AUSTRALIAN DEVELOPMENT LIMITED
(Incorporated in South Australia, Australia)

Noble's Nob Mine,
TENNANT CREEK,
Northern Territory

GENERAL DESCRIPTION
OF
COMPANY OPERATIONS

OPEN FILE

May, 1970.
Copy 1 of 2
CR70/103
AUSTRALIAN DEVELOPMENT NO LIABILITY
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OF
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May, 1970.

obtained on site
during visit in
March 1971 E.F.P.
<table>
<thead>
<tr>
<th>CONTENTS</th>
<th>Sect.</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Personnel – Australian Development No Liability</td>
<td>1</td>
</tr>
<tr>
<td>Location</td>
<td>1</td>
</tr>
<tr>
<td>History</td>
<td>1</td>
</tr>
<tr>
<td>Geology and Exploration</td>
<td>1</td>
</tr>
<tr>
<td>Mining</td>
<td>1</td>
</tr>
<tr>
<td>Re-Development</td>
<td>1</td>
</tr>
<tr>
<td>Outside Properties</td>
<td>1</td>
</tr>
<tr>
<td>Milling Practice</td>
<td>1</td>
</tr>
<tr>
<td>Power</td>
<td>1</td>
</tr>
<tr>
<td>List of Maps</td>
<td></td>
</tr>
<tr>
<td>Nobles Nob Mine Cyanide Plan Flowsheet</td>
<td>1</td>
</tr>
</tbody>
</table>
AUSTRALIAN DEVELOPMENT NO LIABILITY
(Incorporated in South Australia, Australia.)

Directors -
F. A. Pascoe (Chairman)
K. M. Bennett (Managing)
K. H. Grant
N. C. Shierlaw
R. H. Punke

Registered Office -
City Mutual Life Building
118 King William Street,
ADELAIDE, S.A.

Secretary -
F. Purcell

Capital -
Authorised
6,000,000 shares of 10¢ each $600,000

Issued
5,000,000 shares of 10¢ each $500,000

Managing Agents for -
Nobelex N.L.

Noble's Nob Mine Personnel -

General Manager L. F. Roach
Mine Accountant D. E. McLaren
Chief Geologist A. J. Weil
Surface Superintendent J. G. Crowe
Mining Engineer A. H. Dean
Mine Foreman E. C. Wright

Consultants -
Geologist C. F. Wegener
Geophysicist J. E. Webb
LOCATION

Noble's Nob Mine is situated in the Northern Territory, twelve miles (8 sealed surface, 4 gravel) eastwards from Tennant Creek township, and 320 miles from the railhead at Alice Springs.

It is a self-contained community, having its own power and water supply, swimming pool, tennis court, canteen (wet and dry) etc.

HISTORY

The Ives Proprietary Gold Mining Company N.L. was formed in May, 1920, to secure gold options in Western Australia. Subsequently, after some years of unsuccessful prospecting, the Company went into liquidation on 20th August, 1945, for the purpose of reconstruction. The new Company then formed was called Australian Development No Liability.

In July, 1947, C. E. Blackett was commissioned to examine the Rising Sun Group of Leases and reported favourably on Noble's Nob Mine, the option on the leases being taken up by Australian Development in September, 1947; the terms being that if the option be exercised within two years, $140,000 from gold won, $10,000 in cash and 75,000 shares in the Company be paid. Also payment be made for ore at grass, plant, etc.

The Rising Sun Group of Leases comprised the Rising Sun, Weaber's Find, Kimberly Kids and Noble's Nob.

Prior to 1939, William Weaber and John Noble made their first discovery of gold on these leases at Weaber's Find. (It is interesting to note that William Weaber was blind and John Noble had only one eye.)

John Noble subsequently discovered Noble's Nob, where he must have found encouraging surface prospects to sink a shaft by the hammer and tap method in hard haematite, as no significant values were found until a depth of 50' below the surface had been reached.
By November, 1948, Australian Development No Liability had sunk a new shaft to 150' horizon and had its first treatment plant in operation. This plant consisted of a secondhand 10-head stamp battery, and wheeler type grinding and amalgamating pans.

Following sensational developments in the mine in July, 1949, when No. 1 pilot winze was being sunk (the first 40' averaging 50-60 ozs to the ton) a further 5-head of stamp was added to the original plant and cyanidation of the classified current sands by percolation commenced.

