REPORT ON
BLACK ANGEL

and

WHITE DEVIL LEASES.

TENNANT CREEK — NORTHERN TERRITORY.

November 8, 1949.

LOCALITY.

The Black Angel and White Devil Leases are situated 25 miles west-north-west of Tennant Creek. The Black Angel is the most westerly mine of the Tennant Creek Goldfield, and the White Devil adjoins on the east boundary.

LEASES.

The property under option included the following leases:

<table>
<thead>
<tr>
<th>Name</th>
<th>Lease No.</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>G.M.L.</td>
<td>Acres</td>
</tr>
<tr>
<td>Black Angel</td>
<td>29E</td>
<td>20</td>
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<tr>
<td>Black Angel Extended</td>
<td>30E</td>
<td>20</td>
</tr>
<tr>
<td>White Devil West</td>
<td>12E</td>
<td>10</td>
</tr>
<tr>
<td>White Devil East</td>
<td>13E</td>
<td>10</td>
</tr>
</tbody>
</table>

WATER SUPPLY.

A supply of water, suitable for mining purposes only, is available from a bore situated one mile north of the Black Angel mine. The depth of the bore is 250 ft. and the supply capacity is 12,000 gal. per 24 hours. The water is unsuitable for domestic purposes and such supplies must be hauled from the well and bores at the old telegraph station, a distance of approximately 23 miles.

HISTORY: PRODUCTION.

The Black Angel Mine has been worked since 1936 by several successive owners, and has been held by H. J. Turner since 1939. In common with most mines on the field, the Black Angel was closed down and remained idle from 1942 to 1948.

The mine has been a consistent producer and the output of ore places it amongst the leading properties on the goldfield.

Production records in detail are tabulated below. Recovery reported in the records is in gold bullion, the fineness of which approximates 920.
<table>
<thead>
<tr>
<th>Date</th>
<th>Ore Tons</th>
<th>Bullion Oss.</th>
<th>Average Assay per Ton.</th>
<th>Sands Value per Ton.</th>
<th>Head Value per Ton.</th>
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<tr>
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<td>93.00</td>
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<td>-</td>
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<td>2.4</td>
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5488.66  2652.27  9.68  3.44  13.12

Gold recovery is stated as bullion, sands assay is in fine oz: converting gold bullion 1920 fine, into fine gold, value of production as fine gold is:—

- Gold recovered: 8.95 dwt. per ton
- Average sands assay: 3.44 " " "
- Average head value of ore milled: 12.39 " " "

**GEOLOGY.**

Gold bearing formations on the Black Angel and White Devil leases occur in a wide bed of mudstone with narrow interbedded sandstones, extending for a length of 2,500 ft. Sandstone and slate beds lie tonorth and south of the mudstone. The beds have been considerably folded and show a variable strike in plan, with pronounced local orrumples, or bends. The beds have been sheared in an east-west direction, and along this shear or fault zone, the mudstone has been more or less intensively crushed and brecciated. Long bodies of haematite occur along the shear zone, usually on north side, decreasing in width toward the west end of the lory. In this locality the haematite is less than 10 ft. in width, only inconspicuous where it is associated with the more important of other orebodies. At such points, cross shearing in a north-south direction are strongly in evidence.

The geological structure presents certain significant factors. It is being established that gold occurrence is associated with favourable beds. These favourable beds are mudstone. Suitable localities for orebodies are those where the beds have been sheared, or crushed along the course of zones of shearing, particularly along orrumples in the line of strike have resulted in more
formation of ore shoots. Presence of haematite appears to be essential, and a significant feature is the association of north-south shears with occurrence of gold.

On the Black Angel and White Devil leases, the shearing is usually at an acute angle with the bedding planes of the sedimentary rocks; bends and ormalhes occur, and the intersection of these bends by the shearing, forms favourable locations for ore shoots.

Four auriferous shoots are known of the Black Angel lease; one has worked to below the 105 ft. level, two have not been worked below a depth of 40 ft., and no work has been done on the fourth. These shoots are:

1. The main shoot, which contains the principal workings, is 37 ft. by 16 ft. in horizontal area at surface, where it appears between Nos. 3 and 5 shafts.

