COMMONWEALTH OF VIRGINIA

DEPARTMENT OF CONSERVATION AND DEVELOPMENT

STATE GEOLOGICAL SURVEY

P. O. Box 1428, University Station
Charlottesville, Virginia

RECONNAISSANCE EXAMINATION OF MANGANESE DEPOSITS IN THE JAMES RIVER-ROANOKE RIVER DISTRICT, VIRGINIA

by Harvey C. Sunderman

The James River-Roanoke River manganese district lies in Amherst, Appomattox, Buckingham, Campbell and Nelson counties, Virginia, in the Piedmont physiographic province. The district trends in a northeast-southwest direction, and is approximately 60 miles long and averages about 4 miles in width. The city of Lynchburg is approximately 3 miles west of the central part of the district.

The James River-Roanoke River manganese district has been studied in detail and partially or completely mapped by Furcron, Brown, Jonas, Hewett, Harder, Espenshade, and others. There is no place in the Virginia Piedmont that has received an equivalent amount of geological study. The published and unpublished literature on the area is voluminous.

This report is based upon approximately six weeks of reconnaissance field geology (November 16, 1951 through January 20, 1952), inspections of accessible mine ruins and prospects, and examinations of numerous properties on which "showings" of manganese have been reported. The writer has drawn freely from the voluminous geological literature concerned with this district, and from unpublished information contained in the files of the Virginia Geological Survey.

Manganese has been mined on a small scale in many places throughout the district, and moderate tonnages have been taken from several of the larger mines. At the present time, so far as is known to the writer, all of the larger mines are in a state of complete dilapidation, only very limited prospecting is in progress, and no manganese is being produced. The only evidence of recent prospecting and exploratory work seen by the writer were on the following properties: David Myers, W. F. Tweedy, R. B. Phillips, R. S. Robertson, V. J. Green, and G. Cabell.

The mining history, production statistics, genesis, mode of occurrence, and almost all other phases of the economic geology of the manganese deposits, as well as the general geology of the district, have been ably and meticulously described by Harder, Hewett, Espenshade, Jonas, Furcron, Brown, and others. Consequently, the mining history and production statistics of the district will not be discussed, and only a very brief recapitulation of the general geology and genesis and mode of occurrence of the manganese deposits will be made.

The rocks of the district are low-rank metasedimentary and metaigneous rocks of unknown age and diabase intrusives and unmetamorphosed sediments of Triassic age. The metamorphic rocks have been intricately and complexly folded and faulted. In general, they strike northeastward and dip steeply to the southeast.

The country rock of the district contains small quantities of manganese which has been concentrated in the Mount Athos (quartzite-marble-mica schist) formation by downward percolating meteoric waters. The quartzite members of this formation have offered an exceedingly favorable environment for precipitation and concentration of the manganese. Thus, the manganese deposits are everywhere associated with the quartzite members of the Mount Athos formation, and almost all exposures of this rock contain a "show" of manganese.

The "hard ore" of the James River-Roanoke River manganese district, in general, consists of intimate mixtures of manganese oxides, chiefly pyrolusite, psilomilane, and several undetermined mineral species. There are two main modes of occurrence of these "hard ores" that have been of commercial value, namely, (1) nodules and slabs of "hard ore" in seams of yellow clay associated with quartzite, and (2) replacement pockets and fracture fillings of "hard ore" in quartzite. In addition, residual concentrations of "hard ore" derived from the above listed occurrences are found in clay overburden.

Wad, soft brown to black manganese oxides admixed with sand, clay, mica, and other impurities, is of widespread distribution throughout the district. Since no economically profitable process of recovering metallic manganese from this type of low-grade material has been developed, these deposits have not been considered as potential sources of manganese. The development of economically successful methods for the beneficiation of wad should offer a possible future source of as much, if not more, manganese than is presently estimated to be available from the "hard ore" deposits of the district.

