Production & Sales Corporation, which operated it until December 1932. The mine remained idle from 1932 until September 1940, when it was bought from Mr. Nelson by the American Alloy Corporation. During the period of operation by the Hy-Grade Manganese Co. beginning in 1920 it shipped about 6,440 tons of ore, according to the owner, Charles F. Nelson.[11] The successor company, the Hy-Grade Manganese Production & Sales Corporation, is said by Mr. Nelson to have shipped about 3,545 tons. Thus the total production of the mine before July 1941, the date of the first shipment by the American Alloy Corporation, was about 13,500 tons of ore.

Workings.--There are workings along the crest of the ridge for a distance of 2,500 feet, but most of them are at and near the middle part of the ridge. They consist of open cuts, pits, shafts, and tunnels. In 1920 only two tunnels were accessible. The higher of these was at an altitude of 1,393 feet above sea level, or 40 feet below the highest point on the crest of the ridge, and extended west-northwestward into the ridge a distance of 150 feet. From its northwest end two parallel drifts, 15 feet apart, had been driven 100 feet to the northeast, and two such drifts had been run 250 feet to the southwest. Crosscuts connected the parallel drifts at several places, and stopes had been made above the drifts. The No. 6 tunnel was at an altitude of 1,312 feet above sea level, or 120 feet below the highest point on the crest of the ridge, and extended 268 feet west-northwestward. At a distance of 163 feet from the portal a drift had been run 84 feet to the northeast and another drift had been run 114 feet to the southwest. Small stopes had been made above both drifts.

The Hy-Grade Manganese Co. cut another tunnel (No. 8) 80 feet below the No. 6 tunnel described above. The No. 8 tunnel,

11/ Oral communication.

at an altitude of 1,233 feet, penetrated the clay and chert residuum of the New Scotland limestone and continued into limestone. It passed through the weathered strata that contained manganese in the higher workings, but in this tunnel these strata contain only stains of manganese oxides. The tunnel has since caved in and is now inaccessible.

The Hy-Grade Manganese Production & Sales Corporation enlarged the small open cuts at the west and joined them into one, from which it obtained the bulk of its ore. In 1941 the cut was about 850 feet long, 50 to 75 feet wide, and 30 to 50 feet deep.

Geology.--A section of the rocks exposed in No. 8 tunnel was measured in 1928 by M. I. Goldman. His notes indicate that 40 feet of shattered Oriskany sandstone, veined with red clay, is underlain by 82 feet of more or less sandy chert and clay, residual from the New Scotland limestone. This material is underlain by a 2½-foot bed of sandstone containing phosphatic nodules and manganese stains. The sandstone is underlain by 13 feet of cherty clay, which merges downward into 20 to 40 feet of clay derived from limestone, probably the Keyser. Wavellite was observed on chert about 7 feet above the phosphatic sandstone.

The New Scotland limestone on the ridge is weathered to cherty clay to the depth of the lowest tunnel, which is at an altitude of 1,233 feet, or more than 200 feet below the crest of the ridge. Although the cherty layers have a general dip of 35° to 40° to the southeast, the individual layers are bent into small folds or wrinkles, so that the dips in a single exposure may range from nearly horizontal to nearly vertical. At the southwestern end of the open cut the beds have been compressed into a small recumbent anticline. These minor structural features have caused intense fracturing of the strata.

The New Scotland limestone is underlain on the northwest side of the ridge by a few feet of coarsely granular limestone that, according to Bridge and Butts,[12] may be equivalent to the Coeymans limestone. As the fossils are not entirely diagnostic this unit is included with the Keyser limestone, which thus includes about 220 feet of coarse-grained dark-gray fossiliferous limestone, thin-bedded knotty limestone, and shaly limestone.

Underlying the Keyser near the foot of the ridge is thin-bedded and laminated, more or less shaly limestone of the Tonoloway, and on the southeast slope of the ridge there are a few exposures of the Onondaga shale member of the Romney shale.

Manganese ore deposit.--The deposit of manganese ore occurs in the lower part of the sandy and cherty clay that is residual from the New Scotland limestone. Most of the ore is immediately above the phosphatic sandstone bed near the base of the New Scotland, but some is found just below this bed. The ore is irregularly distributed through a zone from about 15 to 30 feet thick. The ore body has the same attitude as the chert beds; it strikes northeast, parallel to the trend of the ridge, and its dip apparently averages between 20° and 25° SE. at the mine but increases to 40° or more both northeast and southwest of the mine. The workings show that ore occurs for a total distance of 2,500 feet along the ridge and extends down the dip into the hill below the level of No. 6 tunnel but not as deep as No. 8 tunnel. Thus the depth from the surface to the bottom of the ore body is between 130 and 200 feet vertically or between 260 and 400 feet along the dip of the ore zone.

The manganese oxides at Mineral Ridge include pyrolusite, wad, manganite, and psilomelane, of which pyrolusite is the most common. The proportion of pyrolusite increases with depth to the level of No. 6 tunnel, but in No. 8 tunnel only wad was found. The oxides occur in seams parallel to the bedding of the

12/ Bridge, Josiah, and Butts, Charles, oral communication.

is about 1,600 feet; that of the northern pit is about 1,560 feet.

Moses Orndorff prospect[9] (4)

No prospecting has been done on this property on McIlwee Ridge since Stose and Miser[9] visited the 12-foot shaft in the Oriskany sandstone at this place, which is about 1,160 feet above sea level. The shaft revealed sandy manganese oxide in a vein 1½ inches thick near the surface but the quantity is far too small to be commercial.

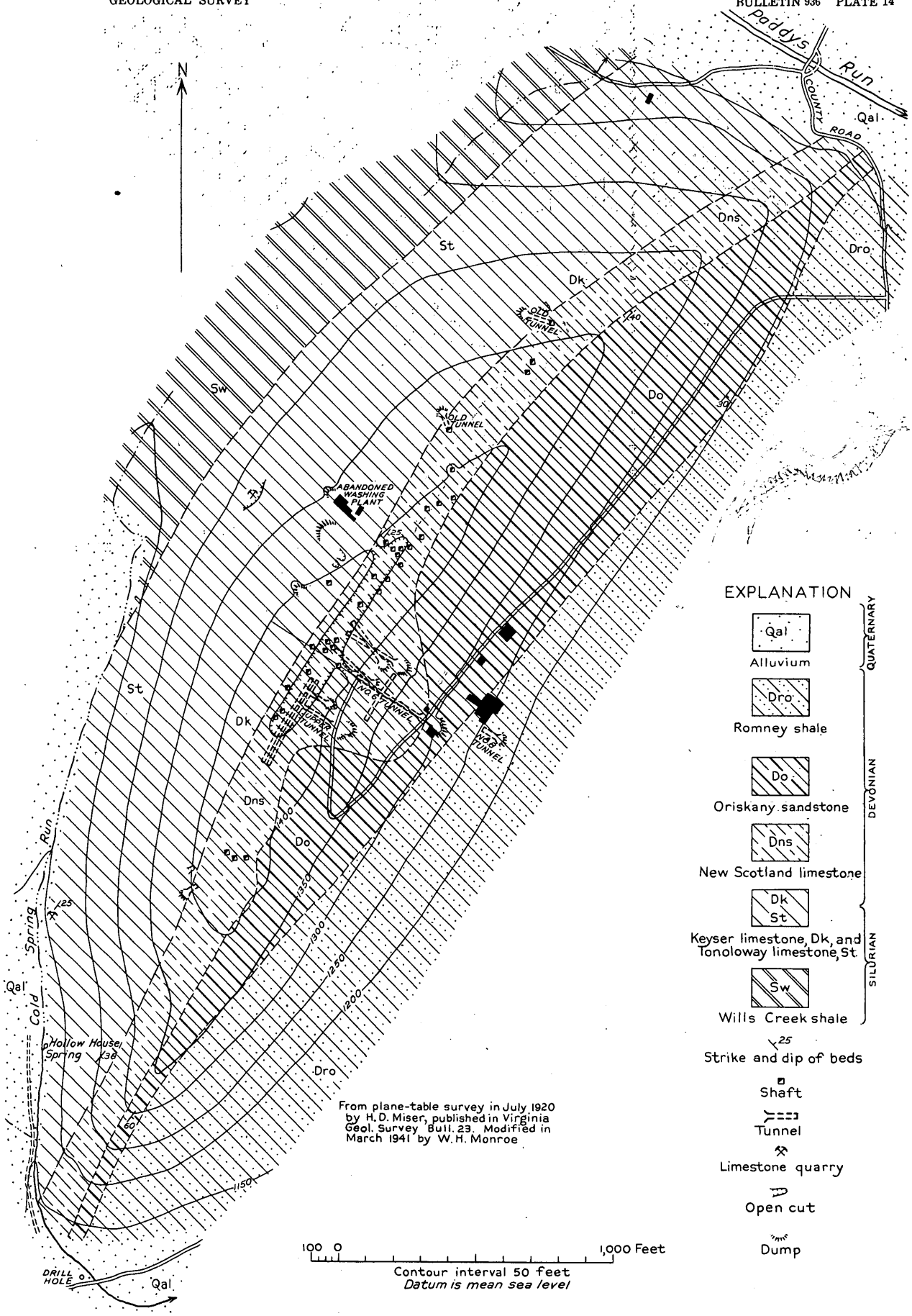
Mineral Ridge mine[10] (5)

The Mineral Ridge mine is on Mineral Ridge, also known as Manganese Ridge, in Cedar Creek Valley, 2½ miles north of Zepp and 8 miles west-northwest of Strasburg. Mineral Ridge is on the northwest side of the valley and extends northeastward from Cold Spring Run (also known as Hollow House Run) to Paddys Run, a distance of 4,800 feet. (See pl. 14.) It attains an altitude of 1,440 feet above sea level and rises about 300 feet above the runs at either end. Its crest is narrow and straight and its slopes are steep. At its eastern base is a gently rolling area with an altitude of about 1,100 to 1,200 feet above sea level.

History and production.--Intermittent mining of manganese ore on Mineral Ridge dates as far back as 1834, and the total production of the mine before 1920 was about 3,500 tons of ore.

On April 1, 1920, the mine was leased from Charles F. Nelson by N. H. Mannakee and associates who operated under the trade name of Hy-Grade Manganese Co. This company continued to operate, removing ore mainly from the No. 6 tunnel and from drifts to the northeast and southwest, until January 16, 1929. In October 1929 the property was leased by the Hy-Grade Manganese

9/ Stose, G. W., and Miser, H. D., op. cit., pp. 70-71.
10/ Condensed from idem, pp. 57-69.



GEOLOGIC MAP OF THE MINERAL RIDGE MINE

MANGANESE MINES AND PROSPECTS

Most of the manganese mines and prospects in Cedar Creek Valley have been described by Stose and Miser,[5] and in the following pages a brief summary of their findings is given. These are supplemented by descriptions of new developments made since the publication of their report and of a few prospects that, though opened many years ago, were first studied during the recent field work. The number in parentheses following the name of each mine or prospect corresponds to that showing the location of the property on the map (pl. 13).

Nelson No. 2 prospect[6] (1)

The Nelson No. 2 prospect is a tunnel driven northwestward into the Oriskany sandstone on the southeast flank of the Sarah Orndorff Ridge, at an altitude of about 1,150 feet. The tunnel stopped in sandstone and did not encounter any manganese oxide.

Nelson No. 1 prospect[7] (2)

The Nelson No. 1 prospect is a northwesterly trending tunnel, 132 feet long, on the southeast slope of Stave Mill Ridge (McIlwee Ridge), at an altitude of about 1,320 feet. The tunnel entered the Oriskany sandstone and was not driven far enough to reach the New Scotland limestone.

Limestone Ridge prospects[8] (3)

The pits on Limestone Ridge exposed brecciated chert cemented and in part replaced by manganese oxide inclosed in dark wad soil. No manganese ore in commercial quantity was discovered in the pits. The altitude of the two southern pits

5/ Stose, G. W., and Miser, H. D., op. cit., pp. 57-88.
6/ After idem, p. 71.
7/ Idem.
8/ Idem, p. 72.

chert and clay, in veinlets that cut the chert, and in small pockets replacing chert and clay. Associated with the manganese oxides at some places are brown iron oxide, a few small quartz crystals, and a very little wavellite.

The ratio of manganese oxides to oxide-bearing chert and clay in the ore zone differs from place to place, and little is known concerning it.

Analyses of shipments of manganese for chemical purposes are not available. Analyses of 20 carload lots of manganese ore that was shipped before 1921 for metallurgical purposes are given in the accompanying table, adapted from the table on page 66 of the report by Stose and Miser. They show the following range in composition: Manganese 39.53 to 52.67 percent, average about 46 percent; iron 0.85 to 7.10 percent; phosphorus 0.22 to 0.42 percent; silica 0.85 to 10.63 percent; and alumina 1.62 and 9.20 percent (recorded in two analyses).

The manganese ore marketed after 1920 is reported to have averaged about 45 percent manganese.

Analyses of manganese ore shipped before 1921 from Mineral Ridge mine

	Manganese (Mn)	Iron (Fe)	Phosphorus (P)	Baryta (BaO)	Silica (SiO_2)	Alumina (Al_2O_3)	Moisture
1....	48.64	....	.....	....	.....	....	10.25
2....	44.76	3.90	0.296	....	7.10	9.20	1.25
3....	52.67	.85	.227	....	1.08	....	1.57
4....	48.37	3.25	.226	....	7.05	....	1.58
5....	49.18	1.30	.284	....	2.05	....	5.46
6....	50.28	3.25	.257	....	5.43	....	1.60
7....	48.03	4.50	.261	....	5.55	....	7.65
8....	45.61	5.57	.23	....	5.78	....	5.71
9....	45.59	6.18	.42	6.87	.85	1.62	.....
10....	43.47	4.10	.27	....	9.51	....	6.20
11....	39.53	7.10	.....	....	9.60	....	.....
12....	42.16	4.08	.....	....	1/3.14	....	.....
13....	42.77	5.14	.23	....	8.06	....	9.06
14....	44.50	....	.....	....	8.02	....	12.32
15....	41.08	....	.....	....	10.63	....	3.00
16....	42.02	4.98	.29	....	10.54	....	5.70
17....	48.14	4.03	.23	....	6.13	....	.....
18....	51.97	1.76	.22	....	3.22	....	.....
19....	48.36	2.65	.24	....	3.41	....	.....
20....	48.93	1.50	.....	....	4.40	....	.....

1/ Includes alumina.

Mining and preparation of the ore.--Before 1915 the mine was worked by means of shafts, open cuts, and tunnels. The ore was hand-picked to free it from chert and clay, and some is said to have been washed and ground in a mill on Paddys Run. From 1915 until 1921 the ore was all mined from a large open cut.

The Hy-Grade Manganese Co. built a mill on the bank of Paddys Run at the northeastern end of Mineral Ridge. This mill was abandoned and a new one was built by the Hy-Grade Manganese Production & Sales Corporation in 1929 on the southeast slope of Mineral Ridge just northeast of the portals of tunnels No. 6 and No. 8 (pl. 14). This mill was equipped with a ball mill, a Fehrenwald sizer, 12 jigs, 4 sand tables, and 3 slime tables.

In 1940, when the American Alloy Corporation bought the property, most of this equipment was utilized in a new plant, equipped with crushers, jigs, tables, and classifiers, which was erected at the same site as its predecessor. The corporation is planning to use steam shovels in an open cut. The manganese ore is hauled in trucks to Strasburg, where it is shipped by rail.

McCune prospect[13] (6)

An inclined tunnel 20 feet long, at an altitude of 1,380 feet, and a small pit were opened about 35 years ago on the west slope and near the crest of Fox Ridge. Both of them were made in sandstone beds of the Oriskany, and the tunnel followed one or more of the beds. They revealed some thin veins of manganese ore, but the quantity of it was small, only 200 pounds being obtained.

Brill prospect[14] (7)

A pit 20 feet deep on the crest of Fox Ridge at an altitude of 1,410 feet penetrates pebbly beds of the Oriskany sandstone,

13/ After Stose, G. W., and Miser, H. D., op. cit., pp. 73-74.
14/ Idem, p. 73.

The marketed manganese ore from Cedar Creek Valley that has been consumed by the chemical and brick industries has commanded a higher price than metallurgical ore; and, because most of the marketed ore from the valley has been used in those industries, it has been possible to do some mining in this area even when prices for metallurgical ore were low.

