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G M I SHORT PAPER

NO. 9

SOME MANGANESE DEPOSITS in the SOUTHERN OREGON COASTAL REGION

by

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Junior Geologist, Department of
Geology and Mineral Industries

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PRICE 10 CENTS

FOREWORD

Early in 1940, a survey of all the Oregon manganese deposits of record was initiated by the Department. Over seventy-five such deposits were examined, and the results were published in 1942 as Bulletin No. 17, "Manganese in Oregon."

Commercial production of manganese in western Oregon has come almost entirely from two properties, namely: The McAdams property close to the Coos-Curry county line, and the Tyrrell property in the Lake Creek district of northeastern Jackson county. The McAdams mine represents an occurrence of manganese associated with red, "jaspery" cherts. It is more or less typical of most of the deposits in the coastal region of southwestern Oregon; therefore, it seemed to justify a more detailed study than that reported in Bulletin 17. Randall E. Brown, junior geologist for the Department, spent two weeks during the spring of 1942 in making a detailed geologic investigation of this property, and in examining other properties in western Curry county. Results of his survey are published in this short paper, and, as far as origin and commercial possibilities are concerned, these results should be applicable to other deposits of this region.

A detailed survey of the Tyrrell manganese property, which contains a distinctly different type of mineralization from that of the McAdams, will appear in another short paper in the near future.

Earl K. Nixon

Director

Portland, Oregon

November 20, 1942

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RANDALL E. BROWN*

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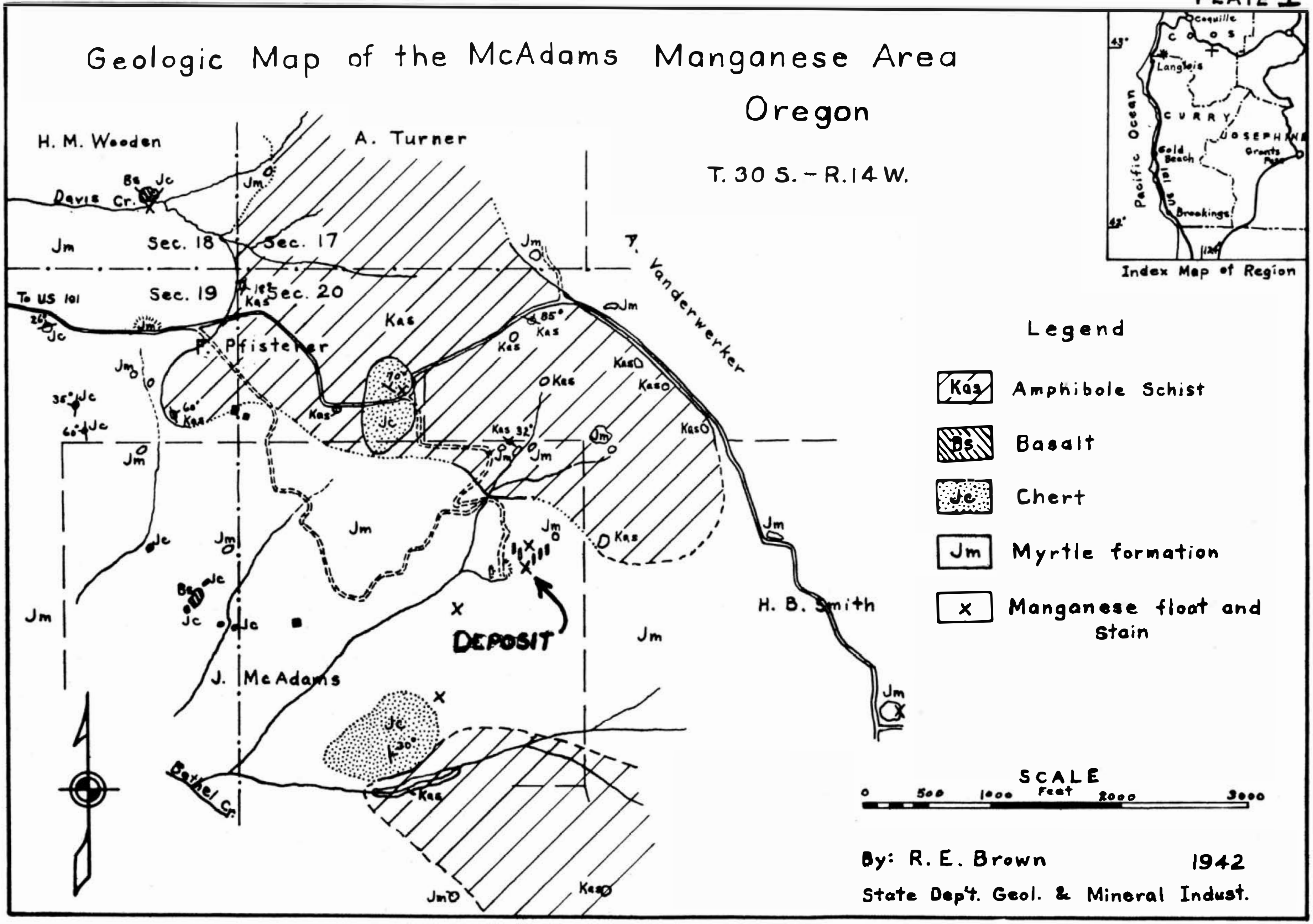
Manganese oxide boulders are mixed with boulders of rhodonite, chert, amphibole schist and quartz in a (McAdams) surficial manganese deposit in southern Coos County near Langlois, Oregon. The deposit is associated with chert in an amphibole schist zone within the Myrtle sandstone of the region. The deposit is compared to other manganese deposits in chert in the southern Oregon Coastal region. Evidence indicates that these deposits were formed as bog manganese deposits within the chert which, similar to the chert deposits within the Franciscan formation of California, formed as siliceous spring deposits.

