PREFACE

This company intends to reopen the old Zapopan gold mine at Brocks Creek, Northern Territory.

The London publisher, financier and Member of the House of Commons, Horatio Bottomley, once owned the Zapopan mine. In 1892, he secured the option on the mine and floated the Brocks Creek Gold Mining Company to work the Zapopan, the Eureka and the Howley (now owned by BHP) mines. In 1902, the mine was sold to the New Zapopan Company. In 1910, the mine and the plant were purchased by the South Australian Government and later became the property of the Commonwealth Government. The following picture shows the Zapopan gold mine at the turn of the century.

Zapopan Gold Mine, Brock's Creek.

ZAPOPAN GOLD MINE
AT THE TURN OF THE CENTURY
PREFACE

The influx of unusually large quantities of water into this mine was a serious problem for early miners. The Mines Director's report in 1907, the last year of the underground operation, reads:-

"Pumping operations were, on the last day of the previous year, suspended on the New Zapopan mine and by the end of February all the underground workings were flooded. During those 2 months Chinese tributors worked below, being gradually driven out by the rising water."

The underground workings have been filled with water ever since. The ore is heavily sulphided and the recovery appears to have been only about 40 per cent. For example, 124 ozs gold was recovered from 500 tons of refractory ore in 1896 (recovery: 0.25 ozs gold per ton) and tailings were assayed to contain over an oz gold per ton.

The Company believes modern technology will certainly overcome all those difficulties. The grade of ore mined in the past was rich and the reefs were wide. A number of gold mining leases and Exploration Licences have recently been secured by the Company.

April 1981

M Sakurai, Director
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<th>and</th>
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<td>7. Main Reef</td>
<td>12</td>
<td>13</td>
</tr>
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<td>8. Main Reef 2</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>9. No 2 Oblique Reef</td>
<td>12</td>
<td>13</td>
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<td>10. Golden Reef</td>
<td>13</td>
<td>14</td>
</tr>
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<td>11. Ah Qee's Reef</td>
<td>13</td>
<td>14</td>
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<td>21</td>
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<td>21</td>
<td>22</td>
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<td>21</td>
<td>22</td>
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<td>17. DDH 2 and 3, Oblique Reefs</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>18. DDH 4, Ah Qee's Reef</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>19. DDH 5 and 6, Oblique Reefs (Western Extension)</td>
<td>22</td>
<td>23</td>
</tr>
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<td>20. Zapopan Creek Tributaries</td>
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<td>26</td>
</tr>
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<td>26</td>
<td>27</td>
</tr>
</tbody>
</table>
1. **INTRODUCTION**

The gold deposits at Zapopan and exploration and development plans thereof are discussed in this pamphlet.

The Company has just commenced the work and has not yet gained the data and information on the ore deposits, based on its own exploration. The data and information from the following published and unpublished literature were helpful to the writer in the preparation of this pamphlet.

Kind permission allowing access to the literature was given by officers of the State Reference Library and the Library of the Department of Mines and Energy. The writer wishes to express his appreciation.

- Parkes 1892
- Brown & Basedow 1906
- Brown 1908
- Woolnough 1912
- Jensen 1914
- Jensen 1915
- Jensen, Gray and Winters 1919
- Cottle 1936
- Rayner & Nye 1937
- Sullivan & Iten 1952
- Crohn 1968
- Mines Director's Report in: 1895
  - 1896
  - 1903
  - 1904
  - 1905
  - 1906
  - 1907
2. LOCATION AND ACCESS

The location of the Zapapan mine is approximately 170 km southeast of Darwin and 75 km northwest of Pine Creek (Fig 1). The mine is conveniently situated near the new Stuart Highway and is accessible nearly all the year round. The access from the Stuart Highway to the mine is along Fountain-head Road to Brocks Creek turn-off, thence Brocks Creek Road to Brocks Creek, thence Zapopan Road to Zapopan (Fig 2). The following table (Table 1) gives distance and road conditions from the Stuart Highway to the mine.

<table>
<thead>
<tr>
<th>ACCESS FROM</th>
<th>TO</th>
<th>NAME OF ROAD</th>
<th>PAVEMENT AND ROAD CONDITION</th>
<th>DISTANCE (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stuart Highway</td>
<td>Brocks Creek turn-off</td>
<td>Fountain-head</td>
<td>Sealed All weather</td>
<td>5</td>
</tr>
<tr>
<td>Brocks Creek turn-off</td>
<td>Brocks Creek</td>
<td>Brocks Creek</td>
<td>Unsealed Gravel paved Nearly all weather</td>
<td>5</td>
</tr>
<tr>
<td>Brocks Creek</td>
<td>Zapopan</td>
<td>Zapopan</td>
<td>Unsealed Track</td>
<td>1.5</td>
</tr>
</tbody>
</table>
FIG 1
LOCATION OF THE ZAPOPAN MINE
FIG 2 STUART HIGHWAY TO THE MINE
3. **CLIMATE AND VEGETATION**

The region has a monsoonal climate with distinct dry and wet seasons and biogeographically belongs to Eucalyptus savannah. The dry season lasts 7 months from April to October and the wet season 5 months from November to March. Temperatures throughout the year are between 25 and 30 degrees C. The hottest month is November and the coolest month is July.

The general landscape near the mine is open forest consisting of several species of Eucalyptus trees and tall annual sorghum grass. The common species are Eucalyptus miniata, E. tetrodonta, E. Camaldulensis, E. chlorostachys and Malaleuca SPP.

