

DEPARTMENT OF MINES WESTERN AUSTRALIA

ANNUAL REPORT
1984-85



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PRESENTED TO BOTH HOUSES OF PARLIAMENT



*To the Honourable David Parker, B.A., M.L.A.,
Minister for Minerals and Energy*

Sir,

*I have the honour to submit the Annual Report
of the Department of Mines of the State of
Western Australia for the period January 1984 to
June 1985, together with reports from officers
controlling Divisions, and tables and diagrams
showing progress of the Mining Industry.*

D. R. KELLY

Perth, 1985

Director General of Mines

- Page 22 Column 1, end of paragraph 3: 291 should read 3 291.
- Page 35 Column 1, end of paragraph 6: ?Cambrian Antrim should read ?Cambrian Antrim Plateau Volcanics.
- Page 47 Column 1, paragraph 4: a royalty of between 10 and 12.5 per cent should read a royalty of between 5 and 12.5 percent.
- Page 49 Column 1, last paragraph: 1 50 should read 1 504.
- Page 65 Column 2, paragraph 2: Kagoshima should read Kyushu.
- Page 71 Column 2, heading: Prosecuting licence extensions should read Prospecting licence extensions.
- Page 71 Column 3, diagram headed Tenement Applications: the legend colours should be reversed i.e. light blue for Exploration Licences and dark blue for All other tenements.
- Page 78 Table B: column heading 1984/84 should read 1984/85.
- Page 79 Table D: in the column \$M Variation: -0.003 should read +0.003. In the column % Variation: -15.0 should read +15.0 and in the TOTAL % Variation: 4.3 should read +4.3
- Page 82 Table Summary description of fatal accidents: 2/2/84 should read 22/2/84.
- Page 84 State Batteries Division Schedule No.1, for year ending 31 December 1984, Number of Parcels treated, Marble Bar: 19 should read 10. TOTALS for year ending 31 December 1984 should read

TOTALS	360.6402	294	31	144.2	261.4988	222.238	82.349	304.587	9.78
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Note that the totals for the year ending 30 June 1985 are correct as printed.

- Page 88 Table Wells Completed...., Development Wells, Nth Rankin A 06/CW2: Rig released should read 16.03.85, and Drilling (2 249) should read 4 171.
Exploration Wells, Melaleuca # 1, Spud date 11.0.84 should read 11.04.84.
- Page 92 Table Petroleum Production, Cumulative production Condensate (heading): 0³ KL should read 10³ kL. Cumulative production, Gas, Total: 5 583.6 should read 15 583.6.
- Page 93 Table Accident Statistics ..., heading: Year ending 30 June 1985 should read Six months ending 30 June 1985.
For the year ending 31 December 1984, Total, man-hours exposure: 286 630 should read 2 866 304.
- Page 94 ALUMINA, Alcoa of Australia Ltd, Del Park/Huntley/Pinjarra 1984/85 Total: 1 657 should read 1 621;
COPPER/SILVER/ZINC: Seltrust Mining Corporation Pty Ltd should read BP Minerals Australia;
IRON ORE: Broken Hill Pty Ltd should read BHP Minerals Ltd.
- Page 95 Royalties collected 1983, 1984 and 1984/85
Construction materials, aggregate:
1 252. 36 548 2 169
should read 1 252 77 965 58 712.
Construction materials, sand:
22 875 92 381 108 941
should read 22 875 50 964 52 128.
- Page 98 Production and value of minerals ..., value \$, 1984, CLAY: WHITE CLAY, Bristile Ltd, Goomalling, South West: 9 278 should read 9 287.
- Page 102 NICKEL CONCENTRATES, Western Mining Corporation Ltd, Kambalda, Value \$, 1984/85: 42 336 442 should read 42 336 242.
NICKEL CONCENTRATES, (Totals) Quantity tonnes, 1984/85: 496 630 should read 496 451.
PETROLEUM: CRUDE OIL: the heading kilolitres should be in the 1984/85 Quantity tonnes column, not the 1984 Value \$ column.
PETROLEUM: CRUDE OIL: Home Energy Co Ltd, Blina, Value \$ 1984: 8 471 592 should read 8 471 692.
PETROLEUM: NATURAL GAS: the heading 10³ m³ should be in the 1984/85 Quantity tonnes column, not the 1984 Value \$ column.
- Page 103 SILICA SAND, 1984/85, Quantity tonnes, total: 409 136 should read 406 636.
TANTALITE, Greenbushes Tin Ltd - Processed tantalite Quantity Tonnes, 1984: 6 should read nil.
TANTALITE, Quantity tonnes, 1984, total: 145.0 should read 139.0.

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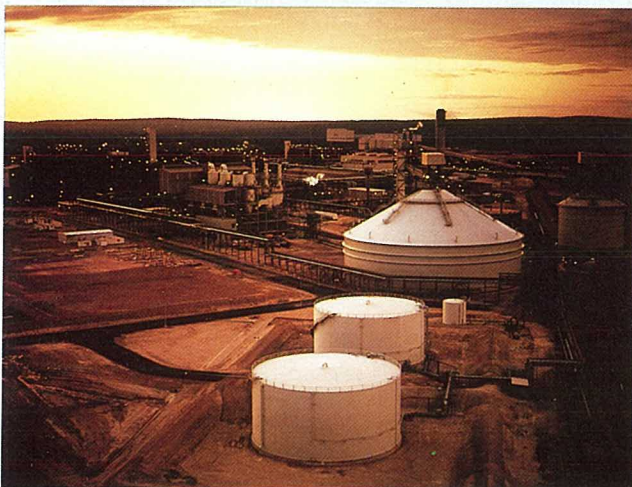
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HIGHLIGHTS



Glomar Main Pass III flaring at Saladin No. 1 exploration well (WAPET photo).

- The Wagerup alumina refinery was officially opened for Alcoa of Australia on 11 April 1984. Production of bauxite from Alcoa's Willowdale mine to supply the refinery also commenced in 1984.
- Worsley Alumina commenced mining bauxite at Boddington in 1984 to supply the Worsley refinery which was commissioned in May 1984.



Worsley alumina refinery at dusk (Worsley Alumina photo).

- Gas from the North West Shelf became available to Western Australians in August 1984. The delivery of gas to local consumers is only the start of a project which will eventually supply eight power and gas utilities in Japan with liquified natural gas. This export phase will require the highest ever investment for a single project in Australia.
- A record number of 73 petroleum exploration wells (22 offshore and 51 onshore) were drilled in 1984. Of these five were classed as oil discoveries and one as an oil and gas discovery.
- The Mines Department recorded over 500 producers of gold in 1984. Around 150 companies are actively involved in gold exploration at present not including the many prospectors and small operators in the State.



Night view of headframe at the Golden Crown Lease, Day Dawn (Roberts Construction photo).

- Gold exploration and mine development increased rapidly during 1984 and the first half of 1985. Gold production for the year ending 30 June 1984 exceeded 37 tonnes, the first time the 1 million troy ounce production level has been reached since 1941.
- Two small oil fields commenced production in 1984: Sundown in the Canning Basin and Mt Horner in the North Perth Basin.

- The Golden Grove shaft was sunk on the Scuddles copper-zinc deposit near Yalgoo. The shaft was sunk to 379 metres and development work was carried out on two levels.

- The shipping channel at Cape Lambert was deepened to 19 metres allowing a ship carrying 238 000 tonnes of iron ore to sail from the port creating an Australian record for export cargo.



Bulk carrier loading record 238 000 tonnes of iron ore at Port Lambert (Cliffs Robe River photo).

- In early 1984 the 1 000 millionth tonne of iron ore was exported from Western Australia. Hamersley Iron produced its 500 millionth tonne of iron ore on 30 June 1984 after 19 years of operation. Mt Newman Mining produced its 400 millionth tonne since 1969 and Robe River its 150 millionth tonne. Not all this ore is exported, some is shipped to the Eastern States.

- A large gold prospect was discovered at Boddington, south of Perth. This prospect has the potential to produce 5 000 kilograms of gold per year and could be the largest producer in the State within three years.



Shaft sinking at 160 metre depth, Golden Grove (EZ photo).

- Funding was approved in the 1984/85 budget for the construction of Mineral House II. This is to be an eleven storey building, located immediately to the north of Mineral House I with a lift core and access way connecting the two buildings. The main entrance will open onto Plain Street.

- The new Baldy Explosives Reserve was officially opened by the Hon. David Parker, M.L.A., Minister for Minerals and Energy on 16 November 1984. The old reserve, at Woodman Point on Cockburn Sound, had been in use since 1904 for the storage and distribution of explosives. In 1979 Cabinet approved the relocation of the reserve to Baldy and the move was completed in 1984.

- Dampier Salt, the biggest salt producer in Australia, exported its 25 millionth tonne in June 1985.



Salt stockpile at Dampier (Dampier Salt photo).

NORTH WEST SHELF GAS—Project review

In August 1984, natural gas which had been trapped, unknown and dormant beneath the seabed off the North West Shelf for millions of years, became available as a vital source of energy for the people of Western Australia. The delivery of gas to consumers marks the completion of only the first stage of a project which is ultimately expected to cost in the order of \$11 000 million and will supply eight power and gas utilities in Japan with 6 million tonnes of LNG a year.

The Department has been extensively involved in the project since the original offshore exploration permit under the Petroleum Act 1936 was awarded to Woodside (Lakes Entrance) Oil Co N.L. in 1963 and in that year a few lines of reconnaissance aeromagnetic survey were carried out.

In 1967 the first offshore well was drilled at Legendre. Before granting permission to drill the Mines Department reviewed the drilling programme, drilling vessel, operational procedures, safety and emergency procedures, oil-spill-contingency plan and well-abandonment plan. Although some oil was found in the well it was considered non-commercial and the well was abandoned.

The present exploration permit WA-28-P under the Petroleum (Submerged Lands) Act 1967 was awarded by the Mines Department in 1969 to Woodside (Lakes Entrance) Oil Co N.L., Shell Development (Australia) Pty Ltd, and Burmah Oil Company Australia Ltd. Since that time production licences have been granted and the Joint Venture partnership has changed considerably. It now consists of Woodside Petroleum Ltd, Shell Development (Australia) Pty Ltd, California Asiatic Oil Company, BHP Petroleum Pty Ltd, BP Development Australia Ltd and Japan Australia LNG (MIMI) Pty Ltd.

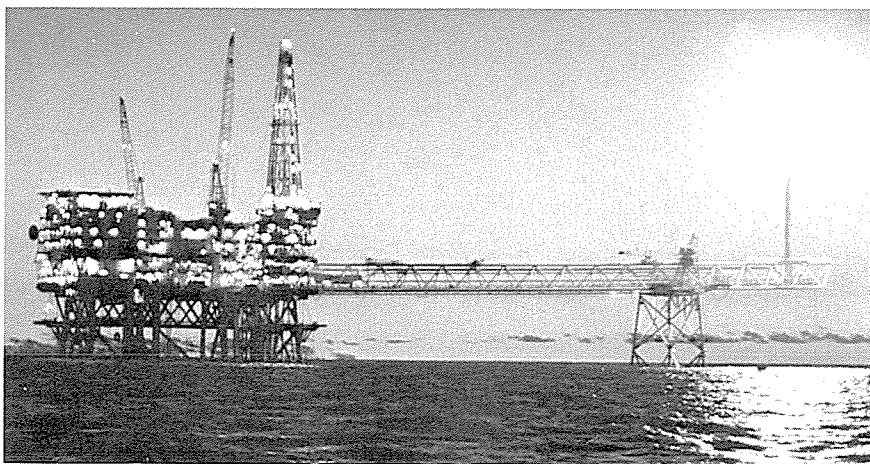
Further drilling in 1971/72 led to major gas/condensate discoveries at North Rankin, Goodwyn and Angel. The gas-saturated sandstone beds have a cumulative thickness of about 300 m and extend over an area of more than 50 km. Proved recoverable hydrocarbons are estimated at 852 billion cubic metres (30 trillion cubic feet) of gas and 83 million cubic metres (524 million barrels) of condensate.

The development of these fields was subject to lengthy negotiations between the Commonwealth, State and Joint Venturers during the late 1970s. The Joint Venturers were required to prepare a Notice of Intent detailing their proposed development plan which was studied by various Government Departments and this was followed by a detailed Environmental Review and Management Plan considered by the Environmental Protection Authority.

panying Directions cover a wide range of activities, the principal items being the construction, installation and operation of the offshore drilling and production platform and submarine pipeline.

The location of the North Rankin gasfield, the first field to be developed, is in a remote cyclone-prone stretch of the Indian Ocean about 135 km northwest of Dampier, where the sea depth is 125 m. The expected time to deplete the gasfield is about 30 years and the platform is designed to withstand storm waves of up to 23 m high and winds of 270 km per hour, which statistically can be expected to occur about once in every 100 years. This is the accepted industry practice for similar environmentally hazardous locations, e.g. Gulf of Mexico or North Sea.

The Burrup Peninsula where the gas-treatment plant is based has



Dusk at the North Rankin A Platform (Woodside Petroleum photo).

As a result of these negotiations agreement was reached with the State Government, and terms acceptable to the Government for the project development were reached in 1980.

The offshore development regulated by the Mines Department under the Petroleum (Submerged Lands) Act and the accom-

a hot dry climate with summer temperatures averaging 35°C.

It has the advantage of being closer to the gasfield than other sites considered, in a relatively protected location for tanker facilities, totally uninhabited and yet close to one of the main population centres of the sparsely populated Pilbara region.

The annual report of the Department is changing from a calendar year basis to a financial year basis. To cater for the transitional period, this report covers an 18-month period to include the whole of the 1984 calendar year and the first half of 1985. The next report will be for the 1985/86 financial year.

The Mining and Mineral Processing Industry

Performance and outlook

The signs of economic recovery evident in the latter half of 1983 continued through 1984 and the first half of 1985. Demand and commodity prices improved generally in 1984, and some commodities have shown further substantial improvement in 1985. Alumina is an important exception on both counts, with continuing world oversupply and a consequent depressed price situation. Current low prices in the alumina industry contrast with the buoyancy in the latter half of 1983 which led to an increased capacity in Western Australia in 1984.

The annual survey for 1983-84 conducted for the Australian Mining Industry Council concluded that although there was an overall profit increase of 21 per cent (to \$461 million) in Australian industry, this was inadequate when related to after-tax returns on funds employed (4.4 per cent) or after-tax returns on assets (3.7 per cent). For the last three consecutive years these figures have been less than 5 per cent. This compares with an industry eight-year average of 12.3 per cent. Indications are that 1984-85 will show a limited improvement.

Over 80 per cent of the value of Western Australian mineral production is exported, with trading predominantly in US dollars. While prices in this currency and in pounds sterling have improved, the

variation in Australian-dollar terms has been significantly greater because of the gradual decline in the Australian dollar against the US dollar through 1984 and a major drop in value early in 1985. Exchange rate relativities and variations in the price of gold are shown in the accompanying graph.

Improved sales revenue and increased competitiveness of Australian industries through better use of production capacity, are benefits that could be eroded if continued devaluation triggers a new inflationary spiral. There has been a cost containment in industry limiting cost increases to about 5 per cent. This, coupled with the stringent cost-cutting measures forced on the industry during the preceding years of recession, has resulted in a strong, efficient, technologically progressive industry which has an edge over many of its competitors around the world. For example, although the alumina industry is going through a sustained depressed period, the Western Australian industry has one of the most modern and efficient plants in the world and can compete in a very tight market. The mineral sands industry has also shown development initiatives enabling it to cope with a changing, diversified market demand.

There is, however, a negative effect of the devaluation of the Australian dollar. Industry has committed itself to a number of major capital developments in the last six or seven years, many of which have been financed through overseas borrowings. The cost of servicing such debts is now very high. Major investments during this period include two alumina refineries with a combined \$1 500 million investment, nickel with over \$300 million, diamond \$470 million and natural gas committed to around \$11 000 million by the

time the second stage of the North West Shelf Project is completed.

Exploration activity and development

Minerals. On the basis of the 1983-84 figures (which are the latest available data) Australia showed a continuing decline in mineral exploration expenditure overall. In contrast Western Australian figures for 1983-84 were higher than the previous year, due to increased activity in the gold sector. In fact the \$185 million spent on exploration in Western Australia represented 44 per cent of the Australian total and was more than double that of Queensland, the next most active state.

The continuing high level of activity in gold for the last four years has resulted in some 15 major developments. With projects presently committed, capital expenditure will have amounted to over \$350 million by the end of 1985 and could reach \$500 million if a number of new projects, which have already been defined, are developed over the next two to three years.

Gold, at nearly \$100 million, leads exploration expenditure in the State, followed by base metals at \$36 million. Most expenditure on base metals has been on exploration and evaluation of the following three deposits: the Nifty copper prospect in the East Pilbara; Golden Grove copper-zinc-silver in the Murchison; and Pillara lead-zinc in the West Kimberley. Many of the major companies are apparently increasing their effort in the search for polymetallic deposits, particularly those with associated precious metals.

Diamond exploration expenditure has markedly decreased from \$43 million in 1982/83 to \$16 million in 1983/84, with the lessening of interest following the euphoria of the Argyle discovery in



Boring anchor pin holes for diamond drill rig on 370 m level at Golden Grove (EZ photo).

nificant resources, and are at a relatively advanced stage of evaluation.

Exploration for uranium continued at a cost of nearly \$10 million per annum.

Oil and gas. The number of exploration wells drilled in 1984 was a record 73, an increase of 4 on 1983, but there was a 5 per cent decrease in metres drilled. A further 37 wells were drilled in the first half of 1985, maintaining the increased activity. Most drilling was again concentrated in the offshore Carnarvon and onshore Canning basins. In 1984 offshore seismic surveys were drastically reduced compared with previous years, but recent oil discoveries, especially near Barrow Island, resulted in a resurgence in activity in the first half of 1985. From 5 019 line km in 1984, offshore surveys covered 11 836 km for the six months to 30 June 1985. Onshore seismic lines were 6 335 km in 1984 and a slightly reduced 2 288 km for the first half of 1985.

Five oil discoveries and one gas and oil discovery were the significant features of the 18 month's exploration. Two small oil fields commenced production in 1984; Sundown, being the second producer in the Canning Basin, and Mt Horner the second in the North Perth Basin. The decision was made to develop the Harriet field

in the Barrow Sub-basin, and this should be in production late in 1985.

The entry into production of the North Rankin Gas Field with availability of gas through the Dampier-Perth pipeline in August 1984 was the highlight in the petroleum industry; whilst in mid-1985 the decision was made to proceed with the second stage of the North West Shelf project. This massive LNG export phase will require the highest investment for a single project ever undertaken in Australia.

Mineral production

The production level of a number of commodities has increased significantly due to the installation of new capacity and greater utilization of existing plant. This, together with generally improved prices, has resulted in an overall increase of 14 per cent in the value of Western Australian mineral production in 1984 to \$4 174 million. A further increase occurred in the first half of 1985 to an annual rate of nearly \$4 900 million.

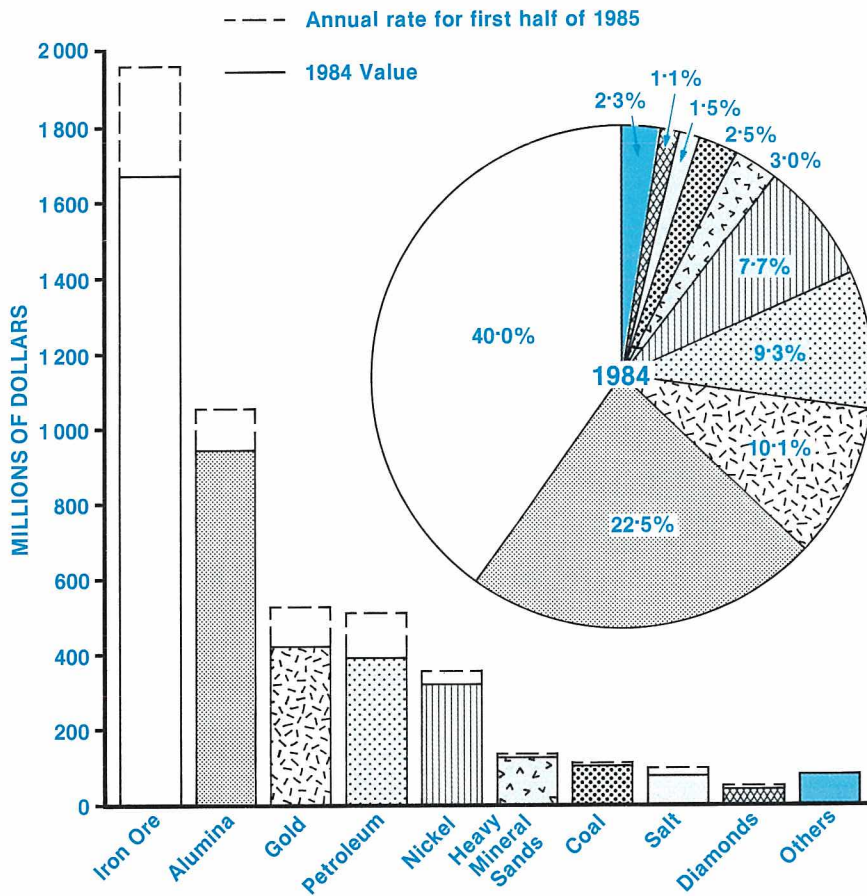
Alumina, gold and natural gas have all added significantly to their 1983 production levels through in-

creased capacity and through new projects coming on-stream. Iron ore, ilmenite, zircon, gypsum and salt have all improved their performance as a result of a better market situation. Gold and iron ore require a special mention. Gold has increased output from 23.9 t in 1983 to 32.1 t in 1984 (breaking the one-million-ounce barrier) and a 36.5 t pa level in the first half of 1985. Projects in the pipeline could result in production exceeding 50 t in the next few years and conceivably reaching 60 t under favourable conditions. A sudden surge in demand for iron ore in early to mid-1984 resulted in shipments of nearly 91 Mt in 1984 after a low of 75 Mt in the previous year. Production figures for 1983, 1984 and the first half of 1985 are tabulated below for the main commodities.

The value of production increased significantly from 1983 to 1984 for iron ore, alumina, gold, petroleum products and nickel. These commodities retained the same relative order of production value with iron ore at \$1 671 million contributing 40 per cent of mineral production value, alumina at \$941 million contributing 22.5

Mineral	Units	Production		Diff. %	Prod. First Half 1985	Diff. Annual Rate %
		1983	1984			
Alumina	Mt	4.0	5.0	+26	2.6	+4
Base metals: (primary)						
Copper conc.	Kt	35.7	38.5	+8	10.1	-48
Zinc conc.	Kt	26.4	70.4	+266	-	-
Coal	Mt	3.9	3.7	-7	1.8	-
Diamond	M cts	6.5	5.7	-13	2.9	+3
Gold	t	23.9	32.1	+35	18.5	+15
Gypsum	Kt	439.4	637.7	+45	284.1	-11
Iron ore	Mt	75.0	90.6	+21	44.0	-3
Mineral sands:						
Ilmenite	Kt	881.3	1 408.0	+53	587.7	-17
Leucoxene	Kt	10.2	32.1	+15	3.1	-81
Rutile	Kt	86.2	60.8	-30	37.4	+23
Zircon	Kt	272.4	337.0	+24	177.2	+5
Monazite	Kt	12.9	15.6	+21	7.5	-4
Nickel conc.	Kt	494.0	496.6	-	216.9	-13
Nickel ore	Kt	19.4	-	-	-	-
Petroleum:						
Oil	ML	1 260.8	1 296.0	+3	570.7	-12
Natural gas	Mm ³	1 052.7	1 332.0	+27	883.4	+33
Condensate	Kt	3.2	22.0	+700	74.0	+673
Salt	Mt	3.9	4.7	+21	2.4	+2
Silica sand	Kt	292.0	353.0	+21	187.2	+6
Silver	t	25.6	38.4	+50	11.8	-69
Spodumene conc.	Kt	2.5	6.7	+268	4.1	+23
Talc	Kt	164.9	161.0	-2	56.7	-30
Tantalite conc.	t	272.4	145.0	-47	38.0	-48
Tin conc.	t	774.8	720.0	-7	222.0	-12

VALUE OF MINERAL PRODUCTION



per cent, gold at \$422 million contributing 10 per cent, petroleum products 9 per cent and nickel just below 8 per cent. The value of mineral production for the main industries for 1984 and the first half of 1985 is shown on the accompanying diagram. Details of production and value for all minerals produced in the State are tabulated in the Statistical Digest on pages 98 to 104.

Royalties

State royalty revenue has increased significantly over the last few years and amounted to \$125.5 million in 1984, a rise of 19 per cent on the 1983 level. In the first half of 1985 there was a smaller increase and \$68.3 million was collected for the six-month period.

Increases in royalty revenue from 1983 were recorded for all the main commodities except crude oil. However most of the increase came from iron ore, alumina and nickel with rises of 22 per cent, 32 per cent and 27 per cent respectively.

The accompanying diagram shows the relative levels of royalty income from the major commodities for the last 10 years.

No adjustments to royalty rates have been made in the 18-month period to 30 June 1985, pending the outcome of an inquiry into mineral (including petroleum) revenues in Western Australia. The independent inquiry commissioned by the State Government was begun in July 1984 under the directorship of Dr P. G. Bradley, a Canadian economist, and a preliminary report for public discussion and comment was released in May 1985. A final report to Government is now expected in the first half of 1986.

Commodity reviews

Introduction

Western Australia's economy is export dominated and relies heavily on the primary minerals industry. During 1983/84 mining contrib-

uted about 53 per cent of the value of overseas exports from the State.

In 1984 the Western Australian industry contributed 30 per cent of the total value of Australian overseas trade in primary mineral products. The main commodities from W.A. responsible for Australia's world importance in the mineral trade were iron ore, nickel, alumina, and the heavy mineral sands ilmenite, rutile, zircon and monazite. A smaller but significant contribution was made by the Western Australian tantalite, lithium, salt, gypsum, silica sand and talc industries. In the near future industrial diamond and natural gas will be added to this list.

In addition the industry provides a range of industrial minerals for the domestic construction and manufacturing industries.

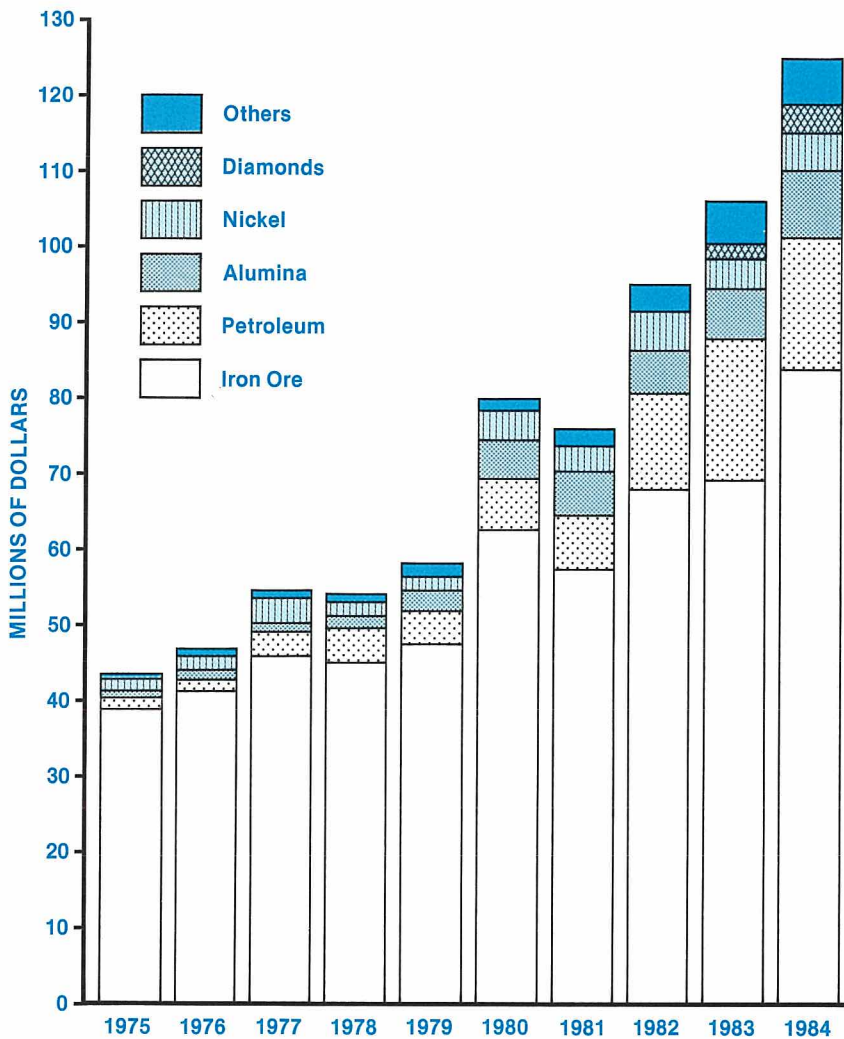
Iron ore

Iron ore continues to be the major mineral produced in Western Australia and the value of production has continued at about 40 per cent of the total value of minerals produced. As most of the production is exported it has been influenced by the very competitive and depressed world market of recent years.

However, whilst iron ore prices have shown little or no improvement over the last 18 months, there have been significant improvements in price and production in a majority of the steel industries around the world reflecting a strong resurgence in demand for raw materials. World steel production increased by nearly 47 Mt or 7.1 per cent from 1983 to 1984; Japan's steel production picked up from about a 97 Mt to 105 Mt pa level in early-mid 1984. Pilbara iron ore producers were able to take added advantage of this due to a strike at the time in India, one of its significant competitors.

About 70 per cent of Australian iron ore goes to Japan to supply 48 per cent of that country's requirements. However, there has been a diversification of markets

ROYALTY REVENUE



by the Pilbara producers over the last few years, particularly to Europe, but also to the fast-growing markets in South East Asia and, to a lesser extent, the Middle East. In recent months potential long-term supplies to Eastern European markets have also been investigated by Mr Lang Hancock. The long-term potential of China is being examined by almost all parties with interests in Western Australian iron ore.

During the last decade producers and potential producers in the Pilbara have had little success in securing markets for new developments. However, one or more new projects may be developed in the near future for markets in China and Rumania. For the present, the three main suppliers need to make major contract renewals with Japan; these are perhaps the most significant renewals since

production began. Newman and Hamersley are seeking to renew two major contracts amounting to 10 Mt pa of ore in 1985, whilst Robe River's number 2 contract is up for renewal next year. It is expected that these contracts will be renewed at similar shipment levels but with negotiability on pricing.

To some extent the devaluation of the Australian dollar has cushioned the effects on Australian producers of a combined 25 per cent reduction in ore prices in US dollars over the last two years, with only a 1.4 per cent to 2.2 per cent increase in negotiated prices for 1985. However the industry has had to introduce stringent cost-saving measures over recent years to remain competitive. The low incidence of industrial unrest has been one factor in achieving competitiveness over the last 18

months. Higher capacity utilization has been another factor. The Western Australian industry has a 117 Mt pa nominal capacity. From a 75 Mt pa or 65 per cent shipment rate in 1983, utilization has increased to around 80 per cent or 91 Mt in 1984, with only a slight decrease to about 88 Mt pa shipment rate in the first half of 1985.

All sectors of the iron ore industry in Western Australia - Government, mining companies and trade unions - have seen the need to work together to maintain and improve competitiveness. To this end a tripartite group was launched in August 1984—the Western Australian Iron Ore Industry Consultative Council. This Council monitors the status of the industry world-wide and seeks to promote a climate of good industrial relations in the iron ore industry.

Some significant milestones in the iron ore industry have been recorded between January 1984 and June 1985. Perhaps the most significant was the export of the 1 000 millionth tonne of iron ore from Western Australia in early 1984. A second milestone was the shipment of Hamersley Iron's 500 millionth tonne of ore on 30 June 1985, after 19 years of operation. Mt Newman Mining, Western Australia's second most important producer, recorded its 400 millionth tonne of shipment since 1969 and Robe River its 150 millionth tonne. BHP's Koolan Island operation exported its 30 millionth tonne of ore in its 20th year of production.

Hamersley Iron shipments in 1984 were 38.2 Mt, just below their peak of 1980, whilst there was a significant increase in Mt Newman Mining's shipments to 31 Mt. The run on ore from about May 1984 resulted in significant depletion in stockpile levels. Hamersley shipments exceeded production by almost 5 Mt, whereas Newman has had periodic problems in responding to the sudden increase in demand. This level of demand has been largely maintained through the first half of 1985.

Hamersley, with their Channar deposit to the east of Paraburdoo, and also Newman have been undertaking feasibility studies to encourage a joint venture project with the Chinese, and it is hoped that a definite development decision will be made in the near future. Both companies have been expending significant capital in upgrading existing facilities; Newman undertook a \$75 million programme of channel dredging and wharf improvements, and Hamersley Iron's 1984 capital expenditure was \$39 million spent on a number of projects including converting the power at Dampier to natural gas.

The Robe River operation has completed similar capital programmes of channel deepening and natural-gas conversion, both within their time estimates and budget. The competition for control of the Cliffs Robe River 35 per cent interest was eventually resolved at the end of 1983 in favour of Peko-Wallsend. As with the other major producers, Cliffs also took advantage of increased demand, with improved shipments from 13 Mt in 1983 to nearly 15 Mt in 1984, but the level later dropped by about 1 Mt pa.

Goldsworthy Mining Associates also experienced ownership changes in the period. BHP's takeover of Utah's operations was the first significant event, and then Mt Isa Mines sold out its shares in GMA to the remaining partners. The present ownership of GMA is BHP 41.66 per cent and Consolidated Goldfields 58.33 per cent.

Goldsworthy have negotiated a further two-year extension of the Japanese contract from April 1985 to June 1987, which will allow production to continue at 4.8 Mt pa by which time the Sunrise Hill-Shay Gap ore reserve will be almost exhausted. There have been suggestions of small "tide-over" and lower grade developments, pending the possible development of Goldsworthy's Mining Area C for the Chinese market.

In November 1984 BHP's Cockatoo operation in the West

Kimberley closed down as reserves were depleted. This operation has been worked for 33 years, supplying high-grade ore largely to BHP steel mills in the Eastern States. Shipping from the stockpile will continue for a further year, after which time the adjacent Koolan Island operation could possibly take up domestic shipments together with its export commitments. Reserves at Koolan are sufficient to sustain about a further 8 years of expanded operation, and BHP is exploring for further reserves on the adjacent Kimberley mainland.



Iron ore mining on Koolan Island.

Another exploration prospect has created press and share market interest in the last nine months. This is the Southdown magnetite prospect near Albany in the South West of the State. A strong aeromagnetic anomaly has been outlined, and detailed ground investigation is required to define the resource.

Bauxite/Alumina

Prompted by an upturn in the aluminium and alumina markets in 1983, Alcoa decided to commence production from its Willowdale mine and Wagerup refinery, some 20 months after construction had been completed. Production started at Willowdale in February 1984 and was shortly followed by the commissioning of the Worsley Alumina Project in March 1984.

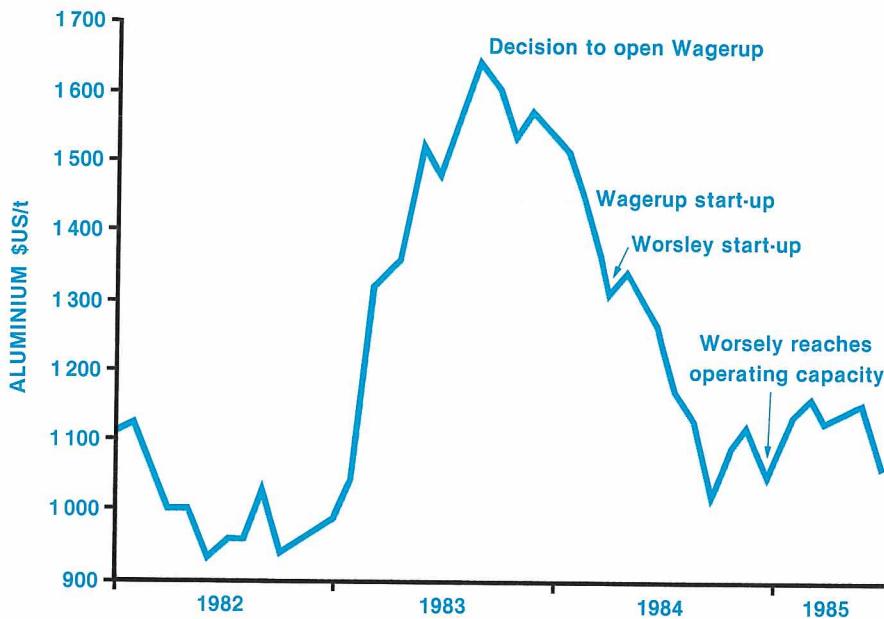
These projects added 1.5 Mt to the Western Australian alumina capacity, which now stands at 5.3 Mt pa from four plants. These plants are largely responsible for Australia providing 30 per cent of marketed western world alumina.

The reduction in large aluminium inventories and subsequent price rises in 1983 was short lived and by the time the new Western Australian plants started up there were already signs of a deteriorating situation. General stocks and supplies of both aluminium and alumina increased around the world through 1984 due

to an over-reaction to the previous upturn. This caused prices to fall and some reactivated plant was again closed, with an overall general drop in capacity utilization by the end of the year.

While Alcoa managed to operate its refineries at rated capacity through 1984, the low demand at the beginning of 1985 led to a 12 per cent reduction in Kwinana production. This cutback is expected to remain in force for the remainder of the year. The 1 Mt pa Worsley operation made its first shipments in May 1984 and only reached capacity by December. The added capacity was reflected in production figures which showed 4 Mt alumina production in 1983, 5 Mt in 1984 and an operating rate of 5.2 Mt pa in the first half of 1985.

ALUMINIUM FREE MARKET (LME) PRICE



In general, however, the world alumina industry is suffering from severe structural over-capacity with growth of the industry not matched by that of aluminium. It has been estimated that, unless significant closure of existing capacity occurs, there could be up to 6 Mt of surplus alumina stock over the next few years. However the Western Australian alumina industry is generally considered to be one of the most efficient in the world, and should therefore be very competitive in tight markets. It has been suggested that new long-term-contract alumina prices are depressed to the extent that they

amount to only 65 per cent of the long-run marginal cost. In 1984 and early 1985 terms, the average value of Western Australian and Australian alumina was around \$Aus 190/t; it has been suggested that corresponding spot prices at the turn of the year have been under \$US 100/t.

Low prices, increasing costs, high overseas loan repayments and forward exchange rate contracts are put forward as the major factors in Alcoa's reduced profits of \$43.7 million net for 1984 (which also includes Eastern States aluminium). This has been calculated to give a 1.8 per cent return on assets, down

from 2.5 per cent in 1983. Their figures for the first half of 1985 have shown a small profit rise to give a 2.3 per cent return on total assets of \$2 395 million, but this improvement was attributed mainly to Australian currency devaluation.

The proposed \$1 300 million aluminium smelter and power station project for Kemerton, near Bunbury, has been a pressing issue for the past 18 months. However in June 1985 the State Government decided that the development could not proceed in the near future and the project was shelved.

Nickel

The nickel industry world wide was more severely hit by the 1981-83 recession than perhaps any other mining industry. In addition to cutbacks in operations, the nickel industry in 1984 began with very large stocks both at mining centres and metal exchanges. Whilst western world consumption of nickel metal increased by 12.2 per cent in 1984 a large portion of this was met from inventories. Thus the effective demand from producers rose by only 4 per cent, which again was met from stocks at plant sites. Western world production did increase in the second half of 1984 to about 84 per cent of effective capacity. Stocks were established at about three months supply at the end of 1984, but the supply-demand situation stabilized and was expected to be almost in balance in 1985.

Overall, Western Australian production rode the recession better than most, thanks to the diversification of Western Australian operators into other commodities. For example WMC's gold developments helped to carry its nickel operations. Overall, nickel production in Western Australia remained constant between 1983 and 1984, but has declined by nearly 13 per cent or equivalent to a level of 7 500 t pa of contained nickel for the first half of 1985. WMC's Kambalda operation showed a slight increase in production from 1983 to 1984, but



Cat 769 truck hauling ore at WMC Mt Charlotte gold mine.

output has significantly fallen in 1985. The Agnew operation of BP/MIM has progressively reduced output, latterly as a result of a rockfall underground and limited throughput of the mill when treating sulphide ore only. The Agnew mine has had the difficulty of continuing high-cost development programmes to give access to better, more amenable ore in depth through a very difficult economic period for both joint-venture partners. Significant, shallow, disseminated sulphide mineralization, extractable by open-pit methods, was discovered by the partners just 3 km north of the present mine, and could provide an additional source of cheaply won ore within the next year.

Strict cost controls, improvements in efficiency, and innovative developments (for example improved comminution in the smelter process) have improved the situation for Western Australian producers. It has been estimated that WMC's Kambalda-Kalgoorlie-Kwinana operation is now the second lowest-cost nickel producer in the world behind INCO in Canada. Changes in the mining method and new equipment have been introduced by WMC at Windarra in an attempt to improve the efficiency at this very marginal, low-grade operation. Both WMC and Agnew were reportedly producing at or just above break-even operating cost in the latter part of 1984. In the case of Agnew, this is insufficient return on major investment over the last seven years or so and cannot sustain the continuing need for more capital development to fully exploit the reserve to its potential. In fact a proposed \$30 million feasibility study leading to a major expansion of the Agnew operation was shelved in October 1984.

Australian nickel producers have received a significant price advantage from a weak Australian dollar, but in US-dollar terms the 1984 price was only marginally better than the depressed 1983 figure. The London Metals Exchange cash average for 1984 was \$US 2.16/lb,

or +2 per cent on 1983 figures, although this does not reflect the gradual improvement to \$US 2.30/lb in the latter part of the year. This improvement has continued in 1985 to reach \$US 2.50 to 2.80/lb and, with the very favourable exchange rate of the last four months, should give a considerable lift to the State's producers. In fact, on the basis of present prices, the small producer Metals Exploration is considering redevelopment of its Nepean mine, south of Coolgardie, which has been on care-and-maintenance since January 1983. Deliveries to WMC's smelter could start in September 1985.

Gold

Extensive exploration, stock-market activities and project development have characterized Western Australia's gold scene for the past three years. The industry covers a very diverse range of groups from the single prospector through to major mining groups and consortia. In 1984 the Mines Department recorded over 500 producers. In addition around 150 companies are currently actively involved in gold exploration, and new floats appear regularly. These figures do not include the many prospectors and smaller gold operations in the State. From a low of 11 200 kgs of fine-gold production in 1980 the State's industry has rapidly grown so that the recorded production in 1984 was 32 100 kgs and in 1985 is running at a rate of 36 900 kg pa. This is the first time that the 1 million troy ounces production level has been achieved since 1941. From being a relatively small industry in the State from the start of the minerals boom in the 1960s, the gold industry in 1984 has emerged as third in importance in the State's mining industry in terms of value of production (\$422 million).

In 1980 there were only 3 major producers in the State, by 1982 there were 8, and now there are at least 20, with a number of others in various stages of evaluation and development. Although much of the production is from

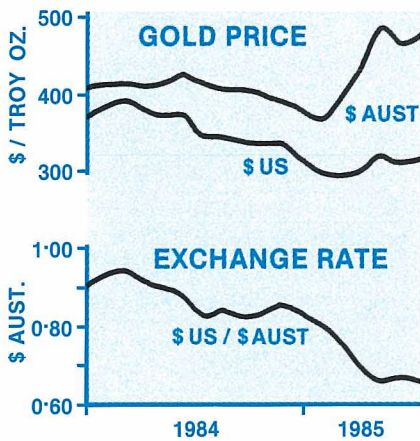
large underground operations, such as Mt Charlotte, Fimiston and Central Norseman, most of the current new developments are based on open-cut mining of low-grade zones associated with old mines. Many of these will have a relatively short life, about 4 to 10 years, but such is the profusion of projects at present that additional and replacement production should continue to increase at least to the end of the decade. Production levels could approach those of the major Western Australian gold era at the turn of the century.

The long-term future of the industry will rely on the continued development of the major underground mines, but the two biggest producers are both largely open-cut operations (Telfer and WMC's Kambalda) and they will play a significant part in the future. An encouraging feature is the discovery of a major new "greenfields" gold prospect at Boddington, and some early exploration indications of others. Boddington, with a potential of over 5 000 kg pa, could be the largest producer in the State in about three years.

The speculative nature of much of the industry and the volatility of price in response to a variety of world actions will always make activity in the industry difficult to predict. An added uncertainty for Australian producers recently has been the threatened removal of tax exemption for gold, although the Commonwealth has since dropped this proposal.

In US-dollar terms the gold price showed a significant drop from around \$380/oz to \$350/oz in mid-1984 and has progressively dropped to below \$300/oz early in 1985 to firm at around \$315-325/oz towards mid-year (see accompanying graph). However the exchange rates throughout 1984 resulted in a relatively stable Australian price, just above \$Aus 400/oz, a level at which most of the State's operations and new developments could comfortably manage. The subsequent weakening of the Australian dollar early in 1985

has encouraged development in industry, with the price at \$Aus 470 to 480/oz.



Diamond

The second year of commercial production from Argyle alluvial deposits in the East Kimberley showed the predicted decline in grade from 5.8 to 3.9 carats/t resulting in a decrease in diamond production from 6.2 to a level of 5.7-5.8 million carats pa for 1984 and 1985. Sales have been below this level, partly due to the decision of the CRA-Ashton partners (Argyle Diamond Sales) to exercise their option from mid-1984 onwards to sell 25 per cent of the cheap gems and industrials independently from the Central Selling Organisation of De Beers. Argyle Diamond Sales have been engaged in setting up a sales office for this

purpose in Antwerp, whilst accumulating a saleable stock.

In addition, some diamonds have been retained for cutting and polishing at a pilot-scale facility in Perth, and the first full-scale marketing promotion of Western Australian gems was initiated in mid-1985.

The State-owned 5 per cent in the Argyle project was offered to the public in November 1984 through the Western Australian Diamond Trust, which is managed by the WADC. Diamonds continue to be sold independently through an agent in Antwerp.

The general trade in rough gem and industrial diamonds has shown substantial improvement in both volume and value through 1983 and 1984 after a distinct lull in the early part of the decade. In detail, however, the latter half of 1984 and early 1985 sales have been well below the levels of the first half of 1984. Demand for high-quality investment-grade gems still remains weak.

The market situation is very important to Argyle, with development work progressing on the pipe, from which 20-25 million carats pa of predominantly cheap gems and industrials will be introduced to the market from 1986. The construction programme for the hard-rock pipe development commenced in November 1983 and is

reportedly on budget (\$465 million) and scheduled to begin production in December 1985.

Two other prospects, downstream from Argyle's alluvial operations, are progressing through exploration and evaluation; the Gemex-Freeport joint venture on Lower Limestone Creek and Afro-West in Lower Smoke Creek. Both have put pilot recovery plants on site in 1985, and although in-ground concentrations of diamonds are lower than at Argyle, the prospectivity is based on higher gem contents, and therefore significantly higher values per carat. Large reserves of alluvials are reported to be present.

Whilst the euphoria of the Argyle find sustained a high level of exploration through the early 1980s (\$40-50 million pa), the latest figures for Western Australia for 1983/84 show a distinct decline to only \$16 million.

Tin, tantalum, lithium

Whilst the tin, tantalum and lithium industries are small in the context of total Western Australian mineral production, the importance of tantalum and lithium in their own world markets is high and of growing significance as developments continue at Greenbushes in the South West.

The massive, hard-rock pegmatite deposits of tantalite/cassiterite and spodumene discovered in the early 1980s will, when fully developed, place Greenbushes in a prominent position in world tantalum and lithium markets.

For the last few years both the tin and tantalum industries have generally been depressed. Greenbushes Tin Ltd has progressed their new developments in a period of continuing export restrictions on tin (through the International Tin Agreement) even though London Metal Exchange prices have improved, and while there has been little or no demand for tantalum. Restrictions still continue on tin production, whilst a successful bid to supply the US General Services Administration



Stripping of overburden before pit development at Argyle AK-1 diamond mine.

Strategic Stockpile enabled the company to sell its total stocks and 1984 production of tantalite.

Low demand and low prices have forced other traditional tantalite producers to cease production, and expanded tantalum consumption has generally been met from inventories. This should hold down prices for 1985, but significant rises in price and demand are expected towards the end of 1985.

In this environment, Greenbushes Tin Ltd has secured a loan of \$15 million to revive development of its hard-rock reserves and is progressing with plant and underground development in phases, with stage 1 due to be on-stream in mid-1986. At that time the company expects to be able supply about 20 per cent of western world tantalite demand. Other developments in pilot-scale tantalum powder production and tailings retreatment plants are progressing.

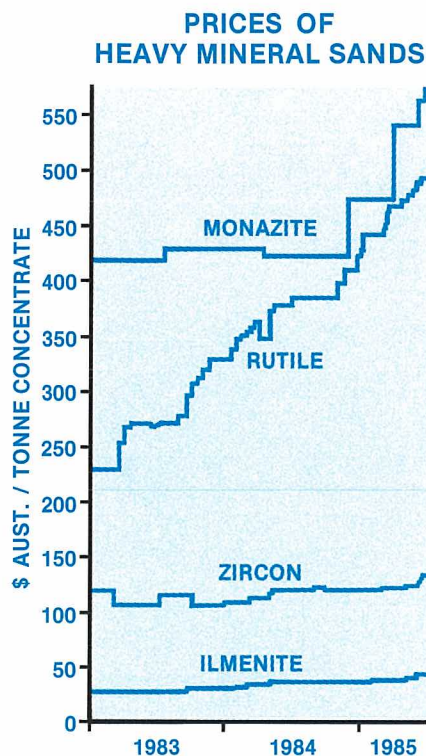
In two and a half years of production Greenbushes Tin Ltd has achieved a level of about 8 per cent of the world lithium production. Spodumene production is expanding to a present capacity level of 20 000 t pa of concentrate. The combination of massive reserves of high-grade spodumene and very low mining cost should see the company penetrate a traditionally closed market, at present dominated by one US producer. Use of spodumene concentrate is limited to the glass-ceramics market, and by undertaking a \$1 million feasibility study into the possible development of a lithium-carbonate plant, the company is seeking to expand its market into the aeronautical and high-technology electrical industries by 1988.

Heavy mineral sands

The signs of a revival in prices for titanium-bearing heavy mineral sands in late 1983 have been borne out in 1984, and especially in the first half of 1985. Ilmenite prices have improved from around \$35/t at the beginning of 1984 to stand at \$45 to \$50/t by June 1985. Rutile

prices, because of a general shortage of natural high titanium-bearing material around the world, have increased about \$170/t over the same period to stand at around \$500/t at present although a major part of this increase occurred after November 1984.

Whilst relatively constant prices persisted for zircon and monazite through 1984, there has been a rapid and continuing rise in monazite prices since December 1984 and in zircon since May 1985. Zircon prices are still relatively low, but demand is reasonable. Mineral sands products are traded in Australian dollars, and so this is one industry which has not been able to take full advantage of the favourable exchange rate.



This situation has resulted in increased production and sales revenues by the Capel and Eneabba operations, but difficulties with hard rock by one operator, and movement to a new mine site by another, together with rising production costs (mainly because of lower grades), mean that profits did not improve significantly for every operator in 1984. Higher production levels for rutile and zircon and higher overall prices, together

with more stable operating conditions, improved the results for 1985. Westralian Sands, the biggest sand miner in the State, reported a record profit increase of 230 per cent in the first half of 1985.

The improved situation, particularly the scarcity of rutile, has led to a number of process developments being given the go-ahead over the last year. Associated Minerals Consolidated and Westralian Sands are proceeding with synthetic rutile plant developments costing \$60-65 million at Eneabba and Capel respectively; while Allied Eneabba is studying another \$60 million development to produce rare earths from monazite, using ion-exchange technology. In addition SCM Corporation of New York is expanding the Australind titanium dioxide pigment plant, and is contemplating converting to the chloride-processing route in order to reduce effluent problems. These developments will ensure that the industry moves with changing marketing trends and remains the world's major mineral sands producer for the foreseeable future.

Base metals

Failure to discover additional ore at the Teutonic Bore deposit, and reduction in the exploitable reserves because of a general recession in base-metal prices, brought operations to an end at this **copper, zinc, silver** mine in November 1984. Processing will continue on stockpiled ore until late 1985.