The amount of recoverable manganese in Cedar Creek Valley depends in part upon the proportion of marketable manganese concentrates obtainable from the ore as mined. This proportion was estimated by comparing the weights of various lots of ore that have been mined hitherto with the weights of the manganese concentrates obtained from them. The maximum ratio was found to be about 1 ton of concentrates to 6 tons of crude ore and the minimum about 1 ton of concentrates to 15 tons of crude ore. From these figures, combined with rough calculations of the volume and tenor of ore still in the ground, it is estimated that about 30,000 tons of manganese concentrates containing 40 percent or more of manganese is recoverable in the proved mining areas in Cedar Creek Valley during times of high prices for manganese ore; and it is also estimated that this tonnage of recoverable concentrates could perhaps be doubled by further exploration of the present known ore bodies. The largest known ore body in the valley is at the Mineral Ridge mine, where additional development work may reveal extensions of the present known ore body. Additional prospecting might reveal new deposits or extensions of known deposits on Limestone Ridge, on Fox Ridge (see pl. 15), on Bonnet Hill, on the various hills comprising Big Hill, on Capola Mountain east of the present workings, and on the hill due east of Capola Mountain. At all of these places more or less promising prospects have been opened in the past.

Relation of ore deposits to physiography and structure.--All the mines and ore-bearing prospects in Cedar Creek Valley are near the crests of low hills, from 200 to 400 feet above the lowland of the valley, with the exception of the Rhesa A. Orndorff prospect, which is at water level on Trout Run.

Manganese oxides are found only at those places where the strata have been shattered by jointing, close folding, and minute faulting. Only in the channels thus formed, it appears, could the manganese-bearing solutions circulate freely. Close folding, such as that observed at Mineral Ridge and Capola Mountain, caused more shattering than the more open folding observed elsewhere, as on Big Hill. Structure has also determined, to some extent, in what formations the manganese oxides were deposited. In certain areas where, as at the Mineral Ridge mines, the dips were prevailingly gentle, the downward-seeping ground water passed through the Oriskany sandstone and deposited the oxides in porous, weathered New Scotland limestone; but where, as at the Capola Mountain mine, the dips are nearly vertical, the path of least resistance was entirely within the Oriskany sandstone, and the oxides were precipitated in that rock.

Economic possibilities.--Ore has been marketed from only four properties in the valley: the Mineral Ridge mine, the Bonnet Hill mine, the Godlove mine, and the Capola Mountain mine. At the time of the author's last visit to Cedar Creek Valley, in May 1941, none of the properties was being operated, but the American Alloy Corporation was planning to resume operations at the Mineral Ridge mine.

Only a small part of the marketed manganese ore from Cedar Creek Valley has been used for metallurgical purposes. All of the ore from the Godlove mine and most of that from the Bonnet Hill and Mineral Ridge mines has been used for chemical purposes --in the manufacture of dry batteries and of flint glass--and for making bricks.

which carry some manganese oxide. The prospect has produced about 2 tons of pyrolusite ore which forms thin veins and pockets in the fractured sandstone. The ore contains much silica in the form of sand grains and quartz pebbles, whose presence indicates that the manganese oxide has replaced pebbly sandstone.

Godlove mine[15] (8)

The Godlove mine is 1¼ miles northwest of Zepp on the northeast end of Godlove Hill, which is just south of Shell Run and between Bonnet Hill and Paddys Mountain. The hill is about a quarter of a mile wide and half a mile long, and attains an altitude of 1,440 feet above sea level.

The mine was first worked about 100 years ago and was operated intermittently until 1915. It was operated more intensively from 1915 to 1920, when three to five carloads of ore used for chemical purposes was shipped. There has been only intermittent prospecting since.

The workings consist of several shafts and two tunnels, one at an altitude of 1,364 feet and the other at 1,327 feet. The upper tunnel extended southward 185 feet, and drifts and inclines aggregating about 150 feet branch from it. The lower tunnel was about 300 feet long and trended a few degrees east of south. The portals of both tunnels had caved in by 1940, but some of the shafts could still be entered. The manganese ore deposit is concentrated in a bed of clay 4 or 5 feet thick and in fractured sandstone at the base of the Oriskany sandstone on the southeast side of the Godlove Hill syncline.

The extent of the ore deposit has not been determined fully, but all the workings were concentrated in a north-south belt 400 feet long and 200 feet wide. The manganese oxides consist of pyrolusite with a small amount of psilomelane. Mining was

15/ Modified after Stose, G. W., and Miser, H. D., op. cit., pp. 81-85.

done by hand in shafts and tunnels, and all the marketed ore was hand-picked.

Bonnet Hill mine[16] (9)

The Bonnet Hill mine is 2 miles southwest of the Mineral Ridge mine and 1 mile northwest of Zepp. The mine is on Bonnet Hill, a low northeastward-trending ridge on the northwest side of Cedar Creek Valley. The hill extends from Wymer Run to Shell Run, a distance of 5,000 feet, and attains an altitude of 1,510 feet above sea level. (See pl. 15.)

The mine was first worked in 1848 and was last worked in February 1920. The total reported production of the mine, most of which was made during several years prior to 1920, has been about 12 carloads of ore of which 8 were chemical ore and 4 metallurgical ore.

The mine workings are on and near the crest of the ridge at about equal distances from the north and south ends. They include several prospect pits, largely in surface material 6 feet deep with soft ore at the base, several shafts 30 to 40 feet deep, short irregular drifts running from the shafts, an open cut, and three tunnels. All the shafts and tunnels were caved in 1940. Two of the tunnels are on the east slope, one at an altitude of 1,470 feet and the other at an altitude of 1,415 feet, or 85 feet below the crest. This lower tunnel is 300 feet long and trends west-northwest. The other tunnel is on the west slope.

As at the Mineral Ridge mine the manganese ore deposit is in the lower part of sandy, cherty clay, residual from the New Scotland limestone, which dips steeply toward the southeast. This residual chert forms the crest of the ridge at the mine and for several hundred feet northeast and southwest of the mine. Because of settling during weathering of the limestone, the dips

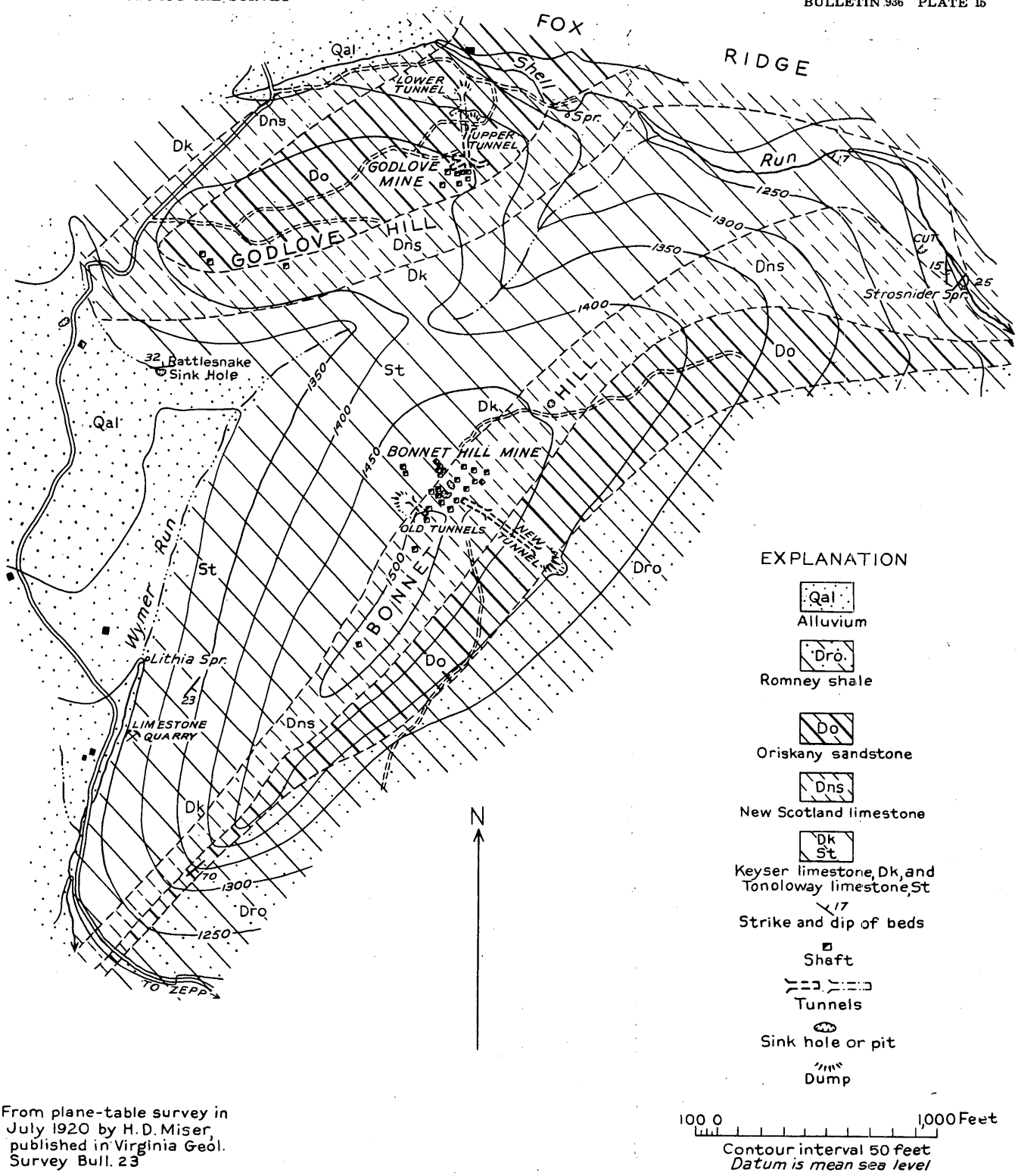
16/ Modified after Stose, G. W., and Miser, H. D., op. cit., pp. 74-80.

Oriskany sandstone. Manganese deposits in the weathered residuum of the New Scotland limestone are found at the Mineral Ridge and Bonnet Hill mines and at the Limestone Ridge, Rhesa A. Orndorff, Mary Orndorff, Frank Peer, James Orndorff, R. L. Orndorff, and Ralph Orndorff prospects. The deposits in the Oriskany sandstone are found at the Godlove and Capola Mountain mines and the McCune, Brill, and Mary Orndorff prospects.

Of the deposits in the residuum of the New Scotland limestone only that at the Mineral Ridge mine could be studied in detail, but the others are more or less similar. At the Mineral Ridge mine the manganese oxides, mostly pyrolusite, are concentrated along bedding and joint planes, where they form films and relatively narrow lenses in which the oxides have partly or entirely replaced the sandy clay and chert.

The manganese deposit of the Capola Mountain mine is typical of the deposits in which the oxides are obtained from highly weathered Oriskany sandstone. There the oxides, mostly pyrolusite and wad, are found in veinlets, in lenses filling voids between bedding planes and fracture surfaces, and in somewhat larger masses along bedding and fracture surfaces, where the oxides have replaced the sandstone. In general the oxides have replaced only the finer-grained material; in the conglomeratic beds, for example, the sand grains have been replaced by manganese oxide while the quartz pebbles have not.

The manganese oxides in the several mines and many prospects of Cedar Creek Valley have been concentrated and deposited in the present ore bodies by ground water, which presumably obtained its manganese content from the rock during weathering. Although the source of the manganese is not known it may have been disseminated manganese carbonate in the New Scotland limestone or the Oriskany sandstone. Only in the zone of weathering are the oxides concentrated into minable ore bodies, and most of these ore bodies lie above the present ground-water level.



From plane-table survey in July 1920 by H. D. Miser, published in Virginia Geol. Survey Bull. 23

GEOLOGIC MAP OF THE BONNET HILL AND GODLOVE MINES

prices were paid, manganese mining in western Virginia, as elsewhere in the United States, was greatly stimulated. Most of the above-mentioned mines * * * were opened, and numerous new localities were prospected for manganese ore. In November 1918, when the armistice with Germany was signed, the demand for domestic ores practically ceased, except for the filling of unexpired wartime contracts, and work at most of the mines and prospects stopped.

The Mineral Ridge mine was worked at times between 1920 and 1932 and was reopened in 1940. The Capola Mountain mine was operated in 1937 and 1938, and was further prospected in 1940, but no work was being done at the mine at the time of the author's last visit to the area in May 1941. So far as known little mining or prospecting was done elsewhere in the valley between 1920 and 1940.

Prior to 1920, it appears that less than 4,500 tons of manganese ore had been shipped from Cedar Creek Valley.[4] Since 1920 it is estimated that between 10,500 and 11,000 tons have been shipped. The total production of manganese ore for the valley before 1941 has thus been about 15,000 tons.

Minerals of the ore.--The manganese minerals found in Cedar Creek Valley are all oxides, and four of them that are common are pyrolusite, wad, psilomelane, and manganite, named in the order of their abundance. Psilomelane is not so common here as at some mines in other parts of Virginia, although it has been recognized at all the mines in the valley.

At the Mineral Ridge mine a few quartz crystals and a small quantity of the phosphate mineral wavellite are associated with the manganese deposit, and at nearly all the mines and prospects hydrous iron oxide is associated with the manganese oxides.

Types of deposits.--The manganese deposits in Cedar Creek Valley are replacement pockets and fracture fillings, irregular in size and shape. Some of the deposits occur in sandy clay and chert derived from weathering of the New Scotland limestone, others in porous, friable sandstone and conglomerate of the

4/ Stose, G. W., and Miser, H. D., op. cit., pp. 44, 59, 75, 81.

in the chert are somewhat irregular; beds have been observed that dip as much as 45° SE., but the average dip at the mine is probably about 30° SE.

On the southeast slope of the ridge, and reaching the crest at the southwest and northeast ends of the ridge, is porous, friable, pebbly sandstone dipping steeply toward the southeast and containing molds of fossil shells characteristic of the Oriskany sandstone. The Oriskany is overlain on the lower slopes of the northeast side of the hill by greenish-brown shale of the Onondaga member of the Romney shale.

Just northwest of the crest of the ridge and on the road that extends northeast from the mine along the crest of the ridge are many exposures of coarsely granular fossiliferous limestone, knotty limestone, and shaly limestone of the Keyser. The Tonoloway limestone is exposed at the crest of the anticline, just south of the saddle between Bonnet and Godlove Hills.

Concerning the manganese ore deposit, Stose and Miser[17] say:

> Although the ore is irregularly distributed through the chert and clay, the general dip and strike of the ore body are the same as those of the chert and clay. The strike is therefore to the northeast and the dip is probably about 30° SE. The workings show that it [the ore] occurs at or near the surface within a belt about 60 feet wide and 400 feet long, trending northeastward from the old tunnel that is on the west slope. The shafts southwest of the tunnel * * * failed to discover ore. * * * A cut * * * near the Strosnider Spring [at the northeast end of the hill] * * * penetrated yellow rocky sandy loam and no manganese minerals were found.
>
> The shafts at the mine followed workable ore to a depth of as much as 40 feet below the surface and the new [lower] tunnel revealed ore at an elevation of about 95 feet below the highest point on the crest of the ridge. * * *
>
> The ore-bearing zone penetrated by the shafts consists of chert, clay, and ore, and lies parallel with the bedding of the chert and clay. Where it was seen by the writers in one of the shafts it was several feet thick. Mr. Adkerson says it averages 8 feet thick in the shafts. The zone was just being penetrated in the new [lower] tunnel when work was discontinued there. At places the pure ore makes up by weight more than half of the zone and some of the larger pockets yielded as much as 6,000 lbs. of pure ore. The ore has replaced the chert and clay. * * * The ore consists of pyrolusite and psilomelane, mostly the former.

17/ Stose, G. W., and Miser, H. D., op. cit., p. 78.

Fourteen analyses included by Stose and Miser [18] show the composition of the ore from the Bonnet Hill mine. Ten analyses of soft ore showed 55.93 to 59.53 percent manganese, 0.10 to 1.27 percent iron, 0.199 percent phosphorus (1 analysis), and 0.97 and 5.90 percent silica (2 analyses). Three analyses of hard ore showed 49.58 to 52.38 percent manganese, 0.39 to 1.87 percent iron, 0.078 to 0.141 percent phosphorus, and 11.86 to 15.75 percent silica.

Rhesa A. Orndorff prospect [19] (10)

The Rhesa A. Orndorff prospect is an old tunnel at an altitude of 1,186 feet, on the north side of Trout Run and 1½ miles southwest of Zepp. The tunnel follows the strike of the mineralized zone 60 feet, and a lower parallel drift, reached by a slope 35 feet long down the dip of the bed, is said to go in 200 feet. Seventy tons of manganese ore is said to have been removed from the tunnel and placed on the dump at the edge of the run. Iron and manganese oxides occur in chert beds 1 to 2 feet thick separated by thin sandy clay beds near the middle of the New Scotland limestone. At the entrance the oxides are chiefly those of iron but in depth they are reported to be chiefly manganese and to fill crevices and seams in the chert and partly replace it. As determined by an examination of fragments on the dump, the manganese oxide is pyrolusite, in part intimately mixed with some iron oxide. No analyses of the manganese material are available.