Table 2 gives monthly mean temperatures, monthly mean rainfall and monthly mean numbers of rainy days at Darwin, the nearest city, and Pine Creek, the nearest town, for there is yet no meteorological data based on observation at the Zapopan mine. The data was supplied by the Commonwealth Bureau of Meteorology.
<table>
<thead>
<tr>
<th>Month</th>
<th>Mean rainfall (mm)</th>
<th>Mean number of days of rain</th>
<th>Temperature C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Darwin</td>
<td>Pine Creek</td>
<td>Darwin</td>
</tr>
<tr>
<td>January</td>
<td>383</td>
<td>265</td>
<td>19</td>
</tr>
<tr>
<td>February</td>
<td>325</td>
<td>242</td>
<td>18</td>
</tr>
<tr>
<td>March</td>
<td>267</td>
<td>203</td>
<td>17</td>
</tr>
<tr>
<td>April</td>
<td>101</td>
<td>48</td>
<td>8</td>
</tr>
<tr>
<td>May</td>
<td>13</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>June</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>July</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>August</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>September</td>
<td>15</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>October</td>
<td>55</td>
<td>45</td>
<td>5</td>
</tr>
<tr>
<td>November</td>
<td>132</td>
<td>110</td>
<td>11</td>
</tr>
<tr>
<td>December</td>
<td>244</td>
<td>197</td>
<td>16</td>
</tr>
<tr>
<td>Annual</td>
<td>1,542</td>
<td>1,129</td>
<td>97</td>
</tr>
<tr>
<td>Period of record (y)</td>
<td>68</td>
<td>101</td>
<td>68</td>
</tr>
</tbody>
</table>
4. **HISTORY**

In 1885, Sanders first opened up the mine and, after a trial crushing, abandoned the property.

It was taken up by Mellor in 1888 and was worked until his death in 1890.

In 1891, Webb purchased the mine and offered an option to the London financier, Horatio Bottomley, who floated the Brocks Creek Gold Mining Company to work the mine together with the Eureka and Howley mines. This company carried out considerable development work and erected a battery.

The mine was taken over by the Brocks Creek Goldfield Company in 1897. Considerable development work was carried out on the 45 metre level (150 feet level).

In 1902, it was sold and the New Zapopan Company was formed. The New Zapopan Shaft was sunk to a depth of 67.5 metres (225 feet) and this level was developed. The company ceased the underground operation in 1907 but continued to treat tailings until 1915.

The South Australia Government purchased the mine and the plant in 1910, which later became the property of the Commonwealth Government.

In 1969, GML 139 B and 140 B were taken up by Marsh, Fenton and O'Brien.

Sakurai took up GML 338 B to 340 B, 343 B, 344 B and 346 B in 1980 and EL 2540 was also granted to him in 1981. Subsequently, Zapopan Consolidated Pty Ltd was formed for exploration and development on these properties.
5. PRODUCTION RECORD

The production from the Zapopan mine is shown on the following table, (Table 3).

**TABLE 3. PRODUCTION RECORD**

<table>
<thead>
<tr>
<th>Year</th>
<th>Mill Ore Treated tons</th>
<th>Production Grade ozs</th>
<th>Recovered ozs/ton</th>
<th>Cyanide Ore Treated tons</th>
<th>Production ozs</th>
<th>Grade Recovered ozs/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>1888</td>
<td>300</td>
<td>240</td>
<td>0.80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1889</td>
<td>100</td>
<td>64</td>
<td>0.64</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1892</td>
<td>881</td>
<td>801</td>
<td>0.91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1893</td>
<td>1,606</td>
<td>803</td>
<td>0.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1894</td>
<td>3,400</td>
<td>2,226</td>
<td>0.65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1895</td>
<td>375</td>
<td>517</td>
<td>1.38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1896</td>
<td>3,91</td>
<td>1,642</td>
<td>0.42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1897</td>
<td>800</td>
<td>469</td>
<td>0.59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1898</td>
<td>1,710</td>
<td>1,314</td>
<td>0.77</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1899</td>
<td>3,040</td>
<td>2,408</td>
<td>0.79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1900</td>
<td>2,800</td>
<td>2,125</td>
<td>0.76</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1901</td>
<td>5,790</td>
<td>1,637</td>
<td>0.28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1902</td>
<td>500</td>
<td>50</td>
<td>0.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1903</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1904</td>
<td>1,744</td>
<td>729</td>
<td>0.42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1905</td>
<td>7,603</td>
<td>3,214</td>
<td>0.42</td>
<td>2,686</td>
<td>539</td>
<td>0.20</td>
</tr>
<tr>
<td>1906</td>
<td>5,048</td>
<td>3,402</td>
<td>0.67</td>
<td>6,810</td>
<td>1,725</td>
<td>0.25</td>
</tr>
<tr>
<td>1907</td>
<td>327</td>
<td>270</td>
<td>0.83</td>
<td>2,145</td>
<td>760</td>
<td>0.35</td>
</tr>
<tr>
<td>1908</td>
<td></td>
<td></td>
<td></td>
<td>5,220</td>
<td>983</td>
<td>0.19</td>
</tr>
<tr>
<td>1909</td>
<td></td>
<td></td>
<td></td>
<td>650</td>
<td>679</td>
<td>1.04</td>
</tr>
<tr>
<td>1910</td>
<td>40</td>
<td>20</td>
<td>0.50</td>
<td>675</td>
<td>293</td>
<td>0.43</td>
</tr>
<tr>
<td>1915</td>
<td></td>
<td></td>
<td></td>
<td>144</td>
<td>46.2</td>
<td>0.32</td>
</tr>
<tr>
<td>Total</td>
<td>39,950</td>
<td>21,931</td>
<td>0.55</td>
<td>18,326</td>
<td>4,725.2</td>
<td>0.26</td>
</tr>
</tbody>
</table>
6. **MINING TENURES**

The following properties are secured or are being applied for by the Company, or are being litigated. The positions of the properties are shown on Fig 3 and Fig 4.

