DEPARTMENT
OF MINES
WESTERN
AUSTRALIA

ANNUAL REPORT 1989-90

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DEPARTMENT OF MINES WESTERN AUSTRALIA

Honourable Jeff Carr, B.A., J.P., M.L.A.
Minister for Mines, Fuel and Energy
Small Business and the Mid West
Parliament House
PERTH WA 6000

Dear Minister

In accordance with Section 62 of the Financial Administration and Audit Act 1985, I submit for your information and presentation to Parliament the Annual Report of the Department of Mines of the State of Western Australia for the year ending June 30, 1990.

The Annual Report has been prepared in accordance with the provisions of the Financial Administration and Audit Act 1985.

The Report uses the format established in previous years, with the Department's activities described within the framework of Corporate Objectives. These are set against a background of the mining and petroleum industries in 1989-90.

Information of a more general nature about this Department and its activities will be published later in the year as an Annual Review.

I commend to you the loyal and responsible contribution of officers from all sections of the Department towards the implementation of Government policies.

Yours sincerely

D.R. KELLY
DIRECTOR GENERAL OF MINES
August, 1990

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DIRECTOR GENERAL OF MINES' REPORT

The continued prosperity of the mining and petroleum industries is vital to both the State and the nation.

This was never more evident than in early 1990 when, contrary to expectations, Australia's value of gross domestic production actually grew in the first three months, confounding predictions of a recession.

This unexpected result can be firmly attributed to mining: particularly the boom in gold, iron ore and coal, combined with the commencement of Liquefied Natural Gas exports from the giant North West Shelf Project.

The continuing strength of the Western Australian mining and petroleum sector and its contribution to the national economy will come as no surprise to most West Australians. During 1989-90 the industries enjoyed another record year.

The total value of production at an estimated $10,438 million was $2,534 million up on 1988-89, an increase of 32%. Export performance was equally impressive, providing over 60% of the State's exports.

The vast revenue from these industries not only profits companies' shareholders but also provides benefits to the community through direct and indirect employment, regional development and payments to government.

The mining and petroleum sector is now contributing approximately 15% of State raised revenue. Two commodities which had a very significant impact on the WA economy in 1989-90 were gold and petroleum.

Gold remains the largest single commodity in terms of value of production, number of operating mines and employment. Gold production continued to break records, partially due to companies fast tracking mining to minimise the impact of the forthcoming gold tax.

Rapid expansion in the gold sector over recent years saw the recruitment of inexperienced personnel and a dilution of experienced supervision across this section of the industry. The result was an increase in accidents and following a spate of fatalities in underground mines, the Minister for Mines instigated a formal inquiry chaired by the State Mining Engineer.

The Committee included representatives from industry, unions and an independent safety specialist. The Inquiry's report made a range of recommendations, the most critical being the need for improved education and training of all new employees.

In the future, changes in goldmining practise due to increased underground mining and the working out of open pit mines will place an increased emphasis on safety. This will require more specialist mining inspectors. The Department has found it difficult to recruit mining engineers with the necessary experience but hopefully new initiatives introduced in 1990 will facilitate future recruitment.

The Department has already partly met this challenge by increasing the size of the Inspectorate and raising its efficiency. In the case of open cut mines, an intense education program was initiated in June in response to a high incidence of pit wall failures. The goal is to improve open pit design and promote rapid introduction of site specific pit wall monitoring.

The high level of mining activity generally has generated an increased volume of company information on exploration which is placing pressure on the Geological Survey Division's ability to process and ensure access to this information. During the year, 3129 mineral and 496 exploration reports were received. Despite the additional workload the Geological Survey was able to complete the preparation of a major reference book on the geology of the State. Memoir 3 is currently being printed and is expected to be released in September 1990.

To improve access and utilisation of company exploration reports, considerable resources are being devoted to develop a computerised geoscientific database.

A range of other computer systems is also under development to improve the Department's operations and provide an improved service to industry. These include new systems and expanded databases in the petroleum exploration, mining tenement, mine site and mine safety areas. Some 25,000 on-line transactions are now being handled daily by the computing network which has been expanded to all regional offices. Thirteen centres are now on line ranging from Collie to Kununurra.

Mapping is another area of the Department where computerisation is having a significant effect. A Geographic Information System pilot study, conducted by the Surveys and Mapping Division, demonstrated its capacity to resolve complex geological issues and land use planning issues. A computer aided architectural design system was acquired to provide for the digital generation of diagrams and figures.

Petroleum production expanded dramatically during the year, more than doubling the value of sales achieved in the previous financial year. Projections indicate it is set to become the State's single largest

primary resource. The most significant event in the sector during the year was the commencement of shipping of Liquefied Natural Gas from the North West Shelf Project.

During the year the Department continued to provide a diverse range of management, monitoring, and consultancy services concerned with protection and rehabilitation of the environment.

All proposals for mining and petroleum exploration or development are assessed on their environmental impact and appropriate environmental management conditions are enforced and monitored by the Department's inspectors. Plans are in place to increase the number of inspectors and to extend their powers. The Department worked closely with the Environmental Protection Authority in producing stringent development guidelines and ensuring mutually accepted evaluation procedures.

A working party was convened to examine conservation and rehabilitation in the quarry industry. With considerable support from the Geological Survey Division, the Working Party report was released for public comment in May. The Department is hopeful that adoption of the recommendations will improve current quarrying rehabilitation practices. The Chemistry Centre provided a wide range of analytical and advisory services covering all areas of environmental policy including public health, safety and pollution.

To help improve the Chemistry Centre's operations, a complete review of charging policies was undertaken and Treasury approval for a new fee structure obtained. This work involved the development of a new cost accounting framework to establish appropriate hourly charge rates. Standard costings were reviewed for a wide range of services and this has resulted in a significant move towards full cost recovery.

During the year the transport, storage, and use of dangerous goods and explosives came under increased public scrutiny. Revised procedures were introduced covering the implosion of buildings and a temporary ban was placed by the Explosives and Dangerous Goods Division on the use of fireworks while safety guidelines were revised. Inspection services monitoring the transport and storage of dangerous goods were increased and a number of projects commenced covering regional public health and safety issues.

During the year the Department was responsible for the collection of $357 million in revenue. This was an increase of $112 million or 46% over the preceding year, reflecting buoyant conditions in the resources industries. On the expenditure side, total payments made by, or administered by, the Department for the year amounted to $48.52 million. The net increase in payments from the previous year, excluding some extraordinary items, represented a very small rise of 3% in the Department's major operating expenditure account. This is a very creditable result given the increase in activities in the Department's area of responsibility and a general rise in costs.

To ensure that staff and financial resources are allocated efficiently, the Department completed a three year Corporate Plan and commenced the implementation of Program Management. Integration of the Corporate Planning and budgeting processes will help to ensure that all resources are allocated to most effectively achieve the Department's objectives.

Faced by reductions in government funding, a buoyant mining sector, and increased pressures in the areas of safety and environmental management, the Department faces a challenging year ahead. I am confident that staff will meet this challenge and continue to provide a high level of professional advice and management. The Department's commitment to training and effective recruitment will help in this regard. Such a commitment is necessary to maintain our standard of excellence and to replace experienced staff who are likely to retire in the next few years. In this regard, the Department bade farewell in June 1990 to Jim Blake, Assistant Director General, who retired from the Department after 40 years of loyal service. His expertise will be sorely missed.

Finally, to improve industry and the public's understanding of the role and function of the Department, a Communications Branch was established in February 1990. This group is now working on a wide range of projects, all of which are aimed at providing a better flow of information to the Department's publics.

The Department looks forward to the next year with confidence, certain in the knowledge that it will be able to consolidate the good work that has been performed during the year under review.

D.R. KELLY

Director General of Mines

Western Australia

In 1989-90 the Western Australian mining and petroleum industry again enjoyed exceptional growth that reinforced its position as the premier industry in this State.

The total value of mining and petroleum production for the financial year is estimated at $10,438 million which is an increase of $2,534 million (32%) on the previous financial year (Figure 1).

The petroleum sector was the most significant contributor to this increase, while the major sectors of gold, alumina and iron ore all recorded substantial rises in both quantity produced and value (Figure 2).

Western Australian production is now dominated by these four major sectors which in total contribute over 80% of the value of the industry (Figure 3).

Predictions of falling world demand and prices for commodities in the 1989-90 year failed to materialize with the notable exception of gold. The four major sectors all recorded strong growth in output and prices remained relatively stable which, with a full year's production of LNG, led to the year's favourable outcome.

The World Scene

Although industrial growth in the world's major economies was somewhat slower in 1989-90 than for the previous year it was still healthy at an estimated 3%. Particularly important for Western Australia, with its dependence on exports, was the continued strength of overseas private non-residential fixed investment. This sector is one of the main areas generating demand for the primary mineral and energy products such as iron ore, alumina, oil and gas, nickel and mineral sands which are the State's prime exports.

Australia's internal economic conditions are also extremely important to trading relations as they set the financial climate within which producers have to operate. A principal concern remains high domestic interest rates which are having a doubly depressing effect on international competitiveness. The high rates have kept the Australian dollar artificially high therefore substantially reducing the incomes of producers who generally have their prices denominated in United States dollars. The second effect is to increase the cost of borrowings which lowers local producers competitiveness relative to their overseas rivals. It is a credit to the industry that despite these impediments and Australia's higher inflation rate the overall health of the industry remains good.

COMMODITY ANALYSIS

Gold

Gold production in 1989-90 showed a further strong rise to yet another record level of an estimated 148 tonnes, a 28 tonne increase (23%) over 1988-89. The price of gold varied throughout the period but was on average lower than in the previous year (Figure 4) and this resulted in a reduced percentage increase in the value of gold production. Despite this the value of gold production also achieved a record high at $2,372 million, up $343 million (17%) on 1988-89, maintaining its position as the principal mineral produced in Western Australia.

The major causes behind the strong performance of the gold sector have principally been the continuing activity from the days of a booming gold price and the bringing forward of production in anticipation of the introduction of company income tax in January 1991. On the negative side was a lack of investment capital for the sector through a depressed stock exchange which in turn has been reacting to the lower gold price. These conditions and the diversion of capital towards development have led to a decline in the exploration effort from it's previously high levels.

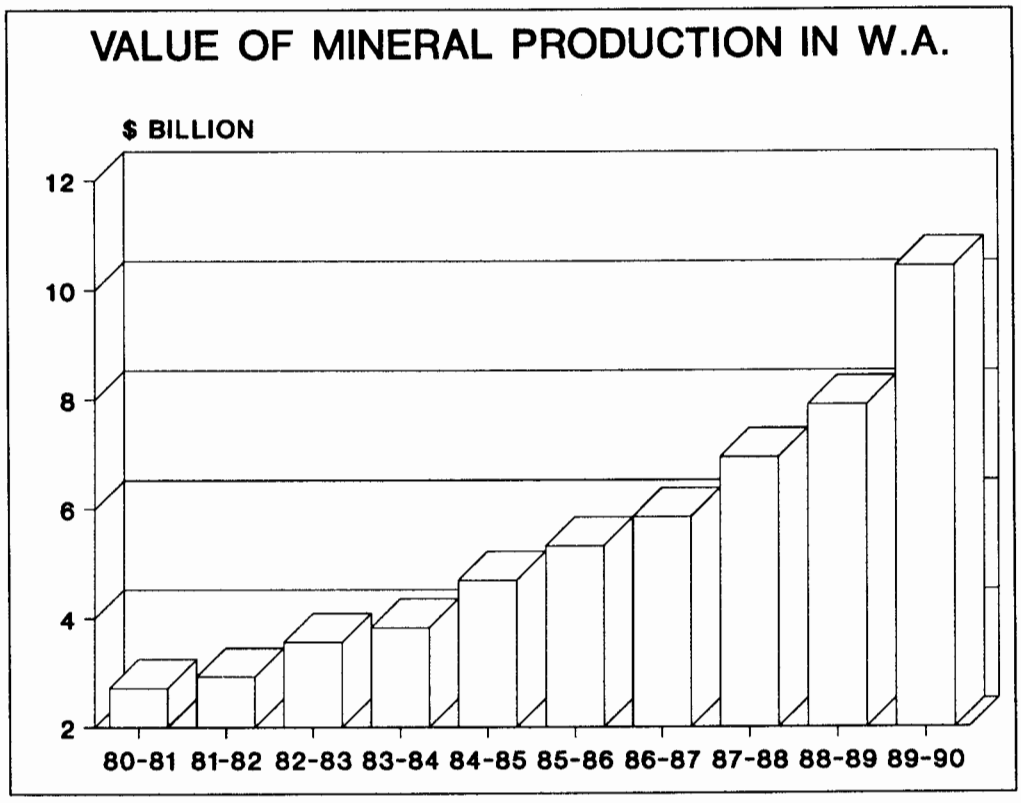
The industry in Western Australia is undergoing a transition phase from a large number of uncoordinated, small, individual producers to a more concentrated and efficient industry structure. Pressure for these changes is coming mostly from the economics of the industry which is facing lower prices and a higher cost of finance. The physical nature of the industry is also undergoing changes as the easy to mine high grade open cut deposits run out and mining has had to proceed underground with the higher costs and risks that this entails.

A critical problem, brought on by the high levels of activity, has been the rising accident rate, especially in the underground sector. Many significant measures have been instituted with commendable industry cooperation to curb this problem. A further concern in the industry, due to its rapid expansion and accelerated production, is the incidence of pit wall failures. This is being given a high priority in terms of the Department's safety effort.

Alumina

Alumina has displaced iron ore as Western Australia's second most important mineral. The 1989-90 value of production at $2,336 million fell just short of gold after a huge $717 million (44%) increase over the preceding year. The prime reason for the increase was the strong alumina price flowing on from the increases in aluminium metal prices of previous years (Figure 5). In response to strong demand, production also increased by about 8% to reach 6.7 million tonnes. The strong

Figure 1.



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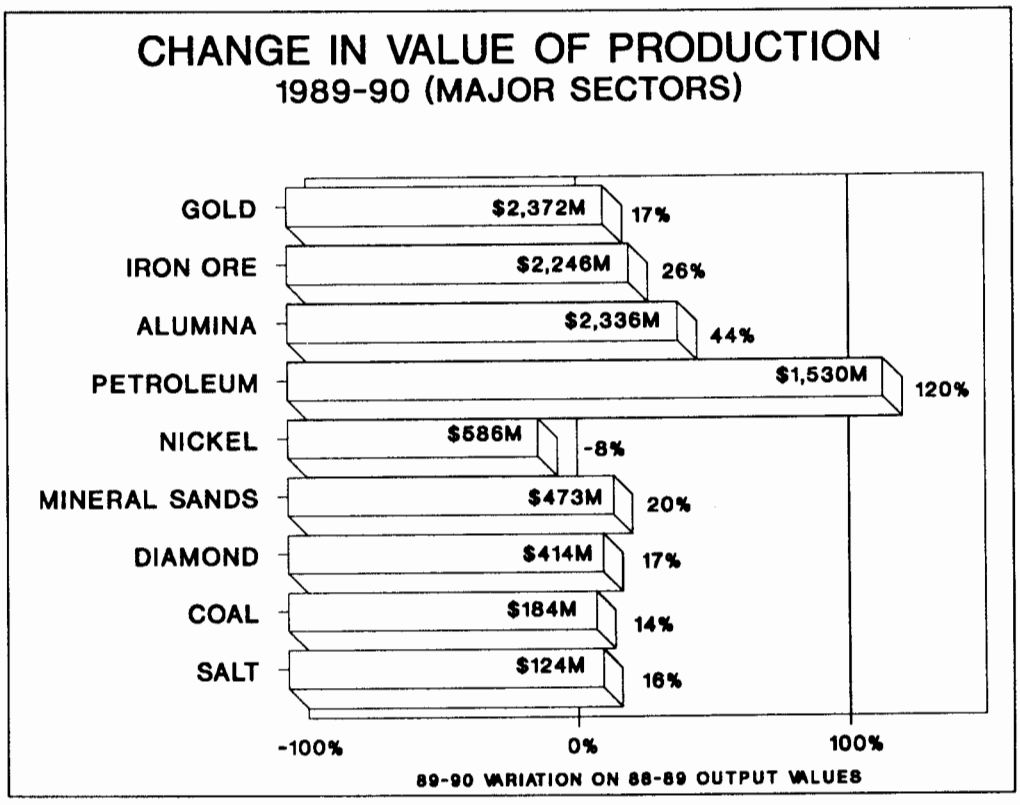


performance has encouraged Worsley to institute plans to upgrade the capacity of their plant by 25%. However, Alcoa's expansion plans at their Wagerup refinery have been deferred for further examination.

The recent downward price trends in the aluminium industry point to a weakening of the alumina price during the 1990-91 financial year.

During the year the gallium by-product extraction plant at the Pinjarra alumina refinery was closed down due to falls in the world demand for gallium metal and a marked decline in the metal price.

Iron Ore

Despite strong growth in demand for iron ore, the third year of price rises and consequent record value of production, iron ore slipped in ranking to the third most valuable mineral produced in Western Australia.

The strong growth in demand in Australia's iron ore markets in Japan and East Asia helped raise the tonnage of shipments by 7% to 106 million tonnes. The price rises of the 1989-90 iron ore year were followed in April 1990 by a further 16% average price rise, the third successive negotiated annual increase, which combined to lift the value of production to a new record of $2,246 million. This was an increase of $466 million (26%) over the value for the previous year.

Record shipments have left stockpiles depleted and created an incentive to develop new deposits. During the year construction at the Channar mine was completed and the first ore was shipped in January. The eventual production from this mine will be 10 million tonnes per annum. In recent years there has been strong demand for high grade lump ore and consequently a number of scree ore deposits were developed. Recently though world demand has shown a preference for fine ore which is encouraging for the development of deposits such as the large reserves at Marillana Creek. BHP, the developers of the deposit, have recently shipped a large bulk sample of the ore for evaluation in Japan.

Petroleum

Petroleum is the fastest growing sector of the Western Australian industry. During the financial year the value of production more than doubled with the commencement of Liquified Natural Gas (LNG) exports in July 1989. World oil prices, which drive the prices for the whole petroleum sector, were higher on average than in the previous year. This affected the returns to producers and, in combination with large rises in production, led to the spectacular increases in the values of all petroleum products seen in the year.

Oil production rose by 80% to reach 4.0 million kilolitres. However the value of oil produced rose by 123% to over $600 million reflecting improved oil prices. Condensate production rose by 39% while the value increased by 66% to reach $236 million. Western Australia now produces over 1.6 million kilolitres of condensate per annum. Natural gas production increased by only 6% for the year but the value rose by 25% to $357 million.

The new feature of the petroleum sector was the commencement of LNG exports in July 1989. The value of the shipments amounted to $336 million in 1989-90 and is expected to double in 1990-91 to exceed $600 million. When the North West Shelf project reaches full capacity in 1995, export values should be in the region of $1,500 million per annum.

The North West Shelf area is, along with the Timor sea, the area of greatest potential for petroleum development in Australia. The recent successes at Wanea, Cossack, Griffin, Chinook and Echo are evidence of the strength of the exploration effort in the area. A number of these discoveries will be developed in the next few years.

If further evidence was needed of the confidence in the area it was clearly demonstrated by the North West Shelf participants' decision to proceed with the Goodwyn A platform. This will cost in the region of $1,600 million to build and it comes following the decision to commit over $900 million to the construction of the third LNG train on the Burrup Peninsular.

Nickel

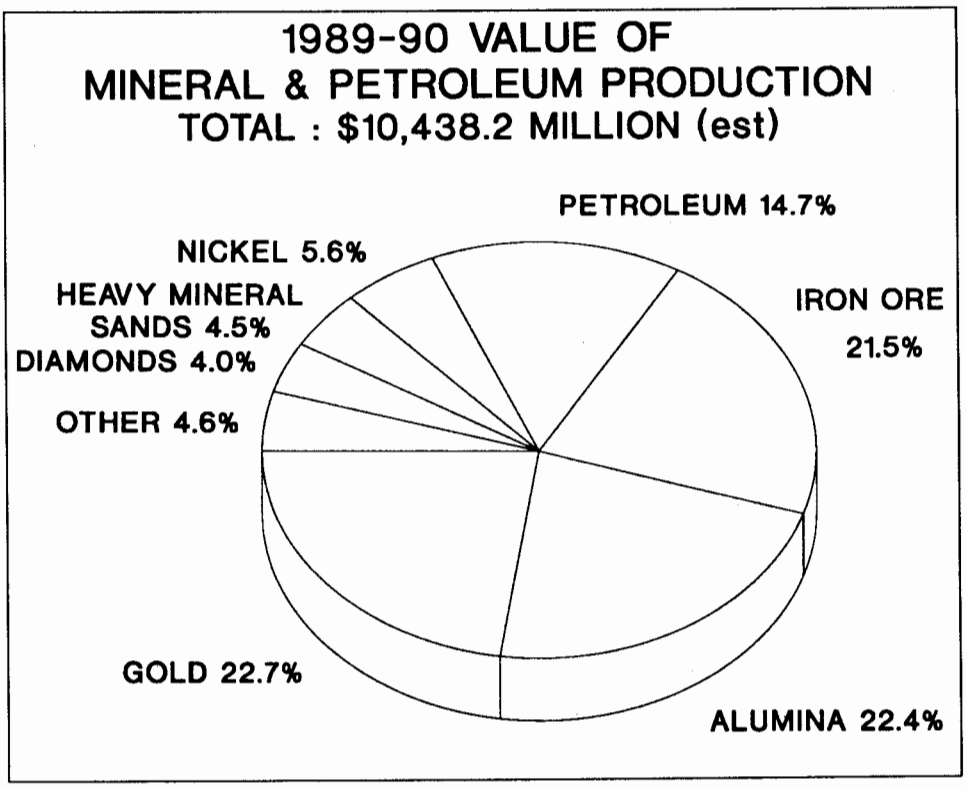
The nickel price fell during 1989-90 and this caused the value of nickel production in Western Australia to fall by 8% to $586 million. Production however rose by 26% to 48 257 tonnes of contained nickel emphasising, despite the lower prices, the health of the sector. The main reason for the increase in production was Western Mining Corporation's decision to re-develop the old Agnew operation at Leinster.

High nickel prices, still two to three times greater than their lows of 1987, have led to plans to develop new nickel operations in Western Australia. Final feasibility studies have been undertaken on the Mount Keith deposit to be jointly developed by Australian Consolidated Minerals (ACM) and Outokumpu Oy. A recent announcement to proceed with development of the Radio Hill deposit near Karratha by the operator AGIP Pty Ltd was also welcome for the future of the industry in the state.

Mineral Sands

Continuing high prices for mineral sands have ensured that the sector maintains it's strong growth of recent years. In total the value of mineral sands at $473 million

Figure 3.



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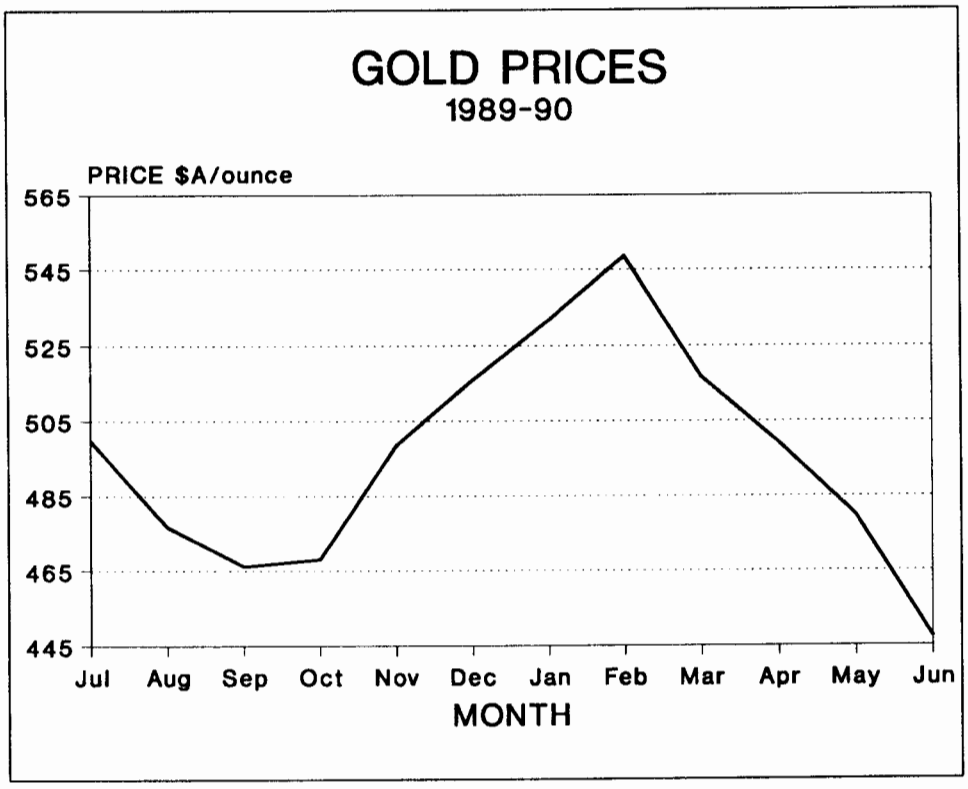

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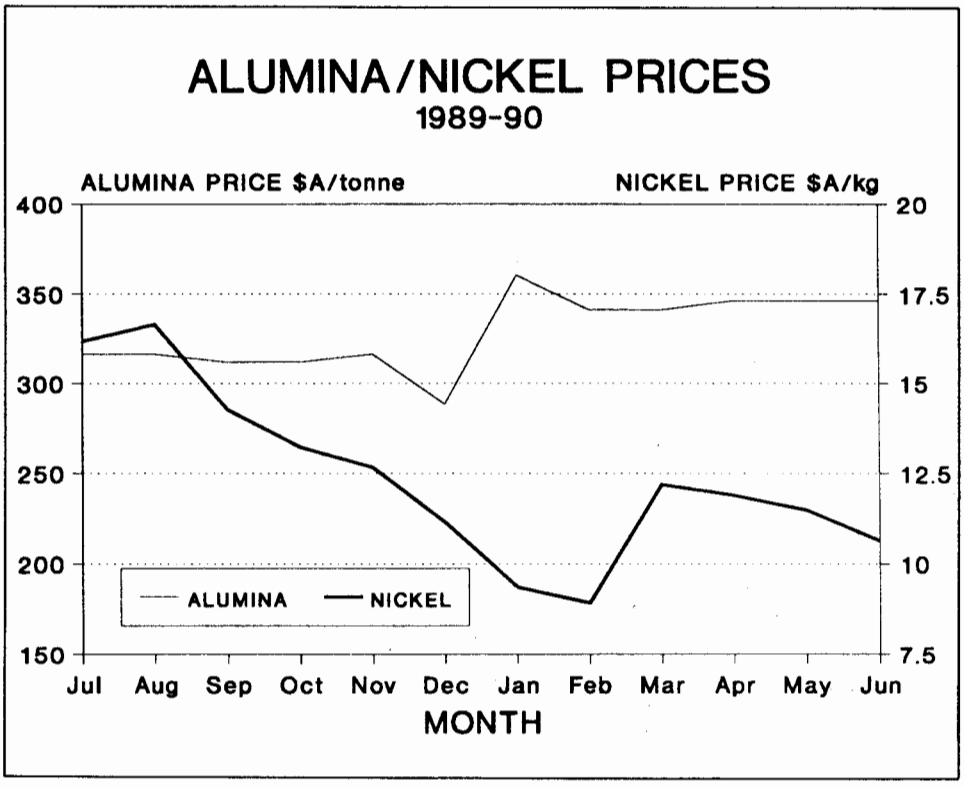
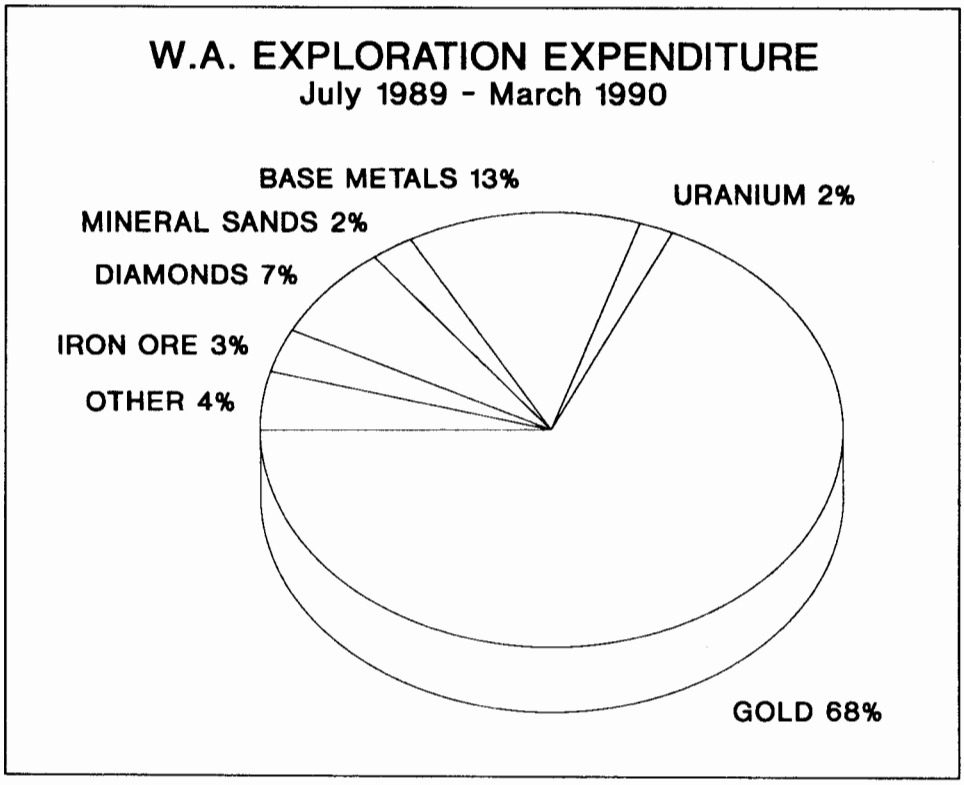


Figure 6.



in 1989-90 ranks it as the sixth most valuable sector in the State's mining industry.