An orebody is a mixture of minerals that varies in richness in different parts of the mass. Consequently, a single sample taken in any one place is not representative of the entire orebody except in the case of an extremely improbable coincidence. If the aggregate of the samples is equal to the orebody, the sampling is perfect; however, it is not econimically possible to sample in this manner. Therefore, it is imperative to select a small number of samples in such a manner that all parts of the orebody will be represented proportionately. The usual method of collecting a set of representative samples is by a proportionately integrated aggregate of specimens from the following sources: (1) prospect pits and trenches; (2) drill holes; (3) surface outcrops; and (4) mine workings. All of the mines in the district are full of water or caved in, the prospect pits and trenches are overgrown with vegetation and badly caved, and only a very small amount of drilling data are available. Hence, it is impossible to collect a representative set of samples from any property in the area. Consequently, any estimate of ore grade and ore tonnage of the James River-Roanoke River manganese district would of necessity be only a "guesstimate" based dominantly on intuition, education, and experience in the geological profession. Such a "guesstimate" would be absolutely inconclusive to any qualified geologist or mining engineer.

During the periods that the manganese properties in the James River-Roanoke River manganese district were prospected and in active operation, they were studied carefully and in detail by accredited representatives of the Virginia Geological Survey, United States Geological Survey, and the United States Bureau of Mines. Conditions existing at those times were more ideal, indeed, for determining the quantity and quality of ore present, whereas, under the conditions existing at the present time, neither the quality nor the quantity of the ore can be estimated with any degree of accuracy. It is therefore felt that the reports prepared by geologists of the United States Geological Survey, and particularly the report of G. H. Espenshade, give a clearer and more concise estimate of economically recoverable ore than any estimate that could be made at the present time by the writer. Any such estimate by the writer would naturally be based on inadequate and incomplete data. To obtain a more accurate estimate of tonnage and grade of ore that might be recovered under present conditions, it would be necessary to open again all of the mines, prospect pits and trenches, and to redrill most of the properties. It is evident that such a procedure cannot be economically justified.

When the James River-Roanoke River manganese district was producing ore, the final manganese concentrate from each mine was unique; in fact, each shipment from most of the individual mines differed, from preceding shipments, in manganese content and impurities. This unfortunate circumstance was caused mainly by the crude ore treatment processes practiced in the district. The consumers of the ore could not depend on a constant supply of a product of a uniform grade. The larger steel and chemical industries were not interested in such variable concentrates and the markets that were available for a non-uniform concentrate did not pay a premium price for the product.

A consistently uniform manganese concentrate can be obtained from a small, properly designed, modern treatment plant that contains factory-built equipment. Such a plant should be designed by a qualified mining engineer or metallurgist so that it would be adapted to maximum recovery of manganese from local ores.

It has been estimated that a small, modern treatment plant capable of producing 10 tons of high-grade manganese concentrate a day would cost $75,000 to $100,000 or more. Whether there is a sufficient quantity of economically mineable "hard ore" in the district to justify the initial cost of such a plant is questionable. In his report, Espenshade (Espenshade, G. H., The James River-Roanoke River manganese district, Virginia; Unpublished report of the United States Geological Survey, p. 80, 1944) states: "With a price of $30 to $40 a ton for washed ore in small lots, it is possible that 10,000 to 15,000 tons could be obtained from the district. A still higher price and a very vigorous exploration program would probably increase this tonnage."

Any estimates of reserve manganese ore for this area must of necessity be based largely upon production records of former mines and extrapolation from these statistics. Such estimates are inconclusive and hazardous; however, they do serve to give a figure which is of the same order of magnitude as the absolute quantity and quality of ore than can be economically recovered from a district.

The reported production of manganese ore (35% or more Mn.) from the James River-Roanoke River district of Virginia from 1868 through 1940, as given by Espenshade, is 43,989 to 53,989 long tons. The reported production from the same district for the period from 1941 through 1950, inclusive, obtained from the annual production reports of the United States Geological Survey and the United States Bureau of Mines, is 417 long tons. The total reported production of manganese ore (35% or more Mn.) from this district is therefore in the order of 45,000 to 55,000 long tons. The total reported production of manganese ore for the entire State of Virginia from 1867 through 1950 is 378,300 long tons, and of manganiferous ore (10-35% Mn.), 163,650 long tons. Production statistics on manganese ore and manganiferous ore for Virginia, including different regions and counties, are given in tables 1 through 7 which are included at the end of this report. (Tables 1 and 2 attached hereto. Others in files of Survey.)