### Gold Mining Leases

<table>
<thead>
<tr>
<th>GML No</th>
<th>Area (Hectares)</th>
<th>Granted on</th>
<th>Secured from</th>
</tr>
</thead>
<tbody>
<tr>
<td>139 B</td>
<td>8</td>
<td>1979</td>
<td>Currently litigated</td>
</tr>
<tr>
<td>140 B</td>
<td>8</td>
<td>1979</td>
<td>Currently litigated</td>
</tr>
<tr>
<td>338 B</td>
<td>8</td>
<td>Application</td>
<td>M. Sakurai</td>
</tr>
<tr>
<td>339 B</td>
<td>8</td>
<td>Application</td>
<td>M. Sakurai</td>
</tr>
<tr>
<td>340 B</td>
<td>8</td>
<td>Application</td>
<td>M. Sakurai</td>
</tr>
<tr>
<td>343 B</td>
<td>8</td>
<td>Application</td>
<td>M. Sakurai</td>
</tr>
<tr>
<td>344 B</td>
<td>8</td>
<td>Application</td>
<td>M. Sakurai</td>
</tr>
<tr>
<td>346 B</td>
<td>8</td>
<td>Application</td>
<td>M. Sakurai</td>
</tr>
</tbody>
</table>

### Exploration Licences

<table>
<thead>
<tr>
<th>EL No</th>
<th>Area (Sq miles)</th>
<th>Secured from</th>
<th>Granted on</th>
</tr>
</thead>
<tbody>
<tr>
<td>2450</td>
<td>15.42</td>
<td>M. Sakurai</td>
<td>12.12.80</td>
</tr>
<tr>
<td>2981</td>
<td>10.28</td>
<td>Zapopan Consolidated</td>
<td>Application</td>
</tr>
</tbody>
</table>

### Litigation

GML 139 B and 140 B were granted to Marsh, Fenton and O'Brien in 1970.

The current lessees are:

- McEntee E.M. 62 shares
- Marsh C.J. 38 shares
- Fenton W.B. 10 shares

**Total** 110 shares
FIG 3
GML's 338 TO 340
343, 344 & 346 B

Old railway bridge

100 m

300 m

200 m

Longitude 131°30'
In 1980, M. Sakurai was negotiating with McEntee to purchase her shares in the GML's and, on contacting other lessees, the rest of the shares were sought. In December 1980, Newvo Holdings Pty Ltd lodged a plaint claiming forfeiture of the GML's because of noncompliance of the labor covenant and prior right of 14 days to mark off GML's by Newvo Holdings. The hearing has so far twice been adjourned and the next hearing is scheduled for 23 April.

7. **TOPOGRAPHY**

The EL area lies in a large alluvial plain along a major tributary, including numerous sub-tributaries, of Howley Creek running from east to west. Zapopan Creek is one of the sub-tributaries and runs from north to south to join the major Howley Creek tributary. The Zapopan mine is situated in this alluvial plain near Zapopan Creek.

The entire EL area is generally flat, with the exception of low hills in the northwestern part of EL 2450 and a few other places. The highest elevation in the area is 135 metres and the lowest 90 metres. Rock outcrops are very scarce and there are no continuous outcrops from which good section of sedimentary sequence can be observed.
8. REGIONAL GEOLOGICAL SETTING

The area is situated in Pine Creek Geosyncline of the Lower Proterozoic age. The Lower Proterozoic rocks are thought to have deposited under shallow marine conditions.

The area lies on the southern outskirts of a symmetrical and concentric dome structure around the core of the Burnside Granite (Fig 5). The Burnside Granite is almost concordant to the sediments and is thought to be synkemmatic.

The oldest unit in the dome area is the South Alligator Group. The unit, about 5,000 metres thick, consists of pyritic black shale and siltstone, chert-banded siltstone, algal carbonate, banded iron formation, jaspilites and tuff.

The South Alligator Group is intruded by basic sills and dykes (Zamu Dolerite). The Zamu Dolerite is folded together with the sediments.

The Finniss River Group, 1,500 or 5,000 metres thick, overlies the South Alligator Group. The unit comprises siltstone, slate and minor arkose, quartzite and schist.

After the deposition of the Finniss River Group, all formations in the Pine Creek Geosyncline were folded and intruded by granitic rocks during the Carpentarian age, one of which is the Burnside Granite.
FIG 5 REGIONAL GEOLOGY
(From Solid geology of Pine Creek Geosyncline 1:500,000, 1979 BMR)

- Burnside Granite
- Zamu Dolerite
- Burrell Creek Formation
- Kapalga Formation
- Gerowie Tuff
- Koolpin Formation

Fault

Anticline

Syncline

Scale 1:125,000

0 5 10 km
The Lower Proterozoic South Alligator Group consists of three formations: the Koolpin Formation, the Gerowis Tuff and the Kapalga Formation. The Koolpin Formation, up to 700 metres thick in the Brocks Creek area, is characterised by pyritic and carbonaceous sediments. The Gerowis Tuff, up to 1150 metres thick in the Brocks Creek area, conformably overlies the Koolpin Formation. The tuff is the main tuff unit in the Geosyncline and contains interbedded chert and hematitic siltstone. The Kapalga Formation, up to 600 metres thick in the Brocks Creek area, conformably overlies the Gerowie Tuff. The unit is similar to the Kapalga Formation and is composed of carbonaceous and ferruginous sediments.

