REPORT ON THE BLACK ANGEL - WHITE DEVIL GROUP OF GOLD MINING LEASES, TENNANT CREEK GOLDFIELD, NORTHERN TERRITORY, AUSTRALIA

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by HECTOR J. WARD

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Fig. 1 Tennant Creek Goldfield, Northern Territory, Australia, showing location of Black Angel Mine

Fig. 2 Sketch plan showing relationship of Crusader, Black Angel and White Devil Group of Leases. Tennant Creek Goldfield

Fig. 3 Surface geology in the vicinity of Black Angel and White Devil Workings, Tennant Creek Goldfield, Northern Territory, Australia.

Fig. 4 Black Angel Gold Mine, Tennant Creek.

Fig. 5 Black Angel Mine, Black Angel Lease, Tennant Creek Goldfield, Northern Territory.

SCALE:

2 miles to 1 inch.

400 feet to 1 inch.

100 feet to 1 inch.

100 feet to 1 inch.

50 feet to 1 inch.

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1. **SUMMARY AND CONCLUSIONS**

An inspection of the Black Angel - White Devil group of goldmining leases about 21.5 miles on a true bearing of N61°W from Tennant Creek, Northern Territory (fig. 1.) was made during the latter part of September, 1963.

In the area the gold-bearing lenticular quartz-hematite bodies which crop out are some of the biggest in the Tennant Creek Goldfield. They are in a shear zone about 5,000 feet long (fig. 3.). The shear zone strikes either east or about N60°E and dips steeply to the north or to the south. The country rocks are part of a sandstone-shale-mudstone-siltstone sequence of Lower Proterozoic rocks in which gold and gold-copper orebodies have been found elsewhere in the Goldfield.

In 1937 magnetometer surveys disclosed two very strong magnetic anomalies, one near the Black Angel and the other near the White Devil workings. Between 1957 and 1959 Peko Gold Mines Ltd. drilled four diamond drill-holes in an attempt to discover whether the anomalies represented Peko-type orebodies. No such copper orebodies were found.

The drilling by Peko Gold Mines Ltd. was not aimed to test the zone of oxidation and secondary enrichment which may be present. No systematic testing of this zone has yet been undertaken.

The total recorded production is 6,530.44 tons of ore averaging 9.3 dwts of gold per ton. The bulk of the production has come from the Black Angel section of the area.
2.

The deepest shaft is 180 feet below ground level (figs. 3 and 4). However, about 6,000 tons of the total production has come from mine workings within 70 feet of the surface close to Nos. 2 and 3 shafts (fig. 5).

Considering the horizontal extent of the quartz-hematite bodies (namely about 5,000 feet) only a small amount of exploration and development work has been done. This is insufficient to finally evaluate the economic worth of the deposits in the Black Angel-White Devil area.

The orebodies in their present state must be regarded as targets for exploration and not immediate mine development and production.

Exploration capital can be safe guarded if the results of each stage of the exploration programme recommended below are assessed with respect to the financial risk involved before proceeding with the next stage.

The total cost of the programme is estimated at £16,500 to £21,500 if geological and geochemical investigations are followed by drilling.

2. RECOMMENDATIONS

A staged programme of mineral exploration should be undertaken to determine whether economic gold ore is in the zone of oxidation and enrichment.

The first step is to carry out a detailed geochemical survey using either copper or bismuth as pathfinders for gold.
3.

The estimated cost is £3,500.

The second step involves examination of the underground workings to prepare adequate geological and assay plans and sections. This step will be contemporaneous with the first. The estimated cost is £3,500.

The third step is to drill the strongest geochemical anomalies. No definite cost can be estimated for this step. The cost may range from £10,000 to £15,000 depending on the drilling methods used and the number of holes required.

Under no circumstance is any drilling recommended until a geochemical survey is undertaken and the results assessed.