Teutonic Bore was the State's only base-metal mine. However there are some encouraging prospects proceeding through the evaluation stage. At Golden Grove the large Scuddles **copper-zinc** deposit is being tested. Shaft sinking, the collection of a bulk sample, and drilling to confirm reserves, were completed in April 1985, and metallurgical test work is currently in progress. The two-year evaluation, expected to cost about \$15 million, may lead to a decision to commence a full feasibility study by the end of 1985.

WMC's **copper** prospect at Nifty in the Throssell Range, to the east of Marble Bar, continued drilling to identify a resource amenable to open-pit mining with 4 to 5 per cent copper content in the oxidized zone. Evaluation for development is still continuing, while exploration also progresses on the delineation of primary ore.

Centenary International Mining has announced recently that they intend to carry out a feasibility study on a high-grade **silver** deposit at Lennon's Find in the Pilbara. This also contains minor amounts of zinc, lead and copper. AMOCO/ GEOPEKO'S Jillarwarra prospect, in the Ashburton, is reported to contain a very large tonnage (250 Mt) of 2 per cent **lead** and by-product silver.

In the West Kimberley, BHP/ Shell/Trend Exploration have defined a substantial reserve of **lead-zinc** at Pillara. A feasibility study has been completed, and it is understood that the partners are currently studying the possibility of mining the deposit.

June and was piped to the South West in August 1984. The first stage is for domestic consumption and production is currently at the rate of 3.6 million m³ of gas per day. Production in 1984 was 457 million m³ and in the first half of 1985 was 771 million m³. This already significantly exceeds that of the two existing gas producers at Dongara and Woodada.

Recoverable reserves of gas on the North West Shelf are estimated to be 229 billion m³ with a further 16 million kL of condensate, sufficient to allow an ultimate annual production of 6 Mt of LNG and 1.4 Mt of condensate. In mid-1985 the first step in realizing stage 2, (the export stage) of the project was taken when the agreement for the Japanese to purchase LNG was signed. Exports are due to commence in 1989.

Following the start of oil production from the Blina Field in the Canning Basin in 1983, the Sundown Field established full production in July 1984. Two further oil discoveries were made on the

produced in the State. Recent oil discoveries near the Barrow Island Field have stimulated activity in the offshore Carnarvon Basin. Three oil discoveries were made in the 1984-85 period and extension drilling was carried out on the discoveries at Harriet, South Pepper, Chervil, Talisman and at Barrow Island itself. The Bond Corporation operated Harriet Field, 14 km northeast of Barrow Island, and is committed to development at cost of \$243 million with the construction of a platform and associated facilities commencing in May 1985. Exploration of the North Herald prospect, south of Barrow Island, is also producing encouraging results and if these are sustained the prospect could be developed shortly. The State's total recoverable crude oil reserves are estimated to be 20.7 million m³ of which 95 per cent occur in the Carnarvon Basin.

Other minerals

Production of **coal** for domestic power generation declined in 1984, and this is expected to continue into 1985 with increased North West Shelf gas production. Annual coal production had increased for a number of years, reaching nearly 4 Mt in 1983. However in 1984 output dropped to 3.7 Mt tonnes and is operating at a rate below 3.6 Mt tonnes per annum in the first half of 1985. Coal evaluation and exploration continued in the Wilga and Boyup Brook Basins, near Collie, and at Hill River in the Northern Perth Basin.

Evaluation has continued at two **uranium** prospects, which have the potential to add to the very large identified resource at Yeelirrie. Power Reactor and Nuclear Fuel Development Corporation of Japan (PNC), at Mulga Rock in the Officer Basin, has been carrying out bulk sampling and metallurgical testing, followed by a feasibility study. Total Mining Australia has recently carried out trial solution extraction on the Manyingee deposit in the North-West, near Onslow.



Sample preparation area at Golden Grove (EZ photo).

Oil and Gas

1984 saw the commencement of gas production on the North West Shelf, 13 years after the first well was drilled in 1971. Gas from the North Rankin Field, 130 km north-northwest of Dampier, was first delivered onshore to the processing facility on the Burrup Peninsula in

northwest edge of the basin. One of these, Home Oil's West Terrace No.1, reached the stage of long-term production testing.

Barrow Island continues to be the major oil producer, maintaining similar output levels to that of the previous year and supplying about 95 per cent of the total oil



Oil Storage tanks at Barrow Island (WAPET photo).

Four producers along the northwest coast increased **salt** shipments in 1984 by over 20 per cent to 4.7 Mt and between them should achieve a level of 5 Mt pa in 1985. Conzinc Rio of Australia's Dampier Salt, the biggest producer in Australia, passed a landmark in June 1985 with the export of its 25 millionth tonne.

With the imminent depletion of reserves at Useless Loop, Agnew Clough's Shark Bay **gypsum** and salt operations are intended to be moved north to the Peron Peninsula, with the possibility of a new expanded facility to handle 0.7 to 1 Mt yearly. While Agnew Clough at Shark Bay and Southern Asiatic Enterprises on Lake Cowan dominate the gypsum scene, a number of other smaller producers have expressed their willingness to expand supply. The number of producers has grown from 8 in 1983, 12 in 1984 to 13 in 1985, increasing the output rate by 45 per cent from 1983 to 1984 and a further 6 per cent in the first half of 1985.

Talc, silica sand and attapulgite are other significant export products from Western Australia, while there are a host of other industrial minerals produced to serve the domestic market.

Mining Act

Following a Mining Act Inquiry set up in July of 1983, the Mining Amendment Bill, 1985 was introduced into Parliament during the Autumn Session.

This Bill, in the main, reflected the recommendations of the Inquiry which, amongst other things, proposed to remove the power of veto over exploration and mining currently enjoyed by private land owners and place this with an independent tribunal.

Whilst the Bill passed through all stages in the Legislative Assembly, the Legislative Council decided to set up a Select Committee to review the proposed amendments and report back to Parliament with their recommendations.

It is anticipated the report of the Committee will be considered during the 1985 Spring Session of Parliament.

Mines Department

The total establishment of the Mines Department at the end of the 1984/85 year was 823 positions, comprising 626 Public Service, 7 contract, 45 Ministerial and 145 wages positions. In addition, there were 15 part-time wages employees engaged as cleaners and gardeners at the various outstations.

This represents a net increase in establishment of 11 positions over the 18-month period from the 812 positions at the end of 1983. Five of the new positions were created in the Mining Engineering Division - four Noise and Vibration Officers and one State Coal Mining Engineer; two in the Computer Services Branch to facilitate the development of Departmental information systems; one in the Petroleum Division for processing tenement applications; one in the Mining Registration Division to process company reports; one position of Mineral Economist to advise on the value of the State's resources and one additional contract position in the Minister's Office.

There were of 91 vacancies advertised during this 18-month period compared with 60 in the previous 12-month period.

Up to 21 additional persons were employed through funding made available by the Community Employment Programme for the data gathering and input phases of specific projects which included computerization of the records system, hydrogeological reporting, analysis of dust samples and updating of mineral data files.

THE CASSIDY SHAFT PROJECT—KMA Mount Charlotte

The Cassidy Shaft, at Kalgoorlie Mining Associate's Mount Charlotte Mine, was planned and developed to access the Mount Charlotte Deeps and Reward orebodies which are displaced some 150 m laterally and in depth from the current operations in these orebodies. The total project cost is \$55 million, of which some 60 per cent is attributed to sinking and equipping the shaft.

The shaft is 6.5 m in diameter and concrete lined; it is 1 184 m deep. Shaft equipment consists of steel sets (at 5 m intervals) and guides, and there are 5 compartments: cage and counterweight, two skips, and ventilation ducting. Services are carried in the cage compartment. A total of 11 plats have been developed from the shaft. The upper 3 connect to levels

which were developed from existing workings at Mount Charlotte to allow for raise drilling. The next 4 are future production levels, and the lower 4 provide for services and materials handling; (crusher, load station, spillage clean up). Shaft sinking and lining required excavation of 109 000 tonnes of rock and the placement of 6 200 m³ concrete; (shaft wall .25 m nominal).

WINDER DETAILS

	Production	Service
Power	1 600 kW	800 kW
Drum diameter	2.6 m	2.6 m
Speed	12.5 m/sec	9 m/sec
Capacity	11.25 tonnes	*9.6 tonnes (45 men)
Head Ropes	4 x 26 mm	4 x 26 mm
Tail Ropes	2 x 37 mm	2 x 37 mm
	(*14.1 tonnes heavylift at 2 m/sec.)	

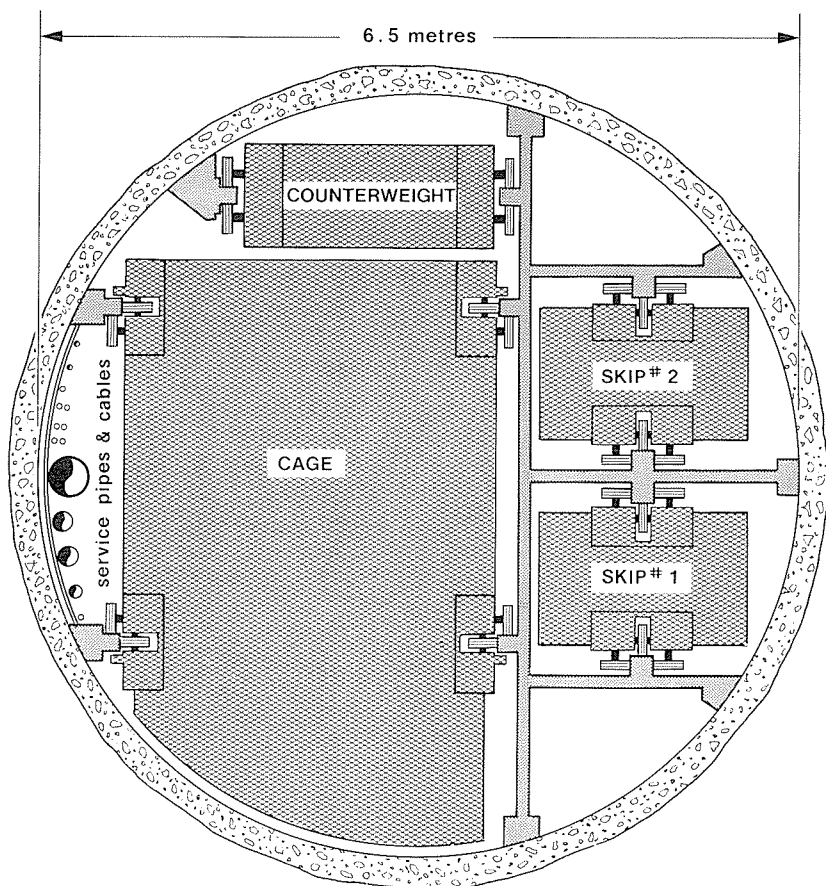
Shaft equipping steel work totalled 1 600 tonnes.

The first 590 m of shaft was stripped to raise-drilled pilot holes which were developed from existing levels during 1981-82. The presink was commenced in January 1982, and the stripping in May. Full sinking of the lower half of the shaft was begun in November 1982, and was completed soon after mid 1984. Drilling was done with a jumbo and mucking with a cactus grab suspended from a five deck sinking stage. Equipping of the shaft which was done from the bottom up, was completed in December 1984.

Construction of the permanent headframe commenced in January 1985 and was completed by the end of March. There are three independent structures; headframe (50 m high), skyshaft, and bins, totalling 375 tonnes of steelwork.

The two G.E.C. Koepe (friction) winders installed are the first ground-mounted units of this type in Australia. Roping up and commissioning was finished in May 1985.

The production hoist has a capacity of 1.3 million tonnes per year. Initially this hoist will handle mainly waste rock from development on the new levels, but some ore from existing producing levels will be brought up the Cassidy Shaft before production is commenced in 2 to 3 years from the deeper orebodies accessed by the shaft.



Cassidy Shaft layout

The level of activity in the mining industry throughout the State continued to expand during 1984, and to mid 1985, with maximum expansion taking place in gold mining. The principal areas of new and expanded activity are described in the body of the report, together with some relevant production data.

Additional staff have been appointed or approved to undertake new occupational health and safety initiatives in noise abatement and radiation safety in mines, and changes in staff arrangements have been planned to rationalize aspects of machinery safety inspections in mines, following formation of the Department of Occupational Health, Safety and Welfare early in 1985.

The Mining Engineering Division continued to pursue new avenues of investigation into various aspects of occupational health and safety in the mining industry, and to establish improved systems for inspection, control, and communication with all sectors of the industry.

The sustained growth in the mining industry previously referred to, and the continued expansion in geographical spread and technical complexity, have exceeded the capacity of the Division to provide the service to industry that is required. Proposals to restructure the Division, in order to adequately equip it to do justice to its assigned tasks, have been put forward. These include a proposed significant expansion in staffing of the Division.

Mining Activities

Production figures quoted in this section refer to the calendar year 1984 while figures in brackets are for the 18-month period 1 January 1984 to 30 June 1985, where those figures are available.

Alumina

Alcoa of Australia Ltd commenced production of bauxite from the Willowdale mine and alumina at the Wagerup refinery. The company mined bauxite from 209.3 ha of land at its Jarrahdale, Del Park, Huntly and Willowdale minesites. This ore was processed at the Kwinana, Pinjarra and Wagerup refineries, resulting in the production of 4.65 (6.80) Mt of alumina.

The *Worsley Alumina Pty Ltd* mine at Boddington commenced production in 1984, mining bauxite from 18 ha of land. The ore was treated at the Worsley refinery which was commissioned during the year and produced 0.36 (0.81) Mt of alumina.

Attapulgit

Mallina Holdings excavated and stockpiled attapulgit-bearing clay from Lake Nerramyne minesite and this was treated at Narngulu to produce attapulgit.

Clay, shale and limestone

The increased level of activity in the housing and construction industries gave a welcome boost to the production of clay, shale and limestone.

Midland Brick Co. Pty Ltd, the largest producer, mined clay and shale from several pits in the Shire of Swan.

Limestone was produced for use in the construction industry, mainly in road and groyne construction, cement and lime manufacture, and cut stone for building.

Coal

Coal production in 1984 was slightly down on the record 1983 figure. A total of 3.69 (5.53) Mt was produced, of which 2.90 (4.32) Mt came from open-cut mines.

Western Collieries Ltd produced 1.59 (2.35) Mt from its No.

2, 6 and 7 underground mines and the No. 5 open cut.

At Western No. 2 the east side of the mine was closed down following extraction of all available coal. Emphasis on development continued in the southwest sector resulting in a total mine production of 429 243 (614 782) t.

Western No. 6 production amounted to 320 024 (525 102) t. Roof-bolting tests proved highly successful, resulting in improved stability and a marked reduction in the use of timber supports.

New mechanical and electrical workshops were constructed and two flame-proof diesel-powered transporters were commissioned.

The Western No. 7 mine was still in the development stage and only 39 085 (72 231) t of coal was produced. The main ventilation fan installed on the surface in February 1985 is powered by a 75 kW electric motor and is hooked up to an auxiliary diesel engine for use in emergencies.

The Western No. 5 open cut produced 803 548 (1 137 183) t of coal. Rehabilitation work continued during the year and 23.5 ha was planted with native plants and trees.

Griffin Coal Mining Company Ltd produced 2.1 (3.19) Mt of coal from the Muja and Chicken Creek open cuts with Muja contributing 2.03 (3.08) Mt of the total.

Coal output from the Chicken Creek open cut was 72 817 (110 233) t. Acidic water from the open cut is treated with lime before being discharged into the channel leading to the Collie River.

Copper-zinc

Teutonic Bore mine ceased underground production in November 1984. In September 1984 the access road into the pit was lost due to a massive wall slip and had to be re-routed to extract the remaining 42 000 t of copper/zinc ore. A stockpile of 54 000 t of ore remained to

be treated at 30 June 1985. The treatment of 317 800 (502 800) t of ore produced concentrates with calculated metal content of: 9 468 (15 968) t Cu; 36 589 (54 589) t Zn; 43 067 (68 567) kg Ag.

The addition of a heavy-media circuit will enable additional low-grade material to be economically treated in 1985.

Electrolytic Zinc, Amax, Esso and Aztec, as joint venturers, engaged Thyssen Mining to sink the Golden Grove shaft on their Scuddles deposit near Yalgoo.

The shaft was sunk to the 379 m level and 1 227 m of development was completed on two levels and extensive diamond drilling was carried out to evaluate the orebody. On completion of this work, all equipment including the headframe was removed from site pending evaluation of the orebody and a study to assess the feasibility of mining.

Diamond

Argyle Diamond Mines Pty Ltd continued production from alluvial diamond deposits while developing the AK-1 mine in the pipe and constructing a kimberlite treatment plant. Diamond recovery amounted to 5.6 (8.6) Mct from 1.6 (2.25) Mt of ore treated. Overburden removed from the AK-1 deposit was 15.37 (23.28) Mt. The kimberlite treatment plant is scheduled to commence production in late November 1985.

Dimension stone and aggregate

Supplies of stone and aggregate used in the building and construction industry were mined from numerous small quarries throughout the State to meet local requirements.

Gold

Gold exploration and mine development continued at an ever increasing rate with gold production for 1984 exceeding 32 t valued at \$422.25 million. Production for the year ended 30 June 1985 exceeded 37 t and was valued at \$508.89 million.



Construction of treatment plant for Argyle Diamond Mines Pty Ltd

Pilbara Mining District. *Newmont Holdings Pty Ltd* continued production from open-cut gold mining operations at Telfer. In addition to the routine treatment of ore, low-grade ore treatment using heap leaching methods was commenced in May 1984. Production of gold amounted to 3 741 (5 743) kg. Planned expansion of the treatment plant in 1985-86 will enable higher tonnages of lower grade material to be treated.

Metana Minerals N.L. produced 189.9 (278.4) kg of gold from alluvial deposits at Nullagine.

Golconda Resources Pty Ltd recovered 112 kg of gold from the retreatment of tailings at the Blue Spec mine. The operation was completed in June 1984.

The tailings retreatment operation at the Comet gold mine returned 15.4 (16.6) kg of gold with an additional 0.8 (5.3) kg being produced from an alluvial deposit.

Endeavour Resources Ltd operated an alluvial gold mine at Marble Bar from July to December 1984 producing 14 kg of gold.

Bamboo Creek Management Pty Ltd commenced underground mining operations at Bamboo Creek in the latter part of 1984 and a carbon-in-pulp treatment plant was commissioned in November 1984.

Peak Hill Mining District. *Horseshoe Lights Gold Pty Ltd* upgraded the treatment plant with construction of a carbon-in-pulp plant and produced 285 kg of gold during 1984.

Murchison Mining District. Additional crushing and screening, and wet treatment sections were added to the *Whim Creek Consolidated N.L.* plant which produced 1 091 kg of gold.

Paddys Flat Gold Mines reopened the Ingliston mine and produced 20.2 kg of gold.

Endeavour Resources commenced work on the Blue Bird open-cut mine just south of Meekatharra.

Pivot Resources N.L. commenced operations, treating alluvial deposits at Nannine and produced 47 kg of gold.

Hill 50 Gold Mine N.L. installed a carbon-in-pulp circuit and substantially increased development at the Main shaft. Ore was produced from the Morning Star, Water Tank Hill and Hill 50 shafts, with additional ore coming from open cuts. Production for 1984 amounted to 1 290 kg of gold.

V. and D. Ridolfo Pty Ltd treated 106 000 t of ore from the St George open cut and re-treated 21 500 t of sands from the Boogardie State Battery producing 362 kg of gold.

Australian Consolidated Minerals contracted Roberts Construc-

tion to sink the Golden Crown shaft near Cue. The shaft was sunk 256 m and 1 194 metres of level development was completed, delineating a significant orebody.

Metana Minerals N.L. developed an open-cut mine and constructed a treatment plant near Tuckanurra at the old Reedys mine. Gold recovery amounted to 622 kg.

In addition to the above mentioned gold mining operations in the Murchison Mining district, 32 small operators were known to be recovering gold from tailings retreatment, alluvial mining, open-cut and underground mining, dry blowing and metal detecting.

Yalgoo Mining District. *Prag Pty Ltd* recovered 30 kg of gold from leases near Warriedar.

Mt Margaret Mining District. The district's major producer the Lancefield gold mine operated by *WMC Ltd* produced 1 217 kg of gold from the Eysers shaft and open-cut operations on Telegraph and West lodes.

Several new mining operations were commenced in the district in 1984. *Tower Hill Gold Mines* commenced an open cut in January and completed construction of a treatment plant in March 1985.

Sons of Gwalia N.L. commenced mining in August 1984

when a carbon-in-pulp plant was commissioned. Gold recovery in 1984 was 519 kg.

Harbour Lights Mining Ltd commenced construction of a treatment plant at Leonora in December 1984 and this was completed in May 1985.

Balmoral Resources N.L. reopened the Great Western mine at Wilsons Patch, but difficulty was experienced in treatment of the high-sulphide ore at the Leonora State Battery. Exploration was discontinued following two stope collapses in 1985.

North Coolgardie Mining District.

In April 1984 *Ejudina Gold Mines Pty Ltd* completed construction of a treatment plant incorporating crushing, grinding and a carbon-in-pulp process. 182 000 (307 500) t of ore was treated from the open-cut mine for a recovery of 594 (1 053) kg of gold.

Centamin Ltd used a mobile crushing plant and heap leaching process to recover 47 (80) kg of gold at Callion.

Paget Gold Mining Co. Ltd commenced dewatering and rehabilitation of existing shafts located 20 km east of Porphyry.

Broad Arrow Mining District. *Ora Banda Gold Mining Pty Ltd* mined and treated ore from the Wentworth mine at Grants Patch until early 1985 when economic re-

serves were exhausted. Production commenced from an open cut at the old Eureka mine near Bardoc. Gold recovered totalled 51 (87) kg.

Pan Continental Gold Mining Areas Pty Ltd commenced construction of a carbon-in-pulp treatment plant in July 1984 at the Paddington minesite. By the 30 June 1985, 3.5 Mt of overburden had been removed from the orebody and the treatment plant had been commissioned. The first gold was poured on 28 June 1985.

BHP Minerals established a small gold mining operation at Ora Banda known as the Gimlet South project. An open cut and carbon-in-pulp process will produce and treat 100 000 t of ore yearly. The treatment plant was commissioned in April 1985 with the first gold poured towards the end of May. By 30 June 1985, 18 kg had been recovered.

WMC Ltd Gold Operations continued production at Siberia from the Missouri and Sand King open cuts. The Sand King neared the end of its economic life and is expected to close in the second half of 1985. However a new open cut, to be known as the Lady Bountiful, located near Mt Pleasant should commence production around this time. Gold recovered from the Sand King and Missouri was 587 (742) kg.

East Coolgardie Mining District. The Kalgoorlie-Boulder area in the East Coolgardie Mining District continues to be the main source of gold in the State.

During the 18-month period covered by this report, five moderate size open cuts were established by *North Kalgurli Mines Ltd* and a separate oxide circuit was commissioned in the mill. This relieved pressure on underground production, enabling exploration and development work to proceed in an orderly manner at the two operating underground mines. Gold production was 2 138 (3 359) kg.

Central Kalgoorlie Gold Mines N.L. commenced mining the Hid-



Crushing, screening and beneficiation plant at Mt Whaleback

den Secret and Mt Ferrum open cuts during 1984 and constructed a 100 000 t capacity treatment plant, enabling oxidized ore to be processed by the carbon-in-pulp method. The company produced 70 kg of gold.

Kalgoorlie Mining Associates completed the Cassidy shaft sink to a depth of 1 184 m including six flats and a loading pocket. Servicing of the shaft was completed in December 1984.

Production from Mt Charlotte increased marginally to 3 750 (5 223) kg. At the company's Fimiston leases a marked increase in ore production from the Perseverance and Lake View underground mines and a newly developed open-cut mine at Fimiston resulted in the recovery of 291 (4 857) kg of gold.

Gold Resources Pty Ltd expanded operations at Fimiston, mining ore from an open cut in the 'B' lode and at the White Hope mine where open-cut and underground mining was carried out. Cross cutting to the Oroya West orebody from the Paringa shaft continued on the 3, 4 and 5 levels.

Great Boulder Holdings Ltd, a wholly owned subsidiary of WMC Ltd, continued mining the Great Boulder-Horseshoe open cut at Fimiston. Production from the Great Boulder section was transported to Kambalda for processing, ore from the Horseshoe section was transported to Kalgoorlie Mining Associates' Oroya plant. Total gold recovery from the open cut was 1 816 (2 435) kg.

A number of small mines and tailings retreatment plants operated throughout the year.

Coolgardie Mining District. *WMC Ltd* continued production from underground at the Victory decline and from the Defiance and Orchin open cuts. Heap leach trials for treatment of oxidized low-grade ores were carried out during the year.

A considerable number of small operations covering a wide range of mining techniques oper-

ated throughout the district. One of the most notable of these was Mr Bill Powell's McPhersons Reward mine.

Yilgarn Mining District. *Kia Ora Gold Corporation N.L.* produced 540 (800) kg of gold from underground and open-cut mining at Marvel Loch. Work on upgrading the treatment plant commenced to increase its capacity to 250 000 t pa.

Great Victoria Gold Ltd commenced an open-cut operation at the old Great Victoria gold mine near Marvel Loch.

A carbon-in-pulp treatment plant with a capacity of 1 000 t/day was completed in August 1984 and 134 kg of gold was recovered during the remainder of the year. A further 260 kg of gold was recovered in the first six months of 1985.

Southern Goldfields Ltd brought the Nevorina mine into production with the completion of construction of a carbon-in-pulp plant. Gold produced was 65 (577) kg.

A number of prospectors and small producers were active in the Southern Cross - Marvel Loch area throughout the year.

Dundas Mining District. *Central Norseman Gold Corporation Ltd* produced ore of significantly

higher grade than in 1983, recovering 3 211 (4 672) kg of gold from 172 000 (298 000) t of ore. A new semi-autogenous grinding mill and associated feed system was commissioned in March 1985, the fiftieth year of continuous operation by the company.

Australis Mining N.L. continued to produce ore from the Mt Henry gold mine located 20 km south of Norseman. In 1984 a total 127 (168) kg of gold was recovered.

East Murchison Mining District. In April 1984 a 100 000 t/month carbon-in-pulp plant was commissioned to treat tailings at Wiluna. Known as the Wiluna Dumps project, the *Barrack Mining Group* produced 523 (903) kg of gold.

WMC Ltd commenced an open cut at the Emu mine near Agnew which produced 121 kg of gold in 1984.

Grants Patch Partners re-treated the old Emu tailings dump at Agnew recovering 390 (473) kg of gold.

Gypsum

Southern Asiatic Enterprises Pty Ltd produced 194 000 t of gypsum from its Lake Cowan operations at Norseman, while the *Shark Bay Salt Joint Venture* was the State's largest producer with more than 250 000 t in 1984.



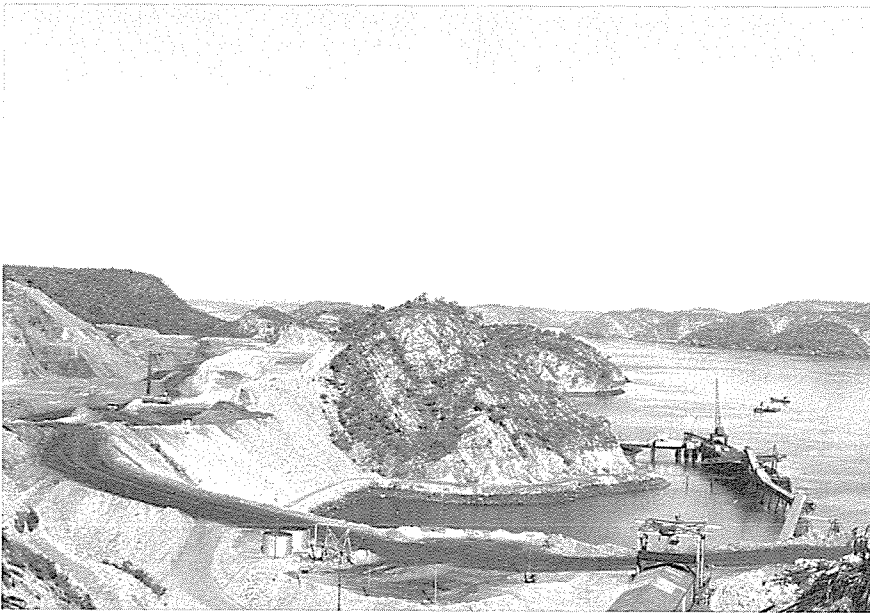
Varying sizes of Haulpak trucks at Mt Whaleback

Iron ore

BHP Minerals Ltd ceased production at Cockatoo Island in November 1984 having mined all economic reserves of iron ore. Shipping is expected to continue for the next two years from stock-piled material.

January 1985 was the twentieth anniversary of mining on Koolan Island, and in May 1985 the 30 millionth tonne of iron ore was produced.

The company shipped 3.46 (5.11) Mt of ore.



Port facility and part of open cut at Koolan Island

Cliffs Robe River Iron Associates mined Mesas L and N in the Eastern Deepdale area and shipped 14.89 (22.2) Mt from Cape Lambert.

The shipping channel was deepened to 19 m by dredging and subsequently a ship carrying 238 000 t of iron ore sailed from the port creating an Australian record for export cargo.

Goldsworthy Mining Ltd mined and shipped 4.7 (6.9) Mt of iron ore from its Shay Gap and Sunrise Hill minesites.

Hamersley Iron Pty Ltd shipped 37.1 (57.0) Mt from its minesites at Tom Price and Paraburdoo.

Mt Newman Mining Co. Pty Ltd shipped 30.9 (45.2) Mt of iron

ore from its Mt Whaleback minesite. Port redevelopment, including dredging and wharf modifications, was carried out during the year.

Magnesite

Norseman Gold Mines N.L. established a mining operation at Bandalup with a mobile crushing and washing plant.

In February 1984 the first shipment, consisting of 13 400 tonnes, was despatched to Queensland Alumina Ltd.

Allied Eneabba Ltd mined 6.9 Mt of ore at Eneabba which was processed at Narngulu to produce 422 000 t of saleable product. The company has announced its intention to build a plant at Narngulu for the extraction of rare-earth minerals.

Westralian Sands mined 3.3 Mt of ore to produce 495 000 t of concentrate. At the Yoganup plant a system of portable conveyors has been introduced resulting in a significant reduction in transport costs and greater flexibility in operation.

The construction of a synthetic-rutile plant at the North Capel minesite was commenced.

Cable Sands Pty Ltd mined 817 000 t of ore at the Prowse and North Capel sites. A total of 294 000 t of concentrate was treated at the Bunbury plant for a recovery of 176 000 t of heavy mineral sands. Excavation at the Prowse mine was completed and mining at the North Capel site commenced.

A new plant on the Waroona deposit commenced operation in April 1985.

Nickel

WMC Ltd operates 11 nickel mines in the Kambalda, St Ives and Widgiemooltha areas as well as a nickel mine at Windarra and nickel concentrators at Kambalda and Windarra.

During the year declines were advanced at Otter, Juan, Fisher, Foster and McMahon. Preparatory work was carried out for sinking the Foster shaft, where the pre-sink was completed and a permanent headframe installed.

The Kalgoorlie nickel smelter treated 477 000 (676 000) t of nickel concentrate and 77 400 (110 600) t of nickel matte was produced.

Agnew Mining Company Pty Ltd progressed to full operating status during 1984. The main shaft complex was completed and the winder commissioned.

Mineral sands

Figures quoted are for calendar year 1984.

A total of 16 Mt was treated to produce 1 517 878 t of mineral products.

Associated Minerals Consolidated Ltd treated 922 000 t at Capel for the production of 116 872 t of heavy mineral sands. As in the 1983 the tonnage of material mined was severely restricted. The synthetic rutile upgrade plants were, however, working to capacity.

The Eneabba operation treated 3.8 Mt to produce 308 000 t of concentrate. The company announced its intention to build a synthetic-rutile plant at Geraldton.

The concentrator was upgraded to a capacity of 800 000 t pa but has not yet been brought up to full production. During the year 565 000 (776 000)t of ore was treated.

Salt

The bulk of the State's export salt production continued to come from Dampier, Lake McLeod, Port Hedland and Useless Loop.

Production for 1984 amounted to 3.9 Mt valued at more than \$75 million.

Spodumene

Greenbushes Tin N.L. produced 7 548 t of spodumene from 51 857 t of ore treated. The spodumene concentrator was rebuilt during the year to improve its efficiency.

Talc

WMC Ltd Joint Venture extended the plant at Three Springs to permit an increase in production.

A dispute over the ownership of the leases caused *Westside Mines Pty Ltd* to cease mining at Mt Seabrook.

Tin and tantalite

Greenbushes Tin N.L. treated 1.8 Mt of ore to produce 540 t of tin and 155 t of tantalite concentrate. As in previous years, the production of tin was limited by the tin quota. Elsewhere in the State tin/tantalite miners either suspended operations or operated at restricted outputs according to their respective tin quotas.

Operations

Kalgoorlie

The gold mining industry has once again made remarkable progress in the Kalgoorlie Inspectorate, with new mines being brought into production and others expected to commence during 1985-86.

In addition to the upsurge in gold activity, Metals Exploration has announced that the Nepean nickel mine near Coolgardie will

reopen and in June 1985 WMC commenced dewatering and removal of overburden at the South Windarra open pit in preparation for recommencement of nickel ore production.

The major capital investment in mining projects within the Kalgoorlie Inspectorate is indicative of the optimism with which mining companies are facing the coming year.

Perth

Due to staff shortages, Perth based inspectors had a particularly busy and difficult period and were not been able to carry out mine safety inspections at a satisfactory frequency.

The Murchison Goldfield was extremely active in both prospecting and mine development. Activity in the Yalgoo Goldfield diminished temporarily while the operators of the Golden Grove project assess their exploration data.

Prices for mineral sand products have improved and the companies at Eneabba and Capel were mining at full capacity by the end of the financial year.

Although the market for alumina has not improved, Alcoa of Australia Ltd commenced another mine at Willowdale and the Worsley Alumina group began building up to full-scale production.

Karratha

An increase in activity in the iron ore industry due to a rise in demand on world markets resulted in a record 91.1 (136.4) Mt of ore being shipped from the Pilbara and Kimberley mines in 1984.

The level of activity is expected to be maintained and expanded as markets in China and Europe are developed. New ventures at Marandoo and Channar are being considered.

In November 1984 iron ore mining at Cockatoo Island ceased after 33 years and production in excess of 31 Mt of iron ore.

Although confidence in the gold mining industry was main-

tained and gold mining was resumed at Bamboo Creek, the local tin/tantalite industry remained in a depressed state due to an oversupply on world markets.

Collie

Production from the three underground and three open-cut mines totalled 3.69 (5.54) Mt. Employment in the industry remained static at 1 238 persons.

Mining accidents

Ten fatalities occurred as a result of mining accidents in 1984 and one occurred in the first six months of 1985. Of the 11 fatalities, 4 were associated with surface and underground gold mining, 3 with underground nickel mining, 2 with iron ore mining, 1 with underground copper-zinc mining and 1 with alumina production. Details are on page 82.

The table on page 83 shows the accidents in the industry for 1984 and these are segregated according to the mineral mined and processed. Further relevant statistics appear on pages 81 and 82.

Ventilation

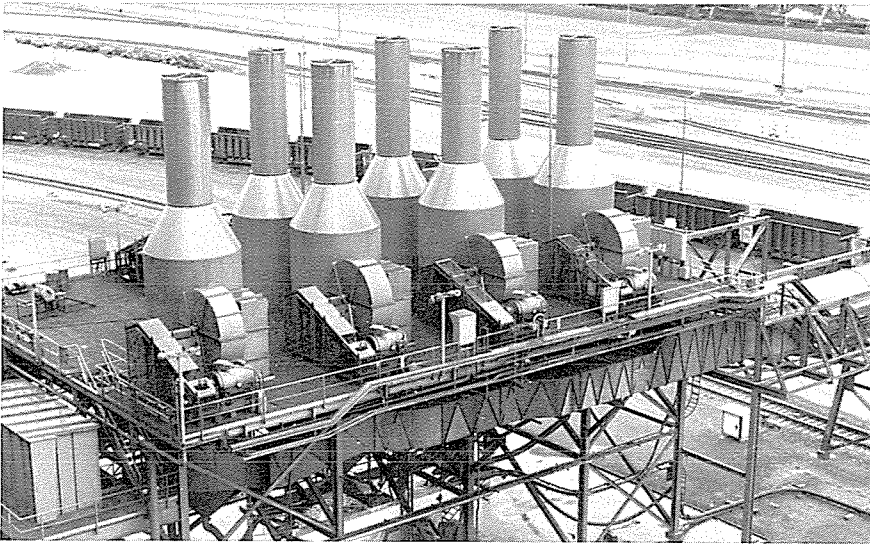
Samples of airborne dust were taken to test compliance with the regulations.

Sampling for various gases and vapours in working places, particularly in laboratories, highlighted some problems concerning high concentrations of bromoform and thallium vapours. These problems were subsequently overcome.

Talc bagging plants are yet another source of concern. An economic dust extraction system, which will maintain dust concentrations at acceptable levels, is proving difficult to find.

Samples of airborne mineral sands dust were taken and analysed for thorium and uranium. Only one sample contained more than the derived limit of 0.28 mg/m³ thorium in Schedule 5 of the Radiation Protection (Mineral Sands) Code (1982).

Most mining companies carried out contaminant-sampling



Dust collection operation at Mt Newman's ore handling facility, Port Hedland

programmes on a regular basis. Sampling results were submitted to the Mines Department for entry into the CONTAM data storage system.

In the hard-rock (bluemetal) quarrying industry, the exposure to dust of drillers and crushing/screening plant operators is still cause for concern. The problem can be attributed to a lack of utilization and/or maintenance of dust-collection equipment on drills and the reluctance to use water sprays for dust suppression purposes during crushing and screening. It is claimed that water sprays coagulate the dust particles and make them stick to the aggregate resulting in rejection for road construction. Total wet screening solves both problems and inspectors continually work towards its installation.

Airconditioned and thus pressurized cabs are now provided on most items of earthmoving equipment utilized in surface mining operations. This has significantly reduced the incidence of excessive exposure to dust by equipment operators.

Ventilation personnel continued to inspect underground diesel engined equipment and arrange for the issuing of permits.

Twenty fuming accidents were reported. Fifteen were attributed to blasting fumes underground whereas the other five oc-

curred on the surface as a result of various fume leaks or emissions while welding and cutting. None of the 20 resulted in serious injury to the personnel concerned.

Radiation

The Code of Practice on Radiation Protection in the mining and processing of mineral sands has now been implemented throughout the industry. This was supervised by the Interim Mines Radiation Safety Committee. Three health physicists from the Radiation Health Branch of the Health Department with expertise in radiation safety have been appointed Special Inspectors of Mines (Radiation) and these officers perform the detailed surveys and inspections and make recommendations relating to code implementation. The Interim Mines Radiation Safety Committee met on several occasions throughout the year and gave particular attention to the development of guidelines for the assessment of dust containing radioactive contaminants in mine and plant atmospheres.

The results of the public inquiry into radiation protection in the mineral sands industry (the Winn Report) became available in 1984. This report indicated that all companies were in compliance with the code of practice but more

emphasis was needed on the recommended radiation protection practice of keeping all radiation exposures As Low As Reasonably Achievable (ALARA). The report also recommended the setting up of a Mines Radiation Safety Board along similar lines to the Ventilation Board and made a number of recommendations regarding the staffing and operation of the board.

Administrative processes for the establishment of the board and the appointment of a radiation secretariat are well advanced.

Annual Reports from sand mining companies, whilst variable in content, show compliance with the code of practice.

Machinery on mines

The resurgence in mine development activities reported in 1983 continued at an accelerated rate throughout 1984/85. With the effective loss of one mechanical engineer in January 1985, the machinery inspection section was hard pressed to cope with the increased workload. Significant projects handled by the section included the State's first friction winding hoisting installation at the Cassidy shaft and hoisting systems for the Hill 50 shaft, Fraser shaft, Golden Crown and Chaffers shafts. Smaller haulage systems checked and approved included Fraser mine, Paget mine, Morning Star secondary egress, and Lindsay's Reward mine. In addition, design aid was given to a variety of prospector-type mining enterprises.

Winding machinery accidents

Twenty six mishaps involving winders and hoists were reported during the 18 months ending 30 June 1985. Nineteen were of a minor nature with no significant damage or potential danger to personnel. The remaining seven, which resulted in injuries and/or more serious damage, were caused by:

- drum shaft failure;
- headsheave shaft failure;

rope break due to crosshead falling;
brake failure;
driver error;
wall plates/skip hang-up; and
unauthorized manriding.

All the mishaps were investigated and remedial action was undertaken to prevent recurrences.

Electrical inspections

Special Inspectors of Mines (Electrical) carried out 782 inspections covering 380 mining operations during 1984 and for the first six months of 1985 undertook a further 377 inspections covering 382 mining operations, there being 46 additional mining operations to those existing 18 months earlier.

There were no fatal accidents involving electricity on mines during the 18-month period but 45 electrical accidents were reported, of which only 4 warranted investigation.

Prosecutions

Twelve prosecutions were conducted during 1984. Eleven resulted in convictions as follows: a quarry manager was fined \$50 for not wearing a safety helmet while in the treatment plant in contravention of Regulation 4.3; three mineworkers were each fined \$20 for not wearing safety helmets in a quarry in contravention of Regulation 4.3; a miner was fined \$75 for firing outside the recognized blasting times in contravention of Regulation 7.30(2); three underground workers were each fined \$100 for travelling in a shaft on a conveyance containing equipment, in contravention of Regulation 15.52(1); another man involved with the same incident was fined \$100 for a contravention of Regulation 15.10; and a miner was fined \$200 for contravention of Regulations 8.19 and 8.23(1) for working with inadequate ventilation; a workman was prosecuted for breaches of Regulations 8.23(1) and 1.9(a). He pleaded guilty to a charge of drilling in a development end more than 3 m from fresh air without having installed ventilating equip-

ment to adequately ventilate the end. He also failed to comply with a request to correct this situation. Fines and costs amounted to \$107.

Rehabilitation

Land damage resulting from surface stripping techniques used by some gold prospectors and illegal miners was discussed briefly in the 1983 report. In an endeavour to curb such activities, tenements are now issued subject to conditions requiring approval by the District Inspector of Mines for the use of earth-moving machinery. In addition, a working party has been set up under the chairmanship of the Assistant Director General of Mines to investigate and make recommendations on matters of conservation and rehabilitation in the mining industry.

The iron ore miners are continuing with their efforts to rehabilitate disturbed and mined land within the harsh Pilbara climate. Cliffs Robe River Iron Associates have been able to maintain a good survival rate for the perennial species returned to the rehabilitated mesas, and a seed collecting programme is continuing in order to stock the ripped and prepared surfaces as they become available. Hamersley Iron have prepared over 32 ha of land at Paraburdoo for rehabilitation and experimental work is continuing on the slopes at Tom Price. Mt Newman continued research in an endeavour to find the most suitable way of rehabilitating waste dumps in what is a very difficult environment for the establishment of flora and fauna. Goldsworthy Mining Limited completed contour ripping of dumps at Goldsworthy in order to control water erosion and to provide an enhanced environment for natural regrowth.

Proponents of new projects in the gold mining industry are planning their rehabilitation before commencing mining. Most of those projects are over old mining areas from which vegetation has been stripped long ago, however, most

companies intend to revegetate with native trees in and around these new operations.

Alcoa of Australia Ltd continued to rehabilitate mined land at Jarrahdale, Pinjarra and Willowdale. Rehabilitation of 333 ha was accomplished, being 128 ha more than the area opened up for mining.

The mineral sand miners at Eneabba continued their efforts to restore the land to the native heath type vegetation cover. This year's results have been very encouraging, as satisfactory regrowth followed good rains.

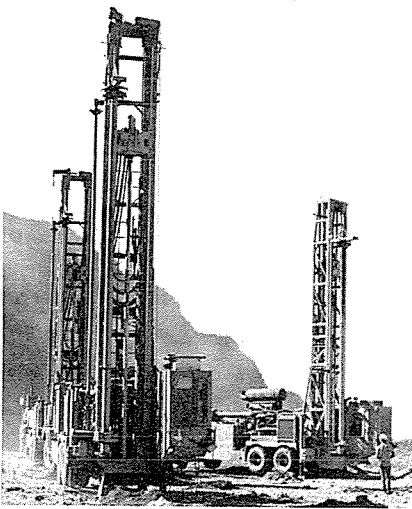
Rehabilitation of coal mine waste dumps continued at Collie by means of dozing to flatten the perimeters followed by spreading of topsoil, fertilizing and sowing with grasses. Some tree planting has also been undertaken. Departmental remedial work to combat the spontaneous combustion problem in the old Co-operative mine area continued in accordance with budget allocations.

Noise and vibration

The Department was allocated funds in the 1984/85 Budget for the formation of a Noise and Vibration section within the Division. The section will administer the provisions of the Noise Abatement (Hearing Conservation in Workplaces) Regulations 1983 on minesites and will consist of a mechanical engineer and three workplace inspectors. The section is expected to be fully operational by September 1985.

Drilling

In the calendar year 1984 the Drilling Branch drilled 129 bores totalling 9 406 m and during the first 6 months of 1985 a further 61 bores totalling 2 925 m were completed. In addition, aquifers were developed in 187 bores and aquifer testing of a further 5 bores was carried out during the 18 months ending 30 June 1985. Other work included repairs to 53 bores, television camera scanning of 67 bores, side-wall coring of 14 bores and perforation of a further 7.



Production drilling at the Argyle Diamond mine.

The television-borehole-scanning equipment continues to be in demand with approximately 40 jobs now being undertaken each year.

The Statewide groundwater investigation programme by the Geological Survey of Western Australia continued as follows: work was completed on the Harvey Deep, Busselton Shallow and Fortescue flood plain projects; drilling continued on the Robe River flood plain; and two new projects, one in the Cataby area and the other in the Roebuck Plains out of Broome were commenced.

The branch worked upon a number of specific State-funded projects such as the land salinization research projects at Lake Toolibin, Maringa Farm, East Perenjori, Newdegate and Esperance. A further bore was constructed at Del Park in the ongoing experimentation in multi-port piezometer testing.

A summary of drilling and associated work is tabulated on page 81.

Ventilation Board

Section 23 of the Mines Regulation Act was amended to increase the size of the Ventilation Board from five to seven members to permit representation from the Chamber of Mines and the Australian Workers Union. Both vacancies have been filled and the board now

comprises the following personnel:

Mr J.M. Torlach, (Chairman)
State Mining Engineer;
Dr. F. Heyworth, Principal Medical Officer;
Mr. D. Sykes, Senior Scientific Officer, Air Quality Branch;
Mr D. Collie, Principal Mining Engineer;
Mr H. Jones, Chamber of Mines representative;
Mr J. Beckwith, Australian Workers Union representative; and Mr I. Loxton, Senior Inspector of Mines.

During the period January 1984 - June 1985 the board held 11 meetings and made two field tours, the first being to mines in the Kalgoorlie and northern region of the Kalgoorlie Inspectorate; the second to mines in the North West including the Argyle diamond mine, BHP's Koolan Island and Newmont's Telfer operations.

A comprehensive dust sampling programme was carried out in the nickel mines of Western Australia during 1984.

The primary aim of the programme was to determine whether or not asbestos fibres were being released into mine atmospheres as a result of mining operations, and if so, in what concentrations. Fibres were found in only one mine and were at concentrations below the acceptable standards of purity. A secondary aim of the programme was to undertake sufficient sampling for determination of talc, nickel and silica dusts and oil-mist concentrations to permit the development of a mixture threshold limit value (TLV), compliance with which would substantially protect mineworkers from the combined effects of the various components of these dusts. This work has resulted in the establishment of an agreed TLV, pending further medical advice on the effects of dust mixtures on the human body.

The Ventilation Board continues to work closely with the inspectorates and the mining companies in its effort to fulfil its primary function - to prevent mine

workers from suffering damage to lungs due to the presence of atmospheric contaminants in the working places.

Board of Examiners - Certificates of Competency

Certificates of competency issued for management and supervisory positions under the Mines Regulation Act and the Coal Mines Regulation Act during the 18-month period ended 30 June 1985 are detailed on page 83.

Staff

The State Mining Engineer, J.M. Torlach, was appointed on 9 April 1984. Mr Torlach joined the Mines Department after extensive experience in the mining industry in Queensland and Tasmania.

The Deputy State Mining Engineer, J.M. Faichney retired on 20 July 1984 after serving 34 years with the Mines Department.

G.J. Dodge was appointed Deputy State Mining Engineer on 6 September 1984 and D. Collie assumed the position of Principal Mining Engineer on 13 December 1984.

J.R. Wilczewski was appointed Mechanical Engineer - Noise and Vibration on 29 January 1985.

R.A.C. Williams assumed the position of Senior Mining Engineer, Technical Services on 15 February 1985.

H.L. Burrows retired on 16 April 1985 after serving 31 years with the Mines Department in all three Inspectorates.

J.P. Boucaut, Mining Engineer - District Inspector of Mines transferred from Karratha to the Kalgoorlie Inspectorate on 6 October 1984 and D.H. Austin, Mining Engineer - District Inspector of Mines transferred from the Kalgoorlie to the Perth Inspectorate on 22 October 1984.

The positions of Regional Mining Engineer - Perth, State Coal Mining Engineer, District Inspector of Mines - Karratha, and Mechanical Engineer - Kalgoorlie, remain vacant even though all positions have been advertised extensively.

THE DUKETON BATTERY

At present there are 15 state batteries compared with the peak number of 40 batteries operating in 1913. Of these, the batteries at Meekatharra, Laverton, Boogardie and Coolgardie are still operating on the original installation site. However not all batteries have had a similar experience, the life of the battery at Duketon, 110 km north of Laverton, being very brief indeed.

The short history of the Duketon battery is documented in a succession of Annual Reports made by the then Superintendent of Batteries to the Minister for Mines. Extracts from these and from a letter from the Duketon manager are reproduced below. They provide an interesting insight into labour and material supply problems of the day as well as problems of ore supply and gold production.

"Here (Duketon) a new 10-head battery, locally manufactured by Messrs J. and E. Ledger, is being erected; two Cornish boilers by Martin and Co., South Australia; one compound condensing engine by Thompson and Co., Victoria; steam pumps, cyanide plant, ore bins and elevating gear, rock-breakers, and ore-feeders. The whole will form a very complete plant, and will give a good opportunity of settling a much discussed question, viz., whether the addition of rock-breaker, elevated ore bins, and automatic feeders will reduce the cost of treatment at State mills with intermittent crushings of various tonnages. I have always maintained that where loss of time is caused by the numerous small crushings usually received at each battery, the automatic system loses its beneficial effects; and further where fuel is a serious item (as it undoubtedly is in nearly all cases), each additional horsepower called into requisition adds to the working costs, and in many instances will total the wages paid for manual

labour. I shall be only too pleased to acknowledge that the introduction of the gear above referred to will produce results more than counter-balancing the additional employment of labour, and above all warrant the initial outlay in districts left to the Government to support."

(Annual Report for 1904.)

However the construction of the new battery did not proceed smoothly. In 1905 a letter to the Battery manager from the Superintendent of Batteries enquiring about additional expense elicited the following list of reasons:

"(1) The scarcity and very poor quality of skilled labour available. One carpenter only knowing anything of battery erection. The fitters have had to be discharged one after another for drunkenness and incapability ...

(2) The large amount of fitting and blacksmith's work we have had to do. Almost everything requiring more or less work before being workable.

(3) All excavations had to be blasted, ...

(4) All sand for bricklayers and for concrete had to be carted long distances ...

You are already aware that material did not arrive as requested. The pipes and pump fit-

tings for instance, though ordered on 18th March, the bulk of the order did not arrive until the end of April ..."

(Letter from S Cullingworth to the Superintendent of State Batteries)

After the problems experienced in erecting the battery and all the interest created in the economics of an automatic system it was hoped that the Duketon battery would have a chance to prove its worth but this was not to be the case:

"The district has not come up to expectations, and all the available stone was practically crushed during the first two months' run since when the mill has been mostly hung up for want of stone."

(Annual Report for 1905)

During 1906 there was no improvement in the situation at Duketon.