Evidence suggests that a basaltic intrusion accompanied the folding within the McAdams area and altered the sandstones to amphibole schist, and that the hot waters associated with the intrusion altered the manganese oxides in the chert to rhodonite. Later oxidation and hydration of the rhodonite formed psilomelane, the principal ore mineral of the deposit.

*Junior Geologist, Oregon State Department of Geology & Mining Industries. November, 1941 to June, 1942.

PLATE I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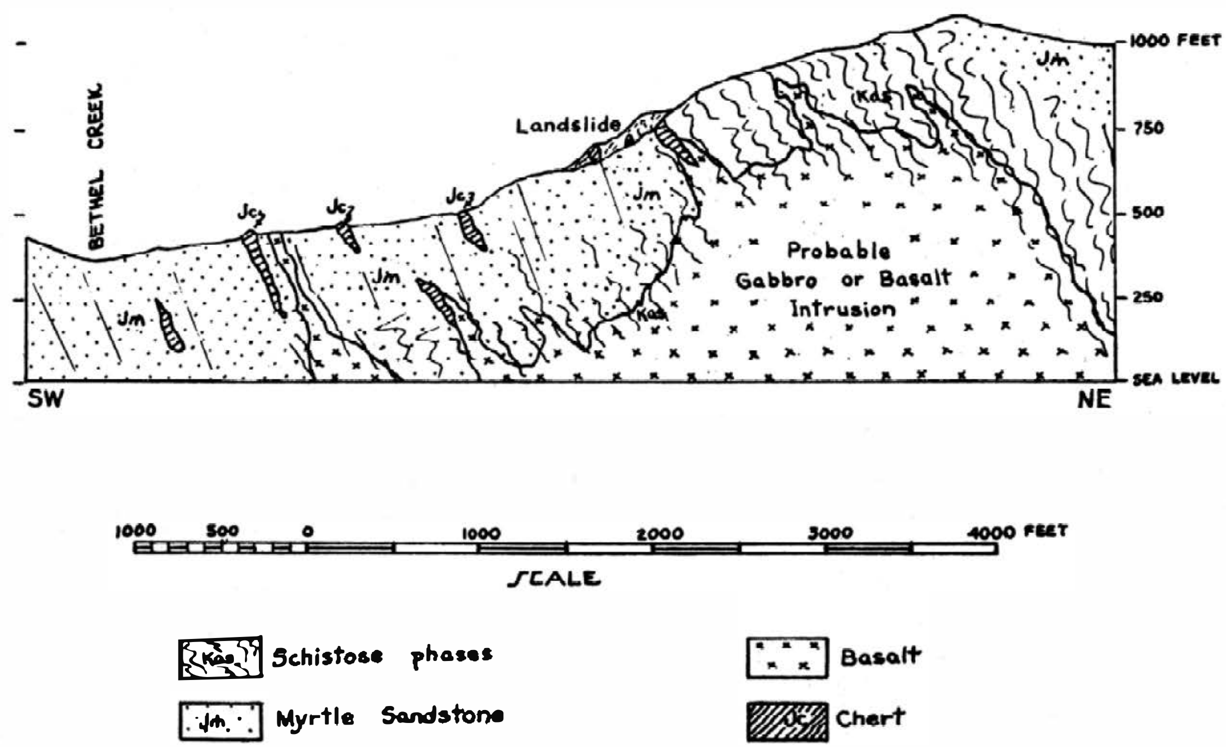