Mary Orndorff prospect (11)

The Mary Orndorff prospect is on the ridge east of the Sugar Hill road, 1.3 miles west-southwest of Cedar Creek Church. The prospect consists of two openings, a shaft, said to be 16 feet

18/ Stose, G. W., and Miser, H. D., op. cit., p. 80.
19/ After idem, pp. 85-86.

stone forms a prominent horseshoe-shaped hill. The southeastern limb of this anticline is broken by a normal fault, which increases in throw toward the southwest. At the Fetzer Gap road, where the plane of the fault dips 84° toward the southeast, the lower part of the Bloomsburg redbeds, or possibly the upper part of the McKenzie formation, on the northwest side of the fault is brought into contact with the Onondaga shale member of the Romney on the southeast side. The displacement at that locality is thus about 1,000 feet (sec. F-F', pl. 13). Still farther southwest along the crest of the anticline, the Clinton formation and the underlying Tuscarora quartzite form the top of Tea Mountain, but, as no outcrops of the Onondaga were seen in the valley to the southeast, the magnitude of the displacement there is not known. At several places along the fault there are large vertical blocks of sandstone resembling the Oriskany, which apparently have been dragged into their present position by the movement in the fault zone. Southeast of the fault the strata of the Oriskany and New Scotland are slightly overturned, and have reverse dips of 65° and 70°, respectively, toward the southeast.

ORE DEPOSITS

History of mining and production.--The history of manganese mining in Cedar Creek Valley before 1920 is summarized as follows by Stose and Miser.[3]

> The manganese deposits of western Virginia have been worked at times since 1834 and have yielded both manganese and manganiferous iron ores. The earliest mine to be worked was the Mineral Ridge mine, in Frederick County. It is said to have been worked for many years before the Civil War, beginning in 1834, and for many years after the war. * * * The Bonnet Hill mine in Shenandoah County was worked in 1848 * * * but no ore from it was marketed at that time. The Godlove mine in Shenandoah County was first worked about 75 years ago * * * and it was again worked * * * 35 to 40 years ago. * * * The Capola Mountain mine was worked extensively many years ago, large amounts of manganese ore being shipped before the Civil War. * * *
>
> During the period from 1915 to November 1918, when there was a great demand for domestic manganese ores, for which high

3/ Stose, G. W., and Miser, H. D., op. cit., pp. 43-45.

boundary of the area here mapped. (See pl. 13.) Paddys and Little North Mountains owe their height to the resistance of the Tuscarora quartzite (Silurian), which forms their crests. Within the syncline younger formations of Silurian and Devonian age are exposed; the youngest rocks in the syncline, namely, the Romney shale and the Brallier and Chemung formations, are exposed in its deeper northern part. The syncline is not a simple fold, for the intense folding, especially in the southwestern part of the area, has crumpled the strata into a series of narrow synclines and anticlines, which plunge into the valley toward the northeast. At the southwestern end of the mapped area there are many parallel folds, whereas at the northeastern end there is only one anticline.

The ridges of Cedar Creek Valley are formed by the outcropping edges of the hard strata upturned on the folds, while the valleys are underlain by the softer intervening strata. Since many of the folds are of nearly the same height, the two manganese-bearing formations, the New Scotland limestone and the Oriskany sandstone, as well as other formations, are repeated several times at the surface. The dip gradually changes in steepness along the strike, and the sides of some folds in the southwestern part of the area have been compressed until they are parallel. The strata are overturned in the anticline on the southeast slope of Sugar Hill, so that here the Wills Creek shale dips 75° SE. and rests on the younger Tonoloway limestone (sec. F-F', pl. 13).

Of the two anticlines on the southeast side of the major syncline, the northwestern one plunges beneath the floor of the valley just southwest of the Fetzer Gap road and the other plunges beneath the valley at a place about three-quarters of a mile farther northeast, where the outcrop of the Oriskany sand-

deep, on the northwest flank of the ridge, and a nearby open cut on the crest of the ridge. The shaft is in the New Scotland limestone and the cut is in the adjoining Oriskany sandstone. The dump beside the cut shows a small quantity of manganese oxide, mostly as a cement and stain in the sandstone. The altitude of the ridge at the cut is 1,474 feet.

Frank Peer prospect (12)

The Frank Peer prospect is 0.4 mile southwest of the Mary Orndorff prospect and is on the northwest slope of the same ridge. It consists of a tunnel and a shaft that probably were opened before 1915. The tunnel starts in the lower part of the residual chert of the New Scotland limestone and trends southeastward toward the shaft. The mouth of the shaft, which is 1,414 feet above sea level, is about 20 feet northwest of and below the contact of the New Scotland and Oriskany formations. No ore was found on the dump during a visit in 1941, but the fragments of chert are stained with manganese oxide and some fragments show partial replacement by psilomelane.

James Orndorff prospect (13)

The James Orndorff prospect is on the next ridge east of the Frank Peer prospect and 0.4 mile northwest of Van Buren Furnace post office. The prospect consists of a tunnel, at an altitude of 1,390 feet, on the southwest side of a small transecting hollow, and a series of shafts extending up the nose of the ridge toward the southwest to an altitude of 1,460 feet. At the time of the visit in 1941 all the shafts and the tunnel, which may have connected with them, had caved in. The prospects are in the upper part of the chert and clay residuum of the New Scotland limestone, about 30 feet stratigraphically below the contact with the Oriskany sandstone. Although there is some

psilomelane in the chert on the dumps, only a little ore is said to have been found in the openings.

Cleve Peer prospect (14)

The Cleve Peer prospect, which was opened in 1940 by J. E. Cully, consists of a tunnel, at an altitude of 1,346 feet, on the southwest side of a low ridge, a quarter of a mile northwest of Cedar Creek and almost a mile west of Van Buren Furnace post office. The tunnel enters the top of the Oriskany sandstone and extends northwestward for a distance of 25 feet in the sandstone. It shows a few small pockets of slightly manganiferous sandstone and a little limonitic sandstone but no sizable body of ore.

R. L. Orndorff prospect (15)

The R. L. Orndorff prospect is on the northwest slope of Big Hill, at an altitude of 1,367 feet and about three-quarters of a mile southwest of Cedar Creek Church. At this locality a shaft, which has caved until it is now only about 10 feet deep, penetrated the residual chert of the New Scotland limestone, probably near the middle of the formation. Chert fragments on the dump are stained with manganese oxide. Another shaft is said to have been dug nearby, but it was not seen.

Unnamed prospect (16)

An unnamed prospect on a hill east of the Fetzer Gap road and a third of a mile south of Cedar Creek consists of a tunnel, now caved, on the northwest slope of the hill and a shaft on the southeast slope, both at an altitude of about 1,320 feet. Nothing is known of the history of this prospect. Both the tunnel and the shaft are in the residual chert of the New Scotland limestone. The dumps contain a little manganese-stained chert.

Sequence of rocks exposed in Cedar Creek Valley, Virginia

	Thickness in feet
Quaternary system:	
Alluvium and fan deposits:	
Heterogeneous mixture of cobbles, pebbles, and silt	0-20
Devonian system:	
Chemung, Brallier, and Romney formations:	
Thick bodies of shale and sandstone	7,000
Oriskany sandstone:	
Coarse, ferruginous, fossiliferous, crumbly sandstone, containing a few conglomeratic layers, particularly in the upper part; this is a resistant bed forming the crests of many ridges	50-100
New Scotland limestone:	
Medium-granular gray to dark-blue abundantly fossiliferous limestone, containing interbedded layers of chert; from 5 to 15 feet above the base of the limestone is a persistent layer of more or less phosphatic sandstone from 2 to 5 feet thick; this limestone layer is resistant and forms many ridges	95-130
Keyser limestone:	
Medium-grained nodular limestone passing upward into alternating granular and bluish-gray fine-grained limestone; top 5 to 10 feet consists of massive granular limestone	170-220
Silurian system:	
Tonolway limestone:	
Thin-bedded, finely laminated dark-gray limestone, containing near top several thin granular layers like the overlying Keyser	250-275
Wills Creek shale:	
Yellow shale, earthy platy limestone, and red shale and sandstone	150
Bloomsburg redbeds:	
Bright red mudrock and sandstone	200
McKenzie formation:	
Yellow shale, containing a few layers of red shale	150
Clinton formation (Keefer sandstone member):	
Gray quartzitic thick-bedded sandstone, composed of subangular to rounded quartz grains in a siliceous matrix	50

Structure

In harmony with the typical Appalachian pattern of linear, plunging folds, the rocks underlying Cedar Creek Valley have been folded into a compound syncline, of which Little North Mountain forms the southeast limb and Paddys Mountain the northwest limb. The syncline follows roughly the course of Cedar Creek from Capola Mountain to and beyond the northeastern

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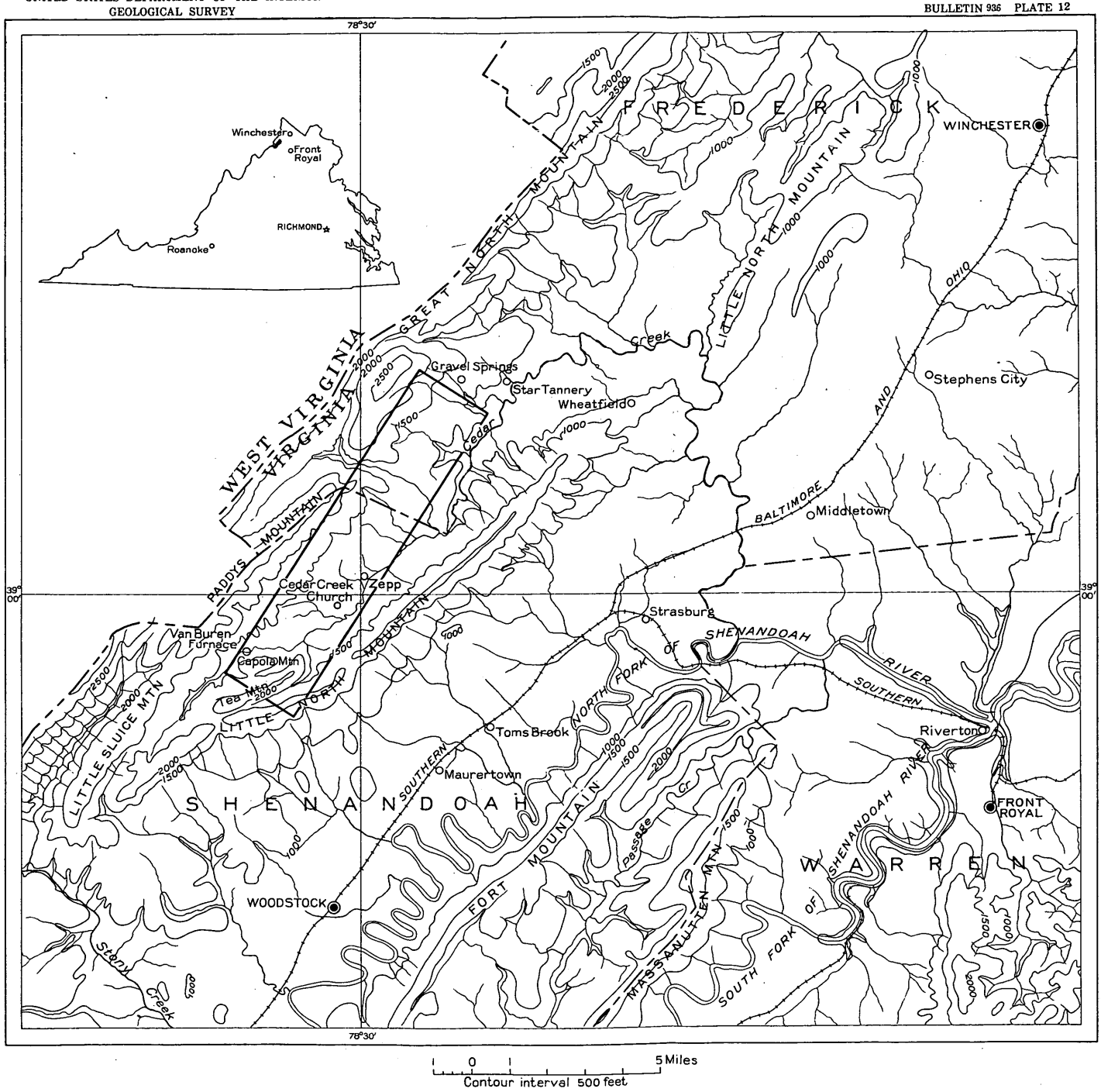

MAP OF PART OF NORTHERN VIRGINIA SHOWING LOCATION OF CEDAR CREEK VALLEY

Great North Mountains. The stream leaves the basin through a gap in Little North Mountain 2½ miles northeast of Wheatfield, and thence flows south to the North Fork of the Shenandoah River, which it enters 2½ miles east of Strasburg.

The middle part of the basin is a broad, gently rolling lowland, into which Cedar Creek has cut an inner, narrow valley, 50 to 200 feet deep. The lowland rises gradually toward the southwest from a little over 1,000 feet above sea level near Gravel Springs to a little over 1,200 feet near Cedar Creek Church, beyond which it is not recognizable. Between the lowland and Paddys Mountain is a belt of ridges with concordant crests whose general level rises from about 1,500 feet at the northeast to 1,800 feet at the southwest. It is on these ridges that the manganese mines and prospects occur. A third topographic surface is represented by the crests of Great North, Paddys, and Little North Mountains, which attain altitudes of 2,500 to 3,000 feet.

GEOLOGY

Stratigraphy 2/

The manganese-bearing formations of southwestern Frederick County and northern Shenandoah County are the New Scotland limestone and the Oriskany sandstone, both of Devonian age. The mapping of the area to the extent that was necessary for understanding the structure involved the mapping not only of these two formations but also of older and younger beds, all of which are briefly described in the table on page 115.

On the geologic map (see pl. 13) the Tonoloway and Keyser limestones are shown as a unit, because any attempt to map each separately would require extensive faunal studies not justified by the present program.

2/ The section on stratigraphy is adapted from notes submitted by Raymond S. Edmundson of the Virginia Geological Survey.

Ralph Orndorff prospect (17)

The Ralph Orndorff prospect is on the southern crest of the double hill east of Capola Mountain and south of Van Buren Furnace post office. The two ridges are projecting ledges of Oriskany sandstone, and are separated in the low saddle by a synclinal belt of greenish-brown shale of the Onondaga member of the Romney shale. The prospect consists of a tunnel near the crest of the west nose of the ridge and of a shaft about 40 feet deep on the crest, whose altitude is 1,602 feet. The shaft is open but the tunnel has caved. Both are in the lower part of the New Scotland limestone which here dips steeply to the northwest. The dumps contain some manganese oxide and much manganese-stained chert.

Capola Mountain mine (18)

Capola Mountain, a ridge trending westward, is just south of Cedar Creek and from 3½ to 5 miles southwest of Zepp. The mountain is about 6,600 feet long and 1,900 feet wide, and its highest point is 1,800 feet above sea level. The backbone of the mountain is a long narrow ridge, paralleled by a discontinuous ridge from 200 to 400 feet to the north. The altitude of the valley floor of Cedar Creek is about 1,320 feet near old Van Buren Furnace and about 1,220 feet at the east end of the mountain.

History and production.--The Capola Mountain mine was operated about 1880 by the Van Buren Furnace Co., which is said to have shipped some manganese ore.

In 1937 M. C. Smithson and associates, operating as Southern Ores, Inc., excavated the large open cut at the western end of the mountain (No. 11 on pl. 16) and obtained ore from it and the tunnels, which trend east from the open cut. This company built a mill at the western end of the cut and operated until 1938,

when the mill burned down. Mr. Smithson says that many of the records were lost in the fire but he believes that the company marketed between 500 and 1,000 tons of ore in 1937 and 1938. This agrees well with a local report that the company shipped 10 or 12 carloads of ore. The ore was hauled in trucks to Woodstock and shipped on the Southern Railway.

In 1940 John E. Cully and associates, known as the Allied Manganese Corporation, obtained from the United States Forest Service, a lease on the western end of the mountain, and opened a cut (No. 9) into an old drift formerly reached only by a shaft (No. 8). The corporation had done considerable prospecting by the spring of 1941, but no ore had been shipped.