Then in 1907 the final blow fell: "During the year the plant at Duketon was dismantled with the object of removing and re-erecting it at Black Range."

(Annual Report for 1907)

After a brief life of two years crushing 3 591 tons and producing 2 896 ounces of gold, the Duketon battery was taken down.



The Duketon Battery 1905

STATE BATTERIES

E. J. GREEN, SUPERINTENDENT

The average gold list price for 1984 calendar year, as advised by the Gold Producers Association Ltd, was \$410.15 per oz. which was a decrease of \$59.60 on the previous year's average of \$469.75. The average price for the financial year 1984/85 was \$422.00 per oz. Recent practice of the State Batteries has been to keep charges at a reasonable level yet at the same time to endeavour to contain the loss and thus subsidy to industry. This has been possible by the revenue gained from tailings treatment, both by State Batteries and allocation to contractors.

The table below shows the tailings treated over the period January 1984 to June 1985 during the calendar and financial years. The introduction of heap leaching has meant that total tailings treated in 1984/85 is substantially in excess of that achieved in 1983 and 1984. State Batteries carbon-in-pulp treatment is also now back to 1983 levels and containment of costs has meant that this activity is now making a significant contribution to revenue. The performance is assessed in the accompanying table.

The increase in the leaching of State Battery tailings was achieved by the use of larger equipment and a change from small vat treatment to large 2 to 3 000 t heap leaching in plastic-lined dams, which has be-

CARBON-IN-PULP ASSESSMENT 1984

Location	Tonnes treated	Cost		Income			Profit (Loss) \$	
		\$	S/t	State Batteries \$	Paid to prospectors			Total \$
					Kg Gold	\$		
Kalgoorlie	19 584	228 099	11.65	217 909	0.968	10 160	228 069	(30)
Coolgardie	15 794	176 554	11.18	152 593	6.979	83 171	235 764	59 210
Meekatharra	12 758.4	131 071	10.27	106 844	0.113	1 185	108 029	(23 042)
Total 1984	48 136.4	535 724	11.13	477 346	8.060	94 516	571 862	36 138
1984/85								
Kalgoorlie	22 754	265 308	11.66	275 081	0.827	8 554	283 635	18 327
Coolgardie	19 303	236 473	12.25	300 613	2.826	53 770	354 383	117 910
Meekatharra	13 795	162 137	11.75	164 138	1.375	15 996	180 134	17 997
Total 1984/85	55 842	663 918	11.89	739 832	4.704	78 320	818 152	154 234

come a widely used method of tailings treatment in Western Australia. This has enabled the overall cost of tailings treatment to be reduced from \$15.36/t in 1983 (vat leaching \$25.10/t and C.I.P. \$12.71/t) to \$11.71/t (heap and vat leaching \$11.12/t and C.I.P. \$11.89/t) in the 1984/85 period (Schedule No. 5 Page 87).

The introduction of more heavy equipment by State Batteries should further help to contain these costs in future years.

The expenditure on general upgrading of State Batteries is itemized in the table overleaf for the period covered in this report.

In a stamp modification investigation a stage has been reached where a prototype hydraulic lift

unit has been successfully tested on a small stem (2 1/2in, 64 mm) and is now being converted to operate on a standard stem (3 1/2in, 89 mm). This unit should be available for continuous operation at Kalgoorlie in the coming year.

Operations

Crushing gold ores

One 20-head, seven 10-head and six 5-head mills crushed 31 144.2 t of ore made up of 294 separate parcels; an average of 105.9 t per parcel in 1984, (28 755.5 t crushed in 1984/85).

The bullion recovered amounted to 261.4988 kg estimated to contain 222.238 kg of fine gold equal to 7.13 g/t of ore. The

TAILINGS TREATMENT

	1984			1984/85		
	Tonnes	Value of extracted gold paid to		Tonnes	Value of extracted gold paid to	
		State Batteries \$	Prospectors \$		State Batteries \$	Prospectors \$
State Batteries heap leach & vat treatment	28 255	272 162	150 828	43 697	353 573	163 845
State Batteries C.I.P. treatment	48 136.4	550 558	81 053	55 842	739 832	78 320
Contract allocations	55 857	108 509	—	102 017	164 979	—
Other revenue	—	1 000	—	—	5 785	—
TOTAL	132 248	932 229	231 881	201 556	1 264 169	242 165

**EXPENDITURE IN UPGRADING
JANUARY 1984 TO JUNE 1985**

Facility	\$
Manager's house, Marble Bar	45 196
Manager's house, Kalgoorlie	48 123
Manager's house, Marvel Loch	43 390
A.C. conversions	4 915
Electrical maintenance	9 713
Engineering maintenance	16 324
Housing maintenance	11 409
Noise abatement	81 956
Heap leach plant and equipment	125 808
Fencing and dust control	25 857
Stamp modifications	27 413
Water supplies	11 757
Ball mill additions	11 180
Erco crusher	13 571
Assay furnace	9 348
Spectrophotometer	9 022
Battery buildings	4 386
Production emergencies	4 924
Baker mill	2 651
Mobile C.I.P. plant	650
TOTAL	507 623

average value of tailings after amalgamation was 2.64 g/t, giving an average value of ore received of 9.78 g/t; in addition 274 smelts produced 350.640 kg of bullion estimated to contain 298.044 kg of fine gold in 1984.

In total 520.282 kg of fine gold was produced in 1984 compared to 585.128 kg of fine gold in the previous year from amalgamation and smelting activities in the State Batteries, (519.678 kg of fine gold was produced in 1984/85).

In 1984 the gross cost of crushing 31 144.2 t of ore was \$78.09 /t. In 1983 ore crushed at the gold plants amounted to 33 247.2 t for a cost of \$68.60/t. In the calendar year 1984 the nett cost of crushing (after payment by prospectors) was \$66.59 /t compared with \$56.48 /t in 1983.

Cyanidation

In 1984 State Batteries at 10 individual battery locations treated 76 391.4 t of tailings by vat, carbon-in-pulp and heap leaching methods for a production of 78.303 kg of fine gold, of which 20.995 kg were paid out to prospectors, the remaining gold was sold for revenue. The average gold content was 2.02 g/t before cyanidation and the actual recovery of completed and part completed installations was 50.63 per cent. On the total of vat and heap leaching tonnes (28 255) installed, 17 045 t were still being treated.

In addition a total of \$13 254.00 was collected for the contract stripping of 15 batches of carbon which produced 34.652 kg of bullion estimated to contain 31.186 kg of fine gold.

The carbon-in-pulp plants at Kalgoorlie, Coolgardie and Meekatharra treated 48 136.45 t of

the total tonnes treated for a production of 47.52 kg of fine gold at a treatment cost of \$11.12 /t, compared with \$12.70 in 1983.

The vat treatment plants and heap leaching plants treated a total 28 255 t at a treatment cost of \$19.88 /t, compared with \$25.09 in 1983. Cost per tonne will be further reduced in 1985 as the high cost small vat treatment is phased out in favour of large 2 500 t leach vats.

The production was made up as follows:

	1984 kg(fine)	1984/85 kg(fine)
Amalgamation gold	222.238	220.255
Smelt gold	298.039	219.744
Cyanidation gold	78.303	99.677
C.I.P. strip gold	58.790	18.935
Totals	657.37	558.611

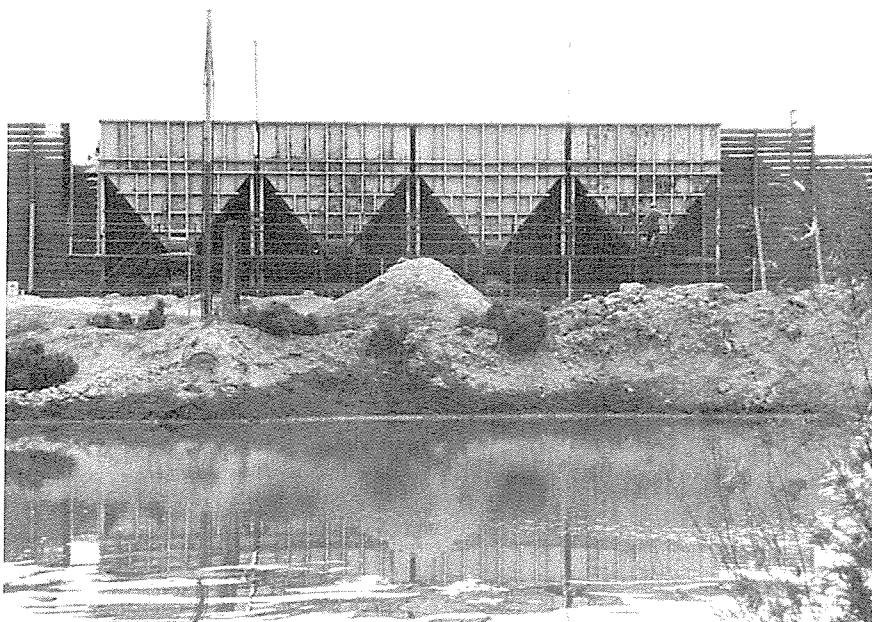
Value of production

The estimated value of production from the State Batteries in 1984 and 1984/85, and the total since their inception excluding the value of gold tax paid to the Commonwealth is shown in the table on page 31.

State Battery Inspector's Report

During 1984, 49 days have been spent in plant inspection with all batteries being visited. With the Noise Abatement Act (Hearing Conservation in Work Places) Regulation being gazetted on 21 October 1983 and to come into effect 12 months from that date, preliminary site identifications of noise hazards have been carried out.

Approved notices and signs have been erected where noise hazards exist and all employees have been issued with suitable hearing protection. A noise survey is to be carried out by a certified "Noise Officer" in the near future.



New feed bins, Kalgoorlie



Heap leaching, Kalgoorlie

VALUE OF PRODUCTION FROM STATE BATTERIES

\$	1984 \$	1984/85 \$	Since inception
GOLD	8 669 463	8 919 814	98 616 784
Other Metals			
Silver	2 037	2 499	19 306
Tin (concentrate)	—	—	515 385
Tungsten (concentrate)	—	—	98 619
Copper (ores for agricultural use)	—	—	11 932
Lead and Zinc (concentrate)	—	—	1 650 865
Tantalite (columbite concentrate)	—	—	207 030
Garnet (concentrate)	—	—	131 001
Other metals total	2 037	2 499	2 634 138
Grand Total	8 671 500	8 922 313	101 250 922

STATE BATTERY OPERATIONS 1984

Battery	Total Tonnes	5 Stamp mill hours run	'Duty' (tonnes per hour per mill of 5 stamp capacity)
Boogardie	3 136	3 303	0.95
Coolgardie	4 352.5	5 835	0.75
Kalgoorlie	4 471	5 083	0.88
Laverton	1 854.5	1 743	1.00
Leonora	4 906	7 253.75	0.68
Marvel			
Bar	741	842	0.88
Marvel			
Loch	3 503	5 471.25	0.64
Meekatharra	1 619.5	2 477.75	0.66
Menzies	1 656.7	2 334	0.71
Norseman	1 901	2 416.25	0.79
Ora Banda	788.5	827.5	0.95
Paynes			
Find	1 404	1 724	0.81
Yarri	810.5	971	0.83
Over all plants	31 142.2	40 281.5	0.77

Operations. The number of tonnes crushed, the hours run and the "duty" (productivity per 5 head mill unit) are shown in the table on page 31.

The introduction of the 38-hour week this year for battery wages staff has reduced operation time by over 5 per cent and throughput must be increased to minimize costs. An improvement of 3.32 per cent over the 1983 throughput has been achieved and further improvement is expected.

Safety. Fifteen time loss accidents and 15 no time loss accidents resulting in 146 man days lost were recorded in 1984. Of the above figures 4 accidents resulted in 112 man days lost. The main area of concern is with eye injuries sustained in 8 accidents. Greater emphasis on eye protection will be promoted in 1985.

Organization

During 1984 an average of 105 men were employed at State Batteries throughout the State. This figure does not include the Superintendent of State Batteries. The average number employed is made up of 85 wages staff and 30 Ministerial appointments.

Due to the fluctuating supplies of ore to be treated the total number of personnel employed ranged between 93 and 109.

Staff

I regret to announce the death in October of Mr James George Duperouzel who had served in State Batteries for the past 24 years, the last 15 as Battery Manager. At the time of his death he was Manager of the Coolgardie State Battery and held in high esteem by all battery staff and prospectors throughout the goldfields.

Manager R. Deller and Foreman L. Boyle retired.

Dick Deller served for 21 years with State Batteries, the last 15 years as Battery Manager. At the time of his retirement he was Manager at Marvel Loch.

Len Boyle served 16 years with State Batteries and at the time of his retirement was Foreman at State Battery, Boogardie.

Manager J. Edwards has been transferred from Ora Banda to Marvel Loch.

WAMEX – Rapid access to exploration data

It is a fact of mineral exploration history that orebodies are seldom found at the first investigation of an area. The importance of earlier exploration results to successive investigators is therefore obvious.

In the 1960s legislation was introduced to obtain reports of all mineral exploration work carried out over mining tenements in Western Australia. Each year over \$100 million is spent by companies on exploration. The Department now holds reports on exploration programmes with an estimated total value of \$2 billion.

Reports are confidential until the relating tenements are relinquished, when the reports become eligible for open-file release. This information provides a valuable guide for further mineral exploration in the same or adjacent areas.

To access this information a computer-compatible card-index was designed in 1970. This manually operated system became the base for the Department's first major step into computerized information technology when WAMEX (Western Australian Mineral Exploration database) was

made available for public use on 30 April 1985.

WAMEX now provides the mineral exploration industry with rapid access to some 4 200 reports included in the database.

For each exploration project on open-file, WAMEX contains the name of the company, where and when it operated, how it approached the exploration, the commodity sought, and a summary of results. There are 11 search terms that include geographic sheet names, tenement numbers, assay values and various technical keywords. These terms can be used individually or in combination to give immediate answers to such questions as:

What are the results of diamond exploration in the Carnarvon Basin?

Which exploration programmes found anomalous gold in the southwest part of the Leonora sheet?

What exploration for phosphate has been done in Western Australia?

This summary information is incorporated into the electronic register, which, in addition to being

available on-line, is also accessible as a microfiche print-out. There are also indexes listing reports associated with relinquished tenements and reports on exploration for specified commodities on 1:100 000 map sheets.

The various indexes direct the enquirer to the particular microfilm roll on which the original report can be read in the Geological Survey library. Alternatively any of the 300 rolls of 35 mm microfilm (each containing up to 500 frames) may be purchased for \$100.

The WAMEX register and indexes can be consulted free of charge or a fiche copy purchased for \$34.

On-line searches of the WAMEX database are charged at \$5.00 for each term searched, plus 60 cents per page of printed output.

A users guide containing a more detailed explanation of the content and indexing philosophy of WAMEX is available as Record 1985/3 of the Geological Survey of Western Australia.

The WAMEX system design, data take-up, and testing has fully occupied the limited staff of the Exploration Data Sub-section for some time. With a much faster means of retrieving indexed data now available, some staff should be freed to reduce the backlog of material available for open-file release and microfilming.

The experience obtained in establishing WAMEX should also be valuable in establishing similar information systems for petroleum and coal exploration data.

Enquiries concerning the use of WAMEX should be made at the Geological Survey library.



Geologist Stephen Lipple explains search procedures at the first public showing of WAMEX on 30 April, 1985

During the period, the Public Service Board formally approved a new staff structure for the Geological Survey. This important change highlights areas of applied geology which need greater emphasis by the Survey, such as the handling of exploration data, mineral economics and fossil fuels; increases coordination and integration of programmes by placing all geological projects under the oversight of one or other of the two Assistant Directors; and allows for rational growth of staff in accordance with proposals already approved in principle.

A diagram showing the essentials of the new staff structure appears on page 39.

The structure was introduced concurrently with changes in the salary scales of professional staff. These changes enable geologists who demonstrate their capability by performance to reach higher salary levels without the need to await a vacancy in order to be promoted.

This should help the Survey to overcome the high professional staff turnover which has adversely affected its productivity at intervals during the last 15 years.

Of the 25 additional staff positions approved in principle in 1983, only 5 had been established by June 1985. By comparison with other State Geological Surveys of Australia, Western Australia still has nearly twice the area per geologist compared with the next State (Queensland) in a list based on that criterion. To mitigate the effects of an inadequate number of staff, the Survey both strengthened its effort to increase output by geoscientific co-operation with other organizations, and established the possibility of carrying out sponsored work.

Insofar as geoscientific co-operation is concerned the Survey has pursued an active programme of isotope geochronology in co-operation with the Western Australian Institute of Technology since 1968, and the programme was extended in 1983 to include isotope studies in groundwater research. In 1984 a postgraduate student from the University of Loeben was hosted on a co-operative project, and during 1985 students or staff members from the State University of New York, Washington University of Missouri, Virginia State University, Oberlin College, the University of Glasgow, and the United Kingdom Open University will work in active association with Survey staff in co-operative projects. These are financially advantageous to the Western Australian taxpayer and valuable to the visiting scientists by providing a clear practical framework for their work. They have the further advantage that visitors expert in a particular field keep the Survey in touch with progress in that field in a very direct and effective way. For example, the expertise of the Open University in geoscientific remote sensing benefits the Geological Survey and, in this case, also the Department of Lands and Surveys which is an enthusiastic participant in this project.

Another route by which the work of the Geological Survey could be expanded is by the performance of sponsored work. A wide range of applied geoscientific research of interest to industry is already carried out by Government-funded organizations in Australia, either by direct company funding or by collective support via such groups as the Australian Minerals Industry Research Association (AMIRA). Such Government organizations as CSIRO and the Bureau of Mineral Re-

sources already augment their funding by accepting industrial support for specified work in areas where they have established expertise; usually this involves a two-year confidentiality agreement with the sponsor. During 1984 the Minister for Minerals and Energy authorized the Geological Survey to accept external funding on this basis, and it is hoped that this means of increasing productivity will be used.

During 1984 some professional staff members attended conferences or field meetings overseas, with only limited support from Survey funds. They included Dr A. H. Hickman, who attended a field seminar of the Precambrian Paleobiology Research Group in South Africa, and Dr A. F. Trendall who attended the 27th International Geological Congress in Moscow in August.

Operations

Some of the more important projects undertaken by the Division are described in the following sections.

Basins, Fuel, and Groundwater Branch

Hydrogeology Section. The aggregate depth drilled for groundwater resources assessment was 11 827 m to the end of June 1985. In addition 713 m were drilled for miscellaneous projects. The aggregate depth drilled was greater pro rata than in 1983 and reflects the increased number of shallow bores drilled during the period.

Five deep bores were drilled in the Perth Basin.

For the Busselton shallow drilling 114 bores at 36 sites were drilled. The finalization of this project completes assessment of the

shallow groundwater resources of the Coastal Plain between Perth and Busselton.

In the Pilbara 10 bores were drilled on the flood plain of the Fortescue River, and 13 bores were drilled on the flood plain of the Robe River. Drilling and testing are continuing.

The Cataby shallow drilling project on the Swan Coastal Plain was commenced. The drilling was suspended to undertake drilling in the northern part of the State but will recommence later in 1985.

Drilling to support hydrogeological mapping and to investigate groundwater supplies for horticultural development on the Broome 1:250 000 sheet was commenced.

Investigations of solid and liquid waste-disposal sites have continued at Woodman Point and Kwinana sewerage treatment plants and at various landfill sites. Active monitoring of pollution plumes from landfill sites is proceeding.

A review of reports relating to the groundwater resources of the Collie Basin was commenced, and, in co-operation with the Public Works Department (PWD) and Department of Agriculture, studies of land and stream salinization have continued.

Exploratory drilling to determine the groundwater potential in the Cascades and Mt Beaumont (Esperance) new land areas was supervised and reported to the Department of Agriculture. Reports were prepared for the PWD on prospects of land drainage in the Collie irrigation area, near Dardanup, and on results of monitoring on Ivanhoe and Weaber Plains in the Ord irrigation area.

Hydrogeological mapping of the Nullagine and Marble Bar Sheets has progressed as time permitted. A draft hydrogeological

map of Western Australia at 1:2 500 000 was prepared for 'The Review of Australia's Water Resources - 1985'. In addition important work has been carried out adapting the international hydrogeological legend for Australian purposes, in particular by devising means of showing salinity.

Close co-operation has been maintained with the Metropolitan Water Authority (MWA) in a variety of projects. Of particular importance has been the close co-operation and drilling supervision in the Urban Water Balance Study aimed at determining the maximum sustainable number of bores that could be produced in the metropolitan area of Perth, and monitoring saltwater intrusion and changes in water quality. Another project is the Natural Infiltration Study, designed to develop methods to determine recharge under different land use conditions and with different depths to the water table. This project has involved studies of tritium in groundwater, in co-operation with the Western Australian Institute of Technology, Department of Chemistry. A report is in preparation.

Work for the PWD has continued. Advice has been given regarding water supplies at Prevelly Park, Augusta, Rottnest Island and other localities. Co-operation has also been maintained with the PWD on salinity studies, effluent licensing, pollution studies, and effluent disposal on the Leschenault Peninsula.

The Section has provided miscellaneous groundwater information for various purposes. Twenty eight inspections involving advice to landowners were carried out, and there were 2 004 public-enquiries. Several lectures to farmers' organizations, public interest groups, and learned societies were given. In addition members of the Section have contributed on various committees, and working

parties, in particular for the Western Australia Water Resources Council.

Fossil Fuel Resources and Phanerozoic Geology Section. The *Petroleum and Coal Resources Sub-sections* continued to assess processing, storage, and retrieval of data from companies exploring for fossil fuels. Inflow of data was high, partly due to continuing surrender of tenements. Requests for data diminished somewhat. Activities included production of 52 microfilm rolls (46 rolls for petroleum and 6 rolls for coal); the establishment of a petroleum exploration database viability study by a steering committee set up to work on the project; and the continued planning for cataloguing and microfilming of backlog data.

A project "Geophysical Synthesis of the Southern Perth Basin" was commenced.

For the Collie Basin, work continued on the coal reserves study and mine plan evaluation and monitoring of company work programmes. Much of this work was related to coal supply for a proposed aluminium smelter. A review of coal-supply submissions for the proposed smelter power station development was undertaken on behalf of the Aluminium Smelter Task Force (ASTF).

In the *Basin Studies Sub-section* a draft depth-to-basement map of the State and accompanying text was prepared for publication in the AAPG Bulletin.

Seismic interpretation of the Lennard Shelf was started and a map of the Devonian reef trend was prepared. A preliminary paper on this project was presented at the Australian Geological Convention in August 1984, together with a geophysical review of the southern margin of Western Australia.

Geophysical reviews of the South Pepper, North Herald, Harriet and Lenita Fields were completed for the Petroleum Division.

Palaeontology Section. The review of the Permian fossils of Western Australia project was enlarged and will now include all fossil groups of Permian age.

Routine palynological determinations resulted in 77 reports being written in 1984 and 8 in the first 6 months of 1985. Most related to the Busselton shallow-drilling project and to boreholes put down to locate the fresh/salt water interface in the urban water-balance study.

A report on the Late Jurassic and Cretaceous palynology of the Perth Basin was completed, and substantial progress has been made on a palynological study of the Collier Basin.

Two reports were written on the Devonian/Carboniferous palynology of each of the Canning and Bonaparte Basins.

Investigations continued on Precambrian stromatolites. One monograph and a short paper were published, three other papers are in press, and another three are in preparation.

Work on the stromatolite assemblage of the ?Cambrian Antrim is in progress.

Geophysics Section. Regional gravity studies in the southwest Yilgarn were commenced and interpretation of aeromagnetic maps of the Eastern Goldfields is in progress.

Seismic data from the Fortescue and Robe River flood

plains were reviewed and a seismic refraction survey conducted on the Fortescue to assist in locating groundwater. Also relating to groundwater occurrence, seismic refraction and magnetic surveys were conducted in the Cuballing catchment area. Seismic refraction surveys at Perillup catchment, Pindalup catchment and Hardie's catchment were completed in the first half of 1985.

For engineering geology requirements seismic refraction surveys were conducted at: North Dandalup damsite spillway; Canning Dam proposed spillway; Maida Vale pipeline and tank site; Harris River dam site 1; Greenmount tank foundation; Laporte effluent disposal area; and Peel Inlet ocean connection cut.

Some 300 boreholes, mainly drilled for groundwater, were electrically logged. The depth capability of borehole logging operations was extended when a truck-mounted SIE digital logging system was acquired. The winch and recording unit were mounted by the suppliers in Brisbane and the recording unit was calibrated in Adelaide during the delivery run.

Using available departmental computer hardware a resistivity-modelling programme and an EDP storage and retrieval system for well-log data were developed. An EDP aeromagnetic data catalogue was developed from information in the M series files.

Field work was completed for a study of the magnetic properties of rocks in the weathered layer near Dwellingup. This project is being carried out in conjunction with the Bureau of Mineral Resources.

Basement Minerals and Geotechnics Branch

Precambrian Geology Section. Seven major mapping projects, all of which were begun in previous years, were continued.

Field mapping on six of these—Ashburton, Sylvania Dome, Murchison, and remapping of the Balfour Downs, Boorabbin and Widgiemooltha sheet areas—was completed during the year.

The Western Gneiss Terrain investigation proceeded satisfactorily with mapping completed on Byro, southern Glenburgh, southern Robinson Range and northern Murgoo.

Ancillary to the Bureau of Mineral Resources southwestern Australia seismic project, 35 large samples of rocks typifying the Yilgarn Block were collected and forwarded to the BMR for physical testing. A 1:1 million scale geological map of the southwest Yilgarn was compiled.

In addition to the field work associated with the above projects, text manuscripts were advanced for explanatory notes for the following sheet areas: Dumblebung; Corrigin; Kellerberrin; Wyloo (remapping); and Cue (remapping).

Other work of the Section included: a critical appraisal of allochthonous blocks in the Ashburton Formation; a study of fan delta deposition in the Beasley River Quartzite; and a compilation of dyke swarms in Western Australia at a scale of 1:1 million.

Mineral Resources Section. The *Exploration Data Sub-section* received 1 709 reports during the year. Despite this influx the backlog of restricted data searches was cleared, 57 new rolls of microfilm



A large sinkhole, the only one of its kind in this region, revisited during geological mapping of the Robertson sheet area

were produced, and a computerized M series database (WAMEX) was completed, tested, and made available for public use. Manual procedures are now largely converted to EDP-based operations thus eliminating much of the duplication previously necessary for the manual card/file system.

It is hoped that a substantial reduction in the backlog of microfilming of open file reports can be achieved by a Community Employment Programme team assembled for training in May 1985.

In the *Mineral Economics Sub-section* little progress was made on updating records of ore reserves and resources as the services of appropriate staff were required by the Department on various other urgent (predominantly royalty-related) matters.

Initial preparations have been made in the development of a reserves and resources projects/commodities databank using PC Focus programming and IBM computer.

The *Economic Geology Sub-section* made some progress on a number of projects.

The bulletin on Darling Range bauxite was commenced and will be completed by the end of 1985.

On the Murchison project about 250 samples were collected from 8 mining centres, supplementing those already collected, for geochemical assessment in association with the Precambrian Geology and Geochemistry sections.

Petrological, geochemical and mineralogical studies of the Narlarla carbonate-hosted lead-zinc mineralization were completed and the conclusions presented at a symposium on the Canning Basin in June 1984.

On the Golden Mile project the compilation of maps at 1:25 000 scale and reduction to the proposed publication scale 1:50 000 was completed. A report on the stratigraphy and structure of the Kalgoorlie mining area was completed.

Engineering and Environmental Geology Section. The *Engineering Geology Sub-section* again conducted projects almost exclusively for other government departments or instrumentalities.

The following are some of the projects completed for the PWD: spillway mapping on the Harding Dam; site work, core logging and two reports for the Jurien Bay small boat harbour; site investigations and report for the Dawesville cut connecting Peel Inlet with the ocean; site investigation and report for Lancelin townsite proposed sub-divisions; and geological advice on stability of survey stations for surveillance of established dams.

Projects continuing for the PWD include: a report on spillway investigation at the Ord River Dam; and reports on investigations for damsites in the Manjimup area.

For the MWA projects completed included: a geological report on the Conway Road tunnel at Rockingham; investigations and geological report on Canning Dam foundations; and a construction report on Wungong Dam.

There were several projects for the MWA in progress at the end of June 1985.

For Westrail general information was supplied on metropolitan hardrock quarries and geologi-

cal reports were prepared for upgrading of the Great Southern railway at Katanning.

For the Main Roads Department numerous projects were completed. These included potential quarry-site locations, cutting-slope stability studies, and bridge-foundation reports in widespread areas of the State.

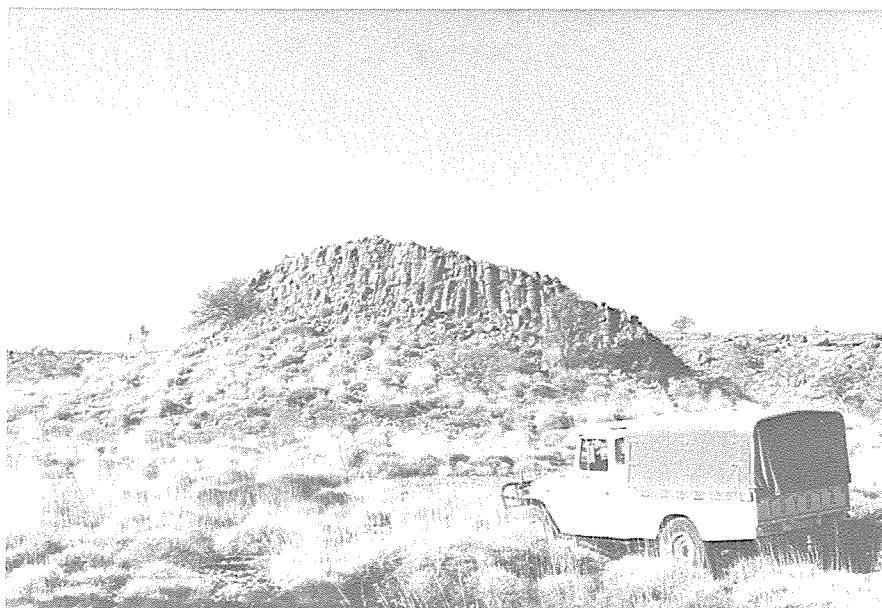
Geological data on alternative power station sites at Collie were supplied to the State Energy Commission.

Further biannual reports were prepared for the ATEND (Accredited Technical Experts on National Disasters) South West Seismic Zone database programme, and a one-day seminar on earthquakes was held in collaboration with the WA State Emergency Service.

The *Environmental Geology Sub-section* made considerable progress on the Perth metropolitan region environmental geology maps with publication of the Muchea and Yanchep sheets and have eight other sheets in various stages of preparation.

The Muja and Collie environmental geology map sheets in the Collie region are complete.

Reports under Regulation 68 of the Mining Act 1978 numbered 220, and papers were reviewed or



An uncommon polygonally jointed sandstone outcrop 16 km southeast of Jigalong



The SIE digital logging unit commissioned in August 1984 has extended the geophysical borehole logging capability to 2 900 metres

prepared on behalf of the Department on environmental matters. Noteworthy among these were papers for the AMEC working groups on the Australian Heritage Act Commission and Mining in National Parks.

Some nine reports were prepared on various planning schemes for the Town Planning Department and several others were prepared for the Department of Conservation and Land Management.

Material was supplied for consideration in the Department of Conservation and Environment's (DCE) Darling Scarp environmental study and for the Environmental Protection Authority's Recommendations for Systems 6 and 7.

Work for the Department of Resources Development included: reports on the 5-, 10- and 25-year mining plans and strategies for bauxite mining by Alcoa for the MMPLG (Mine Management Planning Liaison Group); and reports on conservation and resources for the Reserves Review Committee.

Papers were reviewed and/or prepared for: Informal Group on National Conservation Strategy for Australia; State Conservation Strategy (DCE Report 12); Collie Land Use Working Group; Beekeepers Reserves Management Committee; Review Committee on

Environmental Impact Assessment; and Conservation and Environmental Council, Land Resource Policy Council.

Geochemistry Section. Several projects were completed to the various stages of submission of report, report in press, or report published during the 18-month period.

An orientation study of the trace and other element composition of some Collie coals was published (GSWA Record 1984/3) and a study of the characteristics of Collie coal is continuing.

In co-operation with M. Pryce (GCL) work was completed and a paper prepared on stratabound axinite in the Weeli Wolli Formation and its occurrence in relation to dolerite. Similarly, with co-author J. Lewis (GSWA) a report on a regional geochemical and petrographic study of the Mt Edgar Batholith was in press.

Field and laboratory investigations were completed and reports were in varying stages of preparation for the following projects: geochemistry and petrography of the Corunna Downs Batholith; the transition between the Fortescue and Hamersley Groups, shown in drill core from the Hamersley area; and elemental behaviour in the Saddleback, Western Australia, laterite profile, as a guide to mineralization.

Petrology Section. Routine petrological examinations during the period resulted in completion of 79 reports covering determination of 2 595 samples.

On project work, draft results of an investigation on variation in dates within individual plutons in the Pilbara Block were submitted; an investigation of the geochronology of the Black Range Dolerite and associated rocks was completed; and a study of metamorphism in the Southern Cross Province of the Yilgarn Block was concluded.

Ongoing project work included: investigation of major and trace elements of alkaline granitoid rocks of the Eastern Goldfields; petrology of kimberlitic and lamproitic rocks in Western Australia; extension of studies on metamorphism into the Murchison Province; and petrology of rocks from the Fraser Range.

The co-ordination of geochronological programmes with WAIT continued and, in addition to the geochronology of the Black Range Dolerite mentioned above, a paper on the geochronology of the Gascoyne province was completed.

Support Services Branch

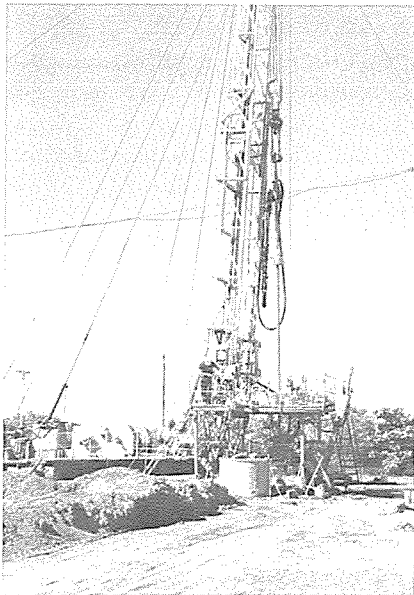
Publications and Information Section. As well as responding to public requests for information on geological and related topics, this



Core drilling to test ongoing stability of the Bickley reservoir concrete gravity dam

Section processed 28 publications to the release stage. The titles are listed later.

COM-fiche indexes, which are expected to satisfy most public enquiries on WAMEX (the computer-based index to open-file mineral exploration reports), were prepared and placed in the library. These indexes allow retrieval of information by map area, commodity, and tenement number. In order to satisfy more complicated enquiries, the Section's existing data terminal has been modified to access WAMEX as well as the commercial databases, AESIS, GEOREF, and INIS.



Drilling for groundwater near Broome

Public enquiries on geological and related topics remained steady, but requisitions for drafting from staff increased substantially.

Library. Up to the end of June 1985, members of the public visiting the library totalled 5 605 of whom 1 295 made use of the microfilm reading and printing facilities. Staff loans totalled 12 621 and 1 541 inter-library loans were arranged.

The ability to locate reference works in other Australian libraries was improved with the addition of online access to the Australian Bibliographic Network (ABN). This supplements the already available printed and microfiche indexes of

Scientific Serials in Australian Libraries (SSAL), and the National Union Catalogues of Monographs and Serials (NUCOM and NUCOS).

A start was made on replacement of missing issues in the journal collection.

Regional Offices

Field work continued on remapping of the Widgiemooltha and Boorabbin 1:250 000 map sheets and a study of the geology and mineralization of the Kalgoorlie/Boulder area.

The Karratha regional office staff complement of two geologists was halved in August 1984 on the resignation of Dr Swindells, who had until then been almost fully occupied on the site geology of Harding Dam. As the dam construction was nearing completion it was decided to cover any remaining geological requirements for this project from Perth.

Numerous hydrogeological investigations including Fortescue and Robe River drilling programmes and hydrogeological mapping in the East Pilbara were conducted and geological advice supplied to the public and other government departments in the North West.

Organization

Staff

During the period some progress was made with the expansion and restructuring of the Geological Survey as approved in principle by the Public Service Board on 25 October 1983.

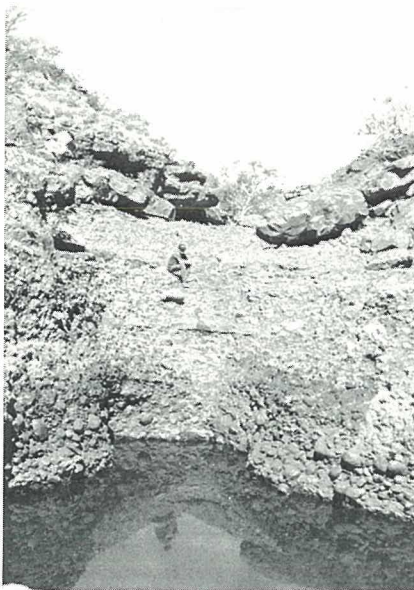
A revised formal staff structure was established and approval was obtained to create 5 of the 25 new items. These were Assistant Director (Basins, Fuel and Groundwater Branch), mineral economics geologist, geologist Level 1 (Publications) and two exploration clerks (Petroleum and Mineral Resources).

In August 1984 Dr P. E. Playford transferred out of the Geological Survey to accept appointment to the newly created position of Assistant Director General of Mines. Dr Playford had completed some 21 years of outstanding professional service with the Geological Survey.

Dr R. D. Gee was appointed to the vacated Deputy Director item and Mr T. T. Bestow to the newly created item Assistant Director, Basins, Fuel and Groundwater Branch. Both items were advertised throughout Australia. Dr A. D. Allen was promoted to Supervising Geologist Hydrogeology



Drilling in the bed of Lake Toolabin to investigate salt encroachment into this fresh water lake



A boulder conglomerate in the Calyie Formation, Robertson sheet area

Section and Mr R. Elliott was appointed to the long-vacant item Senior Geologist, Petroleum Resources.

Other staff movements resulted in 8 professional and 4 non-

professional items being vacant at 30 June 1985.

Accommodation

In February, 1984 the Hydrogeology and Engineering and Environmental Geology Sections were moved from 4-6 Bennett Street to another building across the road. The cost of this operation was borne by the owners of the buildings who wished to consolidate their business in one office block. The Precambrian Geology Section was relocated to a rental office suite at 190 Hay Street, in May 1984. Space vacated on floor 6 of Mineral House was quickly used by Mineral Resources Exploration Data Sub-section and Fossil Fuel Resources and Phanerozoic Geology Petroleum Resources Sub-Section, both of which had urgent need for larger office areas.

Considerable progress was made in the development of departmental plans for extension to

Mineral House. However these plans made it impossible to retain the Geological Survey laboratories in their present position on floor 4 of Mineral House I. This and ongoing problems of laboratory occupational health hazards required a review of the laboratories which was completed early in 1985.

Publications

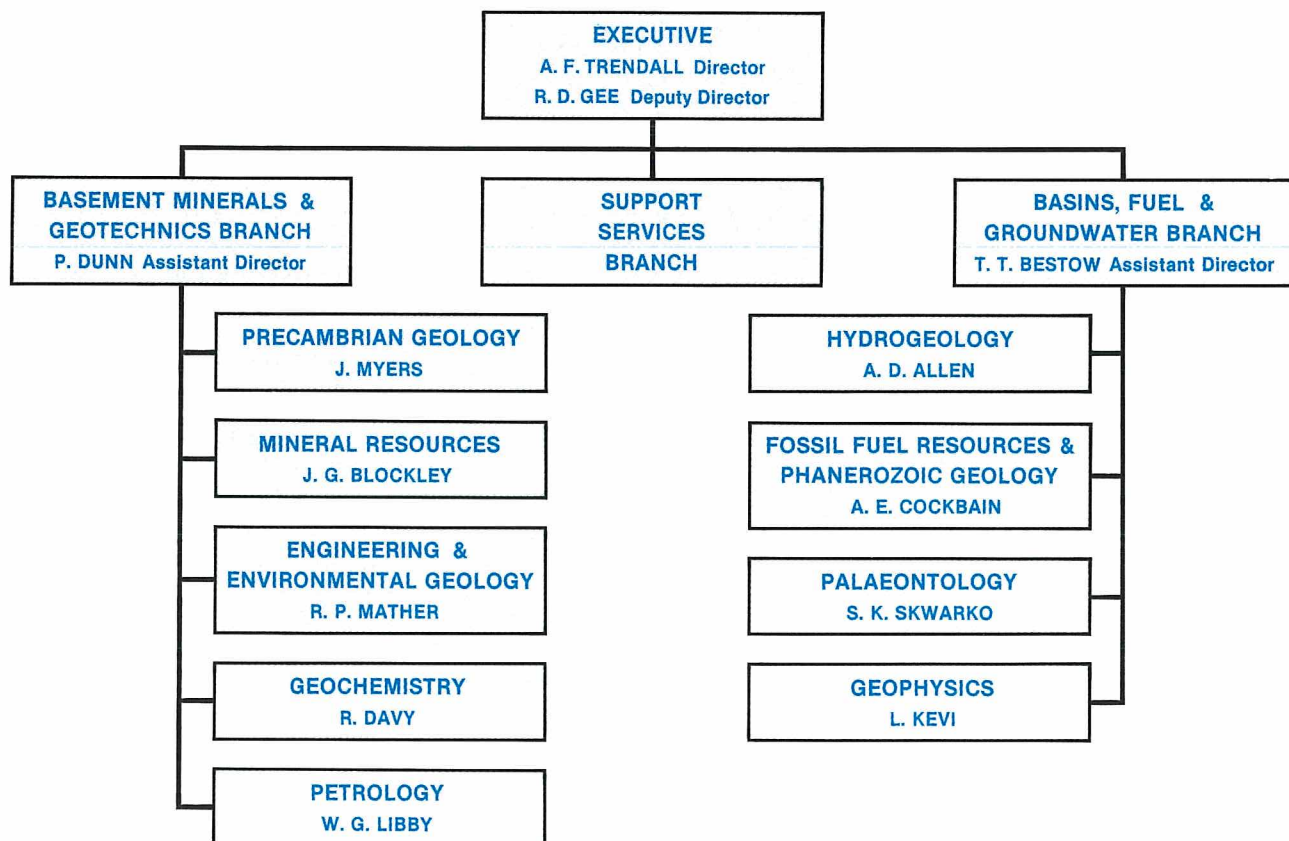
Issued during 1984/85

Bulletin 129. Stromatoporoids from the Devonian reef complexes, Canning Basin, Western Australia; by A.E. Cockbain.

Bulletin 130. Biostratigraphic studies of stromatolites from the Proterozoic Earraheedy Group, Nabberu Basin, Western Australia; by Kathleen Grey.

Mineral Resources Bulletin 14. Nickel mineralization in Western Australia; by R.J. Marston.

Report 12. Professional Papers for 1982 containing:



Revised Late Jurassic and Early Cretaceous stratigraphy in the Perth Basin; by John Backhouse.

The Wagon Creek Formation - an Early Carboniferous submarine fan deposit in the Bonaparte Gulf Basin; by G.M. Beere.

Geochemistry of Archaean metabasaltic lavas, Diemals, Western Australia; by R.W. Nesbitt, I.W. Walker, and D.F. Blight.

Mortimer Hills pegmatite uranium prospect - a Rossing-type uranium deposit in the Gascoyne Province; by J.D. Carter.

Bunbury shallow-drilling groundwater investigation; by D.P. Commander.

Petroleum exploration in Western Australia in 1981; by K.A. Crank and Arie Janssens.

Proterozoic mass-transported breccias - Neereno Hill, Western Australia; by S.L. Lipple.

Geology and hydrogeology of the Boyanup bore line; by R.A. Smith.

A 2 557 m.y. banded gneiss at Barret Well near Edjudina, Eastern Goldfields Province; by J.C. Roddick and W.G. Libby.

Groundwater in the Blackstone region; by P.H. Wharton.

Report 13. Economic potential of the Lower Fortescue Group and adjacent units of the southern Hamersley Basin - A study of depositional environments; by D.F. Blight.

1:250000 geological map with explanatory notes:

Barlee (SG/50-8)

Bencubbin (SH/50-11)

Bremer Bay (SI/50-12)

Hyden (SI/50-4)

Jackson (SH/50-12)

Kennedy Range (SG/50-1)

Newdegate (SI/50-8)

Mount Barker/Albany

(SI/50-11,15)

Mount Phillips (SG/50-2)

Pemberton/Irwin Inlet

(SI/50-10,14)

Perenjori (SH/50-6)

Shark Bay/Edel (SG/49-8,12)

Winning Pool/Minilya (SF/50-13,

SF/49-16)

The Bureau of Mineral Resources compiled and issued the following 1:250 000 geological maps with explanatory notes:

La Grange (SE/51-10)

Pender (SE/51-2)

Youanmi (SH/50-4)

1:250 000 geological map coloured reprints:

Busselton/Augusta (SI/50-5,9)

Kurnalpi (SH/5-10)

Menzies (SH/51-5)

Rawlinson (SG/52-2)

1:50 000 urban geology maps:

Boodarie (2557-II)

Port Hedland (2657-III)

1:50 000 environmental geology maps:

Murchea (2034-I, part 2134-IV)

Yanchep (2034-IV)

Records:

1983/7 Current studies on fossils of Western Australia with a supplement: Bibliography of the palaeontology of Western Australia 1975-1982; by S.K. Skwarko and John Backhouse.

1984/2 Review of petroleum exploration in Western Australia to the end of 1983; by R.M.L. Elliott and R.P. Iasky.

1984/3 An orientation study of the trace and other element composition of some Collie coals; by R. Davy and A.C. Wilson.

1984/5 Analysis of a pumping test from the Darling Range, eastern Collie area, Western Australia; by M.W. Martin.

1984/6 Proposals for ACORP transects in Western Australia; by R.D. Gee.

1984/7 New formation names for the Late Cretaceous and Tertiary sequences of the southern North West Shelf; by R.S. Heath and M.C. Apthorpe.

1984/8 An evaluation of the mineral potential of the (onshore) Carnarvon Basin by; P.H. Harrison.

1984/9 A flow-net analysis of the unconfined groundwater in the 'superficial formation' of the southern Perth area, Western Australia; by W.A. Davidson.

1985/3 WAMEX users guide; by J.D. Carter and S.L. Lipple.

Information Pamphlet:

A guide to the building and facing stones of Perth and Fremantle.

In press at June 1985

Bulletin 128. Geology of the Bagemall Group. The evolution of a Proterozoic intra-cratonic sedimentary basin; by P.C. Muhling and A.T. Brakel.

Report 14. Professional papers for 1983 containing:

The hydrogeology of Lake Mariginiup, Perth, Western Australia; by J. W. Hall.

Carboniferous of Western Australia - a review; by A.E. Cockbain.

Palaeozoic stratigraphy of the Ord Basin, Western Australia and Northern Territory; by A.J. Mory and G.M. Beere.

Structural and stratigraphic relationships in the Archaean granite-greenstone terrain around Cue, Western Australia; by K.P. Watkins and I.M. Tyler.

The Fraser Complex - a major layered intrusion in Western Australia; by J. S. Myers.

A rubidium-strontium date from felsic volcanics within the Mount Roe Basalt of the Wyloo Dome; by J.R. de Laeter, D.B. Seymour and W.G. Libby.

Rubidium-strontium biotite dates in the Gascoyne Province, Western Australia; by W.G. Libby and J.R. de Laeter.

Upward shallowing sequences in the Precambrian Duck Creek Dolomite, Western Australia; by A.M. Thorne.

Stromatolites in the Proterozoic Duck Creek Dolomite, Western Australia; by Kathleen Grey.

Stratabound axinite in the Weeli Wolli Formation and its occurrence in related dolerites; by Richard Davy and Malcolm Pryce.

Report 15. Geology of the Gascoyne Province; by S.J. Williams.

Report 17. The Mount Edgar Batholith, Pilbara area, Western Australia; by Richard Davy and J.D. Lewis.

Report 18. Late Devonian sponges of Western Australia; by J. Keith Rigby.

Records:

1984/8 An evaluation of the mineral potential of the onshore Carnarvon Basin; by P.H. Harrison.

1984/9 A flow-net analysis of the unconfined groundwater in the superficial formations of the southern Perth area; by W.A. Davidson.

1985/4 Explanatory notes on the Dumbleyung 1:250000 geological sheet, Western Australia; by R.J. Chin and A.T. Brakel.

1:250 000 geological map with explanatory notes: Kennedy Range (SG/50-1)

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SAFETY AND TRAINING

In 1982 Woodside Offshore Petroleum opened the first petroleum related offshore training centre in Australia to train personnel required to work offshore on the North West Shelf Natural Gas Project.

The original courses were for maritime industries working on the construction barges for the offshore platform and the submarine pipeline and aimed at all workers, many of whom were to commence working in a remote marine environment for the first time.

In the 3 years since the centre opened nearly 4 000 personnel have been trained in safety, survival at sea, rescue, resuscitation, first-aid and fire fighting techniques.

The centre, located at Jervoise Bay 12 km south of Fremantle, was developed by Woodside but is managed and staffed by WAIT-AID Ltd, a company established by the Western Australian Institute of Technology.

Facilities available at the centre include a Whittaker survival capsule, helicopter ditching simulator, life rafts and allied equipment, a hot fire training area fuelled by LP gas, a breathing apparatus smoke training chamber, a full range of first-aid, safety/survival and fire fighting equipment and also audio visual equipment and training programmes.

The courses at the centre are based on experience gained at the Robert Gordon Institute of Technology in Scotland and include a one-day basic sea survival course, a refresher sea survival course, a four-day fire fighting course and specialized courses for coxswains and engineers who will have to take charge of the Whittaker totally enclosed, motor propelled survival craft in the event of an emergency on the offshore platform.

In the basic sea survival course students are taught the theory of

survival, hypothermia, life support, fire fighting and also helicopter ditching procedures. The one-day course is backed by practical demonstrations and exercises in which students are taught how to enter the water wearing a life jacket, helicopter ditching in the simulator, how to get into a life raft and how to right a life raft that has tipped upside-down. They are also shown how to use portable fire fighting extinguishers.

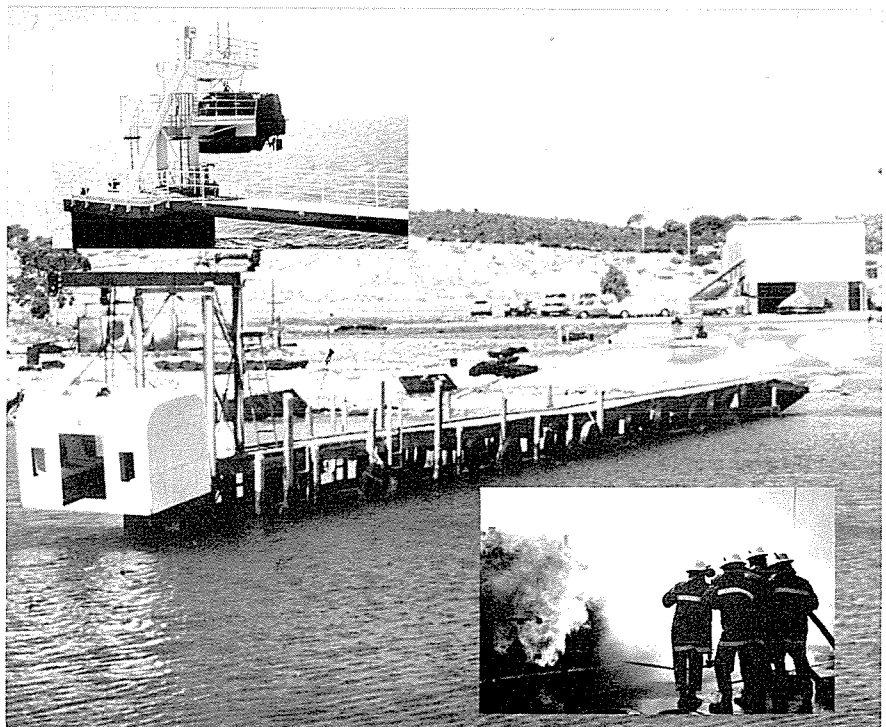
As a follow-up to this basic course the centre also offers a refresher survival course for personnel who have already done the basic course and who have worked offshore for a year or so. In this course the emphasis is on the Whittaker survival craft which is likely to be the main means of escape in the event of a platform having to be abandoned in an emergency. The survival craft provides seating accommodation for 50 passengers and has a single line launch-and-recovery system for a quick controlled evacuation and

safe retrieval after drills. The students gain valuable experience in abandonment procedures and boat handling.