This plant continued in operation until December, 1954, and treated 81,886 tons of ore for a recovery of 196,559 ozs fine gold. Recovery being approximately 75%.

Early in 1952, when the mine had been developed and a substantial tonnage proved, orders were placed for a conventional ball milling and all cyanidation plant, which was brought into production in December, 1954.

This plant continued in operation until 17th December, 1969, treating 455,863 tons for 634,199 fine ozs of gold.

In August, 1967, following the collapse of the crown pillar, the mine was converted to open cut operation, and a modern 450 tons per day treatment plant, together with new workshops etc. was constructed.
INTRODUCTION

In the Tennant Creek area of Northern Territory, Australian Development No Liability operates a small open cut gold mine at Noble's Nob, and is currently developing a small underground gold mine at the Golden Forty, two and a half miles north-east of Noble's Nob. The Company is continuing exploration for extensions and further deposits of ore in its own areas immediately surrounding these mines, and, in its capacity of exploration manager for Nobelex N.L. (which Company is 50% owned by Australian Development No Liability), it is carrying out an intensive exploration programme over 1,400 square miles of Authorities to Prospect and other mining tenements in the Warramunga Goldfield around Tennant Creek. At present, this is the Company's main exploration activity.

Additionally, Australian Development No Liability is expanding its exploration activities into other areas of the Northern Territory. The Company is investigating four Authorities to Prospect totalling 3,400 square miles outside the Warramunga Goldfield.

Several mining tenements held by the Company at Breakaway Find in Western Australia have undergone limited exploration through a farm-out agreement.

WARRAMUNGA GOLDFIELD

Regional Geology:

The Warramunga Goldfield is located in the central portion of the Warramunga Geosyncline which trends in a NNW-SSE direction through Tennant Creek. The rocks in the central portion are of the Warramunga Group, a thick Lower Proterozoic flysch sequence. The succession consists of a rhythmic alternation of greywackes (tuffaceous sandstones), siltstones, and shales.

Rocks considered to be Archaean in age occur below the Warramunga Group sediments, although the relationship is not yet satisfactorily established. The Warramunga Group is overlain by Pre-Cambrian and Cambrian sediments, generally in angular unconformity.
Probably at the close of the Lower Proterozoic, the Warramunga Group was intruded by several granite bosses. Porphyroidal rocks of greatly varying character are common in the Field. The origin of these rocks remains controversial. Basic dykes and sills are widespread.

**Economic Geology:**

Significant quantities of gold, copper, and bismuth have been and are still being produced in the Warramunga Goldfield. Economic mineralization found to date is restricted to the Warramunga Group and is associated with ironstones. The ironstones are generally ellipsoidal masses of haematite and magnetite, which in places, generally towards their centres, contain economic quantities of gold and copper. Alteration envelopes of chlorite, talc, and sericite commonly surround the ironstones.

The ironstones are localized in favourable lithological and structural settings.

There are five mines currently producing in the Field, and three more are being prepared for production.

**NOBLE'S NOB MINE**

Noble's Nob Mine is located on the southern limb of a large west-plunging anticline in sediments of the Warramunga Group. The beds, consisting mainly of greywackes and argillites, strike east-west, and dip south at an average of 65°.

The host-rock for the gold mineralization is a predominantly haematitic lens-shaped (ironstone) body, which originally outcropped prominently at the surface. The ironstone occurs strictly within a disturbed argillite sequence containing the locally significant Haematite Shale. In addition to this lithological control, minor flexuring and a strongly developed vertical east-west striking cleavage act as structural controls.
Underground workings exposed the ironstone over a strike length of 800' (east-west), a maximum of 140' in width (north-south), and to a depth of over 300'. The contact with the enclosing sediments is abrupt, except on the northern side where abundant sericitic wall rock alteration occurs. An inverted conical zone of brecciated sediment, including fragments of ironstone, occurs above the western half of the ironstone. A strong development of lateritization (capping) occurred at the surface, particularly over this brecciated zone. Most of the ironstone at Noble's Nob lies above the base of oxidation. Magnetite is known in the narrow lower extremities of the ironstone body below the base of oxidation, and it has been concluded that the haematite is the oxidized equivalent of the original magnetite. A small (200 gammas) magnetic anomaly occurred over the deposit according to an early magnetometer survey.