Workings.--The manganese workings on Capola Mountain are on the west end of the mountain, at altitudes ranging from 1,480 to 1,700 feet above sea level. They consist of pits, shafts, tunnels, and an open cut, all in an area 1,000 feet long and 300 feet wide. The principal source of marketed ore has been an open cut (No. 11) 300 feet long, from 12 to 40 feet wide, and from 20 to 40 feet deep. The cut is nearly straight with a trend of N. 70° E. The floor of the cut has an altitude of 1,557 feet at its west end or entrance and is there about 12 feet wide; it is horizontal to a point about 70 feet to the east, where it has a width of 15 to 25 feet, then rises to 1,576 feet. At the east end of the 1,576-foot level is the portal of a tunnel, which will be described below. Beyond this level the cut reaches a maximum width of 40 feet and rises by irregular steps to the top or east end which has an altitude of 1,650 feet. The portal of a second tunnel is on the north side of the cut, 30 feet west of the east end and at an altitude of 1,620 feet. Essentially all of the ore obtained by Southern Ores, Inc., was mined from the open cut and the tunnel at the 1,620 foot level.

When the Capola Mountain mine was visited in May 1941, four tunnels were entered; the portals of two others had caved. The

tion, and many citizens of Cedar Creek Valley have generously given the author information about the history of mining and manganese production in the district. Vincent A. Leonhardt and Harry Peer ably assisted the author as rodmen during the field surveys.

Studies of the manganese deposits of the Cedar Creek Valley were made in 1918 by G. W. Stose and H. D. Miser, who also, in 1920, made plane-table surveys of Mineral Ridge, Frederick County, and of Bonnet and Godlove Hills, Shenandoah County. The results of their investigation of these deposits were published [1] in 1922, and were freely utilized in preparing the present report.

Geography

Cedar Creek Valley is in the northwestern part of Virginia, between Little North Mountain on the southeast and Great North and Paddys Mountains on the northwest (pl. 12). The surveyed area (see pl. 13), about 10 miles long and 2 miles wide, covers only the upper part of the valley, near Gravel Springs Church, Frederick County, and Van Buren Furnace, Shenandoah County. Its northern part lies about 7 miles northwest of Strasburg and the southern part about the same distance northwest of Maurertown.

Graded roads connect the area with the paved Strasburg-Star Tannery road, and a graded road crosses Little North Mountain through Fetzer Gap to join the Valley Pike (U. S. Highway 11) at a point between Woodstock and Maurertown. The part of the valley described in this report is sparsely settled, and most of it away from the roads is included in the George Washington National Forest.

Cedar Creek flows northeastward through a basin, 21 miles long and 1 to 6 miles wide, that lies between Little North and

1/ Stose, G. W., and Miser, H. D., Manganese deposits of western Virginia: Virginia Geol. Survey Bull. 23, pp. 57-88, 1922.

Geological Survey in the fall of 1940; and the mapping of the manganiferous deposits in Cedar Creek Valley in Frederick and Shenandoah Counties, Va., was assigned to the author. With the generous permission of Arthur Bevan, State Geologist of Virgini Raymond S. Edmundson contributed his manuscript map of the southwestern part of the Middletown quadrangle, which includes all the Frederick County part of the manganese-bearing area in Cedar Creek Valley, and a brief account of the stratigraphy of that part of the quadrangle for incorporation in this report. Mr. Edmundson also spent an additional week in the field in October 1940, to adjust his mapping to the larger scale, 1:24,000, that was employed by the author in the field surveys for the remainder of the Cedar Creek Valley.

As no satisfactory base map was available for the part of the valley southwest of the Middletown quadrangle, a topographic base was prepared from plane-table traverses that followed the principal roads and extended to the manganese prospects of the area, supplemented by form lines sketched from aerial photographs obtained from the United States Forest Service. A detailed map was made of Capola Mountain. The final map, then, embodies a combination of detailed surveys of the mining properties, less accurate surveys of the principal roads and prospects, and sketched form lines of the other topographic features.

Josiah Bridge, Charles Butts, and R. S. Edmundson spent a few days in the field with the author in March 1941, for the purpose of checking the stratigraphic sections of rocks that are exposed at the various mines and prospects. In May 1941, H. D. Miser accompanied the author on a two-day field trip during which the ore deposits at Capola Mountain and at Mineral Ridge were studied.

Messrs. Charles F. Nelson, of Strasburg, Va., J. Carson Adkerson of Washington, D. C., Dennis Pickens of the American Alloy Corporation, J. E. Cully of the Allied Manganese Corpora-

tunnel at the 1,576-foot level in the open cut (No. 11) extends N. 70° E. along the line of the cut for 155 feet to an ore chute from the higher tunnel, from which it extends N. 22° E. in this direction for 30 feet to the face. The tunnel at the 1,620-foot level runs parallel to the cut for about 40 feet to the top of the ore chute, where a stope rises about 10 feet and a drift continues toward the east, but this higher part was not entered.

The portal (No. 9) opening into the drift of the Allied Manganese Corporation is just north of the crest of the ridge at an altitude of 1,649 feet. A small open cut leads to the portal and from it a crosscut extends southeastward to a drift, in part a stope, which extends parallel to the crest of the ridge, or about N. 70° E., for 105 feet. The altitude of the bottom of the stope is 1,633 feet. A shaft (No. 8) was the former entrance to this drift and stope.

The fourth tunnel (No. 12), entered in 1941, extends northward from the south slope of the ridge at an altitude of 1,620 feet. It is 220 feet long and has two short drifts branching off 160 feet north of the portal. One rises slightly for 15 feet toward the east, then crosscuts 20 feet toward the south, and finally goes 15 feet farther toward the east. The total rise in this drift above the tunnel level is about 15 feet. The other branch goes only 8 feet toward the south. An irregular stope rises about 30 feet along the bedding 200 feet north of the portal.

Many other workings are shown on the map (see pl. 16), but they had all caved at the time of the writer's visit.

Geology.--The sequence of rocks exposed on Capola Mountain is shown on the following page.

The chief structural feature of Capola Mountain is a closely compressed syncline, the axis of which lies just north of the crest of the mountain. A steep-sided anticline extends along the north slope of the mountain. The structure is complicated

by small subsidiary folds that raise the Oriskany sandstone to the surface in the belt of the Onondaga shale member of the Romney along the axis of the syncline. The accompanying sections (see pl. 16) show the approximate attitude of the rocks, but some of the close folding at the west end of the mountain is not shown. One of these close folds is well exposed in the Allied Manganese cut (No. 9 on pl. 16), where the Onondaga shale has been folded down into the Oriskany sandstone in a synclinal belt only about a foot across.

Sequence of rocks exposed on Capola Mountain, Virginia

	Thickness in feet
Onondaga shale member of the Romney shale:	
Yellow to greenish-brown hackly shale, much of it impregnated with limonite	100
Oriskany sandstone:	
Coarse, ferruginous, fossiliferous crumbly sandstone containing in upper part abundant quartz pebbles; contains at places in upper part pockets and seams of manganese oxide; makes ridges on mountain	120
New Scotland limestone:	
Dark-gray more or less granular and fossiliferous limestone containing interbedded layers of chert	120
Keyser limestone:	
Massive granular and shaly limestone	220
Tonoloway limestone:	
Thin-bedded and shaly limestone, generally nearly black on fresh surface	240

Just north of the mine workings is a somewhat larger syncline which encloses a body of Onondaga shale at the Allied Manganese cut (No. 9) and at the west end of the large open cut (No. 11). Between these two places, however, the syncline is not deep enough to include any Onondaga, and the underlying Oriskany sandstone is here exposed along the synclinal axis. The accompanying anticline to the north of this syncline again brings Oriskany to the surface at the two extremities. The dip of the south flank of this anticline, 55° toward the south, was observed only at the Allied Manganese mine. No dips were obtained on the north flank of the anticline, for the Oriskany there is broken into large blocks. There may be a fault along

MANGANESE DEPOSITS OF CEDAR CREEK VALLEY, FREDERICK AND SHENANDOAH COUNTIES, VIRGINIA

By Watson H. Monroe

ABSTRACT

The Cedar Creek manganese mining district is in the southwestern part of Frederick County and the northwestern part of Shenandoah County, Virginia. The manganese ore consists chiefly of the oxides pyrolusite and psilomelane, and forms replacement pockets and fracture fillings in the Oriskany sandstone and in residual sandy clay and chert derived from the New Scotland limestone. Both these formations are of Devonian age, and both form low ridges. The minable bodies have been deposited by ground water in the zone of weathering, and most of them lie above present ground-water level. The manganese-bearing formations, together with the older and younger formations exposed in Cedar Creek Valley, have been compressed into numerous folds, and at the southwestern end of the district one of these folds passes into a normal fault with a displacement of 1,000 feet or more.

Manganese ore has been mined in the valley since 1834, and about 15,000 tons of ore had been shipped from four mines before 1941. Most of the marketed manganese ore from Cedar Creek Valley has been sold to the chemical and brick industries and only a minor part has been sold as metallurgical ore. Because ore for chemical and brick purposes has commanded a higher price than that generally paid for metallurgical ore, mining in the valley has to some extent been carried on during times of low prices for metallurgical ore.

The ratio of recoverable manganese concentrates to manganese-bearing rock varies considerably, the maximum being about 1 ton of concentrates to 6 tons of crude ore and the minimum about 1 ton of concentrates to about 15 tons of crude ore. It is estimated that about 30,000 tons of manganese concentrates containing 40 percent or more of manganese will be recoverable in the proved mining areas in Cedar Creek Valley during times of high prices for manganese; and this tonnage of recoverable concentrates may be doubled by further exploration of the present known ore bodies.

INTRODUCTION

A resurvey of the manganese deposits of western Virginia with a view to evaluating available supplies was begun by the

ILLUSTRATIONS

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Plate 12. Map of part of northern Virginia showing location of Cedar Creek Valley..... 114
13. Geologic map and sections of part of Cedar Creek Valley, Va., showing location of manganese mines and prospects..... In pocket
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15. Geologic map of the Bonnet Hill and Godlove mines..... 130
16. Geologic map and sections of Capola Mountain, Va..... In pocket

this flank, but no fault is shown on the map or sections because of lack of evidence. North of this anticline is the axis of the main syncline.

The structure is similarly complicated farther east along the crest of the mountain, where, as shown on the map (see pl. 16) and section C-C', other small synclines and anticlines are present. The tight folding here has shattered the Oriskany sandstone and formed the numerous joints and small faults along which the manganese oxides have been concentrated. In the open cut (No. 11) four main sets of fractures are exposed. The main set strikes N. 30° E. and dips 33° SE., another set dips north, a third dips southwest, and the fourth is vertical and strikes east. Some of these fractures have highly polished slickensides that indicate slight movement.

Manganese ore deposit.--The ore body revealed in the open cut and tunnels (No. 11) occurs in a bed of pebbly sandstone 12 to 25 feet thick, near the top of the Oriskany sandstone. The ore body dips toward the north with the bedding of the sandstone, whose inclination increases from 65° in the higher workings, at an altitude of 1,670 feet, to 70° in the bottom of the open cut at an altitude of 1,560 feet. The manganese oxides of the ore body are irregularly distributed in veinlets, in fracture fillings, and in irregular masses where they have replaced the sandstone. The most abundant oxide is pyrolusite; manganite and wad also are present.

Near the mouth of the open cut (No. 11) the footwall contains relatively little mineral, but the hanging wall or north wall contains highly fractured sandstone with considerable pyrolusite and some iron oxide. The lower part of this cut is from 11 to 15 feet wide and here all the minable ore has apparently been removed.

At the next level of the open cut (altitude 1,576 feet) the ore body is a continuation of that from the lower level, though

here a small quantity of manganese oxide occurs in pebbly sandstone in the south or footwall. The 155-foot tunnel that extends eastward from this cut contains only a little iron oxide. Higher levels of the open cut reveal an upward continuation of the ore body, but here the ore-bearing zone becomes a little wider. At the portal of the upper tunnel, at an altitude of 1,620 feet, the ore zone is 18 feet wide. The tunnel at this level contains little ore, and most of that obtained from this opening apparently came from the higher drift that was connected with it at its east end by means of a raise.

The lower part of the Oriskany sandstone, just below and south of the ore body just described, also contains manganese oxides but the veinlets are too small to permit mining. From the bottom of the open cut at an altitude of 1,557 feet to the foot of the mountain (altitude 1,420 feet) the fractured Oriskany sandstone contains veinlets of manganese and iron oxides in which iron oxide predominates.

The drift south of opening No. 9 contains veinlets and lenses of pyrolusite and wad, up to 6 inches wide and 4 feet long, in sandstone. Many of the larger veins are along bedding planes of the sandstone. The ore-bearing sandstone in this tunnel, which is partly a stope, reaches a thickness of 3 feet, and in places it contains many lenses of pyrolusite and wad. Some crude ore removed in excavating the tunnel and now on the dump consists chiefly of pyrolusite through which quartz grains and pebbles are distributed. Only a part of this material is lumpy and solid. Similar material was formerly hoisted from the drift through the shaft designated No. 8 on the map and still lies on the dump beside the shaft.

The crosscutting tunnel driven from the south slope of the mountain at an altitude of 1,620 feet penetrated the sandstone throughout its entire length except for the first 25 feet, which is in sandy clay and chert derived from the weathered New Scot-

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land limestone. Manganese and iron oxides are exposed in the northern 70 feet of this tunnel, but the manganese oxide is mostly wad, with a little pyrolusite.

From the data given above and shown on the map, the developed and mined ore body apparently extended eastward from the mouth of the open cut for a distance of about 800 feet and was from 3 to 18 feet wide, becoming narrower with depth. Sandstone containing ore extends downward from the surface to an average depth of less than 40 feet. All the minable ore in the open cut (No. 11) appears to have been removed, and, unless the ore body is found to extend farther east, at least half of the minable ore in the deposit has been mined.

O

UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

GEOLOGICAL SURVEY
W. C. Mendenhall, Director

Bulletin 936-E

MANGANESE DEPOSITS OF CEDAR CREEK VALLEY, FREDERICK AND SHENANDOAH COUNTIES, VIRGINIA

BY

WATSON H. MONROE

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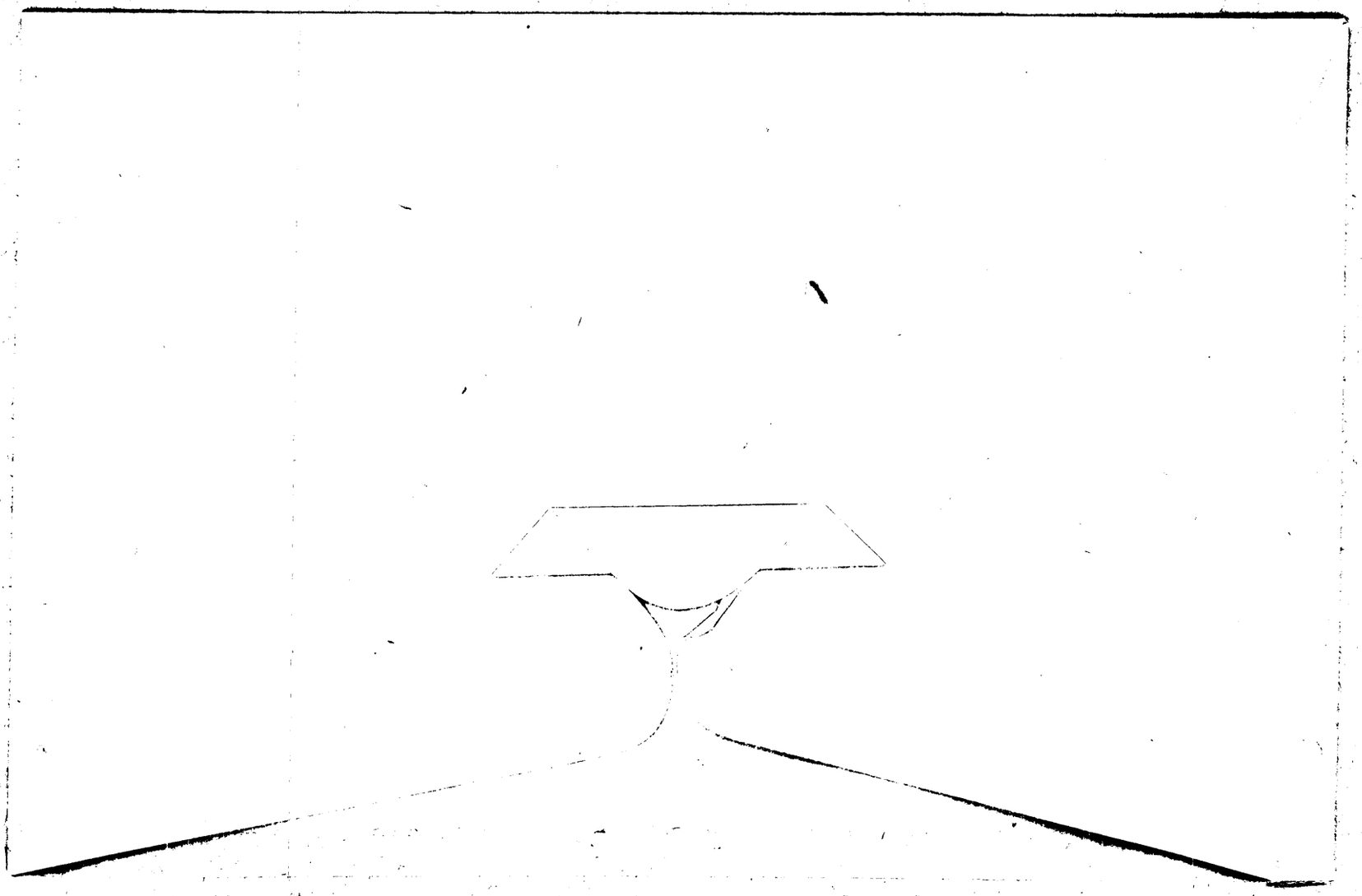

