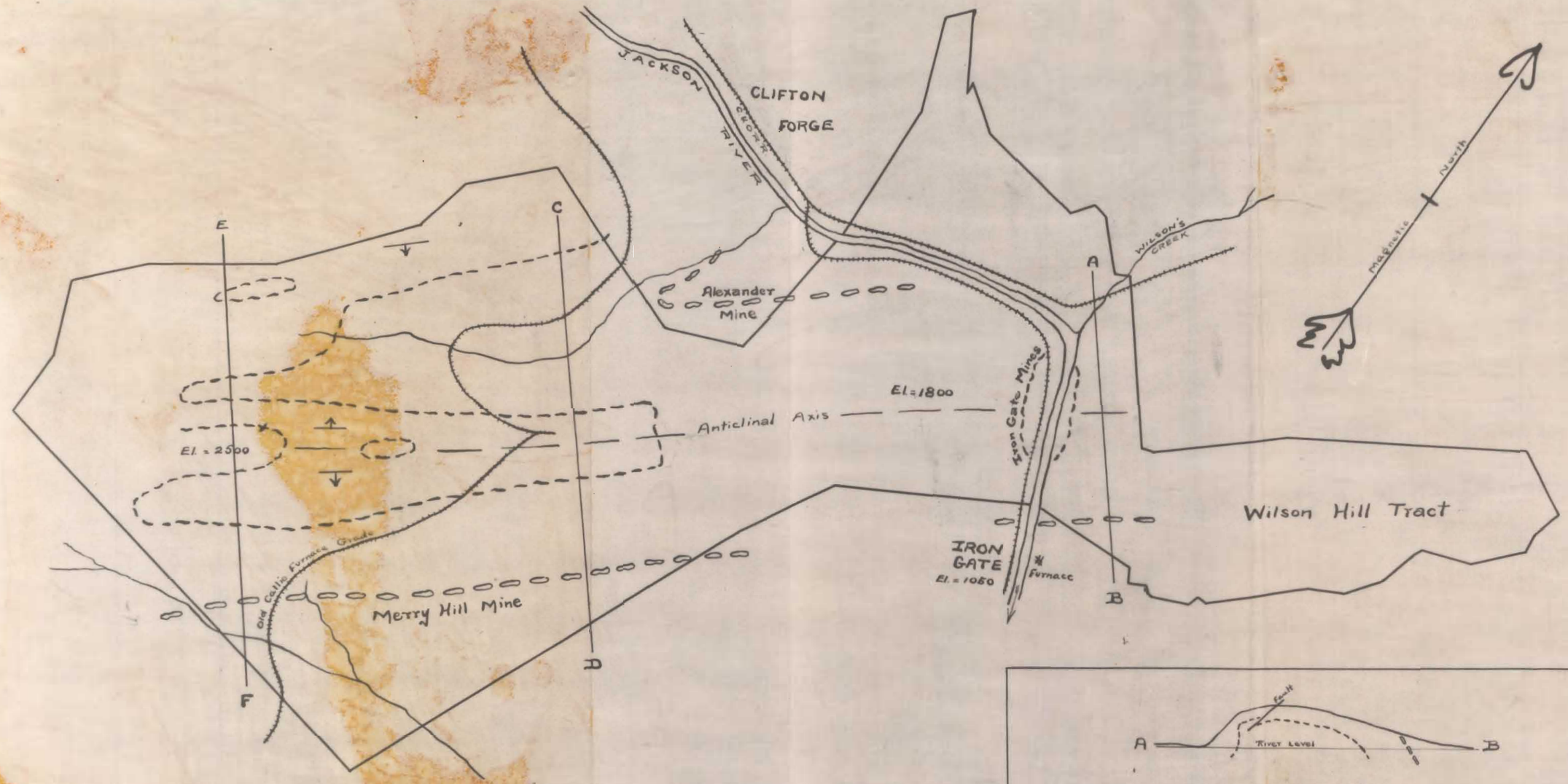
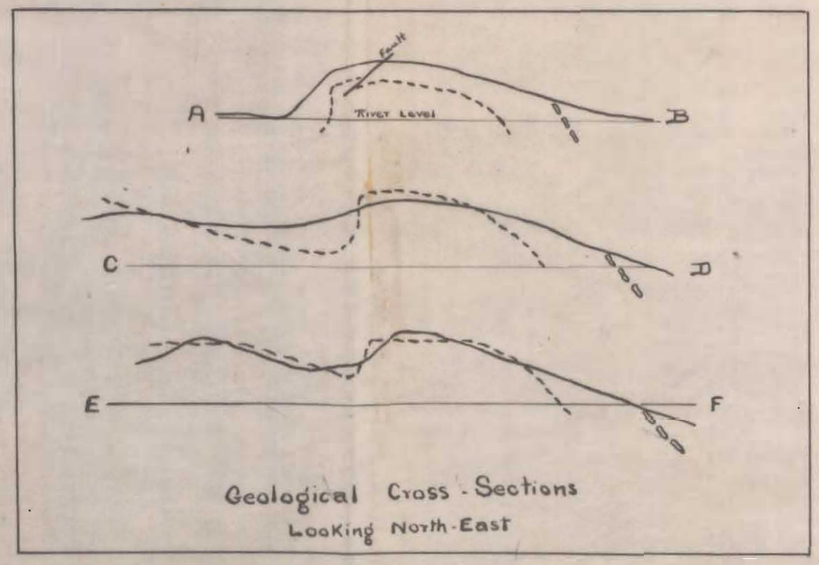


