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A MANGANESE DEPOSIT OF PLEISTOCENE AGE IN BANNOCK COUNTY, IDAHO

BY

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By D. F. Hewett

FIELD WORK

Reports of the discovery and exploration of manganese deposits in southeastern Idaho within recent years having come to the Geological Survey, the writer took advantage of an opportunity to spend a day at the deposits in October, 1926. The examination was made in company with V. C. Heikes, of the Bureau of Mines. The local operators, especially Mr. George L. Smith, of the Idaho Manganese Co., courteously gave assistance during the visit.

SITUATION AND ACCESSIBILITY

The deposits thus far known in the region lie along the west slope of the ridge east of Bear River, about 1 mile southeast of Cleveland, Bannock County, Idaho. The principal deposit, operated by the Idaho Manganese Co., is in the E. ½ sec. 31, T. 11 S., R. 40 E., and others lie farther south in sec. 6, T. 12 S., R. 40 E. The ore that has been shipped thus far has been hauled in motor trucks either to Grace, 14 miles north, on a branch of the Oregon Short Line, or to Oxford, 20 miles west, on the main line of the Oregon Short Line running from Ogden to Pocatello. The cost of hauling to Grace is $3 a ton, and the freight rate from Grace to Ironton, Utah, where most of the ore has been sold, is $2 a ton. The area lies within the Preston quadrangle, which is covered by one of the topographic maps published by the United States Geological Survey.

HISTORY

According to the local operators, float manganese minerals were found in this region in April, 1922, by Sam Ames on the property of the Cleveland Mining Co., a part of the W. C. McGregor ranch. In April, 1924, explorations showed the presence of another deposit half a mile north, and this has since been explored almost continuously by the Idaho Manganese Co., of which Nathan Smith, of Cleveland, is president. Recent explorations south of the McGregor ranch have shown the presence of sporadic manganese minerals, but no ore has yet been shipped.

GENERAL GEOLOGY

Bear River rises east of the Wasatch Mountains in northeastern Utah, flows north into southwestern Wyoming, then northwest into southeastern Idaho, and finally south into Salt Lake in Utah. Along its course are several broad valleys separated by constricted valleys or canyons. Gentile Valley, in southeastern Idaho, is one of these broad valleys. At its south end is the settlement of Cleveland, near the point where Bear River, flowing south, enters a narrow canyon. Twelve miles south of Cleveland the canyon ends and the river enters Cache Valley, one of the large open valleys of northern Utah. East of Gentile and Cache Valleys lie the Wasatch Range and its minor ridges and spurs.

The geology of the region was studied in a reconnaissance manner as early as 1872,[1] and it is within the area of the geologic map prepared by Peale in 1877.[2] Briefly stated, Peale recognized that the higher mountains, such as the Wasatch Range, were made up of a thick section of Paleozoic and Mesozoic rocks that were greatly deformed and faulted in early Tertiary time, after which erosion and minor faulting produced ranges and ridges much as they appear to-day, except that the valleys were deeper and the mountains relatively higher. In late Tertiary time (Pliocene?) a few areas, several of which are exposed in upper Bear River Valley, received sand and gravel, in part of local origin and in part from remote sources. Similar beds, nearly horizontal, cover the divide between Gentile Valley and Cache Valley. During early Pleistocene time each valley contained a lake that received sediments from the bordering ridges to a maximum altitude of 5,800 feet. Terraces at lower levels were also noted—at 5,526 feet, 5,185 feet (Lake Bonneville stage), and 4,825 feet (Provo stage).[3] The terrace at 5,526 feet is well shown on both sides of the southern part of Gentile Valley, and the manganese deposits that are described herein occur in the horizontally bedded fine sand, 100 to 150 feet below this terrace.

In 1883 Gilbert made rather exhaustive physiographic studies of the Lake Bonneville basin, on the basis of which he threw doubt on the existence of a shore terrace at 5,800 feet, reported by Peale, and

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[1] Bradley, F. H., Report on the geology of the Snake River division: U. S. Geol. Survey Terr. Ann. Rept. for 1872, pt. 1, pp. 189–271, 1873.