Gold mineralization is extremely variable, from virtually absent in the upper portion of the ironstone to very rich in the central portion. Several ore shoots were mined and some gold occurred in the sericitic zone on the northern side of the ironstone. It is considered that a significant proportion of the rich gold ore has resulted from processes of secondary enrichment. Mining limits normally have to be determined by assay. Minor Bismutite was associated with the gold ore in the oxidized zone, while minor Chalcopryite occurs at depth.

**GOLDEN FORTY DEVELOPMENT**

In the Golden Forty - Golden Kangaroo area several small mineralized bodies have been discovered. One of these at the Golden Forty contains a gold-bismuth ore shoot large enough to warrant a small scale mining operation.

The mineralized body (ironstone) is a lens-shaped mass (predominantly magnetite and chlorite) with its maximum dimension of 500' orientated east-west and pitching west at around 45°. The other dimensions of the ironstone are 300' vertically and 150' north-south. A thin shell of quartz-magnetite encases the top and upper northern side of the ironstone, making a regular and sharp contact with the enclosing sediments. A flat lying east-west pipe-like ore shoot containing some Bismuthinite and minor Chalcopryite occurs at a depth of 300'.
Underground Development:

All workings were serviced by a three compartment, closely timbered shaft of 11'2" x 3'9" inside measurement, the depth being 341' plus a 15' sump. The shaft was situated just outside the southern wall of the haematite body and connected by stopes, raises, etc. to two prospecting shafts, No. 3 and No. 5, which were fitted with Richardson 5CL exhaust fans creating a down draught at the main shaft.

There were two main levels from the shaft at 215' and 305' which formed trucking levels. A level at 341' together with the 305' level formed the haulage level.

Shaft plats were 12' high and main level drives and crosscuts 7' x 6'.

Owing to rapid change in area and position of gold enrichments in vertical and horizontal distance it was found necessary to outline the ore bodies from vertical levels 30' apart and horizontally at 25' intervals.

In practice sub-levels were driven from rises and winzes at 30' vertical intervals for the length of the orebody with crosscutting for short distance at 25' intervals along the drive. These short crosscuts were then used for long hole sample drill chambers. Sample holes were drilled north and south, horizontal and approximately 30° up for a length of 50' with a sample interval of 5'.

After stoping limits were defined by assay results from intermediate levels, draw point positions were planned on the lower trucking level and rises as draw points were provided.

Mining Methods:

Extraction methods were almost universally open stope methods. The haematite fortunately stands well in walls and narrow pillars despite its jointed nature, and allows extraction by open stope methods if care is taken not to exceed 25-30' width.
In the early days when mining orebodies up to 140' wide, the stopes were laid out as traverse stopes 25' wide with 20' pillars between stopes. In stopes away from the centre of the lode the stopes were laid out longitudinally and worked as shrink stopes. Draw points for stopes were provided by rising from "loading crosscuts" from main trucking levels so the first sub-level, belling out the rise to form an inverted cone, the apex being at the end of the loading crosscut. Adjacent bells overlapped at the first sub-level and belling was carried out in conjunction with stripping of the sub-level to the ore limits.

Pillars between the older stopes were to be extracted by ring boring in the plane of the pillars, when the stopes were emptied from footwall and hanging wall drives with crosscuts so that permanent and safe entry and exit could be maintained.

Transport:

Draw points were designed for loading to 25 cwt side tipping trucks with Elmco 12B loaders. Ore was hand-trucked from stope draw points to grizzleys above ore passes to the haulage level below, where the ore was loaded to 3/4 ton end tipping trucks from an arch gate side chute and transported to and up the shaft.

Hoisting:

Main shaft haulage was by an Austral-Otis one ton double drum winder of 700' per minute rope speed, driven by a 60 h.p. electric motor.
Rock Mechanics

In 1960, an overseas world authority on rock mechanics was commissioned to advise on the best method of obtaining total pillar extraction. In preparation for this operation a complex system of vertical and horizontal ground measuring stations were installed. This was probably the first complete installation of rock mechanics installed in Australia.

Following exceptionally heavy rains in March, 1967, readings on all vertical stations over the main lode area indicated progressively increased tension.

Surface subsidence in the main lode area occurred in the early morning of August 10th, 1967. There were no casualties.

Re-Entry to Mine

With the mine situated on a hill, access to the caved area could be obtained by cutting a slot through the side of the hill. This slot was designed to connect at its lowest level with the 135' level within the mine.

This project was completed in January, 1968, and the total volume removed was 187,000 cu. yds. broken (145,000 yds. solid).