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MANGANESE DEPOSITS OF CEDAR CREEK VALLEY FREDERICK AND SHENANDOAH COUNTIES, VIRGINIA

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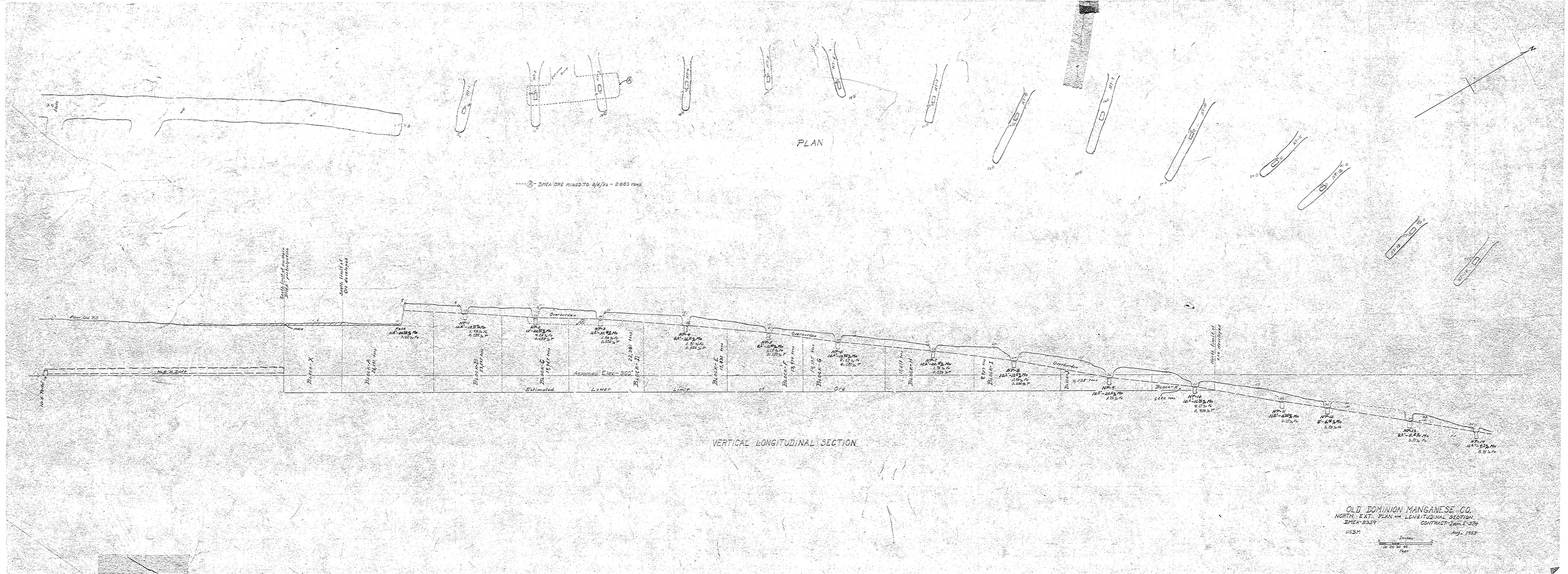

PLAN
----(B)- IMEA ORE MINED TO 8/6/52 - 2880 tons
VERTICAL LONGITUDINAL SECTION
Block X
Block A
Block B
Block C
Block D
Block E
Block F
Block G
Block H
Block I
Block J
Block K
Overburden
Assumed Elev. 300'
Estimated Lower Limit of Ore
OLD DOMINION MANGANESE CO.
NORTH EXT. PLAN AND LONGITUDINAL SECTION
IMEA 2337
CONTRACT-IMA E-374
USBM
Aug. 1953
Inches
Feet

OLD DOMINION MANGANESE CO.
SOUTH EXT. PLAN AND LONGITUDINAL SECTION
DMEM-2359 CONTRACT Zm-5374
AUG. 1953
J.J.B.M.
Scale
Inches
Feet
PLAN
VERTICAL LONGITUDINAL SECTION
Old Working Pit
Old Pit Floor
Company Trench
Old Trench
Spring Cr.
Assume El. 100.00
ST-1
ST-2
ST-3
ST-4
ST-5
ST-6
ST-7
ST-8
ST-9
ST-10
ST-11
ST-12
ST-13
ST-14
ST-15
ST-16
ST-17
ST-18
ST-19
ST-20
N

Residual Ore Zone Samples

Lab.*	Sample	Location	Thickness Ft.	% Net Mn.	Notes
1015	1	Nelson Cut	5.25	32.72	Sharply folded mineralized zone
1016	2	Center "	3.50	31.10	
1020	3	80 W of *1	5.00	13.17	Op. cut side & face
1081		" *12	3.50	12.15	" " N
1023		Open Cut *14	5.15	10.15	
1080		Lure weaver	5.50	36.61	End of S.W. drift

Taking into consideration dilution of replacement ore, Outcrop may be considered to range from 4.21 to 7.87 ft.

Samples No. 6 Tunnel

1082	1	280 in ops. N.E. drift	6.00	5.43	Crushed zone mineralized over larger zone than sampled
1078	2	20 West of *1	3.50	12.47	

Samples South Tunnel

956	1	Sp. *1 S.T.O.C.		48.13	6 Ft. South Side
957	2	" *2 " "		6.40	6 Ft. "
958	3	" *3 " "		20.66	6 Ft. North "
960	1	ST Upraise to Open Cut Sp. *1 & T.		41.33	6 Ft. South Tunnel S 8.10° E. D. 55° E.
961	2	Lower South Tunnel Sp. *2 & T.		47.07	5.16 Ft.
959	3	Between O.C. & Upraise Sp. *3 & T.		35.31	6.5 Ft.

North From Tunnel Entrance Number 6

Lab.*	Sample	Section	Distance	Stratigraphic Thickness	% Net Mn.	Notes
1041	1	A-B	0	4.14	23.76	
1008	2	A-B	10-20	7.00	3.52	At 10 Ft. very iron ore
1020	3	A-B	10-20	7.00	2.87	Bet 10-20
1055	4	A-B	40-50	14.00	3.80	
964	5	A-B	50-60	7.50	19.43	
1045	1	B-C	60-70	6.00	30.45	
965	2	B-C	70-80	6.00	29.65	
1033	3	B-C	80-90	5.50	24.36	
980	4	B-C	90-100	10.75	35.39	
1012	5	B-C	100-110	7.50	26.42	
1061	6	B-C	110-120	7.60	18.48	
1010	7	B-C	120-130	7.75	26.75	
961	1	C-D	130-140	7.50	9.61	
991	2	C-D	140-150	7.00	27.55	
1014	1	D-E	150-160	6.00	5.83	Lean ore zone
1034	1	E-F	160-170	6.00	5.74	" " "
1035	2	E-F	170-180	6.00	5.67	" " "
982	3	E-F	180-190	6.00	3.93	" " "
967	4	E-F	190-200	4.00	19.56	Streaks of ore
1054	5	E-F	200-210	6.00	35.80	
1011	1	F-G	210-220	6.00	16.57	Pronounced enrichment
1049	2	F-G	220-230	6.00	32.08	Good ore
979	3	F-G	230-240	6.00	20.66	Medium-good
1046	4	F-G	240-250	6.00	36.13	Excellent

No samples taken North east of *4-F-G, because horizon beyond there is sparsely replaced and is lean as in samples *1 and *2 A-B.

South From Tunnel Entrance Number 6

Lab.*	Sample	Section	Distance	Stratigraphic Thickness	% Net Mn.	Notes
1051		A-B'	0-10	6.00	5.60	Lean
1000	2	A-B'	10-20	9.00	30.42	Good ore in winze
1008	2 & B	A-B'	10-20	7.00	3.52	Includes 7 Ft. Fe. zone above Mn.
1020	2 & special	A-B'	10-20	7.00	2.87	Fe. zone
962	3	A-B'	20-30	10.00	35.76	
966	4	A-B'	30-40	8.00	25.19	
997	5	A-B'	40-50	9.00	16.07	Including portion of Fe. zone
984	6	A-B'	50-60	10.00	16.07	
1001	1	B'-C'	60-70	6.50	48.91	
963	2	B'-C'	70-80	6.00	29.64	
1003	3	B'-C'	80-90	7.00	26.05	
996	4	B'-C'	90-100	6.50	3.71	
1013	1	C'-D'	100-110	12.00	41.41	
1048	2	C'-D'	110-120	10.00	31.75	
1057	3	C'-D'	120-130	7.00	38.33	
992	4	C'-D'	130-140	4.00	47.50	
1043	5	C'-D'	140-150	7.00	7.38	Thin streaks to barren of ore
1040	6	C'-D'	150-160	7.00	4.50	Lean zone
1064	7	C'-D'	160-170	7.00	2.92	" "
998	1	D'-E'	170-180	7.00	5.25	" "
1018	2	D'-E'	180-190	7.00	3.67	" "
985	3	D'-E'	190-200	7.00	35.87	
1042	4	D'-E'	200-210	8.00	23.70	
986	5	D'-E'	210-220	8.00	5.51	

South From Tunnel Entrance No. 6 (Continued)

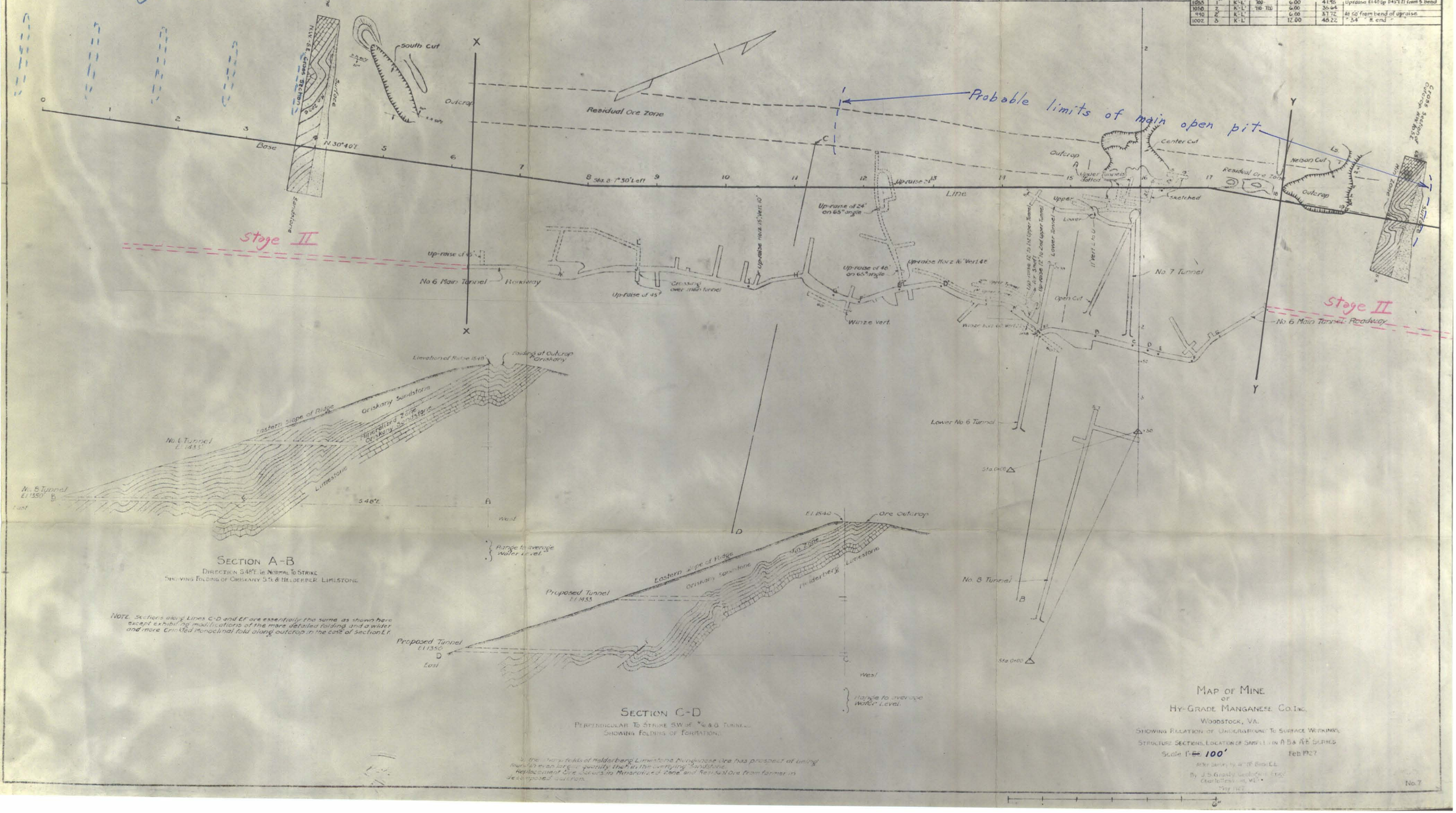
Lab.*	Sample	Section	Distance	Stratigraphic Thickness	% Net Mn.	Notes
964	1	E'-F'	220-230	12.00	36.67	Very good
987	2	E'-F'	230-240	12.00	26.09	
	3	E'-F'	240-250			Not taken
1017	4	E'-F'	250-260	8.00	41.41	Folded zone
995	5	E'-F'	260-270	10.00	29.62	" " Faulted
1051	6	E'-F'	270-280	10.00	28.02	" " "
1011	1	F'-G'	280-290	7.00	15.69	Ferruginous
1015	2	F'-G'	290-300	7.50	27.22	
988	3	F'-G'	300-310	7.00	50.00	above
1029	1	G'-H'	310-320	7.50	32.80	
1050	2	G'-H'	320-330	12.00	34.12	Folded. Crushed zone
1060	2-a	G'-H'	320-330	25.00	31.52	Winze and including 10'
969	3	G'-H'	330-340	18.00	34.60	stratigraphic thickness Fe. above
993	4	G'-H'	340-350	8.00	23.61	Faulted
1047	5	G'-H'	350-375	8.00	27.70	Folded zone
983	0.01	H'-I'	365-375	11.00	17.87	" "
1046	1	I'-J'	375-390	7.00	24.14	Probable full thickness not
1042	2	H'-I'	390-400	5.00	10.58	exposed
1012	3	H'-I'	400-410	6.00	31.18	Upraise sample
1019	4	H'-I'	410-420	5.50	35.42	
1006	5	H'-I'	420-430	5.00	26.24	Owing to general deformation further
1036	6	H'-I'	430-440	7.00	35.75	development may confirm expectation
1027	7	H'-I'	440-450	10.00	11.75	of wider mineralized zone.