2. No. 1 shoot is 20 ft. south of the southern margin of the main shoot; it has a horizontal area at surface of 40 ft. by 18 ft.

3. No. 2 shoot reaches surface west of No. 2 shaft and has a surface area of 20 ft. by 10 ft.

4. The fourth shoot outcrops east of No. 6 shaft and in the open cut has dimensions of 40 ft. by 15 ft.

On the White Devil lease, mining has been little more than prospecting, consequently, evidence of gold occurrence at a number of points cannot be regarded as indicating the existence of workable ore shoots: the importance of the indications must be established by further exploratory work. One shoot of possible importance has been exposed at Rowe's shaft, No. 9; the exposed length is 45 ft. and may extend a further 25 ft. both east and west. Workings 100 ft. east of Rowe's suggest possibilities at this point. Other encouraging localities for exploration exist along the south haematite-mudstone contact on the White Devil leases.

The main shoot, and Nos. 1 and 2 shoots on the Black Angel lease are within the area worked by Nos. 1, 2, 3, 4 and 5 shafts. The strike of the beds is north-east south-west, and the dip is to the north-west about 45 deg.; the strike of the shear zone is 90 deg. The resulting pitch of the main shoot is north-west at 55 deg. A similar pitch may be expected in Nos. 1 and 2 shoots. The main shoot has been proved to a vertical depth of 141 ft.; values were followed from surface to the underwall of the shoot in No. 5 shaft, and were not met above depths of 30 ft. from surface in No. 3 shaft, and 50 ft. in No. 2 shaft. No. 5 shaft passed out of values at a depth of 50 ft. and No. 3 shaft at 70 ft. The shoot at No. 6 shaft is limited to the east by a porphyry formation which crossed the line of lode in a north-south direction, and will give a west pitch to the ore shoot which has been proved to a depth of 50 ft. but probably continues.

Prospects for the location of additional ore shoots are encouraging. The mudstone beds, with included narrow lenses of haematite, extend for 600 ft. from the No. 1 shaft to the porphyry east of No. 6 shaft. This mudstone bed should be more intensively explored. From the abovementioned porphyry, two parallel lenses of haematite, 60 ft. apart, extend east for 260 ft.; mudstone is associated with the south lens. Continuity eastward is then interrupted either by a fault, or an echelon arrangement of the haematite lenses, for the haematite bodies on the White Devil leases lie 140 ft. north of the eastward projection of the line of shear on the Black Angel, and their outcrop reappears beyond a gully 120 ft.
1936 are important; the following is an extract from the report on the Black Angel – White Devil area, on which two major anomalies were located.

"No. 1. anomaly" (White Devil) "of 8,000 gammas, is the strongest discovered at Tennant Creek. It indicates a large elongated body of ironstone, probably coming to within 100 ft. of the surface, but giving no geological evidence of its presence. Within the immediate vicinity of the anomaly there are outcropping bodies of dense fine grained haematite with very little quartz noticeable."

"No. 2 anomaly of 5,000 gammas is also elongated and is on the western extension of the axis of the No. 1 anomaly. The axis of the anomalies is parallel and not far distant from the line of outcropping ironstone in the vicinity. The body responsible probably comes to within 200 ft. of surface."

"The two large bodies giving rise to the anomalies are considered to be important in view of the fact that they are associated with outcropping bodies which have been proved to yield from half to nearly 1 oz. of gold per ton."

Further comment states: "It is considered that the survey results on this area are extremely important as they reveal possibilities of ironstone bodies at sufficient depth to make the area a likely proposition for major operations. As gold deposition is proven in the three groups of workings, it is considered that investigation at depth is warranted."

MINE WORKINGS:

Black Angel:

The main workings on this section of the property are centred round Nos. 1, 2, 3, 4 and 5 shafts.

No. 1 Shaft. This, the most western shaft of the group, is 183 ft. deep, and was sunk to meet the main ore shoot on the pitch, but failed to do so, possibly due to the shaft being placed too far south of the pitch line. The shaft passed through mudstone to the 170 ft. horizon and continued in black slate. No opening out was done at the 183 ft level, but at a depth of 150 ft. a crosscut was driven north in mudstone for 35 ft., where haematite was reached. A short east drive in somewhat altered mudstone was commenced at this level.