[2] Peale, A. C., Report on the geology of the Green River district: U. S. Geol. Survey Terr. Ann. Rept. for 1877, pp. 509–646, 1879.

[3] Idem, pp. 601–604, 641–643.

concluded that although there are terraces existing in Gentile Valley above 5,200 feet they were formed by rivers instead of lakes.[4]

Although the writer's visit in this region was brief and necessarily devoted largely to an examination of the manganese deposits, it yielded observations which indicate that the ridges on both sides of Gentile Valley are covered with a veneer of horizontally bedded fine sediment up to a uniform altitude of about 5,500 feet and that this was deposited along the borders of a lake that was in existence in early Pleistocene time, before Lake Bonneville, farther south, stood at an altitude of 5,200 feet.

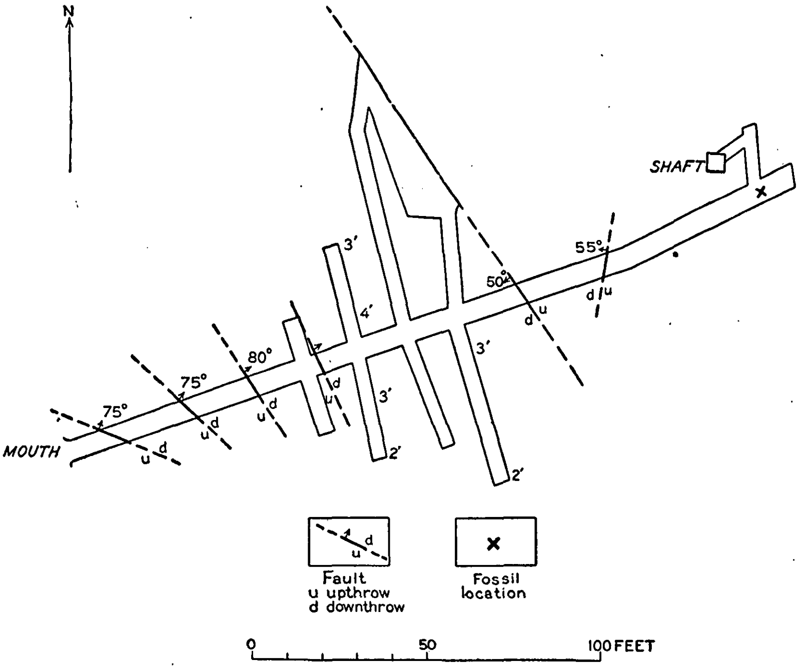

FIGURE 12.—Sketch map of principal workings of Idaho Manganese Co., Cleveland, Idaho. Figures along workings represent thickness of bed in feet

THE MANGANESE DEPOSITS

Workings.—The workings on the tract of the Idaho Manganese Co. include three tunnels—the highest, 75 feet long, at an altitude of about 5,440 feet; the intermediate, 75 feet long, at an altitude of about 5,432 feet; and the lowest, 225 feet long, at an altitude of 5,375 feet. (See fig. 12.) These tunnels explore the beds that underlie the terrace, the top of which ranges locally from 5,475 to 5,500 feet. The floor of Bear River valley near by lies at an altitude of about 4,900 feet. On the property of the Cleveland Manganese Co., half

[4] Gilbert, G. K., Lake Bonneville: U. S. Geol. Survey Mon. 1, pp. 94–96, 1890.

a mile to the south, there is a tunnel 90 feet long at an altitude of 5,250 feet.

The highest tunnel of the Idaho Manganese Co. explores a poorly defined zone of impure, earthy brown wad, 2 to 3 feet thick, which overlies thinly laminated fine sands. Unlike the zone explored in the lowest tunnel, it contains no nodules of hard pure oxides of manganese. The zone is of doubtful value as a source of manganese and is interesting largely because it shows the presence of more than a single manganiferous zone.

The intermediate tunnel extends 20 feet to the top of a shaft, and a drift 75 feet long to the northwest explores an irregular zone of soft wad in which there are sporadic hard nodules of manganese oxides. With the upper part of the shaft, these workings have yielded about 85 tons of ore.

