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CONDENSED GEOLOGICAL REPORT ON TENNANT CREEK GOLDFIELD, N.T.

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by

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CONDENSED GEOLOGICAL REPORT

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I. SUMMARY.

The output of the Tennant Creek Field (16,614 tons for 1948/49) is equivalent to that of a small mine employing 35 to 40 men. The present rate of ore-finding per foot of development is low, as is the output per man-year.

The orebodies are small and discontinuous in depth because of their structural nature, and the possibility also exists that there has been marked secondary enrichment of the ore above the present water table.

Of the four most important producers during the year ended 30.6.49, three are now in difficulties. The Skipper shoot has terminated, the Whippet is showing a fall in grade and a rapid diminution in size at the 200 ft. level, and The Eldorado has so far failed to locate much profitable ore below the water table. Nobles Knob appears to have a bright immediate future, but the deposit now being worked is unlikely to persist to substantial depths.

Further rich discoveries are likely to be made and the field is one of the brightest and most exciting areas in Australia for prospectors, syndicates and small companies. In the present state of geological knowledge however, it would be unwise to regard the Tennant Creek field as a potentially large-scale producer or as a long-term investment. There seems to be good reason to believe however, that production on a scale comparable with that in the past, will continue for 15 to 20 years. Further hematite deposits, with some gold, undoubtedly exist to indefinite depths, but whether it will pay to find and mine these deposits is a question yet to be answered. The present known reserves of ore on the field amount to approximately 100,000 tons averaging 30 dwt. per ton. This is five to six years supply at the current rate of production.

II. INTRODUCTION.

The Tennant Creek Mining Field occupies an area extending some 70 miles east and west and 40 miles north and south. Over this area are scattered a large number of small mines and prospects and it is sometimes difficult to bring a field such as this into perspective so as to obtain some idea of its true valuation. The following notes are designed to help in this direction.

Rate of Production.

For the year ended 30th June, 1949, the Tennant Creek Field produced 16,614 tons of ore, equivalent to 1,300 tons of ore per four weekly period. This is equivalent to the normal output of one fairly small mine employing 35 to 40 men. The gold output for the same period was 27,522 ozs. or 1.65 oz. per ton. In the previous year the average recovery was a little over 1 oz. per ton.

Production per Man.

It is estimated by the Mines Department, N.T. Administration, that there are at present approximately 240 men engaged in mining and prospecting at Tennant Creek and that the total population of the field is 923. The output per miner-year is thus approximately 70 tons. On Western Australian mines, the output averages c lose to 400 tons per miner per year.

Tons per foot of Development.

In arriving at a valuation of the response of a mine or a mining field to exploration, the tonnage of ore made available for stoping by each foot of driving, shaft sinking, cross-cutting, etc., is a very useful index. For twelve Western Australian mines examined by the writer, the figure ranges from 20 to 30 tons per foot of development. One mine, on which this index has fallen to 11 appears likely to go out of production. At Cobar, N.S.W., the figure is close to 80 tons per foot of development.

Mines Department calculations show that at Tennant Creek, for the year ended 30th June, 1949, 7,310 feet of development resulted in the production of 16,614 tons. Since the ore produced probably corresponds fairly closely to the ore developed, the index figure for Tennant Creek would be 2.34 tons per foot of development. This illustrates the difficulty of finding ore at Tennant Creek, a point which will be dealt with below. The low rate of ore-finding is compensated to some extent by the fact that the average recovery by amalgamation was 33 dwt. as against 6.0 dwt. for Western Australia. Taking this into account however, and multiplying the figure of 2.3 by 5, the index would still be only 11.5 as against 20 to 30 for Western Australian mines. It is clear, of course, that the extremely high mining costs at Tennant Creek make the production of high-grade ore necessary and that the ratio of 11.5 to 20 or 30 is unfairly weighted in favour of Tennant Creek.

III. NATURE OF OREBODIES.

Type.

The Tennant Creek gold deposits are rather unique in type in that the gold occurs in, or closely associated with, iron oxide mineral, hematite (Fe_2O_3), which appears to have been derived from magnetite (Fe_3O_4), possibly by surface oxidation processes. The unusual nature of the deposits tends to inhibit comparisons and predictions based on experience with other types of deposits.

Dimensions of Lodes - Structure.

The typical Tennant Creek ore shoot is small, its strike length rarely exceeding 50 to 100 ft. and its width not exceeding 20 ft. Most of the deposits are much smaller than this, and one or two - e.g., Nobles Knob - are larger at some horizons. The most disconcerting feature about the deposits however, is the non-persistence of individual ore-shoots in depth. This arises from their structural characteristics. Thus, the hematite masses do not fill deeply penetrating fissures, faults, shear zones, etc., which cut across all types of rock and can be followed indefinitely in depth; rather, they have, in many places, formed by the replacement of certain beds where these are folded and brecciated.