3. INTRODUCTION

The Black Angel - White Devil goldmining area in the Tennant Creek Goldfield of the Northern Territory was examined on behalf of Aurous Development Ltd., Sydney. The area was visited between the 17th and 22nd September, 1963. Travelling time to and from Tennant Creek took an additional four days.

The purpose of the examination was to determine whether the area warranted testing by drilling. Maps prepared by Ivanac (1954) were used for the examination and are presented here in modified form (figs 3 and 4).

The Mines Branch of the Northern Territory Administration, Tennant Creek, kindly assisted the writer by giving access to diamond drilling results and available plans and sections of the Black Angel - White Devil area.
4. HISTORY AND PROPERTY OWNERSHIP

The Black Angel - White Devil area is thought to have been discovered about 1936. Mines Department records show the first owner as H.J. Turner. In 1941 Turner took up the Gold Mining Leases Nos. 12E, 13E, 29E, and 30E (fig. 2) and held them till 1957. G.M.L. 12E and 13E are at the eastern or White Devil end of the auriferous area and G.M.L's 29E and 30E are at the Black Angel end. Before 1941 the Aerial, Geological and Geophysical Survey of Northern Australia (Richardson, 1937) discovered two of the most intense magnetic anomalies in the Tennant Creek Goldfield, one on the Black Angel and the other on the White Devil. In 1957 Turner sold the leases to H.V. Lennard, who in turn optioned them to Peko Gold Mines Ltd. Tennant Creek. Peko Gold Mines Ltd. undertook a limited drilling programme to determine whether a copper orebody similar to that at Peko was present in the Black Angel - White Devil group of leases. No copper orebody was intersected by the four drill holes drilled by Peko Gold Mines Ltd. who subsequently relinquished title to the area. Between 1960 and 1962 Leslie Jones of Tennant Creek held leases in the area. In June 1963 A. McDonald of Tennant Creek took possession of the Black Angel section by applying for Prospecting Area 210E together with G.V. English. At the time of the examination other mining tenements in the area were P.A. 211E and 212E held by J. English, Tennant Creek, G.M.L. 662E held by G.F. Richards,
Tennant Creek and G.M.L. 680E applied for by J. Forbes, Sydney. The present owners are arranging to secure title over the ore zone by pegging four claims totalling 64 acres. The claims are to be known as the Golden Angel, Black Angel, Golden Heart and White Devil.

Adjoining the Black Angel leases are the shallow workings known as the Crusader group of Leases (former G.M.L.'s 383E, 394E, and 385E) held by H.V. Lennard from 1952 to 1955. Messrs. L.J. Kittle and J.J. Higgins of Tennant Creek held the Crusader workings under G.M.L. 82E until October 1956. Peko Gold Mines held the ground while testing the Black Angel-White Devil Group of leases.

During the tenure of the area by Peko Gold Mines the Bureau of Mineral Resources Geology and Geophysics carried out a geochemical prospecting programme for copper in the Black Angel - White Devil area as part of a regional geochemical survey for copper of the Tennant Creek Goldfield (McMillan and Debnam, 1961). The results of this survey are outlined in a following section.

5. PRODUCTION

Gold ore has been mined principally from the Black Angel lease (G.M.L. 29E, later G.M.L. 655E and now P.A. 210E) from a group of five shafts (fig.3). The largest tonnage of ore has been taken from a stope between Nos. 2 and 3 shafts less than seventy feet from the surface. Reportedly about 450 tons
of the total production has been taken from other workings (namely 90 tons from No. 6 shaft and about 350 tons from the White Devil shaft).