Greater output of ilmenite, combined with a slight increase in the average price, raised the value of production by $22 million (33%) to $90 million. Upgraded ilmenite (synthetic rutile) recorded a $36 million increase to reach $131 million for the year. This rise was a combination of a 25% increase in tonnages and a 10% rise in price. The value of rutile production went against the mineral sands trend by recording a fall of $4 million (6%) in value, principally due to a 18% fall in production. Zircon production rose in value by $24 million (16%) to reach $175 million despite a fall of 12% in quantity produced.

There was significant growth in the mineral sands sector during 1989/90. In addition to expansion at Eneabba West, AMC are involved in a corresponding expansion of their dry plant and a second synthetic rutile plant at Narngulu. The Tiwest joint venture (previously the Cooljarloo project) commenced operations of its first stage in March 1990. The construction of the second stage, which consists of a synthetic rutile plant at Muchea, is well advanced with completion due by the end of 1990.

Western Australia now produces about 30% of the world's ilmenite, 40% of the world's zircon, and 50% of the world's monazite. The State's large resources of mineral sands, coupled with steadily increasing world demand, are expected to lead to further development during the 1990s. Apart from increased mining, there is considerable potential for additional processing, including production of synthetic rutile, titanium dioxide pigment, titanium tetrachloride, titanium metal, zirconia and zirconia products.

This potential will only be realised if developments proceed in a manner which is sensitive to the needs of the environment and local communities.

Diamonds

In 1989-90 diamond sales dropped marginally (by 7%) but the value of this rose to $414 million, up $59 million (17%). This was principally due to a sustained price rise in 1989 and an increase in quality through the exploitation of alluvial deposits at Argyle.

Overall, treatment at Argyle has now doubled the initial design capacity of 3 million tonnes per annum. A major re-evaluation of the AK-1 pipe has resulted in an increase in extractable reserves of about 60%.

The strong diamond market and the good prices have resulted in a resurgence in exploration for diamonds. The Mount Elizabeth project is still being investigated by Poseidon and there has been some treatment of bulk samples from the Aries pipe.

Other Minerals

Coal production rose by 360,000 tonnes (10%) and increased in value by $22 million (14%) in 1989-90. Salt production fell but increases in prices saw the value of production rise to $124 million, up $17 million (16%).

The major new contributors to the other minerals area are expected to be the base metals. A number of projects are in various stages of development. The most advanced and most significant is the Scuddles project at Golden Grove south of Yalgoo.

Exploration

In 1989-90 the total expenditure on exploration in the State amounted to an estimated $295 million, some 25 percent down on the previous year, and well below the 1987-88 peak of $466 million.

Variations in overall expenditure largely reflect activity in the gold industry, which currently is on the decline but still accounts for 68 percent of the total (Figure 6). A number of the "junior" explorers and small developers have disappeared and many of those still operating are finding that development funding requires the participation of a larger corporate entity. This, together with a number of takeovers, has resulted in a much greater degree of integration at the major gold mining centres.

The search for base metals and nickel has increased over the last three years. An expenditure of over $40 million per year is currently being expanded. A large percentage of the effort, especially in nickel, has involved a reappraisal of prospects discovered over the last three decades.

Diamond exploration has shown a revival with expenditure of over $20 million a year and heavy mineral sands exploration has also increased, reflecting boom conditions in that industry for a number of years.

Small increases in iron ore exploration are occurring in response to high demand for lump ore. However, the completion of major phases of exploration at Kintyre and Hill River has resulted in lesser expenditure on uranium and coal. Of the other commodities of minor interest, manganese and vanadium are receiving significant attention on account of surges in metal prices for these commodities.

ENABLING LEGISLATION

The Department is established by the Governor pursuant to Section 21 of the Public Service Act 1978 and, in so doing, satisfies Section 11 of the Mining Act 1978.

BACKGROUND

The Department was established on January 1, 1894 as the regulatory body to ensure the safe and orderly development of mineral resources in this State, and to allow the Government and the community to benefit from these activities. This is still the major role of the Department.

The Geological Survey, which had been founded six years earlier, was incorporated with the Department of Mines, closely followed by the establishment of a system of State gold batteries. In 1902 the Government Analyst's Laboratory was transferred to the Department, which signified the start of another role providing services to the mining industry.

These service facilities have evolved with the technological growth of modern mining. As the industry became prominent and complex, regulatory functions demanded a wide range and depth of internal services and expertise. Consequently, many of the sections of the Department traditionally involved in regulation were able to provide further services in the form of technical advice, tenement maps, and safety recommendations. Progressively, this role has been extended and now the Department is called upon to provide services to the community beyond those exclusively related to the mining and petroleum industries, particularly in relation to chemistry and public safety.

Government policy aims to encourage investment in exploration, extraction and utilisation of the State's mineral and petroleum resources. Because of their major contribution to the economy for almost 100 years, mining activities have ramifications that reach directly or indirectly into the whole economic and social fabric of Western Australia. This is reflected in the wide range of activities currently administered by the Department of Mines.

CORPORATE PHILOSOPHY

During the financial year the Department carried out a review of its objectives, and finalised the Corporate Plan for the 1990-1993 triennium.

In establishing its Corporate Philosophy, the Department of Mines has given particular attention to the relationships that exist between the Department, the Government, the community, the natural environment, and the mining and petroleum industries. These relationships are central to the way the resources of the State are developed, the industries are administered, and interaction is achieved with the community. They are summarised as follows:

- The mineral and petroleum resources of the State are owned by the Crown, but are explored and developed almost entirely by private enterprise.
- Exploration and development are undertaken in an organisational framework controlled and directed by Government.
- The mining and petroleum industries play a major role in the economy of the State and mineral, petroleum and groundwater resources are required to sustain our future economic viability and living standards.
- Mineral and petroleum deposits are almost always difficult and expensive to find, small in size relative to the total land mass, finite, and non-renewable.
- Mineral and petroleum deposits are assets only after they have been discovered and delineated and the incentive to engage in high-risk exploration to find them is directly related to the potential for an appropriate financial return.
- Resource development is a temporary activity and should be integral to the principle of multiple land use.
- Changes in the economy, technology, and exploration science may lead to the re-appraisal of previously tested ground; thus the potential of any area can never be totally written off and information about it should always remain available.
- Geoscientific data available from studying the geological record will assist in understanding and predicting events associated with the Greenhouse Effect.
- Chemical services and research, outside those required for the mineral and petroleum industries, are needed to ensure that independent and standardised information is provided to the community.
- Management and the workforce must work together to create a safe working environment.
- Public safety is of major concern in relation to the transportation and use of explosive and dangerous goods.
- Resources allocated to the Department are to be administered efficiently according to the prevailing

principles and standards expected of the Public Service.

- The Department must respond quickly and effectively to changes required by the community through Government.

ROLE

The role of the Department of Mines is to ensure that the community of Western Australia:

- receives maximum benefit from the exploration for, and development of, minerals and petroleum;
- is protected from hazards associated with mining, petroleum activities, explosives and dangerous goods;
- has access to independent geoscientific, chemical and engineering consultancy services, and environmental advice relevant to the mining and petroleum industries, for the protection of community standards; and
- is assured that the human and financial resources of the Department are used efficiently and effectively in achieving its objectives.

BROAD OBJECTIVES

1. **To ensure that exploration and development of the State's mineral and petroleum resources are carried out in a fair manner.**

1.1 Provide an equitable system for giving secure exploration and development titles.

1.2 Minimise potential for disputes, but facilitate their prompt settlement when they arise.

2. **To foster mineral, petroleum and groundwater exploration and development, and assist long-range planning and decision making by Government.**

2.1 Continually improve and update knowledge relating to the occurrence of mineral, petroleum, and groundwater resources and the geology of the State.

2.2 Make available adequate mineralogical, metallurgical and water analytical services and carry out research in these areas.

2.3 Disseminate geoscientific data from exploration and related activities in a timely and efficient manner.

2.4 Ensure that effective geotechnical, hydrogeological, and mining engineering advice is available as required.

2.5 Maintain a favourable climate for mineral and petroleum exploration and development.

3. **To ensure that the community receives a fair return from the exploitation of the State's mineral and petroleum resources; and that proper attention is given to the environment.**

3.1 See that the community benefits from the activities of the mining and petroleum industries.

3.2 Ensure protection and rehabilitation of the environment as it may be affected by mineral and petroleum development.

4. **To ensure that all operations in the mining and petroleum industries and activities involving explosives and dangerous goods are conducted in a manner that is safe for workers and the public.**

4.1 Better the safety and health of workers in the mineral and petroleum industries.

4.2 Minimise hazards to the public from activities involving explosives and dangerous goods.

5. **To ensure that the community has access to independent chemical research and consultancy services.**

5.1 Meet the community's need for applied chemical research in the most effective and efficient manner.

5.2 Ensure that the community's need for independent chemical consultancy services is met in the most effective and efficient manner.

MINISTER

The Minister for Mines, the Honourable Jeff Carr, B.A., J.P., M.L.A.

PRINCIPAL OFFICERS

Dr D.R. Kelly, BE(Hons), PhD, FTS, MIE Aust.
DIRECTOR GENERAL OF MINES AND ACCOUNTABLE OFFICER
(Appointed by the Governor pursuant to Section 29 of the Public Service Act)

Mr E.J. Blake, Dip Pub Admin.
ASSISTANT DIRECTOR GENERAL OF MINES
(retired 1.6.90)

Dr C.D. Branch, BSc(Hons), PhD, FAusIMM.
ASSISTANT DIRECTOR GENERAL OF MINES

Dr P.E. Playford, BSc(Hons), PhD, MAusIMM.
DIRECTOR, GEOLOGICAL SURVEY DIVISION

Mr I Fraser, BSc(Hons).
DIRECTOR, PETROLEUM DIVISION

Dr J.W. Hosking, MSc, PhD, FAusIMM, FRACI.
DIRECTOR, CHEMISTRY CENTRE (W.A.)

Mr M.L. Meaton, BSc(Agric)(Hons), BEc.
DIRECTOR, ROYALTIES AND POLICY DEVELOPMENT DIVISION

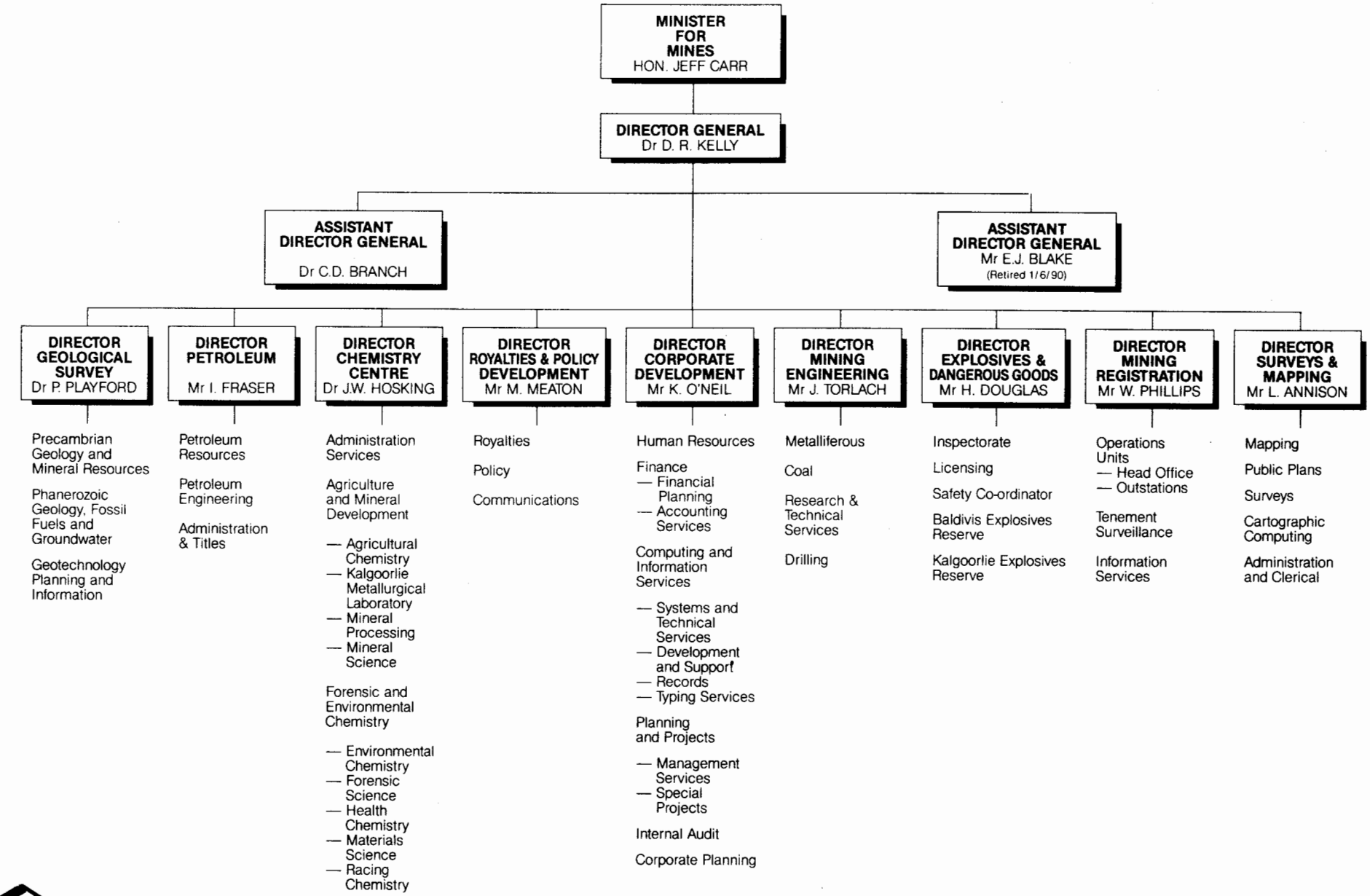
Mr K.O. O'Neil, MBA, AASA, Dip Pub Admin.
DIRECTOR, CORPORATE DEVELOPMENT DIVISION

Mr J.M. Torlach, BE(Min), MAusIMM.
DIRECTOR, MINING ENGINEERING DIVISION

Mr H. Douglas, APTC(Chem), C CHEM, ARACI, MAusIMM.
DIRECTOR, EXPLOSIVES AND DANGEROUS GOODS DIVISION

Mr W. Phillips, Dip Pub Admin.
DIRECTOR, MINING REGISTRATION DIVISION

Mr L. Annison, L.S.
DIRECTOR, SURVEYS AND MAPPING DIVISION


MINISTER FOR MINES
HON. JEFF CARR
DIRECTOR GENERAL
Dr D. R. KELLY
ASSISTANT DIRECTOR GENERAL
Dr C.D. BRANCH
ASSISTANT DIRECTOR GENERAL
Mr E.J. BLAKE
(Retired 1/6/90)
DIRECTOR GEOLOGICAL SURVEY
Dr P. PLAYFORD
DIRECTOR PETROLEUM
Mr I. FRASER
DIRECTOR CHEMISTRY CENTRE
Dr J.W. HOSKING
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Precambrian Geology and Mineral Resources
Phanerozoic Geology, Fossil Fuels and Groundwater
Geotechnology Planning and Information
Petroleum Resources
Petroleum Engineering
Administration & Titles
Administration Services
Agriculture and Mineral Development
— Agricultural Chemistry
— Kalgoorlie Metallurgical Laboratory
— Mineral Processing
— Mineral Science
Forensic and Environmental Chemistry
— Environmental Chemistry
— Forensic Science
— Health Chemistry
— Materials Science
— Racing Chemistry
Royalties
Policy
Communications
Human Resources
Finance
— Financial Planning
— Accounting Services
Computing and Information Services
— Systems and Technical Services
— Development and Support
— Records
— Typing Services
Planning and Projects
— Management Services
— Special Projects
Internal Audit
Corporate Planning
Metalliferous
Coal
Research & Technical Services
Drilling
Inspectorate
Licensing
Safety Co-ordinator
Baldivis Explosives Reserve
Kalgoorlie Explosives Reserve
Operations Units
— Head Office
— Outstations
Tenement Surveillance
Information Services
Mapping
Public Plans
Surveys
Cartographic Computing
Administration and Clerical

DIVISIONS OF THE DEPARTMENT

The Department of Mines is structured into nine Divisions which represent homogeneous centres of professional excellence in a diverse organisation.

Activities of the Divisions are targetted at achieving the five broad corporate objectives. The matrix at pages 18 - 19 shows the Divisions and the broad objectives into which they have input.

The **Geological Survey** of Western Australia systematically records and interprets the geology of the State and provides this information to Government, industry and the general public in order to assist the exploration, development and conservation of the State's mineral, petroleum and groundwater resources. It evaluates mineral and petroleum resources as a basis for decision making by Government and assists and advises on a variety of community needs, including urban planning, land-use matters, and engineering developments.

Petroleum facilitates the undertaking by industry of geophysical and drilling programs for the identification and development of oil and gas accumulations. It ensures that sound engineering principles and standards are applied to system design and plant assembly in production facilities and ensures accurate product measurement for royalty calculations. It also maintains an effective title allocation and registration system, monitors and advises on State and Commonwealth legislative amendments, and advises on matters requiring interpretation and application of legislation.

The **Chemistry Centre (W.A.)** provides chemical, metallurgical and mineralogical consultancy and analytical services to Government instrumentalities, private industry and the general public. It assists in mineral processing, soil and fertiliser analysis, agricultural trials, water quality assessment, food nutritional quality evaluation, forensic science, environmental monitoring, chemical aspects of occupational and physical environments, materials testing; and undertakes research and development in all these areas.

Royalties and Policy Development develops mineral and petroleum royalty systems which are fair and equitable and administers the collection and audit of royalties paid on behalf of the State and Commonwealth. It also provides economic advice on mining and petroleum industry issues, collects and disseminates statistics and assists in the development and co-ordination of general departmental policies. The division informs staff, industry and the public about the role of the Department and the importance of the mining and petroleum industry.

Corporate Development provides administrative services for the Corporate Executive and the divisions of the Department. These services include the management of the Department's human resource, finance, computing, corporate planning, auditing, typing and records activities.

Mining Engineering administers mine safety legislation aiming to safeguard and promote the health and safety of those working in the industry. It provides advice to the Government and to industry on mining engineering matters, including deep mining, open-cut mining, quarrying, drilling, the environment, and rehabilitation. It carries out exploratory drilling and associated services for the Department and other Government organisations.

Explosives and Dangerous Goods reviews, formulates and administers laws, regulations and policies aimed at the safe manufacture, storage, handling and transport of explosives and dangerous goods; and provides safety advice on these matters and major hazard control.

Mining Registration receives applications and allocates titles that give legal rights to explore for and mine minerals in Western Australia pursuant to the Mining Act. It maintains a mining tenement registry which records tenement holders, conditions and term of the grant, and expenditure details from which the division monitors compliance with the provisions of the Act.

Surveys and Mapping determines and documents the boundaries of tenements and produces and updates all maps and plans necessary for the operations of the Department. All functions from primary field survey to final map production are embraced. The range of cartographic activities includes charting, field surveying, computations, drafting, reprographics, maintenance of archival map products, and advice to the public as an integral part of the tenement management process.

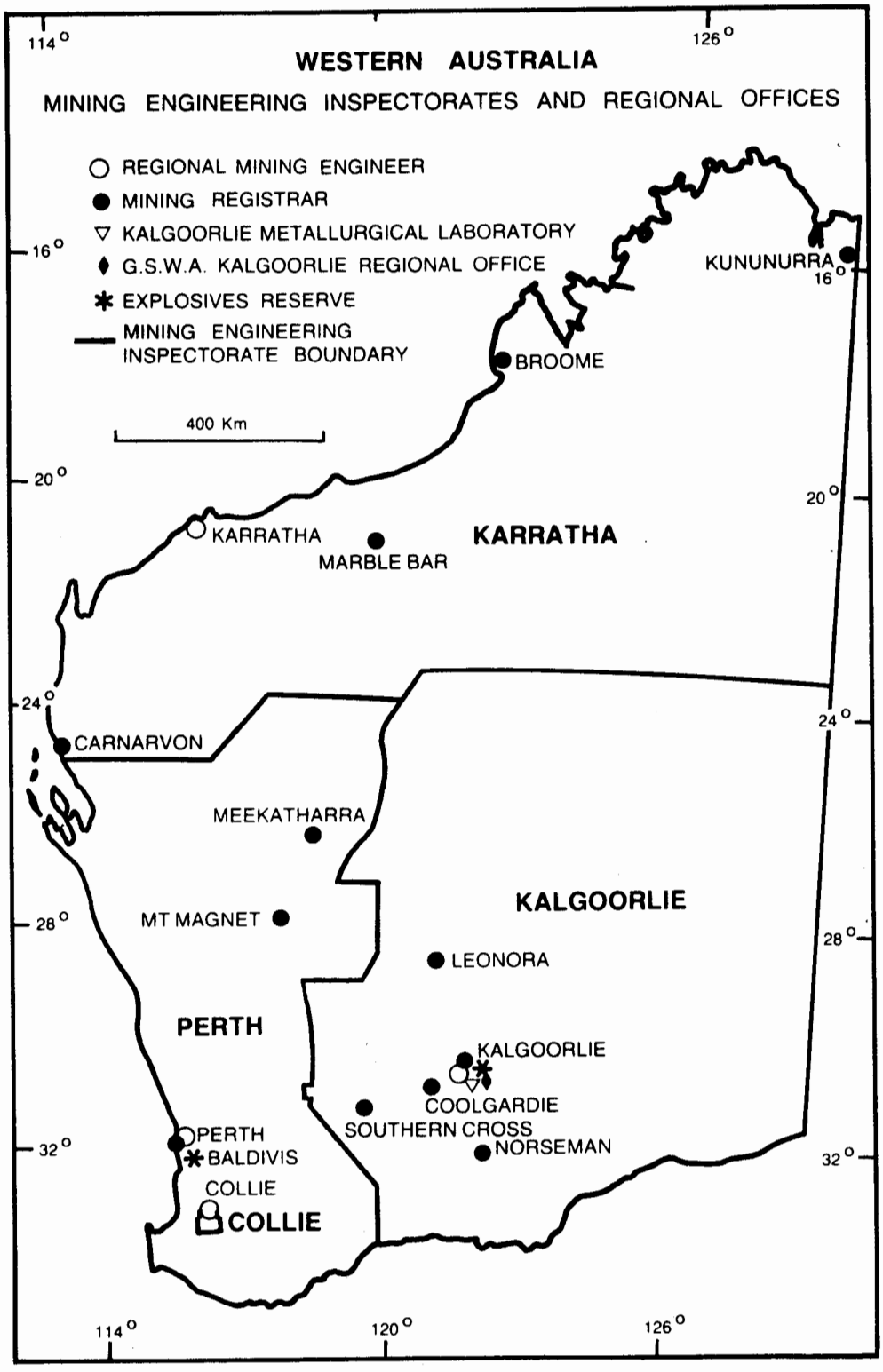
The officers of the Department are mostly located in Perth, with some members of the Geological Survey, Mining Engineering, Chemistry Centre, Explosives & Dangerous Goods, and Mining Registration divisions situated in regional centres. Most of these people work in areas that are large and remote by world standards (Figure 7).

In addition to providing services for land based operations, the Department is also required to administer State and Commonwealth legislation covering offshore oil and gas exploration, exploitation, pipeline transportation; and royalty payments.

A Department directory is included in the Appendices.

Figure 7

Department of Mines Regional Operations



DIVISIONAL ACTIVITIES TO MEET CORPORATE OBJECTIVES

OBJECTIVES BROAD	OBJECTIVES SPECIFIC	GEOLOGICAL SURVEY	MINING ENGINEERING	PETROLEUM
1. To ensure that exploration and development of the State's mineral and petroleum resources are carried out in a fair manner.	1.1 Provide an equitable system for giving secure exploration and development titles.	Provide technical advice in relation to administration of Petroleum and Mining Acts.		Award, maintain and monitor rights to explore and develop petroleum.
	1.2 Minimise potential for disputes, but facilitate their prompt settlement when they arise.	Technical advice on tenement matters.	Technical advice on tenement matters.	Process dealings, assess fees and advise on legislation.
2. To foster mineral, petroleum and groundwater exploration and development, and assist long range planning and decision making by Government.	2.1 Continually improve and update knowledge relating to the occurrence of mineral, petroleum, and groundwater resources and the geology of the State.	Obtain, interpret and evaluate data on all aspects of geoscience and earth based resources (mapping, data collation, evaluation).	Perform exploratory drilling and wireline surveys and associated work.	Petroleum exploration and geology (collate data, production of databases).
	2.2 Make available adequate mineralogical, metallurgical and water analytical services and carry out research in these areas.	Petrological and geochemical studies.		Petroleum engineering and geology (evaluate proposals and study fields and basins).
	2.3 Disseminate geoscientific data from exploration and related activities in a timely and efficient manner.	Publish information and maintain databases (maps, reports).		
	2.4 Ensure that effective geotechnical, hydrogeological, and mining engineering advice is available as required.	Provide geotechnical advice and prepare special maps.	Ensure that effective mining engineering advice is available as required.	Assess discoveries.
	2.5 Maintain a favourable climate for mineral and petroleum exploration and development.	Inform and advise Minister.		Advise Government and liaise with Industry.
3. To ensure that the community receives a fair return from the exploitation of the State's mineral and petroleum resources and that proper attention is given to the environment.	3.1 See the community benefits from the activities of the mining and petroleum industries.	Provide geotechnical advice to assist Royalty determination.	Field checks to assist with royalty determination and collection.	Assist Royalties branch in product measurement.
	3.2 Ensure protection and rehabilitation of the environment affected by mineral and petroleum development.	Review and advise on mining/extraction proposals.	Ensure protection and rehabilitation of the environment as it may be affected by mineral development.	Environmental monitoring.
4. To ensure that all operations in the mining and petroleum industries and activities involving explosives and dangerous goods are conducted in a manner that is safe for workers and the public.	4.1 Improve the safety and health of workers in the mineral and petroleum industries.		Ensure compliance with the Act and Regulations by regular inspections and advice in metalliferous and coal mines (inspect, advise, test, sample, train).	Engineering surveillance and safety inspections.
	4.2 Minimise hazards to the public from activities involving explosives and dangerous goods.			
5. To ensure that the community has access to independent chemical research and consultancy services.	5.1 Meet the community's need for applied chemical research in the most effective and efficient manner.			
	5.2 Meet the community's need for independent chemical consultancy services.			

CHEMISTRY CENTRE W.A.	EXPLOSIVES/ DANGEROUS GOODS	MINING REGISTRATION	SURVEYS/ MAPPING	ROYALTIES
		Award, maintain and monitor rights to explore and mine minerals.	Provide and maintain maps depicting all mining and petroleum tenure and other land tenure; provide public searching facilities; record and certify position and other land tenure status of tenements; and manage surveying operations to establish tenement boundaries.	
		Operate Warden's Court and process Ministerial Appeals. Monitor effectiveness of legislation.	Provide a means of resolving conflict arising in respect to tenement boundaries, positions or markings.	
Provide an analytical and advisory service on minerals.		Monitor performance of tenement holders in the submission of geoscientific reports.	Provide supporting geographical information systems.	
Conduct research in mineral processing.				
		Record and publish tenement data for industry.	Provide a cartographic and map preparation facility.	
Provide a hydrological analytical service.			Provide a cartographic and map preparation facility.	
		Liaise with Industry.		Inform Government and community.
				Collection of royalties and statistics.
Inspect, test and advise on environmentally sensitive areas.		Issue and monitor titles with due regard to protection and rehabilitation of the environment.	Provide a graphical record.	
Inspect, test and advise on occupational health matters in the mining industry.	**Ensure that dangerous goods are transported in a manner that provides maximum protection to the environment.**		Provide a repository for information concerning plans of mines and minesites.	
Inspect, test and advise on aspects of dangerous goods handling, storage and transport.	Provide a high level of assurance of public safety at places where explosives and dangerous goods are manufactured, stored or transported.			
Support agricultural research and regulatory programs; support law enforcement by scientific investigation; and solve problems relating to consumers, the environment, chemical industry.				
Support agricultural research and regulatory programs; support law enforcement by scientific investigation; and solve technical problems relating to consumers, the environment, and chemical industry.				

OBJECTIVE 1: EQUITY AND TITLES

To ensure that exploration and development of the State's mineral and petroleum resources are carried out in a fair manner.

Through this objective the Department seeks to provide an effective title system to encourage efficient and equitable exploration and development of the State's mineral and petroleum resources.

Need for Secure Title

The capital intensive nature of the mining and petroleum industries makes it imperative that where exploration leads to the initiation and development of a project, explorers must have secure tenure. The ground-rules for access to land and security of tenure are embodied in mining and petroleum legislation from the West Australian Parliament. This legislation not only protects the rights of the title holder but also the rights of the community. The various Acts require that holders of exploration or mining titles meet certain commitments to retain these rights.

The framework under which the Department operates is aimed at protecting the rights of all parties (from the large corporation to the small individual), as well as providing a fair and reasonable return to the community for the rights given to carry out mining operations and to see that such operations are carried out in harmony with other land usage.