Since the individual favourable beds are normally 100 to 300 feet in thickness and because the folds in the beds frequently have a flat pitch, it is quite normal at Tennant Creek for an oreshoot to persist for 50 to 200 feet below the surface and then to cut out completely on a flatly pitching keel. Geological and geophysical study to date indicate that other discontinuous ironstone masses certainly occur at deeper levels in the vicinity of the shoots discovered to-date, but the task of finding payable gold in them underground is more difficult than that of finding it at the surface.

Secondary Enrichment.

Apart from the structural controls outlined above, probably the most important factor affecting the persistence in depth of Tennant Creek gold shoots is the possibility that there has been very substantial secondary enrichment. The area has been a peneplain for a very long period of time and hence the rate of erosion of the deposits has been very slow; this has allowed circulating waters to permeate the same ground for very long periods, and, apparently, to dissolve the gold and redeposit it lower down in the lodes. The unusual chemical environment of the orebodies (hematite) with which some manganese dioxide is frequently associated, may have facilitated enrichment. Evidence suggesting secondary enrichment is :-

(1) Many shoots, e.g., Whippet and Skipper, were relatively barren for 25 to 50 feet below the surface and contained unusually rich ore below these levels. At the Whippet, the grade fell off at the 150 foot and 200 foot levels. Such rapid variations of grade with depth, independently of structural conditions, strongly suggest secondary, rather than primary, gold deposition. The leaching of the gold from the surface outcrop is particularly suggestive. At the Nobles Knob mine, ore which had averaged 30 to 40 dwt. per ton suddenly passed below the 135 ft. level into ore containing up to 50 oz. per ton. In the Eldorado mine, enriched ore was found above the water table (depth 320 ft.) but exploration at the 400 ft. level has so far failed to reveal ore of the grade mined above the 300 ft. level.

(2) The small amount of alluvial gold found at Tennant Creek suggests that gold was taken into solution and carried down to form the rich pockets now being discovered.

IV. MAJOR INDIVIDUAL PRODUCING MINES.

For the year ended 30th June, 1949, 83 per cent. of the total ore output was obtained from four mines - Eldorado, Whippet, Skipper Extended and Nobles Knob.

Eldorado.

As mentioned above, this mine is at a critical stage in its history, in that ore must now be found below the water table. Some gold has certainly been found at the 400 ft. level and it is imperative for the field that exploration at this level should be most painstakingly carried out, and that results should be conscientiously preserved.

Whippet.

The best ore extended from approximately 70 ft. to 140 ft. below the surface. At the 150 ft. and 200 ft. levels, the grade has fallen considerably. Exploration on the 200 ft. level also indicates that the lens is rapidly diminishing in size and may be very small indeed at the 300 ft. level.

Skipper Extended.

The oreshoot cut out for structural reasons at a depth of 100 ft. Underground prospecting may reveal further shoots but no success has been obtained to date.

Nobles Knob.

This mine has a bright future for a few years, but recent geological mapping indicates that it will bottom at a relatively shallow depth. It is boat-shaped, with a flatly east-pitching keel. However, exploitation of this deposit in the immediate future should compensate for the loss of production occasioned by the depletion of the Skipper and Whippet deposits.

V. OTHER IMPORTANT DEPOSITS.

Northern Star.

When this mine comes into production, it should make a substantial contribution to Tennant Creek production for a limited time. However, the limits of the present orebody have been exposed and the life of the mine will then depend on the possibility of discovering new deposits.

Black Angel.

This mine is potentially an important producer and it is expected that mining will be resumed here during 1949-50.

Additional Prospects.

Exploration is being carried out on a number of deposits which have produced ore in the past, and some of them should make a substantial contribution to production within one or two years.

VI. POSSIBILITY OF DISCOVERIES.

(1) There are a considerable number of deposits on the Tennant Creek field which have not been followed down into the zone in which important enrichments have been found in other mines. Once the geological criteria of the enriched zones are generally known, it may be possible to discover a number of deposits of the Skipper, Whippet and Nobles Knob type.

(2) A better knowledge of the structural factors governing the localization of known rich shoots, may lead to the discovery of further shoots by underground exploration in the vicinity of the known shoots.

(3) A considerable area, especially in the eastern part of the field, has not yet been adequately prospected on the surface, though some gold has been found.

These points and the past history of the field indicate that there is a strong possibility of the discovery of further small but rich shoots of ore at Tennant Creek.