The South Alligator Group is intruded by basic lavas (the Zamu Dolerite). The rocks are altered to amphibolite and epidiorite and are folded together with the sediments.

The rock types reported in drill cores and in underground workings are comprised of banded quartzite, amphibolite, cherts, sericite-amphibole schists and black graphitic slate. The Zapopan deposits appear to lie in the South Alligator Group. Detailed information on the ore horizons, however, has not been obtained.

Highly sulphided quartz was mined at the Zapopan mine. Calcite, pyrite, chalcopryite, galena and arsenopyrite are reported to occur in association with gold or gold-bearing quartz.

It is interpreted that the overall geological structure in the Zapopan area is anticline plunging southeast (Fig 6).
Fig 6: Overall Geological Structure
10. **THE ZAPOPOP GOLD DEPOSITS**

10-1. **GENERAL CHARACTERISTICS**

The gold deposits at the Zapopan mine occur in steeply-dipping metamorphosed eugeosynclinal volcanic and sedimentary rocks of Precambrian age. The deposits are concordant to the bedding of the country rocks.

The gold deposits of the Brocks Creek area - Zapopan, Howley, Golden Dyke etc - lie entirely within a distinctive zone of black graphitic slate, iron-rich sediments and tuff of the South Alligator Group (Sullivan & Itan, 1952; Vanderplank, 1965; Crohn, 1975; Nicholson, 1979). (Note: The South Alligator Group in this area used to be called the Golden Dyke Formation). Highly sulphided quartz was mined at the Zapopan mine. At the Cosmopolitan-Howley mine, however, gold was recovered from both quartz veins and the surrounding graphitic slate. The deposits have an appearance of syngenic and the gold enriched beds appear to have been original constituent of the sediments as has been proposed for certain deposits in Canada and Brazil (Ridler, 1970, 1973; Hutchison, Ridler and Suffel, 1971; Eleischer and Routhier, 1971).

The Zapopan deposits resemble the gold deposits in the Archaean of Western Australia, since the environments in both occurrences are composed of tholeiitic dolerite intrusives, tuff, chert and black graphitic slate. The deposits might be linked with the genesis of the Zamu Dolerite, for the association of gold with sodic-intrusive is a common feature in the Western Australian Shield, the Archaean of Canada and Africa, and younger gold deposits in British Columbia, Alaska, California and the Philippines (Gallagher, 1940; Woodall, 1975).
10-2. **GOLD REEFS**

The gold reefs in the Zapopan area are discussed in this chapter. The Zapopan mine is situated on an alluvial flat with a thick soil mantle and the underground workings have been filled with water since 1907. The discussion, therefore, has to rely upon the historical information listed in Chapter 1 and an underground working plan taken from an old "mine tracing".

**Main Reef**

The Main Reef is also called the No 1 Oblique Reef or the Main Fissure Reef and is the main E-W striking reef (Fig 7, Fig 8). It strikes 282 degrees and dips to the south at 55 to 60 degrees. At the 40.8 metre level (136 feet level), it was driven along its course for 132 metres and at the 67.5 metre level (225 feet level) for 21 metres. The reef is 0.9 metres wide carrying 0.83 ozs of gold per ton. The vertical drill hole in 1915 apparently intersected this reef at 102.3 to 109.5 metres. Another parallel reef was met at 143.7 to 145.2 metres assayed 0.295 ozs gold per ton.

**No 2 Oblique Reef**

The No 2 Oblique Reef is 1.8 metres wide carrying 0.43 ozs gold per ton. No information is available on the position and the extent of which it was worked. A possible position is inferred by the writer and marked on Fig 9. There is a possibility, if this position is correct, that the No 2 Oblique Reef represents an eastern part of the Main Reef which is offset by a fault.
Golden Reef

The Golden Reef strikes 330 degrees and dips to the northeast (Fig 10). It was driven on for 66 metres at the 45 metre level (150 feet). The reef appears to be composed of 4 reefs - No 1 to No 4 Golden Reefs. The Nos 2, 3 and 4 Golden Reefs are situated close to each other and occur at 30 metres east of the Golden No 1 Reef. The Golden No 1 Reef is a pyrite rich reef and 2.4 to 3 metres wide carrying 1.4 ozs gold per ton. The Golden Reef No 2 is 0.6 metres wide. The Golden No 3 Reef contains very heavy pyrite and is 2.4 metres wide carrying 1.2 ozs gold per ton. The Golden No 4 Reef is a large reef, 6 metres wide, of which the best ore is reported to have carried 2 ozs gold per ton.

Ah Qee's Reef

The Ah Qee's Reef is another large reef, 2.7 metres wide, carrying 0.45 ozs gold per ton. It strikes 215 degrees and, at the 45 metre level (150 feet level), was driven for 24 metres. It is difficult to determine the position of this reef. The position inferred by the writer is marked on Fig 11. The reef appears to dip to the southeast and seems to have been understopped by a winze (arrow on Fig 11).

Saddle Reef

No information is available on details of this reef. It was encountered and driven across at the 67.5 metre level (225 feet level).

Reef Found by Drilling

A large reef, 10.5 metres wide, was encountered between 44.7 and 55.2 metres by the government drilling in 1915.
It is reported that the whole of this distance is mineralized with pyrite and galena (up to 10% Pb). No information is available as to gold values.