An on-going review of legislation, procedures and policies is being undertaken to ensure that registration of titles and tenement matters is effected with efficiency and within acceptable time-frames.

Operations

This objective is met through the operation of a title registration and dispute settlement system. A range of permits and titles is issued through Perth and eleven regional offices. The range of "rights" for exploration and development include miners rights, exploration permits, mineral leases, general purpose leases, production licenses and pipeline licenses.

The prime responsibility for the issue of these rights, their registration, transfers and other dealings rests with the Mining Registration and Petroleum Divisions. They are assisted by the Surveys and Mapping Division which provides plans of the titles.

Both the Geological Survey and Mining Engineering Divisions provide technical advice needed to formulate conditions for mining tenements. They also monitor titles for compliance with statutory obligations. Field inspections are sometimes a requirement of these functions. The Geological Survey provides ongoing advice on geoscientific and geotechnical matters relevant to the administration and regulation of proposed exploration programmes and mining projects.

Regional Mining Registrars' offices are maintained for the local mining industry to lodge applications and dealings and have access to departmental public plans and other departmental services

A Warden's Court System operates to deal with disputation, complemented by both legal and administrative appeal rights.

As well as the Warden's Court in Perth, Wardens sit on a regular basis in Warden's Courts located throughout the State in the regional Mining Registrars' offices ensuring that members of the industry located in these areas have ready access to the Warden's Court services.

The Petroleum Division handles all onshore and offshore petroleum rights and all technical, safety, exploration, development, production and pipeline matters, including award of titles, technical advice, monitoring of compliance to the Acts, and inspectorate functions. Offshore, this includes administration of the Commonwealth adjacent area on behalf of the Joint Authority which is the State and Commonwealth.

Customer Service

To assist in providing services to the public the Department's computerised mining tenement index system, TENDEX, was further expanded during the year.

The Regional TENDEX Network was completed by installation of computer facilities in the Broome, Carnarvon and Norseman Mining Registrars' offices. The Tendex system is now available in all the Department's Mining Registrars' offices and allows members of the industry located or operating in the regional areas access to details of a mining tenement located anywhere in the State.

Enhancements to the TENDEX system itself now allow historical data to be stored for a tenement. Details of changes to holder, area, plan and shire can be retained and displayed, increasing the usefulness of the system. A further enhancement was the introduction of "reserved land" screens which allows details of tenements affected by conservation reserves to be held on the data base. This new feature assists the Department to effectively monitor some of its responsibilities in relation to the environment.

The Mining Information Centre located on the 1st Floor, Mineral House has now been operating for over two years and is succeeding in its original brief as a "one-stop shop" where members of the public and the mining industry can access a wide range of departmental services and information in the one area.

Mining Tenement Activity

The reduced level of registration activity for minerals experienced in 1988-89 continued during the year.

The total area of the State held under mining titles as at 30 June 1990 was 22 107 827 hectares and the number of titles in force was 17 449 compared with 26 278 115 hectares and 21 792 in force at the end of last year.

The 5076 titles received during the year and the 4212 titles granted represented a 20% decrease over the previous year's figures.

Whilst the total number of titles in force has decreased there have been subtantial changes in the number of each type of tenement that comprise that total.

Prospecting Licences which comprised 63% of the total titles in force in 1987-88 made up only 44% of this year's total, but mining leases which had supplied 24% of the total comprised 40% of this year's total.

This change in emphasis is a result of the flow-on created by the large number of prospecting licences reaching the end of their fourth year and being converted to mining leases.

Another interesting aspect has been the increase in the average size of mining titles. In April 1987 the average size of a live mining lease was 206 hectares; this had increased to 298 hectares by April 1990.

There remains a significant number of applications for mining titles that cannot be processed until the review set down in the Government's "Balancing the Scales" policy is implemented.

During the year a total of 12 988 dealings on mining titles were received.

The Tenement Surveillance area experienced a 31% decrease to 11 499 in the number of Form 5 reports lodged. However, the number of applications for exemption from expenditure reached an all time high with 3356 exemptions being applied for. The high level of tenement forfeitures has continued this year with some 1317 tenements being forfeited.

Industry Liaison Committees

Throughout the year, regular meetings of the Mining Industry Liaison Committee (MILC) were held.

Topics covered in MILC meetings included:

- Revised guidelines for technical reporting
- Conditions governing exploration on land controlled by the Department of Conservation and Land Management
- Prior notification to applicant of imminent grant of exploration licence
- The imposition of unconditional performance bonds to ensure rehabilitation of mine sites
- The appointment of environmental inspectors under the Mining Act 1978
- Protection of rangeland monitoring sites on pastoral leases

Title System Objectives

To maintain an efficient, fair and equitable title system for the mining industry in the future, the following aims remain as important elements:

- Acceptance of the concept of multiple land use
- Access to all land for exploration purposes to provide government with detailed information on land use
- Retention of Warden's Court hearings and statutory appeal rights
- Electronically assisted processing of tenement applications
- An electronic mining tenement register with statewide access
- Tenement boundaries based on graticular sections

Petroleum Tenements

An increase in the spread of active petroleum tenements across the State reflects the improved local gas market position promoted by the Division, lingering effects of the 1986 crude oil price crash and an expansion into some frontier offshore areas as part of government policy to increase access for exploration.

As at 30 June, 1990 there were 140 current petroleum titles in Western Australia - 99 exploration permits, 21 production licences and 20 pipeline licences. Management of these titles includes evaluation of the environmental, safety, technical, and administrative effects of all activity within the titles, with computerisation being evaluated to improve data handling and customer service.

The policy of gazetting smaller exploration permit areas to encourage more evenly spread exploration is continuing. Twenty-five permits were advertised this year, and eight new permits were awarded, five onshore and three offshore. Awards for permits advertised in the offshore Perth Basin, an area which has not seen exploration for nearly ten years, are pending. Surrenders and expiries increased, particularly in the remote onshore regions where ten tenements were dropped.

The Petroleum Division has addressed the need for efficient turn around of permit administrative matters, and has almost completed clearing all backlog dealings and transfers.

Substantial amendments to the State's petroleum legislation were introduced into the Spring session of the 1989 Parliament. The amendments were not able to be debated in that session and were carried over to the Autumn 1990 session. The matters addressed included provision for explorers to retain tenure over presently non-commercial discoveries by way of Retention Leases, the extension of access and special prospecting authorities to facilitate seismic acquisition and provision for production of petroleum to occur through a surface installation outside of a production licence by way of a deviated well.

During the year the drafting of further amendments to accommodate Drilling Reservations (DR's) was commenced, and while such amendments are dependent upon the passage of the Bill referred to above, it is anticipated that DR amending legislation will be introduced into the Spring session of the 1990 Parliament.

Also this year the Department continued its efforts to have the Limited Partnership Legislation amended so as to make it more compatible to the drilling fund concept which the Department is keen to foster.

Mapping

Essential support for the mining and petroleum registration process was provided by the Surveys and Mapping Division.

During the year improvements were made to the mapping process and the charting of all tenements is now being completed within ten working days of being received in Head Office. The tenement index system TENDEX has proved an effective management tool to monitor the charting function.

The plan monitoring system PLANMON is now complemented by PLANEX which assists with monitoring and managing the internal public plan maintenance process.

A systematic program utilising the Department's computer-based petroleum mapping system produced a total of 146 computer generated maps showing various combinations of data.

The system was also used to provide a number of high precision cartographic-quality base plots of petroleum tenements, wells drilled, and sedimentary basin boundaries for map publications.

The overlap of legislative responsibilities between the Commonwealth and the State Government in both petroleum and mineral issues has led to the need for the accurate determination of the Base-Line for the new limit of the territorial sea of Australia.

This Base-Line, which is being determined by the Australian Land Information Group (AUSLIG), together with the outer territorial sea boundary, will be shown on Departmental maps.

Computer software to generate the territorial sea boundary has been developed by external contractors on behalf of both the Department of Mines and the Department of Land Administration.

The following three new thematic maps relating to mining conservation and the environment have now been made available to the public:

- Conservation Reserves of Western Australia, State Map 1:2,500,000
- Conservation Reserves of Western Australia, South West Region 1:1,000,000
- Aboriginal Reserves of Western Australia, State Map 1:2,500,000

These plans have already created considerable interest as the first all embracing series to show environmentally sensitive and restricted lands.

Mining Information System

To improve access to information on mining projects and mineral deposits in the State a computer based enquiry system has been developed (MINEDEX). The system will ultimately incorporate a common core of data on all projects and sites with a mineral resource inventory, mine management data, locality information and production statistics. In addition, it will contain direct cross reference links into other computer systems within the Department.

Programming has largely been completed to handle enquiries on all aspects of:

- corporate data on projects and sites covering information on owners, commodity groups, type of site, stage of development and basic locality data;
- mineral resources inventory and geological information;
- comprehensive locality information; and
- cross reference linkages.

In addition, programming is at an advanced stage for monitoring and tracking notices-of-intent for mine development.

At the same time, data capture has been progressing to provide:

- a comprehensive project and site 'core data' index, with cross referencing to other systems;
- a complete mineral resources inventory;
- locality mineral resources inventory;
- development of a uniform project filing system (about 40% completed).

The system is available for enquiries on the data so far collected which covers 1200 projects and 2250 sites.

Graticular Sections

A 19% downturn in tenement applications allowed resources to be re-allocated into the introduction of graticular section plans at Mineral House and the Mining Registrar Offices.

The Offshore Mineral Series graticular plans originally scheduled in the 1988-89 program have now been produced.

The first three offshore Exploration Permit Applications in the WA Adjacent Area under the Commonwealth's Mineral (Submerged Lands) Act 1981 were received and processed. Applications are applied for in blocks based on 1 minute x 1minute graticular sections.

Several onshore exploration permits based on graticular sections were also received and processed.

Surveys of Tenements

Although 334 tenements were surveyed during the year, the backlog of leases that require survey is in excess of nine years work at this rate and continues to increase annually. The cost of survey relative to the increased area of tenements, in conjunction with limited funding available, is the major cause of this backlog.

The solution appears to partly lie in changing the actual field survey methods together with amendment to attendant regulations and the phased introduction of a user pays system. Liaison with the private sector has focused attention on this issue and a combination of using Global Positioning System (GPS)/Signet techniques, 3-dimensional computer adjustment programs, and the acceptance of field data in an electronic format, will all assist.

SDI Due for Release

Development of a software package to allow the capture of survey data from existing survey documents by manual input or by digital data transfer is nearing completion. Due for release in September 1990 the package has been developed by the Department of Land Administration with input from the Surveys Branch of the Department. Survey Data Input (SDI) will be the front end of the data base and will provide the necessary updating functions.

When fully operational SDI will dramatically reduce the contract survey role attributable to document production, compress the examination process and significantly reduce the time for certification of survey documents.

As an interim step, before the full implementation of SDI, two new software initiatives developed by the Department of Land Administration (Landcap and Landraw) have been installed in the Surveys and Mapping Division. Landcap is a data entry program which allows the fast and accurate examination of survey data and storage in a digital format. Landraw uses the Landcap data and, with further enhancement, produces a graphical display which can be plotted as the survey document.

OBJECTIVE 2: EXPLORATION AND DEVELOPMENT

To foster mineral, petroleum and groundwater exploration and development, and assist long range planning and decision making by Government.

The discovery and development of W.A.'s mineral, fossil fuel, and groundwater resources are intrinsic to the State's development. The Department's second objective enshrines this principle as an ongoing requirement with specific activities including the provision of scientific advice to Government and the public on medium and long term planning and decision making, particularly in relation to the mining and petroleum industries, engineering and urban development.

Decisions regarding development of any mineral or fossil fuel resource should be made on the best scientific information and advice available. The Department of Mines is the central location for geoscientific information. This is provided by mining and petroleum companies, various research organisations and institutions, plus field and office studies by the Department's own geoscientists.

Divisional Roles

Six Divisions of the Department implement this objective. The Geological Survey carries out geoscientific mapping, research, and provides advice relating to mineral, fossil fuel, and groundwater resources within the State. Mining development operations and drilling in support of hydrogeological investigations, and advice regarding development of such resources, are the functions of the Mining Engineering Division. The Petroleum Division is responsible for fostering petroleum exploration, drilling, engineering, oil and gas production and pipeline transportation.

The Surveys and Mapping Division supports this work through its cartographic, mapping and land information services whilst Mining Registration monitors the performance of tenement holders in the submission of geoscientific reports. The Chemistry Centre provides analytical, mineralogical, and metallurgical services within the confines of this objective.

The integration of this geoscientific knowledge began more than 100 years ago. Since then the material compiled from all sources, including the Department's own field investigations, has proven to be of significant benefit to the whole community; with continuous delineation, definition, analysis, and mapping of the geological resources of Western Australia. This information base now assists with evaluation of the economic development impact not only for residents of this State but for the whole of Australia.

Geological Survey Liaison Committee

The Geological Survey Liaison Committee, established by the Minister for Mines in October 1986, brings together the interests of industry and research institutions to ensure Geological Survey work meets their most appropriate needs.

Two subcommittees have been established: a Yilgarn Subcommittee to meet the special needs of the important goldfields region; and a Hydrogeology Subcommittee set up to consider the requirements of hydrogeology in the State.

General Geology Mapping

Geological field mapping projects continued in the Eastern Goldfields (in collaboration with the Commonwealth Bureau of Mineral Resources), Kimberleys, Hamersley Basin, Savory Basin and Paterson Orogen, and mapping was commenced in the Hill River region of the Perth Basin.

By the end of the year, field work had been completed in the Savory Basin and in the Menzies and Davyhurst 1:100 000 sheet areas in the Eastern Goldfields, the Paraburdoo and Rocklea 1:100 000 sheet areas in the Hamersley Basin, and the Hill River and Arrowsmith 1:100 000 sheet areas in the Perth Basin.

During the year the following fully coloured standard series geological maps were published:

Dunnsville	1:100 000
Bardoc	1:100 000
Newman	1:250 000
Robertson	1:250 000
Albany	1:1 000 000

Geological maps at an advanced stage of preparation for printing at the end of the year include the Menzies 1:100 000 sheet, Lake Lefroy (solid geology) and Cowan

(solid geology) 1:100 000 sheets, and the Turee Creek 1:250 000 sheet.

Special Purpose Geological Maps

Two special maps of the southeast Pilbara at 1:250 000 scale and two of the Southern Cross area at 1:100 000 scale were published at the end of the year.

Regolith Mapping

Regolith mapping, undertaken for the first time in 1988, continued in the Eastern Goldfields in the Norseman 1:100 000 sheet area. Compilations of the Dunnsville and Kalgoorlie 1:100 000 regolith maps were completed during 1989.

Environmental Geology Maps

The Gleneagle, Albany and Torbay 1:50 000 environmental geology maps were published during the year, and the Yallingup 1:50 000 map was at an advanced stage of preparation at the end of the year.

Geochronology

Research was undertaken with a view to (a) defining the extent of the Narryer Gneiss Complex in the northwest of the Yilgarn Craton and (b), in collaboration with Curtin University, defining a region of late uplift on the western margin of the Yilgarn Craton based on Rb-Sr biotite age determinations.

The geochronology program included preparation of reports on work carried out previously on the Fraser Complex, southeast Pilbara Craton, Murchison Province, King Leopold Orogen, Windimurra Complex and southern Pinjarra Orogen. Work on the geochronology of the Mount Bruce Supergroup was completed for a MERIWA project and the results have enabled more precise correlation between the sequences in the Pilbara Craton in Western Australia and those of the Kaapvaal Craton in Southern Africa.

Mineralisation Studies

Research continued into the style of gold mineralisation in the Kalgoorlie-Menzies and Wiluna-Norseman belts. Detailed studies of the geochemistry of the basic, ultrabasic and granitoid rocks in the Kambalda to Menzies area are nearing completion.

A report on the carbonate-hosted zinc-lead mineralisation in the Kimberley area was published, together with two reports containing miscellaneous papers on hydrogeology, the Collie Coal Measures, geochemistry of alkaline rocks, and structures in the Kimberley, Eastern Goldfields, and the northern Yilgarn Craton. A significant contribution was made to a report on the mineral sands industry in the South West of the State.

Basin Studies

Work on the Cretaceous sequence of the southern North West Shelf, carried out in conjunction with Curtin University and partially funded by MERIWA, was completed in December 1989.

Seismic structure-contour (time-structure) maps based on the base of the Grant Group in the Canning Basin were released in January 1990. The maps have been digitized and will be available initially at 1:250 000, and later at 1:1 000 000 scale. Seismic structure-contour maps based on the top of the Nita Formation (Ordovician) in the Canning Basin have been compiled and are scheduled for release in mid-1990. Non-digitized seismic structure maps were compiled for various horizons in the Perth Basin and were released in October 1989, in conjunction with petroleum tenement gazettals.

Reports on the biostratigraphic distribution of palynomorphs in the Permian rocks of the Collie and southern Perth Basins have been submitted for publication. A correlation chart of the Phanerozoic, prepared during the compilation of Memoir 3, was released in August 1989.

Hydrogeology

The first hydrogeological map of the State was published during the year. The map is at a scale of 1:2 500 000 and complements the recently issued State Geological and Mineral Deposits maps. It shows the location of the groundwater-bearing sedimentary basins and fractured rock provinces and provides information on rock-types, groundwater salinity, artesian areas, and other data.

A draft of the Broome 1:250 000 hydrogeological map was prepared and the explanatory notes edited. Compilation of the Derby hydrogeological map was delayed because of other work commitments.

Field investigations of the hydrogeology and hydrochemistry of the palaeodrainage systems in the Kalgoorlie and Lake Ballard areas have been completed, and a detailed report compiled. In addition, 1:250 000 hydrogeological maps of the Kalgoorlie, Kurnalpi, Boorabbin and Widgiemooltha sheets were in preparation at the end of the year. The hydrogeology drilling program in the Perth Basin continued with the drilling of the Karridale Line in the southern part of the basin, south of the previous Cowaramup Line. Together, these lines have located a very large source of fresh groundwater. In addition, investigation has commenced of the shallow aquifers of the Scott Coastal Plain, in the south coastal part of the Perth Basin.

Detailed investigations continued into the effects of bauxite mining on the quality of groundwater in the Darling Range, and a network of monitoring bores has been established in the intermediate rainfall zone to assess the effects of trial mining on groundwater in this area.

Major salinization studies continued in the Merredin area, where rising water tables are bringing salt to the surface in the townsite and threatening damage to housing. A major bore network has been established and long-term pumping is to be carried out to evaluate the possibility of widespread lowering of the water table. A similar investigation is to commence in the Upper Denmark Catchment, on the south coast of Western Australia, as part of an Integrated Catchment Management Project.

Over the last three years the water supplies available to more than 100 Aboriginal communities in the Kimberley area have been assessed. Water bores have been drilled at about 80% of these sites, with a success rate of approximately 95%. Most of the sites are in fractured and crystalline rock aquifers, and the high success rate has been made possible by the use of helicopters to locate the best drilling sites. By comparison, drilling in similar areas based on sites selected on the ground has generally resulted in a success rate of less than 20%.

Geological Studies for Landuse Planning

Appraisals of the resource potential of some 930 B and C Class Conservation Reserves and about 780 "Red Book" areas proposed as new reserves were completed during the year. Procedures were also developed for the award of Geoscientific Permits to facilitate the conduct of low-impact geoscientific studies in National Parks and A Class reserves. Some 28 applications for Geoscientific Permits were received during the year and 18 had been granted by early 1990.

Engineering Geology

The Geological Survey stationed one geologist at Collie during the year to assist the Water Authority in the completion of the Harris River Dam. Work was also undertaken at the New Victoria, North Dandalup, and Manjimup Dams.

There was an increased demand for geotechnical advice on ground stability in both open-pit and underground mines. Work was undertaken to initiate research projects aimed at increasing our knowledge of the long-term use of cable bolts and the stability of pit slopes. This work is important in terms of safety in operating mines and the management of abandoned open pits.

Geoscientific Databases

The Geological Survey maintains a number of geoscientific databases, and work continued on updating WAMEX (mineral exploration data), WAPEX (petroleum exploration data), MININFORM (resources and reserves of Western Australian minerals), ROCKMIN (petrological data), and the geophysical databases. Work continued on the development of the hydrogeological component of SWRIS (State Water Resources Information System).

During the year approximately 3165 mineral exploration and 496 petroleum exploration reports were received. The number of reports made available to the public on microfiche was 1253.

New Publications

Memoir 3 on "The Geology and Mineral Resources of Western Australia" was being printed by the State Printing Division at the end of the year. This major publication is a synthesis of our current knowledge of the geology and mineral resources of Western Australia. Together with the recently published 1:2.5 million scale maps of the geology, hydrogeology, and mineral deposits it will be a valuable source of information on all aspects of the geology of the State.

Geological Survey Division staff were listed as authors of 39 external publications during the year.

Information Sales

The geoscientific data made available by the Geological Survey on microfilm and microfiche, together with its maps and publications, provide a valuable information base for industry and contribute towards maintaining a favourable climate for exploration. The value of publications sold amounted to $125 391 while microfilm and microfiche sales realised $99 970.

Consultation and Advice

The demands on the Mining Engineering Division's resources to provide advice to industry, to government and to the broader community continued to grow. The demand for geotechnical, hydrogeological, environmental and engineering advice has been accelerated by complex economics, new technological achievements, further expansion in the industry, environmental awareness, health and safety moves by government, and a range of sociopolitical factors.

Land Information

A representative from the Surveys and Mapping Division assisted a taskforce to redefine the role and objectives of the Westerm Australian Land Information System community. Recommendations were made on data custodianship, standards and accountability and a proposal prepared for the establishment of an Office of Integrated Land Information.

In a joint exercise, Surveys and Mapping and Geological Survey Divisions undertook a Geographic Information System (GIS) pilot study to demonstrate the capacity of a GIS to resolve complex geological issues. The exercise also demonstrated that WALIS digital data can be readily integrated from several diverse sources. The study covered part of the Perth Metropolitan North-West Corridor, a dynamic and volatile region, and aided the planning process of not only this Department but also the Department of Planning and Urban Development.

The environmentally sensitive EPA System 5 was another region covered by a joint project. It involved the Department, CALM and the EPA. The project used digital data sets such as land tenure, mining and petroleum tenements, regional geology and EPA red book areas to develop a Land Information System (LIS) capable of resolving ongoing environmental and planning issues.

Cartography

The use of new technology is continuing to affect areas of map production and graphical publication. The acquisition of a computer aided drafting design (CADD) system by the Surveys and Mapping Division now allows for the digital generation of many requests for diagrams and figures and will provide an archive for all future work. "Scitex", a computer-based system for the digital preparation of maps, was again used in the production of some of the coloured maps produced by the Division.

The mapping programme this year saw nine maps published. This was below the original schedule because of a revised priority which required the completion of five Archaean series maps by September 1990.

Eight 1:250 000 scale maps were laser scanned and reprinted and two thematic maps produced. The first was the continuation of the series showing petroleum tenements in WA (four colours, December 1989) and the other a special map covering the North West Shelf oil and gas production installations.

A notable highlight of the year was the introduction of a new map series showing Precambrian geology. Two 1:100 000 maps (Lake Lefroy and Cowan) were published to complement the existing sheets of the same area. This map series adds to the geoscientific data available to the mining industry, scientific organisations and the community at large in the development of our mineral resources.

With the completion of the bulk of the material for Memoir 3, more time was available to reduce the backlog of bulletins and reports as well as provide photographic support for the newly established Communications Branch. Material produced totalled 1500 units comprising figures, diagrams, slides and overheads.

A gazetteer, supporting the Western Australian Localities Map (produced in 1988), was completed and provides a list of all place names on the map. Information has been categorised into a feature code suitable for use by the public.

Photographic Services again provided the reprographic component vital to the mapping program and played an integral part in the provision of photographic expertise.

Displays and Public Presentations

As part of the gazettal of areas for petroleum exploration, the Geological Survey ran field excursions to the Perth, Carnarvon, and Bonaparte Basins. These excursions have been well received by industry and were well attended. Prior to the Perth Basin excursion a seminar, presented jointly by the Geological Survey and the Petroleum Division, was held at which the geology and petroleum resources of the basin were discussed. Again, the seminar was very successful and further seminars are planned in association with future gazettals.

Liaison With Petroleum Industry

The Petroleum Division maintains close liaison with the petroleum industry both on a day-to-day basis and for special projects. This ensures the Department has up-to-date information on the activities of the industry for dissemination and can provide advice to industry and Government clients.

The Division has increased the provision of information on exploration activities, development projects, production trends and legislative incentives and changes. An in-depth review is being conducted of all petroleum tenement activity, safety monitoring and production information held by the Division in manual and computer databases in order to establish a cohesive information plan which can improve customer service. Two issues of Petroleum in Western Australia magazine were published. These include details of all current petroleum events and future plans, and editorial comment on important issues such as the impact of seismic surveying on the onshore environment. Articles

emphasising the recent successes in the State have also been published in trade journals.

The Division, in collaboration with Geological Survey, compiled a Departmental submission to the Harman Committee on power generation, including summaries of all gas reserves in the State. Updating and improvement of these summaries, plus new pages on oil discoveries, is underway for publication in a volume entitled "Oil and Gas Fields of Western Australia."

In order to promote exploration and particularly to increase gas reserves as required by industry, several meetings were held to discuss administrative and legislative incentives. A one day seminar was conducted in association with Geological Survey to provide background technical data on the offshore Perth Basin areas.

Regular meetings are now being conducted with operating companies to discuss safety and operational matters, drilling and workover programs and current or future development projects. The companies are also being informed of any changes in legislative requirements which may affect their operations.

Petroleum Exploration

The petroleum industry demonstrated increasing confidence in the State's petroleum potential this year after the 1986 crude oil price shock.

Drilling rates have increased and there have been a number of important oil and gas discoveries. The impact of these discoveries is currently being assessed.

All requests for approval of exploration activity were assessed for safety, technical parameters and suitability evaluation procedures. They were then referred to relevant agencies for consideration of potential environmental impact.

Each of the 33 exploration wells and 13 development wells drilled was monitored and requests for testing and completion reviewed. This included petrophysical analysis of wireline logs using an in-house program.

Petroleum Development Projects

The 1988-89 financial year witnessed one of the highest levels of petroleum development activity in the history of the State. This increased the chances of meeting long-term objectives of petroleum self-sufficiency, improving the balance of payments and providing substantial employment.

The Petroleum Division was actively involved in reviewing and monitoring the following oil projects which were completed:

- Talisman. This development uses the first floating production, storage and offloading facility (FPSO) in Western Australia for the oil produced from a single subsea wellhead. Talisman 1 came on-stream in July 1989 at a peak production of 3 200 kilolitres per day.
- Chervil. This $12 million project also involved the use of innovative technology and comprised a monopod platform, a mechanically jointed subsea pipeline and processing and storage facilities on Airlie Island. It came on-stream in August 1989 at a peak rate of 1 000 kilolitres per day.
- Saladin. Three offshore platforms, 8 subsea pipelines and production, storage and offloading facilities on Thevenard Island were constructed in this $150 million development. Production commenced in November 1989 at a peak rate of 9 500 kilolitres per day.

In addition, the Division continued reviewing and discussing with industry new developments at Goodwyn, Cowle, Yammaderry, Tubridgi, Cossack, and the development of the Lowendal gas gathering project.

Petroleum Production

The number of producing fields in the State continued to grow, particularly due to the increasing speed of development possible with new technology. The State now has 18 producing fields, with two on extended production tests.

Oil and gas reserves and deliverability have been assessed for reservoirs at the North Herald, Chervil, South Chervil, Saladin and Mount Horner fields. Assessment of the Goodwyn field is under way. Collation of all production data in the State for analysis is continuing. In line with the implementation of new technology a study has been completed on the possibility of oil production for sub-economic reservoirs in WA using non-conventional methods.

Diverse Chemical Analysis

The Chemistry Centre provides extensive analytical services to Government, industry and the general public. These services include the analysis of minerals and mineral products, and the areas of mineralogy, metallurgy, and water analyses.

During 1988-89 the amount of consultancy work undertaken by the Centre increased markedly. This trend continued this year with Chemistry Centre officers undertaking consultancy work to industry in diverse areas, including occupational health and mineral processing.

The Chemistry Centre also continues to support the Geological Survey and Mining Engineering Divisions in encouraging exploration and mining by the provision of analytical data and advice.

The Mineral Processing Laboratory of the Chemistry Centre continued to raise its level of involvement in mineral sands processing during the past year. The levels of gold related consulting testwork and research activity remain high in the Mineral Processing and Kalgoorlie Metallurgical Laboratories. Workloads associated with bullion analysis continue to increase, with 3429 gold bar drillings being received in the year for gold and silver analysis. This was a 40% increase on numbers for the previous year. Much of the fire assay work was for umpire testing.

Courses on atomic absorption spectroscopy for the gold industry and the carbon-in-pulp process for gold recovery were given in Kalgoorlie and Perth.

There was an overall increase in demand for the specialist equipment and expertise available in the Centre, particularly for value added processing improvements for a wide range of minerals.

OBJECTIVE 3: COMMUNITY AND ENVIRONMENT

To ensure the community receives a fair return from the exploitation of the State's mineral and petroleum resources; and that proper attention is given to the environment.

The Department of Mines is responsible for ensuring that the financial and material benefits which accrue to the State and Federal Governments, on behalf of the community, are commensurate with the level of industry activity and the value of the minerals and petroleum produced.

These resources are an asset belonging to the community and a direct charge is made for their depletion; this is separate and in addition to the obvious benefit which derives from profitable, decentralised industrial development.