Conclusions reached by Miser, Espenshade, and others, who have studied the geology, manganese deposits, and production records of the James River-Roanoke River manganese district indicate that the total tonnage of manganese ore (35% or more Mn.) in this district is less than its past production.

It appears that the chances for profitable production of manganese from this district is dependent upon a high market price for small lots of washed ore delivered to a local purchasing point. This would enable small deposits to be worked by previously used methods of mining, washing, screening, and sorting. Small lots of ore averaging 40% in manganese content might be profitably produced from a number of properties in the district for a price of $1.50 to $2.00 per unit (48% Mn. basis). If underground operations of any extent are worked, they would require a price of $2.00 or more per unit (48% Mn. basis), since timbering, pumping water, and other operational costs would be materially increased.

In view of the detailed studies previously made in the district by geologists, as previously stated, and since it is not the policy of either the Federal Geological Survey or any State Geological Survey to make detailed examinations and render reports on privately owned properties, the writer feels that any further investigations in the district by representatives of such agencies would serve only to usurp the functions of private consulting geologists and mining engineers.

A list of references on manganese in Virginia to which the reader is referred for additional information, follows this report.

Espenshade, during his investigation (1940-1942), visited and examined some 39 mines and 35 prospects in Appomattox, Campbell and Nelson counties. All of these properties are described in some detail in his preliminary report. Copies of this report together with geologic and mine maps are available for consultation, by any interested party, in the offices of the United States Geological Survey in Washington, D. C., and the Virginia Geological Survey in Charlottesville, Virginia. This report is now in process of publication by the United States Geological Survey and copies of it should be available within a few months.

During his recent examination of the district the writer visited and examined the following properties: W. F. Tweedy, G. C. Scott, David Myers, A. E. Neighbors, Mrs. J. B. Trent, W. H. Irvine and others, R. S. Burruss, R. B. Phillips, Mrs. B. R. Harrison, A. dePorry, G. Cabell, J. S. Burleigh, W. Durham, J. L. Mosby, R. S. Robertson, Mrs. V. J. Green, W. G. Burnette, C. L. Burgess, E. B. Lewis, and several properties adjoining these of which he does not know the ownership. Since all of these properties were visited and described by Espenshade, they are not again considered in this brief report.

From the writer's examination of the district and from information available in the reports of Espenshade and others, it is believed that under favorable market conditions, as above discussed, small tonnages of washed manganese ore could be produced from the following properties: Bell, Burton, Dews, Grasty, Halsey, Mortimer, Myers, Neighbors, Phillips, Saunders, and Wood.

Respectively submitted

Harvey C. Sunderman

Virginia Geological Survey
P. O. Box 1428, University Station
Charlottesville, Virginia
March 17, 1952

REFERENCES ON MANGANESE IN VIRGINIA

1. Barnard, E. E., and Ryan, C. W., Unpublished report on Manganese ores of Chestnut Mountain, Appomattox County, Virginia: Lynchburg, 6 pp., June, 1930.

2. Boyd, C. R., Resources of south-west Virginia ..., 321 pp., New York, John Wiley and Sons, 1881 (manganese: pp. 37, 66-68, 71, 94-96, 144-148, 164, 172-178, 194, 206).

3. Britton, J. B., Analyses of Campbell and Appomattox counties, Virginia iron and manganese ores and limestones: The Virginias, vol. 2, no. 11, pp. 170-171, November 1881.

4. Brown, W. R., Age relationships of certain metamorphic rocks in the vicinity of Lynchburg, Virginia: Virginia Acad. Sci. Proceedings 1940-1941, (abstract), p. 215, 1941.

5. Campbell, J. L., Geology and mineral resources of the James River Valley, Virginia, 119 pp., New York, G. P. Putnam's Sons, 1882, (manganese, pp. 97-99).

6. Cooper, B. N., Origin of the narrow Cambrian belts north of Draper Mountain, Virginia: Virginia Geol. Survey Bull. 51-g, p. 153, 1939.