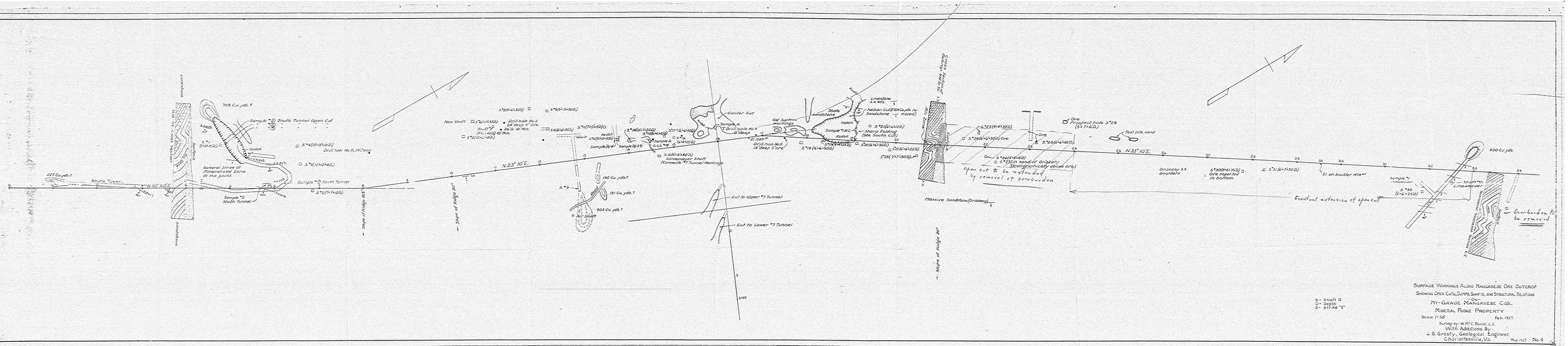
South From Tunnel Entrance No. 6 (Continued)

Lab.*	Sample	Section	Distance	Stratigraphic Thickness	% Net Mn.	Notes
972		I'-J'	450-470	14.00	26.24	0.50" Fe. above
1065	2	I'-J'	470-480	15.00	36.46	Lower portion very lean to barren
1067	3	I'-J'	480-490	7.50	21.87	
968	4	I'-J'	490-500	17.00	40.85	Upraise
1035	5	I'-J'	500-510	9.00	14.36	Marked D.L.
1046	6	I'-J'	510-520	10.00	15.85	Lean and in part barren
1001	7	I'-J'	520-530	9.00	36.75	
1044	8	I'-J'	530-540	8.00	11.50	Lean
1057	8.5	I'-J'	545-	8.50	44.05	5 N. 40° E. D. 35° S.E.
		I'-J'	550-575			Roadway diverges N from mineralized zone
986	9	I'-J'	575-590	7.50	34.35	Mineralized zone 16 East of roadway
		I'-J'	590-595			Not taken
999	10	I'-J'	595-600	7.00	18.02	Folded zone - faulted
1027A	11	J'-K'	600-	7.00	24.56	Upraise
1009	1	J'-K'	600-605	6.00	24.27	Squeezed zone
1005	2	J'-K'	605-610	5.00	34.19	Folded
1039	3	J'-K'	610-615	2.50	26.07	Squeezed
1030	4	J'-K'	615-620	4.00	20.55	"
1004	5	J'-K'	620-625	5.00	36.57	"
1014	6	J'-K'	625-630	2.00	20.91	
994	7	J'-K'	630-635	4.00	17.22	
971	8	J'-K'	635-640	4.50	28.04	
1016	9	J'-K'	640-700	5.00	6.99	
970	10	J'-K'	700-710	9.00	18.69	Upraise

South of *10 J-K 700-710 Ft. and following main roadway folding and faulting has by squeezing eliminated the ore from the working faces.

1055	1	K'-L'	700	6.00	41.65	Upraise El 40 Up 94.5° El from S. bend
1058	2	K'-L'	710-722	6.00	36.64	
990	2	K'-L'		6.00	37.72	At 50 from bend of upraise
1002	3	K'-L'		12.00	48.22	" 34 " N. end "




SURFACE WORKINGS ALONG MANGANESE ORE OUTCROP
SHOWING OPEN CUTS, DUMPS, SHAFTS, and STRUCTURAL RELATIONS
ON
MY-GRADE MANGANESE CO.
MINERAL RIDGE PROPERTY
Scale 1" = 50'
Feb. 1927
Survey by: W. M. C. Bond, C.E.
With Additions By:
J. S. Grosty, Geological Engineer,
Charlottesville, Va.
May 1927
No. 4
S = Shaft
D = Depth
S = Strike
N 23° 10' E.
N 35° 10' E.
South Tunnel
South Tunnel Open Cut
Sample #1 South Tunnel
Sample #2 South Tunnel
General Strike of Mineralized Zone at this point.
Drill hole No. 8, 39' Deep
Drill hole No. 6, 14' Deep
Drill hole No. 5, 14' Deep
Drill hole No. 4
Drill hole No. 2, 46' Deep
New Shaft
Shaft "F" (11'x 10') 40' Min.
Sanitarium Shaft (Kennedy "F" Tunnel Workings)
Air Shaft
Center Cut
Sample A
Old Surface Workings
Limestone
Shale
Sandstone
Natural Cut (2704 Cu. yds. removed)
Sharp Folding (see South C.S.)
Cut to Upper "F" Tunnel
Cut to Lower "F" Tunnel
Massive Sandstone (Quartzite)
Open cut to be extended by removal of overburden
Ore
Prospect hole S.29
Test pits, sand
Ore reported in bottom
Eventual extension of open cut
Sample Y
Shaft on Lineamover
Overburden to be removed
400 Cu. yds.
Slope of Ridge 20°
Slope of Ridge 15°
Sandstone
Limestone
Shale
Slate
Ridge line
Ridge line Course of Ridge
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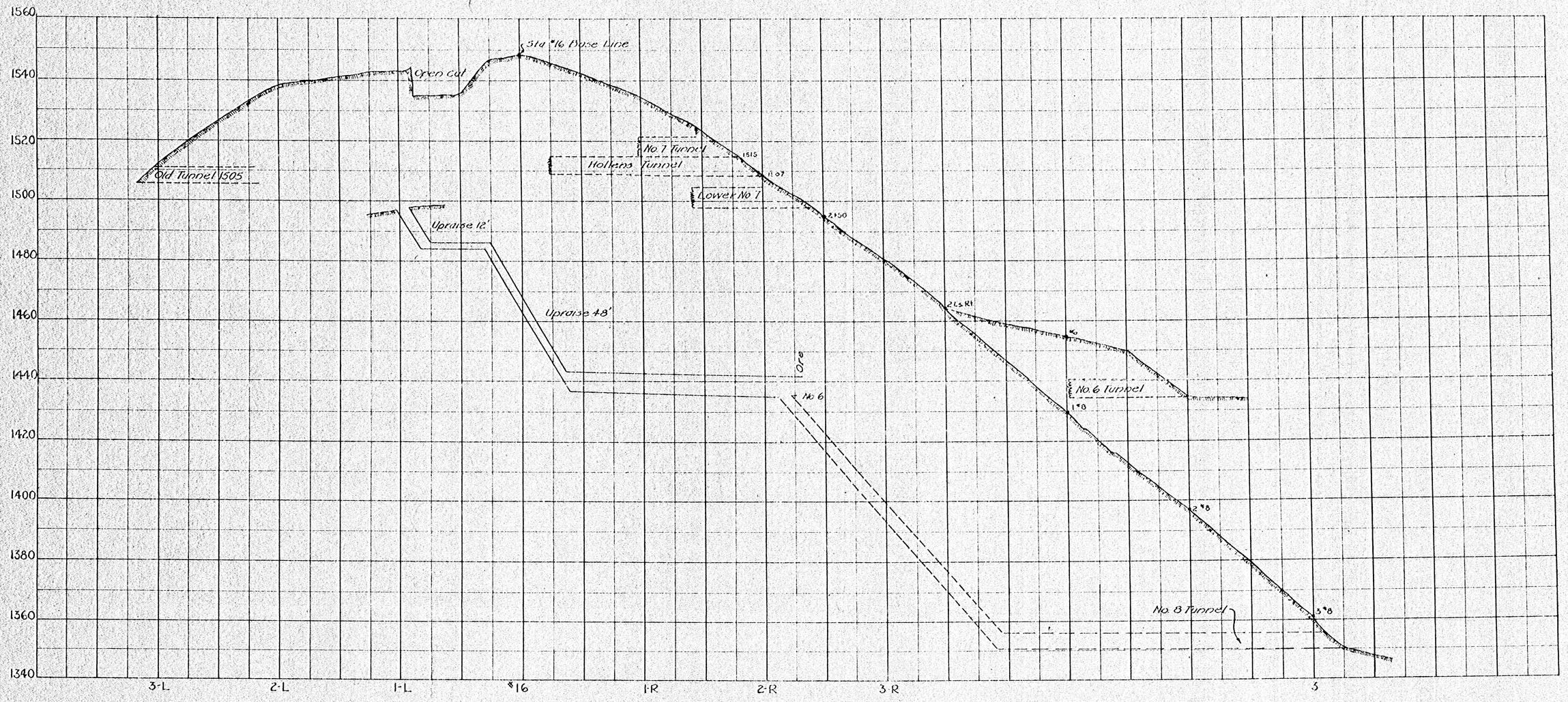


MINERAL RIDGE MINE OF
HY-GRADE MANGANESE CO. INC.
WOODSTOCK, VA.

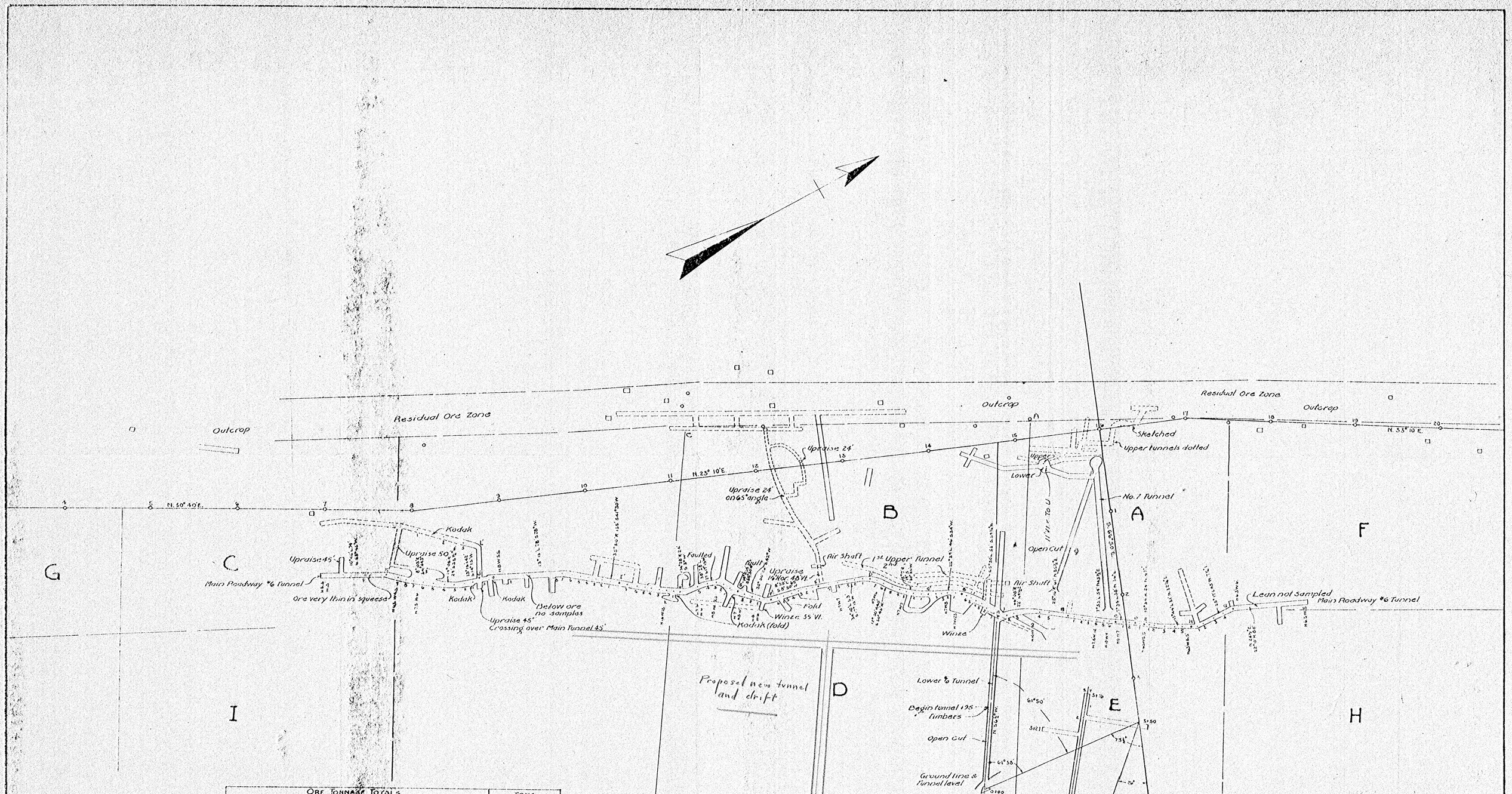
Scale Horz. 1" = 50'
Vert. 1" = 20'

Feb. 1927.

Survey by W. McC. Bond, C.E.
May 1927.

To accompany Report By J. S. Grady, Geological Engr. Charlottesville, Va.

No 8



ORE TONNAGE TOTALS	TONS	
POSITIVE ORE		
Area A From Outcrop to Main Roadway of #6	48,992	
" B " " " " "	120,198	
" C " " " " "	47,900	
Residual Outcrop Ore	82,500	299,590
Deduct 15,000 Tons of Ore reported mined and shipped	15,000	15,000
Probable additional Positive Ore which can be added as follows:		284,590
Residual Outcrop Ore (a)	32,500	
Mine Dumps - Run of Mine Quality (b)	5,000	
		322,090
POSITIVE TO PROBABLE ORE		
Immediately below Area A and in Area E between #6 & #8 Tunnel levels	24,167	
" adjoining C " G i.e. from Outcrop to #6 Tunnel level	64,350	
" below Area B and in Area D between #6 and #8 Tunnel levels	77,632	166,149
PROBABLE ORE		
Area F which adjoins Area A on North end and distances from 117 to 535+ on ridge survey - from Outcrop to #6 Tunnel level (circ)		
Ore Tonnage Range 314,520 to 228,000 Tons	228,000	228,000
PROBABLE TO POSSIBLE ORE		
Area I below both Areas C and G and from #6 Tunnel level to #8 Tunnel level (circ)	56,650	
Area H below area F strike distance 1,000± from #6 to #8 Tunnel levels		
Ore Tonnage Range 125,200 to 174,850 Tons	125,200	174,850
POSSIBLE ORE		
From #8 Tunnel to approximate water level		
Below Area E	25,407	
" " D	69,348	
" " I	61,050	
" " H	130,240	286,045
ORE TOTALS		
Positive Ore (after deducting 15,000 tons)	284,590	
Probable additional Positive Ore	57,500	
Positive to Probable	166,149	
Probable	228,000	
" to Possible	174,850	
Possible	286,045	
GRAND TOTAL		1,182,154

MAP OF MINE
OF
HY-GRADE MANGANESE CO. INC.
WOODSTOCK, VA.

SHOWING HEIGHTS & WIDTHS OF MAIN WORKINGS & LOCATION OF SAMPLES & ORE CLASSIFICATION AREAS A, B, C, D, E, F, G, H, I OF MINERAL RIDGE MINE

Scale 1" = 50' May 1927

After Survey by Wm. McBond, C.E.

To Accompany Report by J.S. Grosty, Ph.Sc.D., Geological Engineer, Charlottesville, Va.

No. 6

Residual Ore Zone Samples

Lab.*	Sample	Location	Thickness Ft.	% Net Mn.	Notes
1073	1	Nelson Cut	5.75	32.72	Sharply folded mineralized zone
1016	2	Center "	3.50	31.10	
1011		Shaft *12	4.00	17.17	Op-cut side S. face
1061		" "	3.50	12.15	" " N. "
1073		Open Cut *14	8.75	10.15	
1080		Lure weaver	5.85	34.61	End of S.W. drift

Taking into consideration dilution of replacement ore, Outcrop may be considered to range from 4 ft. to 7 ft.+.

Samples No. 8 Tunnel

1082	1	260 in opp. N.E. drift	6.00	5.43	Crushed zone mineralized over larger zone than sampled.
1078	2	20 West of *1	3.50	12.47	

Samples South Tunnel

956	1	Sp. *1 S.T.O.C.		48.13	6 ft. South Side
957	2	" *2 "		6.40	6 ft. " "
958	3	" *3 "		20.66	6 ft. North "
960	1	ST. Upraise to Open Cut	Sp. *1 S.T.	41.33	6 ft. South Tunnel S.20°E. D.55°E.
961	2	Lower South Tunnel	Sp. *2 S.T.	47.07	5.75 ft.
963	3	Between O.C. & Upraise	Sp. *3 S.T.	35.31	6.5 ft.