The centre's four-day fire fighting course is aimed at turning out personnel who, in the event of a major fire onboard a rig or platform, can intelligently and knowledgeably assist trained fire fighting personnel.

Inspectors from the Department who are regularly required to visit the North Rankin platform and drilling vessels have benefited from these courses which are also available to industry.

The course recognizes the fact that increasing numbers of offshore oil workers travel considerable distances over water by helicopter to a remote work location where every person is his own safety officer. There is no local fire brigade to phone in an emergency and each person is part of a team which must be prepared for an emergency which may never occur.



Woodside Offshore Training Centre at Jervoise Bay. Inserts show the Whittaker capsule and a class learning firefighting techniques

Exploration and development

During the last 18 months a total of 110 exploration wells were drilled and 25 477 line kilometres of seismic recorded at a cost of \$390 million. A record number of 73 wells (22 offshore and 51 onshore) were drilled during 1984 even though the total penetration was down by 10 per cent (114 727 m in 1984 compared with 125 741 m in 1983). This decrease was due to the large number of shallow stratigraphic test holes drilled. Thirty seven exploration wells were drilled in the first six months of 1985, resulting in a total penetration of 74 720 m.

Seismic acquisition dropped again in 1984 with a recorded coverage of 11 354 line kilometres (5 019 km offshore and 6 335 km onshore) compared with 24 200 km in 1983, a decrease of over 50 per cent. This continued decline in activity is expected to adversely affect the number of exploration wells to be drilled in the next two or three years. During the first six months of 1985, however, seismic surveys covered 14 124 km (11 836 km offshore and 2 288 km onshore), a marked increase on the previous year. Recent oil discoveries near Barrow Island have stimulated interest in the offshore Carnarvon Basin resulting in a resurgence of activity in this area. A list of the wells drilled and seismic surveys conducted between 1 January 1984 and 30 June 1985 are shown in the tables on pages 88-90.

Of the total number of wells drilled, five were classed as oil discoveries and one as an oil and gas discovery, to give a success ratio of about 1 in 9 based on new-field wildcats. As in the previous few years the most active areas for petroleum exploration were the offshore Carnarvon Basin and onshore Canning Basin, where about 80 per cent of the drilling and 70

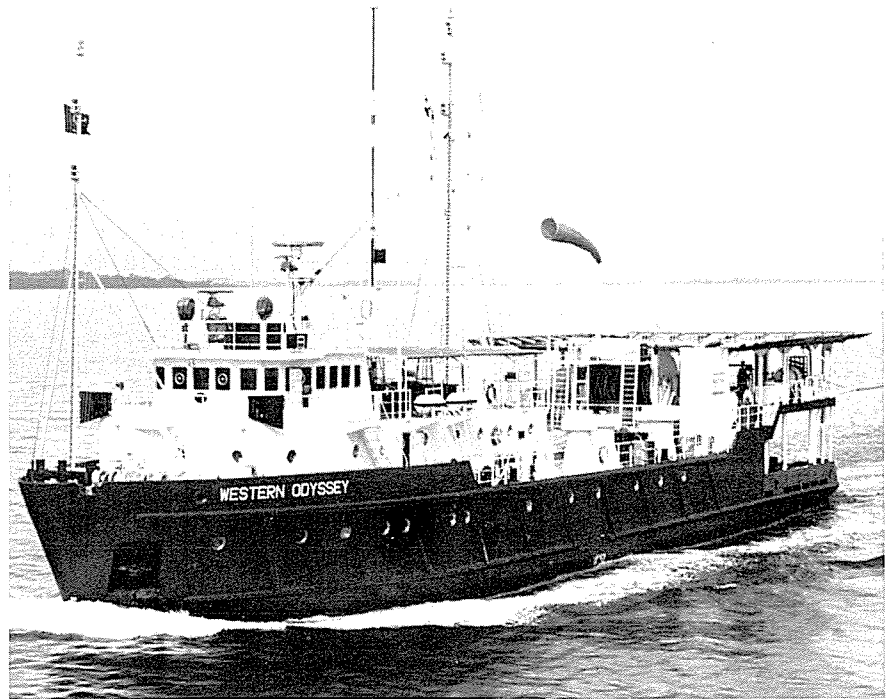
per cent of the seismic work was carried out.

Three oil discoveries were made in the Barrow Sub-basin of the offshore Carnarvon Basin. The first, Talisman No. 1, is located northeast of Barrow Island and flowed at a rate of up to 1 813 kL per day from three sandstone reservoirs. Australian Occidental's Lenita No. 1, drilled to test a structure some 5 km northeast of the Harriet Field, intersected a 5 m oil column. Oil also flowed from the Saladin No. 1 well drilled southwest of Barrow Island by West Australian Petroleum Pty Ltd.

duced oil from a pay zone 16 m thick.

Pictor No. 1 drilled by BHP in the Canning Basin, produced at a rate of $57 \times 10^3 \text{ m}^3$ per day of gas and 35 kL per day of fluids (20 per cent oil). Minor hydrocarbon shows were recorded in several wells from the onshore Canning Basin, offshore Carnarvon Basin and the Bonaparte Basin.

Extension wells with a combined penetration of 22 600 m were drilled at five potential oil fields (all offshore) and three producing fields during the last 18 months. Five wells were drilled over the Harriet Field, 2 at South



Seismic vessel "Western Odyssey"

Onshore oil was discovered at two locations on the northwestern edge of the Canning Basin. Oil flowed at a rate of 123 kL per day from West Terrace No. 1 and the well is currently undergoing long-term production testing. Esso's West Kora No. 1, drilled to test a structure 5 km from where the Kora No. 1 well intersected 16 hydrocarbon-bearing zones, pro-

duced oil from a pay zone 16 m thick. Pepper, 2 at Chervil and 1 at Talisman and resulted in a success rate of 50 per cent. A total of 21 extension wells were drilled on Barrow Island during the same period and all produced oil in commercial quantities. Two other onshore extension wells were completed, Sundown No. 3, which was plugged and abandoned, and Blina No. 5, a suspended oil producer.

Development drilling was carried out at the North Rankin, Woodada and Barrow Island Fields and a total of 25 wells were completed. All 16 wells drilled on Barrow Island flowed oil, one of the two Woodada wells produced gas, and all the North Rankin wells were successful. Development drilling totalled 39 384 m.

A highlight for 1984 was the commencement of gas production from the North Rankin Field on the North West Shelf. Initially the gas was used for commissioning the Domgas Plant at Withnell Bay and it became available for commercial distribution in the southwest from August 1984. Exports of LNG are expected to commence in 1989.

Tenements

At 30 June 1985 there were 93 permits to explore for petroleum in Western Australia, 30 offshore and 63 onshore. The permit area held comprises 768 263 km² made up of 248 932 km² offshore and 519 331 km² onshore.

A summary comparison of permit dealings for the years 1983 and 1984, as well as the first six months of 1985, is shown in the table on page 91. At 30 June 1985 the area still available for application totalled more than 700 000 km².

During 1984 there was a general decrease in permit applications and the area and number of permits held dropped compared to 1983, continuing the trend started near the end of 1982. Permit surrenders, expiries and cancellations fell slightly in number but renewals were down by two-thirds resulting in a 19 per cent decrease in the number of permits held.

However there was, renewed interest in onshore exploration during the first six months of 1985 with seven new permits granted, six renewed and only one surrendered. Offshore permit activity was still depressed, although the number of surrendered permits was less than in 1983 and there were three areas where permit applications were pending.

Development and production

In Western Australia production of crude oil totalled 1.850 x 10⁶ kL and gas 2.615 x 10⁹ m³ for the period between 1 January 1984 and 30 June 1985. Oil was produced from the Barrow Island, Blina, Sundown, Dongara and Mt Horner Fields while gas and condensate were produced at the North Rankin, Dongara, Mondarra, Yardarino and Woodada Fields (see table page 92).

Barrow Island Oil Field (West Australian Petroleum Pty Ltd). Barrow Island Field is located on a 233 km² island 88 km north of Onslow and 145 km west of Dampier. The first well was drilled in 1964 and since then 706 wells have been completed. Production commenced in April 1967 and at 30 June 1985 a cumulative total of 32.96 x 10⁶ kL of oil had been produced.

There are at least 27 different reservoirs producing or holding oil and/or natural gas in the field. The four main producing pools are the Lower Gearle Siltstone, "Windalia Sandstone", Muderong Shale and Cretaceous/Jurassic sandstones.

WAPET commenced their 1984 drilling programme in mid-July and to the year's end 16 wells had been completed, 12 testing Muderong objectives and 4 the Windalia Pool. During the first six months of 1985 a further 21 wells were drilled. Of the total 37 wells, 21 were classed as extension tests and there were 16 development wells.

The status of the 706 wells drilled on Barrow Island to 30 June 1985 is shown in the table on page 92. A breakdown of annual, half-year and cumulative production for the field is shown in the table on page 92.

Blina and Sundown Oil Fields (Home Energy Company Ltd). Blina Field is located 105 km southeast of Derby in the Canning Basin. The oil discovered in Blina No. 1 (1981) was substantiated by three extension tests. Oil pro-

duction commenced on 30 September 1983 and 79.5 x 10³ kL of oil had been produced to 30 June 1985.

The two main reservoirs at Blina are the Upper Devonian Nullara Limestone and the Lower Carboniferous Yellow Drum Sandstone. All four wells are currently producing, Nos. 1, 2 and 3 from the Nullara Limestone and No. 4 from the Yellow Drum Sandstone.

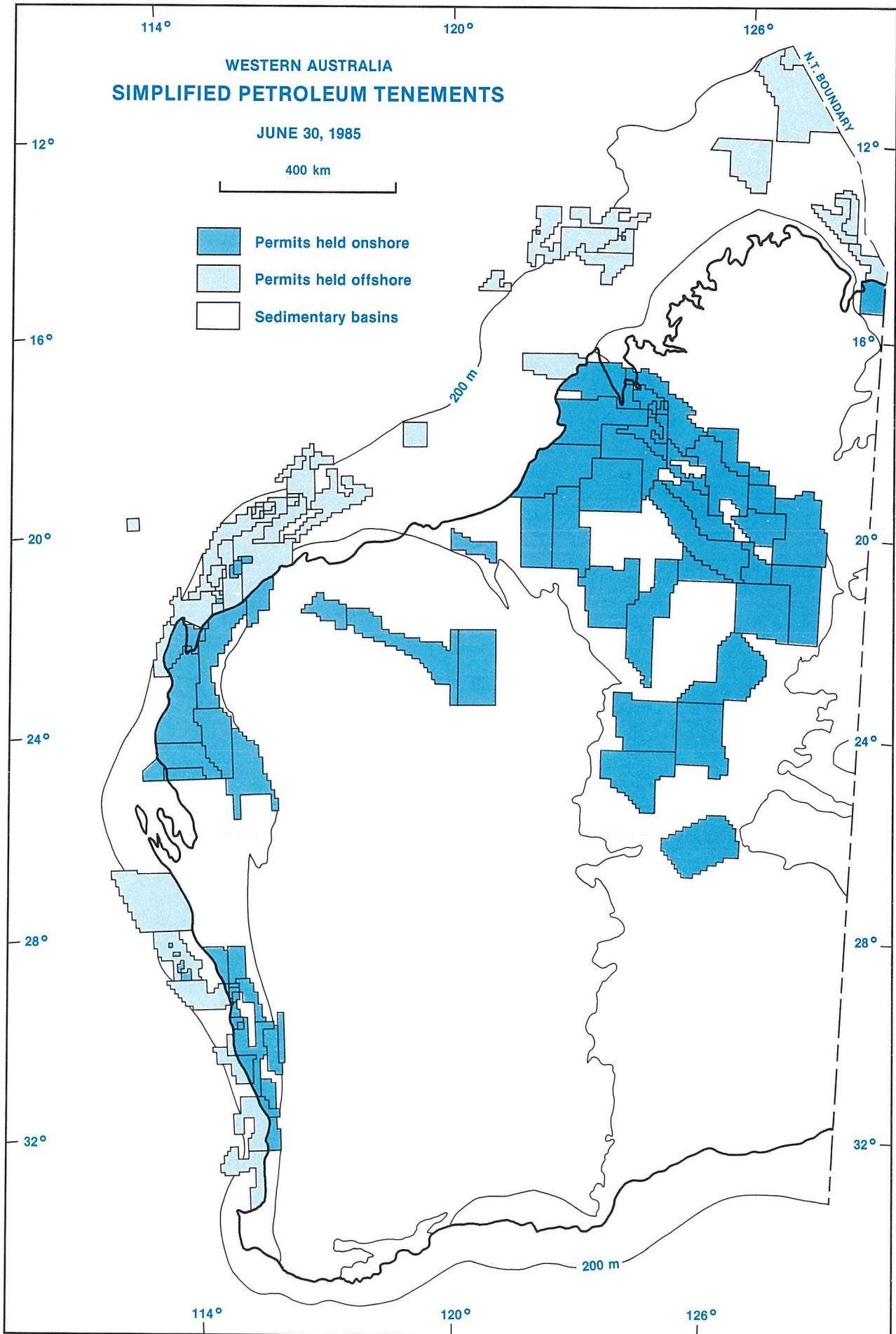
Blina No. 5, drilled in mid-1985, produced a small amount of oil from both the Nullara Limestone and dolomite of the Yellow Drum Sandstone. Another well, Blina No. 6, is due to spud in July 1985.

Oil was discovered 26 km northwest of Blina where the Sundown No. 1 well encountered oil shows in 10 separate zones within Permo-Carboniferous sandstones of the Grant and Anderson Formations. This well was subsequently completed as an oil producer from the '1100 sand' horizon as was a second well. Sundown Nos. 1 and 2 failed to produce naturally so rod pumps were installed and full production was established in July 1984. Total production from 1 January 1984 to 30 June 1985 was 9.2 x 10³ kL.

Sundown No. 3, drilled in October 1984, confirmed the existence of a thin pay zone in the '1100 sand' and encountered oil shows in a good quality '1180 sand' reservoir suggesting the presence of another oil pool even though the well was later plugged and abandoned. A fourth well, due to spud in July 1985, will test two deeper potential reservoirs as well as the existing sandstone oil reservoir.

Disposal of oil from the Blina and Sundown Fields totalled 65.0 x 10³ kL for the period 1 January 1984 to 30 June 1985 (see table on page 93.)

Dongara, Mondarra and Yardarino Gas Fields (West Australian Petroleum Pty Ltd). These three fields are located approximately 320 km north of Perth and 65 km south of Geraldton in the northern part of the Perth Basin. Production from



the Dongara Field commenced on 25 October 1971 followed by the Mondarra Field in 1972 and Yardarino in 1978.

The four reservoirs in these fields are the Aranoo Member (Early Triassic), the Dongara Sandstone (Early Triassic), the Wagina Sandstone (Upper Permian) and the Irwin River Coal Measures (Lower Permian).

A total of 25 wells have been drilled in the Dongara Field and at present there are 10 gas producers, 2 oil producers, 2 oil and gas producers, 7 shut-in wells, 1 water source well and 3 abandoned wells. Gas, produced at a rate of about $1.70 \times 10^6 \text{ m}^3$ per day, was transported in a 36 cm diameter pipeline from Dongara to Pinjarra via Perth and Kwinana. The Mondarra Field, 2 gas wells and 2 abandoned wells, produced gas at a rate of $0.07 \times 10^6 \text{ m}^3$ per day and the Yardarino Field produced gas at a rate of $0.02 \times 10^6 \text{ m}^3$ per day. Oil production from Dongara averaged about 21 kL per day.

In 1984, four wells were recompleted to the Aranoo Member of the Kockatea Shale. Two of these wells, Nos. 9 and 24, are now gas producers whereas Nos. 14 and 16 are shut-in even though No. 14 produced crude oil for four months.

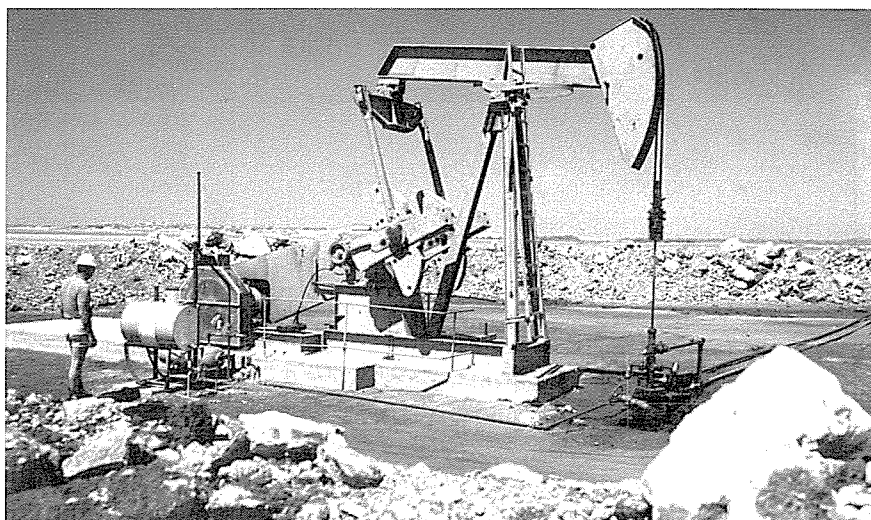
Five turbine compressor units at the Dongara Plant were re-staged to match anticipated field gas production.

Disposal of gas from the Dongara, Mondarra and Yardarino Fields totalled $984 \times 10^6 \text{ m}^3$ for the period 1 January 1984 to 30 June 1985. Dongara oil disposed of during the same period equalled $11.1 \times 10^3 \text{ kL}$.

Mt Horner Oil Field (Pacific Basin Exploration Pty Ltd). The Mt Horner Field is 380 km north-northwest of Perth in the Perth Basin. The first well was drilled in March 1965 by West Australian Petroleum Pty Ltd and since then, five extension wells have been completed. Of these 6 wells, 4 are classed as suspended oil producers

and 2 (Nos. 2 and 6) are plugged and abandoned. Production commenced in May 1984 and 953.5 kL of oil had been produced to 30 June 1985.

There are at least three potentially productive units at Mt Horner; the Cockleshell Gully Formation, Kockatea Shale and basal Triassic sands.



Production pump at Barrow Island

North Rankin Gas Field (Woodside Petroleum Development Pty Ltd). The North Rankin Field is located 130 km north-northwest of Dampier and 265 km west-northwest of Port Hedland, off the coast of Western Australia. The first well, North Rankin No. 1, was drilled in 1971, and since then five extension wells and seven development wells have been completed. Production started in July 1984 and at 30 June 1985 a cumulative total of $1\ 227.5 \times 10^6 \text{ m}^3$ of gas and $146.7 \times 10^3 \text{ kL}$ of condensate had been produced.

The main reservoir is in porous sandstones of the Upper Triassic Mungaroo Formation. Gas is currently being produced at a rate of about $3.6 \times 10^6 \text{ m}^3$ per day and condensate at 570 kL per day. Total recoverable reserves of gas and condensate at North Rankin are estimated to be $229 \times 10^9 \text{ m}^3$ and $16 \times 10^6 \text{ kL}$ respectively.

Disposal of gas from the North Rankin Field totalled $1\ 028 \times 10^6 \text{ m}^3$ for the period 1 January 1984 to 30 June 1985. The amount

of condensate disposed of during the same period was $119.5 \times 10^3 \text{ kL}$.

Woodada Gas Field (Strata Oil N.L.). Woodada Field is located 13 km northwest of the township of Eneabba, in the Perth Basin. The discovery well was spudded in 1980 and since then 10 wells have

been drilled. Gas production commenced on 24 May 1982 and $465 \times 10^6 \text{ m}^3$ of gas had been produced to 30 June 1985. The current production rate is about $0.17 \times 10^6 \text{ m}^3$ per day.

The main reservoir is limestone in the Carynginia Formation of Early Permian age. Of the 11 wells drilled in the field, 2 are gas producers, 7 are shut-in wells and 2 are plugged and abandoned.

Gas was initially produced from Woodada Nos. 1 and 2 wells but in mid-April 1983 production from the No. 2 well became sub-economic and the well was shut-in. The number of wells producing gas peaked at six but at the end of 1984 only Woodada No. 1 and East Lake Logue No. 1 were still in production.

In January 1985 the SEC commenced a study to determine whether the partially depleted Woodada reservoir would be suitable as a storage facility for natural gas. It is envisaged that North West Shelf gas could be injected into the Woodada reservoir and used to service the South West of the State in

the event of an interruption to normal supplies. The SEC will purchase Woodada gas until the study is completed, as continued production is required to prevent the field from watering out.

Oil pricing and royalties

The price of Australian crude oil is regulated by the Federal Government through its customs and excise powers. Late in 1984 the Government announced that from 1 January 1985 indigenous crude oil would be marketed through a partial allocation scheme until 1988. After that date a free market may be introduced, but this is to be reviewed in 1987. Under this scheme small venturers producing up to 8 000 kL/d are required to dispose of all crude through allocation arrangements.

As from 1 May 1985 the import parity price for Western Australia crude delivered at Kwinana Refinery has been set at:

Barrow Island oil	\$285.53/kL;
Dongara oil	\$271.63/kL;
Blina/Sundown Oil	\$280.68/kL.

Excise is levied on the import parity price of crude oil at various rates depending on whether the crude is classified as "new" "intermediate" or "old". According to the Petroleum Acts a royalty of between 10 and 12.5 per cent is payable to the State on all hydrocarbons produced.

During the last 18 months total royalties paid on petroleum in Western Australia were \$27 742 426. This was derived from \$21 916 106 paid on crude oil sales, \$5 764 019 on natural gas and \$62 301 for condensate (see table on page 93. Annual royalties paid in 1984 totalled \$17 840 905 compared to \$18 443 370 in 1983, a decrease of 3 per cent.

The Federal Government introduced a Resource Rent Tax (RRT), which applied from 1 July 1984, for new developments outside existing licence areas in those offshore areas where the Commonwealth's Petroleum (Sub-

merged Lands) Act applies. RRT is a levy of 40 per cent which is imposed on the income received from the sale of petroleum recovered. This levy is applied prior to company tax and is tax deductible.

Reserves

Estimated recoverable reserves for Western Australia at 30 June 1985 were 20.73 x 10⁶ m³ of crude oil 2 322.03 x 10⁹ m³ natural gas, 141.27 x 10⁶ m³ condensate and 29.35 x 10⁶ m³ liquid petroleum gas. The table on page 91 shows details of these reserves.

Carvarvon Basin gas reserves of more than 800 x 10⁹ m³ represent the largest accumulation of potentially producible gas in the State at present. Large gas fields in the Bonaparte Basin, Browse Basin and Exmouth Plateau require further technological advances before production would be feasible.

Ninety five per cent of the State's oil reserves are located in the Carnarvon Basin, but at present only one field within that basin, Barrow Island, is producing oil. Oil is also produced in small quantities from the onshore Perth and Canning Basins where recoverable reserves are estimated to be 0.64 x 10⁶m³ and 0.44 x 10⁶m³ respectively.

Main changes to the oil reserves since 1983 were the addition of the Chervil, Harriet and North Herald Fields and annual re-evaluation of field reserves. Addition of the Wilcox Field and the upgrading of many other field reserve estimates represent the major gas reserve changes.

Operations

Engineering

The petroleum engineering (construction) section continued appraising the design, construction and commissioning of the pipelines and facilities for the North Rankin Gas Field and Western Australia's first offshore oil field at Harriet, 14 km northeast of Barrow Island.

The North Rankin 'A' Platform was commissioned for production of fuel gas for use on the platform on 4 May 1984. The submarine pipeline was commissioned and gas was brought onshore to the treatment plant on the Burrup Peninsula on 30 June, and on 29 August 1984 gas reached Perth via SECWA's Dampier-to-Perth trunkline.

A 57 km 273 mm diameter gas pipeline spur to Cape Lambert off the Dampier-Perth trunkline was commissioned and became operational on 20 August 1984.

Construction work commenced in May 1985 for development of the Harriet Oil Field. An eight-leg offshore drilling and production platform is under construction at Geraldton, and oil storage and shipping facilities are being built on one of the Lowendal Islands. Oil from the offshore platform will be transported to the island through a 219 mm diameter, 6.5 km long submarine pipeline and from the island to the loading terminal through a 762 mm diameter, 3.5 km long submarine pipeline.

Accidents

Figures relating to accident statistics in the petroleum exploration and production industry are shown in the table on page 93.

Pipelines

A total of 419 work proposals relating to the Dongara-to-Pinjarra Natural Gas Pipeline from Government Departments, instrumentalities and other parties were processed between 1 January 1984 and 30 June 1985. There were 12 encroachments on the pipeline during this period, all by the State Energy Commission.

Organization

Mr Rod Dedman was appointed as Production Geologist with the Petroleum Division in July 1984. On 25 January 1985 Mr Peter Hammett retired and at 30 June 1985 the position of Petroleum Engineer - Operations was still vacant.

BOUNDARY PEGS—Security with confidence

Some things in life are so simple they are often taken for granted and their tremendous significance can be overlooked. Such can be the case with the boundary pegs defining a mining lease or licence.

The principle of defining the limits of property is not new, and much significance has been placed on property markers from the dawning of civilization. The need to have a system which defines occupied territory and which enables re-establishment of boundaries in the face of intruders or incursions of nature has been paramount in most civilizations.

The ancient civilizations of the Nile Valley and the Tigris-Euphrates basin are credited with having originated a system of property marking and recording. These records were complete enough to enable re-establishment of the property after the annual floods when visible markings and other evidence of occupation had been lost.

The Romans are renowned as the developers of the rule of law. Many of their principles concerning ownership of land underlie some of the common law relating to the boundaries of today. The pegs defining modern mining tenements are directly descended from these principles.

Such was the importance placed by the ancients on the boundary marks established to separate properties that religious as well as civil significance was attached to their establishment and preservation.

Ancient Hebrew farmers recognized a law which translated as "Thou shalt not remove thy neighbour's landmark which they of old time have set".

The Romans had a god, Terminus, to protect the boundary stones of property, and on February 23 of each year a solemn ceremony took place at the actual boundary marks. This had the ef-

fect of reinforcing the position of the boundary in front of witnesses. There was an old English custom called "Beating the Bounds" and a similar one in Scotland known as "Riding the Marches" wherein, on a certain day of the year, school children were walked around the local village or parish and took part in rites designed to help them learn their bounds.

All this leads to the importance of the pegs and other markings used to define mining tenements in Western Australia. Pegging is accompanied by a written description of the position of the tenements, and many people believe the written description is the final arbiter of where or how big a tenement is. This is not so. In fact the original position of a peg prevails over both the peg itself and its described position. Thus if a peg is moved, the boundary does not move in sympathy. Similarly if the position of a peg is not accurately described the peg may not be moved to correspond with its described position.

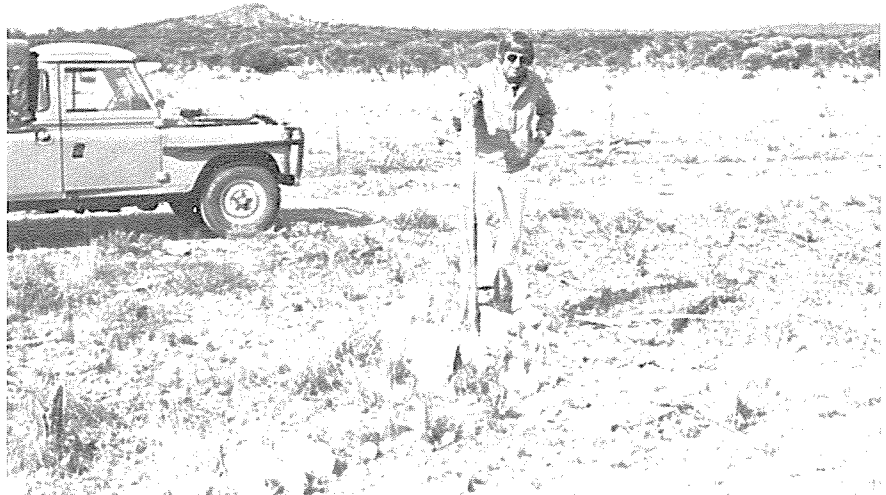
This same principle applies to a formal survey of the tenement.

The survey accurately establishes the position of the tenement as pegged, and cannot alter this position, although the shape may be regularized and boundaries may be locally straightened, provided no other tenements are adversely affected. A formal survey incorporates the tenement into a centralized public record in the Department of Mines.

Once surveyed, tenement boundaries can be confidently re-established in their original positions should any marks become destroyed or lost.

The requirement that trenches be set may seem somewhat crude and elementary but experience over the years has demonstrated that digging or disturbing the ground in a distinctive pattern is universally recognized evidence of occupation. Against a backdrop of undisturbed ground, such as in outback Western Australia, evidence of trenches will be visible for many years.

So it is that the regulations regarding pegging of mining tenements in Western Australia have evolved.



A survey post originally placed in 1939 and found recently in good condition

With continuing interest in mineral exploration and development in Western Australia, the resources of the Surveys and Mapping Division have been under pressure to meet the demand for cadastral and geological mapping, at the same time as maintaining the public plan system and the programme of tenement surveys. The upheaval caused by the new Mining Act has now stabilized and the high level of activity, particularly in gold exploration, augurs well for the continued interest in mining.

Tenement surveys

There were 728 tenements surveyed during 1984 at an average cost of \$781 each. The average cost to survey a further 561 tenements in the first half of 1985 escalated to \$1 250 due to a 54 per cent increase in the average size of tenements, increased survey costs, and a significantly higher proportion of tenements being surveyed in the northern parts of the State, where surveying is more expensive.

In an effort to contain expenditure on surveys, boundaries already surveyed will not be resurveyed where they form the boundaries of a new tenement held by the same owner. This occurs in some transitions and conditional surrenders. This new approach, which eliminates the need for field work for such tenements, is justified on the basis that there is no change in ownership, and only 50 per cent of the scheduled survey fee is lodged.

Approved leases awaiting survey at the end of December 1983 numbered 2 251. Approved leases on the 30 June 1985 numbered 1 50 after the surveying of 939 over the 18-month period. To significantly reduce the backlog of surveys a considerably expanded survey vote would be required.

There is continuing pressure for the Department to survey tenements to locate boundaries which the applicants have not maintained as required by the regulations. Lack of maintenance is particularly evident with tenements that have changed hands. Much time is wasted by surveyors having to search for marks that the new holder cannot locate. Apart from any inconvenience, holders are placing the security of their tenements at risk by not regularly maintaining their pegs and ensuring their boundaries are intact. On request, 38 surveys were carried out at the holders' expense to verify doubtful boundaries.

A backlog in processing the surveys has been carried forward from the boom of the 1970's. This was slightly reduced from 2 654 at the start of 1984 to 2 515 at the start of 1985. This was then significantly reduced to 1 744 by 30 June 1985 with the formation of a task force to carry out this work.

Levelling

A levelling project to determine the thickness of the roof of the Cabaret Cave at Yancheb was undertaken.

Levelling to boreheads for the Hydrogeology Section of the Geological Survey was carried out in the vicinity of Cataby and between Bunbury and Busselton.

Geodetic work and traversing for standard plan production

Some survey control points were established in the Moolyella district to rationalize survey discrepancies.

Work is still required to complete the generation of co-ordinates for mapping, for which control has been completed. There are currently 389 new standard plans and a further 586 are required.

Petroleum tenements

A high level of petroleum exploration has been maintained.

Recent legislative changes gave a new definition of the territorial sea and required an accurate delineation of the baseline defining the territorial sea. This is being determined by the Commonwealth on behalf of the States, and will be supplied both in digital form and on special charts. These boundaries will require translation onto Mines Department maps for both offshore and onshore tenements, and the maps will consequently have to be redrawn.

The format of the quarterly edition of the petroleum tenement map has been improved. It is now produced in two colours, which improves the clarity of the information. Additional information concerning data on microfilm, blocks available for application,

	First Half 1985	1984	1983
No. of tenements surveyed	211	728	1 048
Cost per tenement \$	1 250	781	555
No. of field books lodged	70	161	186
Total boundary line run km	379	977	274
Total traverse line run km	181	279	1 652
Total area defined by survey ha	15 647	35 537	37 125
Distance travelled km	24 705	67 572	70 749
Total value of cadastral surveys \$	263 785	568 414	581 353
Total value connection surveys \$	27 829	87 190	91 844
Total value special surveys \$	3 972	22 056	34 349
Total value of all surveys \$	295 586	677 660	707 546
Surveys completed at holders' expense	10	28	-

and prices for obtaining the data are now included in the brochure accompanying the map.

Updating the printed quarterly editions of the petroleum tenements map by supplying an interim addendum notice is more suitable than providing dyelines of an updated map between printed editions.

Survey guidelines to position wells drilled for petroleum need to be reviewed to incorporate the use of new technology now available.

Geological maps

A highlight of this work is the initial production of Environmental Geology maps of Muchea and Yanchep at 1:50 000. Design of the format entailed a close liaison between geologists and cartographers.

The standard of these productions can be judged by the fact that the Muchea map was awarded the 1984 Australian Cartographic Excellence Award for General Purpose Cartography at the International Cartographic Conference 1984.

A total of 19 full-colour geological maps were completed including 4 reprinted by laser-scanning technology. This is a rate of one major map prepared and printed each month during the reporting period.

Compilation of a new base for the State 1:2 500 000 map is completed and fair drawing is progressing. This map will be the base for the next State geological map and petroleum tenement map.

Cadastral plans

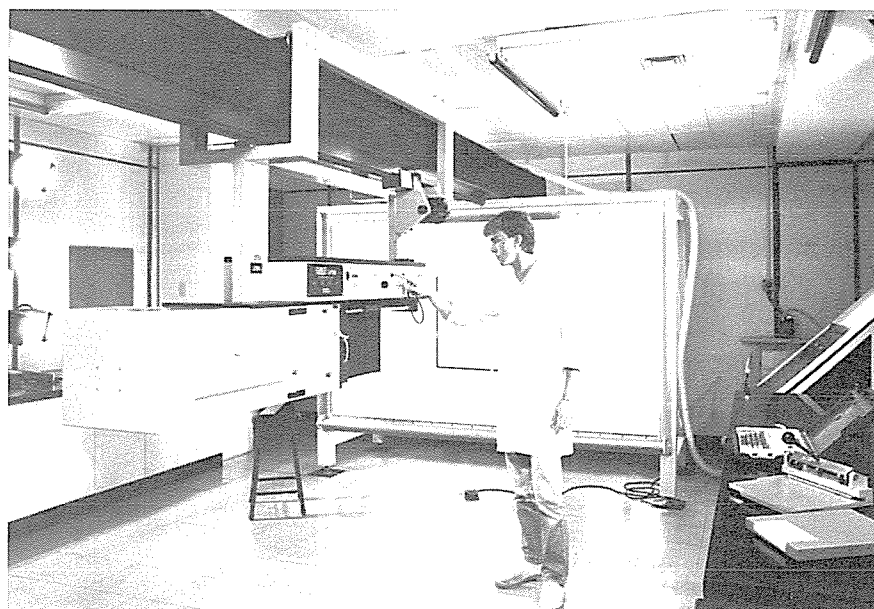
In the West Pilbara and Peak Hill Mineral Fields and areas of gold interest around Kalgoorlie, replacement of the old Transverse Mercator mapping by modern Australian Map Grid mapping is near completion.

Reprographic work

During extensions and renovations to the reprographic area to accommodate much needed new equip-

ment, the work of the section was seriously curtailed. Private reprographic facilities were used to maintain the work flow.

The recently installed OPTICOPY 8/20C registrator process camera is exceedingly accurate, fast, and versatile. It can produce a composite plan from numerous drawings at other scales (such as a 1:250 000 format from 24 line compilations at 1:50 000 scale) without the need for manual cutting and joining.



Fingertip control for precise setting of the Opticopy process camera

“Bright Light” film is now in use in the contact dark room allowing simplified handling of exposures and screens under yellow light. A plastic laminator is being used to replace cloth-backed mounting. An automatic film processor is providing fast turn around of colour and black and white film processing.

The services of the reprographic staff are being increasingly used for photography assignments as other divisions become aware of the service available.

Public plans

In the 18-month period to 30 June 1985 a total of 9 505 tenements were added to the public plans. As a large number of these involved surrender or transition of existing

tenements, many maps are in need of replacement to clarify the data they now carry.

There are presently 1 622 public plans in use, a reduction from the 1 741 in use in 1983 because of progressive replacement of 1:50 000 scale plans by 1:100 000 scale plans.

Public plans are now computer listed enabling plan maintenance and replacement programmes to be monitored.

Land Information System Products

Microfiche indexes containing information about all reserved and freehold land in the State have been purchased and installed in the Division. This system is a computerized record of information supplied by the Office of Titles and the Department of Lands and Surveys.

The indexes are of three types: ownership; legal description; and position. The third type includes the Valuer General Maps in microfiche form and the whole system provides a cost-effective method for searching land records. By using these indexes it is now possible to answer many land in-

formation inquiries in-house, saving time otherwise spent in travel and manual search.

Technical information

Requests for supply of information on old tenements, particularly in gold mining areas, continues. Sales revenue for the reporting period was \$126 001. Current explosive magazine reserves were catalogued in graphic form.

Computerizing of records

Amongst other tasks in this area staff have been involved in the creation of TENDEX, a limited information memory bank based on the survey tenement register. This will eventually be included in the Mines Department Mining Tenement Information System.

Cartographic computing

The Cartographic Computing Section has now been located with the Survey Branch at 69 Adelaide Terrace. It is far from ideal and the provision of proper accommodation in Mineral House II is eagerly awaited.

An officer was seconded to work with the Lands Department to gain experience in software for cadastral data manipulation, leading to production of a pilot system using tenements. Time was also spent in familiarization with software for the Department's new IBM system. A PLOT 50 2-3 drafting package was purchased. An officer was allocated in early May 1985 to work with the MTIS Project Manager and Computer Services Staff in the development of the TENDEX introductory tenement information system.

Staff

Total establishment numbers remain static at 131 despite increasing demands for involvement in more varied activities. There is a considerable backlog of work in updating of plans and maintenance of

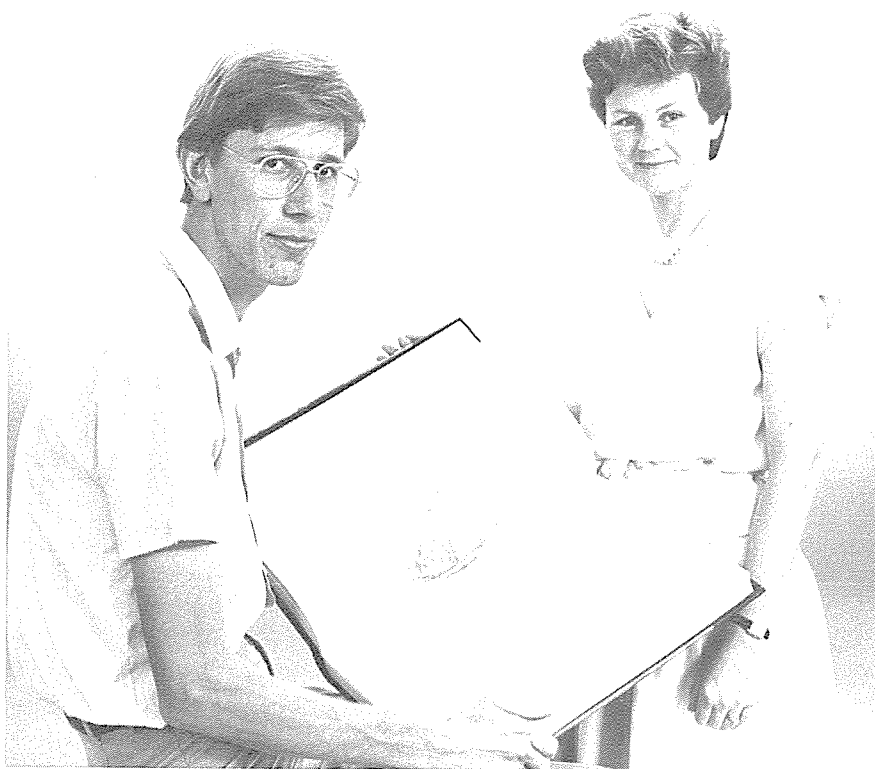
records, leaving little scope to undertake new initiatives or increase production of geological plans. A total of 1 070 hours of drafting work were contracted out.

Mrs Leanne Ford of the Mapping Branch won the W.J. Kirkby Award, presented by the W.A. Division of the Australian Institute of Cartographers, with an aggregate of 85 per cent for her studies at Wembley Technical College. Mr

Congress in Brisbane in April 1984 and Mr G.R. Sharp, Chief Cartographer, attended the 13th Conference of Chief Cartographers in Canberra.

Other staff participated in various training courses and technical seminars to better understand modern technology and supervisory techniques.

The 12th International Cartographic Association Conference in Perth, August 1984 and the Austra-



Award winners Michael Prause and Leanne Ford

Michael Prause, also from the Mapping Branch, attained third place with an aggregate of 81 per cent.

Other activities

One field inspection was carried out in the Kalgoorlie and Coolgardie areas and liaison with the Mining Registrars at these centres was maintained throughout the year.

Joint visits with officers of the Mining Registration Division were made to inspect plans and operations in the Southern Cross, Collie and Bridgetown areas.

Mr W.R. Moore, Director, attended the 26th Australian Survey

Carto One (map automation) Seminar, which preceded it, were significant events in the calendar for Western Australian cartographers. Mr D.T. Pearce, the Division's Assistant Director, was the Conference Director whilst Mr W.R. Moore convened the Austra-Carto One Seminar Committee. Twenty-six officers of the Department registered for the conference.

The Department was included on the programme of technical tours. Staff of the Division achieved a commendable standard in the presentation of displays and demonstration of our work and function.

WORLD ACCLAIM FOR FORENSIC SCIENCE LABORATORY

International recognition of the Forensic Science Laboratory was confirmed in September 1984 when Mr Vin McLinden, the Chief of the Laboratory was appointed to the Presidency of the International Association of Forensic Toxicologists (TIAFT) for the triennium to 1987. His election took place at the 21st meeting of the Association held at Brighton, England. TIAFT, which brings together the world's leading forensic toxicologists, is particularly active in the UK (where its headquarters are established), in North and South America and most parts of western Europe. More recently its influence has extended to Asia where Japan has contributed strongly to its membership.

Mr McLinden is the first Australian and only the second person outside England and the USA to occupy this prestigious position, his immediate predecessor originating from Switzerland. His election is seen as a recognition of the enhanced reputation which the Forensic Science Laboratory enjoys amongst its overseas counterparts in forensic toxicology and in other areas of forensic science. The Laboratory has maintained contacts over the years with overseas forensic scientists by visits to kindred laboratories in England, through forensic science symposia and through visits by a number of the world's leading forensic scientists, including two former presidents of TIAFT.

It was recognized in the early 1960s that there was a need for an international organization to facilitate communication amongst forensic toxicologists. The late 1950s saw the introduction of the first of a long list of new mood affecting drugs which have played a prominent part in forensic toxicology ever since. Little information was available about toxic levels of such drugs and consequently the need arose to share any information

available on drug levels in overdose cases. With the formation of TIAFT this was achieved rapidly through the medium of a bulletin and regular meetings in Europe and USA. Since its humble beginning the Association has broadened the scope of its activities and now provides a range of services to aid the science.

Forensic toxicology was originally concerned with the detection of poisons. The concept of poison and poisoning has been with society throughout history and many notorious cases of poisoning have been recorded. The role of the forensic toxicologist has changed somewhat over the years so that today in the Forensic Science Laboratory he is not solely devoted to the examination of exhibits in connection with sudden deaths. He may be involved with the analysis of specimens from traffic offenders for alcohol and drugs or the examination of exhibits relating to prison security or even the examination of blood and urine samples from racing horses or greyhounds in connection with doping control programmes. The factors linking all these activities are the requirement for analysis of human or animal viscera or fluids for the presence of drugs or poisons and the knowledge to properly interpret the results of the analysis.

Thus in the case of a sudden death the forensic toxicologist must be able to discern whether or not a concentration of barbiturate in blood is consistent with an overdose. With a traffic offender he could be called on to interpret a level of diazepam (Valium) in the blood. In relation to a positive caffeine detection in a racehorse, the stewards require advice as to whether metabolites accompanying the detection of caffeine are consistent with the administration of the drug one hour, one day or perhaps several days prior to the race.

Forensic toxicology is a very dynamic field of science. The types of drugs used have changed markedly over the last 25 years and we have seen in this time the introduction of a wide range of drugs including antidepressants, antihistamines, sedatives, hypnotics and antianxiety agents. More recently the increased use of illicit drugs has provided much experience in the analysis of heroin and cannabis derivatives.

Change is confined not only to the types of drugs used but also to the degree of potency of many of the newer drugs. Today's pharmacologists and drug manufacturers are producing drugs with a high specificity of action and low dose rate so that a patient is effectively medicated with minimum of untoward side effects. Some modern drugs have a physiological effect at a dose as low as one milligram.

The gradual change to low dose drugs has created analytical problems for the toxicologist. Necessity, however, sparked research into the technology of instrumentation which has provided effective analytical techniques and equipment. Forensic toxicology has always been at the forefront in the application of chemical analysis and that tradition has never been more appropriate than it is today. Thus in the mid 1980s computers, mass spectrometers, capillary gas chromatography, liquid scintillation counters, liquid chromatography with a multiplicity of different detectors and data systems will be found in a forensic toxicology laboratory for the detection, identification and quantification of low levels of drugs in human and animal exhibits. Despite all this sophisticated equipment, problems still arise from time to time to test the skills of the most experienced forensic toxicologists.

GOVERNMENT CHEMICAL LABORATORIES

R. C. GORMAN, DIRECTOR

The overwhelming demands made on the analytical and advisory services of the Government Chemical Laboratories in 1984 and early 1985 principally by other Government Departments highlight, if nothing else, satisfaction at the high standard of work emanating from the Laboratory. These demands, however, have placed considerable stress on the resources of manpower and equipment. This was particularly evident for example, in 1984 when more than 87 000 samples were submitted for examination. This number represents a 27 per cent increase over the previous year, considerably higher than the 8 per cent increase of 1983 and even greater than the previous record increase of 24 per cent in 1982.

The table on page 63, which shows the source and allocation of work in 1984, highlights the wide range of Government Departments or Authorities to whom the GCL gave assistance. Again there was considerable growth in both the Agricultural Chemistry and Water Science laboratories, mainly due to research associated with soil treatment and fertilizer options in the Peel Inlet—Harvey Estuary region aimed at reducing the phosphorus input into the estuary.

Lack of staff increases except in the forensic area again continued to inhibit prompt and efficient handling of the exceptionally large increases in workload, although some temporary assistance was available for a three-month period to assist with the Peel Inlet work. Three new permanent staff were appointed to the Forensic Science Laboratory which has been under great stress for a number of years coping with greatly increased work loads from the police, arising from the increased crime rate. Difficulties were being encountered in preparing reports in time for court

hearings or to enable the police to pursue their criminal investigations. The assistance of the Police Department in drawing this matter to the attention of the Government so that the additional staff were obtained is appreciated.

Future of the Government Chemical Laboratories

A major concern over the last few years has been the uncertainty of the future siting and function of the Laboratories. Following three reviews in three years each of which resolved that there was a need for a centralized Government Chemical Laboratories to exist in its present form, but with increased financial support and accommodation, apprehension was raised yet again with the announcement late in 1984 that another functional review would be instigated. The future of the Laboratories was still unresolved as of this report.

The limited tenure on the current site however was confirmed late in 1984 when a firm decision was made to demolish the existing administration block, store and the staff room to make way for the building of Mineral House II on the vacated site. A new temporary building was erected on the Hay Street frontage which now houses the administration and clerical staff, store and library. The temporary nature of the building was on the basis of a move from the site within five years.

Advice and consultation

Each of the laboratories continues to report increased involvement of senior staff in advisory and consultation work. This important activity is not listed in the statistics, nor easily quantified but nevertheless is a service very much in demand. Advice is given to other Government Departments and also many requests are received from the public. There is a very

large reservoir of knowledge, experience and expertise amongst the staff spread over the range of laboratories. This provides the basis of a public service on many topics including those which relate to consumers.

Undoubtedly one of the strongest features of a complex of laboratories under the one roof and the same administration is the potential for mutual assistance and co-operation amongst the various member laboratories. This is certainly evident in the Government Chemical Laboratories where not only is there a sharing of high cost equipment but even more important is the sharing of expertise. The work of one laboratory commonly overlaps another and the frequent intermingling and close contact of staff from different laboratories leads to a broadening of expertise and knowledge and an enhanced advisory service. It is viewed with concern that any decision on the future of the Laboratories which would lead to disintegration of the complex would lead to a deterioration in the level of advisory and consultation service currently available to Government Departments and also to the public.

Collaboration between the Laboratories is essential to ensure that maximum value is obtained from resources available. The following are just a few recent examples to illustrate the mutual dependence of the laboratories on one another :

- (1) Water Science and Food and Industrial Hygiene Laboratories both contributed to the solving of the mercury pollution problem of Princess Royal Harbour, Albany;
- (2) Food and Industrial Hygiene Laboratory provided assistance to Forensic Science Laboratory where pesticides were involved;

- (3) Forensic Science Laboratory used the expertise of the Materials Science Laboratory in the investigation of polymers;
- (4) Agricultural Chemistry Laboratory and Water Science Laboratory co-operated on the phosphorus environmental problem of the Peel Inlet/Harvey River;
- (5) Mineral Science Laboratory and Forensic Science Laboratory both carried out investigations in connection with the same exhibits taken in relation to cannabis seizures;
- (6) On a number of occasions two or more laboratories collaborated to prepare replies to requests for advice from other Government Departments.

An extension of this aspect of the GCL's activities is the provision of specialized advice to

these committees is becoming increasingly valued by other Departments.

Chemical spills

There has been increased publicity lately in connection with spillages of dangerous and some not so dangerous chemicals. Officers of the GCL have been called to a number of incidents during the year, usually to identify the chemical involved and the action required. The publicity arising from some of these incidents suggests some over-reaction. Whilst every precaution must be taken to protect the public from any danger and whilst it is vitally important that expert advice is given, there have been occasions when representatives from an excessive number of Government authorities have been called to the scene.

is specifically requested. This policy was adopted to reduce the overinvolvement of valuable manpower resources.

An exercise in co-operation

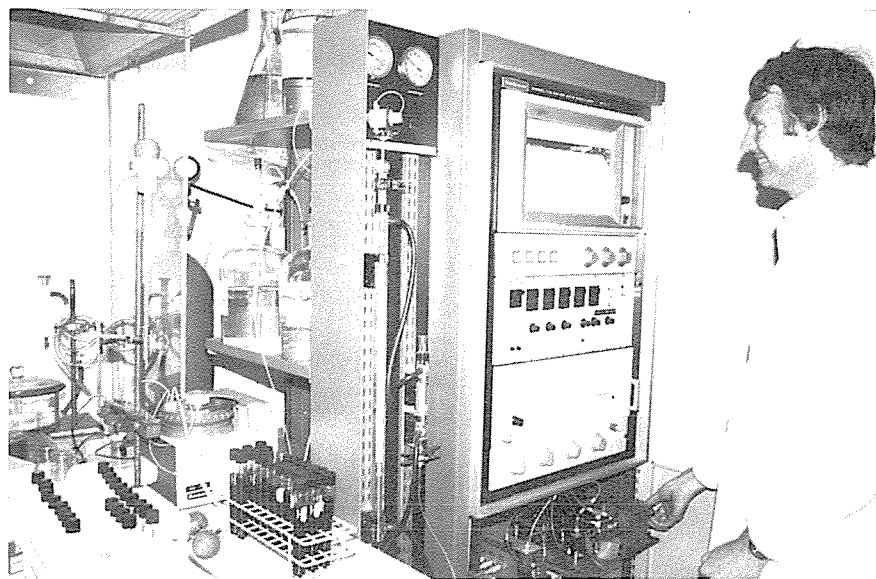
It is pleasing to record the excellent co-operation which can and does exist between Government Departments. Such co-operation was illustrated by the case involving high levels of mercury in fish from Princess Royal Harbour, Albany. The details of the exercise are described later in this report but through the combined efforts of the Departments of Health, Fisheries and Wildlife and Conservation and Environment in collaboration with our Water Science and the Food and Industrial Hygiene Laboratories, the source of the pollution was found, treatment and remedial measures prescribed and within four months of the first detection of high levels of mercury in fish from the area, no additional mercury pollution occurred. The co-operation of these Departments in overcoming this potential public health problem is appreciated.