MCADAMS MANGANESE DEPOSIT

INTRODUCTION

Location: The McAdams manganese deposit is in southern Coos County, Oregon, five miles from the Pacific Ocean, at latitude 42° 57' north and longitude 124° 24' west. The deposit is three miles by road east of U.S.Highway 101 four miles north of Langlois, and 28 miles south of Coquille, the nearest railhead, in the SE¼ of the NE¼ of sec. 20, T. 30 S., R. 14 W.

Tho deposit lies at an altitude of 800 feet, between the 500 and 1000 foot marine terraces north of Bethel Creek. It is in a region characterized by abundant rainfall, moderate temperatures, and heavy growths of vegetation, particularly along the many streams.

Owner: Land is owned in fee by James C. McAdams of Langlois. The property is leased to the Golden Surf Mining Interests of Crescent City, California.

History: Approximately 100 tons of manganese ore was shipped from the deposit in 1917 and 1918 by Mr. McAdams. This ore, collected as float from the ground surface, assayed 46% manganese and was shipped to the Tacoma smelter. Another 100 tons was shipped by John Winters and Austin McAdams in 1941 to Ogden, Utah. This lot was divided in two shipments which assayed 49% and 47% manganese and 14% and 16.5% silica respectively. Ore containing considerable chert and rhodonite accounted for the decrease in grade of the second lot of 50 tons.

Development: The deposit is exposed by three open cuts in the lower part of the occurrence and by several trenches above the open cuts. The exposures show boulders and fragments of manganese ore intimately mixed with masses of chert, amphibole schist, sandstone, slate and quartz in a soil creep zone. The base of the ore zone is the surface of the Myrtle sandstone, exposed in the trenches and open cuts.

The road to the deposit from the county road is usable only in dry weather, and mining operations are therefore intermittent.

GEOLOGY OF THE AREA

The principal rock in the region is the Myrtle sandstone, mapped by Diller[1] as Upper Jurassic and Lower Cretaceous. Recent work by Taliaferro[2] indicates that the "Myrtle formation" is too generalized and is the probable equivalent of the Upper Jurassic Franciscan formation of California.

The Myrtle sandstone consists of buff to greenish-gray sandstone, shaly sandstones, sandy pebble conglomerates and siliceous limestones. The sandstones, predominant in the area, are well lithified but so thoroughly broken into small fragments that determination of the bedding is frequently impossible. Near the contact with the amphibole schist the sandstone is silicified and a schistose structure is occasionally present, which indicates a transitional phase between the unaltered sandstone and the amphibole schist. The limestone of the formation crops out about two miles southeast of the area mapped, and is a finely crystalline, light gray siliceous limestone containing no visible foraminiferal remains or other evidence of organic origin. It is the probable equivalent of the Whitsett limestone lentils of the Roseburg quadrangle. The limestone has been altered since deposition, presumably by the same igneous body which metamorphosed the Myrtle sandstone in the McAdams area. This is further borne out by the occurrence of amphibole schists and graphite schist a quarter of a mile westward from the limestone outcrop.

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[1] Diller, J.S., Geologic Atlas of the United States, Port Orford folio, Oregon no. 89, U.S.Geol. Surv., 1903.