No. 2 Shaft. is 110 ft. east of No. 1 shaft. It is the main haulage shaft, and is 103 ft. deep. All ore above the 103 ft. level can be worked from it, and deeper values have been proved by winzing to 38 ft. below the level, or a total vertical depth of 141 ft. A crosscut has been driven 24 ft. north, and 45 ft. south of the shaft meeting the footwall at 30 ft. From these, drives are cut 45 ft. east and 55 ft. west, and at 23 ft. west, the winze has been sunk to a total depth of 58 ft., passing out of values, due probably to the pitch of the shoot, at 38 ft. A strong fault shows in a crosscut at 78 ft. west of the shaft, and also in the main crosscut at the shaft.

Sampling by the Geological Survey gave the following results:
- Main crosscut: to 14 ft. south of the shaft; 1.0 to 5.9 dwt. per ton, average 2.3 dwt. per ton.
- West Drive: 10 ft. to 55 ft.; 0.6 to 29.5 dwt. per ton, average 8.7 dwt. per ton.
- North crosscut: at 40 ft. west of shaft; three samples cut assayed 9.1, 2.3 and 20.1 dwt. over sections of 4 ft.
The general average of the sampling is low, but it is stated that all material broken on the 103 ft. level, amounting to 420 tons, was milled in the crushing of 605 tons put through in October, 1949, for the recovery 158 oz. of gold, the average head value being 7.8 dwt. per ton. The statement appears correct, and it may be inferred that sampling did not correctly represent the value of the ore mined.

At the 67 ft. level ore has been stopped for a length of 70 ft. and a width of 15 ft. The stope rises above the 50 ft. level to about 35 ft. from surface; at the 50 ft. level the stope is 70 ft. long and 10 ft. wide. Crosscuts extend 30 ft. north, in stuff, and 45 ft. south in sandstone.

Ore remains in situ between the 67 ft. and 103 ft. levels; below the 103 ft. level the only work done is the winze showing ore to 35 ft. The shape of the workings does not permit calculation of tonnage, but an amount of 2,000 tons is a reasonable approximation of ore unstoped above the 103 ft. level.

It is very essential that careful sampling be carried out to determine tonnage and grade of ore remaining in the main shoot above the 103 ft. level, and to determine accurately the boundaries of the ore shoot.

South of the main ore shoot, and separated from it by 20 ft. of sandstone, is No. 1 shoot, which has been worked by an open cut and a shaft to a depth of 40 ft.; connection has been made with the main shoot workings at the 50 ft. level. This shoot calls for further prospecting below the depth reached.

Nos. 3, 4 and 5 shafts, situated within a distance of 100 ft. east from No. 2 shaft, were sunk to depths of 70 ft., 50 ft. and 50 ft. respectively, and, in turn, passed through the orebody into country rock by reason of the angle of pitch. Throughout the main shoot workings, north-south cross shears intersect the lode and are in close association with the gold occurrence.

Between Nos. 5 and 6 shafts: The intervening distance is 260 ft. Haematite and lode formation persist, but no ore shoot has been located. Two long costeans at 135 ft. and 175 ft. east of No. 2 shaft cut across haematite, lode formation and highly ferruginous sediments, probably mudstone; normal mudstone occurs at the ends of the costeans. It is stated that gold was obtained by panning in these workings.

Further prospecting of the formation between Nos. 5 and 6 shafts is warranted.

No. 6 Shaft: This shaft is 500 ft. east of No. 1 shaft. Ore is being broken in an open cut 40 ft. long, 15 ft. wide and 35 ft. deep, the shoot ending against porphyry at the east end.

The shaft has been sunk to a depth of 54 ft. in haematite; nothing is known of values, if any. A drive has been put out 45 ft. on a bearing of 70 deg. and connects with the open cut workings. Values were not met in the drive between the shaft and the west end of the open cut shoot at 40 ft. east. At 43 ft. east of the shoot a north crosscut is stated to show gold. Ore from the open cut has not been milled separately, but 180 tons was included in the crushing of October, 1949, which had an average head value of 7.8 dwt. gold per ton. East of the open out, porphyry, dipping west, crosses the line of lode and will force the shoot to the westward with increasing depth.
shaft at 60 ft. west of No. 6 shaft. This shaft is 10 ft. deep and has been sunk on the lode channel; it is reported to have produced ore worth 11 dwt. per ton. The shaft is north of the drive at the 54 ft. level. Deeper work at this point is desirable.