10-3. POTENTIALITY

The potentiality of the Zapopan mine is discussed in this chapter. A precise evaluation of the ore deposits is impossible at this stage because of the lack of factual data. The discussion is, therefore, of only a preliminary nature.

The known reefs referred to in the previous chapter are diagrammatically summarized as follows (Table 4).

**TABLE 4 GOLD REEFS**

<table>
<thead>
<tr>
<th>Reef</th>
<th>Strike (degree)</th>
<th>Dip (degree)</th>
<th>Width (metre)</th>
<th>Length Mined</th>
<th>Grade (ozs/ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main</td>
<td>282</td>
<td>60</td>
<td>0.9</td>
<td>132</td>
<td>0.83</td>
</tr>
<tr>
<td>No 2 Oblique</td>
<td>Unknown</td>
<td>Unknown</td>
<td>1.8</td>
<td>Unknown</td>
<td>0.43</td>
</tr>
<tr>
<td>Au Qee's</td>
<td>Unknown</td>
<td>Unknown</td>
<td>2.7</td>
<td>24</td>
<td>0.45</td>
</tr>
<tr>
<td>Golden No 1</td>
<td>330</td>
<td>NE</td>
<td>3</td>
<td>66</td>
<td>1.4</td>
</tr>
<tr>
<td>Golden No 2</td>
<td>330</td>
<td>NE</td>
<td>0.6</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>Golden No 3</td>
<td>330</td>
<td>NE</td>
<td>2.4</td>
<td>66</td>
<td>1.2</td>
</tr>
<tr>
<td>Golden No 4</td>
<td>330</td>
<td>NE</td>
<td>6</td>
<td>66</td>
<td>Unknown</td>
</tr>
<tr>
<td>Saddle</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>Reef found by drilling</td>
<td>Unknown</td>
<td>Unknown</td>
<td>10.5</td>
<td>Not worked</td>
<td>Unknown</td>
</tr>
</tbody>
</table>
The specific gravity of the ore is now assumed as 2.65. Tonnage per vertical metre on each reef is calculated as follows (Table 5). The tonnage, however, cannot be calculated on some reefs due to the lack of data and these are omitted from the calculation.

**TABLE 5  TONNAGE PER VERTICAL METRE**

<table>
<thead>
<tr>
<th>Reef</th>
<th>Width (m)</th>
<th>Length (m)</th>
<th>Depth (m)</th>
<th>Volume (cu. m)</th>
<th>Tonnage (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main</td>
<td>0.9</td>
<td>132</td>
<td>1</td>
<td>118.8</td>
<td>314.82</td>
</tr>
<tr>
<td>Golden 1</td>
<td>3</td>
<td>66</td>
<td>1</td>
<td>198.0</td>
<td>524.7</td>
</tr>
<tr>
<td>Golden 3</td>
<td>2.4</td>
<td>66</td>
<td>1</td>
<td>158.4</td>
<td>419.76</td>
</tr>
<tr>
<td>Golden 4</td>
<td>6</td>
<td>66</td>
<td>1</td>
<td>396.0</td>
<td>1,049.4</td>
</tr>
<tr>
<td>Au Qee's</td>
<td>2.7</td>
<td>24</td>
<td>1</td>
<td>64.8</td>
<td>171.72</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,480.4</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A figure of 2,480.4 tons per vertical metre is obtained. This gives the following tonnages for the depths of 50, 100, 150, 200, 250 and 300 metres respectively (Table 6).

**TABLE 6  DEPTH AND TONNAGE**

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Tonnage (tons)</th>
<th>Depth (m)</th>
<th>Tonnage (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,480.4</td>
<td>200</td>
<td>496,080</td>
</tr>
<tr>
<td>50</td>
<td>124,020</td>
<td>250</td>
<td>620,100</td>
</tr>
<tr>
<td>100</td>
<td>248,040</td>
<td>300</td>
<td>744,120</td>
</tr>
<tr>
<td>150</td>
<td>372,060</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
From the above table, the 200 metre depth gives some 0.5 million tons of ore at the Zapopan gold mine. The deepest level worked at the Zapopan mine is 67.5 metres (225 feet). From the above calculation of tonnage, a 67.5 metre depth gives 167,425 tons.

The production record, however, shows that only some 40,000 tons of ore was mined from a depth of 67.5 metres. This difference appears to be caused by the following reasons.

1. The 67.5 metre level was not fully developed. This is evident on the old mine working map.

2. Some reefs were apparently struck but could not be worked because of an influx of water. The Mines Director's Report in 1896 reads:— "Systematic development consists of opening to 120 feet the main two-compartment shaft on lease No 329, at that depth a 4 feet reef was struck, averaging 31 dwts (1.55 ozs) to the ton, but the influx of water at that depth was more than the 6 inch pump could cope with."

Further, the Report in 1906 reads:—
"---, (the tributers) put down a winze on No 1 large Oblique Reef for 85 feet, and at that depth took out a crushing of 115 tons which yielded 93 ozs 19 dwts of gold and worked No 2 Oblique Reef (which averaged 6 feet in width) for 65 feet below the lower level, the last parcel understope being 465 tons for 214 ozs gold, but, under the conditions of working, it was impossible to make it pay, as all stone was hauled by windlass and water pumped to the 225 feet level, besides using the mine's large winding and pumping appliances."
3. The influx of large quantities of water to the main shaft also caused miners to go down to a deeper level before an upper level was fully driven. It reads in the South Australia pp. No.55 Brown & Basedow 1906:-

"Owing to the unusually large quantities of water in this mine, too much driving in the upper levels is not advisable, as it results the influx of additional quantities to the main shaft, and it is a matter worthy of investigating by the directors whether the inflow of water from the 135 feet level could not be checked by dams, as is done in some other Australian mine."