[2] Taliaferro, N.L., Correlation of the Jurassic of Southwestern Oregon and California, Bull. Geol. Soc. Am., vol. 52, no. 12, pt. 2, 1941.

Basalt occurs as several small outcrops forming stack-like ledges generally surrounded by a silicified sandstone zone. The basalt is compact, occasionally vesicular to amygdaloidal, greenish to gray in color, and occurs in topographic forms in striking contrast to the surrounding sandstones. The forms of the outcrops suggest that the basaltic bodies are volcanic necks coming up from a larger body of basalt or gabbro beneath. Erosion left the necks as prominent outcrops by the removal of the surrounding less resistant sandstones.

The basalt is very fine-grained with occasional megascopic crystals of plagioclase feldspar in an aphanitic groundmass. Chlorite is abundant, resulting from the alteration of ferromagnesium minerals.

The basalt is intrusive into and cross-cuts the Myrtle sandstone. Regional relationships indicate that it was probably intruded in late Cretaceous time, probably during the Chico epoch simultaneously with uplift and folding of the Upper Jurassic sediments.

The schist is a variable crystalline rock designated "amphibole schist". It crops out as small rocky ledges and isolated masses which are the outcrops of a large schist mass striking northwestward and underlying the area. The zone of schist outcrops continues to the northwest for at least a mile, to the southeast for several miles, and eastward for nearly half a mile.

The schists are mineralogically very diverse and include mica and sericite schists, glaucophane schists, actinolite schists, amphibolites and rarely graphitic schists. The origin of these varied schists is of considerable interest. Diller says:[3] "Their occurrence in places along the contact between igneous and sedimentary rocks has supported the view that they result from contact metamorphism, and a closer study of them microscopically and chemically tends to show that the original rock from which they are derived is igneous in some cases and sedimentary in others".

The predominance of sericite schists in the area, the frequent silicification, and the occurrence of schistose structure within the sandstone near their mutual contact indicate that the schist was probably derived in part by metamorphism from the Myrtle sandstone. Presumably erosion has proceeded farther in those areas where evidence suggests that the schist was derived principally from the basalt. If this be so, it may be expected that the sericite schist will change, probably to a glaucophane schist, derived by the metamorphism of the basalt, at a surface not far below the present ground surface. This is borne out by the association of glaucophane and sericite schist within the area.

The chert of the area is a highly siliceous rock, frequently closely resembles jasper, and varies in color from red and brown to gray, green and white. The chert occurs in small but numerous, more or less circular outcrops aligned in zones parallel to the general structure. The attitude, where determinable, is similar to that of the enclosing schists and sandstones. The chert is uniformly bedded and occurs in layers which range in thickness from one half to five inches, average about three inches, and are overlapping and irregular like spring deposits. The white, green and gray cherts are amorphous to cryptocrystalline and are generally well bedded in contrast to the poorly bedded and fractured crystalline red cherts. The relationship between the red cherts and the green and white cherts cannot be determined in this area because of the lack of sufficient exposures, but in other areas in the region, the red cherts underlie the white cherts and overlie the country rock, which may be sandstone, schist, or serpentine. The red chert thus forms the base of the chert lenses and may have formed in some manner related to its original deposition. Manganese, where it occurs in the chert lenses, is invariably associated with the red "jaspery" chert and is only rarely found concentrated more than as stains on seams and fractures of the white or grey cherts.

Nearly all specimens show a few minute, round to oval, dark to whitish dots throughout the rock. These are residual casts of radiolaria, the characteristic fossil of the formation. These casts are more readily detected in the amorphous gray and green cherts than in the crystalline red cherts.

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[3] op. cit. Port Orford folio, no. 89.

The origin of the radiolarian cherts is an interesting problem. Features in the hand specimens and in the field relations do not support the theory of direct organic origin. The chert contains abundant radiolarian remains but shows no further evidence of organic origin, particularly in the siliceous matrix. Lawson discusses the origin of the cherts of the San Francisco Peninsula:[4]

> "The cavities of the Radiolaria have been filled with chalcedonic silica, and are in definite contrast with the non-chalcedonic matrix. The discrete character of the fossils is significant of their mode of accumulation. The silica seems to have been an amorphous chemical precipitate, forming in the bottom of the ocean in which the Radiolaria thrived. The dead Radiolaria dropped into this precipitate, became embedded in it, and were so preserved."