Open Cut Operation

After a careful appraisal of tonnage and grade of ore available, it was decided that total ore extraction could only be obtained by open cutting the ore body.

Open cutting operations commenced in February, 1968.
The basic design of the open cut called for the following:-

Vertical height between berms - 40'
Width of berms - 10'
Slope angle of walls - 75°
Overall angle - 60°
Width of haul road - 20'
Road Gradient - 1 : 10
Overall length of open cut - 760'
Overall width of open cut - 375'
Total volume to be removed (approx.) - 1,250,000 cu. yds.
Volume removed to date - 1,045,000 cu. yds.
(Waste/ore ratio being approximately 5 : 1)

The open cut operation was designed to be completed in two stages, the first stage entailing the removal of some 978,000 cubic yards, and a second stage will complete the project.

Considerable care was necessary in operating heavy equipment over and adjacent to several open underground stope areas. This problem was overcome by caving of surface area by controlled blast hole firing.

Modifications to the original open cut design have had to be carried out as the cut progressed, due to ground conditions and underground workings.

Present open cut equipment consists of:-

2 Gardner-Denver Air-Tracs
2 Caterpillar 980 Front End Loaders
1 Wabco Truck - 15/20 ton
1 Euclid Truck - 12/18 ton
1 Caterpillar D9 Bulldozer
1 Caterpillar DB6 Bulldozer - on part-time duty.

Waste trucking is accelerated by the additional use of:-

1 Albion Leyland 5-ton Truck
1 Toyota Diesel 5-ton Truck
OUTSIDE PROPERTIES

1. **GOLDEN FORTY**

   This mine has a two compartment shaft with an inside diameter of 7'4" x 5'4".

   The shaft will be cement lined for its entire depth of 400'.

   The main hoisting compartment is 4'4" x 5'4" with the remaining compartment for services.

   Hoisting is provided by a 60 H.P. electric winder with a maximum rope speed of 700' per minute. The cage being operated in balance with a counterweight.

   **Level Development:**

   Initially two main levels will be developed at the 280' and 380' levels respectively.

   These levels are designed to provide selected sites for underground diamond drill exploration.

2. **GOLDEN KANGAROO**

   This shaft has the inside dimension of 8' x 5'6" and is inclined at 65° to the vertical.

   Initial depth 400 feet.

   Work on this shaft was temporarily suspended following surface caving at Noble's Nob mine, when all available personnel were required to bring the home mine back into production as soon as possible.
MILLING PRACTICE

Crushing Section

Ore from the open cut is fed by a Cat 980 loader to a link-Belt 3' wide by 14' long vibrating feeder which feeds a 36" x 24" Jaques jaw crusher.

Crushed ore is conveyed to a stockpile area, where it is blended and fed to a 50 ton bin by a Cat 980 loader.

Ore is fed from the bin by a variable speed belt conveyor to a 24" x 13" Hadfield jaw crusher. Crushed ore is elevated to a double decked 6' x 3' Tyrock screen, having a 1" aperture top deck, and a 5/16" aperture bottom deck. Both oversize products are crushed in 3' Symons shorthead crushers and return to the screen.

Minus 5/16" material is conveyed to the fine ore bin.

Grinding and Classification

Crushed ore is fed from the fine ore bin by four Syntron feeders (one feeder being operational at a time) and conveyed to the ball mill. The mill is a 7' x 7' Ruwolt grate discharge type, driven by 250 H.P. motor at 23 R.P.M. and charged with 2 1/2" forged steel balls.

Tonnage is recorded by a Ramsay continuous weigher.

Ball mill discharge is elevated to a 60" continuous strake. Strake tailing is cycloned in 15" Warman cyclones. Spigot discharge at 80-83% solids gravitates to the ball mill and cyclone overflow at 45055% solids gravitated to a primary thickener.

Strake concentrate gravitates to a storage cone and is batch tabled and amalgamated. Table tailing is returned to the grinding circuit.
Agitation

Cyclone overflow is thickened in a 50' diameter x 10' Link-Belt thickener.

Thickener underflow at 53%-55% solids is agitated in three 25' diameter x 14' Devereau agitators in series.

Overflow from the thickener goes to classification and precipitation.

Counter - Current Decantation

Agitator discharge gravitates to a three stage C.C.D. system using three 50' diameter x 10' Link-Belt thickeners. Underflow from thickeners is 55-60% solids.