The lowest tunnel (fig. 12) follows a nearly horizontal zone of earthy wad and hard manganese oxides to the point, 140 feet from the entrance, where it is cut off by a northwestward-trending fault. The tunnel continues 80 feet farther to the bottom of the shaft, but an irregular drift 22 feet above the tunnel explores what appears to be the same manganese zone beyond the fault. The indicated vertical displacement of the fault is therefore 22 feet. The workings shown in Figure 12 have yielded by sorting 13 cars or about 500 tons of ore that ranged in manganese content from 37.7 to 47.3 per cent. West of the 22-foot fault mentioned above are four minor faults, which trend northwest but dip steeply northeast and along each of which the manganese-bearing zone on the northeast side is dropped from 1 to 4 feet. The central block, bounded on the northeast by the 22-foot fault, appears to be a wedge that has dropped with reference to the adjacent blocks. Water stands at the face of this tunnel and in several of the drifts south.

A letter from George L. Smith, dated May 4, 1927, states that since October, 1926, the drift 22 feet above the lowest tunnel has been driven 105 feet east and from it 150 feet of crosscuts have been run.

The sediments.—The materials exposed in these workings include sand, sandy clay, sandy marl, and manganese oxides. In part they are thinly laminated, but generally the materials occur in layers 1 to 4 feet thick, not sharply separable. The colors commonly range from pale gray to greenish gray, but some beds are buff, chocolate-brown, or black. The presence of volcanic ash was suspected, but samples proved to lack characteristic features of ash, and it is probably absent. The most abundant material is pale greenish-gray sandy clay, showing faint traces of lamination. A fragment was disintegrated in water and washed free from clay. The remainder, about half the original specimen, was examined under the microscope. The largest grains were well-rounded quartz 0.10 millimeter in diameter, but most of the grains range from 0.02 to 0.07 millimeter. Of these, about 80 per cent were subangular quartz and the remainder were angular orthoclase and microcline. Glass and biotite were absent. A fragment of the coarsest material slightly stained by wad was similarly examined. The largest grains were well-rounded quartz 0.15 millimeter in diameter, but most of them ranged from 0.05 to 0.10 millimeter. Of these about 90 per cent were angular quartz and the rest were orthoclase and microcline. Sandy marl is present but not abundant.

Manganese minerals.—The manganese-bearing layers are brown wad with admixed brownish sand, in which are scattered hard, cavernous nodules of mixed psilomelane and pyrolusite, some as much as 2 feet in diameter. Some zones contain brown wad only, but the zone explored in the lowest tunnel contains more nodules than wad. The nodules are not the simple smooth rounded forms that are characteristic of manganese deposits in the eastern United States but are irregular in outline and highly cavernous. There is no simple relation between the distribution of psilomelane and that of pyrolusite. Iron oxides are inconspicuous or absent (see analysis, p. 218), but a pit near the mouth of the lowest tunnel showed a local bed in which the lumps contained 10 to 20 per cent of iron. Some of the rather pure black nodules show thin films of calcite along shrinkage cracks. In the light of what is known of manganese nodules elsewhere, it seems clear that the hard cavernous nodules have grown where they are now found in the layers of brown wad, which was doubtless deposited as a sediment. The hard nodules have grown only in the purest layers of wad, however, so that impure layers are now found just as they were laid down. The cause of their deposition is obscure; they may be chemical precipitates in shallow water or may have been deposited by microorganisms.

The principal ore zone ranges from 1 to 4 feet in thickness in the existing workings. It trends northeast and dips southeast at a low angle, probably at no place more than 5°.

An examination of the surface of the ridge east of the mine shows that the loosely consolidated sand and clay are limited eastward by an irregular surface cut across beds of hard limestone and quartzite, which have a complicated structure. No fossils were found in these beds, but it seems clear from what is known of the geology of the region that the beds belong to Paleozoic formations.

Fossils in the sediments.—In the course of the exploration of the deposit the owners found three well-preserved teeth and some fragments at the point marked near the end of the lowest tunnel, 100 feet below the surface. Through their courtesy the teeth were sent to the United States National Museum, where they have been examined by J. W. Gidley. His report follows:

The three larger specimens are parts of molars or grinding teeth of an extinct species of mammoth, known as *Elephas colombi*. The two smaller pieces are parts of a mastodon tooth. Both of these mammals were very numerous in North America during parts of the Pleistocene.