The chert is essentially inorganic in origin and believed to be the deposit from siliceous springs in the ocean bottom, similar to those springs well known in various volcanic regions. Moreover, if the chert were organic in origin, we should expect to find the deposits over wide areas with fairly uniform thickness, but the numerous chert lenses are small in areal extent and of widely variant thickness. The form of the chert deposits thus agrees with the theory of siliceous spring deposition.

STRUCTURE

The structure within the mapped area is a homocline striking northwestward and dipping steeply northeastward. East of the area the sandstones have a prominent westward dip and northwestward strike and indicate that the McAdams area is located on the west limb of a closely folded syncline. The synclinal axis as inferred from the work of Diller[5], from the distribution of the rocks in the area and the visible structure, probably lies a short distance east of the mapped area.

The schist, because of its resistance to erosion, forms the high points of the area except in the southern part where erosion has exposed only scattered outcrops in creek beds. The relationship of the schist, and therefore the underlying basalt, to the synclinal axis suggests that the basalt was intruded into the zone of weakness resulting from the close synclinal folding of the sandstone, probably simultaneous with folding. What relationship this phenomenon may have had to the manganese deposit is not known.

MINERALOGY

The McAdams manganese deposit consists of manganese oxide masses in a soil creep zone resting on the normal Myrtle sandstone exposed in the open cuts and trenches. The manganese occurs as pods, nodules and boulders of psilomelane, rhodonite and wad, intimately mixed with an unsorted, heterogeneous rubble aggregate of boulders and angular fragments of chert, amphibole schist, sandstone, slate and quartz in a granular sandy matrix of residual clay, decomposed sandstone and soil.

Psilomelane, the principal ore mineral, has formed by the alteration of rhodonite. Rhodonite occurs as boulders of the pure mineral and as incomplete replacements of red chert boulders, but never of the green or white chert. Thin sections show that the chert has been replaced by the rhodonite on the surface and along seams, and that later alteration of the rhodonite formed the impure hydrous manganese dioxide, psilomelane. Weathering altered the psilomelane to soft, sooty-black wad. Small nodules were completely altered to wad, but larger boulders were altered to wad only to a depth of half an inch or less. Boulders of apparently pure psilomelane usually contain unreplaced cores of red chert or unaltered cores of rhodonite, and indicate the incomplete replacement of the chert and the incomplete rhodonite alteration. Careful ore sorting requires all boulders larger than about 6 inches in diameter to be broken in order to keep the silica content low and the manganese content high.

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[4] Lawson, A.C., Geology of the San Francisco Peninsula, U.S.G.S. 15th Ann. Rep't, p.425, 1895
[5] op. cit. Port Orford folio, no. 89.

Surface water and weathering have locally enriched the deposit. A layer of soft, impure, sooty black wad 8 to 10 inches thick and 5 feet wide in the main pit overlies a layer of residual clay two feet below the ground surface. It is evident that ground water dissolved some of the manganese from a point higher on the hillside, transported it downslope and deposited it where changing conditions were such as to cause precipitation from solution above the impermeable clay. Elsewhere the manganese bearing solutions percolated through the permeable rubble of the soil creep zone and precipitated the manganese throughout the zone as disseminated, unrecoverable nodules. Barite occurs throughout the chert and rhodonite as lamellar crystals in veinlets, and traces of epidote are present in vein quartz seams in the chert. No calcite was noted.

The microscopic characteristics of the ore indicate that rhodonite is the primary mineral of the deposit, although it is evidently not the original manganese mineral in the area. Deposits in nearby areas indicate that manganese is found only in chert lenses, which were formed by the precipitation of silica from siliceous springs. This relationship between the manganese and the cherts was observed by Lawson[6] in his studies of the cherts of the San Francisco Peninsula. Later work by Harder developed the hypothesis of a paragenetic relationship between the cherts and the manganese. He states:[7]

> "The manganese ores in the Franciscan jaspers in their present form are clearly secondary concentrations, as is shown by their replacement of jasper and by the intimate association of manganese oxide and quartz veins, suggesting their contemporaneous deposition. That the jasper itself is a source of the ore is shown by the facts that it is invariably associated with the ore deposits throughout the Coast Ranges and that ores do not occur in the sandstones or shales in the formation."