WINE WORKINGS.

White Devil Leases.

The line of the workings lies to the north of the eastward extension of the axis of the Black Angel workings. Conspicuous features are three long lenses of haematite, separated by short breaks, and associated throughout, with mudstone. The western lens is 300 ft. long, with a mean width of 55 ft.; the middle lens is 340 ft. long and 50 ft. wide; the east lens has a length of 300 ft. and a mean width of 8 ft. The anomaly reported by the Aerial, Geological and Geophysical Survey of Northern Australia, is situated to the north of the middle lens.

The contact of the haematite and mudstone along the south side of the haematite lenses has been followed by shallow shafts at fairly wide intervals. These shallow workings are stated to have shown gold in most cases. At the eastern end of the line, No. 17 shaft, 15 ft. deep has given prospects containing up to 10 oz. of gold per ton; similar isolated prospects were obtained in the surrounding surface, but no systematic effort has been made to locate an ore shoot.

Favourable prospecting conditions on the White Devil extend over a length of 1,100 ft. along the haematite-mudstone contact. A second line, along which prospects of gold have been obtained, extends for the full distance, at from 40 ft. to 100 ft. south of the haematite, following a mudstone-slate contact.

The principal working on the White Devil lease is at No. 9 or Rowe's shaft; this is 40 ft. deep with a drive bearing 76 deg. at the 40 ft. level, extending 27 ft. east and 15 ft. west. The width worked is 7 ft., the footwall only, being exposed. Production was 378 tons of ore of an average grade of 10.6 dwt. per ton. The workings are in a crumble in the mudstone beds, which are cut obliquely by the shear and dip north-west, as on the Black Angel, at an angle of 53 deg. The dip of the footwall is south at 70 deg. A shaft, 74 ft. west of Rowe's is 35 ft. deep and at 24 ft. east a shaft has been sunk to a depth of 24 ft. It is reported that all these workings produced ore worth from 8 to 10 dwt. gold per ton.

At 120 ft. east of Rowe's workings is a small open out from which good gold is stated to have been won; No. 11 shaft, 10 ft. deep; No. 12 shaft, 10 ft. deep, and No. 13 shaft, 12 ft. deep, are 300 ft., and 360 ft., and 400 ft., respectively, east of Rowe's workings. All are in mudstone on the south edge of the haematite, with the exception of No. 12 shaft, which is at the east end of the west lens. Three shallow shafts, Nos. 14, 15 and 16, are 6 ft.
across the mudstone, the most southern being 70 ft. south of the
contact.

No. 17 shaft, 860 ft. east of Rowe's is 12 ft. deep in mudstone
- a small quantity of stone worth 10 oz. gold per ton was found here,
and prospecting on the adjacent surface is stated to have disclosed
good prospects, but no systematic exploration for an ore shoot has
been done.

The workings on the White Devil leases are small and widely
spaced. One ore shoot has been definitely located, but the general
occurrence of gold along the length of the haematite-mudstone contact
on the south side of the ironstone, is definitely encouraging to
further and more intensive prospecting for the purpose of proving
the White Devil area.

SUMMARY AND CONCLUSIONS.

The Black Angel - White Devil group of leases, 25 miles west-
north-west of Tennant Creek, forms one of the areas of greatest
potential importance on the goldfield.

The four leases included in the option are :-

<table>
<thead>
<tr>
<th>Lease</th>
<th>Acres</th>
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<tbody>
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<td>G.M.L.</td>
<td>29E</td>
</tr>
<tr>
<td>G.M.L.</td>
<td>50E</td>
</tr>
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<td>12E</td>
</tr>
<tr>
<td>G.M.L.</td>
<td>13E</td>
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Since 1936, production from the Black Angel leases was 5,488.66
tons of ore from which were recovered by amalgamation, 2652.27 oz.
of gold bullion, an average recovery of 9.68 dwt. per ton; the average
head value of all ore treated, in terms of fine gold is 12.34 dwt.
gold per ton.