A key element of this task is that the extraction of these resources is managed responsibly in respect of both the economic use of these finite resources regardless of size and the minimising of environmental impacts. It is also recognized that any industrial activity, as with agricultural and urban development, must have some impact on the environment and that, in addition to limiting or containing these effects, appropriate systems must be set up to properly manage and maintain rehabilitation.

A FAIR RETURN

Royalties

In Western Australia, with few exceptions, mineral and petroleum producers are required to pay royalties to the Government. The major exception is the gold industry where royalties are not paid.

The Royalties and Policy Development Division administers the collection of such royalties and in the year ending June 30, 1990 royalties for minerals and petroleum amounting to $264.2 million were credited to the Consolidated Revenue Fund (CRF), 50% more than the previous year.

These royalties were paid by more than 130 companies operating under 27 Acts, including 23 State Agreement Acts negotiated for specific projects.

Divisional Roles

While the Royalties and Policy Development Division is primarily involved in royalty collection, assistance is provided by the Petroleum, Mining Registration, Mining Engineering, and Geological Survey Divisions.

Royalty Levels

Royalty payments are determined using three basic methods.

Specific rate royalties are levied on low value products and range from 5 cents to 50 cents per tonne. They are generally applied to low value commodities.

Ad-valorem royalties are based on the value of the mineral produced with rates of royalty varying from 1.65% to 7.5% depending on the degree to which processing of the mineral takes place.

Profit based royalties have a much higher rate of royalty applied (generally above 20%) but are based on net profit, thus allowing companies deductions for all production costs.

Under petroleum legislation, a rate of between 5% and 12.5% of the value of production at the wellhead is applied. Agreements are negotiated with each producer which define the method by which the petroleum recovered is to be valued for royalty purposes. These agreements are complex and take a considerable length of time to negotiate. Royalty is collected on an interim basis until these agreements are finalised. Negotiations for such agreements continued during the year with the participants in the North West Shelf, and Herald/Pepper projects. An agreement was finalised for Harriet while negotiations commenced for the Saladin field and several smaller projects.

The Mining Information system (MINEDEX), when fully developed, will provide a valuable database for the Department to assist in improved collection and forecasting of mineral production and royalty payments.

Petroleum Royalties and Commonwealth Collections.

During the year petroleum royalties paid into the Consolidated Revenue Fund (CRF) increased by 152% to $51.8 million. This included $44.3 million from the production of crude oil, and $7.5 million from natural gas consumed locally and liquefied natural gas exported to Japan. A combination of higher oil prices, higher production through the commissioning of the Saladin Oilfield, lower capital expenditure on Barrow Island and the commencement of the North West Shelf's Liquefied Natural Gas exports to Japan contributed to the substantial increase in overall royalty payments.

In addition to the Consolidated Revenue Funds receipts, the Department is also responsible for royalty collection on behalf of the Commonwealth in offshore areas. Total petroleum royalty payments by the industry amounted to $89.4 million of which $49.8 million was passed to the Commonwealth and $39.6 million retained by the State. Collection of these funds in addition to the CRF collection imposes considerable consultation and audit responsibility on the Department.

Royalty Audits.

Audit checks increased with over 800 royalty returns being examined. The preparation of royalty audit manuals continued with manuals completed for two major petroleum projects and substantial progress made towards several other projects.

In 1984 the Commonwealth introduced Resource Rent Tax (RRT) into offshore areas for new projects. Under the previous legislation royalty was shared with the States and hence a new sharing agreement is necessary for RRT revenue. Negotiations with the Commonwealth commenced in 1988 and are expected to continue for some time.

Negotiations for changes to royalty arrangements took place during the year with one petroleum and 13 mineral producers. Significant changes to arrangements were made in seven out of the 14 cases.

Aboriginal Liaison

Since 1984 an Aboriginal Liaison Officer has materially contributed to the Department's role of ensuring that all Western Australians receive maximum benefit from the exploration and development of minerals and petroleum.

The officer conducts workshops and provides advice to Aboriginal communities, to exploration and mining companies and to Government. The acute awareness by Aboriginal communities of the potential effects of exploration and mining upon their environment has resulted in the Aboriginal Liaison Officer being in continuous demand for both advice and as a negotiator between the various parties. The officer also undertakes policy reviews regarding land access and land-use.

Some 90 Aboriginal communities and 40 companies have drawn on these services over recent years, many on an ongoing basis.

THE ENVIRONMENT

The Department is involved in a diverse range of management, monitoring and consultancy roles concerned with protection and mangement of the environment. In addition to the activities which specifically relate to the mining and petroleum sectors, the Chemistry Centre provides a range of analytical and advisory services covering all areas of environmental activity.

Divisional Roles

Six Divisions play an active role in management of the environment.

The Mining Registration Division places conditions on titles designed to ensure protection and rehabilitation of the environment. These conditions are developed by the Mining Engineering Division. All new development proposals are assessed and appropriate conditions recommended for each project to ensure adequate environmental management and protection in accordance with the Government's policies. The Division co-ordinates the Departmental response to the EPA for resource projects that are the subject of formal environmental assessments. Monitoring of these projects to ensure compliance is undertaken by the Mining Registration and Mining Engineering Divisions.

The Petroleum Division provides advice on environmental matters related to petroleum exploration and development and operates in cooperation with other Government departments and industry. In order to ensure improved liaison with all interested parties and to see that guidelines and directions for petroleum activity are met, an environmental officer dedicated to the Petroleum Division is to be appointed.

The Chemistry Centre assesses environmental reviews and management programs with regard to the impact of mining and industrial developments on the environment.

Key areas which the Chemistry Centre evaluates include: occupational health considerations of chemical use; stack gas or other process chemical emissions; disposal of waste chemicals or byproducts; the use of local water resources; and the effect on the quality of these resources.

Groundwater contamination and pollution studies are an important element of the Geological Survey Division's programme and drilling is undertaken as required.

The Explosives and Dangerous Goods Division ensures that hazardous substances are transported in a manner that provides maximum protection to the public and the environment.

During 1989 the Explosives and Dangerous Goods Division provided the chairman for a Working Party, set up by the Western Australian Advisory Committee on Hazardous Substances, to investigate and make recommendations on the feasibility of prescribing routes for the transport of dangerous goods. The objective is to maximise public safety and protect the environment. Initially, the Working Party is reviewing the road transport of flammable and combustible liquids and sodium cyanide and the attendant protection of water resources, catchment areas and environmentally sensitive wetlands.

The geographical area under review will initially be limited to metropolitan Perth and nearby regions of the Swan Coastal Plain and associated catchment areas between the Moore and Murray rivers.

The Geological Survey undertakes reviews of mineral and petroleum prospectivity in areas proposed as new conservation reserves. These reviews are to ensure that wherever possible mineral or petroleum resources are not sterilised and that exploration access is maintained to potentially favourable areas.

National Parks and Nature Reserves

The Government announced a new policy on exploration and mining in National Parks and Nature Reserves in February 1988. Under this new policy the Department of Mines has a role in proposing areas that should be considered for exploration access, reviewing boundaries and assessing the mineral and petroleum potential of proposed reserves. During the year the Department assessed more than 900 'B' and 'C' Class nature reserves identified for possible upgrading to Class 'A' classification.

The Department is also responsible for the assessment of geoscientific study permit applications for non-disturbing geological research in National Parks and Nature Reserves.

Cyanide Monitoring for Industry

Companies involved in gold mining activities in environmentally sensitive areas are assisted with their cyanide monitoring programmes by the Chemistry Centre's development of analytical procedures for the accurate determination of very low levels of cyanides in effluents and groundwater.

The Chemistry Centre also works with commercial laboratories to ensure the mining industry has continued access to high quality analytical services.

Applied research programs developed from similar joint efforts include the evaluation of methods for the neutralisation of cyanide effluents and spillages, and a national project to monitor the fate of cyanide residues in tailings from mining operations.

This latter project, organised under the auspices of the Australian Mineral Industry Research Association, brings together 14 companies from throughout Australia. The $246 000 project is examining the interaction of cyanide with soils and tailings residues to better understand the degradation and transport of cyanide in the environment. Additional analysis of metal cyano complexes is being provided by the Centre for Chemical Analysis, University of NSW.

Petroleum Guidelines

A study commissioned by the Minister for Mines of conservation and rehabilitation in relation to onshore seismic lines was completed, resulting in the drafting of a set of guidelines to be followed by all companies engaged in approved survey activity. The report has been endorsed by the Government.

Mining Proposals and Response to Guidelines

One hundred and forty six (146) new mining proposals were received and reviewed by the Department for their environmental impact, together with a further 40 proposals for major expansions to existing operations. Of the 186, 124 were for gold ventures and 11 for base metals.

The impact and effects of conditions set by Mining Engineering in environmental matters can now be clearly seen in many of the major mining centres. Waste dump and tailings dam design and rehabilitation in accordance with Department guidelines has been accepted by the majority of gold mining companies and the improvements are visible in the Murchison and northern goldfields.

To further assist the industry achieve required standards, two additional guidelines were released relating to heap and vat leaching. The Mining Engineering Division also coordinated the production of a video on environmental management at minesites. The EPA, CALM, the Chamber of Mines and Energy and AMIC contributed financially and technically and the resultant video, "A Stake in the Future", was released by the Minister for Mines in February 1990 together with a companion handbook.

At the request of the Minister for Mines, a work party was convened to examine conservation and rehabilitation issues in relation to the quarry industry. The work party included representatives of Government, local government, industry and the Conservation Council. Its report was released by the Minister for Mines for public comment in May.

The Work Party recommended that: a set of comprehensive guidelines should form the basis for all quarry rehabilitation in the State; a special body should be established to monitor and enhance quarry rehabilitation performance; and if poor rehabilitation practice continues in the quarry industry, the Mines Department should be given power to ensure rehabilitation of all quarries.

Regional Environmental Issues

The Department maintains its membership of Land Conservation District Committees in the Pastoral zone. The Mining industry has been encouraged to obtain membership.

The Department's aim through membership is to assist in the development of improved land management practices by the mining industry and to improve relationships between the mining industry and pastoralists.

Local mining development planning committees have been convened and commenced operations in the Yilgarn/Westonia and Leonora Shires. These are coordinated and chaired by Department officers. Mt Magnet, Meekatharra and Laverton communities decided to maintain informal groups with input from local government, industry and Government Departments. The committees are operating successfully and are considering local issues affecting mining operations such as bypass roads, sewerage systems and rehabilitation. Each committee is preparing local environmental strategies. The Yilgarn Committee commissioned a report on environmental issues around Southern Cross from a consultant.

The Golden Mile Mining Development Planning Committee continued its activities at a low level following the release in Kalgoorlie of the Concept Plan by the Minister for Mines in July 1989.

Wonnerup Operation

The Wonnerup clean-up operation to remove old mineral sand tailings with high radiation levels from rural and residential land is being carried out by Cable Sands (WA)

Greater than expected amounts of garnet in the sands reduced plant throughput and has put the operation slightly behind schedule. Progressive rehabilitation is being carried out satisfactorily.

Environmental Management of Tailings

In 1988-89 the Department commissioned Australian Ground Water Consultants to prepare a report on the suitability of current WA practices for the storage and disposal of mine tailings.

This report, received in October 1989, is being used by the Department to prepare guidelines for the environmental management of tailings dams.

OBJECTIVE 4: SAFETY FOR ALL

To ensure that all operations in the mining and petroleum industries and activities involving explosives and dangerous goods are conducted in a manner that is safe for workers and the public.

One word sums up this objective—safety. In pursuing this objective the Department maintains safety as the key ingredient for all workers within the mining and petroleum industries and for the public of Western Australia. Such work involves legislation, guidelines, technical advice, and inspections.

Divisional Roles

Five divisions implement this objective. A high standard of technical competence is required in the Department's inspectorate which includes the Mining Engineering, Petroleum, Explosives and Dangerous Goods Divisions, and the Chemistry Centre. The Surveys and Mapping Division provides a repository for information concerning all plans of mines and minesites for Departmental purposes and public access.

The Petroleum Division acts to ensure public and worker safety in all petroleum exploration, construction and production activity.

The Explosives and Dangerous Goods Division acts to assure public safety at places where explosives and dangerous goods are manufactured, stored or transported.

The Chemistry Centre provides technical inspections, tests and advice on occupational health matters within the mining industry as well as providing similar services on all aspects of dangerous goods handling, storage and transport for the Department as well as the Environmental Protection Authority.

Amendments to Mines Regulation Act and Regulations

The Mines Regulation Amendment Bill 1989, incorporating the Principles of Parts III and IV of the Occupational Health, Safety and Welfare Act, passed through the Legislative Assembly and awaits the second reading debate in the Legislative Council.

Amendments to Coal Mines Regulation Act and Regulations

A Bill passed through both Houses of Parliament in June 1990 to amend the Coal Mines Regulation Act. The amendments were related to the introduction of:

- an open cut undermanagers certificate of competency
- rationalization of experience requirements for granting of certificates
- an examination in WA Coal Mining Law where reciprocal certification is contemplated
- removal of the restriction on persons being employed underground for more than seven hours per day

A new bill entitled The Coal Mines Bill 1990 is being drafted together with new regulations. This is a complete rewrite and modern translation of The Coal Mining Legislation.

Mine Plans

Legislation requires that mining companies prepare plans of mine workings and lodge them with the Department where, subject to approval, they are made available for research.

During the year, 861 plans of mines and mine sites were received from 120 mining operations submitted by 55 companies.

Fatal and Lost Time Injury Recording

The fifth report from the computer based accident and reporting system (AXTAT) "Fatal and Lost Time Injuries" was issued. This publication presents a comprehensive analysis of injury data for the industry and information on trends in injuries that have emerged over the past two years. It is used by organisations to keep management and safety professionals informed

about accident statistics as an aid in evaluating the effectiveness of their safety programs and to promote discussion at safety committee meetings in an effort to increase safety awareness at all levels.

Presentations of the AXTAT system were made to public servants and to groups from the Chamber of Mines and Energy, industry and the Trades and Labour Council.

A total of 2211 accidents were classified and recorded during the year.

Inquiry into Safety in Underground Gold Mining Operations

During 1989 and January 1990 fatalities in Western Australian underground goldmines, and an overall increase in the incidence rate of serious injury, resulted in the Minister for Mines instigating a formal Inquiry.

Government, Industry and Union representatives and an independent safety specialist were appointed to a consultative steering committee which convened in February 1990. The Report with recommendations was submitted to the Minister in June 1990.

The Inquiry, which was restricted to the underground gold mining sector, was conducted in two stages. The first involved a phase of information gathering on a voluntary basis, with the second being formal interviews at which the principal objective of the Inquiry was to thoroughly examine and appraise the major issues impacting on operating safety in existing arrangements and practices in underground gold mines. The Committee was also asked to examine systems and operating practices, and make recommendations for future improvement in mine safety performance.

The Inquiry recommendations highlight the need for a collective approach to the issue of mine safety, the importance of thorough training, the elimination of unsafe practices and, most importantly, the need for an unequivocal commitment from all levels and all sectors in the industry to make safety an integral component of the mining process.

Contaminant Monitoring

The contaminants monitoring system CONTAM performed satisfactorily throughout the year with more than 39,000 atmospheric contaminant samples recorded. These records were subject to review by the Ventilation Board for exposure to gas, fumes and dust by mine employees.

The design of CONTAM 2 is now underway. It is anticipated that this will be operational by January 1991. The new system will provide improved management information and hence will allow trends in atmospheric contaminant concentrations to be more readily determined.

Safety in the Petroleum Industry

As part of a general review of safety standards in the Western Australian petroleum industry a draft schedule of specific requirements for onshore exploration and production was produced and circulated for industry comment. The comments were then incorporated into a new schedule which will replace the current directions on drilling operations and geological and geophysical surveys issued in 1982.

Revised requirements were also produced to replace the "Petroleum Pipelines Regulations" issued in 1970. The new document, entitled "The Schedule of Specific Requirements as to Onshore Petroleum Pipelines - 1990", which represents a significant update of the earlier Regulations.

During the year, the Petroleum Division has been actively involved on the Consultative Committee on Safety in the Offshore Petroleum Industry (COSOP) which was established to advise on offshore safety matters in Australia following the Piper Alpha disaster in the North Sea in 1988.

The Australian Response Document, which has been proposed as a result of the Committee's deliberations, will be issued to the offshore industry in the third quarter of 1990.

As part of this safety review, the Petroleum Division carried out a survey of all work permit systems on offshore platforms to ensure their compliance with current safety standards.

In conjunction with the Department of Occupational Health, Safety and Welfare a system for testing and accrediting offshore crane drivers has been implemented. In addition, the Petroleum Division has taken over responsibility for the inspection and on-going certification of pressure vessels and cranes on petroleum sites from DOHSWA. This is in accordance with the provisions of the Occupational Health, Safety and Welfare Amendment Act, 1987 which excludes petroleum sites already covered under the State's Petroleum legislation.

A total of 44 field inspections was made during the financial year by Petroleum Division inspectors including two overseas inspections involving a derrick barge and a drillship which were being imported for use in Australian waters.

Long Term Stability of Deep Open Cut Mines

Investigations into the stability of open pit walls were undertaken to develop guidelines for the safe

abandonment of these pits following mining. Interim guidelines were issued to the industry in August 1989.

A survey of operating open pit operations indicated a high incidence of major pit wall failures and lack of geotechnical investigations by many operating companies. Site inspections resulted in some mining operations being suspended by the inspectorate because of pit wall stability problems. A small number of operations have suffered severe production losses due to pit wall failures.

An intense education programme was initiated in June to improve open pit design and promote the rapid introduction of site specific pit wall monitoring. This programme is being strongly supported by the open pit operators.

Radiation Safety Initiatives - MIDAS

The Mines Dose Assessment System (MIDAS) is a computer based radiation exposure recording and reporting system being developed by the Department of Mines. The system will be fully operational by the end of 1990.

The first module of MIDAS has already been distributed to the relevant companies for evaluation to ensure that the system will fulfil the needs of both industry and the regulatory authorities.

The system will be used for monitoring radiation exposures of workers involved in the mining and processing of radioactive ores.

The industry database will be maintained within the Department but each company will be able to maintain its individual data software modules developed and distributed by the Department.

The database will be useful for the analysis of radiation exposure trends and will release industry radiation safety officers from repetitive and time consuming administrative tasks. A better performance in the monitoring and control of radiation exposure is expected.

Radiation Research

The Department has reviewed its radiation research priorities, especially with regard to the Mineral Sands industry but also in other areas of the mining industry. Areas that are currently being investigated include:

- particle size studies
- effective respiratory protection factors
- radon in underground mines
- bioassay techniques e.g. thoron-in-breath analysis, neutron activation analysis

Initiatives in the Coal Industry

Significant progress is being made in the implementation and development of training programmes in both underground and open cut mining. These include induction and mobile equipment operator courses with suitable refresher courses. There were appointments of additional training officers and support personnel.

The first female to be employed as a miner in the Collie coalfield, in this case as an open cut truck driver, commenced duties with the Griffin Company at Muja Open Cut in December 1989. Two additional females were subsequently employed in similar occupations.

Improvements in regard to the storage, transport and handling of potentially hazardous chemicals in use at coal mines were under discussion and development throughout the year. Under the guidance of the inspectorate, the companies actively sought manufacturers' data sheets for all chemicals in use in industry.

Safety and Working Hours

The Department played an active role in implementing and scrutinising working conditions in mines throughout the State, utilising the resources of Mining Engineering and the Chemistry Centre.

Guidelines for the handling of cyanide solution have been issued and action taken to improve the storage of cyanide.

A new "approved persons" system for statutorily required inspections of classified machinery on mines has been established. A data base for this machinery has been developed and a total of 25 persons, other than Departmental Inspectors, have been approved to carry out these statutory inspections on six specific mines.

A number of mining companies were successfully prosecuted for breaches against the Mines Regulation Act for employing workers in excess of the number of days or hours permitted. The Department's Inspectorate will continue to take a firm stand on this important issue of work safety.

Public Safety

The Explosives and Dangerous Goods Division continued to provide technical expertise for the assessment of hazards associated with the manufacture, storage, handling and transport of explosives and

dangerous goods. This constant high level of advice to industry, combined with regular inspections, has ensured that public safety standards are maintained.

In carrying out its task, the Division monitors and reviews laws and regulations with regard to hazardous substances and provides safety advice together with ongoing programmes of hazard analysis and risk assessment while maintaining a high level of general and specific inspections.

The continuing increase in the number of licences issued under the Explosives and Dangerous Goods Act for storage, transport and use of explosives and dangerous goods indicates that public safety awareness through the regulatory licencing system remains high.

Additionally, the high level of requests for advice on compliance with the regulations and the resolution of public safety problems show the public and industry in general are now much more aware of the role the Division plays in the control of dangerous goods.

Extensive review work was carried out with the Public Safety Sub-committee and the Parliamentary Draftsman on drafts of the proposed Dangerous Goods Regulations. Comments received from the public following the public review assisted in the drafting process.

Implementation of the recommendations of the Public Safety Sub-committee via the Dangerous Goods Regulations necessitated amendments to the Explosives and Dangerous Goods Act. In late June an Amending Bill was introduced to Parliament to provide for:

- the control of pipelines and exemption of pipelines already controlled by other Government instrumentalities
- the preparation of total hazard control plans and emergency response training
- good samaritan clauses to protect the participants providing aid at an emergency involving dangerous goods
- the Explosives and Dangerous Goods Division to have the authority to implement Codes of Practice.

The Bill also contains general administrative clauses to simplify the processes for:

- the appointment of Inspectors
- the classification of dangerous goods
- the authorisation of explosives
- the presentation of evidence in court.

Additionally, penalties for breaches of the Act will be raised to $50 000.

Public Safety in Greenfield Planning

A considerable amount of time was spent in reviewing the major hazards implications in the plans for two industrial parklands in Western Australia: Kemerton and East Rockingham.

Participation in the planning stages of an industrial park allows the Department to manage overall risks which may occur, thereby optimising public safety and land-use.

Major hazards work was also carried out in the Kwinana industrial area. An officer was seconded to the State Emergency Service to coordinate emergency response plans developed by major industry in the area.

Joint Operations

Chemistry Centre staff have continued their participation in ventilation seminars. They have also assisted with inspections of mining operations to advise on the safe use of chemicals.

Health Chemistry Laboratory staff have also visited the Pilbara and Kimberley regions as consultants to the mining industry. This involved advising staff on chemical handling and process problems, including the health effects of chemical exposure and the correct use of protective equipment.

Occupational Health

Consultancy to industry and the community continues to increase under the "general duty of care" provisions of the Occupational Health, Safety and Welfare Act. Many of the queries received relate to safety information on chemicals which must now be supplied to the workplace. Officers from Mining Engineering and the Chemistry Centre are currently sitting on a tripartite working party, drafting legislation relating to the provision of information on chemicals in the workplace.

OBJECTIVE 5: CHEMICAL SERVICES AND RESEARCH

To ensure that the community has access to independent chemical research and consultancy services.

This objective encompasses the key role of the Chemistry Centre which is to provide a range of highly specialised services to Government, industry and the Western Australian public. Specifically it relates to those activities outside the research and consultancy services provided to meet objectives 2 to 4.

The Centre is responsible for chemical research and related scientific advice in the fields of agricultural, forensic, materials, health and racing chemistry. Advice is provided to more than 30 government agencies, industry and the general public.

The Chemistry Centre has the technical expertise and the experience to respond rapidly to a range of problems such as contamination of imported food products, a chemical spill of any description, or exposure of workers to any potentially hazardous material.

Commitment to this objective is achieved by the Centre's active support of, and participation in, agricultural research and regulatory programmes. These include product evaluation, processes and methods, and analysis. It also provides support for law enforcement agencies through scientific investigation in forensic research, drug detection, and investigating and reporting on various exhibits which may comprise evidence.

In addition, the Centre has applied its problem-solving expertise in such diverse areas as applied research, investigations regarding water quality pesticides in food, occupational health matters, Standards, and consumer complaints. This work has addressed the concerns of environmentalists, the chemical industry and the general public.

Diversity in Laboratory Analysis

During the year the Centre continued to work on many specialised and wide-ranging projects, including pesticide monitoring, soil and plant analysis, and investigations for the Department of Consumer Affairs. It also assisted commercial laboratories to gain accreditation in food analysis, and was involved in lupin research, mineralogy, metallurgy and groundwater monitoring.

The successful development of a fast and accurate immunochemical assay for trace levels of alkaloids in lupins by the Agricultural Chemistry Laboratory, in conjunction with Curtin University's School of Medical Technology, has been used as a tool to help the State maintain the low alkaloid quality of an export worth one hundred million dollars annually.

A Report of Investigation titled "Chemical Analysis of Phosphorus in Western Australian Soils — Methods, Applications and Interpretation" by staff in the Agricultural Chemistry Laboratory summarises extensive work conducted over the last decade and sets a baseline of knowledge for future research into the movement of phosphorus in the coastal sandy soils of WA.

The nutrition of horticultural crops on coastal plain sandy soils in WA has important implications for the control and understanding of the eutrophication of estuaries and the pollution of groundwater. Agricultural Chemistry Laboratory staff have worked with the Department of Agriculture to study phosphorus and nitrogen nutrients in soils. This work is providing a better understanding of the complex interactions of agriculture with the environment of the Swan Coastal Plain.

The Chemistry Centre continued to be active in the resolution of air pollution problems. One case involved the field and laboratory investigation of unpleasant odours being produced by fibrocement products following a change in production procedures. A solution to the problem was given to the manufacturer.

The Toxicology Section of the Forensic Science Laboratory investigated an aconitine poisoning case resulting from the ingestion of a Chinese herbal potion. This case raised issues relating to the licensing of Chinese herbalists.

The Health Chemistry Laboratory made an inspection of a large vault in a Government Department which housed old books and plans following complaints of an irritating, offensive odour which was causing headaches and nosebleeds. Excessive use of an amine in the insulation material was identified as the cause. Removal of the insulation was recommended.

The Racing Chemistry Laboratory was again very active in detecting a range of drugs used illicitly in horse racing, pacing and the greyhounds. The Laboratory continued to expand its capacity to detect low dose drugs, An innovation introduced this year was a procedure where the positive identification of drugs is confirmed by one of the racing chemistry laboratories in the Eastern States. As a result of this operation, efforts are being made to ensure uniform procedures are used in each of Australia's four major racing chemistry laboratories.

The Forensic Science Laboratory continued its service to the Police and Corrective Services departments by conducting analyses in arson, drug, and toxicology cases.

There was a marked increase in the number of amphetamine and methylamphetamine drug cases investigated, with trafficable quantities of these drugs being identified by the Laboratory. The effects of the increased availability of these drugs were observed in a corresponding increase in the number of sobriety cases examined for, and in the increased incidence of, amphetamines in fatal motor vehicle accidents.

The Materials Science Laboratory continued its work into assessing the suitability of materials for contact with potable water. As the only centre in Australia with the appropriate methodology to carry out this function, the Laboratory received many requests from interstate to assess various materials. This work is done in conjunction with the WA Water Authority and the Health Department.

Investigations by the Chemistry Centre have assisted:

- the Ribbons of Blue project involving hundreds of school children in a water monitoring program
- the Health Department to determine trends in organochlorine pesticide levels in human health
- the Ministry of Consumer Affairs and the Small Claims Tribunal in relation to a series of consumer concerns and complaints
- the Building Management Authority and the Main Roads Department by advising on paint failures
- the Health Department with problems concerning corrosion staining on surgical instruments

Organisational Developments

During 1989-90 the project team for the new Chemistry Centre complex at Bentley was formed. This complex will include replacement laboratories for the Centre's Hay Street and Bentley facilities which are up to 50 years old, overcrowded and fail to meet current standards. It is also planned to include facilities for the CSIRO and Curtin University.

Detailed studies of the site adjacent to Curtin University were undertaken. A schematic design report was prepared by the architects and other consultants. This document addresses the occupational health and safety requirements for staff, security, staff interaction, housing of sophisticated scientific equipment and the extensive range of services necessary in a laboratory complex with a diverse range of responsibilities. Funding for detailed designs and the preparation of tender documents has been requested for 1990-91.

CORPORATE SERVICES

With the continuing tightening of finance and staff throughout Government, the Department has worked hard to improve its resource management. This has been made more difficult with the delegation of a number of central government functions without a corresponding transfer of staff. Delegated functions included the devolution of the purchasing function from the Department of Services and devolution of certain staffing responsibities from the Public Service Commission.

The changes have necessitated an increased emphasis on planning and in this respect progress has been made in the Department's corporate planning activities.

Corporate Planning

The Department's committment to Corporate Planning was continued during the year with the secondment of the Deputy Director, Explosives and Dangerous Goods Division, to the position of Corporate Planner.

The Corporate Plan for 1990-93 was printed during the year and distributed to external stakeholders, politicians and all staff of the Department. Seminars were held by the members of the Corporate Directorate to advise all staff of the Corporate Planning process, its relevance, and its importance in determining the future direction of the Department.

With the introduction of Program Management into government departments, the Department has moved to integrate the Corporate Planning and budgeting processes. To ensure consistency and compatibility, the Manager, Financial Services, was seconded to carry out the role of Corporate Planner for 1990-91. Apart from the role of coordinating reviews of the operational plan, performance indicators and specific action plans, the terms of reference of this appointment are specifically prescribed as "linking the philosophical view of organisational objectives as defined in the Corporate Plan into the budgeting and resource management processes of the Department."

By the end of 1989-90 a framework had been developed for Program Management based on a cost centre approach. Significant adjustment has been made at the component level of the Plan, whilst retaining the program and sub-program descriptions as detailed in the Corporate Plan.