Sketch-Map of the Charter Oak Lands
Alleghany and Botetourt Cos., Va.
~ Scale 1" = 100 poles ~

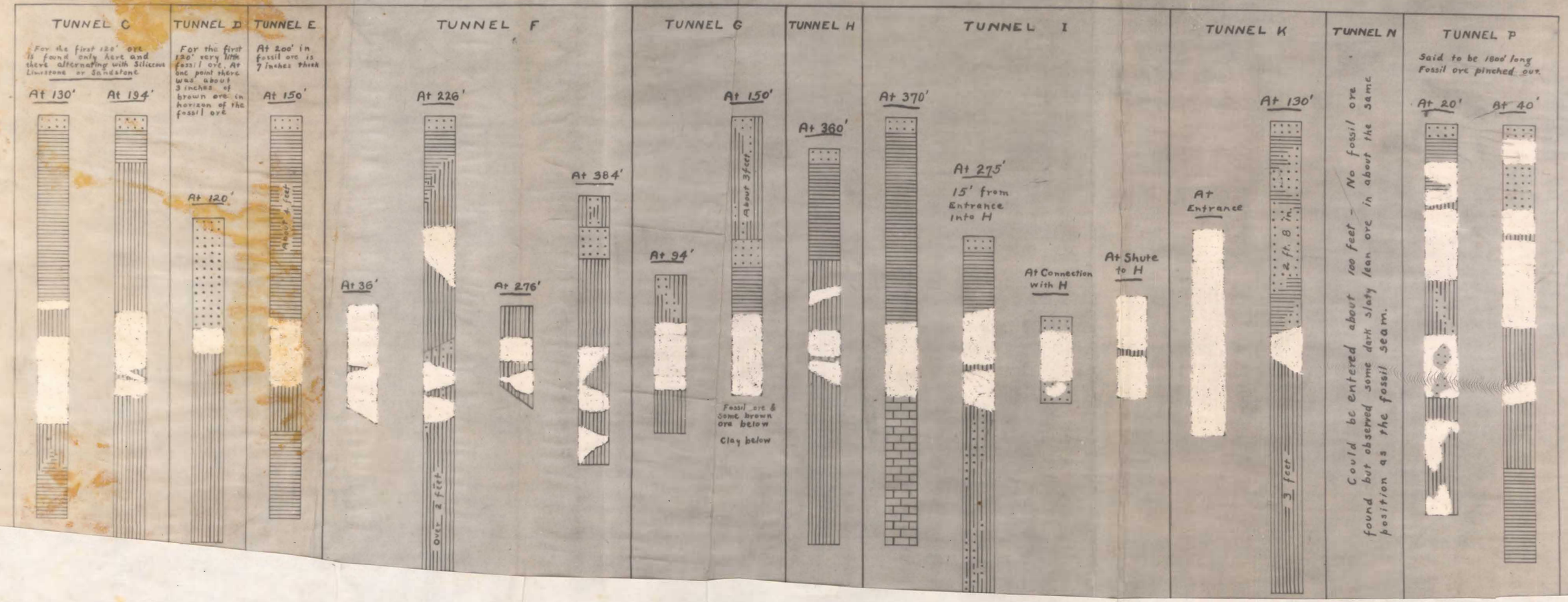
ooo Represents approximate crop-line of Oriskany ore-horizon
---- Represents approximate crop-line of Clinton ore-horizon