Recorded production from the White Devil leases was 378 tons of
ore of an average grade of 10.6 dwt. per ton.

Gold, either in workable tonnage of ore, or in prospects, occurs
throughout a length of 2,300 ft. in crushed and brecciated mudstone,
along a line of shearing which follows closely the contact of the
mudstone beds and the parallel haematite lenses. Mudstone is con-
sidered as the most favourable of the sedimentary rocks for the
occurrence of gold; and bands, or crumples in the strike of the beds,
where out by the shear zone, with resulting intensified brecciation,
form particularly favourable localities for the occurrence of ore
shoots. A number of such points on the leases have been very in-
adequately prospected.

On the Black Angel leases, at the west end of the line, four ore
shoots are known.

The main shoot, at Nos. 2,3,4, and 5 shafts, 37ft. by 16 ft. in
horizontal section at surface, and 70 ft. by 15 ft. at the 67 ft.
level, has been proved to a vertical depth of 141 ft. and
probably continues to greater depth. The shoot has been ex-
tensively stoped to the 67 ft. level, and stoping has been
commenced at the 103 ft. level.

No. 1 shoot, 30 ft. south of the main shoot outcrops over an
area of 40 ft. by 18 ft. It has not been worked below a depth
of 40 ft. from surface, and definitely warrants deeper prospect-
ing.
The shoot at No. 6 shaft is 260 ft. east of the main shoot, it is 40 ft. by 15 ft. in area and workings have reached a depth of 35 ft. further downward extension can be expected. A favourable prospecting area, which justifies close attention lies between No. 6 shaft and No. 5 shaft to the west.

On the White Devil leases, one definite ore shoot has been disclosed, and encouraging prospects have been obtained along a length of 1,100 ft. The shoot at No. 9 or Rowe's shaft, has been proved for a length of 43 ft. and a further extension along the strike of possibly 50 ft. is indicated by shafts to the east and west of the workings. The length of the White Devil haematite-mudstone contact offers attractive scope for extensive and systematic prospecting.

Ore reserves in the Black Angel section are difficult to calculate, but in the No. 2 shaft workings it is estimated that 2,000 tons of ore are available above the 103 ft. level. Ore continues below that level for 58 ft., and probably further, but in the present state of development, no tonnage can be estimated.

Encouraging operating results and favourable geological factors, including an extensive mudstone bed, which is buckled and bent in places along the strike, a strong intersecting east-west shear zone, crossed by pronounced north-south shears, and closely associated has haematite, are supported by the results of the geophysical survey, in the location of two very strong anomalies. The report of the Aerial, Geological and Geophysical Survey of Northern Australia states: "It is considered that the survey results of this area are extremely important as they reveal possibilities of ironstone bodies at depth sufficient to make the area a likely proposition for major operations."

The proposition is essentially one of prospecting and exploration to prove extension of known ore shoots, and to locate new shoots. Work should be directed to:

a. Prospecting for the downward extension of the main shoot from 58 ft. below the 103 ft. level.

b. Continue the north crosscut at the 103 ft. level of No. 2 shaft.

c. Prospect the No. 2 ore shoot from surface.

d. Explore the downward extension of No. 1 shoot, either by winzing from the present depth, 40 ft., or by crosscutting from the 67 ft., and subsequently the 103 ft. level.

e. At No. 6 shaft, crosscut north from the west drive at 70 ft. and 160 ft. west from the shaft to locate the shear zone, where the occurrence of gold is possible.

f. Systematically prospect the outcropping formation between Nos. 5 and 6 shafts.

g. On the White Devil leases, drive east and west at No. 9 shaft, and sink a further 50 ft. on the shoot.

h. Carry out closer and deeper prospecting along the length of the mudstone-haematite contact on the White Devil leases.
Briefly, the Black Angel–White Devil leases form an attractive exploratory proposition; they have a satisfactory record of production, and geological evidence favours extension of known ore shoots and the existence of new shoots. The extensive scope for prospecting in favourable beds makes possible the proving of a mine of large tonnage possibilities, and in the course of exploratory work, an important tonnage of ore may be won from development operations.

(sgd) M. R. McKeown

Consulting Mining Engineer.