The presence of these teeth shows that the beds in which the manganese oxides are found were deposited during the Pleistocene epoch.

The workings of the Cleveland Mining Co. appear not to have yet found a persistent zone of manganese minerals. One and one-half carloads of material of good grade have been shipped from workings largely within a few feet of the surface, at a horizon lower than that explored by the workings of the Idaho Manganese Co. The material contains more iron than that mined by the Idaho company.

Genesis of the deposits.—The data gathered during this examination indicate that the deposits of brown wad were laid down in a body of water present in the region during the Pleistocene epoch and were immediately covered with sandy clay and fine sand. There can be no doubt that if explored inward from the outcrop they will be found to terminate at or near the place where the recent sediments meet the surface of older hard rocks that form the near-by ridges. Here, as in many other localities, the hard nodules of pure manganese oxides appear to have grown by accretion from manganese in solution since the wad was laid down. It is interesting to speculate whether the manganese was disseminated or locally concentrated in the Paleozoic rocks, and whether the body of water in which the sediments were laid down was relatively permanent, such as a lake, or intermittent, such as a stream, as indicated by Gilbert.

The uniform fineness of the sediments that overlie and underlie the manganese beds, considered with their locally laminated character, indicates that the body of water was relatively permanent and quiet. Consistent with this interpretation is the even height of the terrace that marks the top of the loosely consolidated sediments. In the south end of Gentile Valley the top of the terrace stands uniformly about 5,500 feet above sea level, and the topographic map shows that it extends northward on both sides of the valley for 15 miles or more at this altitude. The conclusion seems justified that in early Pleistocene time Gentile Valley was occupied by a lake, the surface of which remained constant at about 5,500 feet long enough to allow considerable sediment to accumulate along the borders of the lake if not over its entire bed. Probably the hard-rock lip at the south end of the basin stood at 5,500 feet, and the Pleistocene beds have only been dissected to their present form with its erosion. It seems entirely possible that this lake in Gentile Valley was local, and that its equivalent at this altitude was not present in the Salt Lake basin.

As horizontal beds of unconsolidated material of probable Pliocene age attain an altitude of 6,200 feet over the broad, flat divide between Gentile Valley and Cache Valley, such beds may be present sporadically in Gentile Valley.

Accumulations of manganese minerals are not uncommon in geologically recent depressions, such as marshes and lakes, and are known though much less common in stream channels, recent or old. In very few places, however, has the source of the manganese been definitely established, and the mineral is generally assumed to have been disseminated as minute particles in the near-by rocks. In the United States geologically recent manganese bogs are known in Columbia County, N. Y.,[5] Jefferson County, Mont.,[6] and elsewhere. Such deposits appear to be more common in the Canadian provinces, as they have been reported from a number of localities in Albert County, N. B.,[7] in the Cypress Hills, Alberta, and near Kaslo, B. C.[8] Some of these deposits of bog manganese minerals have been explored, but none of record have produced more than several hundred tons of marketable ore, although some are reported to be larger.

Accumulations of manganese in river-channel deposits are recorded but are uncommon. Two deposits have been explored in Virginia[9] and another is known in California.[10]

This investigation does not indicate the source from which the manganese concentrated in certain beds near Cleveland, Idaho, has been derived. A lead deposit has been explored in the Paleozoic rocks about 2 miles to the east, but although manganese minerals occur in some lead deposits none have been observed here. It seems that the source of the manganese must be the minute quantities known to occur in many rocks, sedimentary as well as igneous.

Mining.—Thus far neither the ore nor the inclosing sand has been sufficiently coherent to require the use of much explosive, and most of the drifts have been run and the ore mined by use of pick and shovel only. After being mined, the material is trammed by hand to an open bin on one side of the dump, where the hard nodules of manganese oxides are broken and sorted. When sufficient cleaned ore

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[5] Dale, N. C., Postglacial manganese in Columbia County, N. Y.: New York State Mus. Bull. 207–208, pp. 85, 100, 1918.