He summarizes by saying:

> "This hypothesis (of siliceous spring origin of the cherts) would also account for the presence of manganese in many of the chert lenses, because manganese in the form of bog ore is a very common spring deposit."

These facts are as descriptive of the manganese deposits of the southern Oregon coastal region as they are of the deposits of the California Coast Ranges.

Many manganese deposits in the western United States have been formed, according to Hewitt and Pardee[8], by the alteration of rhodochrosite to rhodonite by basic igneous intrusions and probable concentration of the manganese by circulating hot waters. In each of the regions studied, not less than 3,000 feet and probably not more than 5,000 feet of rock has been eroded away and the deposits are referred by Hewitt and Pardee to an upper mesothermal or lower epithermal habitat.

The occurrence of manganese oxides with chert throughout the entire coastal region studied indicates that the rhodonite may have been formed by the alteration of originally deposited manganese oxides in the chert. Alteration was accomplished by circulating hot waters related to the basaltic intrusion, but the effects of any concentration of manganese by the solutions cannot be determined owing to lack of exposures of the manganese in place.

Manganese deposits in the California Coast Ranges, as noted, occur almost exclusively within chert lenses. Furthermore as Harder noted, the manganese is frequently associated with the red chert. Probably the original factor determining the deposition of the manganese was the highly fractured character of the red chert, which would make it permeable to solutions carrying the manganese. Replacement of the chert by rhodonite and psilomelane indicates that the replacement is due to the inherent character of the rock. Lawson summarizes his discussion of the differences in the cherts of the San Francisco Peninsula:[9]

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[6] Lawson, A.C., op. cit. pp. 423-424.

[7] Harder, E.C., Manganese Deposits of the United States, U.S.G.S.Bull.427, pp. 166-167, 1910.

[8] Hewitt, D.F. and Pardee, J.T., Manganese in Western Hydrothermal Ore Deposits, Chap. 11, Ore Deposits of the Western States, Amer. Inst. Min. Engr. p. 682, 1933.

[9] Lawson, A.C., op. cit. p. 423.

"The gradation thus observed in a series of slides from specimens taken at random seems clearly to be a gradation in time, and not merely a gradation in space. It indicates the different stages of a process of crystallization in a solid amorphous mass. If this be granted, there seems to be no good reason for doubting that in general the holocrystalline cherts, or jaspers, were originally amorphous silica, and that they owe their present character to a process of crystallization quite analagous to that of devitrification in the volcanic rocks."

There appears to be no significant difference in the chemical content of the red, white, and green cherts. The red color is probably due to the oxidation of the iron contained as an impurity in the cherts, and this oxidation is caused by the fractured character of the red chert together with its coarser crystallinity. This coarser crystallinity may also explain the manganese concentration in and the replacement of the red chert.

The degree of concentration of the manganese originally present in the chert is not known. In all the deposits examined within the region the manganese is concentrated at the top of the red chert zone, and below that zone the manganese content of the chert decreases rapidly. The manganese was probably concentrated in a zone near the top of the red chert and spread by replacement of the enclosing jasper. Deposition of the manganese at the top of the red chert is probably due to conditions existing at the time of deposition of the chert but may be due in part to the less permeable overlying white cherts.

ROBERTS MANGANESE DEPOSIT

The Roberts manganese deposit is one and one half miles northeast of Edson Butte near the South Fork of Floras Creek, in the NW¼ sec. 13, T. 31 S., R. 14 W. It is 12 miles east of Langlois and 32 miles south of Coquille.

The country rock of the region is Myrtle sandstone, which is intruded by numerous large basalt plugs, which enclose many chert lenses. The manganese occurs in the eroded remnant of one of these chert lenses, which now forms a small knoll. The chert consists of an upper member of white chert 30 feet thick, and a lower member of red "jaspery" chert ranging from two to ten feet thick. The chert lens strikes N. 65°E. and dips from 15° to 40° north.

Psilomelane is the principal manganese mineral and occurs at the top of the red chert member, directly beneath the white chert, and as a replacement of the red chert. The manganese bearing chert is generally low in grade and assays about 30% manganese.