4. The New Zapopan Shaft was sunk at a wrong position, and, due to two faults near the shaft as shown on the old mine working map, any development from this shaft was limited only to the west of the shaft. The Mine Director's Report in 1906 reads:-

"-- a drive south-east at the lower level for 200 feet along a big slide of fault which cut off most of the known reefs in the mine, and crosscut from this drive a small leader for 17 feet north and 18 feet east, nothing payable being found and through want of funds the company discontinued all underground work and allowed levels to be flooded."
11. **EXPLORATION PLAN STAGE 1**

11-1. **SITE SURVEYING AND GRID LAYOUT**

A topographic map of 1:5,000 scale will be prepared by the photogrammetric method from the published colour photographs and has been ordered to a contractor. The area which the topographic map portrays is shown on Fig 12. Additional topographic maps on the surrounding areas will be prepared, as requirement arises.

The following points will be surveyed with a theodolite (they have already been pegged by a tape and compass survey). The lines between these points are referred to as the base lines for exploration (Fig 13).

**Point 1**

100 metres due south of the old railway bridge which is located about 1.5 km east of Brocks Creek Siding.

**Point 2**

300 metres due east of Point 1.

**Point 3**

200 metres due south of Point 2. This is the datum peg of GML 338 B.

**Point 4**

200 metres due south of Point 3. This is the datum peg of GML 339 B.

**Point 5**

200 metres due south of Point 4. This is the datum peg of GML 340 B.

**Point 6**

200 metres due south of Point 5. This is the datum peg of GML 344 B.
1. **Point 7**

400 metres due east of Point 4. This is the datum peg of GML 343 B.

2. **Point 8**

400 metres due west of Point 6. This is the datum peg of GML 346 B.

Then a grid of 100 metre centre will be established based on the above lines. Selected areas will be further subdivided to grids of 50 metre centre and then to 25 metre centre.

3. **Geological Mapping**

Because of the scarcity of outcrops, geological mapping is difficult. Nevertheless, every outcrop within the area of the 1:5,000 topographical map will thoroughly be mapped. Possible projected positions of all reefs on the surface and all surface workings in the area to the east of Zapopan Creek will be plotted on the topographical base map.

4. **Costeining**

The following reefs will be followed on the possible eastern and western extensions with several costeans.

(a) The Main Reef on the surface.
(b) Projected position of the Golden Reef on the surface.
(c) Projected position of the Ah Qee's Reef on the surface.
(d) Projected position of the reef found by the 1915 drilling on the surface.
(e) Several reefs in the area to the east of Zapopan Creek.
Zapopan Creek is conveniently situated, its course being transversal to the attitude of quartz reefs and rock formations. Back-hoe trenching on the Zapopan Creek bed will be carried out and the advantages of this work are:

1) quartz reefs and mineralized beds will be sought and evaluated,
2) rocks, exposed by trenching, can be mapped,
3) "wash" can be panned for any alluvial values and
4) soil samples (fine particles of gravel) can also be analysed on Pb, As and Hg values which are used as pathfinders for gold.

11-4. UNDERGROUND MAPPING AND SAMPLING

The New Zapopan Shaft will be drained and the underground workings cleared. This will enable the Company to map underground geology consisting of reefs, sedimentary and volcanic sequences, major and drag folds, and faults. Discussion is underway with a contractor, M.R.Millwood Pty,Ltd, who has recently completed pumping and clearing work of the Cosmopolitan-Howley mine for B.H.P. and Homestake Mining.

Since the accuracy of the old mine workings map is doubtful, the underground base map must be prepared by the methods of mine surveying. Work sheets will be traced from the base map on a good grade of oiled tracing paper. Then drives, raises, winzes and the last stopes will be thoroughly studied and geologically mapped.

Uniform channels will be cut across the face of exposed ore and the resulting chips, fragments and dust collected to make up samples.

Initially, channels will be spaced at 5 metre intervals and, where the first sampling indicates appreciable value, additional intermediate channels will be cut at 0.5 metre intervals.
11-5. DIAMOND DRILLING

Six holes will be drilled initially and the results of these 6 holes will decide a plan on the next group of drill holes. The particulars of the first 6 drill holes are as follows and the positions are shown on Fig 14.

DDH 1

DDH 1, inclined 60 degrees from the horizontal, will be drilled from 60 metres northwest of the Golden Reef to the direction of 240 degrees. If the dip of the Reef is assumed 60 degrees to the southeast, the hole is expected to strike the Golden Nos 2, 3, 4 Reefs at a 52 metre vertical depth (60 metre inclined depth) and the Golden No 1 Reef at 82 metre vertical depth (95 metre inclined depth) (Fig 15). The drilling will be terminated at a 120 metre inclined depth.

DDH 2 and 3

DDH 2 and 3 will be vertical drill holes and are planned to follow the intersection obtained by the most successful drill hole in the 1915 drilling. (Fig 16). The two holes will be situated at 30 metres east and west of the 1915 drill hole. The holes are expected to strike three reefs between 45 and 55 metres, 102 and 110 metres and 138 and 145 metres (Fig 17). The drilling will be terminated at a 150 vertical depth at each hole.
The North Star bores recently commenced are intended to test the saddle reef theory for the Pine Creek field at the extreme southern end.