Geological Cross-Sections
Looking North-East

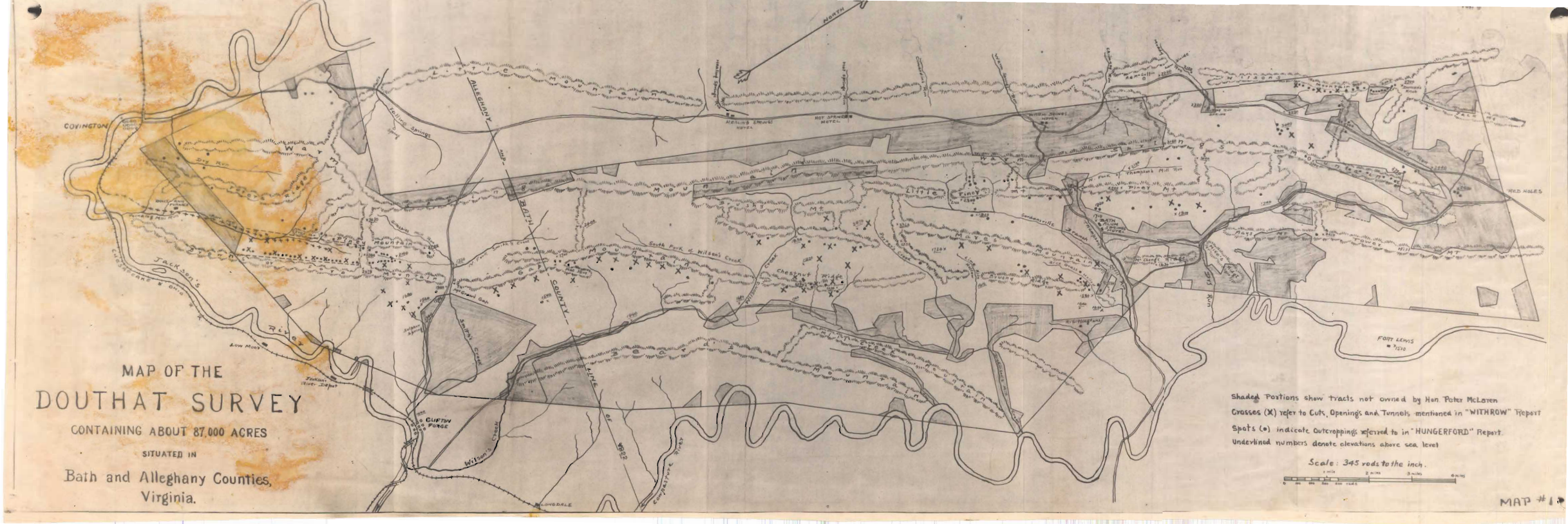
Sections of Vein at the Iron-Gate Fossil-Ore Mines Alleghany Co. Va.
After E. J. Schmitz, Trans. Am. Inst. Mining Engineers,
Atlanta Meeting October, 1895.