<table>
<thead>
<tr>
<th>Year</th>
<th>Ore Produced (Long Tons)</th>
<th>Recovery by Amalgamation (Dwts/Ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st July 1935 to 30th June, 1936</td>
<td>221.3</td>
<td>18.0</td>
</tr>
<tr>
<td>&quot; 1936 &quot; &quot; 1937 &quot;</td>
<td>87.5</td>
<td>2.6</td>
</tr>
<tr>
<td>&quot; 1937 &quot; &quot; 1938 &quot;</td>
<td>134.8</td>
<td>18.2</td>
</tr>
<tr>
<td>&quot; 1938 &quot; &quot; 1939 &quot;</td>
<td>430.0</td>
<td>21.7</td>
</tr>
<tr>
<td>&quot; 1939 &quot; &quot; 1940 &quot; 1,163.06</td>
<td></td>
<td>6.9</td>
</tr>
<tr>
<td>&quot; 1940 &quot; &quot; 1941 &quot; 992.28</td>
<td></td>
<td>12.6</td>
</tr>
<tr>
<td>&quot; 1941 &quot; &quot; 1942 &quot; 1,207.63</td>
<td></td>
<td>7.6</td>
</tr>
<tr>
<td>&quot; 1942 &quot; &quot; 1947 &quot; No production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot; 1947 &quot; &quot; 1948 &quot; 575.52</td>
<td></td>
<td>7.3</td>
</tr>
<tr>
<td>&quot; 1948 &quot; &quot; 1949 &quot; No production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot; 1949 &quot; &quot; 1950 &quot; 1,183.5</td>
<td></td>
<td>6.7</td>
</tr>
<tr>
<td>&quot; 1950 &quot; &quot; 1951 &quot; 379.0</td>
<td></td>
<td>3.9</td>
</tr>
<tr>
<td>&quot; 1951 &quot; &quot; 1963 &quot; No production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot; 1963 to date</td>
<td>155.85</td>
<td>3.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6,530.44</strong></td>
<td><strong>9.3</strong></td>
</tr>
</tbody>
</table>

According to Ivanac to the end of June 1949 the tonnage produced represents about 3 per cent of the total gold mined at Tennant Creek, and the number of fine ounces is about 16 per cent of total production.
From the production figures it can be seen that Turnier was responsible for the greatest tonnage of ore produced. Furthermore, the grade of the ore has steadily decreased. In the writer's opinion this is in some measure due to the fact that mining was conducted largely by continually stripping the walls of the stope between Nos. 2 and 3 shafts. The total footage of horizontal exploratory openings from Nos. 2 and 3 shafts is some 500 feet. From No. 1 shaft on the 150 foot level only 90 feet of crosscuts were made. At 54 feet below the surface in No. 6 shaft 200 feet of drifting was undertaken. Over the most productive period (6 years) of the mine's history 2165.7 ozs. of gold was won, worth roughly £30,000. Taking into consideration mining and development costs and a period of enforced idleness during the 1939-45 war, perhaps insufficient funds were available to the owners to explore the deposits systematically should they have so desired.

6. LOCATION, ACCESSIBILITY.

The Black Angel - White Devil group of leases are 21.5 miles on a true bearing of N61°W from Tennant Creek township at approximate Longitude 133°58' E and Latitude 19°29'S. The Black Angel Mine is 32 miles by road from Tennant Creek. The first 22 miles is a north-westerly bitumen road to the Orlando Mine, then a bush track trending south-westerly for 10 miles to the Black Angel - White Devil workings.

Tennant Creek is some 600 road miles south of the port of Darwin and 300 miles north of Alice Springs at the rail head from Adelaide. It has good shopping, postal and
accommodation facilities and is the closest source of mine labour.

7. **GENERAL INFORMATION**

The Black Angel - White Devil area is situated in low-lying hills about 50 feet above the general elevation of the surrounding plain. Apart from the nearly mile long line of dark red-brown to black quartz-hematite lode no natural features distinguish the area particularly from any other part of the goldfield.

Throughout the Tennant Creek Goldfield the temperature is seldom less than 55°F between May and September which makes for a pleasant winter period. The high (90° - 115°F) summer temperatures often become unbearable. South-easterly winds prevail in strength throughout the year excepting for stormy periods when the wind blows from the north and west. The average annual rainfall at Tennant Creek is 14 inches and it is likely that about the same amount of rain falls in the mine area.