Agricultural Chemistry Laboratory

Research effort was maintained despite a spectacular increase of 34 per cent in service work supporting agricultural research. High priorities were Peel-Harvey Estuary catchment studies, acidity and structure of wheatbelt soils, urban land pollution, molybdenum status of crops and the chemistry of lupinseed and cereal grains.

Soil structure

Better crop yields have followed applications of gypsum to some heavy, hard setting soils of the wheatbelt. In some districts up to 40 per cent of arable land is comprised of soils of this type. Research centred at the Dryland Research Institute, Merredin aims to define the chemical and physical characteristics of gypsum-responsive soils and to relate these properties to differences in soil



Measuring amino acids in animal feedstuffs

more than 40 technical committees on which various members of the staff are represented. The functions of these committees cover the fields of environment, health, computing, foods, water quality, waste disposal, pesticides, analytical chemistry, effluents, chemical safety, paints, oils, detergents, cleaning products, registration of laboratories and a number of other areas. Advice given by staff on

The Transport Emergency Action Scheme Committee is investigating the best procedures to be followed in these accidents. As chemical advice may be available in the first instance from representatives of the Health Department or the Explosives and Dangerous Goods Division of the Mines Department, both of whom generally attend such spillages, our current policy is to attend only if assistance

structure, permeability to water, clay dispersion and crop yields.

Laboratory investigations tested the relationship between degree of dispersion and the proportions of calcium, magnesium and sodium in the clay complex of a range of soils. A low proportion of calcium can cause high dispersion and consequent poor soil structure. Gypsum dressings should correct this and result in improved crop yields on these soil types. Data obtained did not fit relationships already established for similar soils in Victoria and did not assist in clearly defining problem soils of W.A. Future research will be conducted in collaboration with the Department of Agriculture and the University of W.A.

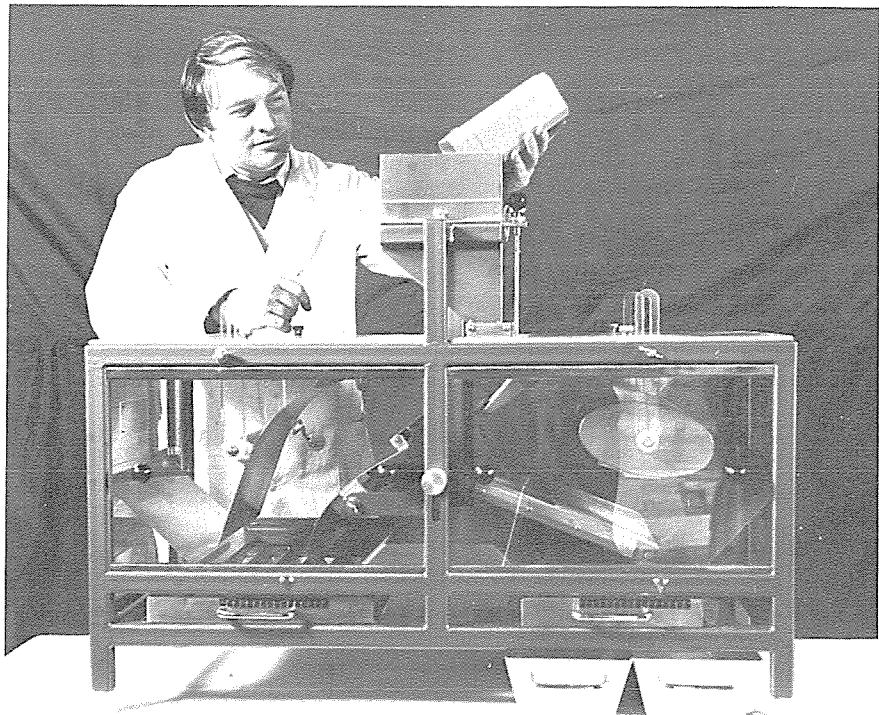
The interest of farmers in the agronomic effects of gypsum stimulated search for gypsum deposits throughout the wheatbelt. As a result, a substantial number of samples were examined for gypsum content. Sodium chloride content was also checked since it can cause damage to soil structure and plants.

Sweet lupinseed

A two-fold increase in production of sweet lupinseed in Western Australia activated renewed interest in the marketing of the seed for human consumption. Potential sales to Japan alone are about 120 000 tonnes per annum. Overseas buyers of stock foods continue to press for information on the composition and food value of this relatively unknown source of high protein food. There is therefore a demand for additional chemical information relating to both human and animal nutrition.

Two reports were issued comparing chemical composition of two successive commercial crops. The data show that differences in growing season had little effect on the average composition of lupinseed produced for export.

A research programme supported by Rural Credits Development Fund was completed. It was successful in developing a method



High tension electrostatic separator

for analysis of alkaloids present in sweet lupinseed at very low levels. It enables the screening and selection of plant breeding material on large numbers of seed samples. Attendance at the 3rd International Lupin Conference in France confirmed that our research is unequalled overseas. A collection of lupin alkaloids is now held as standard reference materials and for supply to overseas researchers.

Local industry was supported by provision of technical information and testing of lupin kernels and seed hulls obtained from trials with dehulling machinery. Novel human foods containing lupinseed were analysed to assist local initiatives.

An information pool was established, covering composition and uses of lupinseed. Two reviews of scientific publications on the topic were prepared as supportive evidence for the acceptance of lupin products as human food.

Molybdenum in plant and animal nutrition

The importance of molybdenum as a trace element in plant and animal nutrition is well known in W.A. Recent research aims to monitor re-

sidual effects of molybdenum fertilizers and to investigate the practicability of diagnosing a molybdenum deficiency situation using chemical analysis of either plants or soils.

For wheat, molybdenum content of grain was a better indication of molybdenum status than concentrations in either whole tops or youngest leaves.

Accurate and precise measurement of low levels of molybdenum using existing methods is very tedious. Priority was given to investigations of more rapid, sensitive and precise procedures for use in W.A. conditions.

Peel-Harvey Estuary studies

Contributions were made to understanding the role of catchment soils in the algae problems of the estuaries. There was evidence of net reductions in the amounts of total and organic phosphorus in the soils enabling prediction of run-down times of phosphorus pools available for leaching into the estuaries.

Organic phosphorus held in peaty sands was shown to be concentrated in the fulvic acid fraction. The rate of release of phos-

phorus for leaching to the estuaries would therefore be dependent upon the rate of breakdown of this fraction.

Soil testing for prediction of farmers' needs for fertilizers to maintain economic production of pastures on the catchment was carried out free of charge in 1984 and 1985.

Engineering Chemistry Laboratory

A feature of the Laboratory is the ability to adapt its mineral beneficiation and processing expertise to a wide variety of applications. The projects undertaken arise from an internal programme, from Government requirements and from industry's requests for confidential testwork.

Electrostatic separation

Several years ago the technique of high tension electrostatic separation was applied to the beneficiation of coastal lime sand (calcium carbonate) by removing the contaminant silica. At ambient temperature both silica and limestone are non-conducting and efficient separation is impractical. When the sand is heated to 180-220°C, the silica becomes conductive and can be separated from the grains of calcium carbonate (limestone). In 1984/85 a combination of crushing, sizing and high tension electrostatic separation was successfully applied to beneficiate a lightly agglomerated limesand. The concept appears to be commercially practicable.

Pelletizing

The disc pelletizer was put to good use on several projects during the year. One of these related to the pelletizing of fine lime kiln dust and others were connected with the pelletizing of high sulphur content fertilizers for use in the areas around the Peel-Harvey Estuary. The use of such fertilizers is expected to reduce the amount of phosphorus leached into the estuary and hence reduce the incidence of algal bloom and consequent

water pollution. Another pelletizing project was to incorporate the trace element molybdenum (as sodium molybdate) in a limestone granule for use on acid soils. The pelletizing equipment was fabricated on-site. It is a variable speed disc pelletizer with interchangeable 1 m and 0.45 m discs on an adjustable tilt frame incorporating appropriate water sprays and scrapers.

Diatomite

Through its own innovative work complemented by work done on contract basis for companies, a significant level of expertise has been attained in evaluating diatomite for use as a filter aid. The processing involves physical beneficiation of the ore by pneumatic classification and modification of the surface of the beneficiated diatomite by flux calcination. During 1984/85 work was done for a West Australian company on diatomite from another State. This diatomite was composed almost exclusively of *Melosira* diatoms, mostly *M. granulata*, a species which is rare in Western Australian diatomites.

Reject carbon from carbon-in-pulp

In gold processing, carbon is rejected from the carbon-in-pulp circuit when its capacity to adsorb gold is no longer restored by the re-activation stage of the process. The gold content is 90-150 grams per tonne depending on the efficiency of elution of gold. The development of a means of recovering the gold and a simple agglomeration-incineration-cyanidation method is currently being investigated. The value of the contained gold is insufficient to support significant capital and operating costs.

Food and Industrial Hygiene Laboratory

Public awareness of the potential hazards of chemicals has increased the number of enquiries received regarding the dangers of specific chemicals. This awareness has contributed not only to the increased

volume of work in the industrial hygiene field but also increases in most other aspects of the laboratory's work.

Mercury in Albany harbour

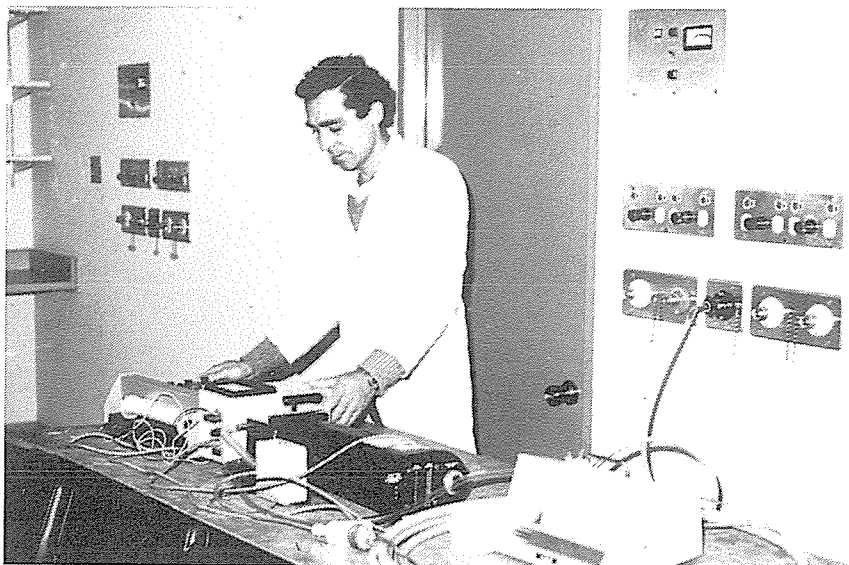
A survey of fish sold in fish and chip shops throughout the State, showed that samples of cobbler and flathead from Albany had mercury levels in excess of 0.5 mg/kg, the level permitted by the Food and Drug Regulations. Subsequent samples of fish were caught in Princess Royal Harbour, Oyster Harbour, Frenchman's Bay and several other fishing locations on the south coast. When examined for mercury, only certain species of fish caught at the western end of Princess Royal Harbour had levels above 0.5 mg/kg.

The source of the mercury was traced to the evolution of mercury along with hydrogen fluoride in the manufacture of superphosphate, by treating rock phosphate with sulphuric acid. The levels of mercury in the rock phosphate are very low ranging from only 0.2-0.6 mg/kg, but a large proportion of this is evolved with the hydrogen fluoride. Scrubber treatment of the gaseous effluent collected both the fluoride and the mercury, which was being discharged into the harbour and showed up in elevated levels of mercury in sediments in the western end of the harbour. Investigation by the Water Science Laboratory showed that subsequent treatment of the scrubber effluent to reduce the pH and the fluoride also removed the mercury in the effluent to acceptable levels. However the company was required not to discharge any effluent treated or not into the harbour but to dispose of it on land or by reuse in the process.

There is an on-going monitoring of fish and sediment in the harbour to see how long the residual mercury in the sediment will cause increased mercury uptake by fish. Dredging to remove the affected sediment would be a very expensive exercise and could cause further environmental problems.

Pesticides

The banning of the use of ethylene dibromide (EDB) for the fumigation of fruit has meant that fruit imports into Western Australia from the Eastern States are now dipped in dimethoate instead of being fumigated with EDB. A range of fruit and vegetable samples have been examined to ensure the necessary treatment was being carried out.



Monitoring purity of hospital gas line

The carelessness or stupidity of using second hand containers for food or feedstuffs was illustrated in two cases where wheat for stock was stored in sacks labelled as having been used for pesticide formulations. In both instances the label indicated that the sack had been used for aldrin. Chemical examination of the wheat showed that the concentration of aldrin was well above that recommended for stock feed. In addition the fabric of the bags was shown to be excessively contaminated.

Factory inspections

MOCA or 4,4'-methylene bis (2-chloroaniline), a curing agent used in the manufacture of industrial plastics, is a suspect carcinogen. Exposure to MOCA is best monitored by examination of workers urine, taken as soon as possible after the exposure. MOCA can find its way into the body by inhalation of the dust or by absorption

through the skin. Workers at one factory frequently had high MOCA levels in their urine. It appears in this instance that the dirty nature of the factory led to absorption of MOCA through the skin or by dust inhalation. The Department of Industrial Affairs ordered that the factory be cleaned up as a result of our investigation. This resulted in a decrease in the levels of MOCA found in the workers' urine.

Forensic Science Laboratory

The demands for analytical, advisory and support services, mainly for the police, increased markedly in the period under review. The biggest impact was felt in the areas of illicit drug identification, the analysis of blood and urine samples in connection with driving offences as well as an almost three-fold increase in the work in relation to drug offences in the penal establishments.

Alcohol, drugs and driving

Since March 1983 when legislation was enacted to enable blood and urine samples to be taken from suspected drug affected drivers, there has been a steady flow of cases received. The drugs most commonly encountered are the benzodiazepines of which Serepax is the most common, cannabis and morphine (derived from heroin).

The following points of interest have emerged :

- (1) in 38 per cent of the cases more than one drug was detected;
- (2) carboxy-THC (the major metabolite of cannabis) was detected in 58 per cent of the cases;
- (3) benzodiazepines were detected in 38 per cent of all cases;
- (4) morphine/codeine occurred in 17 per cent of all cases but not once alone which is consistent with heroin addicts being multi- drug users.

Blood samples from fatal traffic accident victims showed that 39 per cent of all motor vehicle drivers had alcohol levels in excess of 0.08 per cent and 25 per cent had levels greater than 0.15 per cent.

Drugs

Judging by the continued escalation in the service given to the Drug Squad the drug problem in the community continues unabated, particularly with respect to cannabis and heroin. The detection of α -benzylphenethylamine, a manufacturing impurity, indicated that four amphetamine cases involved illicit manufacture of the drug. The non-addictive drug ephedrine was seen more frequently, suggesting possibly that drug pedlars may be substituting it in place of amphetamine to defraud drug abusers. A case of unusual interest consisted of the seizure of 3 kg of cannabis plant material which was found to contain oxazepam. A solution containing 290 mg of oxazepam per litre accompanied the cannabis and it was believed that this was used to spray the cannabis plant material.

Toxicology

A significant trend in recent years has been towards multi-drug deaths. It is not uncommon to find four or more drugs present in a fatal overdose. This trend is disturbing not only in terms of the analytical problems it produces but

also because it adds greatly to the demands on the toxicologists' time.

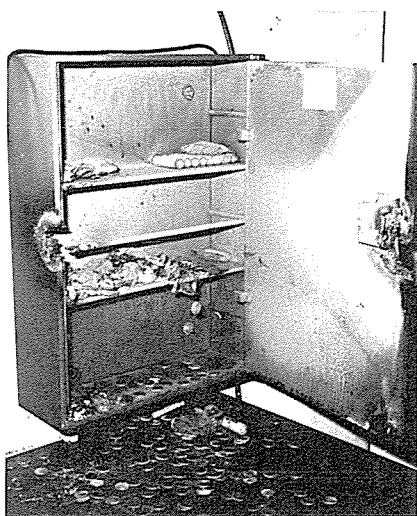
Carbon monoxide continues to be the most frequent means of suicide but it is disturbing that heroin is now establishing itself permanently amongst the drugs causing death. In eight cases received, blood or liver levels of morphine (from heroin) were sufficiently high to have been the cause of death. In the course of toxicological examinations a total of 82 drugs or poisons were encountered, not all of which necessarily contributed to the cause of death.

Doping control in sport

Dexamethasone is a powerful corticosteroid used in racing animals primarily as an anti-inflammatory drug. Its use in horse and greyhound racing was revealed following the implementation of a radioimmunoassay procedure for the detection of the drug. This is the only satisfactory screening method which will allow the detection of low concentrations of this drug. Apart from dexamethasone, other drugs detected were caffeine, frusemide, morphine, oxyphenbutazone, phenylbutazone, pholcodine and trimethoprim.

Criminal investigation

The scientific assistance given to the police in connection with



Scanning electron microscopy characterizes weld spatter found on clothing of safe breakers and stolen items

criminal investigations continues to expand. The most common type of exhibit currently handled is fire debris in connection with suspected arson cases. In about one-third of such cases fire accelerants were detected. Blood samples submitted from alleged rape victims are analysed for alcohol. Of the samples received it is of interest to note that 40 per cent of the victims had blood alcohol levels exceeding 0.1 per cent whilst 57 per cent had consumed some alcoholic liquor.

Kalgoorlie Metallurgical Laboratory

The past 18 months has seen a sustained upswing in mining and mineral processing activity on the Goldfields. This factor combined with an active promotion of the laboratory's reference function has resulted in the number of samples submitted rising by 67 per cent in the calendar year 1984. This trend is continuing into 1985.

Metallurgical testwork

As was the case in 1983, the metallurgical testwork was almost solely concerned with the recovery of gold, with many clients seeking to pursue the cheaper heap leaching and vat leaching techniques. Cyanidation and amalgamation comprised the bulk of the bench scale testwork requested. A one tonne per hour Harris (or Harriwal) gravity concentrator was successfully tested for a client intending to market the machine in W.A. Two substantial pilot scale gravity separation projects were undertaken in 1985, one on fresh underground ore and the other on alluvial ore. Full credit is due to the metallurgical staff who persevered with the testwork on the larger of the two ore parcels under difficult conditions.

Umpire testwork

The laboratory continued to fulfil an umpire role by providing the standard testwork and results for a number of custom milling agreements. Demand for this service is

likely to decrease in future due to changes within the companies currently requesting the work. The start of 1985 also saw the end of monthly testing of refractory and free milling ores for North Kalgurli.

Assaying

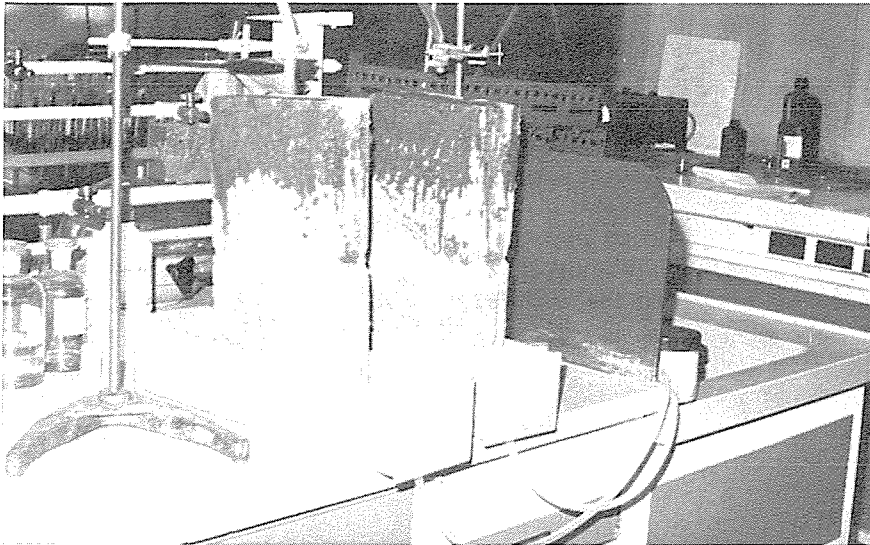
Requests for bullion assaying persisted at the previous high level and may increase further. The installation of a new electric cupellation furnace should enhance the accuracy of this work. The furnace, designed by the Sheffield Mint brings the laboratory into line with the major mints in the U.K. and also the Perth Mint.

Materials Science Laboratory

Activities continued to span a wide range of interests including quality assessment and testing of chemical and related goods purchased for use by Government Departments, and technical evaluation of industrial processes. Major clients included the Building Management Authority, State Tender Board and Consumer Affairs Department.

Building materials and paints

A range of samples of paint and paint flakes were examined, most for testing for compliance with specifications in cases of dispute. One interesting paint failure was examined for Department of Consumer Affairs. A number of cases had occurred over several years with paint peeling from plaster/glass ceilings, particularly over the joints between sheets. The problem was traced to sodium sulphate efflorescence occurring at the plaster/paint interface due to extraction of the soluble sodium sulphate from the plaster by water. The problem can be overcome by addition of small amounts of calcium chloride to the plaster mix during processing. Proper surface preparation by the painter, which can include wiping the plaster surface with a rag moistened in calcium chloride solution in suspect cases, can also prevent the problem.



Laboratory simulation of the development of efflorescence on concrete masonry



Efflorescence on concrete masonry caused by the movement of lime from the mortar joining blocks

Investigational

A problem regarding the cleaning of Rottnest Island stonework on the Harvest Terrace face of Parliament House was investigated. It was discovered that acidic cleaning methods normally used were damaging the stone. A cleaning technique involving dry brushing and an alkaline bleach, followed by an application of ethyl silicate as a sealing and case hardening agent was developed.

Mineral Science Laboratory

Some 15 departments utilized the analytical and consulting services of this Laboratory for the analysis and characterization of rocks, minerals, building materials, dusts and

other related materials. The Laboratory's expertise continued to contribute to investigations and problem solving in exploration, mining, mineral processing, occupational health, forensic investigations, consumer protection and building and construction programmes.

Examination of mineral ores

The Laboratories have, for many years, collaborated with chemists from industry and other interstate and Commonwealth Government departments in the Standards Association of Australia committees responsible for the preparation of methods for the sampling and chemical analysis of iron ores, min-

eral sands and more recently aluminium ores.

The development of definitive analytical procedures is essential for the orderly marketing of mineral resources and is thus critical to the exploitation of the State's mineral resources. These 'standard' methods are essential when disputes arise between the buyer and seller. The Laboratory expects to continue to play a major role in these programmes.

Mineral collection

The Laboratories are responsible for the most comprehensive mineral collection of Western Australian minerals in this State. This indexed collection contains nearly 12 000 specimens including 103 specimens added in 1984. Over 10 000 of these specimens are from Western Australia.

Recent donations include lithium, tin and beryl minerals from the Greenbushes Tin Ltd, gold and mercury telluride minerals from North Kalgurli Mines Ltd, nickel ores from Western Mining Corporation and kimberlite diamond 'indicator' minerals from the Ashton Exploration joint venture.

A mineralogist from the Laboratory has recently made an excursion to update the collection holdings for the Moora 1:250 000 sheet by visiting recently drilled and explored areas to collect mineral specimens. This is part of a

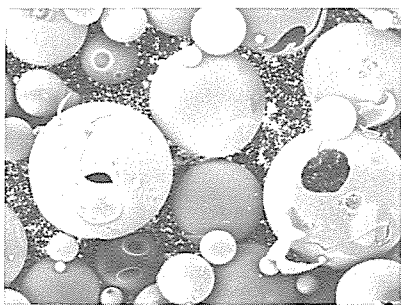


Some of the 12 000 mineral specimens in the mineral collection

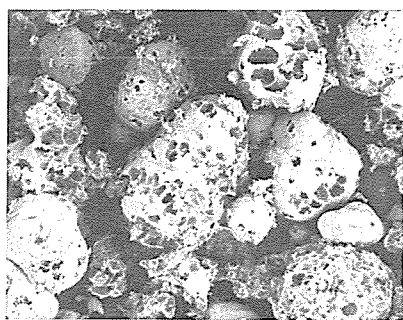
programme to maintain an up-to-date collection by systematically covering Western Australia and by visiting working mines.

Forensic mineralogy

Mineralogy continues to be a valuable tool for assisting police in their investigations. Mineralogical procedures have been of value in some eight forensic cases investigated which involved 75 exhibits. In one more recent case mineralogical information gathered from soil from a vehicle identified a general area where stolen goods were later found.



The type of quality of (a) hollow glass microspheres (x 49) and (b) honeycomb glass particles (x 12) used in some explosives are monitored



The potential of the technique has been established for Perth sands where preliminary mineralogical studies in this Laboratory have established feldspar and heavy mineral differences which allow classification of the sand according to the source location.

Dusts

Nuisance dust and dust that is potentially a health hazard are regularly analysed and characterized. In 1984 over 2 700 dust samples were received with approximately 1 200 each from the Health Department and from the State Mining Engineer.

Chemical analysis and/or mineralogical examination of the dust samples were used to establish the likely source of nuisance dusts and to identify the composition and amount of fibres and materials in air which may represent a health hazard. In some cases dust which was claimed to come from cement, fertilizer or insecticide manufacturers, from mineral processing plants, from sand blasting, joinery works or oil or coal fired burners did in part originate from these local industries. However in other cases they were indigenous to the local area or were not related to any industry and in one case spores and another pollen were the cause of the offending problem. Samples were analysed and characterized from a wide range of work areas including offices where asbestos insulation materials were being used, mining operations including a comprehensive survey of nickel mines, fire assay laboratories, monumental works and fibreglass manufacturers. Instances were found where levels were above the recommended limits.

Water Science Laboratory

The total samples received in 1984 was 16 865, which represents an approximate 30 per cent increase over that for 1983, this level is being maintained in 1985. Without any staff increases over the past six years, sample receivals have been increasing at an average rate of more than 10 per cent per annum. Despite the normal pressures for investigational work, some details of which are referred to below, the backlog of unanalysed samples has rarely represented more than one month of receivals. Such levels of increasing demands on our services cannot continue as any slack between manual and computerized operations has now been taken up.

Water supply treatment

Mundaring - Goldfields water supply - chloramination. After examining aspects associated with the longevity of various types of

chlorine residuals, the lethality of these residuals in relation to bacteria and amoeba, the resultant chemical and organoleptic properties of the different treatments and the costs associated with the changeover, a recommendation was made for the replacement of the existing comparatively ineffective multistage chlorination treatment to a single chloramination treatment at the head works at Mundaring Weir.

This treatment is expected to be operational before the summer of 1985-6.

Moora - water treatment. Following a recommendation based on jar tests and laboratory scale sand filters, the treatment plant at Moora needed some fine tuning for optimizing the chemical treatment. Subsequent to this there were still problems with the quality of the product water from the sand filters and the length of the filter runs. Investigations of various sand sizes in both laboratory and pilot plant scales led to some modification of backwash procedures and alteration of sand sizes. The product water is now of an acceptable quality. Although the filter runs have been lengthened they are still short of that designed. Further work is continuing to improve this.

Australind - water treatment. The performance of the new upflow clarifier/sand filtration plant at Australind fell slightly short of the maximum upflow rate of 3 metres per hour predicted from jar tests. The use of polyelectrolyte aids, so successful in jar tests, have to date given marginally better plant performance, but only after resolution of a number of adverse side effects that had to be overcome. Because of the lengthy procedures associated with optimizing the point and manner of entry for polyelectrolyte coagulant aid, initial investigational endeavour was centred on optimizing the chemical treatment without coagulant aid. Significant improvement has been effected in terms of both product water quality and plant output and

it is confidently predicted that design output rates will be achieved with a margin of safety.

General. Other town water supply problems that warranted additional investigation included leaking clay dams at Wandering, odour and physical properties of the supplies at Binningup and Myalup, the prevention of excessive scale formation at the Hopetoun supply, colour removal at Nannup, turbidity removal from the Harding River dam, colour removal from the proposed Harris River dam at Collie and taste problems at Greenbushes.

Environmental

Regular monitoring continued with respect to the Rights in Water and Irrigation Act, effluent disposal licensing, S.C.M. (Laporte) effluent disposal to the Leschenault peninsula, the Waterways Commission estuarine water bodies at Swan/Canning, Peel/Harvey and Leschenault and the phosphorus input via drains to the Harvey River. Also in addition to the intensive monitoring for the Metropolitan Water Authority for shallow bores for current or future production new monitoring areas of interest not associated with water production for Perth drinking supply included Applecross, Coogee, Cottesloe, Munster and Spearwood.

Investigational

The main investigational work was associated with the removal of mercury from the phosphate fertilizer plant effluent at Albany, which had contaminated Princess Royal Harbour to the extent that some fish species had excessive mercury levels. A successful treatment based on effluent recycling and lime treatment was recommended. This investigational work is at an advanced stage for publication in a scientific journal.

Staff

1984-85 was notable for the number of long serving officers who retired.

To the surprise of those to whom he had declared he would work to 75 if he were allowed, and who knew of his great capacity for work, Mr Ron Gorman announced his retirement as of the end of June 1985.

Ron Gorman joined the staff of the Agriculture and Water Division as it was in 1946, taking a particular interest in trace element nutrition, which he tackled through his application of spectrographic and spectrophotometric methods. Always having a flare for adaptation and 'making do' he helped build an early atomic absorption spectrometer for determining copper and zinc and a makeshift

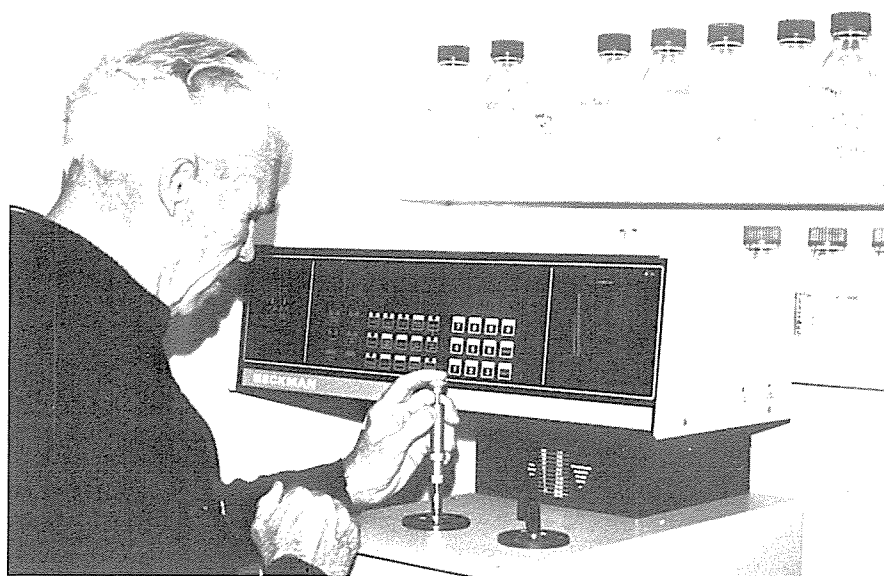
fluorimeter for selenium out of bits and pieces. He became Chief of the Division in 1956, Deputy Director in 1965 and Director of the Laboratories in 1973.

Mr Gorman served actively on Royal Australian Chemical Institute Committees over many years, including a term as President of the W.A. Branch in 1972 and continued to assess professional qualifications up to his retirement. He was a founding member of the Australasian Corrosion Association in W.A. and also served that body as President and conference organization chairman.

Mr Gorman contributed enthusiastically to the preservation of the highest standards of quality control by his involvement with National Association of Testing Authorities on which he continues to serve as State representative.

Mr Don Burns was the first of three Chiefs of Laboratory to retire in this period, early in 1984. Mr Burns completed a working life service to the G.C.L. with nine years as Chief of the Mineral Science Laboratory. He joined the staff in 1945 and over the years contributed much to the professional development of his field of mineral chemistry. He always had the interests of his professional officers at heart and was for a number of years the Professional Officers' representative on the Promotion Appeals Board.

Next to retire was Mr Jack Jago, Chief of Agricultural Chemistry Laboratory in June 1985. He had first joined the G.C.L. in 1950 after war service and an early experience in fertilizer manufacture. In 1955 he moved to the position of Government Chemist in Zanzibar with an even closer association with the applications of chemistry in agriculture. His return to W.A. in 1961 saw another brief stay in the GCL working in the Food and Drug Division before moving to the Department of Agriculture in charge of radio isotope work. He returned to the GCL in 1965 to be in charge of trace element chemis-



Organic carbon analysis of water sample

try, became Assistant Chief in 1969 and Chief in 1974. Mr Jago always exemplified his belief that chemist and agricultural scientist needed to work in close harmony.

Mr Noel Platell's retirement as Chief of Water Science Laboratory was also in June. Mr Platell's early experience was at the Wundowie charcoal iron industry. He joined the then Fuel Technology Division in 1950, and transferred to Agriculture and Water Supply in 1958. Here his interests developed into water treatment and the solution of corrosion problems. Mr Platell, over the years, continued this into work on waste disposal and estuarine pollution. In 1965 he became Second-in-Charge and when the Division was split in 1969 became Chief of Waters, his primary interest.

Mr Platell served both the Water and Waste Water Association and the Australasian Corrosion Association as President and contributed often as a speaker but even more as an enthusiast in all their activities. It was said of Noel Platell on his retirement that he epitomized Kelvin's description of a scientist in that he rapidly saw every problem as measurable and once measured, capable of solution.

Mr Bob Lindsey also retired after 35 years of service at the GCL mainly in the Mineral Science Laboratory. Another senior position became vacant late in 1984 with the resignation of Dr Mike Wort, the Chief of the Engineering Chemistry Laboratory who left to return to private industry after a brief tenure of two years.

Dr John Hosking, a Senior Lecturer in inorganic chemistry at WAIT, who has pursued an interest in mineral processing was appointed to the position of Chief of the Mineral Science Laboratory in July.

Equipment

Approval arising from the 1983-4 budget was given to purchase an ARL 3520 Sequential Inductively

Coupled Plasma Emission Spectro photometer at a cost of \$130 000, the most expensive item of modern equipment ever purchased by the Laboratories. This item is about to be commissioned and is expected to make a major contribution to the Laboratories' performance and efficiency. Only two other major items of equipment were approved and are now in operation. These were a Varian AA-875 Atomic Absorption Spectrophotometer and a Shimadzu UV-visible recording spectrophotometer.

The severe restrictions of the 1984-5 budget saw only two major items approved and these only after considerable negotiation. These were a graphite tube accessory for an atomic absorption spectrophotometer and a high performance liquid chromatograph.

To achieve the objectives of the Government Chemical Laboratories and to keep up with the increasing work loads modern, well functioning equipment is all important, particularly automated equipment which can reduce the use of manpower. In line with this is seen the need for the financial funding to phase out old equipment which cannot meet with today's demands and is costly to repair.

Publications and lectures

The following publications and lectures were presented in 1984 :

Brennan, L.J., Field, R.V., George, T.J. and Marshall, R.E., 1984, Chemical Beneficiation of Zircon Concentrates in Western Australia, *International Journal of Mineral Processing*, 13, p. 251.

Carnell, W.J.F., 1984, Investigation of Soil Wetting Agents, GCL Report of Investigations No. 28.

Challinor, J.M., Pyrolysis Capillary Gas Chromatographic Examination of Alkyd Paints, presented at a Meeting of the International Association of Forensic Sciences, Oxford, UK, 1984.

Challinor, J.M., 1984, Pyrolysis Capillary Gas Chromatography of Alkyd Paints in Forensic Science, GCL Report of Investigations No. 29.

Clarke, R.M., Asbestos Fibres and Health - Inhalation and Ingestion, presented at Australian Waste Water Association Symposium, Perth, 1984.

Coates, P., 1985, Control of Release of Phosphorus from Sediments of Peel-Harvey Estuarine System, GCL Report of Investigations No. 30.

Codling, B.J., Application of Multiuser Computer to a Continuous Flow Analyser, presented at Asian Chemical Conference, Singapore, 1985.

Cunningham, D., 1984, Algal Blooms in the Swan River, GCL Report of Investigations No. 27.

Engineering Chemistry Laboratory 1984, Booklet About the Activities of ECL.

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SOURCE AND ALLOCATION OF WORK 1984

SOURCE	Laboratory								
	Agricultural Chemistry	Engineering Chemistry	Food and Industrial Hygiene	Forensic Science	Kalgoorlie Metallurgical	Materials Science	Mineral Science	Water Science	Total
DEPARTMENT OR AUTHORITY									
Agriculture Department	44 988	10	2 016	5		4	41	224	47 288
Building Management Authority			3			8	4	5	20
Conservation & Environment Department	1 810		134				4	4 552	6 500
Consumer Affairs Department			2			38		18	58
Education Department	25		3				8		36
Fisheries & Wildlife Department	1		1 365				1	342	1 709
Geological Survey	11	1	1		123		1 047	683	1 866
Government Chemical Laboratories	39	59	27	147	16	19	181	26	514
Health Department	4		3 188	4		12	1 417	200	4 825
Hospitals			36			1			37
Industrial Affairs Department			21			1	40	6	68
Leschenault Inlet Management Authority			6					72	78
Main Roads Department						15	39	25	79
Metropolitan Regional Planning Authority								31	31
Metropolitan Water Authority		20	334			5	1	2 229	2 589
Mines Department		18	365		4		1 324	3	1 714
National Parks Authority			1					32	33
Peel Inlet Management Authority								74	74
Police Department	2		4	5 068	19		75		5 168
Prisons Department				330				5	335
Public Works Department			145	2		52	73	7 375	7 647
State Energy Commission			9	6		1	59		75
State Housing Commission		5	2			2	3		12
Swan River Management Authority								344	344
Tender Board						26			26
Waterways Commission			26					6	32
Other Authorities (17)			9	12		23	8	2	54
PUBLIC									
Free					15		39		54
Pay	328	273	150	57	1 982	33	492	611	3 926
W.A. Greyhound Racing Association				441					441
W.A. Trotting Association				710					710
W.A. Turf Club				1 455					1 455
TOTAL	47 208	386	7 847	8 237	2 159	240	4 856	16 865	87 798

BALDIVIS EXPLOSIVES RESERVE

The Woodman Point Explosives Reserve, of some 121 hectares fronting Cockburn Sound, has been used since 1904 for the receipt, storage and distribution of explosives needed by the mining and construction industries of Western Australia.

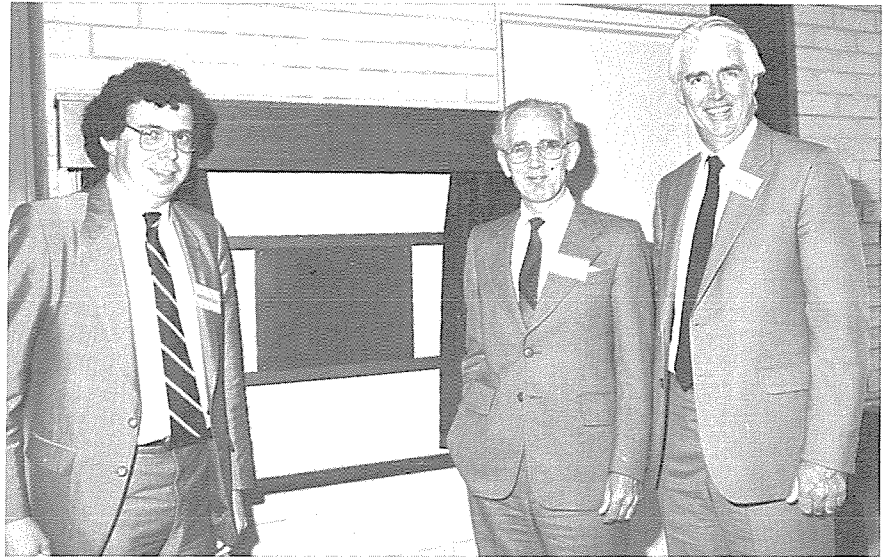
By around 1970 it was apparent that the encroaching recreational facilities of Coogee Beach to the north and the increasing use of Cockburn Road to the east would soon make the reserve untenable. The proposed development of the adjacent quarantine station for public recreational facilities further aggravated the situation and a new site was sought for relocation of the Explosives Reserve facilities.

An inter-Departmental study group, formed to investigate and recommend a new reserve area, recommended in February 1977 that State Forest No. 70, south of Stakehill Road, Baldivis, would meet all the relevant criteria. In 1979 Cabinet approved the establishment of a new reserve at Baldivis.

In October 1983 Cabinet announced that the operations at the Woodman Point Explosives Reserve would be relocated to the new site at Baldivis within 12 months.

The new explosives reserve comprises an area of approximately 80 hectares and is centrally located within a large reserve of 470 hectares. The latter is used for forestry purposes as well as being an explosives safety zone. With the whole area being a pine plantation the proliferation of trees provide a natural blast barrier for explosives magazines and obviated the need for mounding.

The removal of pine trees was carefully controlled with only the minimum taken to enable the construction of roads, firebreaks, fences and buildings. Indeed, a

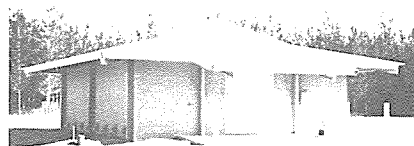


The Hon. Minister for Minerals and Energy, Mr Parker, officially opens the Baldivis Explosives Reserve (Mr H. Douglas, middle, Dr D. Kelly, right)

grove of tuart trees located in the centre of the reserve has been retained.

A suitable water supply was essential to cater for domestic, manufacturing and fire fighting requirements. As scheme water was not available, a bore was put down which feeds into a large capacity holding tank.

To accommodate the storage needs of the public, the Department of Mines has had three magazines constructed with a total holding capacity of 110 tonnes. These magazines were built to Australian Standards specifications and such standards have been imposed on the various explosives manufacturers who have erected their own magazines and manufacturing plant at the reserve.



A new magazine at Baldivis

Facilities have also been made available for the testing and destruction of explosives.

Security of the reserve is provided by Departmental watching staff in the same manner as was done at Woodman Point. However, their 24 hour a day patrols of the area have been enhanced by the installation of a sophisticated electronic security system.

Residential accommodation for security staff has been provided at the perimeter of the safety zone.

Western Australia now has the most modern explosives reserve in Australia and comparable to any other similar facility anywhere in the world. Although the transition from Woodman Point to Baldivis took some 14 years to eventuate, the end result has been worthwhile and is a credit to the State.

More tangible benefits include proposals to construct three factories for explosives manufacturing in addition to the manufacturing operations transferred from Woodman Point.

The Baldivis Explosives Reserve was officially opened by the Hon. David Parker, M.L.A., Minister for Minerals and Energy on 16 November 1984.

EXPLOSIVES AND DANGEROUS GOODS

H. DOUGLAS, DIRECTOR

The Division made several great advances in the development of its operations during 1984; they were in widely different areas and each was very important in its own way.

The Dangerous Goods (Road Transport) Regulations 1983 became fully operational on 1 March and subsequently three accidents occurred in quick succession, each of which generated a significant amount of publicity. The accidents rigorously tested the Inspectorate and the capabilities of the State Road Transport Emergency Assistance Scheme.

Following the promulgation of the regulations, inspectors prepared numerous lectures, guidelines, news articles and advertisements to publicize them.

A significant amount of effort was also expended reviewing and classifying all the pesticides registered in Western Australia. The final steps were taken to computerize the Division's licensing system for flammable liquids, and all flammable liquids licence renewals are now prepared automatically from the licensing database. Significant progress has been made towards automating the explosives and dangerous goods licensing system.

Negotiations continued through the year with ICI Australia Operations Pty Ltd on the development of the Kalgoorlie Explosives Reserve. Several new magazines have been constructed, and the commissioning of a new manufacturing plant is imminent. The Department's involvement in the development culminated in May and June with the appointment of an Officer in Charge of the reserve and an assistant, to supervise all manufacturing, storage and transport operations at the reserve.

Sparklers, originally among the fireworks prohibited from general sale to the public in 1966, had the ban on their sale lifted in July

1984 for a trial period of 12 months. During the trial period numerous reports of unsafe practices were received which included sparklers being thrown onto buildings and shop awnings, and into cars and crowds of people. Several fires resulted, mainly in the Perth central business district during the Christmas and New Year period. Consequently, in June 1985, at the request of the police, fire brigade and Perth City Council, steps were taken to reintroduce the ban and this should take effect in December 1985.

In January 1985, at the invitation of the Asahi Chemical Company, the Chief Inspector attended at Oita, Kagoshima Island, Japan to witness tests on detonators which the company intended to import into Western Australia classed as 1.4B explosives (explosives which present no significant hazard). The tests demonstrated that the detonators, packed as intended for import into Australia, were 1.1B (mass explosive) and they were subsequently authorized as such.

Operations

General

Following the introduction of the Dangerous Goods (Road Trans-

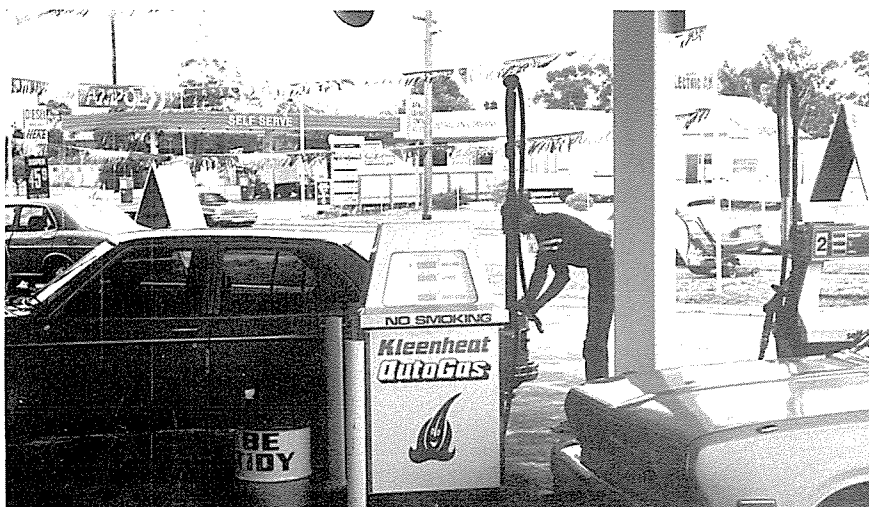
port) Regulations, 1983, inspectors' activities largely centred on the licensing of vehicles and the approval of bulk containers used for the conveyance of dangerous goods. All parts of the state were visited and vehicles and bulk containers were assessed.

By mid 1984 emphasis reverted to the more traditional Divisional activities such as inspections under the Explosives Regulations and the Flammable Liquids Regulations, and this has continued to mid 1985.

Details of inspections carried out during 1984-85 are contained in the table overleaf.

Committee activities

Australian Code. The active participation of the Director in the deliberations of the Australian Advisory Committee for the Transport of Dangerous Goods and its associated sub-committees has ensured that the Western Australian regulations remain consistent with the requirements of the Australian Code for the Transport of Dangerous Goods by Road and Rail. This activity minimizes the confusion and expense incurred by the transport industry when conveying dangerous goods across state boundaries.



Inspectors worked closely with industry to develop safe conditions for self-service of LPG

Summary of Premises, Vehicles and Containers Inspected

	1984	1985 (to June 30)
Explosives		
Premises licensed to store	116	10
Licensed magazines	307	69
Premises licensed to sell	52	16
Premises licensed to manufacture a blasting agent	23	4
Shotfirer's permits	118	17
Miscellaneous, destruction, etc.	238	125
Total:	854	241
Flammable liquids		
Premises licensed to store	4 944	1 846
LP gas on licensed premises	29	10
Field inspection advice on above	213	64
Total:	5 186	1 920
Dangerous goods transportation		
Tank pressure tests	72	61
Packages approved	41	1
Bulk containers	1 209	606
Flammable liquid vehicles	1 364	799
LP gas vehicles	36	25
Explosives vehicles	58	29
Miscellaneous dangerous goods vehicles	204	98
Miscellaneous advice and other field duties	318	127
Total:	3 302	1 746
GRAND TOTAL:	9 342	3 907

Australian Standards. The Division's participation in the drafting of various Australian Standards is comparable with its work on the Australian Code for the Transport of Dangerous Goods by Road and Rail. Neither has any intrinsic legal authority, they become legally binding only when referred to in, or incorporated into, legislation.

Legislation under the Explosives and Dangerous Goods Act has historically made reference to Australian Standards wherever practicable as a means of achieving uniformity with practices in other Australian states, while at the same time retaining our legislative autonomy.

Participation in the drafting of an Australian Standard necessitates significant expenditure by the Division, both in time and money, and it is necessary to examine critically the nature of any proposed standard and its relevance to Western Australia before making a commitment to participate in the drafting committee.

The Division was active on the following drafting committees during 1984-85:

ME/15. LP Gas; reviewed the conditions for the storage and handling of LP gas;

ME/17. Flammable and Combustible Liquids; reviewed the storage, operations, and tank construction requirements for flammable and combustible liquids. It has recently been reviewing the designs for fibre-reinforced plastic tanks for flammable liquids;

AU/17. Tanker Vehicles; completed its work on codes for tankers for the conveyance of flammable liquids and for the conveyance of compressed liquefied gases. Drafts of codes for the conveyance of toxic and corrosive cargoes are now in an advanced stage.

Other standards or committees which the Division reviewed during the year, without actively participating on the drafting committee are:

AS1678, Emergency Procedure

Guides for the Transport of Dangerous Goods;
AS2508, Safe Storage and Handling of Dangerous Goods;
DR85056, Portable Plastics and Metal Fuel Containers for Flammable Liquids;
CE/5 Committee which reviews the storage, handling and conveyance of explosives;
ME/26 Committee which reviews the standard of construction of industrial lift trucks intended for use in hazardous locations.

The time and effort saved by the Division by its use of Australian Standards is very great and may be seen as a major return on our investment of resources in their preparation.

Legislation

In March 1984 the Explosives and Dangerous Goods (Third Schedule) Amendment Order 1984 was gazetted. This amendment brought the definition of Class 3 dangerous goods into line with the definition in the Australian Code.

The Explosives and Dangerous Goods Amendment Act 1984 was promulgated in November 1984 to enable regulations to be enacted to introduce driver training and licensing provisions into the Dangerous Goods (Road Transport) Regulations. At the same time an averment clause was introduced into the Act and provision was made to empower the Chief Inspector to exempt persons or things from the provisions of the regulations.

Numerous amendments were made to the List of Authorized Explosives, many of which related to new explosives products approved for use in Western Australia. Other amendments included the authorization of individual formulations of particular types of explosives previously approved under an authorized generic name.

Amendments were made to the Explosives Regulations to adjust some of the fees prescribed in the Second Schedule of the regulations.



Unsafe practices in the handling and transport of dangerous goods may result in costly incidents such as this—a gutted fuel tanker

The Dangerous Goods (Road Transport) Regulations were amended in March 1984 and February 1985 to reflect the principles and safety recommendations of the Australian Code for the Transport of Dangerous Goods by Road and Rail. Amendments to allow for the licensing of vehicles carrying dangerous goods in packages were subsequently disallowed by the Legislative Council.

Explosives regulations

Shotfirer training. In the 18 months to 30 June 1985, Divisional inspectors conducted six in-service and night school classes for shotfirer training. An additional class was conducted at Christmas Island following a request from the management of the Phosphate Mining Company of Christmas Island Ltd to train employees in the use of explosives.

A total of 299 candidates sat the examination for a shotfirer's permit; 273 permits were issued and 26 candidates failed the exam.

Explosives found, stolen, destroyed.