SCALE 1" = 10"



LITTLE MIDDLE MOUNTAIN

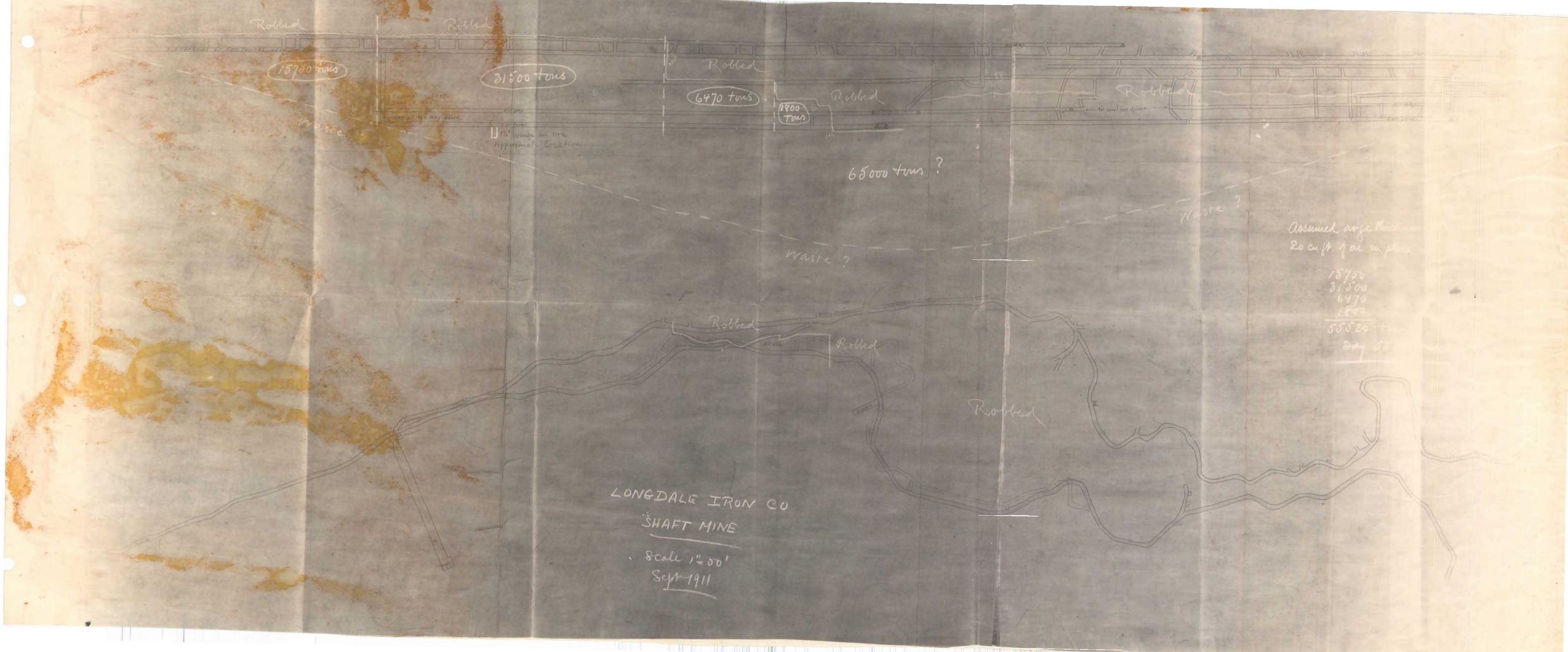
MOORE & HAYNES
2200 ACRE PATENT
NOW OWNED BY
CROWDER, DELANEY, & MILLER
2278 9/10 Acres
SCALE 1" = 40 Poles = 660'


MAP OF THE
DOUTHAT SURVEY
CONTAINING ABOUT 87,000 ACRES
SITUATED IN
Bath and Alleghany Counties,
Virginia.
Shaded Portions show tracts not owned by Hon. Peter McLaren
Crosses (X) refer to Cuts, Openings and Tunnels mentioned in "WITHROW" Report
Spots (•) indicate Outcroppings referred to in "HUNGERFORD" Report.
Underlined numbers denote elevations above sea level
Scale: 345 rods to the inch.
MAP #1
NORTH
COVINGTON
ALLEGHANY
BATH
COUNTY
HEALING SPRINGS HOTEL
HOT SPRINGS HOTEL
WARM SPRINGS HOTEL
Piney
Piney Mt.
Chestnut Ridge
South Fork of Wilson's Creek
Wilson's Creek
Smith Creek
Jackson's
River
Low Moor
Clifton Forge
Longdale
Fort Lewis
Red Holes
Cowpasture River