[6] Harder, E. C., Manganese deposits of the United States: U. S. Geol. Survey Bull. 427, pp. 135–137, 1910.

[7] New Brunswick Crown Land Dept., Fifty-eighth Ann. Rept., p. 16, 1918.

[8] Bancroft, M. F., Investigations in the Slocan district, B. C.: Canada Geol. Survey Summary Rept. for 1917, pt. B, pp. 28–33, 1918.

[9] Hewett, D. F., Some manganese deposits in Virginia and Maryland: U. S. Geol. Survey Bull. 640, pp. 54–56, 61, 1917.

[10] Renrose, R. A. F., Manganese, its uses, ores, and deposits: Arkansas Geol. Survey Ann. Rept. for 1890, vol. 1, p. 494, 1891.

has accumulated in the bin to make a shipment, it is drawn into trucks and hauled to the railroad.

Production and reserves.—The following table presents the weight and analyses of all except one of the cars of ore that had been shipped up to May 3, 1927, by the Idaho Manganese Co.

Summary of shipments by the Idaho Manganese Co.

Date	Tons, dry weight	Manganese (per cent, dry basis)	Insoluble (per cent)	Water (per cent)	Date	Tons, dry weight	Manganese (per cent, dry basis)	Insoluble (per cent)	Water (per cent)
1925	1 car.	(?)	(?)	(?)	Nov. 13	33.50	--	--	--
					Nov. 13	38.95	46.8	7.7	15.5
1926					Nov. 29	35.26	47.6	8.0	16.7
Jan. 23	25.78	44.46	10.3	15	Nov. 29	36.73	44.8	11.0	18.4
Apr. 29	34.57	36.50	15.2	20	Dec. 2	30.94	40.8	13.7	23.7
June 8	34.41	37.7	20.6	6.5	Dec. 17	25.09	42.2	13.7	30.9
June 23	41.38	41.4	10.3	8.4	Dec. 29	33.25	45.75	9.4	18.9
July 2	37.90	44.5	5.2	6.5					
July 12	44.65	46.5	6.8	7.4	1927				
July 16	36.73	43.6	12.3	10.6	Jan. 12	34.75	43.1	7.5	14.5
July 27	42.38	42.8	9.4	16.0	Jan. 25	30.40	41.0	10.6	23.1
July 29	46.61	45.4	5.8	8.2	Feb. 3	32.45	44.6	6.6	14.9
Aug. 3	33.92	45.0	7.7	12.2	Feb. 15	39.63	49.2	6.4	12.7
Aug. 7	43.63	43.0	9.4	10.6	Feb. 17	36.14	48.0	6.4	15.0
Aug. 12	32.89	43.8	10.8	16.3	Mar. 2	21.22	40.4	9.8	19.6
Aug. 24	38.44	38.0	11.7	14.8	Apr. 5	32.40	42.3	9.5	20.0
Sept. 11	36.29	47.3	6.95	5.6	Apr. 20	25.55	47.4	7.4	22.2
Sept. 21	43.46	46.1	8.0	7.0	Apr. 27	35.12	40.2	11.2	18.6
Oct. 11	32.25	41.4	10.4	10.0	May 3	38.00	42.4	3.4	9.9
Nov. 1	35.77	41.5	10.4	14.2		1,200.45			

A 50-pound sample of ore sent to the Montana Laboratories Co., Butte, Mont., for analysis, showed manganese 57.12 per cent and available oxygen 15.67 per cent, equivalent to 85.12 per cent manganese dioxide; silica 3.04 per cent; iron 0.14 per cent; copper 0.026 per cent; lead 0.05 per cent; arsenic 0.04 per cent; water 0.5 per cent. Such material is well adapted for use in dry batteries, but in order to obtain large quantities it would have to be closely sorted free from the small quantities of calcite commonly present.

The yield of the part of the lowest zone that has been explored in the lowest tunnel indicates that it may be expected to yield about 3,000 tons of shipping ore to the acre. Although exploration has not yet determined the extent of the principal bed, it would be surprising if the bed were persistent over more than a few acres. If more than one bed is found, however, the reserve would be correspondingly increased.

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