7. ...., Manganese <u>in</u> Geology and mineral resources of the Burkes Garden quadrangle, Virginia: Virginia Geol. Survey Bull. 60, pp. 275-277, 1944.

8. Currier, L. W., Zinc and lead region of southwestern Virginia: Virginia Geol. Survey Bull. 43, pp. 71, 73-74, 1935.

9. Edmundson, R. S., Manganese in Little Fort Valley, Shenandoah County, Virginia, Unpublished memorandum report in files of Virginia Geol. Survey, 4 pp., September 5, 1950.

10. Espenshade, G. H., The James River-Roanoke River manganese district, Virginia: (An unpublished preliminary report) U. S. Geol. Survey, 82 pp., maps, 1944: (Copies in "open files" of the U.S. and Virginia Geological Surveys).

11. Ewold, H. B., and Sanford, R. S., Investigation of Sweet Springs manganese deposits, Monroe County, West Virginia and Craig County, Virginia: U.S. Bur. Min. R. I. 4433, 5 pp., March 1949.

12. Furcron, A. S., Manganese <u>in</u> James River iron and marble belt, Virginia; Virginia Geol. Survey Bull. 39, pp. 104-109, 1935.

13. Harder, E. C., Manganese deposits of the United States: U. S. Geol. Survey Bull. 380, pp. 255-277, 1908: (Virginia, pp. 258-263).

14. ...., Manganese ores <u>in</u> Mineral resources of the United States, 1908: U. S. Geol. Survey, pp. 135-156, 1909: (Virginia pp. 135-151).

15. ...., Manganese deposits of the United States: U. S. Geol. Survey Bull. 427, pp. 38-66, 1910.

16. Hewett, D. J., Some manganese mines in Virginia and Maryland: U. S. Geol. Survey Bull. 640-C, pp. 37-70, 1916.

17. ...., and others, Possibilities for manganese ore on certain undeveloped tracts in Shenandoah Valley, Virginia: U. S. Geol. Survey Bull. 660-j, pp. 271-304, 1918.

18. ...., Manganese and manganiferous ores in Mineral resources of the United States, 1918: U. S. Geol. Survey, pp. 607-656, 1921.

19. Holden, R. J., Manganese in Virginia: Economic and Civic, pp. 131-135, Richmond, Whittet and Shepperson, 1933, Virginia Polytechnic Institute in Collaboration with Virginia State Chamber of Commerce.

20. ...., Origin of the Oriskany iron and manganese ores: Virginia Geol. Survey Bull. 46-d, pp. 29-34, 1939.

21. Jonas, A. I., Geological reconnaissance in the Piedmont of Virginia: Geol. Soc. American Bull., vol. 38, pp. 837-846, 1927.

22. ...., Manganese-bearing veins in southwestern Virginia: Virginia Geol. Survey Reprint Ser. No. 5, 16 pp., 1942: (Reprinted from Econ. Geol. vol. 37, no. 5, pp. 408-423, 1942).

23. King, P. B., Manganese deposits of the Elkton area, Virginia: U. S. Geol. Survey Bull. 940-b, pp. 15-55, 1943.

24. Kline, M. H. and Agnew, W. G., Yancey-Crawford manganese deposit, Rockingham County, Virginia: U. S. Bur. Min. R. I. 4231, 5 pp., 5 figs., April 1948.

25. ...., Watson manganese deposit, Page County, Virginia: U. S. Bur. Min. R. I. 4232, 10 pp., 9 figs., April 1948.

26. ...., and Robertson, A. F., Investigation of Round Mountain manganese properties, Bland County, Virginia: U. S. Bur. Min. R. I. 4342, 9 pp., 8 figs., July 1948.

27. Knechtel, M. M., Manganese deposits of the Lyndhurst-Vesuvius district, Augusta and Rockbridge counties, Virginia: U. S. Geol. Survey Bull. 940-f, pp., 163-198, 1943.

28. Ladd, H. S., Manganese deposits of the Sweet Spring district, West Virginia and Virginia: U. S. Geol. Survey Bull. 940-g, pp. 199-217, 1944.