A new Operational Plan will be developed early in 1990-91 based on the revised Components of the Corporate Plan. It will form the basis of Divisional Quarterly Reports prepared to advise Program Managers of progress and actions to be taken in implementing the Corporate Plan.

Progress has been made in the development of Performance Indicators, with the emphasis being in areas where measures were inadequate. A comprehensive review of Performance Indicators, and their incorporation into quarterly reports will be pursued during 1990-91.

Human Resource Management

Following two years in which extensive development and introduction of human resource initiatives took place, 1989-90 was a year of consolidation.

The Public Service Commission continued its devolution of powers and the Department was able to successfully integrate these new personnel functions, albeit with greater pressure on existing staff.

In 1989-90, the Department's Approved Average Staffing Level (AASL) was 795.4 Full Time Equivalents (FTE's). With the development of planning and monitoring strategies the Department was able to continue to operate effectively within this level.

The rate of turnover was reduced by around 25% on the previous year with 157 staff resigning or retiring. On the other hand, consistent recruitment and training efforts have enabled the Department to maintain a high level of expertise and increase its stability with a total of 172 new staff being recruited.

Training initiatives were continued with more than 1 180 staff attendances at various management and technical seminars, workshops and courses.

A new video and computer-based training programme was introduced for staff which proved to be very beneficial and well patronised.

The Human Resources Branch continues to work closely with the Office of Executive Personnel. Senior Executive Service representatives within the Department have participated regularly in executive development programmes and seminars.

For the first time, a survival awareness course was conducted for selected field staff.

Staff evaluation processes were further developed. Performance management systems are already in place for Geological Survey, Mining Registration and the Chemistry Centre and Surveys and Mapping Division became fully operational in 1989-90. Other divisions are expected to be operational during 1991.

Through the Health and Safety Committee, considerable emphasis was given to promoting and implementing health, safety and welfare initiatives within the Department. These included training for the First Aid attendants and welfare consulting services.

The Department commenced development of a system which would provide case management for worker compensation claims. During the year there were 37 claims of which 21 were accepted, 2 rejected, and the remaining 14 under consideration.

The Department has prepared and implemented an Equal Employment Opportunity Management Plan. This was endorsed by the Directorate and action plans implemented. The Plan will be reviewed every 12 months and a report forwarded to the Directorate of Equal Opportunity in Public Employment.

On 2 April 1990, the Public Service Arbitrator awarded the second 3% Structural Efficiency instalment to all employees covered by Civil Service Association Awards. The increase was effective from 13 April 1990. Lengthy negotiations took place to agree on the commitments contained within the Memorandum of Agreement which formed the basis for the first Structural Efficiency Principle instalment. These included the amalgamation of 53 Civil Service Association awards into a single Government Officers' Award and then to incorporate within that Award new provisions, including scope for part time, casual and fixed term employment. Agreement was also reached to create a single Public Service General Conditions of Service and Allowances Award to streamline many different existing awards and agreements, and to further restructure and modernise the award.

Management Services

Support to the Corporate Executive to improve resource management was achieved by changes in purchasing operations as well as a range of reviews covering existing activities.

From 30 June 1989 the Department assumed responsibility for its own procurement and disposal of goods and services. This responsibility was delegated by the Department of Services following a successful trial period in the Department. The operations were further reviewed after six months operation with the results fully supporting the devolution decision. Further improvements in the purchasing process are expected with the introduction of a Corporate Card to replace the Local Purchase Order system. This will assist in faster payment of creditors and a simplified record monitoring system.

A number of reviews were completed during the year designed to evaluate and improve performance. These included reviews of the Department's Internal Audit Section, a computerized Asset Register and procedures for the loss, damage or destruction of Crown property. Planning for the implementation of an Energy Management Plan within the Mineral House Complex was also completed.

Capital and Minor Works

During the year, significant effort was directed at Occupational Health, Safety and Welfare issues within the Department.

The major works were:

- Coordination and implementation of 38 Occupational Health, Safety and Welfare Projects within the Chemistry Centre totalling $250 000.
- Coordination and implementation of alterations to the Agricultural Chemistry Laboratory $120 000.
- The completion of the Chemistry Centre, East Perth alterations $215 000.
- Coordination and implementation of the Chemistry Centre's Kalgoorlie Metallurgical Laboratories Noise and Dust Abatement Capital Works Project $62 000.
- Assistance with initial planning of the proposed Chemistry Centre Complex, Bentley and associated CSIRO Mineral Research Facility $500 000.
- Coordination and implementation of the fitout of Level 10 North of the Mineral House Complex $60 000.
- Minor Works coordination and management of 43 minor works ranging up in value to $25 000 and totalling $200 000.
- Coordination and management of 12 specific Occupational Health, Welfare and Safety works totalling $26 000.
- Installation and commissioning of the new Telecom 9600L PABX at a total cost of $235 670.

Financial Management

Significant progress towards the implementation of program management was achieved with the structuring of the Department's budget within discrete programs developed through the corporate planning process. The first phase was completed in April with the 1990-91 estimates being submitted to Treasury in program format and with the 1989-90 budget estimates redrafted to reflect program budgeting. The process of program management will ultimately provide greater flexibility in allowing managers to manage and lead to "one line" appropriations, lessening some of the financial constraints and rigidities imposed by the present system of appropriations and, at the same time, increase accountability.

Computing

After three years of planning and development the Department completed the installation of its regional network during the last quarter of the year. Thirteen regional centres from Collie to Kununurra now have direct access to a number of Perth based computer based systems. This network, which uses the most advanced communications and computing technology, is operational nine hours a day. It has provided a very high degree of reliability to regional centres.

In addition to the online enquiry services originally offered, the Department has now added a direct update facility on a number of databases. This facility will ensure that systems such as those handling tenement applications, title information, tenement rentals and expenditure data will have the advantage of immediate update from a regional office. This will reduce clerical effort and provide more current information to the public and industry.

As additional systems are developed and further data added to the existing databases the regional network will provide an increasingly important service to the community.

The commissioning of the expanded Mineral House complex in 1988 enabled the Department to install the infrastructure for a modern local communications system. The planning and investment in a backbone cabling system has already provided the Department with the anticipated benefits of flexibility on changes/expansions to the local network and reduced staff relocation costs. In addition to supporting workstation access to mainframe databases this backbone cabling system now handles two local area networks. These were successfully trialled during the year.

These developments support the Department's information technology strategy which is aimed at developing a common integrated network using multifunction workstations within three years.

The information technology plan for 1990-91 makes provision for expansion of the local network by the progressive replacement of the stand-alone word processing facilities.

The rapid pace of development in computing technology and data communications continues to make long term planning of computing facilities and the design of complex systems difficult.

This rate of change, however, emphasises the importance of sound structural and architectural standards for central and distributed data networks, improved definition and management of corporate data and adherence to proven software and hardware technology.

With its progressive planning and development of standards during the past three years the Department is well placed to take advantage of continuing technology developments and price improvements.

During the year the addition of new systems and expanded databases in the petroleum exploration, mining tenement, mine site and mine safety areas has generated a significant increase in the use of Departmental computing facilities. Some 25,000 online inquiry and update transactions are now being handled daily by the computing network. The expanded mining tenement information system, which includes TENDEX, PLANMON and TRAXS, now handles over 7000 transactions per day with a large percentage of these arising from public and industry enquiries.

The Department is confident that with the continuing enhancement of databases covering all areas of its operations the level of service provided to the mining and petroleum industries will further improve. This additional usage of Departmental services by industry will provide financial justification for the planned further development and enhancement of computer based services.

The difficulties experienced during the past four years with the recruitment and retention of high calibre information technology staff continued during the past year. To overcome part of this problem, the Department began recruitment and development of new Computer Science graduates. Early indications are that this method, whilst slower in terms of overall systems development time, will in the longer term provide for a more stable systems development staff unit.

Word Processing

The word processing staff and system performed well during a demanding year which involved a continuous high volume of work and physical change due to the continuing relocation of staff.

The Department has now commenced phasing out the existing Wordplex word processing system and replacing it with microcomputers. This will provide a more integrated service throughout the Divisions. The Microsoft "Word for Windows", an upgraded easy to use version of MS Word, is to be the standardized word processing package for the Department.

Records Management

In 1987-88 substantial increases (13%) were experienced in the amount of incoming correspondence, the number of tenement and general files created and the volume of

mail despatched. This level of activity was maintained during 1988-89 and again this financial year.

However during 1989-90 a number of new initiatives have been undertaken to improve records management within the Department and the implementation of them has significantly impacted on the work volumes within the Records Services Branch.

One of these initiatives is the concept of "Project Files", whereby all correspondence and records dealing with various aspects of a project are classified under the project title and files are created under established protocols. During 1989-90 approximately 30% of files were converted to this system.

Further opportunities to improve records management were identified in a major review of the Department's records services. This review was conducted by consultants in the latter half of 1988-89. As a result new procedures and practices have been established, the filing classification system is being updated, lateral colour coded file storage is being introduced, file covers are being converted to include face action sheets and coloured covers are being assigned to project files.

Information technology continued to play a significant role in providing timely and effective services to the Department and industry. During the year the implementation of enhanced software and upgrades in hardware requirements to the computerised Records Management System (RMS) further improved this system's performance.

The implementation of the above initiatives, together with the enhancements to the computerised Records Management System, will keep the Department at the forefront of records management.

Telephone Services

January 1990 saw the commissioning of the new Fujitsu 9600L PABX. This system with increased capacity and flexibility will serve the needs of the Mineral House complex well into the 1990's.

In late June 1990 the Chemistry Centre joined the other Divisions of the Department on the new Mineral House PABX. This initiative produced significant cost savings and improved communication facilities.

In February 1990 the responsibility for the Department's telephone system and associated services (including facsimile and telex) was allocated to the Records Services Branch.

Continued monitoring of telephone usage through the computerised Telephone Information Management System has resulted in more effective and efficient use of PABX facilities and improved cost control.

Facsimile and Telex Services

The use of facsimile transmissions continued to grow during the fiscal year as this technology replaces the use of mail, telegrams and telex in hard copy communications. The level of activity, user needs, and technology advances are being monitored to ensure that the Department is taking advantage of this mode of communication.

Photocopy and Binding Services

During 1988-89 a 70% increase in demand was experienced for photocopying and binding services. In 1989-90 a further 30% rise in activity has occurred. The photocopying machines were upgraded in April 1989 to cope with the expected demand during 1989-90 and the units will be upgraded again in July 1990 to satisfy user requirements during the next financial year.

Internal Audit

A strategic audit plan detailing the audits to be conducted over a three year period was endorsed by the Audit Committee and authorised by the Director General of Mines.

During the year, three system based audits were carried out in accordance with the strategic audit plan. In addition, a value for money audit of the Drilling Branch of the Mining Engineering Division was completed.

The Management Services Branch is currently reviewing the functions and structure of the Internal Audit Branch.

ACCOUNTING

The financial statements for the year ended 30 June 1990 have been prepared in accordance with the provisions of the Financial Administration and Audit Act, 1985 and the Treasurer's Instructions issued pursuant thereto. To assist in comparisons with other government agencies they follow the format suggested in the appendices to the Treasurer's Instructions.

The Statements are prepared on a cash basis in that only collections received and payments made are included.

The Statement of Consolidated Revenue Fund Receipts provides details of actual revenue received and credited to the fund. This is compared with the Consolidated Revenue Fund estimates under the headings "Territorial" and "Departmental" revenue where Territorial Revenue is revenue which has not been generated from fees and charges levied for services provided by the Department. Details of actual revenue for the previous financial year have also been provided to enable comparisons to be made.

REVENUE

Consolidated Revenue Fund

During the financial year the Department was responsible for the collection of $319.49 million through the Consolidated Revenue Fund (CRF). This largely (83%) comprised mineral and petroleum royalties collected from companies operating under State legislation. Part of the revenue was also payments collected by the State on behalf of the Commonwealth for petroleum produced within Commonwealth waters. These receipts subsequently were paid to the Commonwealth by way of special purpose payments after payment into CRF.

In addition to royalties, the Department collected lease and other rental charges (Figure 1, Table 1) and Departmental revenue. The latter, while considerably less as a proportion (2%) was still significant ($6.3 million) and represented charges for goods and services provided by the Department (Figure 2, Table 1).

The Departmental revenue largely originated from charges associated with the Registration, Explosives and Chemistry Centre Divisions (Figure 2).

EXPENDITURE

Consolidated Revenue Fund

Funds are appropriated by the Parliament through the Consolidated Revenue Fund to provide for the operating costs of the Department. This appropriation includes provision for minor works as well as refunds of revenue collected in previous financial years.It also includes expenditure which relates to activities of the mining and petroleum industries which are not operating costs of the Department. For example, costs associated with the Western Australian Coal Industry Council are included. This Council provides a forum at which unions, coal mining companies and Government meet to gain a better understanding of industry needs. The major payments financed through the Consolidated Revenue Fund (Figure 3, Table 2) were salaries, wages and allowances (60.7%) and central administration (19.4%).

During the financial year the Department's CRF expenditure budget of $43.974 million was overspent by $872,000 (2.0%). This was a result of higher salaries expenditure of $888,000 which was mainly due to award increases being greater than forecast and a general under provision in the original assessment of the level of funding required.

Special Acts

An appropriation is made under the provisions of the Petroleum (Submerged Lands) Act 1982 for the Commonwealth's share of royalties received from offshore operations. The Commonwealth revenue has been collected by the State into the Consolidated Revenue Fund. Payments to the Commonwealth totalled $12.205 million in the year, a very large increase on the $4.072 million paid in the previous year (Table 2).

General Loan and Capital Works Fund

Major capital works projects are financed under the State's Capital Works Program from the General Loan and Capital Works Fund.

During the year $1 927 000 was expended on capital works funded from this source (Table 3).

Figure 8

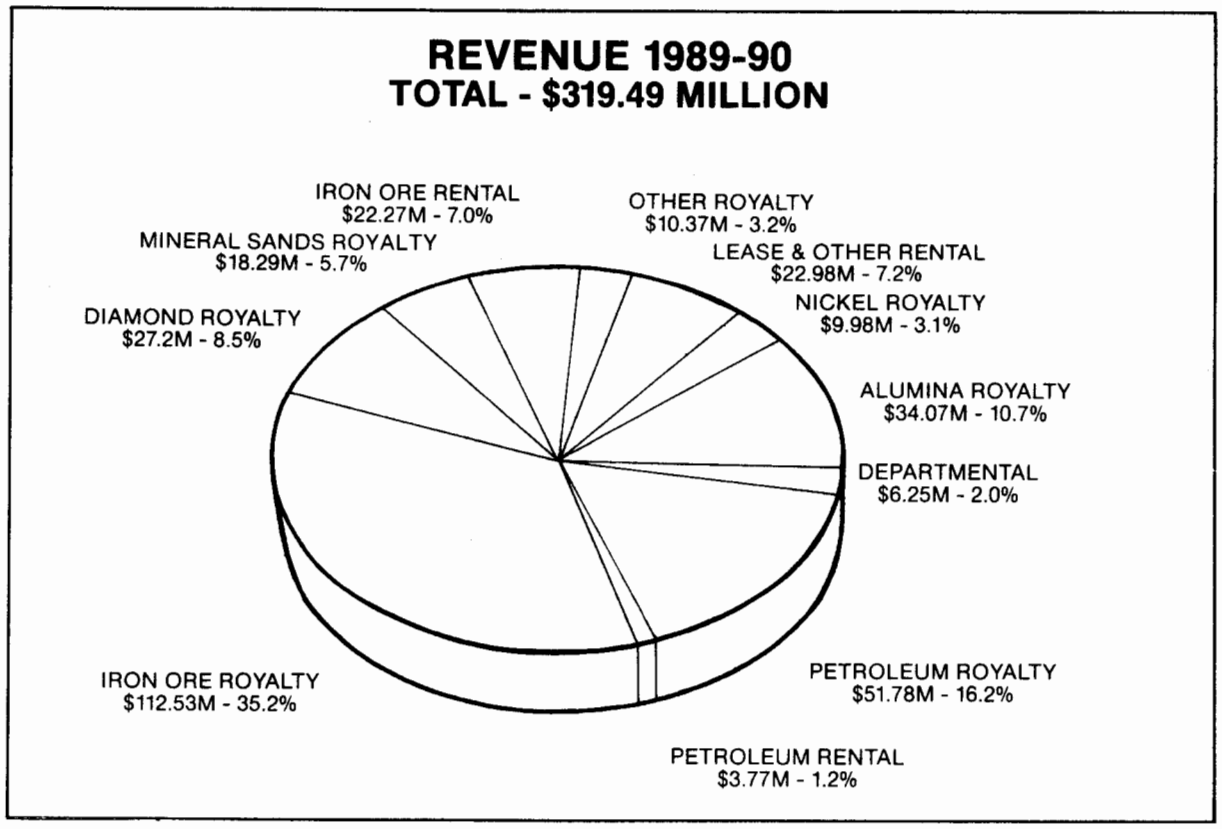
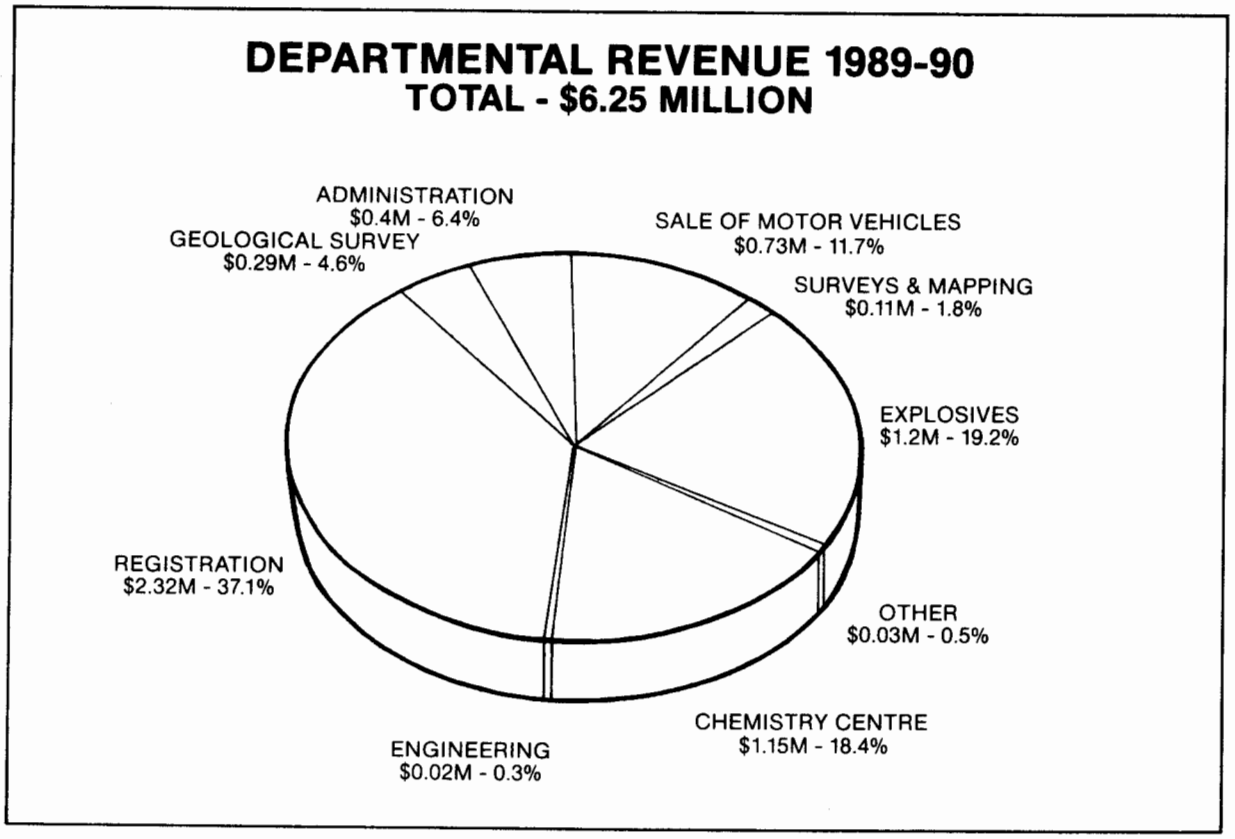


Figure 9



FINANCIAL MANAGEMENT

In accordance with Government's accountability concept, the Department has continued to develop reporting mechanisms which provide the Accountable Officer with timely and comprehensive financial management reports to assist in resource allocation decisions. Work is currently underway to link the philosophical view of organisational objectives as defined in the Corporate Plan into the budgeting and resource management processes of the Department.

PRICING POLICY

The Department has in the main adopted a full cost recovery user pays approach in determining fees and charges for services provided to the public and industry. With some services, where there is considered to be an element of "service to the general public", a nominal fee has been determined. However, this represents only a small fraction of services provided and has minimal impact on revenue.

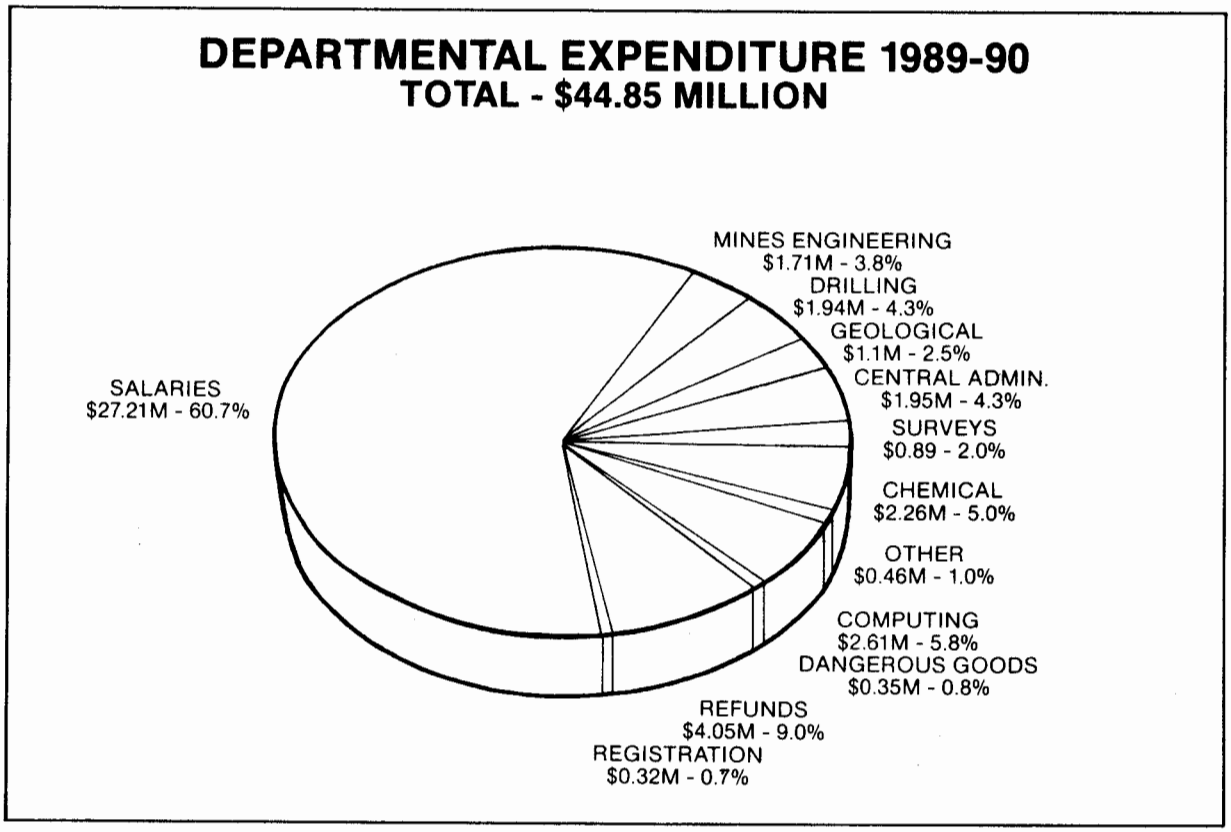
To further refine and enhance the full cost recovery, user pays policy, the Department has begun a comprehensive review process. This will ensure that fees charged are appropriate, and that where necessary, commercial cost accounting systems are developed and implemented throughout the whole organisation during the 1990-1993 triennium.

During 1989-90, a comprehensive review of the fees and charges levied by the Chemistry Centre was conducted. A new cost accounting framework was developed to determine appropriate hourly charge rates, and standard costings were reviewed for the wide range of services provided for implementation in 1990-91. In addition to charging for services provided to non-Government clients and Government trading concerns, a system of notional charging has been developed for services provided to other Government agencies in 1990-91. This initiative is a precursor to charging for services provided to these agencies by the Chemistry Centre if the Government decides to implement this procedure.

ROYALTY POLICY

The Department has a corporate objective of ensuring that the community receives a fair return for the removal of non-renewable resources owned by the people of the State. The Department aims to ensure that these royalties are collected on time and in an economically and administratively efficient manner. Royalties were revised during the year for some commodities.

Figure 10



FINANCIAL STATEMENTS

TABLE 1: STATEMENT OF CONSOLIDATED REVENUE FUND RECEIPTS

1988-89 Actual		1989-90 Estimate	1989-90 Actual	Variance
$		$	$	$
	Territorial			
	Royalties -			
92 722 783	Iron Ore	119 500 000	112 532 211	(6 967 789)
20 579 607	Petroleum	45 000 000	51 777 319	6 777 319
12 055 670	Diamond	15 000 000	27 202 476	12 202 476
20 797 430	Alumina	26 500 000	34 072 745	7 572 745
12 948 114	Mineral Sands	17 500 000	18 293 186	793 186
9 523 121	Nickel	11 000 000	9 978 062	(1 021 938)
7 416 797	Other	9 000 000	10 365 997	1 365 997
44 953 726	Lease & Other Rentals	47 500 000	49 018 095	1 518 095
220 997 248		291 000 000	313 240 091	22 240 091
	Departmental			
2 440 168	Registration	2 532 000	2 317 120	(214 880)
1 145 545	Chemistry Centre	1 011 000	1 146 193	135 193
919 532	Explosives	938 000	1 198 831	260 831
289 750	Sale of Motor Vehicles	700 000	728 800	28 800
298 698	Administration	500 000	403 607	(96 393)
306 159	Geological Survey	398 000	289 144	(108 856)
131 559	Surveys & Mapping	151 000	115 451	(35 549)
8 378	Engineering	42 000	24 267	(17 733)
8 883	Other	8 000	29 839	21 839
5 548 672		6 280 000	6 253 252	(26 748)
226 545 920	**Total Receipts**	297 280 000	319 493 343	22 213 343

Explanations of variations between the yearly estimates and actual results, and the actual results compared with the preceding year, are set out in Note 2.

TABLE 2: STATEMENT OF CONSOLIDATED REVENUE FUND PAYMENTS

1988-89 Actual $		1989-90 Estimate $	1989-90 Actual $	Variance $
	Special Acts			
4 071 680	Petroleum (Submerged Lands) Act 1982	12 000 000	12 204 993	204 993
4 071 680		12 000 000	12 204 993	204 993
	Governmental			
24 628 697	Salaries, Wages & Allowances	26 320 000	27 208 434	888 434
5 801 647	Central Administration	8 698 000	8 697 959	(41)
1 680 995	Mining Engineering	1 694 000	1 713 989	19 989
141 938	Petroleum — Administration & Engineering	140 000	139 982	(18)
304 947	Registration of Mining Titles	319 000	318 960	(40)
1 075 976	Surveys & Mapping	887 000	886 710	(290)
2 368 985	Chemistry Centre	2 261 000	2 260 908	(92)
1 103 993	Geological Survey	943 000	1 095 999	152 999
472 460	Control of Dangerous Goods	402 000	354 679	(47 321)
1 947 353	Exploratory Drilling	2 000 000	1 937 595	(62 405)
149 522	Special Projects	150 000	112 404	(37 596)
159 280	W.A. Coal Industry Council	120 000	82 993	(37 007)
47 125	Golden Mile Mining Development Committee	40 000	35 405	(4 595)
1 132 000	Argyle Social Impact Study Group	-	-	-
41 014 918		43 974 000	44 846 017	872 017
45 086 598	**Total Payments**	**55 974 000**	**57 051 010**	**1 077 010**

Explanations of variations between the yearly estimates and actual results, and the actual results compared with the preceding year, are set out in Note 2.

TABLE 3: STATEMENT OF GENERAL LOAN AND CAPITAL WORKS FUND PAYMENTS

1988-89 Actual $		1989-90 Estimate $	1989-90 Actual $	1989-90 Variance $
	Works in Progress and Completed Works -			
	CHEMISTRY CENTRE (WA) -			
	Agricultural Science Laboratory			
-	Alterations	40 000	14 187	(25 813)
	Mineral Science Laboratory			
103 517	Alterations	34 000	40 000	6 000
52 302	Noise Attenuation	17 000	18 991	1 991
	KALGOORLIE -			
	Additions to Mining Engineering			
212	Division	-	-	-
6 381	Security Office	109 000	103 003	(5 997)
1 277 078	MINERAL HOUSE STAGE 2	915 000	1 096 998	181 998
	New Works			
	CHEMISTRY CENTRE (WA)			
-	Alterations	250 000	196 237	(53 763)
	NEW CHEMISTRY CENTRE COMPLEX BENTLEY -			
-	Planning Fees	500 000	445 000	(55 000)
	KALGOORLIE METALLURGICAL LABORATORY			
-	Noise and Dust Abatement	62 000	12 584	(49 416)
1 439 490	TOTAL	1 927 000	1 927 000	-
	SOURCE OF FUNDS			
1 439 490	GENERAL LOAN AND CAPITAL WORKS FUND	1 927 000	1 927 000	-
1 439 490	**Total**	**1 927 000**	**1 927 000**	**-**

Explanations of variations between the yearly estimates and actual payments, and the actual payments compared with the preceding year, are set out in Note 2.