The explosives confiscated and or recovered for destruction by this Division during 1984-5 included:

- 482 kg high explosives;
- 628 detonators;
- 48 signal flares;
- 80 packs assorted fireworks;

75 railway track signals;
20 smoke bombs.
The Division continued to collect and dispose of deteriorated explosives in the interest of public safety.

Two thefts of railway track signals were reported and one theft of detonators was investigated in detail by the Division and the police.

Conveyance of explosives. Vehicles conveying explosives to and from the Baldavis Explosives Reserve via Great Eastern and Great Northern Highways were supplied with a revised route through the metropolitan area. This route utilized the improvements in traffic movement afforded by the opening of the Roe and Tonkin Highways and minimized the conveyance of explosives through built-up areas.

Analysis and testing. During the review period:

- 6 samples of ammonium nitrate prill were analysed for oil absorption and combustible

material content and were found to be satisfactory;
7 explosives compositions were analysed for compliance with the manufacturer's formulations;
a total of 700 Asahi meters were examined and approved;
1 ohmmeter design was approved for general distribution and use; and
1 exploder system was given general use approval after performing satisfactorily during a 12-month trial period.

Flammable Liquids Regulations

Licensed premises. The allocation of a major part of the Division's resources away from traditional areas during 1984 was redressed towards the end of the year, and by June 1985 all premises licensed to store flammable liquids had been inspected for compliance with the regulations. The number of premises licensed (4 529) was slightly less than the number licensed at the end of 1983 (4 594)

Dangerous Goods (Road Transport) Regulations

Driver licensing. By 30 June 1985 the implementation of plans to require drivers of vehicles conveying dangerous goods in bulk to undergo a course of training was well underway. A committee made up of representatives from industrial groups, unions, State Parliament and the transport industry made recommendations to the Chief Inspector who in turn incorporated all those recommendations into a submission to Parliamentary Counsel for the preparation of legislation.

Prosecutions 1984-5

	Pending	Won	Lost	Withdrawn
Explosives	1	2	4	0
Flammable liquids	1	—	—	1
Dangerous goods	8	3	0	3

The Division continued its policy of education and avoided legal proceedings wherever possible. Several prosecutions were instituted for flagrant and wilful breaches of the Dangerous Goods (Road Transport) Regulations.

The Division has been reviewing training courses for the past six months and has approved several. No significant problems are anticipated with implementation of the new regulations.

Road train operations. Road train operators maintained a good safety record throughout the year and proposals to extend existing approvals for low-flash-point products were received and closely examined. All equipment currently in use in road-train operations is either new or of recent manufacture.

The operation of a triple-bottom road train for the conveyance of crude oil in the Kimberley has been approved on a six-months trial basis, and monitoring of this combination is continuing.

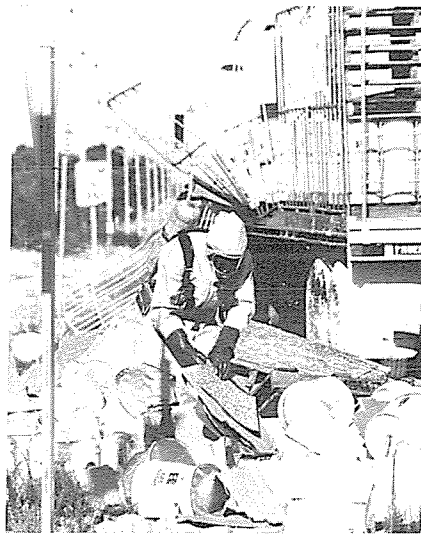
Accidents and incidents

A survey of transport incidents during 1984 showed that the majority occurred when dangerous goods were dislodged from vehicles in circumstances which were little more onerous than could be expected during normal driving. Many of these could have been prevented if adequate steps had been taken to restrain the goods more securely on the vehicle.

As a result of this the regulations will be amended to make it mandatory for tray-top vehicles to be equipped with substantial, well fitting gates when carrying dangerous goods.

Transport Emergency Assistance Scheme. Over several years work has been progressing on the development of a Road Transport Emergency Assistance Scheme. The concept of this scheme was to co-ordinate State Government departments and agencies with appropriate expertise to deal with emergencies, while at the same time ensuring the participation of manufacturers, traders, consignors and prime contractors. All these groups participated in the drafting of the scheme.

The deliberations of the drafting committee culminated early in 1984 when the Minister for



A bad accident scene. This year the Division has published a separate booklet of accident reports

Minerals and Energy released the document describing the format and operation of the scheme.

Since the promulgation of the Dangerous Goods (Road Transport) Regulations the scheme has been put into operation 27 times for transport emergencies and its principles have been followed for several other incidents involving dangerous goods other than while being transported. The scheme is

not without its problems but overall it functions effectively and well.

Tanker roll-over. One incident which occurred during 1984-5 is worthy of special comment as it is the most significant accident which has occurred for many years. Late one afternoon, at a busy suburban intersection, a tanker vehicle loaded with 44.5 kL of motor spirit overturned and two compartments of the tank were punctured. Within minutes approximately 11 kL of petrol had spilled from the tanker and entered the storm-water drains leading to the river.

The accident prompted about 12 hours intensive work by the emergency services and support organizations, and during this time the potential existed for a catastrophe. Though rendering the area safe was not without some problems, these were resolved efficiently and well. The handling of the incident reflected favourably on the developmental work Government and industry have expended on the State Road Transport Emergency Assistance Scheme.

EXPLOSIVES AND DANGEROUS GOODS DIVISION
Department of Mines ph. (09) 325 9966

EXPLOSIVES AND DANGEROUS GOODS LICENCE

Issued in accordance with the Explosives and Dangerous Goods Act and Regulations (See over for payment details)

LOCATION OF PLACE, VEHICLE OR ARTICLE

BELMONT

HOLDERS NAME AND ADDRESS

BELLWAY PTY LTD
54 BELGRAVIA ST
BELMONT W.A.

TYPE OF LICENCE

LICENCE TO TRANSPORT DANGEROUS GOODS.

EXPIRY DATE

15/03/85

FILE No.

13778

INSPECTION DATE

DATE OF ISSUE

28/02/85

FEE PAYABLE

\$65.00

CONDITIONS OF LICENCE

TYPE OF VEHICLE:	PRIME MOVER
MAKE OF VEHICLE:	SCANIA
REGISTRATION NO:	69C 412
DANGEROUS GOODS BEING TRANSPORTED:	CLASS 0

THE CHIEF INSPECTOR MUST BE ADVISED FORTHWITH OF ANY CHANGE IN THE REGISTRATION NO. OF THE ABOVE VEHICLE.

SAMPLE COPY ONLY



H. DOUGLAS
CHIEF INSPECTOR

Licensing of bulk vehicles has progressed satisfactorily. 1 209 inspections were made on bulk containers and 432 approval plates issued for vehicles carrying dangerous goods

Organization

Staff. A number of significant changes occurred within the Division. Mr R.K. Douglas retired in October after an extended period of sick leave. His presence is sadly missed as he served the Division at a very high standard for over 17 years. The position he vacated was filled by Mr C. Howes.

Other changes included:

two new security staff were appointed to oversee operations at the Kalgoorlie Explosives Reserve;

Mr W. Gildare retired in June 1984; and

Mr J. Hanley completed his diploma in Transport Management.

At the conclusion of the reporting period the staff numbered 30; 12 inspectorial, 8 clerical and 10 reserve security personnel.

Training. Included in the training undertaken by staff in 1984-5 were courses on:

computer application;

risk assessment;

transport of radioactive materials; and

bushfire control.

Inspectors also attended a conference run by the Australian Institute of Petroleum and a conference run jointly by the Institution of Engineers and the Chartered Institute of Transport.

Lectures and publications. Many lectures were given on various aspects of the Dangerous Goods



Inspectors attended a Public Works Department training course on the proper use of self-contained breathing apparatus

(Road Transport) Regulations to various groups that were affected by the regulations.

Inspectors also participated in several seminars on various aspects of dangerous goods transport.

Papers were prepared for publication in various trade journals. These principally concerned the Dangerous Goods (Road Transport) Regulations, though editing work was also done on a paper in the journal "Farmer" concerning the rural use of explosives.

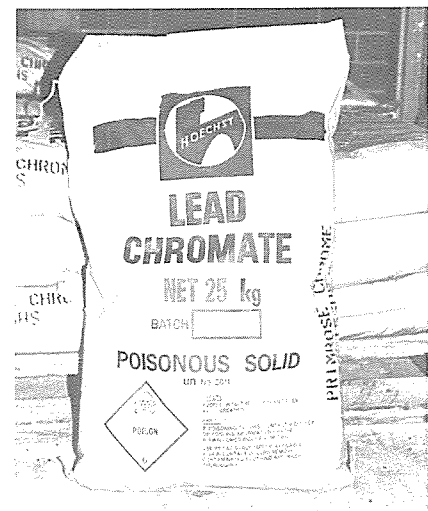
A concise booklet entitled "Understanding the Dangerous Goods (Road Transport) Regulations" was prepared to assist the public and industry to develop their knowledge of all aspects of the regulations.

Other activities. In addition to the committee work mentioned earlier, the Division participated in the deliberation of the Western Australian Transport of Dangerous Goods Advisory Committee and its Emergency Procedures Sub-committee; the Inter-departmental Fire Protection and Public Safety Review Committee; the Western Australian Advisory Committee on Chemicals; and the Community Consultative Committee on Chemicals and its Stored Chemicals Sub-committee.

The Acting Director also attended the 19th Australasian Conference of Chief Inspectors of Explosives in Canberra.

Explosives Licences and Permits

	1983	1984	1985 first half
Import	5	9	6
Manufacture	6	7	6
Blasting agents	380	387	160
Storage Mode A	34	36	18
Storage Mode B	8	12	3
Magazine (1 000kg)	45	37	17
Magazine (5 000kg)	50	44	15
Magazine (no limit)	78	94	51
Sell	32	38	23
Convey	94	95	53
Portable magazines	95	82	50
Storage of detonators	1	1	1
Shotfirers permits	1 836	1 871	644
Fireworks displays	43	49	14
Entry permits	52	124	55
	2 759	2 886	1 116



This package is marked in accordance with the requirements of the Dangerous Goods (Road Transport) Regulations 1983.

1984—A time for review

With the introduction of the 1978 Mining Act the Government, the Department and the mining industry anticipated a considerable range of improvements to registration and other procedures, particularly as this new Act provided for fewer tenement types and increased tenement sizes.

While in principle many improvements did occur, in practice the new legislation has required considerable operational changes to the registration procedures. With progressive amendments to certain provisions of the Act and with the recent Government inquiry into the Act, Department and Registration Division management have recognized the need for change including a move towards computerization.

In March 1984, the Department of Mines commissioned a firm of management consultants to undertake an independent review of the registration function and to recommend appropriate changes and improvements in procedures.

The review process involved a wide range of individuals and organizations within the mining industry, the Department of Mines and other Government departments. The review was strategic in nature, identifying directions of appropriate future change in the structure and management of the division, as well as specific procedural improvements.

Cornerstone to the review's recommendations is a restructure of the head office Division with the various branches - Applications, Dealings and General - being reconstituted as smaller less specialized units responsible for mineral fields on a geographical basis. Advantages of such a unit structure are seen as:

- each unit will combine skills and experience representative of every branch, so the scope and quality of service pro-

vided by each unit will be comparable to those available under the present system;

- improved flexibility in processing a fluctuating workload;
- reduced file traffic within the Division; and
- improved management and supervisory control.

Following the presentation of the report to the Government in August 1984, the Department set about establishing a new structure along the lines recommended in the review and is currently running this structure on a trial basis. If the new structure works efficiently it will be formally adopted.

The review team found the Division's existing space at head office overcrowded and unsuited to their recommended office layout. The Department consequently sought additional space in the Merlin Complex, opposite Mineral House, and in June 1985 the Division moved to Level 1, Merlin Centre, 87 Adelaide Terrace.

Further changes arising out of the review were a renaming of the

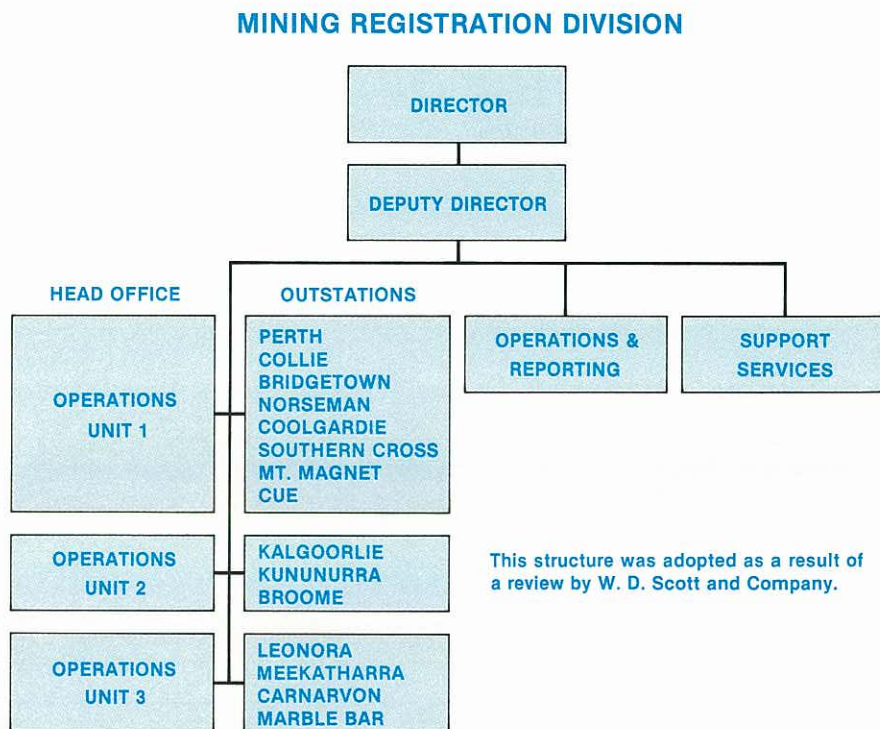
Division to the Mining Registration Division and retitling of the Principal Registrar and Deputy Principal Registrar to Director and Deputy Director respectively.

Other recommendations in the management consultants' report refer to matters such as:

- the implications of amendments to the Act on administrative workload;
- number and location of outstations;
- reporting requirements; and staff training.

Evaluation of such recommendations will commence when the new structure and procedures have settled down and when resources become free to undertake the detailed evaluation and implementation that is necessary.

The reorganization of the Division has not led to increases in staff, yet it is believed that the benefits gained from the new structure will mean improvements in the efficiency of the registration process. The new structure of the Mining Registration Division is illustrated below.



Introduction

The major focus in 1984/85 was on the work commitments or expenditure conditions attaching to existing mining tenements.

To maintain title by extending the two-year term of a prospecting licence for a further two years, licensees are required to lodge operations reports showing work done and monies expended.

The resources of the Division were stretched to the limit in recording the lodgement of these reports and processing exemption applications, in order that extension applications could be dealt with.

In most cases where extension was not given, the ground was quickly taken up by other parties. Often competing applications were involved, resulting in Warden's Court hearings to determine which party had priority.

Some reduction in the volume of tenement applications in respect of new ground meant that applicants did not experience undue delays in obtaining title to ground.

Operationally, one area of major concern signalled by the management consultants' report is the present statutory intent that operations reports be carefully vetted and the enormous burden that this requirement will bring during the life of all licences and leases.

Controls introduced in 1982 to monitor tenement processing have eliminated the backlog of long-outstanding applications that had been prevalent in previous years. Of the 23 236 mining tenement applications received under the Mining Act 1978 to the end of June 1985 over all types of land tenure, 19 228 or 82.75 per cent have been finalized.

Looking ahead, Divisional staff will be involved in a detailed evaluation of the management consultants' report recommendations,

and further improvements in the efficiency of the Division through modified procedures are anticipated.

Amendments to the Mining Act as a result of the 1983 Mining Act Inquiry were introduced into Parliament in March, 1985 but have not yet been passed. Some of the proposed amendments, if enacted, will require regulations to be written and new procedures to be adopted.

Tenement Applications

Tenement receipts between 1 January 1984 and 30 June 1985 were as follows :

APPLICATION TYPE	NO.	AREA (ha)
Prospecting licences	5 745	700 019
Exploration licences	1 170	15 922 744
Mining leases	768	102 054
Miscellaneous licences	289	14 009
General purpose leases	62	1 150

A breakdown into Operational Units of the above tenement statistics is shown on page 73.

The accompanying chart shows the total area of new tenement applications made year-by-year since the introduction of the Mining Act 1978.

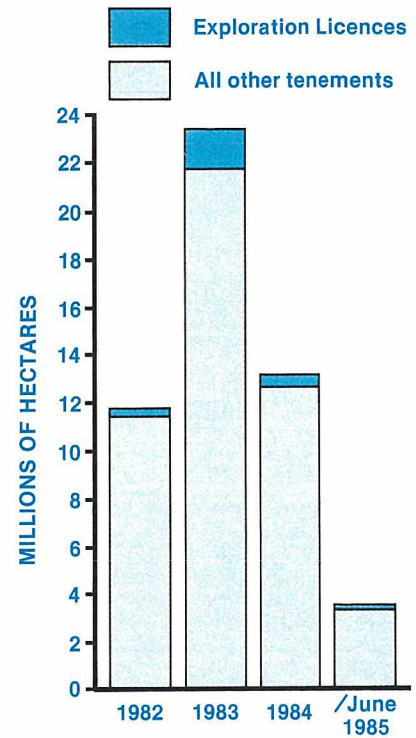
Prosecuting licence extensions

A total of 1 133 applications for extension of prospecting licences were received in the 12 months from 1 July 1984 to 30 June 1985.

At the time of writing, 85 per cent of the applications determined have been approved and 15 per cent refused on various grounds, including failure to comply with expenditure commitments.

In many cases final determination of such applications has been delayed pending receipt of further information from appli-

TENEMENT APPLICATIONS



cants regarding their compliance with expenditure commitments or the outcome of exemption applications.

Dealings

A total of 23 004 dealings were received in the 18 months to 30 June 1985, with approximately half being lodged at the Perth office and the remainder at the Division's 14 outstation offices.

Regarding the more complex dealings however, such as the 6 473 agreements and transfers lodged for ministerial consent and registration, the trend of previous years has been maintained, with approximately 81 per cent being lodged at the Division's Perth office.

Operations and reporting

A total of 18 508 operations reports were filed in the 18 months to the end of June 1985.



Pegging a mining tenement—note stones used in lieu of trenches

This was a substantial increase on the 6 000 reports filed in 1983, and illustrates the magnitude of the task facing Divisional staff in the processing and vetting of these reports.

A total of 5 066 applications for exemption from labour or expenditure commitments were received in the above-mentioned period.

This is a 50 per cent reduction in the number of applications for exemption received in 1983 and indicates both an ongoing amalgamation of adjoining groups of small tenements into single large tenements and the high degree of exploration and mining carried out during the period.

Outstation offices

The continuing heavy workload of many of the Division's outstations has on occasion required the assistance of staff from the Perth office for varying periods.

This has been additional to the ongoing requirement of staff from the Perth office to provide relief for outstation staff on annual or long-service leave.

A number of outstation offices have recently been refurbished with improvements including new carpet, fresh painting and improved counter facilities.

Perth Warden's Court

Prior to February 1983, sittings of the Perth Warden's Court were held fortnightly. In that month, however, it became necessary because of a greatly increased workload for sittings of the court to be held weekly.

Increases in the number and complexity of mining tenement applications and litigation cases were among the main reasons for this increased workload which, to date, shows little evidence of abating.

In addition to the current weekly sittings, special sittings of

the court of one to three days duration are required periodically.

In April 1985 work began on the removal of asbestos from the ceiling and the refurbishment of the Perth Warden's Court situated on the 9th floor of Mineral House.

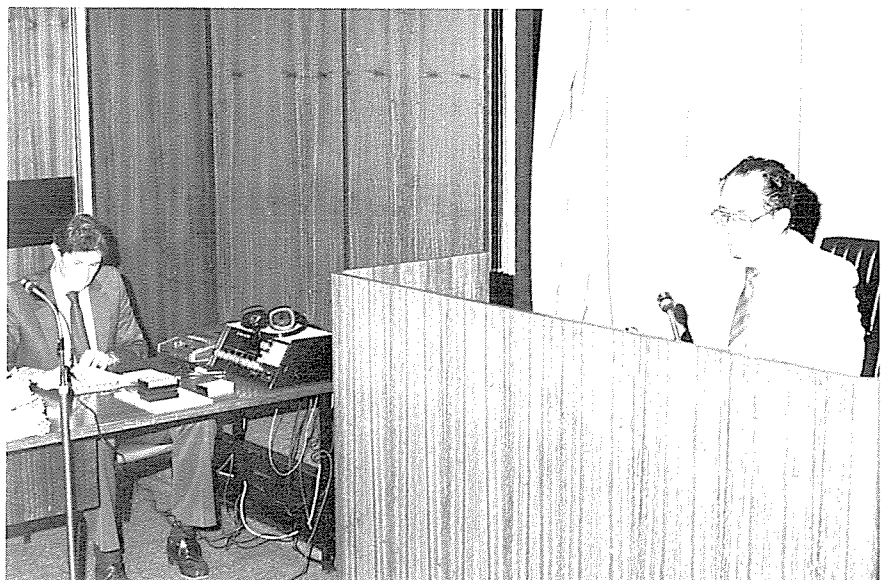
This necessitated the transfer of sittings of the court to various locations for several months and, whilst some inconvenience to the public will result, the refurbished Court is expected to provide an improved environment for all participants.

Warden's Courts - outstations

The heavy workload encountered in 1983 by many of the outstation Warden's Courts was maintained during the 18 months to the end of June 1985 particularly in the East Coolgardie, Mount Margaret and Murchison Mineral Fields.

In a similar manner to Perth, this reflects increases in the number and complexity of mining tenement applications and litigation cases dealt with by outstation Warden's Courts. In a number of cases, extra sittings of the court have been required each month on a virtually permanent basis.

One consequence of this high level of activity is a continuous and



Perth Warden's court in session Warden R. F. Rasmussen presiding

onerous burden on the typing resources of the Division's Perth office to provide the outstations with transcripts of tape-recorded evidence. The demand for such transcripts has far exceeded the capacity of the limited typing resources of individual outstations.

Mining Act amendments

Amendments were passed, effective 1 July 1984, in relation to various fees and charges, as follows:

- application fees of \$50 and \$100 were introduced for prospecting licences and miscellaneous licences respectively;
- application fees for mining leases and general purpose leases were increased from \$15 to \$100 and for exploration licences from \$150 to \$500;

- rentals on prospecting licences and exploration licences were increased from \$0.50 to \$1.00 per hectare and \$18.00 to \$20.00 per square kilometre respectively;
- the pro-rata refund of rental on surrender discontinued; and
- the fee on partial surrender increased from \$6.00 to \$10.00.

Shire rating of mining tenements

In May 1984 the Local Government Act was amended to specifically provide that prospecting licences, exploration licences, and general purpose leases are rateable along with mining leases.

This amendment sought to broadly maintain the status quo in terms of revenue collections from tenement rating that existed under the Mining Act 1904.

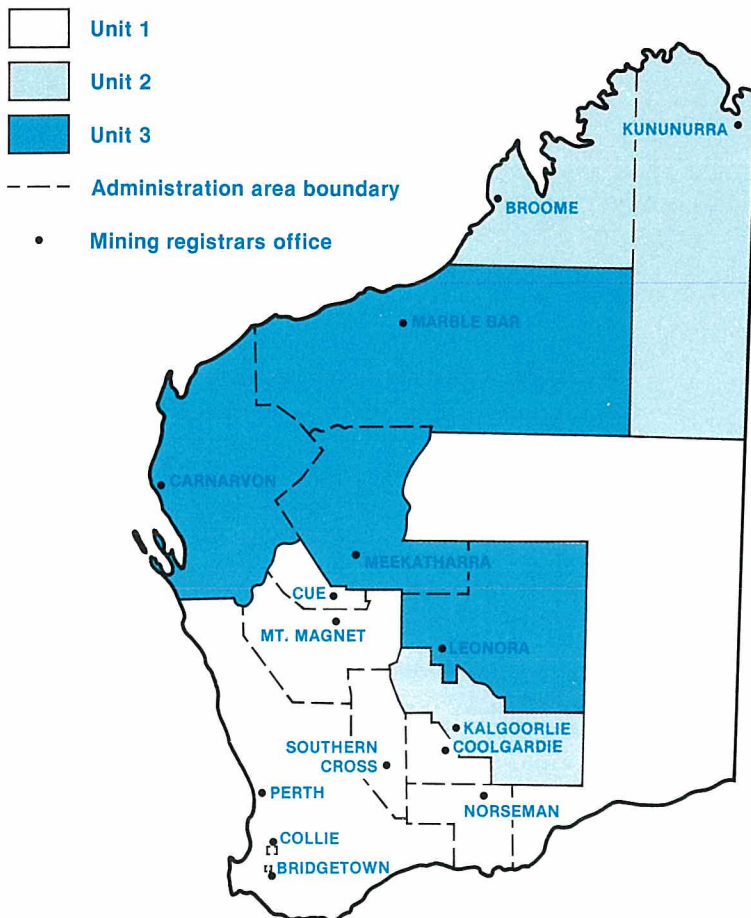
The Department has, as a consequence, experienced a significant increase in the workload of providing advices to shires pertaining to rateable mining tenements.

As a result of the amendments, it was necessary for the Division to provide all affected shires with comprehensive base lists of rateable mining tenements.

This base information is updated by individual advices relating to tenement transactions.

Organization

Established staff numbers for the Division were reduced from 55 to 50 in head office and outstation staff numbers were maintained at 39. Continuing problems were faced by the Division in attracting experienced personnel for appointment to positions that became vacant at more remote outstations.



APPLICATIONS

1-1-84 TO 30-6-85

UNIT 1

TENEMENT	NUMBER	AREA (ha)
PL	1873	211488
EL	291	3184000
ML	260	37655
MISC.	52	1121
GEN.	6	155

UNIT 2

PL	1717	225866
EL	435	6327500
ML	199	17890
MISC.	94	6744
GEN.	21	404

UNIT 3

PL	2155	262720
EL	444	6411300
ML	309	46510
MISC.	143	6144
GEN.	35	591

TOTAL 8034 16740088

PL = PROSPECTING LICENCE

EL = EXPLORATION LICENCE

ML = MINING LEASE

MISC. = MISCELLANEOUS LICENCE

GEN. = GENERAL PURPOSE LEASE

THE NEW MINERAL HOUSE COMPLEX

The sudden and dramatic increase in mining activity sparked by the nickel boom towards the end of the 1960's came at a most inopportune time as far as Departmental accommodation was concerned. The Government of the day was already committed to the construction of Mineral House which was too small from the outset, so much so, that the Explosives Division could not be accommodated in the building when it was opened in 1970.

To keep pace with the demands of the rapidly growing mining industry during the 1970's Departmental staff numbers have grown and in 1985 the Department, apart from those officers located in Mineral House and Government Chemical Laboratories, has 248 of its personnel accommodated in seven other office buildings throughout the city area.

In 1978 planning for additions to Mineral House resulted in a proposal for a building of six floors to be constructed over the existing car park to the east of Mineral House. This plan was later amended and it was proposed to construct a seven storey building at a cost, estimated in 1979 to be \$3 915 000. However, due to lack of funds the project did not proceed.

In the intervening period until funding of the project was approved in the 1984/85 budget, considerable research and planning was carried out to determine the necessary space requirements for existing staff and an appropriate allowance for the future. To accomplish this, all divisions were canvassed and staff given the opportunity to make comment on the various proposals.

This resulted in an accumulation of ideas, many of which have been incorporated in the basic design concept.

During the planning phase investigation by consultants revealed that although it would be necessary to demolish the administrative

wing of the Government Chemical Laboratories, better site usage would be achieved by locating the proposed building immediately to the north of Mineral House and connecting the two buildings by a lift core and access way, with the main entrance opening onto Plain Street.

Following further research into space requirements, with careful consideration being given to the future needs of the Department, a number of meetings were held with the architects and project consultants culminating in the basic design concept being approved by the Minister for Minerals and Energy on December 20, 1984.

Mineral House II will be an eleven storey construction with three levels of parking, one of which will be below ground. Service ducts will be located at each end of the building and each floor will provide 940 m² of useable office space.

The ground floor will provide an inviting entrance between Mineral House I and the new building. The entrance will be glazed to the top of the 1st Floor and incorporate a garden setting which will extend into the foyer. Also included on the ground floor will be a display area, geological museum, general enquiry desk, storeroom and a small recreation area with showers and

change rooms for the many people who nowadays cycle to work or take part in corporate sporting activities.

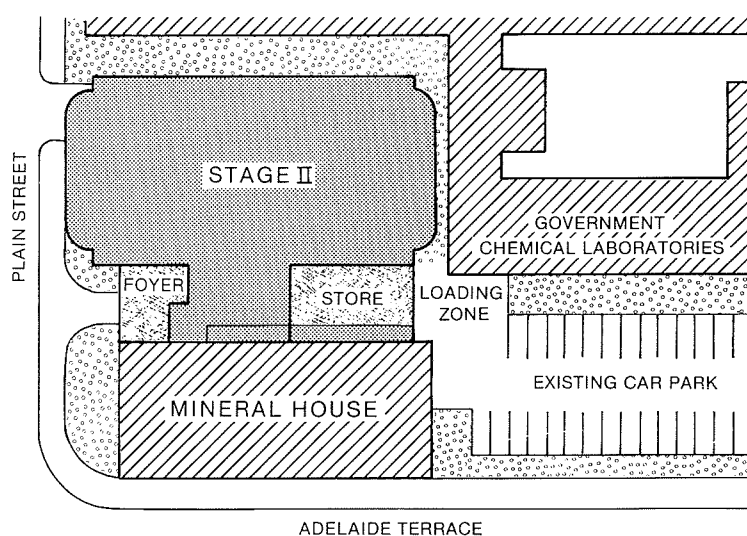
It is proposed to locate many of the public counter functions of the Department on the 1st floor of the complex and research is currently being carried out to ensure that public requirements are satisfied.

An auditorium with seating for 204 persons will be situated on the top floor of Mineral House II. This floor will also incorporate the cafeteria and amenities area currently situated on the 9th floor of Mineral House I which will be utilized for office space.

The contract for the construction of Mineral House II will include provision for the general refurbishment of the existing Mineral House to the same standard of finish as the new building.

Before construction of the new building it has been necessary to provide new accommodation for the Administrative Branch of the Government Chemical Laboratories. New premises have been constructed and are now occupied, leaving the way clear for the commencement of Mineral House II in mid July, 1985.

The Mineral House complex is expected to take 15 months to complete and be ready for occupation in December 1986.



ADMINISTRATIVE SERVICES

A. MISTILIS, ADMINISTRATIVE OFFICER

The period January 1984 to June 1985 has been a demanding but rewarding one for the Administrative Services Division.

Planning for re-organization of the Division was also completed and proposals are presently being considered. A corporate plan for the Division for 1985/86 was also completed.

Approval was obtained to proceed with the design development and documentation phase of Mineral House II to enable Divisions of the Department to be accommodated in one complex. Additional external office space was obtained to adequately accommodate Departmental Divisions until Mineral House II is completed. Also, land was purchased at Carlisle for future consolidation of Departmental near-metropolitan, light industrial activities.

WAMEX, CONTAM and Explosives Licensing computerized systems were commissioned and development of further computerized systems was progressed.

Action was taken to provide for lump sum payments to approximately 400 recipients of fortnightly Coal Mine Workers Pensions.

The activities and services of the Branches of the Administrative Services Division are discussed in further detail under appropriate headings.

Personnel

Since February 1984 the Personnel and Staff Branch has been without the services of a permanent personnel and staff clerk. Two relieving officers have been stationed full time in this branch to cope with the large volume of work.

Besides its normal operations the branch has been involved in other areas such as redeployment and retraining, assisting in the recruiting of staff engaged on Com-



Capturing file movements using the computerized wand system—Merlin Records Sub Centre

munity Employment Programme projects as well as continuing to provide input into the development of the computerized Personal Information Management System (PIMS).

Historically, most of the functions involved in human resource management in the Service have been performed centrally at the Public Service Board. However, the Board is currently planning the phased delegation of many of these existing functions and the implementation of new initiatives to Departments. Examples of these new initiatives include: equal employment opportunity; broadbanding; performance appraisal; human resource planning; and occupational health, welfare and safety.

In order to cope with these additional functions the branch will require expansion and re-organization and a proposal to effect this is currently under consideration.

Financial

The retirement, after many years of service, of the Accountant/Chairman, Coal Mine Worker's Pension Tribunal, in February 1985, provided an opportunity to reorganize the Accounts Branch and re-establish a former senior position devoted solely to providing financial services to the Department.

The growth in revenue collections from the expanding mining and petroleum industries and the level of expenditure necessary to service them, combined with the need for greater accountability by departments made this re-organization necessary.

The proposed re-organization of the branch is intended to focus attention on financial planning and accounting matters, both essential ingredients of the impending Financial Administration and Audit Act.

Coal Mine Worker's Pensions Section

Coal Mine Worker's Pensions. Under the Coal Mine Worker's Pensions Act there were 29 lump sum payments made to eligible beneficiaries and fortnightly payments continued to be paid to 437 pensioners.

During this period the Coal Mine Worker's Pensions Tribunal surveyed the remaining beneficiaries receiving fortnightly pensions. Resulting from this survey the tribunal is recommending amendments to the Act to enable fortnightly pensions to be commuted to lump sum payments thus bringing greater advantages to a majority.

Mine Worker's Relief. The final stage of the wind up of the Mine Worker's Relief Fund took place on 1 May 1984.

The Mine Worker's Relief Board was formally dissolved in September 1984 and SGIO was charged with administering the residue of the Fund.

The Mine Worker's Relief Act will continue to be administered for those beneficiaries who established their entitlement prior to 1 May 1984.

Miner's Phthisis Act. Eight persons were receiving benefits under the Act.

Coal Mining Industry Long Service Leave Act. The act currently covers 1 271 coal mine industry workers in Western Australia.

Management

In 1984 the Government approved the construction of Mineral House stage II. The Management Services Branch has been chiefly responsible for co-ordinating the Department's planning in this area.

During the period under review the Management Services officers worked with consultants to review the tenement registration procedure and co-ordinated a re-

view of all Departmental functions for the Western Australian Government Functional Review Committee.

In the first half of 1985 the branch completed a review of the Administrative Services Division which determined the necessary structure and resources to effectively respond to growing Departmental and Government demands.

The Department's training and staff development function continued to be co-ordinated by the Management Branch although this function will transfer to the Personnel Services Branch when approval for additional staff for that branch is obtained.

Other areas of active involvement by the branch will be in the co-ordination of the proper completion of position data forms for all classified positions in the Department as part of the preparation for the introduction of broadbanding, the introduction of flexitime (incorporating a 9-day fortnight) and the installation of a new telephone exchange.

The branch will be closely involved in accommodation matters during 1985/86, particularly with the construction of stage II and the refurbishment of stage I. Another important area of activity will be

involvement in the planning for the introduction of the Financial Administration and Audit Act.

Systems Audit

Since inception this section has assumed the duty of reviewing Departmental accounting procedures and identifying areas which require attention. More emphasis has gradually been placed on evaluation of the effectiveness of systems operating in the areas of financial management but with only one staff member in this section, progress is slow.

Information

Records

Significant changes occurred to Records Branch functions throughout 1984 and 1985.

The introduction of information technology in the form of a computerized Records Management System (RMS) was accompanied by a restructuring of the branch and the formation of a sub-branch at the Merlin Centre.

Space vacated within Mineral House when the Mining Registration Division relocated at the Merlin Centre enabled resiting of 35 000 files previously stored at Confederation House.



Data capture and data input teams working under Community Employment Programme

Limited personnel resources and increasing demands on the records service throughout 1984/85 required Community Employment Program (CEP) personnel for the computerization programme data preparation and data entry tasks.

Two CEP programmes (estimated to run a combined total of 15 months) were undertaken, one in 1984 and the second in 1985. As at June 1985, 104 000 current-use files had been entered onto the RMS database; about another 30 000 files are in the process of being entered with completion estimated for November 1985.

In the period January 1984 to June 1985, 10 565 files were created, compared to 12 920 for the year 1983. This decrease in actual file creation was offset by a 25 per cent increase in the average items of correspondence received each week; 134 940 items received in 1984/85 compared to 67 600 items in 1983.

Despite favourable reception of the new technology by records personnel there were considerable demands imposed upon individuals in adapting to the new medium of records control while maintaining existing manual systems.

Existing staff resources did not increase despite these additional workloads. To cope with the extra duties and changes, 2 141 overtime hours were worked in 1984, and to June 1985, 1 656 hours. By contrast, overtime worked in 1983 amounted to 733 hours. Overtime should decline when the new system becomes established.

In conjunction with the introduction of the new technology, attention was also concentrated upon improved manual procedures and processes to reduce inefficient file attachments and movement.

With the combined advantages of information technology, decentralization of the service, improved processes and enhanced information assessment, an increasingly effective records service will develop.

Word processing

The emergence of repetition strain injury (RSI) was an unfortunate feature of word processing services during the period under review.

The Mines Department first encountered RSI cases in the second half of 1984, some 2 years after introduction of word processors. Twelve officers from the typing staff were affected, five of them to the extent that they have not been able to return to typing duties although they are in various stages of rehabilitation.

Steps taken to prevent and counter RSI included procuring height-adjustable desks and chairs, insisting on 10-minute breaks every hour, reducing overtime and ensuring that any symptoms of RSI were reported and treated early.

To cope with the resultant backlogs of typing work, the services of word processing bureaux were used regularly and two extra typists have been employed. In order to reduce the overload on typists, authors have been asked to upgrade the work presented wherever possible.

In the area of word processing equipment, another operating system called Gemini was installed as it was found to be more suitable for the preparation of geological and chemical reports. Having two operating systems running in parallel has however created further technical and control problems but it is hoped that, with approval for an enhanced central processing system in the coming year, these problems will be overcome and a more efficient word processing system will be available to be shared by all existing users.

Computer

Good progress was achieved during the period on the development and implementation of computer systems.

The following systems which were commissioned during the year provide the public, exploration, mining and petroleum companies with an improved service

through faster computerized access to industry information.

WAMEX. This state-wide Minerals Exploration system provides access to a wide range of mineral exploration data.

CONTAM. This contaminant collection and recording system provides an essential monitoring and reporting service within the mining industry.

Explosives System. This system provides an improved service on the issuing and renewal of licences, in addition to the availability of advice on explosives and other dangerous goods to the industry and public.

RMS. The partially commissioned Records Management System will provide faster more effective monitoring of the movement and tracking of departmental records.

In addition to the above, a number of key projects are in the development stage, with the main emphasis being placed on Mining Tenement Information Systems and further work on Mineral Information and Petroleum Exploration Systems.

Financial Summary

Operations of the Department during 1984/85 resulted in a cash surplus of \$126.484 million. This result was derived from:

	\$M
Mines Department (surplus)	128.692
State Batteries (deficiency)	-2.208
	<hr/>
	126.484
	<hr/>

Table A provides a summary of the finances on a cash basis as compared to 1983/84.

The accompanying diagram presents a graphical representation of the cash results of the Department (including State Batteries) over the last five years.

TABLE A. CASH SUMMARY
(Actual \$ Values)

	Mines Department			State Batteries		
	83/84 \$M	84/85 \$M	Variation %	83/84 \$M	84/85 \$M	Variation %
Revenue	135.847	156.746	+15.4	1.357	1.596	+17.6
Expenditure	22.203	28.054	+26.4	3.648	3.804	+ 4.3
Cash results	113.644	128.692	+13.2	-2.291	-2.208	+3.6

DEPARTMENT OF MINES CASH RESULTS
(1984/85 Dollar Values)

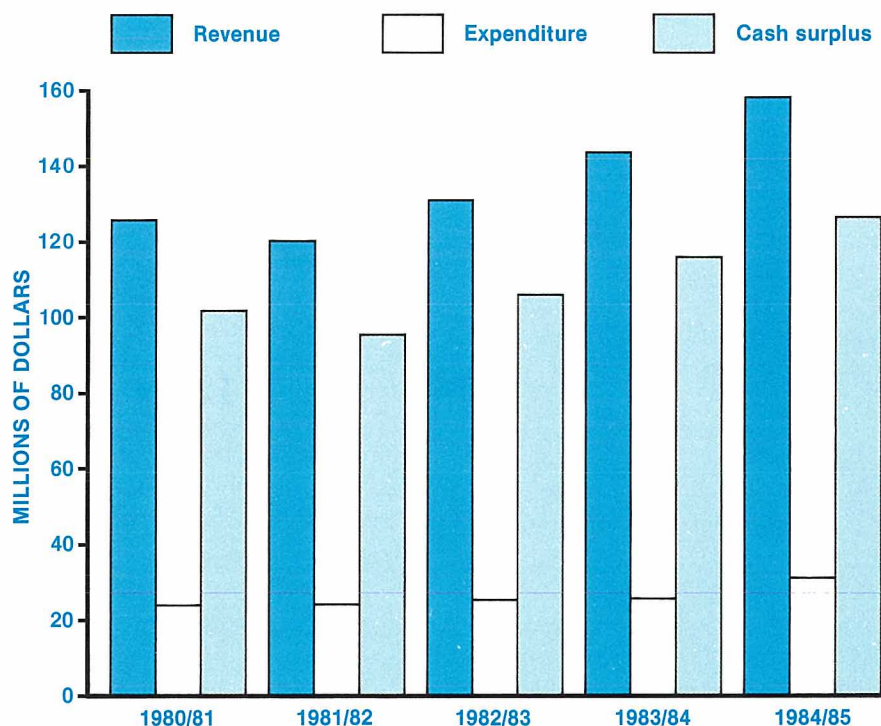


TABLE B. REVENUE - MINING
(Actual \$ Values)

	1983/84	1984/84	Variation	
	\$M	\$M	\$M	%
Royalties	118.126	130.977	+12.851	+10.9
Leases and Other Rents	14.961	22.338	+ 7.377	+49.3
Departmental revenue	1.107	1.405	+ 0.298	+26.9
Chemical Laboratories	0.547	0.643	+ 0.096	+17.6
Explosives	0.401	0.714	+ 0.313	+78.1
Miscellaneous revenue	0.705	0.669	-0.036	- 5.1
TOTALS	135.847	156.746	+20.899	+15.4

Revenue

Table B provides an analysis of the Department's revenue collection from mining activities in 1984/85 as compared to the previous year.

The increase in Leases and Other Rentals was due to full first year rental payments under the Mt Newman Agreement and increased tonneages mined.

In addition, the Explosive Division's revenue collections were boosted as about \$100 000 was received in connection with the decommissioning of the Woodman Point Explosives Reserve and the establishment of a new reserve at Baldivis. Further revenue was also received by the Division as a result of legislation passed under the Explosives and Dangerous Goods Act which required licensing from 1 January 1984 of bulk vehicles conveying dangerous goods.

Royalties. As shown in the table, 1984/85 royalty receipts increased by 10.9 per cent over the 1983/84 total.

Improved demand for iron ore mainly from the Japanese steelmakers, resulted in a 4.6 per cent increase in tonneages shipped which, together with the flow-on effect of the devaluation of the Australian dollar, led to corresponding increases in royalty receipts.

Higher world market prices for nickel, increased production of alumina and improving mineral sands prices resulted in royalty increases for those minerals.

The reductions in royalties from oil and gas sales from Barrow Island and the North Perth Basin were nearly offset by commencement of gas and condensate deliveries from the North West Shelf project.

Diamond royalties were affected by the lower prices and lower grades of material mined towards the end of the alluvial operations.

Expenditure

Tables C and D provide an analysis of total expenditure by the Department on Mining and State Batter-

ies activities respectively in 1984/85 as compared to 1983/84.

The significant increase in expenditure on services and contracts was mainly attributable to the increase in data processing in line with the Department's approved EDP programme.

Increased expenditure for 1984/85 in the area of Registration of Mining Titles was due to the high level of rent refunds as a result of the refusal, withdrawal and surrender of mining tenements.

An additional item of expenditure was classified in 1984/85 due

to accounting requirements associated with the Iron Ore (Goldsworthy - Nimingara) Agreement Act. The amount of \$1.239 million represents the Department's contribution to the State Development Fund.

TABLE C. EXPENDITURE - MINING
(Actual \$ Values)

ITEM	1983/84	1984/85	Variation	
	\$M	\$M	\$M	%
Salaries	15.334	17.151	+1.817	+11.8
Central administration				
Other staffing costs	1.219	1.200	-0.019	-1.6
Communications	0.126	0.142	+0.016	+12.7
Services and contracts	0.439	1.359	+0.920	+209.6
Consumable supplies	0.105	0.112	+0.007	+6.7
Maintenance of plant, equipment etc.	0.031	0.035	+0.004	+12.9
Purchase of plant, equipment etc.	0.033	0.033	+0.000	+ 0.0
Grants, subsidies and transfer payments.	0.006	0.007	+0.001	+16.7
Other services				
Mines Engineering	0.650	0.792	+0.142	+21.8
Petroleum - administration and engineering	0.057	0.052	-0.005	-8.8
Registration of Mining Titles	1.021	2.016	+0.995	+97.4
Surveys and Mapping	0.738	0.918	+0.180	+24.4
Chemical Laboratories	0.561	0.603	+0.042	+7.5
Geological Surveys	0.651	0.700	+0.049	+ 7.5
Control of Dangerous Goods	0.132	0.291	+0.159	+120.5
Exploratory drilling	1.060	1.344	+0.284	+26.8
Special projects	0.040	0.060	+0.020	+50.0
Iron ore (Goldsworthy Nimingara) Agreement Act - Contribution to State Development Fund	0.000	1.239	+1.239	0.0
TOTAL	22.203	28.054	+5.851	+26.4

TABLE D EXPENDITURE - STATE BATTERIES
(Actual \$ Values)

ITEM	1983/84	1984/85	Variation	
	\$M	\$M	\$M	%
Salaries	0.087	0.096	+0.009	+10.0
Central administration				
Other staffing costs	0.349	0.195	-0.154	-44.1
Communications	0.020	0.023	-0.003	-15.0
Services and contracts	0.043	0.048	+0.005	+11.6
Consumable supplies	0.012	0.008	-0.004	-33.3
Maintenance of plant, equipment etc.	0.014	0.002	-0.012	-85.7
Purchase of plant, equipment etc.	0.018	0.005	-0.013	-72.2
Operational services				
Milling and tailings treatment	3.105	3.427	+0.322	+10.4
TOTAL	3.648	3.804	+0.156	4.3

STATISTICAL DIGEST

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DRILLING CARRIED OUT BY MINES DEPARTMENT
OVER THE PERIOD JANUARY 1984 TO JUNE 1985

Place	Purpose	Type of Work	No. of Bores	Meterage
Del Park	Multi Port	Rotary drilling Development	1	40.7
Perenjori	Groundwater Investigation	Rotary Drilling & Coring	6	94.8
Newdegate	Groundwater Investigation	Rotary Drilling & Coring	1	47.6
Esperance	Groundwater Investigation	Rotary Drilling & Coring	13	161.6
Busselton Shallow	Groundwater Investigation	Rotary Drilling Pump Test	68 4	2 781.1
Binninup	Groundwater Investigation	Rotary Drilling	6	3 068.1
Harvey Deep	Groundwater Investigation	Rotary Drilling	2	646.7
Robe River	Groundwater Investigation	Rotary Drilling	14	392.8
Fortescue River	Groundwater Investigation	Rotary Drilling	16	443.3
	Seismic	Rotary Drilling	4 lines	290.0
Keysbrook	Calibration of Geological Logging units	Rotary Drilling Reconditioning Bore	1	408.0
Broome	Hydrogeological Mapping Guide	Rotary Drilling Halliburton Test	8 7	1 256.5
Baldivis		Water Sampling	1	
Kwinana		Run Inflatable Packer	1	
Lake Toolibin	Salinity Studies	Rotary Drilling & Coring	1	49.2
Pindalup	Effects of Bauxite Mining on Groundwater	Rotary Drilling	2	53.5
Yaragul	Effects on Bauxite Mining on Groundwater	Rotary Drilling	2	28.4
Cataby Shallow	Groundwater Investigation	Rotary Drilling Coring Logging	19	735.9
Maringee Farm	Salinity Studies	Rotary Drilling Pump Testing	17	302.0
Broome	Groundwater Investigation	Rotary Drilling	13	1 530.0
Various	Various	T.V. Camera Scan	67	
TOTAL FOR 18-MONTH PERIOD				12 330.2

SERIOUS ACCIDENTS FOR 1984

Class of accident	Inspectorate				Totals	
	Perth	Karratha	Kalgoorlie	Collie	1984	1983
Major injuries (exclusive of Fatal)- Fractures:						
Head	1	2	-	-	3	1
Shoulder	-	1	2	-	3	1
Arm	2	-	2	1	5	11
Hand	6	3	2	-	11	14
Spine	-	1	-	-	1	4
Rib	2	4	-	-	6	5
Pelvis	-	-	-	-	-	3
Thigh	-	-	-	-	-	-
Leg	3	1	7	-	11	8
Ankle	-	-	4	-	4	5
Foot	2	1	7	-	10	9
Amputations:						
Arm	-	1	-	-	1	-
Hand	-	-	-	-	-	-
Finger	2	2	4	1	9	9
Leg	-	-	-	-	-	-
Foot	-	1	-	-	1	-
Toe	-	-	-	-	-	-
Loss of eye	-	-	-	-	-	-
Serious internal	-	1	1	-	2	2
Hernia	4	3	1	2	10	9
Dislocations	-	1	1	-	2	3
Other Major	3	7	3	-	13	5
Total major injuries	25	29	34	4	92	89
Minor injuries- Fractures:						
Finger	13	7	8	3	31	28
Toe	1	1	5	2	9	9
Head	3	8	5	-	16	13
Eyes	3	5	8	-	16	15
Shoulder	2	4	7	3	16	13
Arm	-	10	10	-	20	21
Hand	4	26	20	2	52	69
Back	31	47	28	25	131	119
Rib	2	-	1	-	3	5
Leg	16	26	21	7	70	71
Foot	6	10	17	4	37	47
Other Minor	10	4	8	6	28	19
Total minor injuries	91	148	138	52	429	429
Grand Total	116	177	172	56	521	518

SUMMARY DESCRIPTION OF FATAL ACCIDENTS REPORTED during the 18 MONTHS ENDING 30 JUNE 1985

Name Occupation Date of Accident	Mine details and remarks
G. Abercrombie. Greaser. 8/1/84	Central Norseman Gold Mine, North Royal Open Pit. The deceased was pinned beneath the steering column of a front end loader which rolled over on a haul road.
L. Strong. Radio Operator/Track Crew. 7/2/84	Cliffs Robe River Iron Associates Railway. The deceased jumped from a track grinding machine which was about to run into the back of a loaded ore train.
M. Losasso. Miner. 11/2/84	Central Norseman Gold Mine, North Royal Decline. The deceased was struck in the chest by a steel beam being dragged by a front end loader.
M.H. Jones. Miner. 2/2/84	Western Mining Corporation, Kambalda Nickel Operations, Hunt Decline. The deceased was struck by a fall of rock in 1201 cut and fill stope.
B.J. Laska. Driller's Assistant. 4.3.84	Drilling Rig, Menzies. (First Hit Gold Mine). The deceased was struck by a drill rod during a surface exploration drilling programme.
G. Sendziuk. Stope Charger. 7/5/84	Seltrust Mining Corporation Ltd and Mt Isa Mines Ltd, Teutonic Bore. While moving a drilling rig, the deceased was struck on the jaw by a high pressure air hose following a coupling failure.
L. Sheppard. T/A Truckdriver 1/8/84	Goldsworthy Mining Ltd, Shay Gap. The deceased sustained fatal injuries when the service vehicle in which he was a passenger collided with a Haulpak truck.
L. Bonadrini. Foreman. 1/8/84	Western Mining Corporation, Kalgoorlie Nickel Operations, Long Shaft. The deceased was barring down in the 1002/24 Stope when a slab of rock fell on him.
J. McKeown. Geologist. 3/8/84	Windarra Nickel Mine. The deceased was endeavouring to sample a wall which had been shotcreted. A large slab of shotcrete broke away and pinned Mr McKeown against a large rock crushing his chest.
W.H.T. Watson. Miner. 4/10/84	Kalgoorlie Mining Associates, Perseverance Shaft. Mr Watson was thrown out of a locomotive when it became derailed. He continued to work that shift and the following shift but died on 7 October 1984 of a coronary occlusion.
T. Kilponen. Supervisor JLV Constructions. 19/6/85 19/6/85	Worsley Alumina, Worsley treatment plant. Mr Kilponen was assisting in hoisting a prefabricated platform into position. One end fell throwing Mr Kilponen to the floor some 6 metres below.