**FIG 16  THE MOST SUCCESSFUL DRILL HOLE IN 1915.**

2. **Brock's Creek.**—Three holes were drilled at Zapopan, and one at the Faded Lily. The first bore hole put down at Zapopan cut the lode formation at the depth anticipated, but in a broken zone in which no solid quartz was obtained. No payable ore was obtained, but assays up to 2 dwts. 22 grs. were obtained. A new bore site was selected for a vertical hole. Unfortunately, an obstruction prevented further boring at 209 feet 11 ins., the lode not being anticipated before 300 feet. But a parallel lode was encountered at 149 feet, which continued to 184 feet, the country being highly mineralised with yellow pyrites and galena for the whole of that distance. A second vertical bore hole was put down a few feet from the first vertical hole. This hole cut the one reef at 341 feet to 365 feet 6 ins., which carried 2 dwts. 15 grs., and another parallel reef at 461 feet, which continued to 484 feet, and for the last 5 feet, viz., 479 feet to 484 feet, carried 5 dwts. 21 grs. This result is on the whole very satisfactory. A large body of stone carrying 6 dwts. of gold is payable with modern methods of treatment, and as the past working experience of the Zapopan Mine was that rich gold occurred not so much in the reefs themselves as in shoots in the country off the lode, there is but little doubt that on the reopening of the mine rich patches will be found to sweeten up the larger low-grade bodies.

The Faded Lily bore was put down to try if a rich shoot worked to a depth of about 100 feet by the New Zapopan Company before the closing of the mine had any continuity in depth. No lode was met with, hence only negative results were obtained.

Each of these bores at Brock's Creek has yielded cores of high scientific interest, the true significance of which will be dealt with by Mr. Gray, Government Geologist, in his report on the Brock's Creek district. I have also no hesitation in saying that further boring in this district is highly desirable, inasmuch as Mr. Gray's geological survey has given us many important clues as to where future boring should be carried out.

The high degree of mineralisation of the rocks encountered in the two vertical Zapopan bores and the fact that gold values up to an average of about 6 dwts. were obtained from 5 feet of stone, and lesser values for larger bodies, augurs well for the permanency of the lode. Further boring is justified prior to the reopening of the mine, either by private capital or public money, but the work done up to the present shows that the mine merits the attention which has been claimed for it by old Territorians who know its history.

If a private company with £20,000 capital offer to purchase the mine and Government battery and other property belonging to the mine, payment to be conditional on the mine being put on a payable footing. I consider that the Government would be justified in aiding such company by loans for the mining and developmental work as may be found necessary.
DDH 4

DDH 4, inclined 55 degrees from the horizontal, will be drilled from 50 metres southeast of an estimated position of the Ah Qee's Reef to the direction of 125 degrees. Although the dip of Ah Qee's Reef is unknown, the hole is expected to strike the reef before the inclined drilling depth reaches 90 metres (Fig 18). The drilling will be terminated at a 90 metre inclined depth.

DDH 5 and 6

DDH 5 and 6, inclined 45 degrees from the horizontal, will be drilled 50 and 150 metres west of the DDH 3 to the direction of 12 degrees. The holes are aimed to prospect for a possible extension of the three reefs drilled by DDH 2 and 3. The holes are expected to strike three reefs before the inclined drilling depth reaches 100 metres (Fig 19). The expected depths to penetrate the reefs are between 24 and 30 metres, 54 and 59 metres and 73 and 77 metres. The drilling will be terminated at a 80 metre inclined depth.

11-6. ASSAYING AND MINERALOGICAL STUDY

Channel, core and other important samples will be sent to a laboratory for fire assay. General soil and rock samples will be tested by spectrographical analysis. This method will also be used for determination of Cu, Pb, Zn and As contents in the ore. Several polished and thin-section specimens will be prepared. Texture of the ore, localization and size distribution of gold particles and the relationship between gold particles and quartz/sulphides will be studied.
FIG 19  DDH 5&6, OBLIQUE REEFS

Scale 1:1,000
The purpose of this study is to perceive a suitable ore dressing and gold extraction method preliminary and to gain a better understanding on the genesis of the Zapopan gold deposits, which may lead to discovery of additional ore deposits.

11-7. OUTSIDE EXPLORATION

The area of EL's 2450 and 2981 will be prospected and geochemical soil sampling with a mechanical auger will be carried out. Samples will be panned and also analysed for As, Pb and Hg values, used as pathfinders for gold deposits. The auger sampling will be carried out on a grid of 100 metre centre within the area of the 1:5,000 topographical map. Elsewhere, the sampling will be done randomly and sampling positions will be plotted on a published map of 1:50,000.

Because of the high density and high magnetic susceptibilities of basic igneous rocks, both ground gravity and ground magnetic surveys are useful for estimating positions of the Zamu Dolerite under the thick soil mantle. This, in turn, will enable the Company to estimate positions of the ore horizons under the soil mantle making other drill targets.

12. EXPLORATION PLAN ADVANCED

The results of Stage 1 Exploration Plan provide a rough idea on ore grade, shape of ore bodies, probable ore reserves, ore horizons and other characteristics of the Zapopan gold deposits. It will become evident whether the deposits are, at least partly, amenable for opencut mining in an early stage of exploitation.
A follow-up drilling programme is required for confirming already gained information and scouting new information on additional ore reserves. If the mining proposition will have to be underground from the beginning, then a shaft will be sunk to a depth of 150 metres and two levels - 100 and 150 metre levels - will be constructed. During the course of this work, both proven and possible ore reserves will be gradually obtained.