29. ...., and Stead, F. W., Manganese deposits of the Flat Top and Round Mountain districts, Bland and Giles counties, Virginia: U. S. Geol. Survey Bull. 940-h, pp. 219-245, 1944.

30. McCreath, A. S., The iron ores of the Valley of Virginia: The Virginias, vol. 4, no. 6, pp. 94-96, 1883.

31. ...., and d'Invilliers, E. V., The New River-Cripple Creek mineral region of Virginia, 171 pp., Harrisburg, Pa., Harrisburg Publishing Co., 1887: (Manganese, pp. 20-21, 62, 82, 83, 90, 91, 93, 101-102, 129, 130, 136, 137-138, 139).

32. McGill, W. M., Outline of the mineral resources of Virginia: Virginia Geol. Survey Bull. 47, pp. 37-40, pl. 10, 1936.

33. Miller, R. L., Geology and manganese deposits of the Glade Mountain district, Virginia: Virginia Geol. Survey Bull. 61, 150 pp. 1944.

34. Miser, H. D., Manganese deposits of the southeastern states in Symposium on mineral resources of the southeastern United States, 1949 Proceedings, sponsored by Dept. Geol. Geog. Univ. Tenn., pp. 152-169, Knoxville, Univ., Tenn Press, 1950.

35. Monroe, W. H., Manganese deposits of Cedar Creek Valley, Frederick and Shenandoah counties, Virginia: U. S. Geol. Survey Bull. 936-e, pp. 111-141, 1942.

36. Montgomery, W. B., Investigations of Columbia manganese deposit, Campbell County, Virginia: U. S. Bur. Min. R. I. 4602, 7 pp., December 1949.

37. Moon, L. B., Trends in exploration of mineral deposits: U. S. Bur. Min. I C. 7312, 6 pp., 1945.

38. ...., Investigation of Stange and Byrnes heirs manganese mines, Bland and Giles counties, Virginia: U. S. Bur. Min. R. I. 4659, 32 pp., March 1950.

39. Park, C. F., Jr., Preliminary report on gold deposits of the Virginia Piedmont: Virginia Geol. Survey Bull. 44, pp. 16, 29, 1936.

40. Stead, F. W., and Stose, G. W., Manganese and quartzite deposits in the Lick Mountain district, Wythe County, Virginia: Virginia Geol. Survey Bull. 59, 16 pp., 1943.

41. Stose, Anna J., and Stose, G. W., Geology and mineral resources of the Gossan Lead district and adjacent areas: Unpublished manuscript in the files of the Virginia Geol. Survey (To be published as a bulletin of the Survey).

42. Stose, G. W., and others, Manganese deposits of the west foot of the Blue Ridge, Virginia: Virginia Geol. Survey Bull. 17, 166 pp., 1919.

43. ...., and Miser, H. D., Manganese deposits of western Virginia: Virginia Geol. Survey Bull. 23, 206 pp., 1922.

44. Virginia Geol. Survey, Geologic map of Virginia, 1928.

45. Watson, T. L., Manganese oxides in Mineral resources of Virginia: Virginia Jamestown Exposition Commission, pp. 235-259, Lynchburg, Va., J. P. Bell Co., 1907.

46. Weeks, J. D., Manganese in Mineral resources of the United States: U. S. Geol. Survey, pp. 305-356, 1885.

47. Weld, C. M., and others, Manganese: Uses, preparation, mining costs and the manufacture of ferrous-alloys: U. S. Bur. Min. Bull. 173, 209 pp., 1920.

48. Woodward, H. P., Manganese in Geology and mineral resources of the Roanoke area, Virginia: Virginia Geol. Survey Bull. 34, pp. 108-112, 114-116, 1932.

49. ...., Outline of the geology and mineral resources of Russell County, Virginia: Virginia Geol. Survey Bull. 49, pp. 63-66, 1938.

50. Mineral resources of the United States (annual production reports), published by the U. S. Geological Survey, for the years 1882 through 1923; from 1924 through 1931, published by the U. S. Bureau of Mines. In 1932-33 the name of the volume was changed to "Minerals Yearbook", under which title the annual reports are published by the U. S. Bureau of Mines, Washington, D. C.