FATAL AND SERIOUS ACCIDENTS SHOWING DISTRICTS AND CAUSES, 1984.

DISTRICT	Explosives		Falls		Shafts		Fumes		Miscellaneous underground		Surface		Total	
	Fatal	Serious	Fatal	Serious	Fatal	Serious	Fatal	Serious	Fatal	Serious	Fatal	Serious	Fatal	Serious
Kimberley												7	-	7
West Kimberley												5	-	5
Pilbara											1	47	1	47
West Pilbara											1	88	1	88
Peak Hill												25	-	25
Gascoyne												10	-	10
Murchison				1		3				2		5	-	11
Yalgoo						9							-	9
East Murchison				5						12		5	-	22
Mount Margaret			1						1	3		7	2	10
North Coolgardie											1	1	1	1
Braod Arrow													-	-
East Coolgardie				7		1			1	52		9	1	70
Coolgardie			2	14		2				12		7	2	35
Yilgarn				1						3			-	4
Dundas				5					1	20	1	5	2	30
South West								1				84	-	85
Greenbushes												6	-	6
Collie				2						21		33	-	56
Total for 1984	-	1	3	35	-	15	-	1	3	125	4	344	10	521
Total for 1983	1	3	2	34	-	10	-	-	2	166	1	305	6	518

METALLIFEROUS MINING CERTIFICATES OF COMPETENCY ISSUED
JANUARY 1984 TO JUNE 1985

METALLIFEROUS MINING CERTIFICATES OF COMPETENCY ISSUED
JANUARY 1984 TO JUNE 1985 (continued)

COAL MINING CERTIFICATES OF COMPETENCY ISSUED
JANUARY 1984 TO JUNE 1985

First Class Mine Managers

Certificate Number	Certificate Number
Cunningham P. 163	Hepburn-Brown P. 172
Quinlivan D. 164	Knee M.J. 173
Brodie J. 165	Collings M. 174
W. Loxton 166	Swan R. 175
Foord G. 167	Pinniger, H.R. 176
Gemell S. 168	Lang R.J. 177
Manohar L.M. 169	Bartlett A.J. 178
Fermo E. 170	Weston A. 179
Hegde A.S. 171	Welten P.J. 180
Dorricott H.G. 181	Smith K.P. 182

QUARRY MANAGERS

Certificate Number	Certificate Number
Kendall, W.T.C. 82	Kenny D.J. 92
Pasovsky, J. 83	Moylan, T.B. 93
Bovell, T.J. 84	Tipper R.G. 94
Stokes, G.J. 85	Coackley, S.N. 95
Kirk, L.J. 86	Gerrard, T.C. 96
Xaykhamphoune, P. 87	Webster, J.S. 97
Baldwin, W.E. 88	Thornton, C.D. 98
Denison J.L. 89	Rhodes, J.H. 99
Sullivan, B.W. 90	Dodgson, C.A. 100
Rolland, C.J. 91	

First Class Mine Manager

Certificate Number	Certificate Number
Longworth, A. 50	Gibbons, T.R. 51
(Reciprocal) (Reciprocal)	

Second Class Mine Manager

Farmer, G.J. 21

Third Class (Deputy)

Addis, K. 107	Moloney, L.J. 111
Bailey, T.R. 108	Motion, N.R. 112
Kaurin, P.K. 109	Thompson, G.W. 113
McGurk, B.J. 110	Weighell, S.J. 114

UNDERGROUND SUPERVISORS

Pinniger, H.R. A309	Green, P.D. A339
Djulich, I A310	Roelofs, H.J. A340
Zadow, A.J. A311	Harvey, G.P. A341
Bond, W.F. A312	McEwan, M. A342
Campbell, A.B. A313	Dunmill, E. A343
Murdoch, R.J. A314	Giblett, C.L. A344
Allen, M. A315	Zurro Medina, J. A345
Bradtko, G.V. A316	Latimore, E. A346
Cull, N. A317	McGuckin, P. A347
Down, M. A318	Altham, R. A348
Dayman, E. A319	Allan, M.A. A349
Farrow, J.F. A320	Western, M.A. A350
Ferguson, P.W. A321	Law, D.T. A351
Hanson, R. A322	Spilsbury, C. A352
Inglis, J.L. A323	Holly, D.R. A353
McPherson, A.J. A324	Watts, T.K. A354
Morgan, P.J. A325	Goldson, A. A355
Reed, D.P. A326	Bremen, S.B. A356
Roach, D. A327	White, S.J. A357
Monson, B.L. A328	Watts, H.R. A358
Best, B.C. A329	Mulroney, D.P.J. A359
Nicoli, G. A330	Tatto, E. A360
Bowen, N.R. A331	Rodan, B.B. A361
Flykt, S. A332	Nunan, M. A362
Mills, L.G. A333	Fletcher, J.D. A363
Cannard, N. A334	Stubbing, J.R. A364
Carnicelli, L.E. A335	Livingstone, J.A. A365
Hayward, A. A336	Carpenter, R.E. A366
Law, S. A337	Van Der Merwe, T.L.B. A368
Upton, B. A338	Sporer, A. A368

RESTRICTED QUARRY MANAGERS

Certificate Number	Certificate Number
Elliott, M.J. 119	Murray, R.J. 135
Cross, W.R. 120	Ridge, S.L.J. 136
Loneskie, W.J. 121	Luckie, B.R. 137
Sharpe, I 122	Jongen P.D.J. 138
Tebinke, B.H. 123	Oldman, R. 139
Campbell, D.B. 124	Watts, T.R. 140
Chinnery K.G. 125	Balde, R. 141
Hildebrand, R.A. 126	Armistead, E.P. 142
McCreadie, R.A. 127	Bell, N. 143
McFadzean, B.J. 128	Guest, W.J. 144
Puddey, E.D. 129	Cook, T.V. 145
Russell M.S. 130	McCracken, R.L. 146
Simpson, A.A. 131	Vernon, R.W. 147
Stephens, R.W. 132	Small, M.J. 148
Baynes, L.G. 133	Smith, K.W. 149
McCarthy, J.B. 134	

Open Cut Mine Manager

Dean W.G. 11	Henderson, N.C. 14
Rogers, G.J. 12	Pitts, K. 15
Clark, I.J. 13	

Deputy (Open Cut)

Hill, P.C. 19	Small, C.R. 21
Cogrove, N.S. 20	

SUMMARY OF FATAL AND SERIOUS ACCIDENTS IN 1984

Mineral	Number of Persons Employed	Accidents		
		Fatal	Serious	Minor
Bauxite (alumina)	4 552		68	164
Coal	1 236		56	532
Diamond	332		6	19
Gold	3 539	4	125	417
Ilmenite, etc	864		8	62
Iron	10 706	2	147	487
Nickel	2 966	3	64	114
Salt/gypsum	519		22	43
Tin/tantalite	215		6	18
Copper, zinc	177	1	11	10
Other minerals	267		3	10
Rock quarries	270		5	22
TOTALS	25 643	10	521	1 898

AUTHORIZED MINE SURVEYORS CERTIFICATES ISSUED JANUARY 1984 TO JUNE 1985

Certificate Number	Certificate Number
Harrison, P.A. 67	Carlsson, T.J. 73
Malone, B.A. 68	Fox, D.J. 74
Lyon, A.T. 69	Anaru, C.T. 75
McGuckin, C.R. 70	Pauley, P.J. 76
Wood, P.L. 71	Fratel, M.M. 77
Cotton, J.A. 72	

STATE BATTERIES DIVISION SCHEDULE NO. 1
NUMBER OF GOLD ORE PARCELS TREATED, TONNES CRUSHED, GOLD YIELD BY AMALGAMATION AND HEAD VALUES

Battery	Smelt bullion (kg)	Yield by Amalgamation			Estimated fine gold (kg)	Amalgamation tailings content fine gold (kg)	Contents of ore- fine gold	
		Number of parcels treated	Weight crushed (tonnes)	Bullion (kg)			Weight (kg)	Grade (g/t)
YEAR ENDING 31 DECEMBER 1984								
Boogardie	25.5588	22	3 136	37.8375	32.160	8.774	40.934	13.02
Coolgardie	0.5909	39	4 352.5	68.9888	58.641	20.544	79.185	18.19
Kalgoorlie	137.689	42	4 471	46.5138	39.535	11.367	50.911	11.39
Laverton	3.0359	28	1 854.5	8.8144	7.492	5.674	13.166	7.10
Leonora	52.1124	34	4 906	26.935	22.867	10.732	33.599	7.12
Marble Bar	1.446	19	741	7.3961	6.287	1.992	8.279	11.17
Marvel Loch	52.3335	30	3 503	13.1891	11.210	5.213	16.423	4.69
Meekatharra	7.4536	14	1 619.5	14.1662	12.040	3.370	15.410	9.51
Menzies	65.2225	19	1 656.7	11.9356	10.145	4.937	15.082	9.10
Norseman	0.4821	16	1 901	8.0851	6.871	2.885	9.756	5.13
Ora Banda	90.211	13	788.5	5.9478	5.056	3.829	8.885	11.27
Paynes Find	4.5045	15	1 404	9.0974	7.732	1.973	9.705	6.91
Sandstone	-	-	-	-	-	-	-	-
Yarri	-	12	810.5	2.592	2.202	1.050	3.252	4.01
TOTALS	258.5234	280	28 672.3	259.2334	220.255	79.679	299.934	10.461
Average per parcel: 105.9 tonne. Average yield by Amalgamation (fine gold): 7.13 grams per tonne. Average tailing (fine gold): 2.64.								
YEAR ENDING 30 JUNE 1985								
Boogardie	15.4134	24	2 508.5	15.9174	13.528	4.452	17.980	7.231
Coolgardie	8.387	35	4 017	94.438	80.272	23.038	103.310	25.166
Kalgoorlie	102.176	46	5 174.5	54.050	45.941	11.800	57.741	11.695
Laverton	2.765	24	1 019	5.251	4.463	2.933	7.396	6.874
Leonora	21.629	28	4 810	24.679	20.976	11.643	21.619	6.976
Marble Bar	1.540	9	429	3.261	2.772	0.865	3.637	8.477
Marvel Loch	58.896	25	3 488	13.800	11.730	6.314	18.044	5.139
Meekatharra	5.869	10	911	7.535	6.404	1.619	8.023	7.936
Menzies	38.465	19	1 705.5	13.145	11.187	7.238	18.425	10.526
Norseman	0.482	17	1 659	10.013	8.510	3.935	12.445	6.830
Ora Banda	-	24	1 340	7.740	6.579	4.002	10.581	8.019
Paynes Find	2.901	11	1 070	7.657	6.508	1.325	7.833	7.642
Yarri	-	8	524	1.630	1.385	0.515	1.900	3.626
TOTALS	258.5234	280	28 755.5	259.2334	220.255	79.679	299.934	10.461
Average per parcel: 102.4 tonnes. Average yield by Amalgamation (fine gold): 7.68 grams per tonne. Average Tailing (fine gold): 2.78 grams per tonne.								

STATE BATTERIES DIVISION SCHEDULE NO. 2
DETAILS OF EXTRACTION - TAILINGS TREATMENT

Battery	Estimated tonnes	Head value		Tail value		Calculated Recovery		Actual Recovery	
		Grams per tonne	Total content Kilograms	Grams per tonne	Total content Kilograms	Kilograms	Per Cent	Kilograms	Per cent
YEAR ENDED 31 DECEMBER 1984									
Coolgardie (C.I.P)	15 794	2.14	33.825	0.8	12.689	21.1360	62.5	15.966	47.2
Kalgoorlie (C.I.P)	19 584	1.45	28.498	0.41	8.074	20.4240	71.7	18.399	64.6
Kalgoorlie (Vat)	7 000	1.31	10.050	0.44	3.088	6.692	69.3	6.961	69.3*
Coolgardie (Vat)	2 195	1.6	3.512	1.25	2.754	0.757	21.5	0.757	21.5*
Leonora (Vat)	2 700	1.96	5.286	0.52	1.412	3.874	73.3	3.793	71.7
Laverton (Vat)	4 100	1.85	7.576	1.12	4.608	2.964	39.1	2.964	39.1*
Marvel Loch (Vat)	1 550	1.81	2.807	0.45	0.698	2.109	75.1	2.120	75.5
Meekatharra (C.I.P)	12 758	2.31	29.43	0.59	7.544	21.885	74.4	13.155	44.7
Menzies (Vat)	3 250	1.8	5.850	1.02	3.336	2.514	43.0	2.514	43.0*
Marble Bar (Vat)	5 000	4.5	22.500	2.92	14.616	7.884	35.0	7.884	35.0*
Norseman (Vat)	660	3.03	2.003	0.76	0.499	1.504	75.1	1.314	65.6
Paynes Find (Vat)	1 800	1.84	3.318	0.46	0.822	2.496	75.2	2.476	74.6
	76 391	2.02	154.655	0.787	60.1404	94.5091	61.1	78.303	50.63
YEAR ENDED 30 JUNE 1985									
Coolgardie (C.I.P)	19303	2.48	47.931	0.77	14.906	33.205	69.3	21.599	45.1
(H/leach)	4086	1.78	7.296	0.69	2.836	4.460	61.12	4.460	61.1
Kalgoorlie (C.I.P)	2 2744	1.42	32.404	0.39	8.884	23.520	72.6	20.789	64.2
(H/leach)	9100	1.38	12.570	0.32	2.964	9.586	76.26	9.586	76.26
Laverton (H/leach)	6200	1.75	10.904	1.04	6.507	4.397	40.32	4.397	40.32*
Leonora (Vat & H/leach)	8100	1.69	13.740	0.71	5.766	7.974	58.0	7.974	58.0 *
Marble Bar (H/leach)	5000	4.5	22.500	2.38	11.906	10.594	47.08	10.594	47.08*
Meekatharra(C.I.P)	1 3795.2	2.292	31.617	0.795	10.964	20.653	65.3	13.223	41.8
Menzies (H/leach)	3250	1.8	5.850	1.02	3.336	2.514	43.0	2.514	43.0 *
Norseman (Vat)	160	3.46	0.554	0.86	0.138	0.416	75.1	0.419	75.6
Ora Banda (Vat)	1800	1.92	3.450	0.48	0.864	2.586	74.9	2.609	75.6
Paynes Find(H/leach)	6000	1.5	9.000	1.25	7.497	1.513	16.8	1.513	16.8*
	99538.2	1.987	197.815	0.769	76.567	121.417	61.4	99.677	50.4

* Still being treated - part gold recovery.

STATE BATTERIES DIVISION SCHEDULE NO. 3
DIRECT PURCHASE OF TAILINGS

Battery	YEAR ENDED 31 DECEMBER 1984			YEAR ENDED 31 JUNE 1985		
	Tailings purchased Tonnes	Initial Payment \$	Gold Paid to Prospectors Kilograms	Tailings purchased Tonnes	Initial Payment \$	Gold Paid to Prospectors Kilograms
Coolgardie	1 931.8	6 252.74	7.734	1 587.8	4 111.70	10.075
Kalgoorlie	173.1	1 503.57	2.402	358.4	2 094.85	0.623
Laverton	17.1	61.86	0.859	101.7	212.88	0.618
Leonora	457.2	1 096.42	1.533	189	461.42	1.254
Marble Bar	386.1	646.46	2.952	390.6	660.95	5.731
Marvel Loch	385.85	1 086.87	1.407	318.6	783.93	Nil
Meekatharra	24.3	90.90	0.113	3.6	25.07	Nil
Menzies	464.4	829.69	1.250	170.3	390.09	0.814
Norseman	33.3	293.00	0.581	6.3	180.56	0.419
Ora Banda	230.3	1 283.24	2.164	215.4	902.25	2.229
Yarri	115.6	225.88	-	106.2	223.47	-
TOTALS	4 219.05	13 368.63	20.995	3 447.9	10 047.17	21.763

STATE BATTERIES SCHEDULE NO. 4
STATEMENT OF RECEIPTS AND EXPENDITURE FOR MILLING AT STATE BATTERIES

Battery	Tonnes	Management supervision (\$)	Wages (\$)	Stores (\$)	Expenditure Total Working (\$)	Cost Per Tonne (\$)	Repairs and Renewals (\$)	Sundries (\$)	Gross Expenditure (\$)	Cost Per Tonne (\$)	Receipts (\$)	Receipts Per Tonne (\$)	Profit (\$)	Loss (\$)
YEAR TO 31 DECEMBER 1984														
Boogardie	3 136	56 562.99	54 549.38	43 580.48	154 692.85	49.32	13 628.56	43 187.19	211 508.60	67.44	28 591.90	9.11	-	182 916.70
Coolgardie	4 352.5	47 314.54	102 719.38	65 434.55	215 468.47	49.50	11 133.75	61 382.64	287 984.86	66.16	56 160.49	12.90	-	231 824.37
Kalgoorlie	4 471	99 962.76	83 004.16	61 502.94	244 469.86	54.67	13 554.04	69 422.74	327 446.64	73.23	62 743.45	14.03	-	264 703.19
Laverton	1 854.5	29 556.37	41 254.69	32 747.68	103 558.74	55.84	19 332.10	30 348.13	153 238.97	82.63	13 756.50	7.41	-	139 482.47
Leonora	4 906	26 958.08	116 951.98	50 386.44	194 296.50	39.60	7 659.57	50 358.50	252 314.57	51.42	46 960.90	9.57	-	205 353.67
Marble Bar	741	28 825.05	59 898.92	43 760.67	132 484.64	178.79	11 744.28	17 701.49	161 930.41	218.52	9 273.75	12.51	-	152 656.66
Marvel Loch	3 503	41 818.29	82 749.26	39 977.27	164 544.82	46.97	5 232.60	38 911.36	208 688.78	59.57	39 923.75	11.39	-	168 765.03
Meekatharra	1 619.5	51 715.28	75 060.88	44 122.37	170 898.53	105.52	4 518.06	25 144.65	200 561.24	123.84	17 348.15	10.71	-	183 213.09
Menzies	1 656.7	26 563.23	74 549.34	33 719.85	134 832.42	81.38	4 336.87	27 862.03	167 031.32	100.82	23 382.08	14.11	-	143 649.24
Norseman	1 901	27 363.79	70 388.47	33 427.75	131 180.01	69.00	4 128.00	20 838.00	156 146.01	82.13	25 693.41	13.51	-	130 452.60
Ora Banda	788.5	24 172.78	30 664.52	44 448.02	99 285.32	125.91	2 950.64	11 895.79	114 131.75	144.74	6 628.75	8.40	-	107 503.00
Paynes Find	1 404	17 263.05	49 811.46	19 739.96	86 814.47	61.83	4 500.53	17 285.31	108 600.31	77.35	11 678.75	8.31	-	96 921.56
Sandstone	-	-	-	3 884.56	3 884.56	-	164.76	33.31	4 082.63	-	-	-	-	4 082.63
Yarri	810.5	-	41 683.68	21 859.23	63 542.91	78.39	2 584.19	12 384.99	78 512.07	96.86	5 560.00	6.85	-	72 952.07
Head Office	-	-	-	-	-	-	-	-	-	-	10 354.40	-	10 354.40	-
Cue	-	-	-	-	-	-	-	-	-	-	120.00	-	120.00	-
SUB TOTAL	31 144.2	478 076.21	883 286.12	538 591.77	1 899 954.10	61.00	105 467.93	426 756.13	2 432 178.16	78.09	358 176.28	11.50	10 474.40	2 084 476.28
NORTHAMPTON	-	18 409.92	12 804.45	9 315.36	40 529.73	-	1 549.31	1 197.55	43 276.59	-	-	-	-	43 276.59
TOTAL	31 144.2	496 486.13	896 090.57	547 907.13	1 940 483.83	62.30	107 017.24	427 653.68	2 475 454.75	79.48	358 176.28	11.50	10 474.40	2 127 752.87
YEAR TO 30 JUNE 1985														
Boogardie	2 508.5	52 568.63	42 380.01	34 935.92	129 884.56	51.78	8 410.56	32 750.24	171 045.36	68.19	27 594.95	11.00	-	143 450.41
Coolgardie	4 017	45 547.40	112 337.63	85 087.68	242 972.71	60.49	10 236.87	43 117.23	296 326.81	73.77	52 163.60	12.99	-	244 163.21
Kalgoorlie	5 174.5	97 382.74	107 799.13	74 124.65	279 306.52	53.98	15 215.53	76 013.71	370 535.76	71.61	59 051.21	11.41	-	311 484.55
Laverton	1 019	26 915.88	28 935.33	31 037.29	86 888.50	85.27	22 458.59	12 825.40	122 172.49	119.89	9 998.75	9.81	-	112 173.74
Leonora	4 810	30 661.85	137 079.89	71 201.44	238 943.18	49.68	12 511.16	42 693.06	294 147.40	61.15	47 370.60	9.85	-	246 776.80
Marble Bar	429	28 544.35	53 233.92	34 793.14	116 571.41	271.73	8 496.87	15 498.57	140 566.85	327.66	9 561.25	22.29	-	131 005.60
Marvel Loch	3 488	53 367.58	83 415.69	45 114.28	181 897.55	52.15	8 236.30	36 811.54	226 945.39	65.06	35 424.90	10.16	-	191 520.49
Meekatharra	911	51 142.41	68 560.54	61 176.45	180 879.40	198.55	3 118.31	14 903.57	198 901.28	218.33	12 262.65	13.46	-	186 638.63
Menzies	1 705.5	26 538.11	78 826.98	34 653.37	140 018.46	82.10	4 212.37	20 510.15	164 740.98	96.59	22 973.33	13.47	-	141 767.65
Norseman	1 659	27 158.03	67 612.37	37 803.76	132 574.16	79.91	4 619.76	17 285.99	154 479.91	93.12	24 228.41	14.61	-	130 251.50
Ora Banda	1 340	22 032.53	38 379.89	49 159.23	109 571.65	81.77	1 892.51	16 499.96	127 964.12	95.50	12 540.00	9.36	-	115 424.12
Paynes Find	1 170	20 267.59	41 838.43	20 052.94	82 158.96	70.22	7 141.93	17 159.44	106 460.33	90.99	12 421.25	10.62	-	94 039.08
Sandstone	-	-	-	848.44	848.44	-	42.40	33.31	924.15	-	-	-	-	924.15
Yarri	524	-	38 370.26	21 965.38	60 335.64	115.14	3 710.01	12 949.80	76 995.45	146.94	7 080.00	13.51	-	69 915.45
Head Office	-	-	-	-	-	-	-	-	-	-	12 453.79	-	12 453.79	-
Cue	-	-	-	-	-	-	-	-	-	-	260.00	-	260.00	-
SUB TOTAL	28 755.5	482 127.10	898 770.07	601 953.97	1 982 851.14	68.95	110 303.17	359 051.97	2 452 206.28	85.28	313 919.69	10.92	12 713.79	2 138 286.59
NORTHAMPTON	-	8 152.83	5 503.63	3 552.73	17 209.19	-	46.63	866.70	18 122.52	-	-	-	-	18 122.52
TOTAL	28 755.5	490 279.93	904 273.70	605 506.70	2 000 060.33	69.55	110 349.80	359 918.67	2 470 328.80	85.91	313 919.69	10.92	12 713.79	2 156 409.11

STATE BATTERIES SCHEDULE NO. 5 STATEMENT OF RECEIPTS AND EXPENDITURE FOR CYANIDING

Battery	Tonnes	Management Supervision	Wages	Stores	Expenditure total working	Cost per tonne	Repairs and renewals	Sundries	Gross expenditure	Cost per tonne	Receipts per tonne	Profit	Loss
YEAR TO 31 DECEMBER 1984													
Coolgardie	2 195	-	21 104.46	16 996.05	38 101.05	17.35	2 414.49	8 954.89	49 470.43	22.53	-	-	49 470.43
Kalgoorlie	7 000	3 540.02	67 474.11	104 381.66	175 395.79	25.05	7 730.04	19 160.34	202 286.17	28.89	63 494.76	9.07	138 791.41
Laverton	4 100	-	11 743.17	25 879.63	37 622.80	9.17	459.91	10 310.83	48 393.54	11.80	15 035.24	3.66	33 358.30
Leonora	2 700	-	24 960.75	31 613.39	56 574.14	20.95	4 262.37	10 419.38	71 255.89	26.39	29 090.38	10.77	42 165.51
Marble Bar	5 000	544.05	14 415.57	12 179.37	27 138.99	5.42	689.03	10 518.75	38 346.77	7.66	19 526.74	3.90	18 820.03
Marvel Loch	1 550	-	8 843.91	15 152.90	23 996.81	15.43	-	5 052.72	29 049.53	18.74	16 102.99	10.38	12 946.54
Menzies	3 250	-	16 995.66	13 051.82	30 047.48	9.24	45.00	11 039.13	41 131.61	12.65	58 332.58	17.94	17 200.97
Norseman	660	-	1 431.95	6 841.93	8 273.88	12.53	453.69	1 470.80	10 198.37	15.45	15 799.37	23.93	5 601.00
Ora Banda	1 800	-	19 308.47	16 893.71	36 202.18	20.11	1 883.42	4 992.10	43 077.70	23.93	15 426.06	8.57	27 651.64
Paynes Find	-	-	-	20 128.69	20 128.69	-	8 419.73	-	28 548.42	-	-	-	28 548.43
SUB TOTAL	28 255	4 084.07	186 278.05	263 119.59	453 481.81	16.05	26 357.68	81 918.94	561 758.43	19.88	232 808.12	8.24	22 801.97
Coolgardie CIP	15 794	-	38 376.76	66 457.11	104 833.87	6.53	4 956.94	66 762.97	176 553.78	11.17	152 592.82	9.66	23 960.96
Kalgoorlie CIP	19 584	26 052.63	90 065.17	59 774.91	175 892.71	8.98	2 033.58	50 172.39	228 098.68	11.64	217 909.35	11.12	10 189.33
Meekatharra CIP	12 758.4	-	44 615.60	54 183.93	98 799.53	7.74	620.96	31 650.98	131 071.47	10.27	106 844.03	8.37	24 227.44
SUB TOTAL	48 136.4	26 052.63	173 057.53	180 415.95	379 526.11	7.88	7 611.48	148 586.34	535 723.93	11.12	477 346.20	9.91	58 377.73
SPECIAL AGREEMENTS													
TOTAL	76 391.4	30 136.70	359 335.58	443 535.64	833 007.92	10.90	33 969.16	230 505.28	1 097 482.36	14.37	201 581.49	-	201 581.49
YEAR TO 30 JUNE 1985													
Coolgardie	4 087	-	12 764.85	32 404.39	45 169.24	11.05	2 414.49	17 311.46	64 895.19	15.87	37 859.92	9.26	27 035.27
Kalgoorlie	9 100	3 540.02	4 432.43	61 995.38	69 967.83	7.69	11 808.09	21 531.35	103 307.27	11.35	125 824.37	13.83	22 517.10
Laverton	6 200	-	14 763.07	25 879.63	40 642.70	6.55	459.91	10 310.83	51 413.44	8.29	45 072.19	7.27	6 341.25
¹ Leonora	8 100	-	19 809.62	64 335.15	84 144.77	10.39	4 167.46	7 991.41	96 303.64	11.89	61 472.14	7.59	34 831.50
² Marble Bar	5 000	544.05	16 850.97	19 593.81	36 988.83	7.40	2 198.85	10 665.39	49 853.07	9.97	54 077.41	10.82	4 224.34
³ Menzies	3 250	-	15 154.23	1 620.04	16 774.27	5.16	-	9 741.87	26 516.14	8.16	10 045.24	3.09	16 470.90
⁴ Norseman	160	-	739.83	-	739.83	4.62	-	539.55	1 279.38	8.00	1 990.51	12.44	711.13
Ora Banda	1 800	261.35	18 907.32	12 884.57	32 053.24	17.81	5 326.38	6 070.58	43 450.20	24.14	1 813.70	1.01	41 636.50
⁵ Paynes Find	6 000	-	2 922.48	37 198.47	40 120.95	6.69	8 419.73	243.81	48 784.49	8.13	22 631.46	3.77	26 153.03
SUB TOTAL	43 697	4 345.42	106 344.80	255 911.44	366 601.66	8.39	34 794.91	84 406.25	485 802.82	11.12	360 786.94	8.26	125 015.88
Coolgardie CIP	19 303	-	70 405.83	84 799.21	155 205.04	8.04	8 815.50	72 452.44	236 472.98	12.25	247 344.77	12.81	10 871.79
Kalgoorlie CIP	22 754	27 413.56	102 593.74	81 765.29	211 772.59	9.31	3 353.57	50 182.13	265 308.29	11.66	244 093.62	10.73	21 214.67
Meekatharra CIP	13 795	-	52 052.39	75 816.67	127 869.06	9.27	4 764.64	29 503.30	162 137.00	11.75	148 114.69	10.74	14 022.31
SUB TOTAL	55 842	27 413.56	225 051.96	242 381.17	494 846.69	8.86	16 933.71	152 137.87	663 918.27	11.89	639 553.08	11.45	10 871.79
SPECIAL AGREEMENTS													
TOTAL	99 539	31 758.98	331 396.76	498 292.61	861 448.35	8.65	51 728.62	236 544.12	1 149 721.09	11.55	1 165 318.70	11.71	15 597.61

¹ 14 950 tonnes still under treatment estimated return \$95 134

² Above includes 3 460 tonnes of highest cost small vat treatment

³ Above includes cost of startup capital expenditure (re-usable items)

⁴ Does not include payment to prospectors

⁵ Does include \$15/t prospector gold

WELLS COMPLETED BETWEEN 1 JANUARY 1984 AND 30 JUNE 1985

Well	Operating company	Permit	Rig	Spud date	Rig released	Total depth (m)	Status
DEVELOPMENT WELLS							
CARNARVON BASIN							
Barrow Q88A	Wapet	PL-1H	H35	27.10.84	31.10.84	780	Oil well
Barrow P51A	Wapet	PL-1H	H35	01.11.84	06.11.84	823	"
Barrow Q66A	Wapet	PL-1H	H35	07.11.84	11.11.84	779	"
Barrow Q54A	Wapet	PL-1H	H35	12.11.84	16.11.84	801	"
Barrow F16M	Wapet	PL-1H	H35	23.12.84	03.01.85	945	"
Barrow F24M3	Wapet	PL-1H	H35	04.01.85	16.01.85	959	"
Barrow Q86A	Wapet	PL-1H	H35	11.03.85	15.03.85	784	"
Barrow P41A	Wapet	PL-1H	H35	15.03.85	20.03.85	776	"
Barrow Q68A	Wapet	PL-1H	H35	20.03.85	28.03.85	792	"
Barrow Q47A	Wapet	PL-1H	H35	28.03.85	02.04.85	777	"
Barrow Q45A	Wapet	PL-1H	H35	02.04.85	06.04.85	776	"
Barrow Q52A	Wapet	PL-1H	H35	07.04.85	10.04.85	790	"
Barrow Q74A	Wapet	PL-1H	H35	12.04.85	22.04.85	765	"
Barrow L14A	Wapet	PL-1H	H35	22.04.85	26.04.85	766	"
Barrow L27A	Wapet	PL-1H	H35	27.04.85	01.05.85	779	"
Barrow M11A	Wapet	PL-1H	H35	02.05.85	06.05.85	780	"
Nth Rankin A 01/SE5	Woodside	WA-1-L	NRA Platform	03.11.83	13.01.84	3 117	Gas well
Nth Rankin A 02/CW5	Woodside	WA-1-L	NRA Platform	24.01.84	28.03.84	3 537	"
Nth Rankin A 03/CW4	Woodside	WA-1-L	NRA Platform	29.03.84	30.04.84	2 890	"
Nth Rankin A 04/CW3	Woodside	WA-1-L	NRA Platform	19.08.84	10.10.84	3 541	"
Nth Rankin A 05/CW2	Woodside	WA-1-L	NRA Platform	10.10.84	06.12.84	3 552	"
Nth Rankin A 06/CW2	Woodside	WA-1-L	NRA Platform	06.12.84		Drilling (2 249)	"
Nth Rankin A 07/NE4	Woodside	WA-1-L	NRA Platform	18.04.85	14.06.85	2 894	Susp gas well
PERTH BASIN							
Woodada No. 9	Strata	PL 5	H1700	27.01.84	20.02.84	2 350	P & A
Woodada No. 10	Strata	PL 4	H1700	01.03.84	21.03.84	2 340	Oil well
EXPLORATION WELLS							
CANNING BASIN							
Triodia #1	WMC	EP 143	Coremaster 600	06.01.84	21.01.84	631	P & A
Capparis #1	"	"	"	22.01.84	01.02.84	521	"
Frankenia #1	"	"	"	01.02.84	11.02.84	479	"
Pratia #1	"	"	"	12.02.84	22.02.84	464	"
Solanum #1	"	"	"	22.02.84	10.03.84	834	"
Typha #1	"	EP 225	"	11.03.84	20.03.84	395	"
Panicum #1	"	EP 143	"	21.03.84	29.03.84	278	"
Drosera #1	"	EP 225	"	30.03.84	07.04.84	450	"
Melaleuca #1	"	EP 143	"	11.0.84	21.04.84	450	"
East Crab Creek #1	Gulf	EP 114	Houston 5000	28.10.83	02.05.84	2 813	"
(suspended between 16.11.83 and 11.4.84)							
Minjin #1	Esso	WA-109-P	Maersk Valiant	25.04.84	14.05.84	1 850	P & A
Calytrix #1	WMC	EP 225	Coremaster 600	29.04.84	06.05.84	450	"
Whitewell #1	Home Energy	EP 129	National 370	01.05.84	19.05.84	1 753	"
Notabilis #1	IEDC	EP 103	National 80E	07.05.84	27.06.84	2 808	"
Hoya #1	WMC	EP 225	Coremaster 600	07.05.84	13.05.84	450	"
Hedonia #1	Gulf	EP 114	Troy 600	11.05.84	20.06.84	1 543	"
Clianthus #1	WMC	EP 225	Coremaster 600	14.05.84	20.05.84	450	"
Terrace #1	Home Energy	EP 129	National 370	22.05.84	25.06.84	2 389	"
Kunzea #1	WMC	EP 225	Coremaster 600	27.05.84	04.06.84	450	"
Mariana #1	Home	EP 129	National 370	28.06.84	13.07.84	1 700	"
Atrax #1	Gulf	EP 294	Troy 600	05.07.84	16.07.84	786	"
Bindi #1	Santos	EP 170	National 80E	10.07.84	14.08.84	2 500	"
West Kora #1	Esso	EP 104	Franks Cabot 750	16.07.84	13.09.84	2 606	"
Selenops #1	Gulf	EP 294	Troy 600	19.07.84	04.08.84	1 263	"
Cudalgarra #1	SOC	EP 164	National 370	20.07.84	12.08.84	1 703	Susp w/ oil shows
Pictor #1	BHP	EP 175	National 370	20.08.84	03.10.84	2 146.5	Susp O G C
Ngalti #1	Ranger	EP 216	National 80E	21.08.84	18.10.84	2 757.5	P & A
Nuytsia #1	IEDC	EP 103	National 370	10.10.84	02.11.84	1 350	"
Sundown #3	Home Energy	EP 129	Troy 600	13.10.84	28.10.84	1 220	"
Kilang Kilang #1	Ranger	EP 216	National 80E	26.10.84	03.12.84	2 300	"
Philydrum #1	IEDC	EP 101	National 370	06.11.84	24.11.84	1 608	P & A
Woods Hills #1	Royal Resources	EP 231	Troy 600	11.11.84	03.12.84	1 978	"
Justago #1	IEDC	EP 102	National 80E	13.12.84	12.02.85	3 150	"
Pandorea #1	WMC	EP 143	Cooper 350	24.12.84	26.02.85	2 274.5	"
Mirbelia #1	WMC	EP 143	Cooper 350	08.03.85	12.05.85	2 670	"
East Yeeda #1	Bridge Oil	EP 114	National 80E	06.04.85	26.06.85	3 556	"
Auld #1	Churchill Resources	EP 232	Bourne 5000R	20.04.85	01.05.85	817	"
South Auld #1	Churchill Resources	EP 232	Bourne 5000R	06.05.85	13.05.85	857	"
West Terrace #1	Ampol	PL 8	TSM 6000	17.05.85	02.06.85	1 250	Oil Well
Pandanus #1	Consolidated Cinola	EP 276	Bourne 5000R	21.05.85	01.06.85	880	P & A
West Philydrum #1	IEDC	EP 101	National T-32	26.05.85	05.06.85	1 109	"
West Blackstone #1	Ampol	EP 129	National 370	02.06.85	19.06.85	1 943	"
Blina #5	Home Energy	PL 6	TSM 6000	04.06.85	28.06.85	1 600	Susp Oil well

WELLS COMPLETED BETWEEN 1 JANUARY 1984 AND 30 JUNE 1985 (cont.)

Well	Operating company	Permit	Rig	Spud date	Rig released	Total depth (m)	Status
EXPLORATION WELLS (cont.)							
CARNARVON BASIN							
Harriet #2	Occidental	WA-192-P	Maersk Valiant	18.12.83	25.02.84	2 757	P & A
Harriet #3	Occidental	WA-192-P	Maersk Valiant	28.02.84	19.04.84	2 647	Susp Oil well
Quobba #1	CNW	EP 274	Troy 600	02.03.84	10.04.84	1 931	Water well
Dixon #1	Woodside	WA-28-P	Energy Searcher	05.03.84	17.07.84	4 357	P & Susp.
South Pepper #3	Wesminco	WA-149-P	Glomar Main Pass III	18.03.84	10.04.84	2 290	P & A
South Pepper #4	Wesminco	WA-149-P	Glomar Main Pass III	12.04.84	17.05.84	1 300	P & Susp
East Pepper #1	Wesminco	WA-149-P	Glomar Main Pass III	19.05.84	06.06.84	1 320	P & A
Harriet #4	Occidental	WA-192-P	Maersk Valiant	21.05.84	25.06.84	2 441	Susp Oil well
Talisman #1	Marathon	WA-191-P	Sedco 600	14.06.84	30.09.84	2 924.6	Susp Oil well
Outtrim #1	Esso	WA-155-P	Ocean Digger	22.06.84	13.07.84	1 725	P & A
Echo Bluff #1	Avon	EP 137	Franks Cabot 750	13.06.84	03.07.84	1 204	P & Susp
Harriet #5	Occidental	WA-192-P	Maersk Valiant	26.06.84	25.07.84	2 445	Susp Oil well
Barrow G57M	Wapet	PL-1H	H35	01.07.84	15.07.84	974	Oil well
Dailey #1	Esso	WA-155-P	Ocean Digger	15.07.84	11.08.84	2 541	P & A
Barrow M84M	Wapet	PL-1H	H35	16.07.84	30.07.84	1 017	Shut-in
Harriet #6	Occidental	WA-192-P	Maersk Valiant	25.07.84	27.08.84	2 242	Susp Oil well
Barrow E11M	Wapet	PL-1H	H35	31.07.84	15.08.84	975	Oil well
Barrow F45M	Wapet	PL-1H	H35	16.08.84	27.08.84	925	Oil well
Samson #1	Woodside	WA-1-P	Energy Searcher	17.08.84	19.10.84	3 750	P & A
Barrow F71M	Wapet	PL-1H	H35	29.08.84	09.09.84	887	Oil well
Lenita #1	Occidental	WA-192-P	Maersk Valiant	31.08.84	20.09.84	2 232	Susp oil well
Barrow K78M	Wapet	PL-1H	H35	10.09.84	20.09.84	98	Oil well
Burna #1	Esso	EP 188	Franks Cabot 750	20.09.84	09.10.84	767.6	P & A
Barrow G27M	Wapet	PL-1H	H35	21.09.84	02.10.84	945	Oil Well
Barrow L48M	Wapet	PL-1H	H35	03.10.84	13.10.84	970	Shut-in
Barrow L26M	Wapet	PL-1H	H35	14.10.84	26.10.84	1 003	Shut-in
Gascoyne #1	Esso	EP 189	Franks Cabot 750	30.10.84	09.11.84	525.5	P & A
Montague #1	Woodside	WA-28-P	Energy Searcher	29.10.84	02.06.85	4 362	P & A
Barrow Q47M	Wapet	PL-1H	H35	17.11.84	29.11.84	1 075	Oil well
Barrow J27M	Wapet	PL-1H	H35	30.11.84	10.12.84	1 036	"
Barrow F37M	Wapet	PL-1H	H35	11.12.84	22.12.84	920	"
West Giralia #1	Golden West	EP 166	Bourne 5000R	11.01.85	18.01.85	789	P & A
Barrow G77M	Wapet	PL-1H	H35	16.01.85	26.01.85	948	Oil well
North Giralia #1	Golden West	EP 166	Bourne 5000R	22.01.85	07.02.85	936	Water well
Barrow G55M	Wapet	PL-1H	H35	27.01.85	05.02.85	970	Oil well
Barrow G38M	Wapet	PL-1H	H35	06.02.85	15.02.85	935	"
Barrow M72M	Wapet	PL-1H	H35	16.02.85	26.02.85	988	"
Whitlock Dam #1	Golden West	EP 166	Bourne 5000R	19.02.85	23.02.85	413	Water well
Barrow L34M	Wapet	PL-1H	H35	27.02.85	10.03.85	994	Oil well
Chervil #2	WMC	WA-149-P	Glomar Main Pass III	04.04.85	26.04.85	1 360	P & A
Chervil #3	WMC	WA-149-P	Glomar Main Pass III	27.04.85	08.05.85	1 350	P & A
Barrow M42M	Wapet	PL-1H	H35	07.05.85	17.05.85	1 010	Oil well
Elder #1	WMC	WA-149-P	Glomar Main Pass III	09.05.85	05.06.85	2 500	P & A
Barrow B18M	Wapet	PL-1H	H35	18.05.85	28.05.85	920	Oil well
Barrow G75	Wapet	PL-1H	H35	29.05.85	08.06.85	980	"
Nyanda #1	Bond	WA-192-P	Maersk Valiant	03.06.85	26.06.85	2 467	P & A
Saladin #1	Wapet	WA-24-P	Glomar Main Pass III	06.06.85	26.06.85	1830	Susp Oil well
Barrow Q23M	Wapet	PL-1H	H35	09.06.85	19.06.85	1 060	Oil well
PERTH BASIN							
Leander Reef #1	Diamond Shamrock	WA-162-P	Regional Endeavour	08.11.83	08.01.84	3 234	P & A
Narkarino #1	Balmoral Resources	EP 201	Failing HRW 2500	09.01.84	20.01.84	600	P & A
Mullaloo #1	Esso	WA-170-P	Ocean Digger	15.04.84	20.05.84	2 030	P & A
Minder Reef #1	Esso	WA-170-P	Ocean Digger	23.05.84	09.06.84	1 530	P & A
East Heaton #1	WMC	EP 23	National 370	01.02.85	23.02.85	2 520	Water well
Bonniefield #1	Balmoral	EP 201	Bourne 5000R	01.03.85	12.03.85	1 012	P & A
Robb #1	Strata	EP 100	National 370	01.03.85	20.03.85	1 982	P & A
Wattle Grove #1	Balmoral	EP 201	Bourne 5000R	13.03.85	24.03.85	822	P & A
BONAPARTE BASIN							
Turtle #1	Wesminco	WA-128-P	Glomar Main Pass III	07.01.84	09.03.84	2 700	P & A
Cambridge #1	WMC	WA-128-P	Glomar Main Pass III	24.08.84	19.09.84	2 228	P & A
Skull #1	Aquitaine	EP 126	Troy 600	20.08.84	02.10.84	2 000	P & A
Peewit #1	WMC	WA-147-P	Glomar Main Pass III	24.09.84	04.10.84	1 260	P & A
Matilda #1	WMC	WA-128-P	Glomar Main Pass III	22.02.85	27.03.85	2 313	P & A
BROWSE BASIN							
Echuca Shoals #1	Woodside	WA-35-P	Energy Searcher	08.11.83	29.02.84	4 365	P & A
OFFICER BASIN							
Lungkarta #1	Shell	EP 178	National 110	26.09.84	14.11.84	1 770	P & A
HAMERSLEY BASIN							
Fortescue River #1	Multiplex	EP 304	Alma A6	17.08.84	09.11.84	652	Water well
Fortescue River #1A	Multiplex	EP 304	National 370	05.04.85	23.05.85	2 177	P & A

GEOPHYSICAL SURVEYS CONDUCTED BETWEEN 1 JANUARY 1984 AND 30 JUNE 1985

Name of Survey (SS = Seismic Survey MSS = Marine Seismic Survey)	Operator	Permit	Start	Finish	km Shot
CARNARVON BASIN					
Wilcox North MSS	Woodside	WA-28-P	08.01.84	13.01.84	278
Corella MSS	Marathon	WA-191-P	04.01.84	07.01.84	255.872
Mawby-East Angel MSS	Woodside	WA-1-P	19.12.83	05.01.84	1 708.078
084H MSS	Occidental	WA-192-P	14.01.84	17.01.84	188.663
Koolinda (444) MSS	Wapet	WA-24-P	04.04.84	13.04.84	160
North Giralia SS	Golden West	EP 166	08.06.84	25.06.84	176.72
Colleen MSS	Wesminco	WA-149-P	26.06.84	26.06.84	31.86
J84A SS	Esso	EP 110	09.11.84	12.12.84	207.925
Robe Aeromagnetic Survey	Avon	EP 137	08.11.84	25.11.84	4 100
Dixon-North Kendrew MSS	Woodside	WA-191-P,	15.02.85	25.03.85	1 036.7
		Vacant			
		PLs 1-6,			
		WA-1-P			
B85 MSS	Bond	WA-192-P	16.02.85	06.03.85	1 166
Constance MSS	WMC	WA-149-P	19.02.85	27.02.85	251.5
Barrow 7 (445) MSS	Wapet	PL-2H	30.03.85	04.04.85	190.25
		WA-23-P			
1985 Rough Range Trend MSS	Ampol	EP 41	20.04.85	29.05.85	289.49
Monte Bello (446) MSS	Wapet	WA-25-P	02.06.85	10.06.85	642.54
Rosemary Bank MSS	Woodside	WA-1-P,	03.06.85	29.06.85	2 488
		WA-28-P,			
		WA-4-L,			
		WA-5-L,			
		WA-6-L			
Norma MSS	WMC	WA-149-P	11.06.85	18.06.85	798.78
C85X Experimental SS	Esso	WA-155-P	31.05.85	01.06.85	70.2
Giralia Aeromagnetic Survey	Golden West	EP 166	05.07.85	11.07.85	4 000
Scientific Investigation	GSI	Vacant	01.03.85	24.03.85	1 145 of
		No. 18SL			2 130km
CANNING BASIN					
Colorado 1983 SS	Royal Resources	EP 231	26.12.83	20.01.84	140
Sandridge Radiometric Survey	Meridian	EP 164	25.03.84	30.03.84	350
1984 Fitzroy Basin (Phase III) SS	IEDC	EP 103	03.05.84	29.10.84	538.1
1984 Fitzroy Basin (Phase I) SS	IEDC	EP 101	25.05.84	21.08.84	211.9
Meda 1984 SS	Home	EP 129	01.06.84	18.08.84	556.83
1984 Fitzroy Basin (Phase II) SS	IEDC	EP 102	09.06.84	31.07.84	405
F84A SS (Point Torment)	Esso	EP 104	20.06.84	25.08.84	225.2
1984 EP 114 SS	Gulf	EP 114	10.06.84	10.07.84	238.7
Boab SS	WMC	EPs 143/	03.07.84	04.11.84	592
		225			
Thunder Ridge SS	SOC	EP 142	16.07.84	31.08.84	473.94
Prescott 1984 SS	Great Eastern	EP 240	21.07.84	04.08.84	80
Sahara South SS	Churchill	EP 232	08.09.84	15.10.84	203.8
1984 Fitzroy Basin (Phase IV) SS	IEDC	EP 97	19.09.84	18.10.84	244.152

Name of Survey	Operator	Permit	Start	Finish	km Shot
CANNING BASIN (continued)					
Thangoo SS	Western	EP 142	10.09.84	28.10.84	440
F84B SS	Esso	EP 104	10.10.84	25.10.84	167.35
Gwenneth Lakes SS	Meridian	EP 221	30.10.84	24.11.84	150.05
Anna Plains SS	SOC	EP 142	29.10.84	16.11.84	200.4
1984 Fitzroy Basin (Phase I)	IEDC	EP 101	29.10.84	10.11.84	96
Extension SS					
Capricorn SS	Meridian	EP 164	18.11.84	20.12.84	344.44
Chingal SS	Earth Energy Resources	EP 231	03.12.84	20.12.84	114.5
Windy Corner SS	Sydney Oil	EP 205	07.01.85	25.01.85	200.16
Dolphin MSS (2D)	Marathon	WA-191-P	16.01.85	27.01.85	280.250
De Grey MSS	Lasmo	WA-58-P	24.01.85	13.02.85	251.256
Dolphin MSS	Marathon	WA-191-P	29.01.85	06.02.85	660.627
Shell 308 SS	Shell	EP 308	25.03.85	17.07.85	789.816
1985 Fitzroy Basin (Phase I) SS	IEDC	EP 101	01.05.85	13.05.85	171
Meda 1985 SS	Home	EP 129	03.06.85	27.06.85	232.515
1985 Fitzroy Basin (Phase V) SS	IEDC	EP 97	24.05.85	02.06.85	56.2
Scientific Investigation	GSI	Vacant	01.03.85	24.03.85	985 of
		No. 18SL			2 130 km
PERTH BASIN					
Erangy Spring SS	WMC	EP 23	30.03.84	03.06.84	95
1984 Eneabba SS (S84)	Strata	EP 100	27.04.84	24.05.84	180.30
1984 WA-162-P MSS	Diamond Shamrock	WA-162-P	02.07.84	23.07.84	942.88
Nine Mile SS	Lassoc	EP 201	28.05.84	02.06.84	27
Nine Mile Exp SS	Lassoc	EP 201	25.05.84	26.05.84	6.5
Bonniefield SS	Lassoc	EP 201	19.05.84	25.05.84	70
White Lake SS	Phoenix	EP 204	30.11.84	08.12.84	53.28
Goonderoo SS	Agnew Clough	EP 278	11.05.85	18.05.85	7
V85A MSS	BHP	WA-170-P	12.07.85	19.07.85	544.83
BONAPARTE BASIN					
T-84 MSS	Aquitaine	WA-18-P	07.04.84	08.04.84	179.64
T-84 MSS (Phase II)	Aquitaine	WA-18-P	28.05.84	28.05.84	43.6
Suzanne MSS	WMC	WA-128-P	24.03.84	02.04.84	503.50
Suzanne Extension MSS	WMC	WA-128-P	30.03.84	07.04.84	570.69
Maura MSS	WMC	WA-147-P	23.06.84	30.06.85	670.95
BROWSE BASIN					
1983 Caswell-Echuca MSS	Woodside	WA-34-P,	19.07.84	25.07.84	300.064
		WA-35-P			308.145
Scientific Investigation 17SL	GSI	Vacant	15.05.84	21.05.84	525.66
Scobell MSS	Seahawk	WA-197-P	28.03.85	02.04.85	200
Fantome MSS	Seahawk	WA-197-P,	02.04.85	12.04.85	601
		WA-180-P			
OFFICER BASIN					
Salt Pan SS	News Corp	EP 186	26.02.84	06.03.84	124.18
Hancock SS	News Corp	EP 187	14.02.84	25.02.84	143.71
HAMERSLEY BASIN					
EP 304-1984 Gravity Survey	Multiplex	EP 304	21.03.84	30.03.84	600
Portescue River SS	Multiplex	EP 304	12.11.84	15.11.84	20

SUMMARY COMPARISON OF EXPLORATION PERMIT DEALINGS

	Year to 31 December 1983		Year to 31 December 1984		Half year to 30 June 1985	
	No.	Area (km ²)	No.	Area (km ²)	No.	Area (km ²)
AREA ADVERTISED						
Onshore	6	40 432	6	62 500	-	-
Offshore	10	113 300	10	116 195	4	43 483
Total	16	153 732	16	178 695	4	43 483
PERMITS GRANTED						
Onshore	4	33 859	2	17 870	7	38 220
Offshore	-	-	1	2 575	-	-
Total	4	33 859	3	20 445	7	38 220
PERMIT APPLICATIONS (pending at period end)						
Onshore	-	-	4	19 414	2	15 955
Offshore	2	16 760	-	-	3	33 171
Total	2	16 760	4	19 414	5	49 126
PERMITS HELD						
Onshore	69	630 799	57	491 079	63	519 331
Offshore	43	393 745	34	291 820	30	248 932
Total	112	1 024 544	91	782 899	93	768 263
PERMITS SURRENDERED						
Onshore	9	124 585	10	120 980	1	9 968
Offshore	9	127 099	6	25 310	2	4 037
Total	18	251 684	16	146 290	3	14 005
PERMIT RENEWALS						
Onshore	3	32 822	1	2 280	6	45 973
Offshore	3	17 390	1	725	-	-
Total	6	50 212	2	3 005	6	45 973
PERMITS CANCELLED						
Onshore	3	28 171	2	25 730	-	-
Offshore	4	54 221	2	40 580	2	38 851
Total	7	82 392	4	66 310	2	38 851
PERMITS EXPIRED						
Onshore	2	11 823	2	10 880	-	-
Offshore	3	60 182	2	38 610	-	-
Total	5	72 005	4	49 490	-	-

SUMMARY OF IDENTIFIED RECOVERABLE RESERVES AT 30 JUNE 1985

	OIL (10 ⁶ m ³)		GAS C ₁ + C ₂ (10 ⁹ m ³)		LPG C ₃ + C ₄ (10 ⁶ m ³)		CONDENSATE C ₅ + C ₆ (10 ⁶ m ³)	
	P1	P2	P1	P2	P1	P2	P1	P2
PRODUCING FIELDS								
Barrow Island	7.75	8.37	-	10.92	0.05	0.05	-	0.38
Blina	0.10	0.26	-	-	-	-	-	-
Dongara	0.05	-	1.14	2.97	-	-	-	-
Mt Horner	under review		-	-	-	-	-	-
North Rankin	-	-	228.04	275.44	15.80	18.20	25.07	30.26
Sundown	0.16	0.18	-	-	-	-	-	-
Woodada	-	-	0.28	1.24	-	-	-	-
TOTAL	8.06	8.81	229.46	290.57	15.85	18.25	25.07	30.64
UNDEVELOPED FIELDS								
Angel	-	-	25.80	62.20	-	-	7.16	18.00
Brecknock	-	-	112.00	176.00	-	-	6.33	9.65
Brewster	-	-	-	55.00	-	-	-	-
Chervil	0.58	0.58	-	-	-	-	-	-
Goodwyn	3.30	6.13	82.64	98.04	8.70	11.10	16.17	19.03
Gorgon	-	-	-	57.19	-	-	-	0.16
Central Gorgon	-	-	-	45.57	-	-	-	0.40
North Gorgon	-	-	-	130.34	-	-	-	1.66
Rankin	-	-	5.66	5.66	-	-	0.69	0.69
Harriet	1.68	1.68	-	-	-	-	-	-
North Herald	0.23	0.23	-	-	-	-	-	-
Scarborough	-	-	170.00	555.00	-	-	-	-
Scott Reef	-	-	387.00	701.00	-	-	27.20	46.90
South Pepper	0.90	0.90	-	-	-	-	-	-
Spar	-	-	-	7.04	-	-	-	2.53
Tern	-	-	15.08	17.81	-	-	-	-
Tidepole	0.97	1.18	13.00	17.20	-	-	1.61	2.13
Tubridgi	-	-	2.14	2.16	-	-	-	-
West Tryal Rocks	-	-	-	80.73	-	-	-	3.93
Wilcox	-	-	12.40	19.50	-	-	3.62	5.47
TOTAL	7.66	10.70	825.72	2 030.44	8.70	11.10	62.78	110.55
TOTAL RESERVES	15.72	19.51	1 055.18	2 321.01	24.55	29.35	87.85	141.19
P1 probability 75%; P2 probability 25%. These figures have been prepared by the Mines Department.								