13. **DEVELOPMENT PLAN**

13-1. **OUTLINE OF MINING AND GOLD EXTRACTION**

It is not practicable at this stage that any proposed mining and metallurgical operations are fully discussed.

Generally speaking, the Company hopes that mining will be, at least partly, opencut. Gold extraction process will be principally via hydrometallurgy with gold and silver dissolved by a cyanide solution in agitators and precipitated by zinc dust. There is a possibility that several kinds of ore may be present. One of these would be a refractory ore in which gold is bound up interstitially within pyrite and arsenopyrite crystal lattice. Such an ore will be pre-processed to release gold from the sulphides before cyanide solution is introduced into the ore. There is another possibility that a substantial tonnage of subgrade ore will have to be removed to obtain a high grade ore. The subgrade ore will be processed separately by cyanide leaching and carbon absorption.

It is essential to obtain a clear picture on a nature of the ore and the ore deposits and to carry out detailed engineering investigation in a laboratory.
13-2. **PREVENTION OF INFLUX OF WATER**

Methods to prevent the influx of water into the mine workings are discussed in this chapter.

The area near the Zapopan gold mine appears to be a ground-water basin. There are two water flows - "surface flow" and "underwater" which enter the mine working area. Methods to eliminate the surface and underflow are discussed separately.

(a) **Surface Flow**

Two tributaries of the Zapopan Creek, the eastern and western tributaries, join at the Zapopan gold mine. The western tributary has more catchment area than the eastern tributary (Fig 20). If a channel was cut between the position A and B shown on Fig 20, water from the western tributary would by-pass the mine working area and a great amount of the surface flow into the area would be eliminated.

(b) **Underflow**

The underflow, as a rule, continues even when the Zapopan Creek bed dries out and even if the creek bed is buried. Before proceeding the passage further, two hydro-geological terms - "aquifer" and "aquiclause" need to be discussed. An aquifer is a layer of rock or soil containing a considerable amount of water. Aquicludes are impervious layers which do not yield any water and which usually act as the upper and lower boundaries of an aquifer. There are three basic groups of aquifers:

1) course-grained loose sand and gravel deposits,
2) sedimentary rocks, primarily sandstone and limestone, and
3) fissured or broken igneous rocks.
Hydrogeological investigation is necessary to determine the properties of aquifers and aquicludes that exist near the Zapopan gold mine. Bores will be sunk to the aquifers in the area of the upper Zapopan stream and this water will be used for ore dressing at the lower stream of Zapopan Creek (Fig 21). The water will by-pass the area in the proximity of the Zapopan gold mine. A great amount of the underflow into the mine working area will be eradicated.

13-3. **ENVIRONMENTAL PRECAUTION**

The Company's effort to create and to maintain healthy, natural, ecological environment in the mine will be an integral part of the gold mining operation. When designing tailing dams, it must be insured that there will be no possibility of leakage of As, S, Pb, Cd and cyanide into the natural water flow. The Company's responsibilities will include a farming project in the tailing dam area with palm, mango, pine and papaya trees.
14. **SUMMARY**

The points discussed in the chapters are diagrammatically summarized as follows:

1. **The Zapopan Mine**
   
   **Location:** 170 km southeast of Darwin
   
   **Access:** 11.5 km from the new Stuart Highway
   
   **Climate:** Temperature between 25 and 30 degrees C. Annual rainfall up to 1,500 mm.
   
   **Topography:** Flat
   
   **History:** The mine was worked between 1888 and 1915
   
   **Production:** About 26,500 oz gold was recovered from about 42,000 tons of ore.
   
   **Workings:** The deepest level worked was the 67.5 metre level (225 feet level).
   
   **Major known reefs:** Main Reef
   Golden Reef
   Ah Qee's Reef
   
   **Mining tenures:** 6 CML's owned by the Company
   2 CML's in litigation
   EL 2450 owned by the Company
   EL 2981 application by the Company

2. **Geology**

   **Geological setting:** Metamorphosed eugeosynclinal volcanic and sedimentary rocks of the lower proterozoic South Alligator Group.
   
   **Lithology:** Banded quartzite, chert, sericite - amphibole schist, black graphitic slate, tuff and amphibolite - dolerite.
   
   **Structure:** Tightly folded. Anticline plunging southeast.
   
   **Ore mineralogy:** Au/Ag in association with quartz, calcite, pyrite, chalcopyrite, galena, arsenopyrite.
   
   **Attitude of ore deposits:** Concordant to the bedding of the country rocks.
   
   **Ore and ore horizons:** Highly sulphided quartz was mined. Ore horizons are unknown.
3. **Exploration Plan**

Target ore reserves obtained: At least 0.5 million tons

Expected grade: 17.1 gms gold per ton
(0.55 ozs gold per ton)

Exploration near the mine: Costeaming and diamond drilling. Underground mapping and sampling.

Outside exploration: Geochemical prospecting with a mechanical auger. Ground magnetic and ground gravity surveys.

Advanced exploration plan: Follow-up diamond drilling and underground exploration.

4. **Development Plan**

Mining method: Opencut in early stage of exploitation

Gold extraction: Cyanidation in general, partly flotation and roasting for the refractory ore and partly cyanide leaching and carbon absorption for the subgrade ore.

Expected byproduct: Pb concentrate

Prevention of influx of water: Construction of a channel and water bores in the upper stream area.

Environmental precaution: Tailing dam design and a farming project in the tailing dam area.
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