ACCOUNTS OF THE TRUST FUND

Survey of Leases Under the Mining Act Account

Survey fees collected under the Mining Act are paid into this account. The actual cost of surveys is charged to the Consolidated Revenue Fund, and fees previously collected are then transferred to Consolidated Revenue. If the applicant decides not to proceed with the survey, the fee collected is refunded.

	1989-90 $		1988-89 $	
Opening Balance July 1	5 585 328	CR	4 412 296	CR
Add Receipts				
Survey Fees	1 548 729		1 732 394	
	7 134 057		6 144 690	
Less Payments				
Transferred to Revenue	322 890		282 920	
Refunds	418 121		276 442	
Total Payments	741 011		559 362	
Closing Balance June 30	6 393 046	CR	5 585 328	CR

Chemistry Centre Trust Account

The account was created to hold monies received from industry and other organisations for the purpose of conducting specific projects.

	1989-90 $		1988-89 $	
Opening Balance July 1	70 580	CR	27 870	CR
Add Receipts				
Contributions From				
Industry	333 101		101 047	
Government	-		31 500	
Total Receipts	333 101		132 547	
	403 681		160 417	
Less Payments				
Salaries	18 868		39 662	
Travel	11 448		-	
Equipment, Misc	134 989		50 175	
Total Payments	165 305		89 837	
Closing Balance June 30	238 376	CR	70 580	CR

Barrow Island Royalty Trust Account

The account was created under the Barrow Island Royalty Trust Account Act 1985 which provides for royalty payments received under the Barrow Island lease to be credited to the account and subsequently apportioned between the Commonwealth and the State.

	1989-90 $	1988-89 $
Opening Balance July 1	0	0
Add Receipts		
Royalties Received	45 486 980	23 898 893
* States Share of Royalty Refund	-	183 673
* C'wealth Share of Royalty Refund	7 302 288	551 021
Total Receipts	52 789 268	24 633 587
	52 789 268	24 633 587
Less Payments		
Transferred to Revenue	11 371 745	5 974 723
Remitted to C'wealth	28 505 660	17 924 170
* Refunds of Royalty (i)	7 302 288	734 694
Total Payments	47 179 693	24 633 587
Closing Balance June 30 (ii)	5 609 575 CR	0

(i) Refunds of royalty due to quarterly provisional receipts exceeding assessed royalty due.

(ii) Commonwealth Share of Royalty Payment payable in July 1990.

Deposits: Mines Department Account

Funds held are received for the issue of temporary reserves and exploratory permits pending finalisation of certain legal requirements.

The refunds of deposits and transfers to the Consolidated Revenue Fund following finalisations during the year decreased the amounts held to $305 706 at June 30, 1990.

	1989-90		1988-89	
	$		$	
Opening Balance July 1	382 015	CR	296 011	CR
Add Receipts Bonds, Securities etc.	212 391		185 484	
	594 406		481 495	
Less Payments Transferred to Revenue	-		5 460	
Refunds	288 700		94 020	
Total Payments	288 700		99 480	
Closing Balance June 30	305 706	CR	382 015	CR

Departmental Receipts in Suspense

This account is used to hold moneys temporarily pending identification of the purpose for which the funds were received. The balance of the account as at June 30 1990 is $1 114.

Transfers to Suspense Account

The account is maintained to hold funds to meet any relevant end of year commitment in respect of plant and equipment or land.

	1989-90		1988-89	
	$		$	
Opening Balance July 1	474 500	CR	0	CR
Add Receipts - Transfers Ex CRF - Plant & Equipment	139 307		474 500	
	613 807		474 500	
Less Payments - Purchase of Plant & Equipment or Land	474 500		0	
Closing Balance June 30	139 307	CR	474 500	CR

TREASURER'S ADVANCE

Drilling

Recoverable drilling expenditure is initially charged to a Treasurer's Advance Account. The cost of work performed, together with overhead charges, are recovered and credited to this account. The amount of the advance outstanding as at June 30 1990 is $41 061.

Chemistry Centre

The purpose of the advance is to enable the Chemistry Centre to operate a stores function, for purchasing stock items which may relate to unbudgeted contract analytical activities. Recoupment of the Advance is the stores portion of the service charged to and collected from clients.

The amount of the advance outstanding as at June 30 1990 is $70 094.

NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS FOR THE YEAR ENDED JUNE 30, 1990

1. Accounting Policy

(a) The Financial Statements are prepared on a cash basis in that only collections received and payments made are reflected therein. The disbursements include a net payment of $570 000 to the Treasury Departmental Receipts in Suspense Account for accrued salaries.

(b) The financial statements included in this report have been prepared in accordance with the provisions of the Financial Administration and Audit Act, 1985.

(c) All expenditures incurred by the Department of Mines in the provision of services are not appropriated to the Department. The employer's share of superannuation pensions is met by Treasury. Rental of office accommodation is met by the office of Government Accommodation. Maintenance of government buildings and some power costs are met by the Building Management Authority. The servicing of the Department's General Loan and Capital Works Fund debt is met by Treasury.

(d) Property disposals are effected through the State Tender Board and proceeds credited to Revenue Government Property Sales. Exceptions are:

(i) when the original acquisition was met from General Loan and Capital Works Fund the proceeds are credited to Loan Repayments;

(ii) proceeds received from the disposal of Departmental vehicles are credited to general departmental revenue within the Consolidated Revenue Fund.

2. Explanatory Statement

(a) **Details of expenditure in advance of appropriation approved in accordance with Section 28 of the Financial Administration and Audit Act 1985.**

(i) Salaries, Wages & Allowances (+$888 434)

Supplementary funding of $901 000 was approved to cover an initial underprovision for award increases, an inaccurate assessment of funding required for the Department's approved staffing level and provision for an additional three District Mining Engineers. Supplementary funds were not fully expended as there was a delay in filling the three new positions.

(ii) Mining Engineering (+$19 989)

Supplementary funding of $90 000 was granted to cover additional allowances for all inspectorate staff to increase the level of safety inspections in mine sites. Funding was received late in the year and was therefore not fully expended prior to June 30.

(iii) Geological Survey (+$152 999)

Supplementary funding of $153 000 was approved, mainly to cover additional costs associated with occupational health and safety issues and an overrun in motor vehicle expenses. Savings were achieved in other areas of the Department's operating budget to offset this over expenditure. The supplementation approved was fully expended.

(b) **Significant variations (greater than 10%) between actual revenues and budget estimates for the financial year.**

Territorial Revenue

(i) Petroleum (+$6 777 319)

Increased payments resulted from earlier than expected production from the Saladin Field and increased production from Barrow Island.

(ii) Diamonds (+$12 202 476)

Continued price rises above budgeted levels and increased sales resulted in an 81% increase in revenue.

(iii) Alumina (+$7 572 745)

Continued high price and production levels resulted in higher than forecast payments.

(iv) Other (+$1 365 997)

Increased sales and prices for Spodumene, Tin and Zinc and increased production of Gallium, and Coal were the factors behind this result.

Departmental Revenue

(i) Chemistry Centre (+$135 193)
The higher collections are a result of increased activity throughout the year.

(ii) Explosives (+$260 831)
Increased activity levels, tonnage fees and a carryover of fee collection from 1988-89 were responsible for this result.

(iii) Administration (-$96 393)
Reduced revenue is a result of continued downturn in survey activity.

(iv) Geological Survey (-$108 856)
The shortfall in collections is a result of decreased sales of reports and maps and an initial overestimation of budgeted revenue.

(v) Surveys and Mapping (-$35 549)
The non-implementation of specialised mapping techniques (graticular section) is the major contributor to this result.

(vi) Engineering (-$17 733)
The shortfall in revenue is a consequence of reduced demand for Divisional publications and the delay in the proposed increase in management fees for Mine Manager Certificates

(vii) Other (+$21 839)
This result is due to a higher than anticipated number of searches of the Petroleum Division's registers.

(c) **Significant variations (greater than 10%) between expenditures and budget estimates for the financial year.**

(i) Consolidated Revenue Fund

Savings in Exploratory Drilling, Special Projects and Control of Dangerous Goods were achieved to offset over expenditure for Geological Surveys (refer Note 2 a(iii)).

In addition, there was a significant saving in the Western Australian Coal Industry Council vote (-$37 007) due to less expenditure on consultancy services than originally anticipated.

(ii) General Loan and Capital Works Fund

Approval was granted for an additional $182 000 on the Mineral House Stage II project during 1989-90 to finalise payment, bringing the total cost of the project to $24.087 million. To contain this increase within the budget allocation, works were deferred in other areas and as a consequence there was a nil variation for the total funds allocated.

(d) **Significant variations (greater than 10%) between actual results for the financial year (1989-90) and results for the immediately preceding financial year (1988-89).**

(i) Consolidated Revenue Fund Receipts

Territorial

ROYALTIES	1988-89 $	1989-90 $	VARIANCE $
TOTAL	176 043 522	264 221 996	88 178 474

There was a 50% increase in royalty revenue. Increased production levels and higher prices for iron ore were responsible for higher royalty payments on iron ore (+$19.809 million) and petroleum (+$31.198 million). For diamonds (+$15.147 million), alumina (+$13.275 million), mineral sands (+$5.345 million) and various other minerals (+$3.404 million) the rises were primarily a result of higher prices with some variations in the royalty rates.

LEASE AND OTHER RENTALS	1988-89 $	1989-90 $	VARIANCE $
TOTAL	44 953 726	49 018 095	4 064 369

The increased revenue in this item was mainly due to:

1. Iron ore lease rentals: Increases in shipped tonnages resulted in higher collections.

2. Mining Act: Additional revenue collected as a result of the number of prospecting licences being converted to mining leases and the consequent increase in rental per hectare.

3. Petroleum Licences: The sale of the Harriet Oil Field by Bond Corporation to Phillips Corporation resulted in additional registration fees being collected.

Departmental

	1988-89 $	1989-90 $	VARIANCE $
TOTAL	5 548 672	6 253 252	704 580

The increase in revenue was mainly attributable to sale of more motor vehicles (+$439 050) than the previous year and increased activity levels associated with explosives (+$279 299).

(ii) Consolidated Revenue Fund Payments

Special Acts

	1988-89 $	1989-90 $	VARIANCE $
TOTAL	4 071 680	12 204 993	8 133 313

This item of expenditure represents the Commonwealth's share of royalties received from the Harriet, South Pepper and Saladin oil fields. The increased expenditure is a result of the commencement of the Saladin project and a general increase in the average oil price.

Governmental

	1988-89 $	1989-90 $	VARIANCE $
TOTAL	41 014 918	44 846 017	3 831 099

The increase in expenditure was due to one off payment of overpaid Barrow Island royalty ($2.434 million) and an increase in salary award payments and increments (total $2.580 million). The Argyle Social Impact Study Group Funding was transferred to the Department of Regional Development and the North West for 1989-90.

(iii) General Loan and Capital Works Fund Payments

	1988-89 $	1989-90 $	VARIANCE $
TOTAL	1 439 490	1 927 000	487 510

The increase in expenditure is mainly due to the provision of funds for new works, as detailed in the financial statement.

3. Supplementary Financial Information

	1989-90 $	1988-89 $
- Losses of public monies and public or other property through theft or default	63	4 697
Amount Recovered	-	3 303
Losses for write off	63	1 394
- Public and other property, revenue and debts due to the State, written off in accordance with section 45 of the Financial Administration and Audit Act by:		
The Accountable Officer	13 292	28 178
The Minister	1 047	23 875
	14 339	52 053
- Analysis of losses written off.		
Stock shortages	10 629	-
Bad debts	3 710	52 053
	14 339	52 053
- Consolidated Revenue Fund revenues due and uncollected	95 986	-
Less considered to be irrecoverable	264	-
Amount considered to be recoverable	95 722	Nil
- Unpaid expenditure claims as at 30 June 1990 - CRF	110 949	67 100

CERTIFICATION OF FINANCIAL STATEMENTS

"The accompanying financial statements of the Department of Mines have been prepared in accordance with the provisions of the Financial Administration and Audit Act 1985 from proper accounts and records to present fairly the financial transactions for the year ending June 30, 1990 and the state of affairs as at June 30, 1990.

At the date of signing we are not aware of any circumstances which would render the particulars included in the financial statements misleading or inaccurate".

D R Kelly
ACCOUNTABLE OFFICER

P H Palmer
PRINCIPAL ACCOUNTING OFFICER

DATE 14/8/1990

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OPINION OF THE AUDITOR GENERAL OF WESTERN AUSTRALIA

DEPARTMENT OF MINES

The accounts of the Department of Mines have been audited for the period July 1, 1989 to June 30, 1990 under the provisions of the Financial Administration and Audit Act 1985.

During the year the Department did not conduct a stocktake of public property in accordance with Treasurer's Instruction 406(2) and consequently it has not been possible to determine whether Note 3 to the financial statements fairly presents the losses of property through theft or default.

In my opinion, subject to the above matter:

(i) the controls exercised by the Department of Mines were sufficiently adequate to provide reasonable assurance that the receipt and expenditure of moneys and the acquisition and disposal of property and the incurring of liabilities have been in accordance with legislative provisions; and

(ii) the financial statements of Receipts and Payments and the notes thereto are based on proper accounts and records and have been properly drawn up so as to present fairly the transactions for the period.

ACTING AUDITOR GENERAL
October 15, 1990

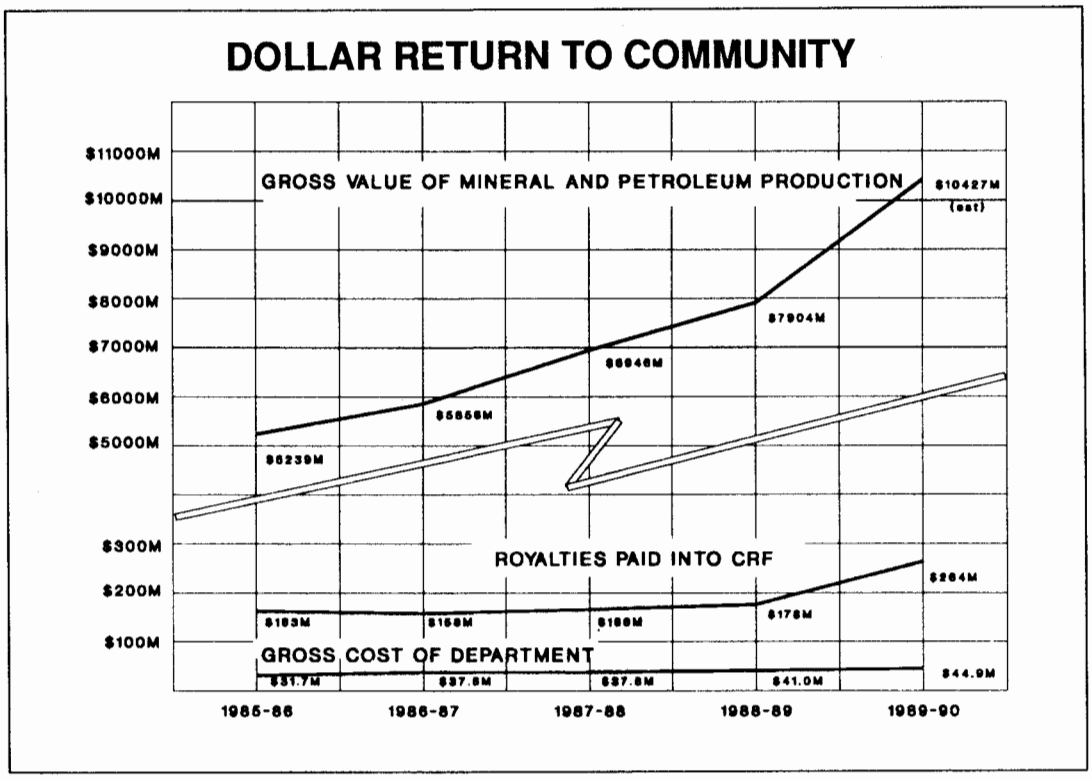
PERFORMANCE INDICATORS

This year sees a continuation of the effort made by the Department to present meaningful indicators of performance at a corporate level.

The general format from last year has been retained, as have many of the workload indicators. Where possible, performance indicators with an explanatory statement have been added for key areas in programs directly tied to Departmental objectives.

In other cases, where insufficient data are presently available to enable precise statistics to be quoted, a statement of intent or philosophy has been included, as an indication of how performance could be reported on in the future.

Performance indicators have been widely used in the Department at project level for many years. Despite this, it is proving far from easy to translate these operational level indicators into meaningful measures of performance for the entire Department. Furthermore it is probable that some of the indicators proposed in this year's report may not be sustainable in their present form, and will have to be re-evaluated in the future.



BROAD OBJECTIVE 1

To ensure that exploration and development of the State's mineral and petroleum resources are carried out in a fair manner.

WORKLOAD INDICATORS

MINING TENEMENTS

Applications Received

	1987-88	1988-89	1989-90
• Prospecting Licences	5 361	3 367	2 426
• Exploration Licences	1 671	1 420	1 451
• Mining Leases	1 838	1 243	998
• Other	406	367	201
Totals:	**9 276**	**6 397**	**5 076**
Area Applied for (Hectares)	21 241 446	18 574 676	17 184 235

Applications Granted

	1987-88	1988-89	1989-90
• Prospecting Licences	5 197	2 897	2 202
• Exploration Licences	1 214	916	785
• Mining Leases	1 379	1 285	1 044
• Other	266	349	164
Totals:	**8 056**	**5 447**	**4 212**
Area Granted (Hectares)	13 915 015	11 047 688	8 963 752

Tenements in Force

	1987-88	1988-89	1989-90
1978 Mining Act:			
• Prospecting Licences	15 216	11 919	7 725
• Exploration Licences	2 578	2 630	2 264
• Mining Leases & Others	5 690	6 636	6 953
1904 Mining Act:			
• Mineral Claims & Others	552	507	507
Totals	**24 036**	**21 792**	**17 449**
Area in Force (Hectares)	26 928 964	26 278 115	22 107 827

Changes to Public Plans

	1987-88	1988-89	1989-90
• Additions	10 507	6 404	5 160
• Removals	-	10963	10 273

Dealings Received

1987-88	1988-89	1989-90
20 714	20 481	12 988

Tenement Surveillance

	1987-88	1988-89	1989-90
• Reports on Operations Received	14 914	16 726	11 499
• Applications for exemption	2 959	3 206	3 356
• Tenements forfeited	353	1 397	1 317

PETROLEUM TENEMENTS

Exploration Permits	1987-88		1988-89		1989-90	
	No.	Area (km^2)	No.	Area (km^2)	No.	Area (km^2)
Advertised						
Onshore	14	32 503	21	44 329	8	**14 774**
Offshore	12	47 926	10	36 863	17	**88 861**
Totals	**26**	**80 429**	**31**	**81 192**	**25**	**103 635**
Granted						
Onshore	10	46 017	9	15 674	5	**11 609**
Offshore	6	17 838	8	21 215	3	**18 207**
Totals	**16**	**63 885**	**17**	**36 889**	**8**	**29 816**
Permits In Force						
Onshore	62	341 605	66	338 209	57	**226 980**
Offshore	32	144 286	41	133 582	42	**160 196**
Totals	**94**	**485 891**	**107**	**471 791**	**99**	**393 667**
Production Licences						
Granted	4	1 463	1	161	1	**318**
In Force	19	6 012	20	**6 173**	21	**6 491**

HUMAN RESOURCES

Departmental Human Resources Committed To This Objective

Geological Survey	2.7	
Mining Registration	80.5	
Petroleum	5.5	
Surveys and Mapping	70.5	
Corporate Development	30.1	
Total:	201.2	FTEs

Departmental Human Resources Committed To Non-Mines Objectives.

In the main these are services performed for other Departments at outstations - usually Mining Registrars' offices.

Total	12.5	FTEs

PERFORMANCE INDICATORS

MAPPING

If amendments to public plans are not completed within 10 days of receipt at head office, industry is given misleading information on ground available for pegging. This can cause disruption and waste industry resources.

The Department allocates sufficient resources to incoming work to ensure that all tenements are charted within 10 working days of receipt.

An indication of performance is the number processed per FTE to attain the schedule.

The figures for 1989-90 are shown below:

Tenement Processing

	Quantity	FTE	Number per FTE
• Tenement Charting (Prospecting Licence, Mining Lease, General Purpose Lease, Miscellaneous Licence)	3 670	3.5	1 050
• Tenement Charting (Exploration Licence)	1 490	3.3	450
• Exploration Licence and Miscellaneous Release Processing	470	3.0	150
• Tenement Cancellations	10 270	3.5	2 930

MINING REGISTRATION

The graphs hereafter illustrate the degree to which applications, dealings and exemptions are registered in accordance with performance criteria set by the Department.
The time criteria have been set to take into account matters such as:

- statutory review periods set by the Mining Act and the Warden's Court;
- more extensive reviews in cases where land may be subject to control by several agencies; and
- legal disputation processes.

Applications and dealings received during 1989-90 were within the parameters set for the performance indicators shown.

In the case of exemption applications, a record number of receivals meant that less than half the targeted percentage could be determined within 3 months, throughout the year. In order to cope with the situation, additional resources will be deployed in this area during 1990-91.

The graphs also show the total number of dealings registrations processed each month. Where the total processed in a month exceeds the number received, the division has been reducing the backlog. This occurred in more than half the months last year.

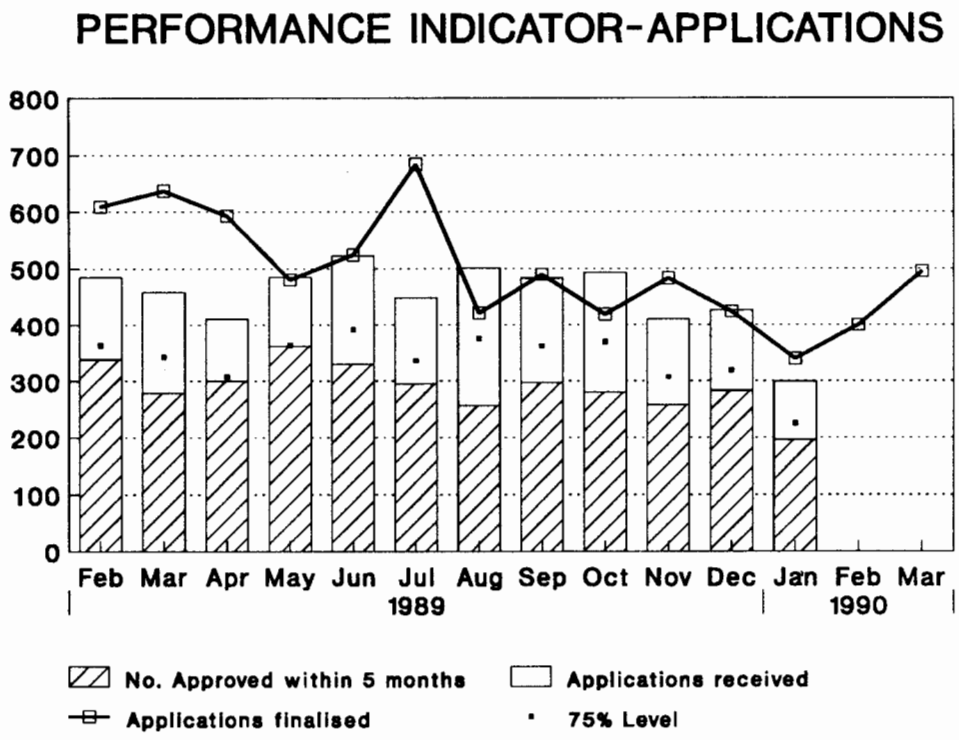


Figure 11 Mining Tenement Applications and Finalisations February 1989 to March 1990.
Indicator: Determine 75% of all applications for mining tenements within 5 months of application.

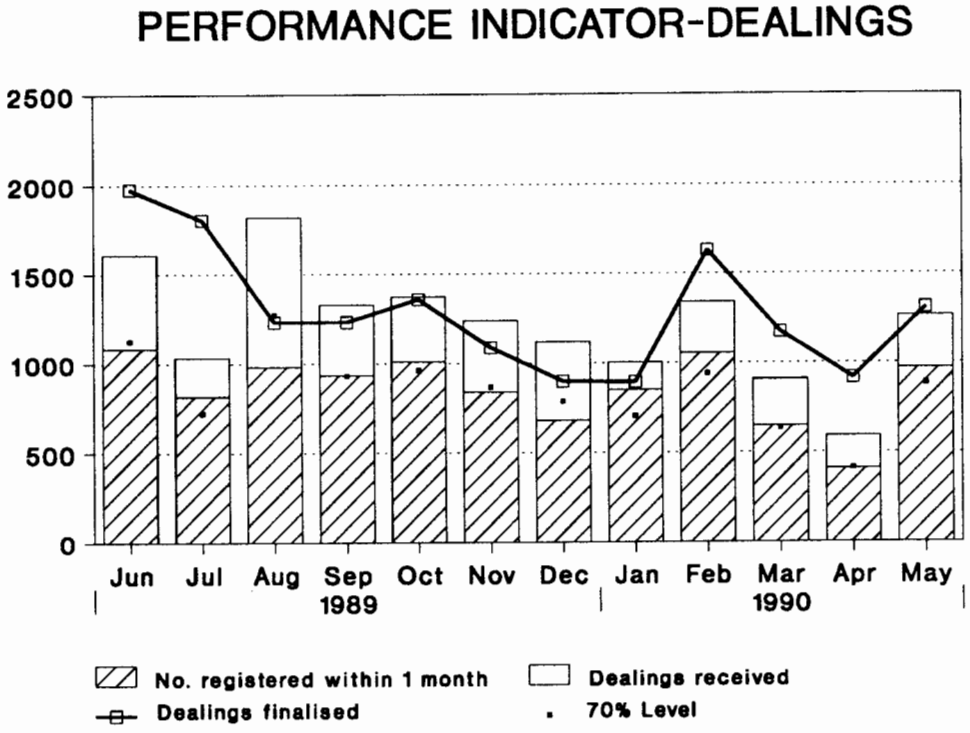


Figure 12 Mining Tenement Dealings Applied for and Finalised June 1989 to May 1990.
Indicator: Register 70% of all dealings received within 1 month of lodgement.

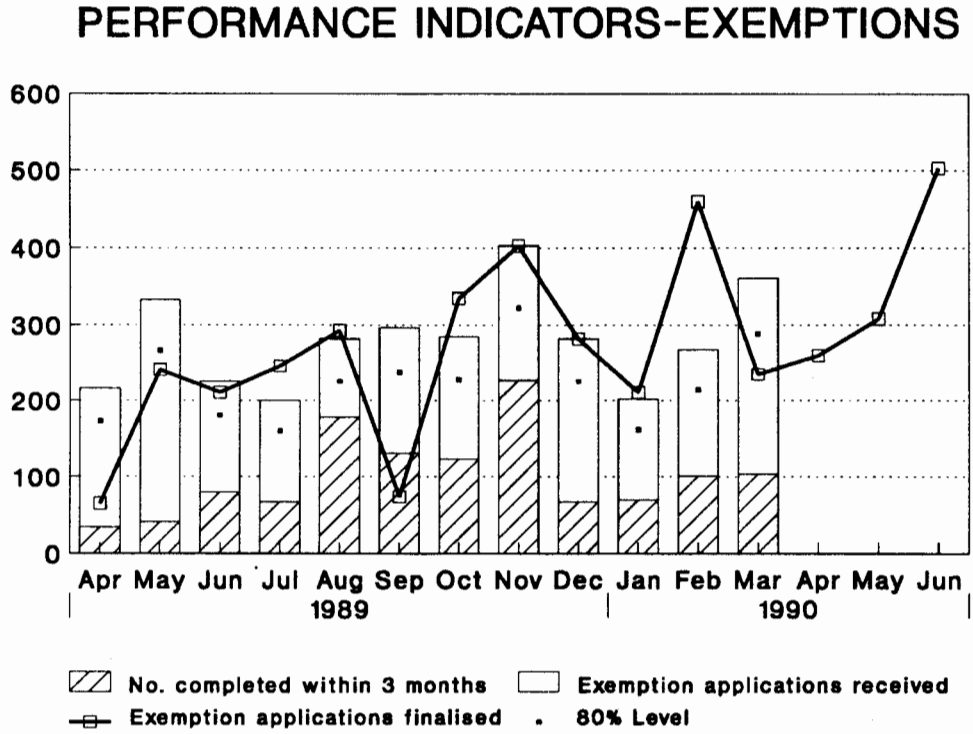


Figure 13 Exemption Applications Received and Processed April 1989 to March 1990.
Indicator: Determine 80% of exemptions within 3 months of lodgement.

BROAD OBJECTIVE 2

To foster mineral, petroleum and groundwater exploration and development, and assist long range planning and decision making by Government.