PETROLEUM PRODUCTION

Field or reservoir	No. of producing wells as at		Production for year 1984			Production Jan 1 to June 30 1985			Cumulative production		
	31.12.84	30.6.85	Gas	Condensate	Oil	Gas	Condensate	Oil	Gas	Condensate	Oil
			(10 ⁶ m ³)	(10 ³ kL)	(10 ³ kL)	(10 ⁶ m ³)	(10 ³ kL)	(10 ³ kL)	(10 ⁶ m ³)	(10 ³ kL)	(10 ³ kL)
CARNARVON BASIN											
North Rankin	4	5	564.8	65.3	-	662.7	81.4	-	1 227.5	146.7	-
Barrow Island	368	376	119.0	-	1 184.7	53.6	-	581.7	2 974.6	-	32 959.6
NORTHERN PERTH BASIN											
Dongara	14	11	693.7	2.3	8.1	281.6	0.8	2.9	10 217.4	39.0	126.1
Mondarra	2	2	14.0	0.2	-	8.1	0.1	-	578.2	8.1	-
Yardarino	1	1	7.4	0.1	-	2.7	0.1	-	121.4	0.7	-
Woodada	2	2	180.2	1.3	-	27.7	0.2	-	464.5	3.5	-
Mt Horner	1	1	-	-	0.7	-	-	0.3	-	-	1.0
CANNING BASIN											
Blina	4	4	-	-	45.7	-	-	17.4	-	-	79.5
Sundown	2	2	-	-	6.5	-	-	2.7	-	-	10.3
TOTALS	398	404	1 579.1	69.2	1 245.7	1 036.4	82.5	605.0	5 583.6	198.0	33 176.5

Note: LPG and natural gasoline were only produced at Barrow Island and production figures are:

	LPG	nat. gasoline		LPG	nat. gasoline
at 31 Dec 1984	2 537 kL	6 576 kL	at 30 Jun 1985	968 kL	3 885 kL

BARROW ISLAND - WELL COMPLETION STATUS BY RESERVOIR

Horizon/pool	Status at 31 December 1984					Status at 30 June 1985				
	On	On	Shut-in	Abandoned	Total	On	On	Shut-in	Abandoned	Total
	Production	Injection				Production	Injection			
Tertiary Carbonates	-	8	1	-	9	-	8	1	-	9
Early Cretaceous - Gearle	3	-	10	-	13	2	-	11	-	13
- Windalia Radiolarite	-	-	1	-	1	-	-	1	-	1
- Windalia Sandstone	324	174	83	5	586	322	189	81	5	597
- Muderong	33	-	17	1	51	43	-	17	1	61
- Flacourt (Oil)	-	-	-	-	0	-	-	-	-	0
- Flacourt (Water Source)	5	-	5	1	11	6	-	4	1	11
- 5500' to 6200' sands	1	-	2	-	3	1	-	2	-	3
Late Jurassic	2	-	4	-	6	2	-	4	-	6
"Other Jurassic"	-	-	1	1	2	-	-	1	1	2
Middle Jurassic	-	-	3	-	3	-	-	3	-	3
Totals	368	182	127	8	685	376	197	125	8	706

Notes: Tertiary Carbonates include salt water disposal. Abandoned wells are fully plugged and abandoned. Recompleted wells are included in horizon/pool of current completion.

DISPOSAL OF PETROLEUM

Field	Year to 31 December 1984				Half year to 30 June 1985			
	Gas sold (10 ⁶ m ³)	Oil sold (10 ³ kL)	Condensate sold (10 ³ kL)	Royalty paid \$	Gas sold (10 ⁶ m ³)	Oil sold (10 ³ kL)	Condensate sold (10 ³ kL)	Royalty paid \$
Barrow Island	-	1 224.1	-	13 218 507	-	555.0	-	7 397 662
Dongarra, Mondarra, Yardarino	698.1	8.2	2.6	2 282 850	285.9	2.9	1.0	1 016 635
Woodada	179.0	-	1.3	1 361 530	27.6	-	0.2	313 267
Mt Horner	-	0.7	-	8 159	-	0.3	-	5 178
Blina, Sundown	-	50.6	-	780 364	-	14.4	-	398 171
North Rankin	456.7	-	24.9	189 495	572.1	-	94.6	770 608
TOTALS	1 333.8	1 283.6	28.8	17 840 905	885.6	572.6	95.8	9 901 521

Note: West Australian Petroleum Pty Ltd also sold 3 885 kL natural gasoline and 779 kL of LPG some of which was blended with crude.

ACCIDENT STATISTICS RELATING TO THE PETROLEUM
EXPLORATION, PRODUCTION AND PIPELINE INDUSTRY

	Year ending 31 December 1984			Year ending 30 June 1985		
	Onshore	Offshore	Total	Onshore	Offshore	Total
NATURE OF INJURY						
Head	-	6	6	1	2	3
Eye	-	14	14	1	2	3
Trunk	10	35	45	13	11	24
Arm	2	17	19	2	4	6
Hand	5	19	24	5	5	10
Leg	3	13	16	6	7	13
Foot	4	14	18	2	2	4
Occupational	-	1	1	-	-	-
Other	-	1	1	-	-	-
AGENCY OF INJURY						
Machinery in operation	1	7	8	6	4	10
Vehicles	1	-	1	3	-	3
Hand tools	1	4	5	5	3	8
Power tools	-	1	1	-	1	1
Manual handling	9	14	23	4	7	11
Harmful contacts	-	14	14	1	1	2
Persons falling or striking	7	42	49	5	9	14
Objects falling or flying	2	24	24	4	5	9
Other	2	5	7	1	-	1
MAGNITUDE OF INJURY						
Minor	19	78	97	16	20	36
Serious	4	26	30	13	9	22
Fatal	-	1	1	-	1	1
TIME FACTOR						
Man-hours exposure	930 643	1 935 661	286 630	484 259	825 802	1 310 061
Man-hours lost	11 340	21 012	32 352	8 460	5 508	13 968

AVERAGE NUMBER OF PERSONS EMPLOYED IN MINING OPERATIONS
IN WESTERN AUSTRALIA DURING 1984 AND 1984/85

MINERAL Company	Location	1984			1984/85		
		Above Ground	Below Ground	Total	Above Ground	Below Ground	Total
ALUMINA							
Alcoa of Australia Ltd	Jarrahdale/Kwinana	1 628	-	1 628	1 582	-	1 582
	Del Park/ Huntley/Pinjarra	1 656	-	1 656	1 621	-	1 656
	Wagerup	439	-	439	451	-	451
	Administration	214	-	214	234	-	234
Worsley Alumina Pty Ltd	Worsley	681	-	681	746	-	746
				<u>4 618</u>			<u>4 634</u>
COAL							
Griffin Coal Mining Co Ltd	Collie	472	-	472	478	-	478
Western Collieries Limited	Collie	359	338	697	360	336	696
				<u>1 169</u>			<u>1 174</u>
COPPER/SILVER/ZINC							
Seltrust Mining Corporation Pty Ltd	Teutonic Bore	139	-	139	119	-	119
DIAMONDS							
Argyle Diamond Mines Joint Venture	Kimberley	142	-	142	174	-	174
GOLD							
Australis Mining N.L.	Dundas/Norseman	34	-	34	34	-	34
Bamboo Creek Joint Venture	Bamboo Creek	-	-	-	79	19	98
Broken Hill Pty Minerals Ltd	Ora Banda	-	-	-	12	-	12
Central Norseman Gold Corporation N.L.	Norseman	202	228	430	200	230	430
Edjudina Gold Mines Pty Ltd	Edjudina	64	-	64	72	-	72
Gold Resources Pty Ltd	Boulder	83	82	165	79	87	166
Great Boulder Mines (WMC)	Boulder	12	-	12	12	-	12
Great Victoria Gold Ltd	Marvel Loch	30	-	30	26	-	26
Harbour Lights Mining Ltd	Leonora	-	-	-	65	-	65
Hill 50 Gold Mine NL	Mt Magnet	108	85	193	105	86	191
Horseshoe Lights Gold Pty Ltd	Horseshoe	28	-	28	28	-	28
Kia Ora Gold Corporation Ltd	Marvel Loch	45	36	81	55	25	80
Kalgoorlie Lake View (Perseverance)	Boulder	263	361	624	232	386	618
Kalgoorlie Lake View (Mt. Charlotte)	Kalgoorlie	28	184	212	34	200	234
Metana Minerals N.L.	Reedy/Nullagine	34	-	34	23	-	23
New Broken Hill Consolidated Ltd	Leonora	34	-	34	36	-	36
Newmont Pty Ltd	Telfer	211	-	211	221	-	221
North Kalgurli Mines Ltd	Boulder	154	197	351	146	170	316
Otter Exploration N.L.	Lake Grace	12	-	12	12	-	12
Sons Of Gwalia Ltd	Leonora	20	-	20	23	-	23
Southern Goldfields Ltd	Marvel Loch	30	-	30	30	-	30
V & D Ridolfo Pty Ltd	Mt. Magnet	25	-	25	25	-	25
Western Alluvials Pty Ltd	Wiluna	18	-	18	20	-	20
WMC Great Boulder Holdings	Agnew	-	-	-	4	-	4
WMC Great Boulder Holdings	Kambalda	55	36	91	61	33	94
WMC Great Boulder Holdings	Windarra	42	67	109	41	67	108
WMC Sand King	Ora Banda	10	-	10	10	-	10
Whim Creek Consolidated N.L.	Meekatharra	77	-	77	77	-	77
All Other Operators	State Generally	958	78	1 036	966	105	1 071
				<u>3 931</u>			<u>4 136</u>
IRON ORE							
Broken Hill Pty Ltd	Yampi/Kwinana	451	-	451	669	-	669
Cliffs Western Australian Mining Co Pty Ltd	Pannawonica/Cape Lambert	1 180	-	1 180	1 346	-	1 346
Goldsworth Mining Ltd	Pilbara/Port Hedland	925	-	925	910	-	910
Hammersley Iron Pty Ltd	Tom Price-Paraburdoo/Dampier	3 843	-	3 843	3 859	-	3 859
Mt. Newman Mining Co Ltd	Newman/Port Hedland	3 443	-	3 443	3 554	-	3 554
				<u>9 842</u>			<u>10 338</u>
MINERAL BEACH SANDS							
Allied Eneabba Pty Ltd	Eneabba	327	-	327	332	-	332
Associated Minerals Consolidated Ltd	Capel	125	-	125	125	-	125
	Eneabba	112	-	112	112	-	112
Cable Sands Pty Ltd	Capel	82	-	82	82	-	82
Westralian Sands Ltd	Capel	135	-	135	150	-	150
				<u>781</u>			<u>801</u>
NICKEL							
Agnew Mining Co Pty Ltd	Leinster	247	91	338	239	84	323
Western Mining Corporation Ltd	Kalgoorlie	355	-	355	360	-	360
	Kambalda	701	675	1 376	698	680	1 378
	Kwinana Refinery	406	-	406	404	-	404
	Mt. Windarra	188	96	284	182	95	277
				<u>2 759</u>			<u>2 742</u>
PETROLEUM PRODUCTS							
Strata Oil N.L.	Woodada	7	-	7	7	-	7
West Australian Petroleum Pty Ltd	Barrow Island	167	-	167	179	-	179
Woodside Offshore Petroleum Pty Ltd	Dongara	9	-	9	9	-	9
	North Rankin A/Burrup Peninsula	926	-	926	1070	-	1 070
				<u>1 109</u>			<u>1 265</u>
SALT							
Dampier Salt Ltd	Dampier	208	-	208	210	-	210
	Lake McLeod	96	-	96	101	-	101
Leslie Salt Co	Port Hedland	54	-	54	55	-	55
Shark Bay Joint Venture	Shark Bay	125	-	125	145	-	145
				<u>483</u>			<u>511</u>
ALL OTHER MINERALS (Including Rock Quarries)							
		573	2	575	596	2	598
TOTALS:		22 992	2 556	25 548	23 887	2 605	26 492

ROYALTIES COLLECTED 1983, 1984 AND 1984/85

Mineral	Royalty collected \$		
	1983	1984	1984/85
Alumina	6 708 516	8 859 777	9 638 703
Building stone	254	794	896
Clay	57 786	95 558	128 566
Coal	738 422	879 162	1 090 174
Cobalt	50 772	84 372	93 540
Construction materials			
aggregate	1 252	36 548	2 169
gravel	264	12 399	14 684
rock	16 193	13 728	14 262
sand	22 875	92 381	108 941
Copper	624 097	276 480	586 568
Diamond	2 035 245	3 450 883	3 062 632
Diatomite	-	51	120
Dilomite	1 841	-	60
Feldspar	209	795	1 655
Garnet sand	4 282	5 302	7 177
Gold	72 143	92 987	100 622
Gypsum	194 217	191 675	159 134
Iron ore	68 996 585	84 053 078	88 531 269
Limestone	142 556	83 051	88 437
Magnesite	-	10 797	10 797
Magnetite	51	-	-
Mica	2 280	402	-
Mineral beach sands			
ilmenite	542 206	901 471	909 724
leucoxene	49 979	146 184	98 546
monazite	122 256	170 989	182 708
rutile	661 662	550 256	492 691
xenotime	1 761	2 059	985
zircon	742 614	1 013 877	987 802
Nickel	3 968 209	5 030 833	5 572 626
Palladium	10 488	20 645	23 018
Petroleum Products			
condensate	35 686	47 833	179 770
crude oil	15 196 442	14 086 943	13 621 418
natural gas	3 211 243	3 706 130	3 754 615
Platinum	10 488	20 639	23 011
Salt	324 041	433 364	505 586
Semi-precious stones			
amethyst	5 531	4 514	5 697
moss opal	2	38	80
Silica sand	108 598	157 039	160 217
Silver	131 583	11 378	76 573
Spodumene	1 225	80 128	82 179
Talc	75 970	73 430	74 073
Tantalite	78 561	89 663	67 425
Tin concentrate	247 045	195 849	144 785
Vermiculite	42	270	596
Zinc concentrate	538 525	561 311	389 744
Total value	105 733 997	125 545 063	130 994 275

QUANTITY AND VALUE OF MINERALS 1983, 1984, 1984/85

Mineral	Unit of Quantity	1983		1984		1984/85	
		Quantity	Value (\$)	Quantity	Value (\$)	Quantity	Value (\$)
Alumina	t	3 983 098	745 084 355	5 004 998	940 855 670	5 326 982	1 056 839 641
Building stone							
quartz	t	2 503	112 815	2 272	102 224	2 644	118 980
quartzite	t	488	7 958	160	2 880	-	-
Clay							
alunite	t	1 147	7 003	-	-	-	-
cement clay	t	20 082	50 205	28 693	71 734	28 155	70 389
fire clay	t	152 554	183 791	221 770	226 326	242 489	292 136
kaolin	t	169	1 014	85	3 199	1 710	31 505
white clay	t	45 760	145 798	53 134	157 932	-	-
Coal	t	3 952 768	99 640 822	3 692 665	105 930 163	3 672 619	109 120 090
Cobalt	t	477	3 169 424	520	6 556 752	449	5 937 452
Construction materials							
aggregate	t	5 033	17 486	126 766	69 696	15 250	56 035
gravel	t	60	240	46 422	52 966	58 944	67 107
rock	t	72 474	144 945	47 557	94 712	46 524	92 686
sand	t	125 405	343 272	236 768	1 146 541	739 311	1 958 695
Copper	t	3 456	4 228 393	3 608	3 348 810	3 424	3 141 119
Copper concentrates	t	35 745	7 284 445	38 452	11 145 646	48 533	12 803 570
Cupreous ore	t	-	-	-	-	42	6 748
Diamonds	carats	6 539 544	68 978 807	5 692 193	45 155 034	5 569 285	45 056 768
Diatomite	t	-	-	257	1 029	257	1 029
Dolomite	t	-	-	-	-	300	2 100
Feldspar	t	3 551	35 507	3 158	21 425	4 779	32 017
Garnet sands	t	2 657	92 967	3 287	115 080	4 269	149 459
Gold	kg	23 881	359 374 810	32 111	422 248 335	37 425	508 891 876
Gypsum	t	439 444	5 500 499	637 683	7 152 245	545 151	6 169 189
Iron ore	t	74 983 543	1 546 325 341	90 631 128	1 671 285 288	89 296 548	1 830 519 885
Limestone	t	345 481	1 686 993	184 696	968 942	209 618	1 187 327
Magnesite	t	-	-	16 729	215 936	16 729	215 936
Mica	t	173	45 591	30	8 037	-	-
Mineral beach sands							
ilmenite	t	871 302)	-	1 336 332)	-	1 187 577)	-
reduced ilmenite	t	-)	25 149 796	140)	53 989 350	140)	55 385 867
upgraded ilmenite	t	10 044)	-	72 133)	-	69 516)	-
kyanite	t	-	-	-	-	39	3 618
leucoxene	t	10 193	1 842 513	32 110	6 951 500	19 571	4 583 699
monazite	t	12 877	5 485 523	15 592	6 767 117	16 590	7 512 887
rutile	t	86 203	20 645 888	60 651	18 834 203	73 484	25 457 548
xenotime	t	-	-	66	358 048	42	397 547
zircon	t	272 391	29 964 159	336 950	37 675 931	362 339	41 279 076
Nickel concentrates	t	494 007	288 621 810	496 630	320 229 972	486 491	363 306 720
Nickel ore	t	19 399	2 919 743	-	-	-	-
Palladium	kg	449	1 963 478	523	2 693 559	461	2 491 786
Petroleum							
condensate	t	3 170	n.a.	22 205	5 558 723	94 861	n.a.
crude oil	kL	1 260 801	300 712 136	1 295 520	283 635 789	1 216 456	284 790 518
natural gas	'000m ³	1 052 738	54 528 779	1 332 156	99 538 071	1 759 631	165 844 011
Platinum	kg	52	863 905	66	1 010 176	81	1 225 011
Salt	t	3 868 254	59 706 681	4 674 017	75 252 113	4 822 931	88 560 999
Semi-precious stones							
amethyst	kg	15 463	73 751	13 676	60 193	59 586	90 368
moss opal	kg	51	33	792	511	-	-
Silica sand	t	292 003	458 499	352 577	2 251 827	404 636	1 274 898
Silver	kg	25 596	11 077 227	38 433	11 505 377	44 670	12 761 245
Spodumene	t	2 492	464 041	6 668	1 380 851	8 505	1 852 772
Talc	t	164 859	n.a.	160 976	n.a.	182 613	n.a.
Tantalite	t	272	6 753 268	145	5 224 379	69	4 219 279
Tin concentrates	t	775	7 621 570	720	6 988 222	569	9 442 807
Vermiculite	t	56	840	423	7 275	471	7 740
Zinc concentrates	t	26 455	5 373 969	70 431	17 318 707	42 438	10 451 891
Total value			3 666 690 100		4 174 208 496		4 663 702 326

QUANTITY OF ORE TREATED AND GOLD THEREFROM IN 1984 AND 1984/85

MINERAL FIELD District	Ore treated (tonnes)	Gold therefrom (kg)	Alluvial/ Dollied/ (kg)	Total Gold (kg)	1984/85					
					Ore treated (tonnes)	Gold Therefrom (kg)	Alluvial (kg)	Dollied/ Specimens (kg)	Total Gold (kg)	Silver (kg)
	1984				1984/85					
ASHBURTON	581	3.843	41.620	45.463	601.00	3.903	26.771	0.214	30.888	0.036
BROAD ARROW	157 953	765.033	6.202	771.235	151 763.00	623.555	2.659	0.036	626.250	11.979
Coolgardie	631 716	3 370.201	4.987	3 375.188	801 863.00	3 731.753	12.817	4.874	3 749.444	445.183
Kunanalling	286	20.155	1.765	21.920	828.00	21.884	1.504	0.103	23.491	0.952
COOLGARDIE	632 002	3 390.356	6.752	3 397.108	802 691.00	3 753.637	14.321	4.977	3 772.935	446.135
DUNDAS	350 332	3 348.126	0.897	3 349.023	317 180.00	3 234.054	0.327	0.768	3 235.149	1 350.973
Bulong	54	28.591	0.708	29.299	99.00	21.799	8.207	0.410	30.216	0.489
East Coolgardie	2 336 874	11 343.058	12.550	11 355.608	2 437 605.00	11 986.412	7.108	3.977	11 997.497	2 468.918
EAST COOLGARDIE	2 336 928	11 371.649	13.258	11 384.907	2 437 704.00	12 008.211	15.115	4.387	12 027.713	2 469.407
Black Range	308	45.306	43.537	88.843	234.00	46.326	59.189	6.358	81.873	2.221
Lawlers	20 991	239.164	9.750	248.914	36 945.00	644.568	9.852	0.340	654.760	22.662
Wiluna	97	504.262	2.268	506.530	-	832.482	1.268	1.258	35.008	330.953
EAST MURCHISON	21 396	788.732	55.555	844.287	37 179.00	1 523.376	40.309	7.956	1 571.641	335.836
GASCOYNE	22	0.596	3.039	3.635	-	-	0.332	1.997	2.329	0.038
KIMBERLEY	-	-	6.854	6.854	-	-	8.199	0.963	9.162	0.095
Mt Malcolm	338 138	1 091.603	41.283	1 132.886	619 962.00	2 105.627	58.779	5.842	2 170.248	44.076
Mt Margaret	210 657	1 601.592	28.545	1 630.137	276 937.00	1 767.899	22.011	4.232	1 794.142	484.248
Mt Morgans	1 836	12.784	4.251	17.035	777.00	9.693	9.000	1.154	19.847	0.399
MT MARGARET	550 631	2 705.979	74.079	2 780.058	897 676.00	3 883.219	89.790	11.228	3 984.237	528.723
Cue	79 801	206.805	42.859	249.664	182 171.00	631.313	42.211	4.021	677.545	0.794
Day Dawn	-	24.031	22.872	46.903	95.00	19.874	17.688	0.708	38.270	6.161
Meekatharra	576 917	979.786	93.737	1 073.523	581 109.00	1 137.106	103.102	4.712	1 244.920	6.915
Mt Magnet	316 179	1 383.887	5.827	1 389.714	313 451.00	1 493.312	8.918	2.947	1 505.177	158.708
MURCHISON	972 897	2 594.509	165.295	2 759.804	1 076 826.00	3 281.605	171.919	12.388	3 465.912	172.578
Menzies	6 167	194.797	1.834	196.631	3 047.00	173.055	2.863	0.223	176.141	5.183
Niagara	102	72.701	0.561	73.262	135.00	16.045	.492	0.257	16.794	0.203
Ularring	53 228	47.382	-	47.382	59 909.00	59.842	-	-	59.842	-
Yerilla	187 483	602.365	0.521	602.886	278 337.00	991.844	.008	0.368	992.220	7.391
NORTH COOLGARDIE	246 980	917.245	2.916	920.161	341 428.00	1 240.786	.363	0.848	1 244.997	12.777
Kanowna	533	19.957	5.090	25.047	245.00	13.553	.405	0.094	21.052	1.806
Kurnalpi	272	0.106	3.170	3.276	334.00	.296	.760	0.078	4.134	0.114
NORTH EAST COOLGARDIE	805	20.063	8.260	28.323	579.00	13.849	.165	0.172	25.186	1.920
PEAK HILL	63 779	577.984	11.850	589.834	263 719.00	842.404	.730	1.912	855.046	43.944
PHILLIPS RIVER	-	51.732	0.066	51.798	158.00	72.367	-	0.066	72.433	19.210
Marble Bar	844 643	3 706.231	29.110	3 735.341	1 496 939.00	4 263.523	.557	4.397	4 321.497	239.619
Nullagine	460	143.484	200.026	343.510	155.00	3.582	.890	7.388	211.860	0.395
PILBARA	845 103	3 849.715	229.136	4 078.851	1 497 094.00	4 267.105	.467	11.785	4 533.357	240.014
SOUTH WEST	49 496	126.670	0.040	126.710	85 864.00	233.055	-	-	233.055	-
STATE GENERALLY	-	-	4.171	4.171	-	-	.671	1.452	3.123	0.225
WEST PILBARA	-	-	7.443	7.443	-	-	.280	0.236	12.516	0.291
YALGOO	4 387	46.584	5.761	52.345	5 595.00	52.578	.429	1.406	65.413	9.190
YILGARN	179 586	904.308	4.692	909.000	435 946.00	1 650.444	.876	0.883	1 653.203	297.612
Total	6 142 878	31 463.124	647.886	32 111.010	8 352 003.00	36 684.148	.723	63.674	37 424.545	5 960.983

PRODUCTION AND VALUE OF MINERALS FOR THE YEARS ENDED DECEMBER 31 1984 AND JUNE 30 1985

Mineral and producer	Centre	Mineral field	Quantity Tonnes	Metallic content	Value \$	Quantity Tonnes	Metallic content	Value \$
GOLD	Total gold reported to the Department of Mines		Ore treated Tonnes	1984 Estimated Kilograms		Ore treated Tonnes	1984/85 Estimated Kilograms	
		State generally	6 412 878	32 111.010	422 248 335	8 352 003	37 424.545	508 891 876
*Includes alluvial, dollied and specimens, gold obtained from tailings retreatment and gold contained in exported gold- bearing material								
ALUMINA								
Alcoa of Australia (W.A.) Ltd	Del Park	South West	2 659 106		498 337 447	2 567 675		508 542 575
Alcoa of Australia (W.A.) Ltd	Jarrahdale	South West	1 529 232		286 612 300	1 414 735		280 709 709
Alcoa of Australia (W.A.) Ltd	Willowdale	South West	459 021		86 832 066	562 136		111 389 299
Worsley Alumina Pty Ltd	Boddington	South West	357 629		69 073 857	782 436		156 198 058
			5 004 988		940 855 670(a)	5 326 982		1 056 839 641(a)
BUILDING STONE : QUARTZ								
Snowstone Pty Ltd	Mukinbudin	South West	2 272		102 224	2 644		118 980
: QUARTZITE								
House R P	Toodyay	South West	160		2 880			
			2 432		105 104	2 644		118 980(b)
CLAY : CEMENT CLAY								
Cockburn Cement Pty Ltd	Karragullen	South West	6 508		16 270	6 508		16 270
Bell Basic Industries Ltd	Armadale	South West	22 185		55 464	21 647		54 119
			28 693		71 734	28 155		70 389(b)
: FIRE CLAY								
Clackline Refractories Ltd	Clackline	South West	252		504	1 336		2 672
Clackline Refractories Ltd	Piawaning	South West				100		200
Midland Brick Co Pty Ltd	Bullsbrook	South West	221 518		265 822	241 053		289 264
			221 770		266 326	242 489		292 136(b)
: KAOLIN								
Greenbushes Tin Ltd	Greenbushes	Greenbushes	85		3 199	1 710		31 505(b)
: WHITE CLAY								
Bristile Ltd	Goomalling	South West	978		9 278			
Bristile Ltd	Jarrahdale	South West	52 156		148 645			
			53 134		157 932			
COAL								
Griffin Coal Mining Co Ltd	Muja	Collie	2 100 765		54 123 113	2 176 739		58 665 367
Western Collieries Ltd	Western	Collie	1 591 900		51 807 050	1 495 880		50 454 723
			3 692 665		105 930 163(h)	3 672 619		109 120 090(h)
COBALT								
(Metallic by-product nickel mining)				Co Tonnes			Co Tonnes	
Agnew Mining Co Pty Ltd	Leinster	East Murchison		112.532	1 525 727		74.612	1 393 204
Western Mining Corporation Ltd	Kambalda	Coolgardie		407.953	5 031 025		373.979	4 544 248
				520.485	6 556 752		448.591	5 937 452(c)

Mineral and producer	Centre	Mineral field	Quantity Tonnes	Metallic content	Value \$	Quantity Tonnes	Metallic content	Value \$		
			1984			1984/85				
CONSTRUCTION MATERIALS : AGGREGATE										
Bell Basic Industries Ltd	Poondano	Pilbara	117 321		35 196					
Calsil Ltd	Port Hedland	Pilbara	3 993		15 170	4 752		18 055		
J Stove	Roebourne	West Pilbara	4 960		17 362	8 032		28 116		
JL Woodhead	Kununurra	Kimberley	492		1 968	2 466		9 864		
			126 766		69 696	15 250		56 035		
: GRAVEL										
Brenel Pty Ltd	Broome	West Kimberley	1 722		8 266	1 722		8 266		
Kane DJ	Mt Welcome	West Pilbara				412		2 031		
Leslie Salt Co.	Port Hedland	Pilbara	38 500		38 500	38 500		38 500		
Pioneer Concrete (WA) Pty Ltd	Port Hedland	Pilbara	6 200		6 200	13 810		13 810		
Pioneer Concrete (WA) Pty Ltd	Paraburdoo	West Pilbara				4 500		4 500		
			46 422		52 966	58 944		67 107		
: ROCK										
Specified Services Pty Ltd	Mt Regal	West Pilbara	47 357		94 712	46 524		92 686		
: SAND										
Calsil Pty Ltd	Port Hedland	Pilbara	4 662		18 648	6 362		25 448		
Clackline Refractories Ltd	Clackline	South West	185		370					
Cottiers Pty Ltd	Port Hedland	Pilbara	1 365		23 149	1 274		18 924		
Marathon Roofing Pty Ltd	Jandakot	South West	54 954		64 732	127 658		133 335		
Monier Ltd	Gnangarra	South West				289 920		692 007		
Monier Ltd	Gosnells	South West				139 093		163 205		
Pioneer Concrete (W.A) Pty Ltd	Port Hedland	Pilbara				1 390		1 390		
Specified Services Pty Ltd	Mt Regal	West Pilbara	10 377		20 761	8 929		19 658		
The Readymix Group (WA)	Karratha	West Pilbara	5 777		31 022	3 387		18 188		
The Readymix Group (WA)	Rocklea	West Pilbara	5 985		41 895					
The Readymix Group (WA)	Turner River	Pilbara	3 114		10 837	3 620		12 597		
The Readymix Group (WA)	Widgiemooltha	Coolgardie	12 292		69 797	12 384		58 909		
The Readymix Group (WA)	Boulder	East Coolgardie	138 057		865 330	145 294		815 034		
			236 768		1 146 541	739 311		1 958 695		
TOTAL CONSTRUCTION MATERIALS			457 313		1 363 915	860 029		2 174 523(b)		
COPPER (metallic by-product nickel mining)										
Agnew Mining Co Pty Ltd	Leinster	East Murchison		Cu Tonnes	764.617	667 247	Cu Tonnes	492.445	403 980	
Western Mining Corporation Ltd	Kambalda	Coolgardie			2 843.856	2 681 563		2 931.912	2 737 139	
					3 608.473	3 348 810(c)		3 424.357	3 141 119(c)	
COPPER CONCENTRATES										
Teutonic Bore Mine Project	Teutonic Bore	Mt Margaret	38 451.5	Cu Tonnes	8 396.6	11 145 646(c)	48 532.5	Cu Tonnes	10 381.054	12 803 570(c)
CUPREOUS ORE										
Walker H & L	Ravensthorpe	Phillips River					42.27	Cu Units	221.07	6 748(d)
DIAMONDS										
Argyle Diamond Mines Pty Ltd	Kununurra	Kimberley		Carats	5 692 193	45 155 034(c)		Carats	5 569 285	45 056 768(c)

Mineral and producer	Centre	Mineral field	Quantity Tonnes	Metallic content	Value \$	Quantity Tonnes	Metallic content	Value \$
			1984			1984/85		
DIATOMITE Hines Horton & Rule	Sabys Peak	South West	257		1 029(d)	257		1 029(d)
DOLOMITE Green K & P	Lake Magenta	South West				300		2 100(d)
FELDSPAR Snowstone Pty Ltd	Mukinbudin	South West	3 158		21 425(d)	4 779		32 017(d)
GARNET SAND Target Minerals N L	Port Gregory	South West	3 287		115 080(d)	4 269		149 459(d)
GYPSUM Agnew Clough Ltd	Shark Bay	Gascoyne	348 144		4 549 104(c)	277 768		4 233 598(c)
Amalgamated Industries Pty Ltd	Wyalkatchem	South West	3 327		6 654(d)	12 490		62 450(d)
Blake & Sita	Lake Brown	Yilgarn	252		1 008(d)	827		3 308(d)
Brady HB & Co. Pty Ltd	Lake Brown	Yilgarn	32 530		81 326(d)	32 577		81 442(d)
Cusak B	Kondinin	South West				3 128		12 602(d)
D & C Nominees Pty Ltd	Wongan Hills	South West	7		28(d)	1 781		7 124(d)
Fitzgerald EM & EJ	Hines Hill	South West	1 526		1 831(d)	3 640		4 368(d)
Green KL & PM	Newdegate	South West	1 132		5 660(a)	2 332		11 660(d)
Hathaway G, R & S	Lake Hillman	South West				1 780		7 120(d)
Kidman G	Varley	South West				2 135		10 675(d)
McAndrew Mining	Yelbini	South West	10 819		32 457(d)	34 357		103 071(d)
Nixon PF & RS	Lake Hillman	South West	4 175		20 874(a)	11 428		57 142(d)
Southern Asiatic Enterprises Pty Ltd	Norseman	Dundas	184 395		1 980 486(d)	109 399		1 074 996(d)
Swan Portland Cement Ltd	Lake Hillman	South West	14 159		347 767(b)	14 513		375 326(b)
West Australian Plaster Mills	Yellowdine	Yilgarn	37 217		125 050(d)	36 996		124 307(d)
			637 683		7 152 245	545 151		6 169 189
Plaster of paris reported as manufactured during the 18-month period - 42 366 tonnes from 62 025 tonnes of gypsum by two companies.								
IRON ORE			Av Assay Fe%			Av Assay Fe%		
SHIPPED INTERSTATE								
BHP Minerals Ltd	Cockatoo Is.	West Kimberley	875 714	67.99	11 605 187	914 968	68.23	10 073 558
BHP Minerals Ltd	Koolan Island	West Kimberley				178 493	66.53	1 963 423
Mt Newman Mining Co Pty Ltd	Mt Whaleback	Peak Hill	4 977 138	64.00	85 004 101	4 657 593	64.00	80 631 944
EXPORTED OVERSEAS								
BHP Minerals Ltd	Koolan Island	West Kimberley	2 360 403	66.67	45 001 392	2 158 916	66.70	46 195 068
Cliffs Robe River Iron Assoc	Pannawonica	West Pilbara	14 949 905	57.27	214 914 147	14 645 149	57.46	227 307 419
Goldsworthy Mining Ltd	Shay Gap, Sunrise Hill	Pilbara	4 737 355	62.27	95 201 352	4 572 191	63.16	103 194 810
Hamersley Iron Pty Ltd	Mt Tom Price, Paraburdoo	West Pilbara	36 806 019	63.10	699 716 700	37 598 304	63.16	806 254 951
Mt Newman Mining Co Ltd	Mt Whaleback	Peak Hill	25 924 594	63.00	519 842 409	24 549 501	63.00	554 476 603
			90 631 128		1 671 285 288	89 275 115		1 830 097 776(c)
PELLETS (EXPORTED OVERSEAS)								
Cliffs Robe River Iron Assoc.	Pannawonica	West Pilbara				21 433	60.71	442 109(c)

Mineral and producer	Centre	Mineral field	Quantity Tonnes	Metallic content	Value \$	Quantity Tonnes	Metallic content	Value \$
			1984			1984/85		
LIMESTONE								
Amalgamated Industries Ltd	Lancelin	South West				777		3 885
Bell Basic Industries Ltd	Wanneroo	South West	45 133		45 133	42 101		42 101
Bellombra V	Wanneroo	South West	5 680		56 800	8 357		83 570
Cypress Nominees Pty Ltd	Moore River	South West	617		9 255	2 213		57 135
Lenkane Exploration Pty Ltd	Kurnalpi	North East						
		Coogardie				3 354		9 392
Specified Services Pty Ltd	Cleaverville	West Pilbara	6 589		6 589	6 349		6 349
Swan Portland Cement Ltd	Wanneroo	South West	126 677		851 165	146 467		984 895
			184 696		968 942(b)	209 618		1 187 327(b)
MAGNESITE								
Norseman Gold Mines NL	Bandalup	Phillips River	16 729		215 936(c)	16 729		215 936(c)
MICA								
Pilbara Mica Corporation Pty Ltd	Pippingarra	Pilbara	30		8 037(c)			
MINERAL BEACH SANDS: ILMENITE								
			Assay TiO ₂ %			Assay TiO ₂ %		
Allied Eneabba Pty Ltd	Eneabba	South West	328 481	59.53)		226 347	59.08)	
Associated Minerals Consolidated	Capel	South West	140 144	54.99)		120 353	54.99)	
Associated Minerals Consolidated	Eneabba	South West	77 898	60.00)		79 653	60.00)	
Cable Sands Pty Ltd	Capel	South West	176 933	54.18)		183 286	54.28)	
Jennings Mining Ltd	Eneabba	South West	97 366	60.00))	
Western Mineral Sands Pty Ltd	Capel	South West	216 035	53.99)		213 172	53.99)	
Westralian Sands Ltd	Yoganup	South West	299 465	55.00)		363 766	55.00)	
			1 336 322)	53 989 350(c)	1 186 557)	55 385 867(c)
: UPGRADED ILMENITE								
Associated Minerals Consolidated	Capel	South West	72 133	92.00)		69 516	92.00)	
: REDUCED ILMENITE								
Associated Minerals Consolidated	Capel	South West	140	65.00)		140	65.00)	
: KYANITE								
Allied Eneabba Pty Ltd	Eneabba	South West				39		3 618(c)
: LEUCOXENE								
Associated Minerals Consolidated	Capel	South West	13 742	12 369	2 446 108	4 589	4 132	805 620
Cable Sands Pty Ltd	Capel	South West	7 916	7 241	2 094 300	5 532	5 071	1 536 580
Westralian Sands Ltd	Yoganup	South West	10 452	9 428	2 411 092	9 450	8 251	2 241 499
			32 110	29 038	6 951 500	19 571	17 454	4 583 699(c)
: MONAZITE								
Allied Eneabba Pty Ltd	Eneabba	South West	10 190	65 714	4 484 742	10 234	66 556	4 738 705
Associated Minerals Consolidated	Capel	South West	216	1 404	87 871	864	5 616	355 858
Associated Minerals Consolidated	Eneabba	South West	2 916	18 982	1 241 845	2 646	17 199	1 189 440
Cable Sands Pty Ltd	Capel	South West	504	3 279	219 240	702	4 447	335 070
Westralian Sands Ltd	Yoganup	South West	1 766	11 090	733 419	2 144	13 547	893 814
			15 592	100 469	6 767 117(c)	16 590	107 365	7 512 887(c)

Mineral and producer	Centre	Mineral field	Quantity Tonnes	Metallic content	Value \$	Quantity Tonnes	Metallic content	Value \$
			1984			1984/85		
			TiO ₂ Tonnes			TiO ₂ Tonnes		
: RUTILE								
Allied Eneabba Pty Ltd	Eneabba	South West	27 691	26 561	8 719 905	31 203	29 909	10 641 662
Associated Minerals Consolidated	Eneabba	South West	32 960	31 309	10 114 298	42 281	40 164	14 816 186
			60 651	57 825	18 834 203(c)	73 484	70 073	25 457 848(c)
			Y ₂ O ₃ kg			Y ₂ O ₃ kg		
: XENOTIME								
Associated Minerals Consolidated	Capel	South West	30	9 300	127 333	19	589	252 990
Cable Sands Pty Ltd	Capel	South West	36	10 710	230 715	23	6 480	144 647
			66	20 010	358 048(c)	42	7 069	397 547(c)
			ZrO ₂ Tonnes			ZrO ₂ Tonnes		
: ZIRCON								
Allied Eneabba Pty Ltd	Eneabba	South West	171 783	113 854	18 936 920	186 648	122 696	21 754 612
Associated Minerals Consolidated	Capel	South West	14 631	9 506	1 747 759	17 773	11 535	2 061 072
Associated Minerals Consolidated	Eneabba	South West	111 831	74 530	12 747 012	120 280	80 110	13 277 605
Cable Sands Pty Ltd	Capel	South West	7 898	5 157	875 766	11 898	7 757	1 332 000
Westralian Sands Ltd	Yoganup	South West	30 807	20 027	3 368 474	25 740	16 731	2 853 787
			336 950	223 074	37 675 931(c)	362 339	238 829	41 279 076(c)
			Assay Ni%			Assay Ni%		
NICKEL CONCENTRATES								
Agnew Mining Co Pty Ltd	Leinster	East Murchison	71 551	14.02	54 598 632	68 898	13.88	60 786 107
Western Mining Corporation Ltd	Carnilya Hill	East Coolgardie	30 660	11.87	19 703 422	34 499	11.70	25 878 757
Western Mining Corporation Ltd	Kambalda	Coolgardie	352 768	11.52	221 040 279	334 498	11.44	42 336 442
Western Mining Corporation Ltd	Windarra	Mt Margaret	41 651	10.87	24 887 639	48 596	11.02	34 305 414
			496 630		320 229 972(e)	496 630		363 306 720(e)
PALLADIUM (metallic by-product nickel mining)			kg			kg		
Western Mining Corporation Ltd	Kambalda	Coolgardie	523.464		2 693 559	461.151		2 491 786
PETROLEUM : CONDENSATE						Tonnes		
Strata Oil NL	Woodada	South West	872		NA	494		NA
West Australian Petroleum Pty Ltd	North Perth	South West	2 062		NA	1 985		NA
Woodside Offshore Petroleum Pty Ltd	North Rankin Field		19 271		NA	92 382		NA
			22 205		NA	94 861		NA
: CRUDE OIL			Kilolitres			Kilolitres		
Esso Exploration and Production Australia Inc.	Derby	West Kimberley	35		3 850(g)	35		3 850(g)
Home Energy Co Ltd	Blina	West Kimberley	55 327		8 471 592(f)	34 186		5 549 415(f)
Home Energy Co Ltd	Sundown	West Kimberley	7 214		1 070 286(g)	8 964		1 391 599(g)
West Australian Petroleum Pty Ltd	Barrow Island	Ashburton	1 224 147		272 259 680(g)	1 166 187		276 259 366(g)
West Australian Petroleum Pty Ltd	North Perth Basin	South West	8 176		1 699 353(f)	6 212		1 395 425(f)
Pacific Basin Exploration	Mt Horner	South West	621		130 928(f)	872		190 863(f)
			1 295 520		283 635 789	1 216 456		284 790 518
: NATURAL GAS			10 ³ m ³			10 ³ m ³		
Strata Oil NL	Woodada	South West	177 752		12 453 530	110 037		8 959 382
West Australian Petroleum Pty Ltd	North Perth Basin	South West	697 756		39 399 061	620 801		39 530 926
Woodside Offshore Petroleum Pty Ltd	North Rankin		456 648		47 685 480	1 028 793		117 353 703
			1 332 156		99 538 071	1 759 631		165 844 011(i)

Mineral and producer	Centre	Mineral field	Quantity Tonnes	Metallic content	Value \$	Quantity Tonnes	Metallic content	Value \$
PLATINUM (metallic by-product nickel mining)			1984			1984/85		
Western Mining Corporation Ltd	Kambalda	Coolgardie	kg 66.396		1 010 176	kg 80.938		1 225 011
SALT								
Dampier Salt (Operations) Pty Ltd	Dampier	West Pilbara	2 109 158		35 210 882	2 055 299		39 666 286
Dampier Salt (Operations) Pty Ltd	Lake McLeod	Ashburton	623 000		9 314 927	741 726		12 631 155
Leslie Salt Co (Inc)	Port Hedland	Pilbara	1 313 908		21 004 645	1 435 339		26 017 365
Shark Bay Salt Joint Venture	Useless Loop	Gascoyne	627 951		9 721 659	590 567		10 246 193
			4 674 017		75 252 113(c)	4 822 931		88 560 999(c)
SEMI-PRECIOUS STONES: AMETHYST								
Soklich Trading Company	Gascoyne	Gascoyne	kg 13 676		60 193	kg 59 586		90 368
: MOSS OPAL								
Soklich Trading Company	Norseman	Dundas	792		511			
SILICA SAND								
Australian Glass Manufacturers	Lake Gngara	South West	33 871		150 160(b)	28 435		129 943(b)
Bell Basic Industries Ltd	Jandakot	South West	66 872		NA	134 631		NA
Monier Sands	Jandakot	South West	63 380		697 180(b)	75 331		828 641(b)
The Ready Mix Group (WA)	Jandakot	South West	83 120		NA	59 914		NA
Western Mining Corporation Ltd	Mt Burges	Coolgardie				34 207		83 807(b)
Western Mining Corporation Ltd	Douglas Lake	East Coolgardie	98 171		240 518(b)	64 955		159 139(b)
Westralian Sands Ltd	Boyanup	South West	7 163		73 368(c)	7 163		73 368(c)
			352 577		1 161 226	409 136		1 274 898
SILVER								
Teutonic Bore Mine Project	Teutonic Bore	Mt Margaret	kg 30 956.433		9 650 710	kg 36 418.738		10 860 000
By-Product of Gold Mining		State generally	7 124.999		1 748 422	7 905.740		1 812 135
By-Product of Nickel Mining			351.591		106 245	345.574		89 110
			38 433.023		11 505 377	44 670.052		12 761 245
SPODUMENE			LiO₂ Tonnes			LiO₂ Tonnes		
Greenbushes Tin Ltd	Greenbushes	Greenbushes	6 668.25	467	1 380 851(c)	8 504.66	596	1 852 722(c)
TALC								
Three Springs Talc Pty Ltd	Three Springs	South West	141 658		NA	178 750		NA
Westside Mines N L	Mt Seabrook	Peak Hill	19 318		NA	3 863		NA
			160 976		NA	182 613		NA
TANTALITE			Ta₂O₅ kg			Ta₂O₅ kg		
Goldrim Mining Australia Ltd	Wodgina	Pilbara	0.50	301	15 486	1.46	727	61 775
Greenbushes Tin NL - Concentrates	Greenbushes	Greenbushes	105.50	49 399	3 981 239	58.45	27 700	3 389 286
Greenbushes Tin Ltd - Processed tantalite			6	6 275	508 534		6 275	508 534
Kincora Pty Ltd	Western Shaw	Pilbara	33	9 491	719 120	9.00	3 340	259 684
			145.0	65 466	5 224 379(c)	68.91	38 042	4 219 279(c)

Mineral and producer	Centre	Mineral field	Quantity Tonnes	Metallic content	Value \$	Quantity Tonnes	Metallic content	Value \$
			1984			1984/85		
			Sn Tonnes			Sn Tonnes		
TIN								
Endeavour Resources Ltd	Moolyella	Pilbara	92.00	65.00	867 697	56.359	39.079	533 857
Goldrim Mining Australia Ltd	Wodgina	Pilbara	1.44	1.04	13 180	1.820	1.240	17 500
Greenbushes Tin Ltd	Greenbushes	Greenbushes	560.12	392.00	5 479 207	462.490	323.560	8 417 060
Hart DN & LE	Abydos	Pilbara	5.265	3.369	39 835	4.397	2.849	35 239
Kincora Pty Ltd	Western Shaw	Pilbara	61.00	44.00	588 305	44.000	32.000	439 151
			719.825	505.409	6 988 222(c)	569.066	398.728	9 442 807(c)
VERMICULITE								
Vermiculite Industries Pty Ltd	Young River	Phillips River	423		7 275(d)	471		7 740(d)
ZINC CONCENTRATES								
Teutonic Bore Mine Project	Teutonic Bore	Mt Margaret	70 431	Zn Tonnes 35 640	17 318 707(c)	42 438	Zn Tonnes 21 677	10 451 891(c)
TOTAL			4 174 208 496			4 663 702 326		
<p>REFERENCES: NA Not available for publication.</p> <p>(a) Value based on the Average Australian Value of Alumina as published by the Bureau of Mineral Resources in the Australian Mineral Industry Review.</p> <p>(b) Value at works</p> <p>(c) Estimated F.O.B. value</p> <p>(d) Estimated F.O.R. value.</p> <p>(e) Estimated F.O.B. value based on the current price of nickel-containing products.</p> <p>(f) Nett well head value.</p> <p>(g) Value based on the price per barrel as assessed by the Commonwealth Government for Barrow Island Crude Oil at Kwinana.</p> <p>(h) Value at pithead.</p> <p>(i) Nominal price at well head.</p>								