An unused bore about 1 mile north of the Black Angel Mine is possibly capable of providing water for domestic use and at least exploratory and small scale mining operations. Timber for such purposes can be drawn from extensive flats two to five miles from the mine. In the vicinity of the workings vegetation is sparse.
8. GENERAL GEOLOGY.

The rocks of the area are part of a sandstone-shale-mudstone-siltstone sequence belonging to the Warramunga Group of Lower Proterozoic Age. The sandstone may be coarse, medium or fine grained. Tuffaceous sandstones are more common in the northern than in the southern part of the area.

On the surface the rocks are reddish in colour. From the deeper mine workings (up to 180 feet below the surface) the rocks are grey green to dark greenish-black, talcose, chloritic slates and schists, dense grey earthy siltstones and fine to coarse grained greywackes.

Bands of rocks which have been termed "grits" or "conglomerates" are in the sandstone-shale-mudstone-siltstone sequence. They are greenish grey hard rocks with rounded pebbles set in a matrix which is soft and ferruginous in many places. The pebbles with few exceptions are less than half an inch in diameter. Some pebbles may be 2 - 3 inches in diameter. Barren white quartz veins fill fractures in these rocks. The strike of the quartz veins is predominantly at right angles to the strike of these rocks. The name "conglomerate" has been retained on the accompanying map (fig. 3).

The "conglomerates" in the main, exhibit the same general attitude as the surrounding sediments. However, variations in dip and strike which do occur lends support to a postulated igneous origin. Whether these rocks are igneous porphyries...
or recrystallised sediments which have been emplaced in the surrounding sediments by virtue of their mobility may only be decided by continued detailed geological and geochemical investigations. The relationship of these rocks to ore in other parts of the Goldfield necessitates an understanding of their origin as an aid in mineral exploration.

9. **STRUCTURAL GEOLOGY**

The sediments trend north-westerly and dip south-westerly. Changes in the attitude of the rocks have been observed. Bedding is not everywhere identifiable because it is obscured by strongly developed cleavage. The Black Angel - White Devil area is possibly on the southern limb of an anticline plunging 30° - 50° W.

The quartz-hematite bodies from which gold has been mined occupy a shear zone striking N60°E in the White Devil workings, E - W in the Black Angel section and N60°E in the Crusader workings. This shear zone dips from 75°N to 75°S as far as can be ascertained.

In the Black Angel section N50° - 60°E faults displace the east-trending shears. One such fault about 110 feet west of No. 6 shaft displaces an easterly lense of quartz-hematite about 20 feet to the north on its western side. The same fault displaces a band of "conglomerate". About 80 feet to the west of this fault is a parallel fault which has been cut by mine workings. It dips 50° - 60°NW. Thus after the formation of the quartz-hematite bodies movement along N50°-60°W
faults caused significant displacements in the ore channel.

A possible fault which strikes N30°E seems to have caused a horizontal displacement of the quartz-hematite bearing shear zone.

The more common occurrence of tuffaceous sandstones in the northern part of the area tends to suggest that some horizontal displacement of the sediments has taken place. This might be substantiated as exploration and development of the area progresses.

10. THE ORE DEPOSIT.

The quartz-hematite bodies with which gold is associated are steeply dipping lenticular masses cutting across the sandstones, shales and mudstones. Transitions from solid quartz-hematite to hematite-rich brecciated wall rock occur in places. The bodies of quartz-hematite have their greatest surface expression in the White Devil section of the area. The biggest body is nearly 400 feet long and about 40 - 120 feet wide. Near the Crusader workings is another large quartz hematite mass. These ironstone bodies are some of the largest cropping out in the Tennant Creek Goldfield. Elsewhere in the area the mineralised shear zone which is nearly 5,000 feet long, contains irregularly spaced pods lenses, veins and veinlets of quartz-hematite.