WORKLOAD INDICATORS

	1987-88	1988-89	1989-90
Petrological Examinations			
• Reports compiled	30	23	29
• Samples determined	875	1 360	539
Palaeontological Reports			
• Compiled and issued	22	16	19
Exploration Information Made Available To Public			
• Petroleum (reports)	553	560	407
• Minerals (volumes)	1 530	819	846
Groundwater and Stratigraphic Evaluation			
Metres drilled	14 917	9457	12 997
Geological Maps Published			
• Major coloured maps	14	11	11
• Other maps	10	6	7
Petroleum Exploration and Development			
• Wells drilled	32	51	45
• Metres drilled	53 390	93 411	99 862
• Seismic surveys (km)	10 854	21 194	30 105
• Producing Fields	15	15	18

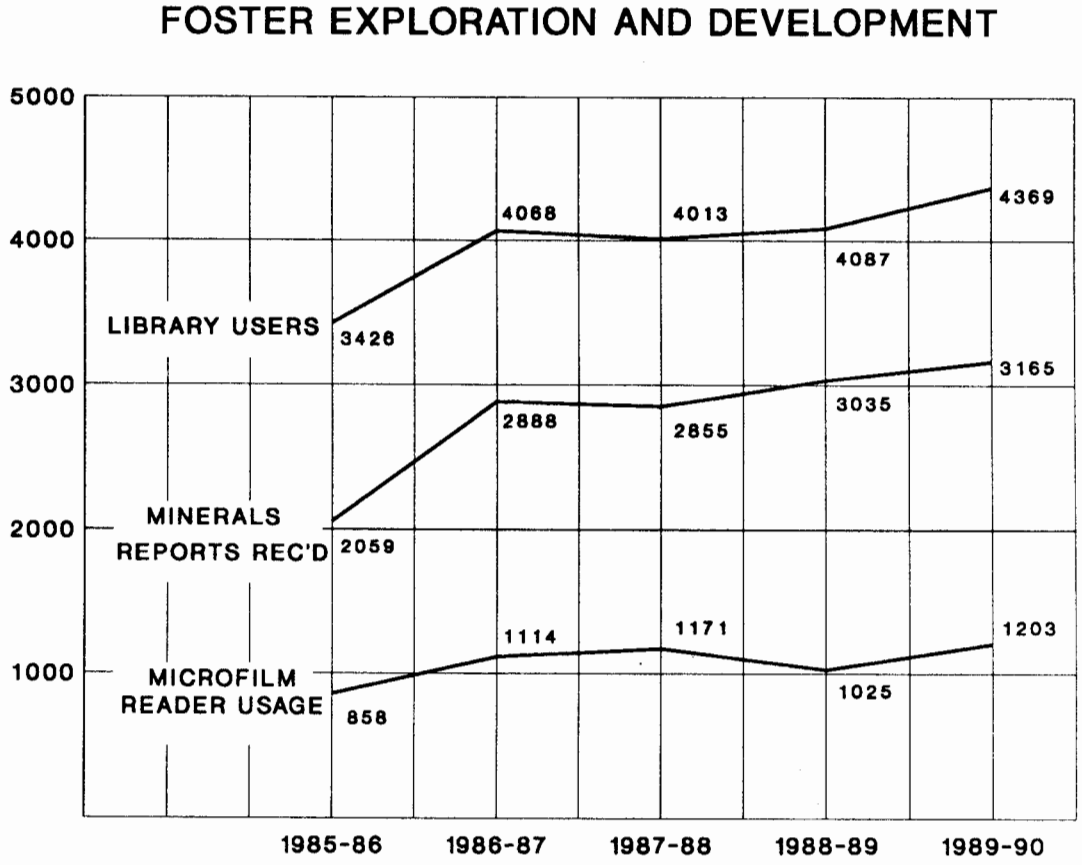
	1987-88	1988-89	1989-90
Library Use by Public			
• No. using library	4 013	4 087	4 369
• No. using microfilm readers	1 171	1 025	1 203
Exploration Reports received from Industry			
• Petroleum	359	383	496
• Minerals	2 855	3 035	3 165
Revenue from Sales ($)			
• Maps and publications	181 086	142 713	125 391
• Microfilm	218 540	104 451	99 970
• Tendex	79 603	64 559	58 010

HUMAN RESOURCES

Departmental Human Resources committed to this Objective

Chemistry Centre	49.8
Geological Survey	104.0
Mining Engineering	32.8
Mining Registration	5.1
Petroleum	4.0
Surveys & Mapping	36.0
Corporate Development	37.5
TOTAL	271.5 FTEs

WORKLOAD INDICATORS (Cont'd).



PERFORMANCE INDICATORS

The key indicators of performance for this objective come from the operations of the Geological Survey. In the Annual Report for 1988-89 it was stated that a set of performance indicators would be developed during 1989 and 1990 as the Survey changed its program planning cycle from a calendar year to a financial year.

However, during the changeover it became evident that not all the proposed indicators would give a meaningful or objective measure of performance. It was decided that only two indicators would be used: (a) the number of projects completed during the year, and (b) the Geological Survey Liaison Committee's view as to the timeliness and quality of the geoscientific and geotechnical output of the Survey.

During the past year, 17 projects were completed and another 20 cancelled or extensively revised in the light of changed work priorities. With the changeover to a financial year planning cycle, the opportunity was taken to reorganize the Geological Survey's work program and integrate it with the departmental corporate objectives. This will facilitate future monitoring of, and reporting on, the program.

The Geological Survey Liaison Committee has expressed general satisfaction with progress of the work program.

BROAD OBJECTIVE 3

To ensure that the community receives a fair return from the exploitation of the State's mineral and petroleum resources; and that proper attention is given to the environment.

WORKLOAD INDICATORS

Royalties	1987-88 $M	1988-89 $M	1989-90 $M
CRF (Note 1)	166.2	176.0	264.2
Total (Note 2)	211.2	195.6	301.8
State Share	162.6	171.9	252.0
C'wealth Share	48.6	23.7	49.8
Value of Mineral and Petroleum Production	6 945.6	7 904	10 347.4 (est)
Notice of Intent Received for Assessment	103	126	186

Human Resources

Departmental Human Resources committed to this objective

Chemistry Centre	2.1
Geological Survey	6.3
Mining Engineering	10.2
Petroleum	4.7
Royalties	11.7
Corporate Development	11.2
Total:	**42.3** FTEs

PERFORMANCE INDICATORS

Fair Return

The Royalties branch has a key role in seeing that the community benefits from the activities of the mining and petroleum industries.

Important factors in royalty administration are their timely and accurate collection.

The performance of the branch is monitored through the following indicators.

	1988-89 %
Royalty received on time (Note 3)	98.69
Royalty audited (Note 4)	79.84
Royalties finalised (Note 5)	99.91

From these indicators, the Government can assume, with a high degree of confidence, that it is not being deprived of any significant level of revenue it is due from the mining industry.

Environment

Since the introduction of the Notice of Intent process, the Department has observed a significant increase in activity directed towards environmental management at mine sites. For instance most new mines have rehabilitation programs, with waste dump and tailings dam management now an important aspect of all mining operations.

These activities are closely related to the Notice of Intent process and the consequent increased awareness by management.

It is difficult to measure this indicator in absolute terms. Of the 186 proposals, 6% were deemed to be environmentally significant and requiring formal assessment. Of the remaining projects 34% were referred to the EPA for informal assessment. This compares with the previous year when 63% were informally assessed. The significant reduction is due to the efficiency of this Department's procedure for environmental assessment.

This NOI process utilises advice and recommendations from EPA and other Departments such as CALM and the Water Authority.

Note 1: Revenue paid into the State Consolidated Revenue Fund (CRF) includes some royalties collected by the Department of Mines on behalf of the Commonwealth for later reimbursement to that Government.

Note 2: Includes all royalties collected from W.A. projects by either the State or Commonwealth Governments. These are all audited by the Department of Mines W.A.

Note 3: Royalty revenues received on or before the prescribed due date as a percentage of total royalties due.

Note 4: Royalty revenues fully audited as a percentage of total royalties due.

Note 5: Royalty revenues excluding those collected under interim arrangements and unpaid royalties as a percentage of total royalties due.

BROAD OBJECTIVE 4

To ensure that all operations in the mining and petroleum industries and activities involving explosives and dangerous goods are conducted in a manner that is safe for workers and the public.

WORKLOAD INDICATORS

Explosives and Dangerous Goods:

.. Licences

	1987-88	1988-89	1989-90
Explosives Licences and Permits	3 878	4 076	4 441
Premises Licensed to Store Flammable Liquids	4 920	4 623	4 476
Vehicles Licensed to Convey Dangerous Goods	1 502	1715	2 032
Dangerous Goods Drivers' Licences	392†	2969	3 418
Prosecutions initiated	17	22	4
Accidents	57	43	42

Mining Engineering:

	1987-88	1988-89	1989-90*
Workers	29 240	30 332	33 943
Accidents			
Fatal	8	16	10
Serious	639	664	588
Minor	2253	1700	1613

1989-90 figures are estimates only, subject to final audit, except fatal accidents.

†The Drivers Licences report in the 1987-88 period was for licences issued in that period, reporting is now on the basis of current licences.

Petroleum:

	1987-88		1988-89		1989-90	
	Onshore	Offshore	Onshore	Offshore	Onshore	Offshore
No. in Workforce	205	1 317	382	1 345	466	944
No. Hours Worked ($x10^3$)	442	1 522	949	1 542	819	1 788
. Accidents						
Minor	14	16	41	16	27	31
Serious	12	17	25	19	2	10
Fatal	0	1*	0	0	0	0
Sub Total	26	34	66	37	29	41
Yearly	60		103		70	
Total No Man hours lost	6 401	6 151*	11 179	8 408	1 821	5 957
Lost-time Injuries per 100 people	0.127	0.026	0.173	0.028	0.062	0.043
Average duration lost-time injuries (hours)	246.19	247.43*	169.38	227.24	62.79	145.29
Lost-time injury frequency rate	58.82	22.99	69.55	23.99	35.41	22.93
Lost-time injury incidence rate	0.127	0.026	0.173	0.028	0.062	0.043

*Fatalities - calculated at 220 day LTI x 12 hours shift.

Human Resources:

Departmental Human Resources committed to this Objective: 109.9 FTEs

Chemistry Centre	4.2
Explosives and Dangerous Goods	30.1
Mining Engineering	57.6
Petroleum	4.3
Surveys & Mapping	1.1
Corporate Development	12.6

PERFORMANCE INDICATORS

WORKER SAFETY

The major impact on sub-objective 4.1. comes from the Mining Engineering and Petroleum divisions which administer the Mines Regulations Act and Petroleum Legislation (various State and Commonwealth Acts).

Accident and injury rates are a function of the level of compliance with the relevant regulations.

Mining Industry:

The figures at the end of this section indicate the effectiveness of the Department in the mining industry.

They show either reduction or improvement in the following:

- number of injuries per 1000 workers (Figure 14);
- fatal accident rate (Figure 15); and
- workers' compensation premiums (Figure 16)

Petroleum Industry:

The Safety Performance for the Petroleum industry during 1989-90 is assessed on the basis of the indicators, recommended in Australian Standard AS 1885 1990, Part 1 and 2. These details are set out on the previous page.

- Lost Time Injury (LTI) Frequency Rate is a measure of the number of LTIs recorded during the fiscal year per million man hours worked;
  Lost Time Injury Frequency Rate equals the number of lost time injuries multiplied by 1,000,000 divided by manhours exposed.
- Duration Rate is a measure of the average number of days lost for each LTI; and
- Lost Time Incidence Rate is a measure of the number of LTIs suffered per employee during the fiscal period.
  Lost Time Incidence Rate equals the number of lost time injuries divided by the number of employees.

The figures indicate that:

- No fatal accidents in the industry for a second successive year.
- 89-90 has a further significant growth in manhours worked yet with a reduction in the number of injuries.

By using these indicators the safety performance of the petroleum industry in Western Australia can be compared with that of other States and with other industries such as petrochemical, construction and transportation.

PUBLIC SAFETY

The Explosives and Dangerous Goods division has a major impact on sub-objective 4.2 through the administration of the Explosives and Dangerous Goods Act.

The three key areas identified last year (premises, major hazards and review of accidents) have been expanded upon to enable a more extensive review of performance. The category of "premises" is presented as a broader category "Inspections" which is broken down into three groups: Transport; Storage; and Explosives.

However a review of the figures alone gives a misleading indication of the Division's performance so the figures need to be interpreted with some care.

The figures don't show:

- that at least one key staff member was seconded out of the Division for most of the year
- that 2-3 FTE's were occupied on non inspectoral duties associated with the preparation of draft storage regulations
- that unforeseeable developments in the chemical industry made it necessary to draw on inspectoral resources to review numerous proposals to develop industrial plants with major public safety impact potential

It is not possible to predict with any certainty that similar events won't occur again. The Division already has one senior inspector attached to the Kwinana Industry Emergency Management Scheme taskforce and the Dangerous Goods Regulations have developed to the stage where the passage of the Explosives and Dangerous Goods Act Amendment Bill is imminent, so the implementation phase of the Dangerous Goods Regulations will follow soon after.

Dangerous Goods Transport Inspections:

No. of Vehicles Registered	
Country	1058
Metropolitan	974
TOTAL:	**2032**
No. of Vehicles Inspected	
Category "S" (Satisfactory)	292
Category "U" (Unsatisfactory)	487
Total:	**779**

Target figure for Inspection	2032
Achieved as percentage of target 38.3%	779

The Division believes that it optimises the application of the regulations if all vehicles are inspected at least once annually.

PERFORMANCE INDICATORS (Cont'd)

It can be seen that the Division is falling far short of this target which is attributed to several possible factors:

- The previous estimate of full inspection was not correct and we are aiming higher than was previously achieved; or
- Additional work associated with the operation of the Dangerous Goods Regulations applicable to storage has reduced our resources available to carry out inspections at previous levels.

The picture should become clearer as more statistics are developed on performance in the coming years and also as we develop categories of non-compliance. For instance a tanker vehicle on which one of the three required fire extinguishers is not operable is a far less threat to public safety than one which has inadequate overturn protection. Such categorisation will allow us to more critically report on satisfactory or unsatisfactory vehicles.

Dangerous Goods Storage:

Dangerous Goods Storage
Inspection 1989-1990

No. of Premises Registered

Status Type	Total Premises	No. of Inspn's S	No. of Inspn's U	Total Inspn's	Target Inspn's	% Achv. of Target
Active Licensed	4010	1110	937	2047	3663 (90% of total)	56%
Exempt from Licence	509	129	35	164	458	35%
Inactive	562	82	116	198	506	39%
New - Awaiting Issue of Licence	154	13	18	31		
Overdue (Licence Not Renewed)	251	60	72	132	226	58%
	5546	1395	1178	2573	3805	67.62%

As with vehicles carrying dangerous goods in bulk, the aim of the Division has been to inspect all premises annually. Observations and trials have shown that when an inspector does not attend at a regional centre for two years or more there is a significant decrease in compliance with basic safety requirements such as secondary containment fire extinguishers, etc.

The Division has never had access to detailed statistics to establish if all premises in a region were in fact inspected or if all inspectors concentrated on problem areas and avoided some others. It has also always been assumed that it is unrealistic to obtain full 100% inspection rate. Sites many hundreds of kilometres from the next adjacent site are prohibitively expensive to inspect every year.

However various other monitoring systems such as auditing inspections, suggest that an inspection rate of 80-95% was maintained until around 1988.

The performance picture should also become clearer in this area as statistics are developed in coming years. A classification system to differentiate levels of threat to public safety is also being developed for premises storing dangerous goods.

Explosives Operations:

Explosives Licences
Inspections 1989-1990

Licence Type	No. Licences	No. of Inspn's S	No. of Inspn's U	Total Inspn's	Target Inspn's	% Achv.
Store	466	96	99	195	233 (50%)	84%
Sale	48	4	1	5	43 (90%)	11%
Disp. Fuels	58			32		55%
Manufacture	10			10	100%	100%
Convey	378	No statistics				

The key areas identified to monitor explosives safety are manufacture, storage and transport.

Manufacturing operations have been very closely monitored through the year. All vehicles must move through explosives reserves to collect or deliver explosives. These vehicles are checked on a daily or weekly basis as they enter and leave the reserve.

Storage facilities inspection rate targets are set relatively low because of the very high engineering standard of storage facilities as a result of past policy decisions. (Following the development of the Australian Standard for magazines in 1979 and its application in Western Australia there has been no record of any illegal entry to such a magazine in Western Australia).

The low inspection rate at sales outlets is an area of significant concern and immediate action has been taken to address this problem.

Major Hazards:

Only two of the predicted four Total Hazard Control Plans were completed during the year. Both were audited and endorsed by the Division. A third plan is in its final form but has not yet been audited. A further five are being prepared.

Review of Accidents:

Last year it was indicated that the Summary of Accident Reports could be presented at a very early date this year. Other demands on the staff meant that this was not possible but, in the longer term, the report prepared by the Division has been accepted favourably in other Australian states and looks like becoming the model for future Australia wide accident statistics collections.

Figure 14

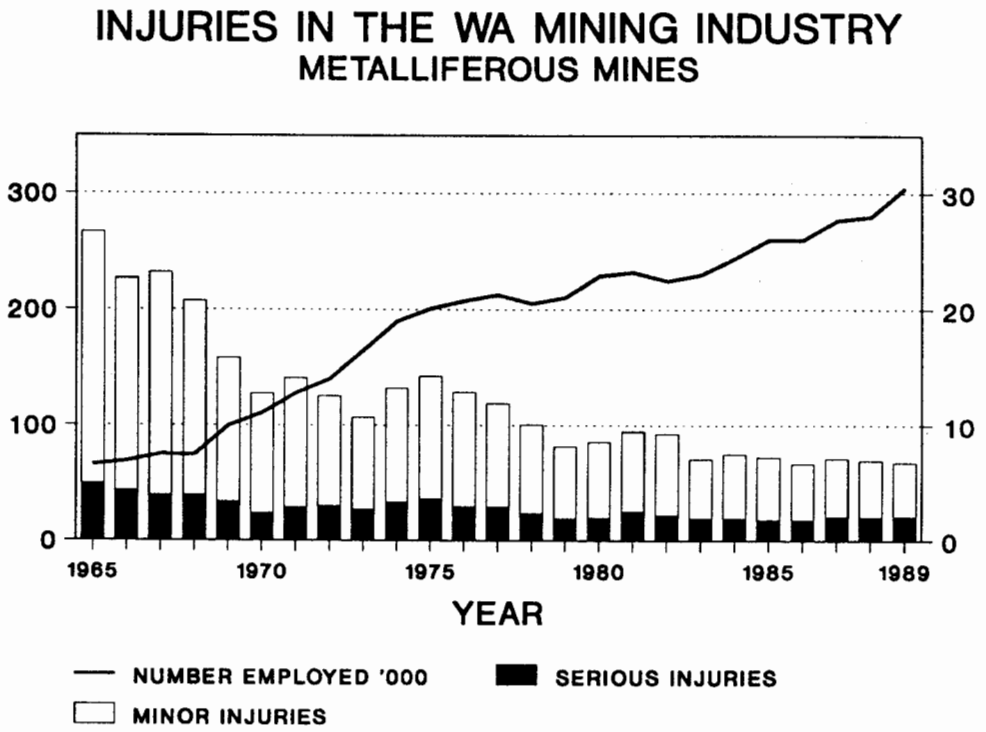


Figure 15

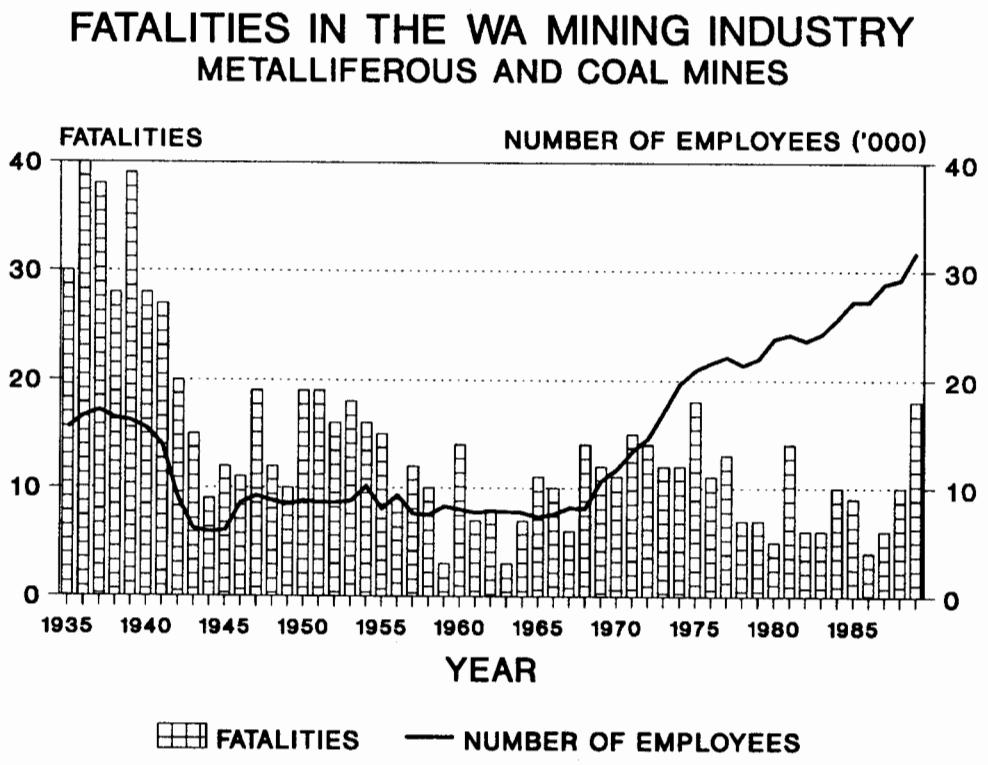
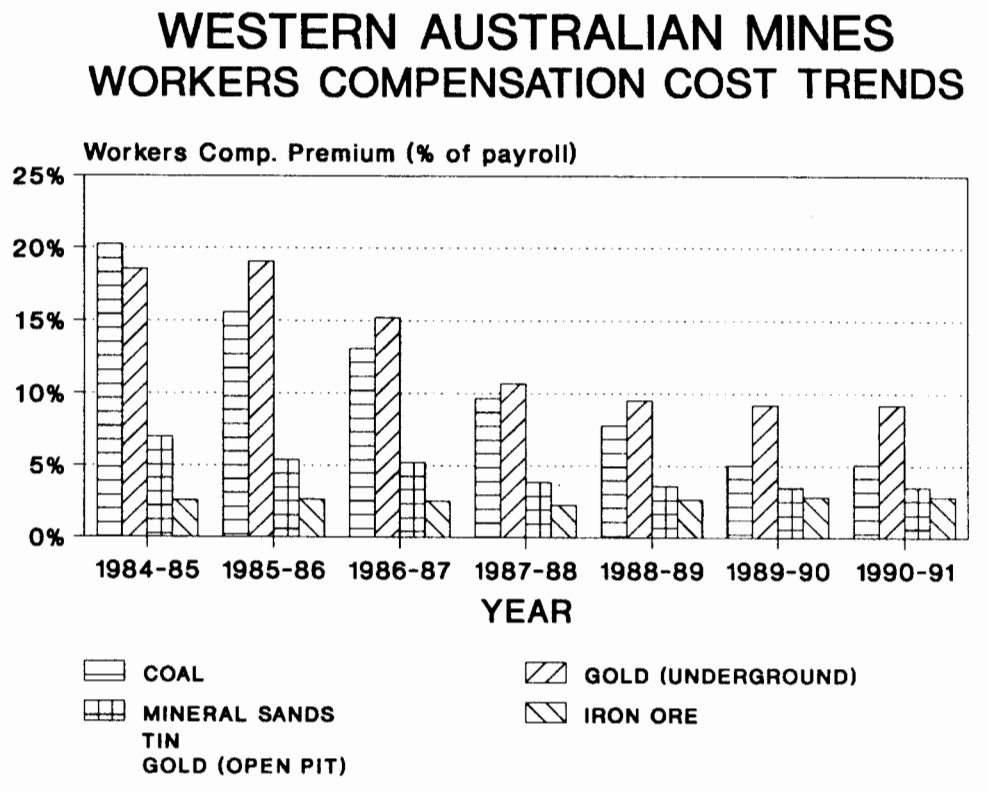


Figure 16



BROAD OBJECTIVE 5:

To ensure that the community has access to independent chemical research and consultancy services.

PERFORMANCE INDICATORS

The key elements determining the Chemistry Centre's effectiveness are:

- quality;
- resource allocation; and
- time.

Quality

The quality of the Chemistry Centre's data and advice can be assessed by the effectiveness of its quality assurance programs. The Chemistry Centre is NATA registered for over 100 chemical test areas and up to 70 different determinations within an area. Additional Test areas are being prepared for NATA registration.

The Laboratories are participating in an increasing number of inter-laboratory proficiency tests. A three day 'Quality Assurance' workshop was run for staff in April.

The Chemistry Centre is also committed to maintaining a high level of research and development in order that it can quickly provide the required level and variety of service demanded by clients.

Resources

In 1989-90 the Chemistry Centre updated its charges and identified the accurate costs for all its services. These have been calculated on a 'full cost recovery basis' and include salaries, consumables, equipment depreciation, rent and related costs. In 1990-91 reports will include either the cost (for clients who pay for the services) or a non-chargeable cost (for Government agencies). The costs for all Government programs will thus be able to be more accurately determined.

Time

The timeliness of the provision of the results and advice to clients is critical for their programs.

Laboratory management systems which will measure the turn-around time are planned as part of the Information Technology Plan. This Plan was prepared in 1989-90 and will, subject to the provision of funds, be implemented during the next four years.

CERTIFICATE OF PERFORMANCE INDICATORS

I hereby certifiy that these performance indicators are based on proper records and fairly represent the performance of the Department of Mines for the year ending June 30, 1990.

D R Kelly
ACCOUNTABLE OFFICER

14/8/1990

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OPINION OF THE AUDITOR GENERAL OF WESTERN AUSTRALIA

DEPARTMENT OF MINES
PERFORMANCE INDICATORS 1989-90

The performance indicators of the Department of Mines have been submitted for audit under section 63 of the Financial Administration and Audit Act 1985, but have not been audited.

As detailed in the August 31, 1989 Report of the Auditor General to Parliament, the opinion had been formed that it was not possible to conduct an audit of performance indicators as required by the legislation. Since they have not been audited I am not in a position to, and do not, express an opinion on the performance indicators of the Department of Mines for the period July 1, 1989 to June 30, 1990.

ACTING AUDITOR GENERAL
October 15, 1990

APPENDIX 1 LEGISLATION

The Department is responsible to the Minister for Mines for the administration of 17 individual Acts of Parliament.

Principal Acts

Mining Act
Petroleum Act

Other Acts

Coal Mines Regulation Act
Coal Mine Workers (Pensions) Act
Coal Miners' Welfare Act
Coal Mining Industry Long Service Leave Act
Explosives and Dangerous Goods Act
Mines Regulation Act
Mine Workers' Relief Act
Miners' Phthisis Act
Mining Development Act
Mining on Private Property Act
Petroleum Pipelines Act
Petroleum (Registration Fees) Act
Petroleum (Submerged Lands) Act
Petroleum (Submerged Lands) Registration Fees Act
Western Australian Coal Industry Tribunal Act

The following Commonwealth legislation is administered in the Western Australian adjacent area by the State and through the Commonwealth/Western Australian Offshore Petroleum Joint Authorities:

Commonwealth Petroleum (Submerged Lands) Act
Commonwealth Petroleum (Submerged Lands) (Registration Fees) Act
Commonwealth Petroleum (Submerged Lands) (Royalty) Act
Commonwealth Petroleum (Submerged Lands) (Retention Lease Fees) Act
Commonwealth Petroleum (Submerged Lands) (Exploration Permit Fees) Act
Commonwealth Petroleum (Submerged Lands) (Production Licence Fees) Act
Commonwealth Petroleum (Submerged Lands) (Pipeline Licence Fees) Act

In addition to its responsibilities under the above Acts, the Department undertakes various functions in relation to a number of special Agreement Acts:

Barrow Island Royalty Trust Account Act
Barrow Island Royalty Variation Agreement Act
Mining (Validation and Amendment) Act.

APPENDIX 2 CHANGES TO LEGISLATION

Explosives and Dangerous Goods Act 1961

(a) Explosives and Dangerous Goods (Third Schedule) Amendment Order 1989.

This amendment to the Third Schedule to the Act was necessary in order to make the classification of dangerous goods in Western Australia consistent with Australian standards and to provide new categories for Chronic Hazardous Substances and Restricted Dangerous Substances.

(b) Explosives and Dangerous Goods (Classification of Dangerous Goods) Amendment Order 1989.

This amendment was required to declare particular substances to be dangerous goods and to classify those substances by reference to the system specified in the Third Schedule to the Act.

Coal Mine Regulation Amendment Act 1990

This Amendment Act creates the statutory management position of Opencut Mine Undermanager, and prescribes the minimum qualifications necessary to satisfy the Board of Examiners.

It provides for the recognition by the Board of Examiners of experience gained in open cut mines and quarries, other than coal mines. Additionally, it introduces a requirement for all applicants for Certificates of Competency to pass an examination on the mining laws of Western Australia.

Finally, this amendment Act removes the prohibition of employees working more than seven consecutive hours, or more than forty two hours per week in the underground mines.

This amendment Act passed through both houses of Parliament by late June 1990, and was assented to and proclaimed to come into effect in early July 1990.

Coal Industry Superannuation Act 1989

The Coal Industry Superannuation Act 1989 was assented to on 12 December 1989 and was proclaimed on 1 July 1990, at the same time repealing the Coal Mine Workers Pensions Act 1943-1988.

The new Act was implemented after extensive consultation amongst coal mining companies, coal mining unions, the Coal Mine Workers Pensions Tribunal and the Government Actuary to provide a more modern superannuation fund for persons employed in the coal mining industry, and to replace the Coal Mine Workers Pensions Fund.

Regulations by which the Fund is structured and operated were also brought into being from 1 July 1990.

Barrow Island Royalty Variation Agreement Act, 1985

Barrow Island Royalty Variation Agreement Amendment.