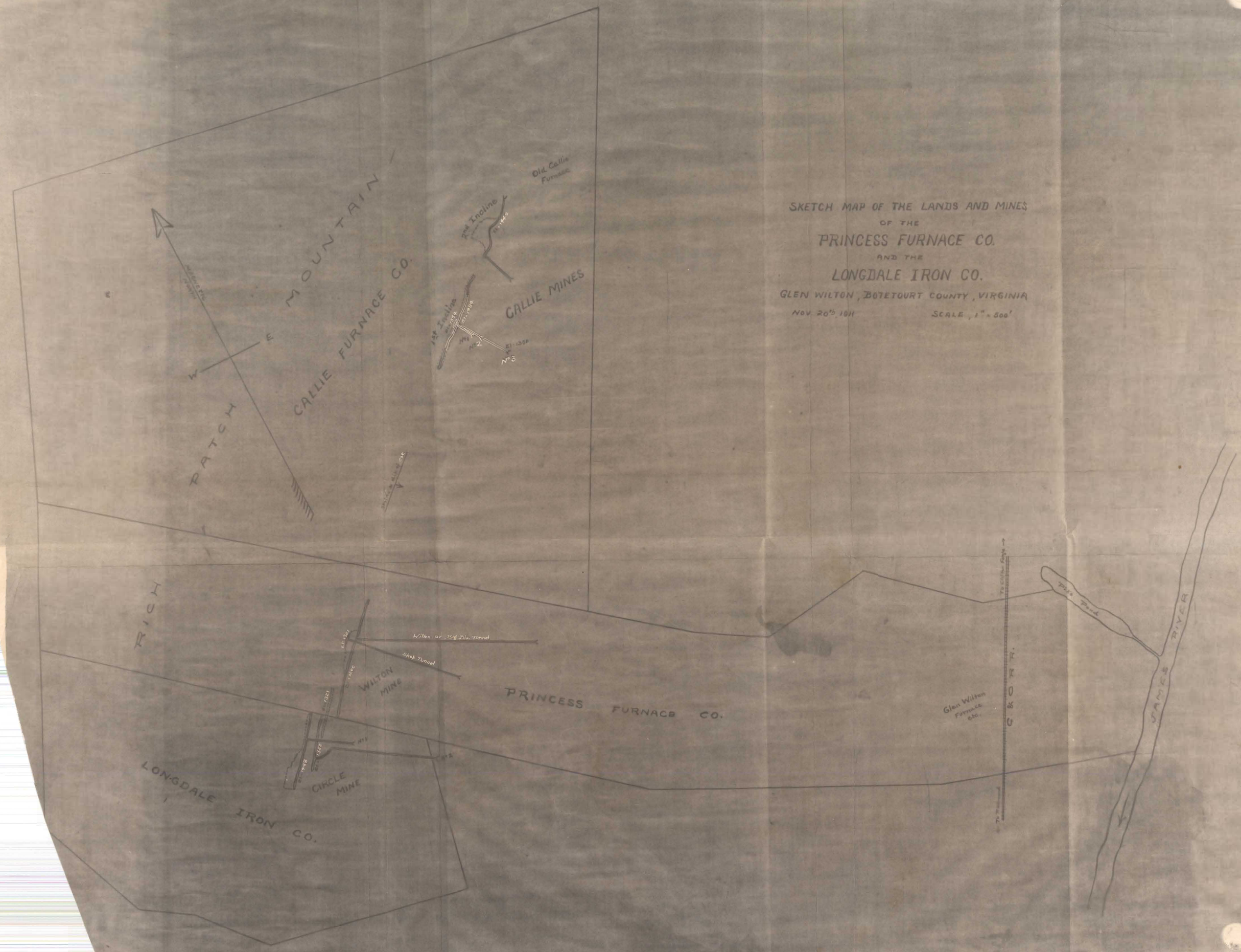
SKETCH-MAP OF
THE DOUTHAT SURVEY
ALLEGHANY AND BATH COUNTIES, VIRGINIA
SCALE 1/125000 - 1" = APPROXIMATELY 2 MILES
= Approximate Oriskany Crop-line
= Mine on Oriskany Ore
= Opening or exposure on Oriskany Ore
= Opening or exposure on Clinton Ore
= Strike and dip
Numbers refer to report
Only outside property boundaries shown
NORTH
JACKSON RIVER
HIGHLAND CO.
BATH CO.
ALLEGHANY CO.
BATH CO.
WILSON'S MT.
Duncan Knob
Falls
Falling Spring Cr.
Healing Springs
Hot Springs
Warm Springs
WARM SPRINGS MOUNTAIN
WARM SPRINGS MOUNTAIN
BRUSHY MOUNTAIN
LITTLE PINEY MT.
PINEY MT.
Dry Run
TOWER HILL
Bath Alum Springs
McCLURE RIDGE
MARE MOUNTAIN
BRUSHY RIDGE
COVINGTON
Covington furnace
WARM SPR. MT.
PEARS RIDGE
FOAKE MT.
GAP MOUNTAIN
McCrowl Gap
Wilson's Creek
Dickinson's Mill Creek
BEARD'S MOUNTAIN
Smith Creek
JACKSON RIVER
Low Moor furnace
CLIFTON FORGE
Iron Gate furnace
Covington furnace
JAMES RIVER
COW PASTURE RIVER
C & O. R. R.
Lonsdale furnace
BATH COUNTY
ROCKBRIDGE CO.
ALLEGHANY CO.
Panther Gap
Gushen furnace