In the Crusader and White Devil workings gold has been mined from steeply-dipping bodies. In the stope of the Black Angel working the ore shoots strike east dip vertically and...
plunge 30°W. From observations on the 57 feet level it seems that the plunge of the ore is related to the dip of the beds near their junction with the near-vertical shears.

The hematite of the quartz-hematite bodies has largely originated from the oxidation of magnetite. Pseudomorphs of limonite after magnetite are present in the zone of oxidation.

Gold, the ore mineral, is fine to coarse grained (i.e., > 5 m.m.). It is accompanied by bismuth carbonate, quartz, hematite, magnetite and some malachite in stains and blobs. The primary sulphide minerals as determined by diamond drilling are pyrite, galena and chalcopyrite, none of which have yet been found in economic quantities.

Sericitisation and hematisation are the principal forms of wallrock alteration.

11. ORIGIN OF THE DEPOSIT.

The quartz-hematite bodies owe their origin to hydrothermal activity possibly under hypothermal conditions of temperature and pressure.

12. OXIDATION AND ENRICHMENT.

Since the formation of the gold-bearing ironstones weathering has caused an upgrading of the tenor of the ore. The magnetite bodies have been partly oxidised to hematite and earthy iron oxides near the surface. Primary sulphides such as pyrite and chalcopyrite have been leached, leaving behind leucoxene structures indicative of their former presence.
Boring—drilling results and shaft sinking indicate that the base of the zone of oxidation is 180 - 190 feet below ground level with oxidation effects extending downwards to nearly 300 feet. Compared to other mines on the Tennant Creek Field, this is a rather shallow zone of oxidation, for example:

<table>
<thead>
<tr>
<th>Mine</th>
<th>Depth of Oxidation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peko</td>
<td>at 350 feet</td>
</tr>
<tr>
<td>Nobles Nob</td>
<td>at 400 feet</td>
</tr>
<tr>
<td>Eldorado</td>
<td>about 600 feet</td>
</tr>
<tr>
<td>Northern Star</td>
<td>below 600 feet</td>
</tr>
</tbody>
</table>

Considering the surface extent of the mineralized zone (nearly 5,000 feet) the possibility of finding gold ore in the zone of oxidation and secondary enrichment is enhanced. The zone is worth testing.

13. LOCALISATION AND CONTROL OF MINERALISATION

The quartz-hematite bodies have been localised along two N60°E shears connected by an East shear. Since their formation they have been displaced by N50°E to N60°E and N30°E faults.

In the Black Angel workings it seems that the plunge of the ore (30°N) is controlled by the dip of the sedimentary rocks where they have been dragged along the East shears. On the south side of the main stope in the 57 foot level crosscut the sediments have been dragged anticlinally along the south side of an East shear. Insufficient evidence is available to prove that certain beds are more favourable than others as ore local.
The N45°E to N60°E faults which have displaced the East shear zone have also exerted a control on the localisation of secondary ore. The geochemical prospecting for copper referred to below indicates to the writer that the N50°E – N60°E faults have allowed at least supergene copper solutions to move along their planes.

14. PROSPECTING WORK AND EXPLORATION

Work Completed

a) Geological: Sufficient detailed surface mapping has been carried out to commence a geochemical exploration programme. Further detailed investigation and sampling at the mine workings is required.

b) Geochemical: The Bureau of Mineral Resources, Geology and Geophysics carried out a geochemical prospecting programme for copper in the Black Angel - White Devil area between 1955 and 1957. It was concluded (McMillan and Debnam, 1961) that the area was possibly intermediate in type between the high-copper-anomaly Orlando area and the low-copper-anomaly New Hope-Plumb area.