North From Tunnel Entrance Number 6

Lab.*	Sample	Section	Distance	Stratigraphic Thickness	% Net Mn.	Notes
1041	1	A-B	4-10		2.76	
1008	2	A-B	10-20	7.00	3.52	At 10 ft. very iron ore
1020	3	A-B	10-20	7.00	2.87	Bet. 10-20
1025	4	A-B	40-50	14.00	31.50	
964	5	A-B	50-60	7.50	19.43	
1045	1	B-C	60-70	6.00	50.45	
965	2	B-C	70-80	6.00	24.63	
1035	3	B-C	80-90	5.50	29.35	
980	4	B-C	90-100	10.75	35.36	
1012	5	B-C	100-110	7.50	22.42	
1061	6	B-C	110-120	7.50	12.49	
1059	7	B-C	120-130	7.75	24.73	
981	1	C-D	130-140	7.50	9.81	
991	2	C-D	140-150	7.00	27.55	
1059	1	D-E	150-160	6.00	5.83	Lean ore zone
1054	1	E-F	160-170	6.00	5.74	
1052	2	E-F	170-180	6.00	5.87	" "
982	3	E-F	180-190	6.00	3.93	" "
967	4	E-F	190-200	4.50	19.58	Streaks of ore
1054	5	E-F	200-210	6.00	55.86	
1011	1	F-G	210-220	6.00	36.87	Pronounced enrichment
1049	2	F-G	220-230	6.00	32.68	Good ore
979	3	F-G	230-240	6.00	20.66	Medium-good
1046	4	F-G	240-250	6.00	36.93	Excellent

*No samples taken North east of *4-F-G, because hor. con. beyond, there is sparsely replaced and is lean as in samples *1 and *2 A-B.*

South From Tunnel Entrance Number 6

Lab.*	Sample	Section	Distance	Stratigraphic Thickness	% Net Mn.	Notes
1031	1	A-B	0-10	6.00	5.60	Lean
1000	2	A-B	10-20	9.00	30.92	Good ore in winze
1008	2 & A'B'	A-B	10-20	7.00	3.52	Includes 7 ft. Fe. zone above Mn.
1020	*28 Special	A-B	10-20	7.00	2.87	Fe. zone
962	3	A-B	20-30	10.00	25.06	
966	4	A-B	30-40	8.00	25.19	
997	5	A-B	40-50	9.00	16.07	Including portion of Fe. zone
984	6	A-B	50-60	10.00	16.07	
1001	1	B-C	60-70	6.50	45.97	
963	2	B-C	70-80	6.00	29.84	
1005	3	B-C	80-90	7.00	26.75	
986	4	B-C	90-100	6.50	37.77	
1015	1	C-D	100-110	12.00	41.41	
1048	2	C-D	110-120	10.00	31.75	
1051	3	C-D	120-130	7.00	38.33	
992	4	C-D	130-140	4.00	47.50	
1043	5	C-D	140-150	7.00	7.38	Thin streaks to barren of ore
1040	6	C-D	150-160	7.00	4.50	Lean zone
1044	7	C-D	160-170	7.00	2.92	" "
998	1	D-E	170-180	7.00	8.25	" "
1018	2	D-E	180-190	7.00	3.67	" "
985	3	D-E	190-200	7.00	35.07	
1042	4	D-E	200-210	8.00	23.70	
995	5	D-E	210-220	8.00	5.57	

South From Tunnel Entrance No. 6 (Continued)

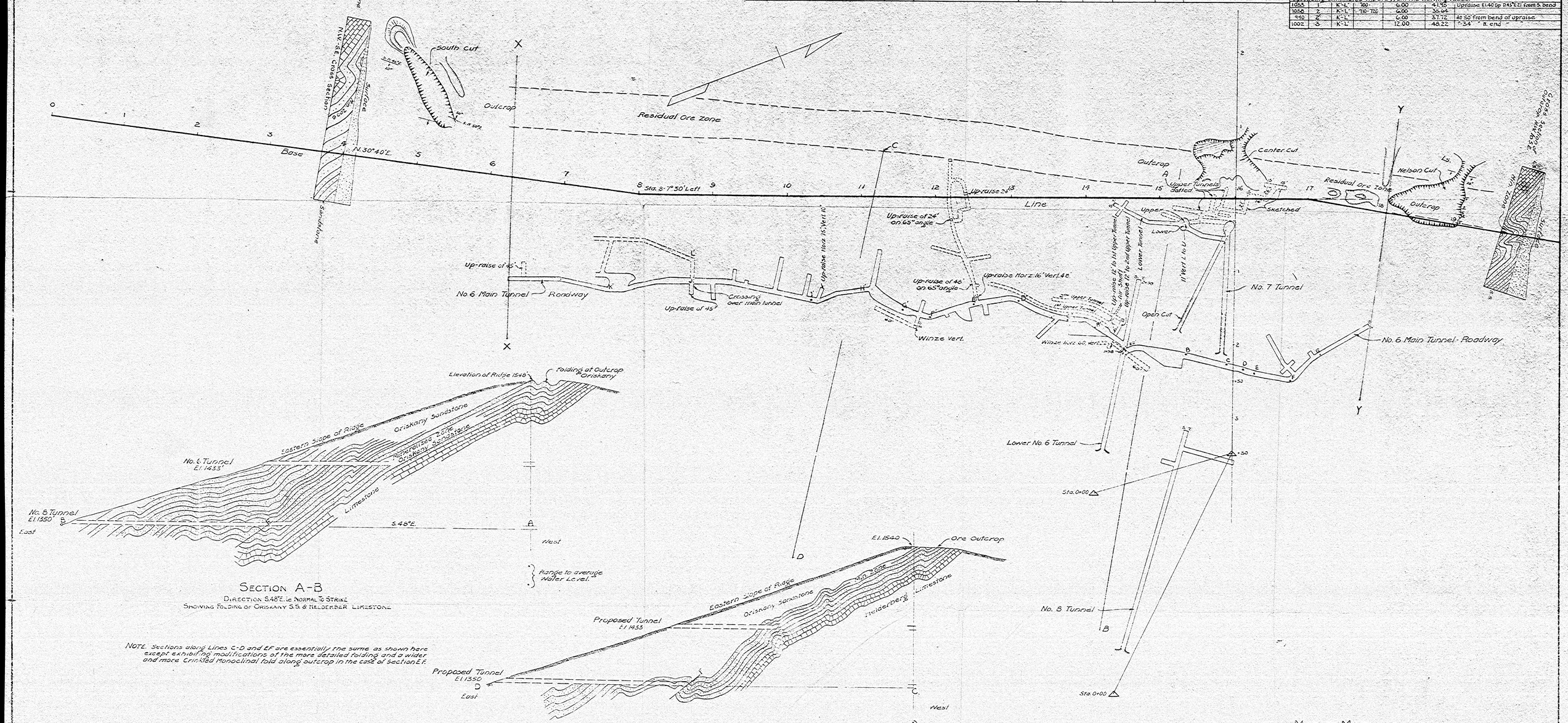
Lab.*	Sample	Section	Distance	Stratigraphic Thickness	% Net Mn.	Notes
986	1	E-F	220-230	12.00	35.67	Very good
987	2	E-F	230-240	12.00	25.09	" "
	3	E-F	240-250			Not taken
1017	4	E-F	250-260	8.00	41.41	Folded zone
995	5	E-F	260-270	10.00	29.62	" - Faulted
1051	6	E-F	270-280	10.00	28.02	" "
1011	1	F-G	280-290	7.00	13.69	Ferruginous
1015	2	F-G	290-300	7.50	27.22	" "
988	3	F-G	300-310	7.00	50.00	" above
1023	1	G-H	310-320	7.50	32.80	
1050	2	G-H	320-330	12.00	36.12	Folded - Crushed Zone
1060	2a	G-H	320-330	25.00	31.32	Winze and including 10'
969	3	G-H	330-340	10.00	34.60	Stratigraphic thickness Fe. above
993	4	G-H	340-350	9.00	23.61	Faulted
1047	5	G-H	350-355	8.00	27.70	Folded zone
983	O (5)	H-I	355-375	11.00	17.87	" "
1066	1	H-I	375-390	7.00	24.14	Probable full thickness not
1062	2	H-I	390-400	5.00	18.58	exposed.
1052	3	H-I	400-410	6.00	31.16	Upraise sample
1019	4	H-I	410-420	5.50	36.42	" "
1006	5	H-I	420-430	5.00	26.24	Owing to general deformation further
1036	6	H-I	430-440	7.00	35.75	Development may confirm expectation
1027	7	H-I	440-450	10.00	11.75	of wider mineralized zone.

South From Tunnel Entrance No. 6 (Continued)

Lab.*	Sample	Section	Distance	Stratigraphic Thickness	% Net Mn.	Notes
972	1	I-J	450-470	14.00	26.24	D. 50° Fe. above
1063	2	I-J	470-480	15.00	30.94	Lower portion very lean to barren
1047	3	I-J	480-490	9.50	21.87	" " " " " "
968	4	I-J	490-500	17.00	40.83	Upraise
1035	5	I-J	500-510	9.00	14.36	Marked OL
1045	6	I-J	510-520	10.00	15.85	Lean and in part barren
1001	7	I-J	520-530	9.00	36.75	
1044	8	I-J	530-540	8.00	11.50	Lean
1037	8.5	I-J	540-	8.50	44.03	S. N. 40° E. D. 35° S.E.
		I-J	550-570			Roadway diverges W from mineralized zone
980	9	I-J	570-580	7.50	34.73	Thin streaks zone 14' east of roadway
		I-J	580-590			Not taken
999	10	I-J	590-600	7.00	18.02	Folded zone - faulted
1028	11	I-J	610-	7.00	24.52	Upraise
1009	1	J-K	610-620	5.00	24.27	Squeezed zone
1005	2	J-K	620-630	5.00	34.19	Folded
1039	3	J-K	630-640	2.50	20.07	Squeezed
1030	4	J-K	640-650	4.00	20.33	"
1004	5	J-K	650-660	3.00	30.57	"
1014	6	J-K	660-670	2.00	20.41	"
994	7	J-K	670-680	4.00	19.22	"
971	8	J-K	680-690	4.50	28.04	"
1016	9	J-K	690-700	5.00	6.99	"
970	10	J-K	700-710	6.00	18.69	Upraise

*South of *10 J-K 700-710 ft. and following main roadway folding and faulting has by squeezing eliminated the ore from the working faces.*

Lab.*	Sample	Section	Distance	Stratigraphic Thickness	% Net Mn.	Notes
1055	1	K-L	700-	6.00	41.95	Upraise El. 40 Up 245° El. from S. bend
1050	2	K-L	710-720	6.00	35.64	
990	2'	K-L		6.00	37.72	At 50' from bend of upraise
1002	3	K-L		12.00	48.22	" 34 " N. end "



Section A-B

Direction S.48°E. ie Normal To Strike
Showing Folding of Oriskany S.S. & Helderberg Limestone

NOTE. Sections along Lines C-D and E-F are essentially the same as shown here except exhibiting modifications of the more detailed folding and a wider and more Crinkled Monoclinal fold along outcrop in the case of section E-F.

Section C-D

Perpendicular To Strike S.W. of *6 & 8 Tunnels
Showing Folding of Formations

In the sharp folds of Helderberg Limestone Manganese Ore has prospect of being found in even larger quantity than in the overlying Sandstone.
Replacement Ore occurs in Mineralized Zone and Residual Ore from former in decomposed outcrop.

Map of Mine of Hy-Grade Manganese Co. Inc.

Woodstock, Va.

Showing Relation of Underground To Surface Workings, Structure Sections, Location of Samples in A-B & A'-B' Series

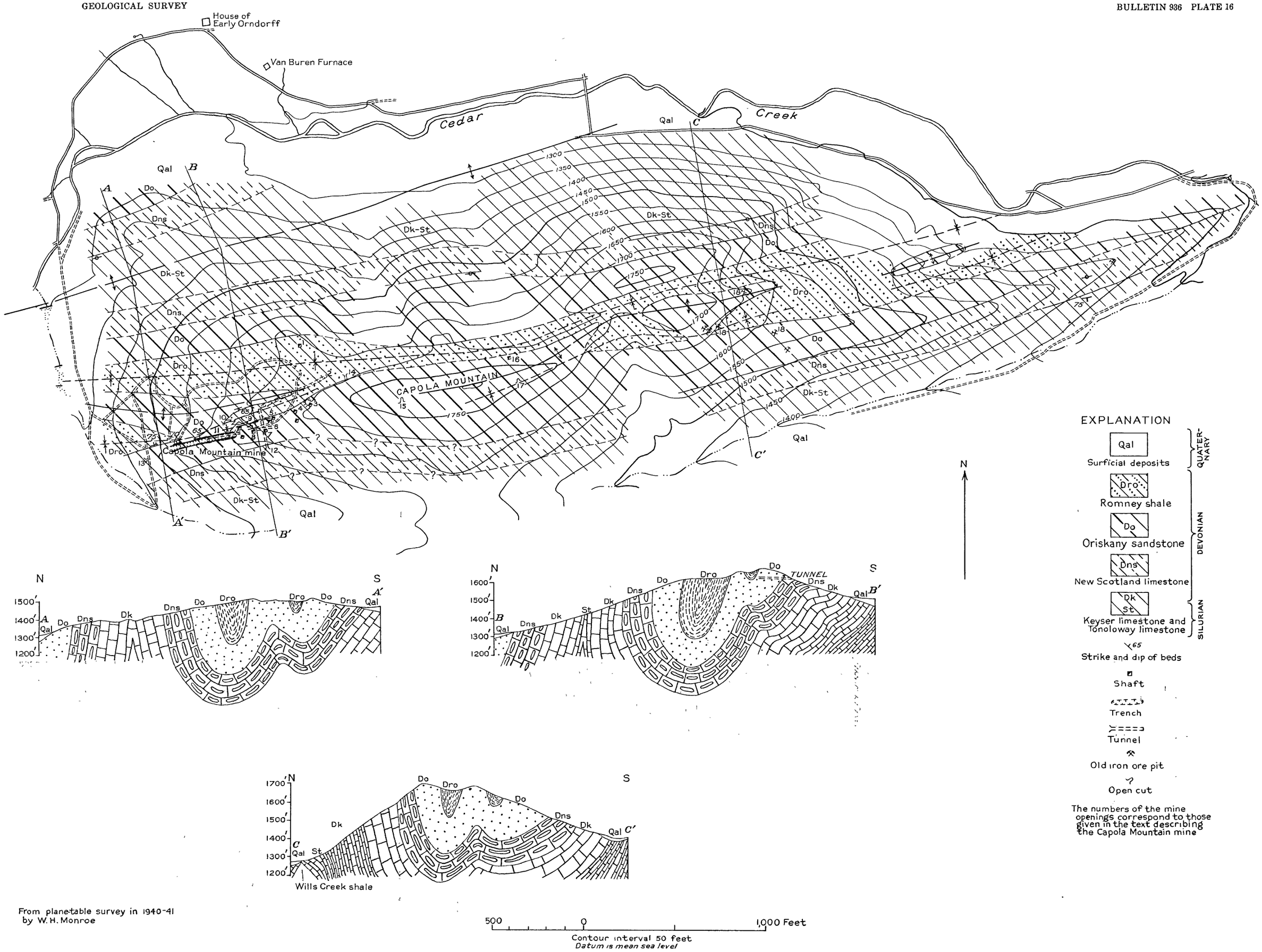
Scale 1" = 50' Feb. 1927

After Survey by W. M. Bass C.E.

By J. S. Grady, Geological Engr.
Charlottesville, Va.
May 1927

No. 7

Surface Workings Along Manganese Ore Outcrop
Showing Open Cuts, Dumps, Shafts, and Structural Relations
—On—
Hy-Grade Manganese Co's.
Mineral Ridge Property
Scale 1" = 50'   Feb. 1927.
Survey by - W. McC. Bood, C.E.
With Additions By
J. S. Grasty, Geological Engineer,
Charlottesville, Va.   May 1927   No. 4



From planetable survey in 1940-41 by W. H. Monroe

GEOLOGIC MAP AND SECTIONS OF CAPOLA MOUNTAIN, VA.