MAP #2

LEGEND
= Prospect in Oriskany Ore
= Prospect in Clinton Ore
= Prospect in Other Ore
= Prospect examined
= Approximate position of Oriskany crop-line
= Strike and dip
Numbers refer to report
NORTH
ALLEGHANY CO.
BOTETOURT CO.
RICH PATCH MOUNTAIN
TURNPIKE
OLD FURNACE
Roaring Run
Johnson's River
JAMES RIVER
Shinkey's Run
Dosher Branch
RIDGE
Crawford's Run
HORTON'S
Stoney Run
Colis Run
Black Lick
CRAIG'S CREEK
C.&O.R.R.
HORTON MOUNTAIN JUNIOR 28-33 34-36 37-38 39-40
SKETCH-MAP OF ROARING RUN PROPERTY
BOTETOURT CO., VIRGINIA
SCALE, 1" = 100 POLES


Robbed
Robbed
15750 tons
31500 tons
Robbed
6470 tons
1800 Tons
Robbed
Robbed
Waste
Approximate location
65000 tons ?
Waste ?
Waste ?
Robbed
Robbed
Robbed
Assumed avge
20 cu ft of ore
15750
31500
6470
1800
55520
LONGDALE IRON CO
SHAFT MINE
Scale 1" = 50'
Sept 1911

Robbed
40
80'
Robbed
110'
30,000 Tons
4500 Tons
avge. hong = 100'
Slope 127'
170'
90'
73000 tons
avge. hong 220'
Slope. 265'
370
270
43000 tons
avge hong 245'
Slope. 287'
220'
35000 tons (?) below Car level
150'
150'
Assumed average thickness of Ore, 10'
20 cu. ft. of ore in place = 1 ton washed ore
43000
73000
30000
4500
150500 tons
say 145,000 tons
LONGDALE IRON CO
SLOPE MINE
Scale 1" = 50'
Sept 1911


SKETCH MAP OF THE LANDS AND MINES
OF THE
PRINCESS FURNACE CO.
AND THE
LONGDALE IRON CO.
GLEN WILTON, BOTETOURT COUNTY, VIRGINIA
NOV. 20th, 1911
SCALE, 1" = 500'
RICH PATCH MOUNTAIN
CALLIE FURNACE CO.
CALLIE MINES
Old Callie Furnace
2nd Incline
1st Incline
No 1
No 2
No 3
Wilton or Big Dip Tunnel
Shop Tunnel
WILTON MINE
PRINCESS FURNACE CO.
Glen Wilton Furnace etc.
C & O R.R.
Pig Pond
JAMES RIVER
LONGDALE IRON CO.
CIRCLE MINE