The writer considers that the copper contour pattern of the area produced as a result of the geochemical survey reveals a noticeable N50°E – N60°E trend in the western part of the area. This trend possibly reflects the N50°E – N60°E faults in the Black Angel – Crusader section. The survey was of a general nature and consequently further detailed geochemical
work will probably disclose a pattern of mineralisation which will assist in providing targets for testing for gold ore in the zone of oxidation and enrichment.

c) Geophysical Results: A magnetometer survey in the Black Angel - White Devil area during 1937 detected two of the most intense magnetic anomalies in the Tennant Creek Goldfield. The results which have been published (Daly, 1957) show that the two anomalies have their centres 400 - 500 feet below ground level.

d) Mining: At the time of inspection the Black Angel stope and the open cut leading into the 50 foot level of the White Devil shaft were the only accessible main workings. The mine workings are shown on Figs 2, 3, 4 and 5.

e) Diamond Drilling: Peko Gold Mines Ltd., Tennant Creek, drilled four holes to test the centres of the two intense magnetic anomalies. The purpose was to determine whether large copper orebodies of the Peko type were present. The holes were not aimed to test the zone of oxidation and enrichment. The position of the drill holes is shown on fig 3. Complete information concerning the results obtained are held by the Tennant Creek office of the Mines Department, Northern Territory Administration. In one hole only (BA3) were signs of economic gold ore found. In drillhole BA3 between 427 feet and 431.5 feet (drill hole length) the results are
427 - 428½ feet  1.7 dwts Au/ton
428½ - 429½ feet  0.25 '' ''
429½ - 431½ feet  6.50 '' ''

With respect to drilling it is worthy of note that the copper anomaly in the Crusader section was not tested.

15. **PROPOSED WORK.**

a) Geological: Geological investigations together with a sampling programme of the mine workings.

b) Geochemical: Detailed geochemical survey using either copper and/or bismuth as pathfinders for gold.

c) Geophysical: Perhaps a survey along more closely spaced traverse lines may show sufficient variations to reflect the fault pattern especially in the Black Angel section. This work is not considered of prime importance at this stage.

d) Mining: In order to facilitate sampling and mine mapping the mine workings should be rehabilitated.

e) Drilling: No diamond drilling can be adequately planned unless a better understanding of the ore controls is obtained. The prime target for drilling is the zone of secondary enrichment. This may be best carried out by waggon drilling providing and only providing that satisfactory sampling equipment can be attached to the waggon drill, otherwise diamond drilling must be used. **Under no circumstance should this work be undertaken until the results of the geochemical survey are known.**
16. **RESERVES AND GRADE OF ORE.**

Past production figures indicate that ore may run as high as 21.7 dwts of gold per ton. Random samples in the Black Angel stopes did not indicate that any gold ore has been left in the stope. However some gold ore has been recently mined, namely 155.85 tons averaging 3.4 dwts on amalgamation of gold per ton. Concerning this parcel of ore A. McDonald says that he added mullock from the dump to the ore mined from a small surface cut near No. 3 shaft. The writer saw where mullock had been removed from the dums and is prepared to believe McDonald's statement as there is no evidence of the mullock being dumped elsewhere.

The known ore shoots have been worked out and consequently no ore can be regarded as proven.

17. **EXPLORATION COSTS.**

Only a general idea of costs can be given at this juncture. However the estimated cost should cover the work recommended.

**Exploratory work over a period of 12 months is estimated to cost £17,000 - £22,000.**

The work recommended will give -

1. Geological mapping and sampling of mine workings.
2. Guidance to underground development and surface prospecting.
3. A geochemical survey to formulate a drilling campaign.
4. A drilling programme to test worthwhile geochemical anomalies.
The cost involved to determine whether drilling is necessary is £7,000.