Filtration

Underflow from the third C.C.D. thickener flows to a 20' diameter x 12' storage rake agitator, and is then filtered on a 14' diameter x 24' Eimco scraper discharge filter where it is given two barren solution and one lime water wash.

Filter cake is repulped with salt water in a 24' x 26' repulper and pumped to the tailings dam.

Classification and Precipitation

Pregnant solution amounting to 1,800 to 2,000 tons per day is made up from the Primary and No. 1 thickener overflows.
These solutions are clarified through thirty-six 9' x 6' leaves. Two sets of leaves are available, one in use and the other being washed.

Pregnant solution passes to a 8' diameter x 12' deaeration tower, lead nitrate and zinc dust are added and the precipitate is filtered off in three of four 30" square frame plate presses each containing 26 frames. Barren solution is metered through a flowmeter-recorder and flows to a storage tank for re-use in the circuit.

Reagents, Plant Control and Sampling

Mill make-up water is bore water pre-treated with lime. Cyanide and lime are fed into the agitators to maintain a concentration in pregnant solution of 0.025% KCN and 0.012% CaO.

Superfloc 127 at approximately 0.02 lbs per ton of ore is added to all thickeners to promote flocculation.

Calgon "T" powder is also added at approximately 0.004 lbs per ton of solution to the pregnant solution to inhibit the formation of hard scale on the clarifier bags; these cloths and the Merrill Crowe press cloths are precoated with a commercial grade of diatomaceous earth.

As well as routine testing of cyanide and lime, operators run colour tests on Barren solution.

Ore head sample and residue sample are taken by Fraser and Chambers 24" series F automatic samplers. Solution samples by continuous drip.

Reagent Consumption

<table>
<thead>
<tr>
<th>Reagent</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Cyanide</td>
<td>0.44 lbs per ton of ore treated</td>
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<tr>
<td>Quick Lime</td>
<td>5.24 &quot; &quot; &quot; &quot; &quot; &quot;</td>
</tr>
<tr>
<td>Zinc Dust</td>
<td>0.32 &quot; &quot; &quot; &quot; &quot; &quot;</td>
</tr>
<tr>
<td>Grinding Balls</td>
<td>2.88 &quot; &quot; &quot; &quot; &quot; &quot;</td>
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</tbody>
</table>
Cleaning-Up and Smelting

Table concentrate is amalgamated once a week in a 30" x 36" barrel using twenty 2½" diameter balls, and at the end of each 14 day period accumulated amalgam is retorted and smelted giving a bullion of approximately 950 fineness.

The precipitation presses are also cleaned up each 14 days. The sludge from the presses is acidified in a stainless steel rake agitator with sulphuric and nitric acid, and then given three washes by decantation, the decanted solution passing to a residue pit filled with scrap iron to precipitate any copper present.

The gold slime from the acid tank is forced into an 18" square frame and filter press containing 12 frames by means of a pressure montejus, given a further water wash and air dried. The resultant cake is dried in an electric oven then mixed with a flux consisting of Borax Glass, Silica, Soda Ash and Manganese Dioxide and smelted in an oil fired Rockwall furnace lined with a high grade sillimanite. The conical buttons recovered from this smelt are resmelting in an A60 graphite crucible in an oil-fired Morgan Major furnace, and poured into bars approximately 300-400 oz for shipment. Fineness of this bullion being approximately 940.

Mill recovery averages 97%. 25% from automatic strake, and the balance from cyanidation.
POWER

1,000 K.W. is available from self-contained electric sets, sited close to load centres; additional demand and standby requirements are met by low speed units of 650 K.W. installed capacity. Engine and alternator conditions are monitored on the self-contained sets, shut down is accomplished before damage can occur; the low speed sets require a driver and operation is generally confined to day shifts.

One Caterpillar D399 and a D398 are on base load; three Ruston VEB's provide any additional requirements. A D333 is installed at the Golden Forty supplying 75 K.W. for winder and services.

On the Caterpillar equipment oil and filter changes are at 1,500 hours, turbo-charge reconditioning at 7,000 hours; Ruston service is continuous with a major inspection at 6,000 hours.

Consumption of distillate is 0.071 gallons per unit. 275,000 kwh's are transmitted per month at a cost of 2.11¢/kwh.

Compressed Air

Three Holman RO60P compressors supply 1800 cfm of compressed air mainly for Air-Tracs.

An additional 600 cfm is available from two Broomwade machines.