51. Butts, Charles, Geologic Map of the Appalachian Valley of Virginia, with explanatory text: Virginia Geol. Survey Bull. 42, 56 pp., plus map, 1933.

52. ...., Geology of the Appalachian Valley in Virginia: Virginia Geol. Survey Bull. 52 (2 parts: Part I, geologic text, 568 pp.; Part II, fossil plates, 272 pp., 22 pls.), 1941.

53. Rogers, W. B., A reprint of annual reports and other papers on the geology of the Virginias, 832 pp., New York, D. Appleton and Co., 1884: (manganese, pp. 159, 169, 174, 181, 221, 527-532).

Table I

Reported production of Manganese Ore and Manganiferous Ore in Virginia during the period from 1867 to 1950, inclusive.*
(In long tons)

Year	Manganese Ore (35% + Mn.)	Manganiferous Ore (10-35% Mn.)	Year	Manganese Ore (35% + Mn.)	Manganiferous Ore (10-35% Mn.)
1867-1879	18,000		1915	1,620	1,944
1880	3,661		1916	4,417	37,700 (x)
1881	3,295		1917	12,360	34,396 (x)
1882	2,982		1918	10,928	12,776 (x)
1883	5,355		1919	3,928	9,765
1884	8,980		1920	2,523	
1885	18,745		1921	717	
1886	20,567		1922	800	
1887	19,835	1,025	1923	987	661
1888	17,646		1924	1,565	204
1889	14,616		1925	3,121	1,800
1890	12,699		1926	3,792	2,135
1891	16,248		1927	3,212	1,206 (x)
1892	6,079	3,000	1928	3,812	105
1893	4,092	1,188	1929	3,051	80
1894	1,797		1930	3,853	193
1895	1,715		1931	1,505	
1896	2,018		1932	525	
1897	3,650		1933	4,882	404
1898	5,662		1934	1,597	40
1899	6,228		1935	2,452	645
1900	7,881		1936	1,361	874
1901	4,275		1937	2,265	1,170
1902	3,041	3,000	1938	2,242	1,670
1903	1,801	2,802	1939	1,661	4,584
1904	3,054		1940	2,216	4,559 (x)
1905	3,947		1941	5,438	3,906
1906	6,028		1942	10,041	3,486
1907	4,604		1943	6,286	10,900
1908	6,144	274	1944	18,010	3,945
1909	1,544	305	1945	7,648	350
1910	1,758	301	1946	1,143	78
1911	2,455	507	1947		5,543
1912	1,537	1,567	1948	381	2,198
1913	4,048		1949	200	1,142
1914	1,724	1,222	1950	50	

Total Reported State Production, 1867-1950
Manganese Ore (35% + Mn.) 378,300
Manganiferous Ore (10-35% Mn.) 163,650

(x) Includes ferruginous iron ore containing 5-10% Mn.

* Source of data: Mineral Resources of the United States (annual production reports), U. S. Geol. Survey, 1882-1923; U. S. Bur. Mines, 1924-1931; Minerals Yearbook, U. S. Bur. Mines, 1924-1950; Files of Virginia Geol. Survey.

Table II

Table showing reported production of Manganese Ore and Manganiferous Ore in Virginia for certain periods during the years from 1867 to 1950, inclusive.*
(In long tons)

Period	Manganese Ore (35% + Mn.)	Manganiferous Ore (10-35% Mn.)
1867 - 1950	378,300	163,650
1867 - 1900	201,751	5,213
1901 - 1918	75,285	96,794
1919 - 1938	48,190	20,952
1939 - 1950	53,074	40,691
1867 - 1918	277,036	102,018
1919 - 1950	101,264	61,643
1941 - 1945	47,423	31,569
1946 - 1950	1,774	8,961

* Source of data: Mineral Resources of the United States (annual production reports), U. S. Geol. Survey, 1882-1923; U. S. Bur. Mines, 1924-1931; Minerals Yearbook, U. S. Bur. Mines, 1924-1950; Files of Virginia Geol. Survey.