Geological costs
Drilling
Total
£3,500
£10,000 - £15,000
£17,000 - £22,000

Hector J. Ward
B.Sc. (W.A.) M.S. (Stamford)
REFERENCES


BRIEF APPRAISAL OF BLACK ANGEL-WHITE DEVIL GROUP OF LEASES

Based on: Report of the Black Angel-White Devil Group of Gold Mining Leases, Tennant Creek Goldfield, Northern Territory, Australia. by Hector J. Ward

Large ironstone (quartz-hematite) bodies are exposed on the surface of the Black Angel-White Devil group of leases, Tennant Creek Goldfield. The country rocks are sandstones, shales, mudstones and siltstones of Pre-Cambrian age.

The easterly-trending ironstone bodies are impressive because they are in a well-developed mineralized zone nearly 5,000 feet long. Gold, the ore mineral, has been found associated with the ironstone bodies. Eismuth, copper and galena minerals occur with the gold. They have not yet been found in economic quantities.

The lower limit of the zone of oxidation and enrichment is about 180-190 feet below the surface with weathering effects persisting to nearly 300 feet in places. The considerable length of the mineral deposit enhances the possibility of finding gold ore in the zone of oxidation and enrichment.

A magnetometer survey in 1937 detected on these leases two of the most intensive magnetic anomalies so far discovered in the Tennant Creek Goldfield. Four diamond drill holes, drilled by Peko Gold Mines Ltd, showed that copper ore bodies similar to the Peko copper deposit are possibly not present. The drilling programme was limited and not designed to test the zone of oxidation and enrichment.

A geochemical survey was undertaken between 1955 and 1957 by the Commonwealth Bureau of Mineral Resources, Geology and Geophysics. The geochemical survey indicated that the Black Angel-White Devil deposits lie somewhere in value between the Orlando deposit and the New Hope-Plumb Deposit as far as copper is concerned.

A geochemical copper anomaly was indicated in the Crusader Area (Golden Angel Lease). It has not been tested.

Over the whole of the ore zone only a small amount of exploration and development work has been done. The gold production from the leases is 6,530.44 tons averaging 9.3 dwts. The bulk of this ore (about 6,000 tons) has been mined from the Black Angel workings.
The ironstone bodies in their present state are favourable targets for exploration. Past geophysical and geochemical work was too broad a scale to correlate results with ore controls. Detailed geological and geochemical work should delineate suitable gold ore targets. Furthermore, a staged technical exploration programme will allow an evaluation of the extensive potential of the leases as work progresses. This applies particularly to the zone of oxidation and enrichment which is worth testing for shoots of gold ore.

Hector J. Ward
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October 29, 1963
SKETCH PLAN SHOWING
RELATIONSHIP OF CRUSADER, BLACK ANGEL & WHITE DEVIL
GROUP OF LEASES (1947-1952)
TENNANT CREEK GOLDFIELD
NORTHERN TERRITORY
Scale 400 feet to an inch

The area was covered by reconnaissance Rto. 2114, 2114A, 2114B and 6414A and 6414B
in mid-September 1953

FIG. 2
BLACK ANGEL MINE
BLACK ANGEL LEASE
TENANT CREEK GOLDFIELD
NORTHERN TERRITORY
AUSTRALIA

APPROX. LONG. 135° 05' S6" LAT. 10° 29' 34"

COMPOSITE PLAN OF WORKINGS
AND
LONGITUDINAL SECTION

Based on plans (date: 9-7-1982) held by
Northern Territory Mines Dept.
Tennent Creek

SCALE: 50 FEET TO AN INCH
GEOCHEMICAL ANOMALIES
IN THE VICINITY
OF
THE ANGEL GROUP OF LEASES.
TENNANT CREEK GOLDFIELD
NORTHERN TERRITORY
AUSTRALIA
SCALE 100 FEET TO AN INCH

REFERENCE
COPPER ANOMALY
BISMUTH ANOMALY
COBALT ANOMALY
LEAD ANOMALY
SILVER ANOMALY
POSSIBLE FRACTURE

EXISTING DIAMOND DRILL HOLE

REHEMED DIAMOND DRILL HOLE

SHA
BLACK ANGEL WORKINGS
100 feet to inch