EXPLANATION

DEVONIAN

Drh / Drm / Dro — Romney shale
(Dark-greenish shale and sandstone of Hamilton age, Drh; *black shale of Marcellus age,* Drm; *dark greenish-brown shale of Onondaga age,* Dro*)*

Do — Oriskany sandstone
(Friable coarse sandstone and conglomerate; contains manganese ore in places)

Dns — New Scotland limestone
(Limestone containing abundant chert layers and a sandstone layer near base; contains manganese ore in places)

Dk — Keyser limestone
(Coarse-grained dark-gray limestone, knotty limestone, and shaly limestone, Dk*)*

St — Tonoloway limestone
(Laminated and shaly limestone, St*)*

SILURIAN

Sw / Sb / Sm / Sc — Wills Creek shale
(Yellow shale, red shale and sandstone, gray sandstone, and ripple-marked quartzite, Sw*)*

Bloomsburg redbeds
(Red mudstone and red sandstone, Sb*)*

McKenzie formation
(Yellow shale, Sm*)*

Clinton formation
(Coarse-grained, white, thick-bedded sandstone, Sc, *Keefer sandstone member)*

U / D 84° — Fault, showing dip
*(*U, *upthrow,* D, *downthrow)*

30 — Strike and dip of beds

24 — Strike and dip of overturned beds

Strike of vertical beds

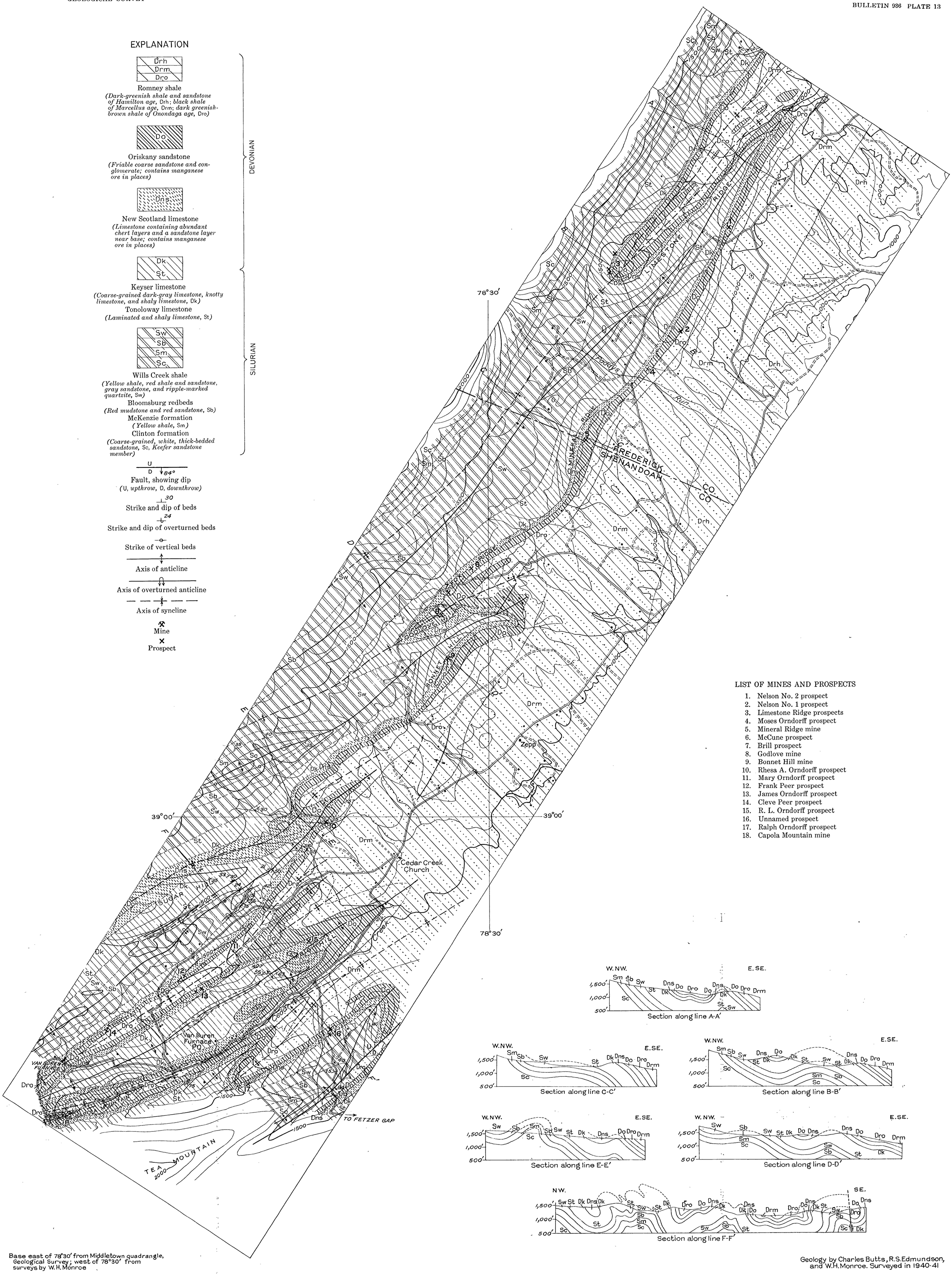
Axis of anticline

Axis of overturned anticline

Axis of syncline

Mine

Prospect



Base east of 78°30′ from Middletown quadrangle, Geological Survey; west of 78°30′ from surveys by W. H. Monroe

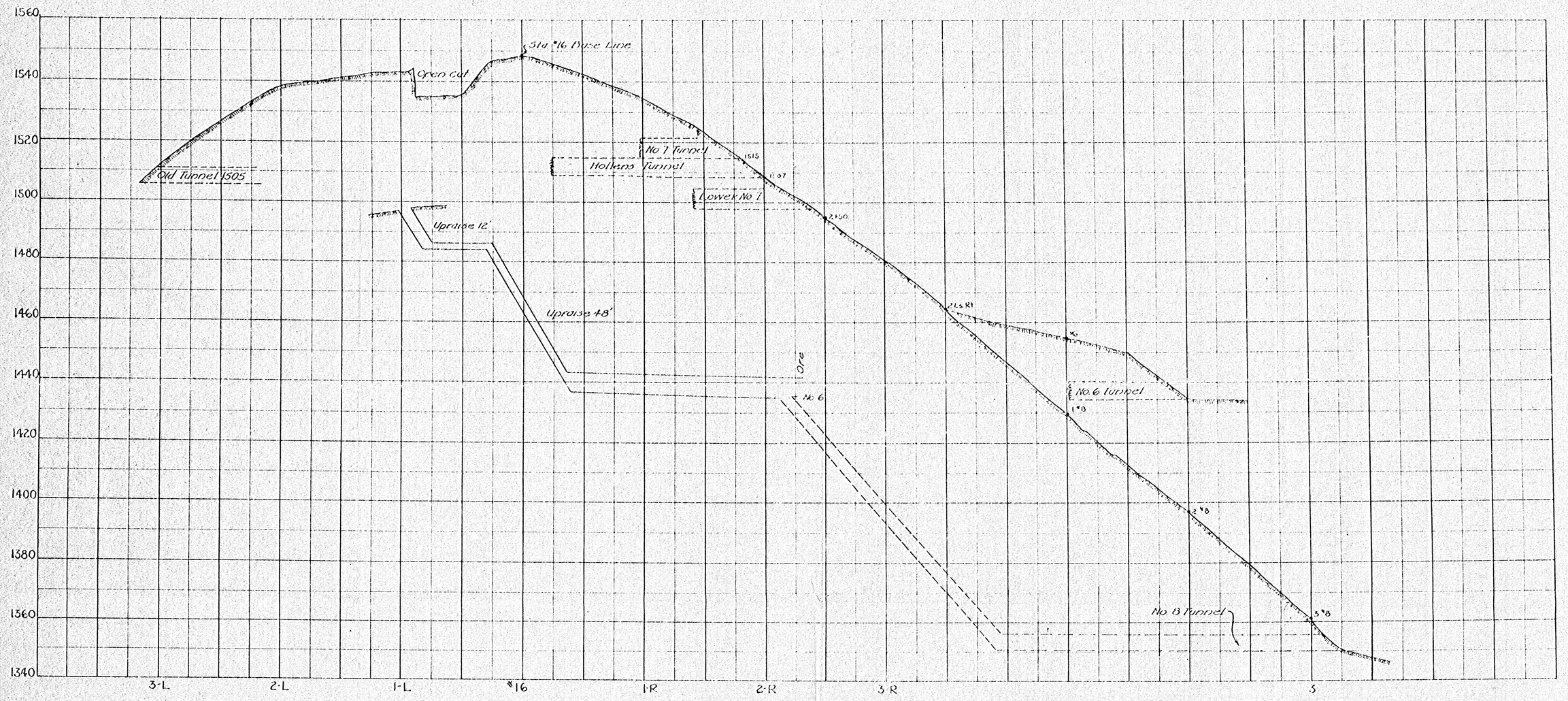
Geology by Charles Butts, R. S. Edmundson, and W. H. Monroe. Surveyed in 1940-41

GEOLOGIC MAP AND SECTIONS OF PART OF CEDAR CREEK VALLEY, VA., SHOWING LOCATION OF MANGANESE MINES AND PROSPECTS

Scale $\frac{1}{24,000}$

1,000 0 5,000 Feet

Contour interval 100 feet
Datum is mean sea level



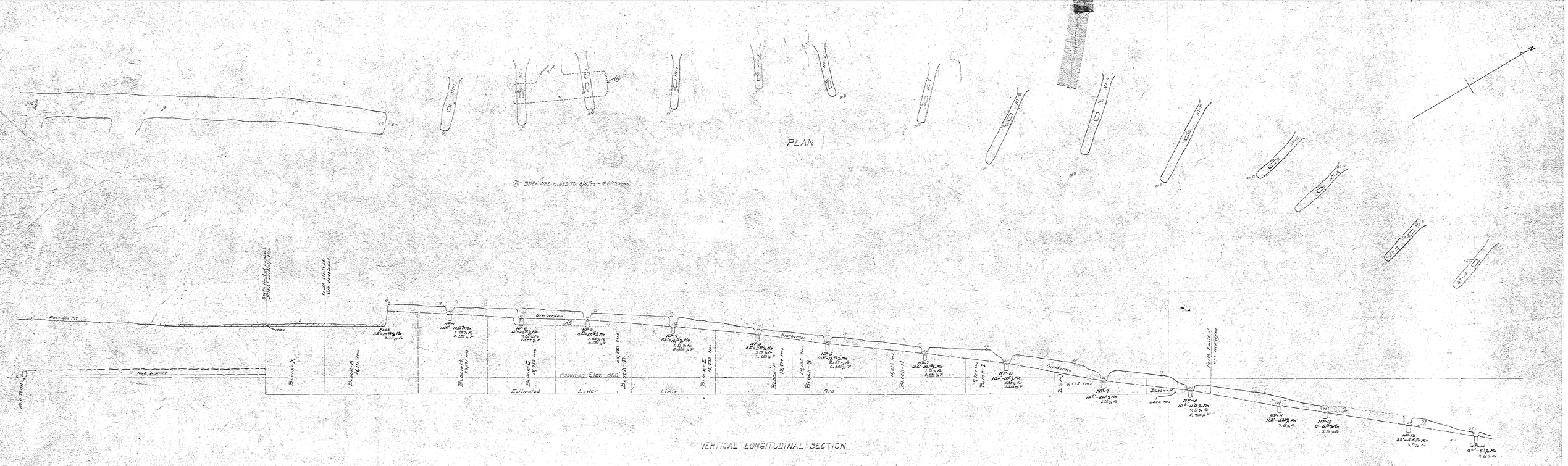
MINERAL RIDGE MINE OF
HY-GRADE MANGANESE CO. INC.
WOODSTOCK, VA.

Scale Horz. 1" = 50'
Vert. 1" = 20'

Feb. 1927.

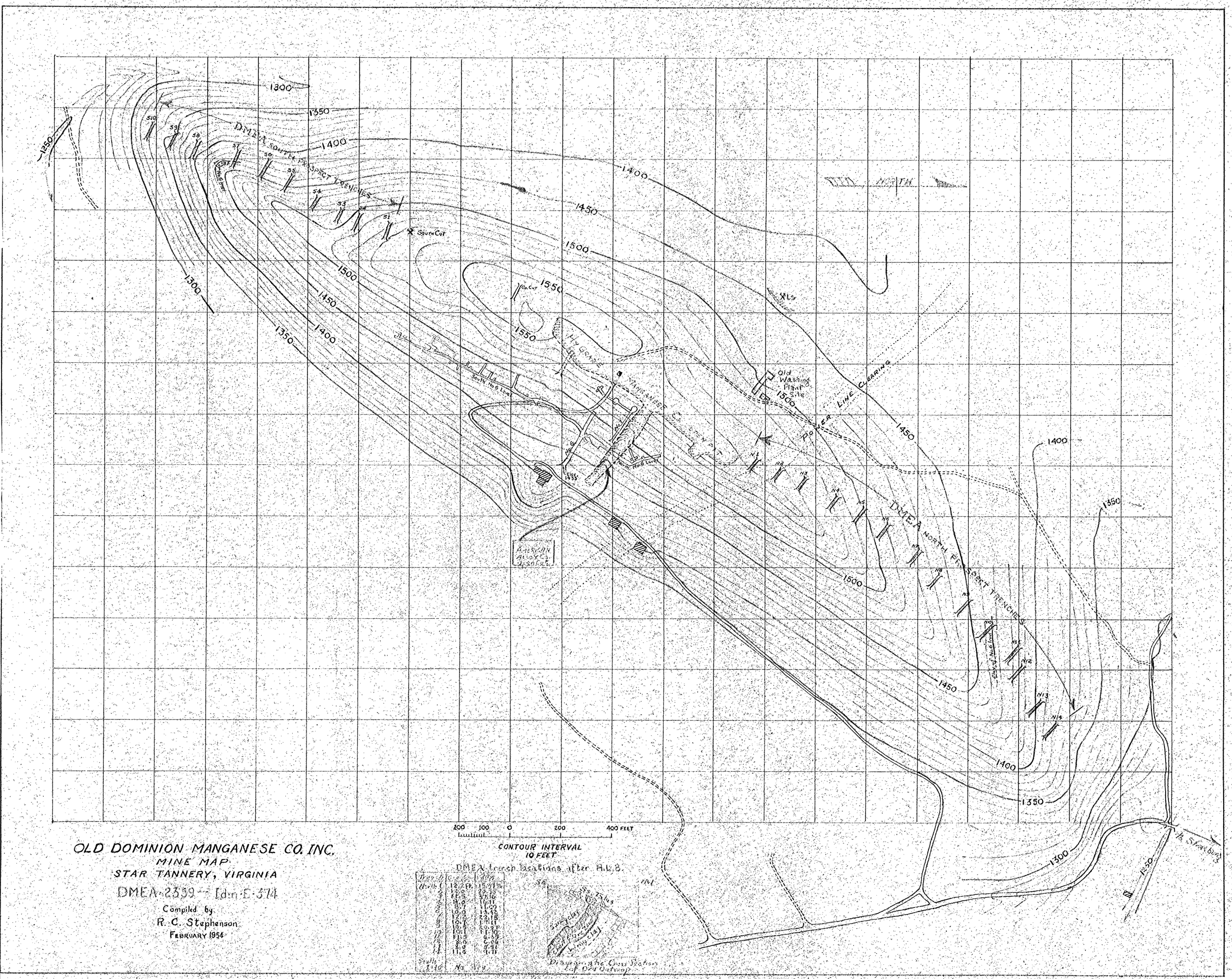
Survey by W. McC. Bond, C.E.
May 1927.

To accompany Report By J. S. Grasty, Geological Engr Charlottesville, Va. No 3



OLD DOMINION MANGANESE CO.
NORTH EXT. PLAN AND LONGITUDINAL SECTION
DMEA-2359 CONTRACT-Idm.E-374
USBM Aug. 1953
Inches 10 20 30 40
Feet

OLD DOMINION MANGANESE CO.
SOUTH EXT. PLAN and LONGITUDINAL SECTION
DMEA-2359
CONTRACT-Idm. E-374
USBM
Aug. 1953
Inches
0 1 2
10 20 30 40
Feet
PLAN
VERTICAL LONGITUDINAL SECTION
Old Working Pit
Company Trench
South Cut
N
ST-1
ST-2
ST-3
ST-4
ST-5
ST-6
ST-7
ST-8
ST-9
ST-10
Old Pit Floor
Co. Trench
North limit of southern DMEA participation block
No. 6 Level South
No. 6 Crosscut
Assumed Elev.-300'
ST-1 no ore
ST-2 no ore
SP-3 no ore
ST-4 no ore
ST-5 no ore
ST-6 no ore
ST-7 no ore
ST-8 no ore
ST-9 no ore
ST-10 no ore



OLD DOMINION MANGANESE CO. INC.

MINE MAP

STAR TANNERY, VIRGINIA

DMEA-2359 -- Id-n-E-374

Compiled by
R. C. Stephenson
FEBRUARY 1954