The basalt intrusions close to the deposit are plugs, probably related to a major intrusive body at a considerable depth. Therefore the effect of the intrusion on the manganese deposit would not be as great as that on the McAdams deposit, where the major intrusive body closely underlies the area in a position highly favorable for hydrothermal alteration of the existing manganese oxides.

The Floras Creek area contains many chert lenses, several of which enclose known manganese deposits. Further prospecting in the area may disclose deposits of commercial manganese ore, associated with the chert.

COLEGROVE MANGANESE DEPOSIT

The Colegrove manganese deposit is three quarters of a mile west of U.S. Highway 101 in the NW½ sec. 2, T. 40 S., R. 14 W., ten miles north of Brookings, Oregon and 38 miles north of Crescent City, California.

The country rock of the region is sandstone, which, similar to that of the McAdams area, contains many chert lenses. This deposit illustrates strikingly the relationship between the white chert, the red chert and the manganese oxides. The east-west trending ridge, at the base of which the manganese occurs, consists principally of white, massive, cryptocrystalline chert dipping north at an angle of 15° to 20°, with a thickness in excess of 200 feet. A small lens of red "jaspery" chert about 30 feet thick crops out at the south base of the ridge along a creek bed, and dips northward beneath the white chert. Pyrolusite and wad nodules occur in a zone two to four feet thick and thirty to forty feet long in the red chert zone, just below the contact with the white chert. The red chert below this zone contains heavy stains and occasional replacement masses of manganese oxides, but the grade of the manganese decreases rapidly downward and indicates original deposition at the top of the red chert lens. No manganese occurs in the white chert.

The manganese zone is limited. Minable ore occurs only along the upper contact of the red chert with the white chert. The manganese at greater depths will be lower in grade and higher in silica because the silica has been leached in part from the manganese at the surface, by surface waters, with resulting enrichment of the surface ore.

SMITH MANGANESE DEPOSIT

The Robert Smith manganese deposit is one and one half miles due east of Gold Beach, Oregon and U.S.Highway 101, in the NW$\frac{1}{4}$ sec. 5, T. 37 S., R. 14 W., at the head of a tributary to Riley Creek. The deposit is 65 miles north of Crescent City, California and 78 miles south of Coquille, Oregon.

The deposit is unique in that it is the first recorded occurrence in Oregon of neotocite, the hydrated manganese silicate. The country rock is serpentine, which encloses a chert lens composed of a white, cryptocrystalline chert and a red "jaspery" chert, identical to other chert lenses in the region. The manganese minerals are limited exclusively to the red chert, but lack of sufficient exposures prevented the determination of the structure and the relationship between the white and red cherts.

Neotocite is the principal manganese mineral. Psilomelane and wad are prominent on seams and fissures where they have formed by the alteration of the neotocite. The neotocite probably formed by the alteration of a primary silicate of manganese, probably rhodonite, by a type of alteration in contrast to that at the McAdams property, where the rhodonite altered directly to psilomelane by oxidation and leaching out of the silica.

CONCLUSION

Evidence indicates that the manganese associated with the chert lenses in the southern Oregon coastal region was deposited as a siliceous spring deposit simultaneously with the chert deposition. The McAdams deposit was formed when circulating hot waters related to a basaltic intrusion altered the manganese oxides to rhodonite and concentrated the manganese in the chert lenses as pods and boulders. The source lode will probably be a variably mineralized zone consisting of masses of rhodonite and rhodonitic chert partly altered to psilomelane.

The extent of the mineralized zone cannot be determined but further prospecting, trenching, and test pitting along the contact zone may uncover more manganese. The manganese boulders probably had their source near the present sandstone-schist contact, but the surface exposures have been so disturbed by soil creep and landsliding that accurate predictions may not be made.

Manganese deposits in the chert lenses are small and frequently low in manganese and high in silica, yet if the conditions of the occurrence of the manganese in the chert are realized, there is every possibility that other deposits of commercial manganese ore may be found. The deposits, because of their small size, must be readily accessible to be commercial, yet it is desirable that under the stimulus of war time prices all prospects of this type should be investigated.

PUBLICATIONS

BULLETINS

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