This amendment enables WAPET to calculate quarterly royalty payments using estimates of current quarters, costs and sales details, rather than details for the previous quarter. Also to move the payment schedule for May 23 each year to June 23.

The tabling period expired in the Assembly on 25 October 1989 and in the Council 24 October 1989. Therefore the Variation Agreement is now operative.

Mining Act 1978 - Regulations

Mining Amendment Regulations 1990, gazetted 22 June 1990

These amendments deleted the concessionary five cents per tonne royalty rate for coal sold to a WA Government instrumentality. To reduce the impact, the rate for coal not exported will be phased in to apply to those sales. For the 1990-91 financial year the rate will be thiry-three and one-third percent, for the 1991-92 year sixty-six and two-thirds percent, and from 1 July, 1992 one hundred percent of the not exported coal rate.

The amendments came into effect from 1 July 1990.

APPENDIX 3 RESEARCH AND DEVELOPMENT PROJECTS

Chemistry Centre (W.A.)

- **Completed**

  Treatment of eutrophic natural waters with lime based chemicals

  Analytical variations in the determination of the total meat content of processed meat samples

  The determination of transferable arsenic in preserved animal specimens from the W.A. Museum

  Ethanol fuel cell development for roadside breath screening

  UV-radiation induced physico/chemical changes in thermoplastics

  Glaze faults in ceramic tiles

  Roasting of refractory gold concentrates; joint project with CSIRO and Curtin University funded by industry and MERIWA

  Carbon-in-Pulp technology: joint project with Murdoch and Curtin Universities funded by industry through AMIRA

  Transport and spillage of liquid sodium cyanide

  Evaluation of essential oil bearing plants for commercial planting in the Kimberleys

  Characterising oils generated from distillation of sewage sludge

- **Commenced and Continuing**

  Evaluation of a locally developed compound vortex cyclonic scrubber

  Alkaloid trends in commercial lupins funded by research grant

  Chemistry of acid soils

  Development and calibration of a phosphate test for WA soils

  Chemical and engineering properties of Harvey soil used for WA cricket pitches

  Soil tests to predict phosphorus and sulphur requirements of WA sandy soils

  Fungicide (iprodione) translocation in lupin seedlings

  Collection and curation of mineral specimens from the 'Big Pit' at Kalgoorlie

  Comparison of XRD and FTIR methods of quartz dust analysis using direct and indirect sample preparation

  AMIRA project: Fate of cyanide near mine tailings involving speciation and quantification of metal cyanide complexes

  Investigation of organochlorine pesticide residues in human breast milk

  Development of automated cyanide analysis methods in environmental waters

  Investigation of malodorous organic chemical emissions from industrial sources

  Drug Evaluation Programme in relation to the control of drugs in racing

  The determination of thallium in urine by Zeeman graphite furnace atomic absorption spectrophotometry

  The simultaneous determination of sulphuric acid and creatinine in urine by liquid chromatography

  Quantitation of respirable silica by FTIR spectroscopy

  Analysis of historical leather by FTIR spectroscopy

Explosives And Dangerous Goods

- **Completed, or not requiring Total Hazard Control plans**

  ICI Australia Operations new Emulsion Explosives Plant at Kalgoorlie

  Kemerton Parkland Study

  Proposed Integrated Hazardous Wastes Plant to be operated by the Health Department

- **Completed to Third Party Audit and under review**

  Wesfarmers' LPG Plant, Kwinana

Woodside, LNG Plant

- **Awaiting development of Total Hazard Control plan**

  CSBP Chlorine Plant, Kwinana

  CSBP Sodium Cyanide Plant, Kwinana

  CSBP Ammonia Storage Facility, Kwinana

  Nu-Farm Chlorine Plant, Kemerton

  Nu-Farm Chlorine Plant, Kwinana

  SCM Titanium Dioxide Pigment Plant, Kemerton

  TiWest Titanium Dioxide Plant, Kwinana

  Liquid Air Separation Plant and associated storage of cryogenic gases, Kwinana.

Geological Survey

Most of the work of the Geological Survey is involved in research and development projects to investigate, interpret and record the geology of Western Australia; relate the mineral, petroleum and groundwater occurrences and potential to that geology; and evaluate the mineral, fossil fuels and groundwater resources of the State. For a full listing of current and proposed projects see "Record 1990-91 Summary of Progress of the Geological Survey of Western Australia during 1989 and plans for 1990 to 1994-95" available from the 1st Floor counter in Mineral House. Some of the highlights of the program are:

Pilbara Craton geological mapping

Geoscientific investigations in the Eastern Goldfields region

Jurassic rocks of the southern North West Shelf

Seismic-horizon mapping in Phanerozoic basins

Drilling for groundwater in the northern Perth Basin

Perth Basin contamination-site inventory

Development of WAMEX Phase 2 mineral exploration database

Geotechnical studies relating to open-pit mines

Salinization studies relating to land-use

Mining Engineering

- **Completed**

  Survey of Tailings Dams characteristics.

  Review of Tailings Dams operating practice.

- **Commenced and Continuing**

  Open Pit wall stability.

  CONTAM: Contaminant Sampling in the Mining Workplace (computerised).

  Review of Underground Fire Precautions and Procedures.

  Development of MINEOPS system.

  Statistical analysis of AXTAT and CONTAM data.

Royalties & Statistics

Financial modelling analysis of major resource projects was performed with particular attention given to iron ore, coal and petroleum royalties. Analysis also continued to assist in negotiation of revenue sharing arrangements between the State and Commonwealth Governments for royalties recovered from offshore petroleum projects. A submission to the Commonwealth review of petroleum excise and royalty regimes was completed during the year. A review of specific rate royalties commenced.

Petroleum

- **Completed**

  Reservoir engineering studies on fields including Chervil, South Chervil, Saladin, Mount Horner

  Possibility of Oil Production from sub economic reservoirs in WA using non-conventional methods

  Submission to the Harman Power Options Review Committee

- **Commenced and Continuing**

  Development of regulations covering onshore drilling, production and surveying

  Amendments to the Petroleum Acts

  Planning for the Goodwyn, Cowle and Yammaderry, Tubridgi, Lowendal and Cossack projects

Supervision of construction projects for the development of the Talisman, Chervil and Saladin oilfields.

Surveys and Mapping

- **Completed**

  Geographic Information System (GIS) pilot study over the Perth Northwest Metropolitan Region to determine the capability of off-the-shelf GIS software to resolve complex geophysical problems.

  Modification, installation and testing of specialised software (Landcap and Landraw) for the automation of the examination, and certification of survey documents.

- **Commenced and Continuing**

  TENEMENT GRAPHICS: The digital capture of all unsurveyed live mining tenements under the Mines Act 1978.

  SDI: The capture, examination, certification and integration of all surveyed tenement boundaries.

  GPS - GLOBAL POSITIONING SYSTEMS: The development of a strategy to increase the use of GPS in mining tenement boundary depiction.

  Geological Mapping: The implementation of automated techniques.

  Graphical Digital Data Base: Development of a database for EPA System 5 to facilitate ongoing analysis and evaluation of resource and environmental information.

APPENDIX 4 PUBLICATIONS

The Department produces a wide range of printed matter to meet the diverse needs of Divisions. These are listed as promotional, informative, or technical. The material must serve all levels of the community; from basic information for the general public, for secondary students, through all levels of industry, and government. The information supplied must be aimed at the appropriate audience.

The promotional publications contain more generally worded material aimed at encouraging awareness of the industries the Department monitors, and to publicise and promote the philosophies behind the Department of Mines. It is only from awareness that knowledge can be acquired. The second is informative — material that can be general information as well as mildly technical such as mineral resources bulletins, which not only promote a subject but also inform a reader about the subject matter in slightly more detail and technical terms. The technical material produced is based on applied science and is of a particular and technical nature which is specifically aimed at the audience which would require and understand such information.

Chemistry Centre (W.A.)

- **Technical**

Agricultural Chemistry Laboratory

"Phosphorus Retention Of Sandy Horticultural Soils On The Swan Coastal Plain" I. McPharlin, N. Delroy, R. Jeffery, G. Dellar and M. Eales, 'W.A. Journal of Agriculture', Vol 31, 1990.

"Response of Carrots to Rate and Time of Phosphorus Applications Under Two Irrigation Regimes" I. McPharlin, G. J. Luke and R. C. Jeffery, W.A. Department of Agriculture Workshop.

"Method for Analysis of Phosphorus in Western Australian Soils" D. G. Allen and R. C. Jeffery, Chemistry Centre Report of Investigation No. 37, 1990.

"Field Trip : Soils and Land Uses in The Gingin Region" Australian Society of Soil Science (Inc.), W.A. Branch, 1989.

"Anti Nutritional Factors in Sweet Lupinseed" D. G. Allen, B. N. Greirson and D. J. Harris. Proceedings: 10th Australian Symposium on Analytical Chemistry, Brisbane, Queensland, 1989.

"Enzyme Linked Immunosorbent Assay for Lupin Alkaloids" B. N. Grierson, D. G. Allen, S. C. Baseden, N. F. Gare and I. M. Watson. Proceedings: 10th Australian Symposium on Analytical Chemistry, Brisbane, Queensland, 1989.

Environmental Chemistry Laboratory

"Monitoring of Gold Mine Tailing Sites for Cyanides" R. S. Schulz, W. Staunton and K. Jones. Proceedings: Chemistry International Conference, Brisbane, August, 1989.

"Impact of Air-Conditioner Discharges on the Swan River, Perth, WA" R. S. Schulz and V. Hossa. Proceedings: Chemistry International Conference, Brisbane, August, 1989.

"Marine Sampling for Heavy Metals", R. S. Schulz Proceedings: An Indio-Pacific Workshop on Analysis of Heavy Metals in Marine Samples - Validation and Quality Assurance, 1990.

"Iron Stain and Blockage Prevention" R. D. Taylor and T. A. Webb. Chemistry Centre Brochure No 6 August, 1989.

Forensic Science Laboratory

"A Pyrolysis-Derivatisation - Gas Chromatography Technique for the Structural Elucidation of some Synthetic Polymers" J. M. Challinor. Journal of Analytical and Applied Pyrolysis, 16 (1989) 323-333

"The Application of a Simple and Inexpensive Modified Carbon Wire/Solvent Extraction Technique to the Analysis of Accelerants and Volatile Organic Compounds in Arson Debris" D. J. Tranthim-Fryer. Journal of Forensic Science, 35, 2, March, 1990, 271-280.

"Pyrolysis Gas Chromatography - Some Forensic Applications" J. M. Challinor. Chemistry in Australia, April 1990.

"Pyrolysis Alkylation - A novel approach to structure elucidation" J.M. Challinor. Proceedings: Gordon Research Conference, New Hampshire, U.S.A., July 1989.

"Scope of Pyrolysis Derivitisation Reactions" J.M. Challinor Proceedings: Conference on Pyrolysis Techniques, Amsterdam, Holland, June 1990.

Health Chemistry Laboratory

"Thallium in Urine by GFAAS" S. Jones, Proceedings: 10th Analytical Chemistry Conference (10AC), Brisbane, August, 1989.

"Aluminium in Foods" S Jones Proceedings: Australasian Food Analysts Meeting, Brisbane, August, 1989.

"Laboratory Safety and Disposal of Chemicals" M. Rowe, Proceedings: RACI Gold and Platinum Group Analysis Seminar, Perth, May, 1990.

Kalgoorlie Metallurgical Laboratory

"Gold Bullion Analyses" B. C. Das, Chemistry in Australia, November 1989.

"Carbothermic Reduction Kinetics of Tin Concentrate Pellets" V. N. Misra, Proceedings: International Symposium on Production and Technology in the Metallurgical Industries, Cologne, West Germany, September 17 - 22, 1989.

"Extraction of Zinc from Complex Polymetallic Sulphide Concentrates" V. N. Misra, Proceedings: International Symposium on Productivity and Technology in the Metallurgical Industries Cologne, West Germany, September 17 - 22, 1989.

"Hydrometallurgical Processing of Complex Polymetallic Sulphide Ores" V. N. Misra, Proceedings: MMIJ/IMM Joint Symposium on Today's Technology for Mining and Metallurgy, Kyoto, Japan,2 - 4 October, 1989.

"The Environmental Engineering Course at WASM" J. H. Kyle and T. N. Little. Proceedings: AMIC Workshop, Ballarat, Victoria, September, 1989.

"The pressure aqueous pre-oxidation of a refractory gold ore from the golden mile, Kalgoorlie, Western Australia" J. H. Kyle, G. Dziurdzak and R. C. Dunne. Proceedings: World Gold '89 Conference, Reno, Nevada, November, 1989.

"The pulp rheology of some Australian gold ores" J. H. Kyle and J. L. Beazley. Proceedings: World Gold '89 Conference, Reno, Nevada, November, 1989.

Materials Science Laboratory

"Building Conservation - Consolidation of Natural Stone", G.M. Ferguson, Proceedings: RACI Polymers and Building Technology Seminar, April, 1990

"Analysis of Ceramic Flooring Materials" G.M. Ferguson, Proceedings: RACI Polymers and Building Technology Seminar, April, 1990

"Analysis of Polymers by Fourier Transform Infrared Spectroscopy" G.W. Richardson, Proceedings: RACI Polymers and Building Technology Seminar, April, 1990

Mineral Processing Laboratory

"Changing Trends in Gold Ore Treatment in Western Australia. The Problem of Refractory Ores" J. Avraamides, Proceedings: World Gold '89, Joint AIME-AusIMM Conference, Reno, Nevada, October, 1989. (Editors R. S. Bhappu and R. J. Harden).

"CIP Carbons - Selection Testing and Plant Monitoring" J. Avraamides, Proceedings: World Gold '89, Joint AIME-AusIMM Conference, Reno, Nevada, October, 1989. (Editors R. S. Bhappu and R. J. Harden).

"Transportation of Liquid sodium Cyanide - Response Strategies for Spills" W. P. Staunton, S. Formby, R. S. Schulz* and J. Avraamides. Proceedings: World Gold '89, Joint AIME-AusIMM Conference, Reno, Nevada, October, 1989. (Editors R. S. Bhappu and R. J. Harden).

"Analysis of Carbon from the Carbon-In-Pulp Process" J. Avraamides and W. P. Staunton. Proceedings: Seminar Gold and Platinum Group Analysis - Problems and Solutions, Perth, May 9 - 10, 1990. (RACI WA Branch Analytical Chemistry Group).

"Gold Processing - R & D into the Nineties" J. Avraamides, Asia Pacific Mining, March 1990.

"Relationships Between Mineralogy, Roasting and Extraction of Gold from Refractory Pyritic and Arsenopyritic Gold Ores and Concentrates" J. G. Dunn, J. Graham and J. Avraamides, Report No. 59 Minerals and Energy Research Institute of Western Australia, April, 1990.

"Practical Aspects Affecting Gold Adsorption and Carbon Fouling" S. R. LaBrooy and J. J. Robinson, Proceedings: Randol Conference, Gold and Silver Recovery Innovations, Phase IV, Sacramento, California, November, 1989.

"Disposal of Cyanide - Containing Tailings" W. P. Staunton and K. Jones, Proceedings: Australian Mining Industry Council Environmental Workshop, Ballarat, Victoria, Vol.1, 1989.

Mineral Science Laboratory

"Interferences in Gold Determination by Flame Atomic Absorption Spectroscopy (FAAS)" B. Price and C. Dodd Chemistry Centre (WA) Report of Investigations No 36, 1989

"P-T Estimate of Metamorphism of Palaeo - Pacific Oceanic Crust, Western New England, N.S.W" H. K. Herbert Proceedings: Pacific Rim Congress 90. Australasian Institute of Mining and Metallurgy, Melbourne, 1990.

"Geological Data from the Mount Clement Gold and Lead Prospects, Ashburton Basin, Western Australia" R. Davy, R. M. Clarke and D. B. Seymour. Western Australia Geological Survey : Record 1989/16.

"Gold Bearing Ilmenite Profiles at Mt. Gibson, Murchison Province - Analytical and Mineralogical Data" R. Davy, R. M. Clarke and M. Sale. Western Australia Geological Survey : Record 1989/18.

"Review of Analytical Methods for Determining Trace Amounts of Gold in Ores and Process Streams" J. Hosking and D. Herring Proceedings: Gold and Platinum Group Analysis Problems and Solutions, RACI Symposium, 1989.

"Dissolution of Samples for Determination of Gold by Wet Chemical Procedures" C. Dodd Proceedings: Gold and Platinum Group Analysis Problems and Solutions, RACI Symposium, 1989.

"Safety in the use of FAAS" C. Dodd Proceedings: Gold and Platinum Group Analysis Problems and Solutions, RACI Symposium, 1989.

"Solvent Extraction" B. Price Proceedings: Gold and Platinum Group Analysis Problems and Solutions, RACI Symposium, 1989.

"XRF - A Review of the Basics; Historical Background Review of X-ray Theory and Development in Modern Instrumentation" A. G. Thomas. Proceedings: AXAA90, Eighth Australian School and Conference on X-ray Analysis and Surface Analysis, University of Melbourne, 11 - 16 February, 1990.

Racing Chemistry Laboratory

"Detection of Methylpredinsolone" J. M. Ralston and A. M. Stenhouse Proceedings: 8th International Conference of Racing Analysts and Veterinarians, Harare, Zimbabwe, February 1990.

"The Detection of Lupin Alkaloids in Horse Urine" A. M. Stenhouse, S. F. Lucks and J. M. Ralston. Proceedings: 8th International Conference of Racing Analysts and Veterinarians, Harare, Zimbabwe, February 1990.

"The Analysis of Morphine and Codeine in Horse Urine" A. M. Stenhouse, J. M. Ralston and C. I. Russo. Proceedings: 8th International Conference of Racing Analysts and Veterinarians, Harare, Zimbabwe, February 1990.

"An Oxycodone Administration of the Horse - A Short Communication" A. M. Stenhouse, J. M. Ralston and C. I. Russo. Proceedings: 8th International Conference of Racing Analysts and Veterinarians, Harare, Zimbabwe, February 1990.

"Cortisol Concentrations in Urine - Comparison of RIA versus GCMS (A Short Communication)" J. M. Ralston, A. M. Stenhouse and C. I. Russo. Proceedings: 8th International Conference of Racing Analysts and Veterinarians, Harare, Zimbabwe, February 1990.

Explosives And Dangerous Goods

- **Informative**

  Notes for the Shotfirer

  Summary of Accident Reports

  Numerous guideline documents on many aspects of the Explosives,Flammable Liquids, Dangerous Goods (Road Transport) Regulations and Risks and Hazards.

Geological Survey

- **Informative - technical**

  Bulletins, Reports, Records, Memoirs - are geoscientific publications describing the geology, mineral resources, and groundwater occurrences of particular parts of the State.

  Microfilm/fiche of released company reports on mineral and petroleum exploration are available for inspection or purchase.

- **Promotional**

  A wide range of Information Pamphlets covering diverse topics available.

  Maps - technical

  1:250 000 Geological series; 163 for whole State coverage
  1:100 000 Geological series
  1:250 000 Hydrogeological series
  1:50 000 Urban geology/environmental series
  1:2 500 000 State geological map
  1:2 500 000 Mineral deposits map
  1:2 500 000 State Hydrogeological map
  1:2 500 000 Principal gold deposits map

1:2 500 000 Wells drilled for petroleum exploration map.

Mining Engineering

- **Informative:**

  Fatal and lost time injuries in Western Australia Mines 1988-89 (October 1989). Fatal and lost time injuries in Western Australian Mines 1989 (May 1990).

  Conceptual Plan for Mining Developments on the Golden Mile.

  Guidelines for Mining Project Approval in WA.

  Guidelines for the preparation of a Notice of Intent and Works Approval Application for new or extensions to tailings dams.

  Guidelines for Environmental Management of Mining in Arid Areas.

  Guidelines for Waste Dump Design and Rehabilitation.

  Guidelines for Heap Leach Projects.

  Guidelines for Vat Leach Projects.

  Interim Guidelines on Safety Bund Walls Around Abandoned Open Pits.

  List of operating mines in WA.

  List of gold producers in WA.

  The Western Australian Mineral Sands Industry Radiation Protection.

  A review of Uncertainties in Internal Dose Assessment for Inhaled Thorium.

  Radiation Exposure Status of Mineral Sands Industry Workers (1983-1988).

  Guideline: Management of Radioactive Waste Arising in the Mineral Sands Industry.

- **Promotional**

  Surface Ventilation Officers Course 1990 Perth

  Cyanide handling manual 1989

Mining Registration

- **Informative**

  Information Pamphlets

  Basic Provisions
  Guidelines on Reporting Requirements
  Miner's Rights
  Marking Out and Applying for Mining Tenement
  Private Land Provisions
  Transitional Provisions
  Prospecting Exploration and Mining on Pastoral Leases

  Prospecting Licences - A guide to Holders

  Exploration Licence - Compulsory Partial Surrender

- **Promotional**

  "TENDEX" - Computerised Mining Tenement Index System.

Petroleum Division

- **Informative**

  Directions as to Drilling Operations.

  Directions as to Geological and Geophysical Surveys.

  List of Permittee/Licensee/Lessee Companies and titles.

  Petroleum in Western Australia magazine.

  Schedule of Specific Requirements as to Offshore Petroleum exploration and production - 1985.

  Industry Safety memorandums.

Royalties & Statistics

- **Informative**

  Principal Gold Producers (produced twice a year for calendar and financial years).
  Statistical Digest of Mineral Production (published twice a year to cover calendar and financial years).

Surveys And Mapping

- **Informative Maps**

  Mineral Tenement Maps

  Department Public Plans
  Index to Public Plans
  Mining Act - Section 57(4) Areas
  Graticular Section Plans

  Petroleum Tenement Maps

  Brochure of Petroleum Tenements
  Petroleum Tenement Map of the State
  Petroleum Act Graticular Section Maps
  Petroleum Tenement Maps

  Thematic Maps

  Areas which have been held under Gold Mining Leases
  Administrative Divisions
  Historic Map - Wiluna to Kimberley Stock route
  Index to Special Agreement Acts
  Map Sheet Index
  Mineral Production
  Petroleum in Western Australia Tenement Map
  Western Australian Localities Map
  Conservation Reserves of Western Australia, State Map
  Conservation Reserves of Western Australia, South West Region
  Aboriginal Reserves of Western Australia, State Map

Corporate Development

- **Informative**

  Computer User Handbook

  Computer Systems Standards

  Departmental Directory - general purpose

APPENDIX 5 PUBLIC RELATIONS, DISPLAYS AND MARKETING ACTIVITIES

February 1990 saw the formation of a Departmental Communications Branch to manage the organisation's publications and public affairs needs.

Immediate priority was given to improving the Department's communications with various external publics and to improving communications within the Department itself.

Activities of the Communications Branch during the first half of 1990 included:

- The preparation and dissemination of 30 media releases on a wide variety of topics including mine safety, new explosives and dangerous goods regulations, the discovery of the world's oldest fossil seaweed, the rehabilitation of quarries and the acquisition of a sophisticated scanning electron microscope by the Chemistry Centre.

  Considerable positive media coverage of Departmental activities was achieved across a wide range of media through the State and also overseas.

- The drafting of new Departmental media policy guidelines.

- The drafting of a media training manual for Departmental Staff.

- Processing in excess of 400 direct media inquiries for comment or information.

- Arranging Departmental participation in excess of 40 electronic media news programmes.

- Designing and producing a number of major displays for special events and expositions including: WAMEX, WA Heritage Week, Mining and Petroleum Industry Photographic Competition, In-house Divisional expositions and Media Conference (mine safety)

- Establishing a new monthly in-house newsletter for staff called "Plain Street Post."

- Organising a mining and resource industry photographic competition in association with the WA Photographic Federation.

- Producing and circulating a number of "Information Brief" background circulars for Departmental staff on topical or controversial issues.

- Producing editorial content for special daily newspaper and magazine supplements on a variety of topics including the centenary of the discovery of gold in the Murchison District.

- Producing a wide variety of brochures, pamphlets, booklets and reports using the Branch's Desk Top Publishing System.

- Organising and co-ordinating the Department's first major media conference at Mineral House for the release of the report of The Special Inquiry into Safety in Underground Gold Mines.

- Organising and planning special public displays at museums e.g. Museum of WA (special fossil discovery); Museum of the Goldfields, Kalgoorlie (History of the Department of Mines), Marble Bar State Battery Museum (History of the Department of Mines).

- Planning a programme of special events to mark the Department's centenary in 1994.

- Planning an attitudinal research survey of Departmental staff.

- Designing, writing and placing a number of public information advertisements.

- Participating in the drafting of 15 Ministerial speeches.

- Collection and analysis of media monitoring data.

- Design and completion of a wide variety of posters and signage.

Other public relations initiatives by individual Divisions of the Department included:

- Mounting a series of in-house Divisional expositions to increase inter-Divisional awareness of the Department's widely diverse services and professional disciplines.

- Arranging tours of the Chemistry Centre for school groups and tertiary institutions.

- Completion of a brochure outlining the activities and services of the Kalgoorlie Metallurgical Laboratory.

- Presentations by the Explosives and Dangerous Goods Division to transport industry and community groups on the safe handling, packaging and labelling of dangerous goods.

- Participation by the Surveys and Mapping Division in the State Map Display in Darwin as part of the Australian Institute of Cartographers Conference. The Division also drafted a Products and Services Guide to enhance and promote its operations.

- An all-day seminar reviewing geology, geophysics and petroleum potential of the Perth Basin in October 1989, held by the Geological Survey and Petroleum Division. The Geological Survey also ran field excursions in the Perth, Carnarvon and Bonaparte basins for industry personnel.

- Chemistry Centre staff from a range of laboratories presented talks on many diverse topics throughout the year. These included cyanide analysis, heavy metal sampling, organics in water, environmental monitoring, occupational hazards, FTIR techniques and laboratory safety. Staff also attended and presented papers at many professional conferences. A series of lectures to third year chemistry students at the University of WA involved a range of staff from several laboratories lecturing on various topics in applied analytical chemistry.

- Other Chemistry Centre activities included: Australian Mineral Foundation course on Carbon-in-pulp and Gold Processing Technology (two officers presented parts of the course); presentation of 1990 Bayliss Youth Lecture to Year 12 chemistry students by Dr J. Avraamides in Perth, Bunbury, Albany, Geraldton and Karratha; a contribution to the "Women in Science and Engineering Project" by Ms K. Jones through several talks to year 11 and 12 female high school students; and staff from the Kalgoorlie Metallurgical Laboratory and the Mineral Science Laboratory running a course on Atomic Absorption Spectroscopy for 33 participants from the gold industry in Kalgoorlie.

APPENDIX 6 THE DEPARTMENT OF MINES BOARDS AND COMMITTEES

Statutory

Board of Examiners for Mine Managers and Underground Supervisors (Metalliferous)
Boards of Examiners, Mine Managers and Deputies (Coal)
Board of Examiners for Quarry Managers
Coal Mines Accident Relief Fund Committee
Coal Mines Accident Relief Fund Trust
Coal Miners Welfare Board
Coal Mine Workers' Pension Tribunal
Mine Workers Relief Fund Board
Radiation Safety Board
Selection Committee for Inspectors of Mines
Mines Survey Board
Ventilation Board

Boards, Committees And Councils On Which The Department Has Representation

Directorate

Australasian Institute of Mining and Metallurgy
Australian Ionising Radiation Advisory Council
Australian Minerals and Energy Council (AMEC) - Standing Committee of Officials
Carlisle Development Working Group
Chemistry Centre Accountability Steering Committee
Chemistry Centre Advisory Council
Chemistry Centre Steering Group
Corporate Executive Committee
Country Planning Council
Gold Producers' Association Ltd
Government Management Policy Advisory Council
Information Technology Advisory Committee
Land Information Plan Committee
MTIS Steering Committee
Microfilm Steering Committee
Mines Department Computer Co-ordinating Committee
Mines Department Finance Committee
Mining Act Steering Committee
Mining Industry Liaison Committee
Mining Tenement Information System (MTIS) Steering Committee
Publications Review Committee
Quarry Rehabilitation Work Party
W.A. Advisory Committee on Hazardous Substances
W.A. Mining Education Consultative Committee
W.A. Water Resources Council
W.A. Water Resources Council - Conservation Committee
Working Party on Conservation and Rehabilitation in the Mining Industry - Seismic Lines

Corporate Development Division

Audit Committee
Coal Mine Workers Pension Tribunal
Common Use Purchasing System (CUPS)
Equal Employment Opportunity Consultative Committee
Health and Safety Committee - Mineral House Complex
Hedland College Council
Hedland College Finance and Staff Committee
Human Resource Planning Committee
Mines/BMA Monthly Review Committee
National RMS Users Group
Purchasing System Working Group
RMS Management Committee for WA Government
RMS Users' Working Group
Reclassification Review Committee
Records Management Liaison Committee
Records Management Steering Committee
Staff Development Officers Network Coordinating Committee
W.A. Government Task Force on Information Technology Establishments

Chemistry Centre of W.A.

Advisory Committee for the Purity of Water
Amira Cyanide Project
Australian Society of Soil Science (WA) Branch Committee
Brodie-Hall Mining Research and Consultancy Centre, WA School of Mines
Chemistry Centre - Computer Advisory Committee
Chemistry Centre - Occupational Health and Safety Committee
Chemistry Centre Complex - Bentley Construction and Fitout Project Control Group
Chemistry Centre-Geological Survey Liaison Committee
Drug Advisory Committee
Fluoridation of Public Water Supplies Advisory Committee
Grain Pool Legume Advisory Committee
Harding Dam Water Quality Committee
Hazardous Substances Advisory Committee
Hazardous Substances Advisory Committee Working Party - Termiticides
International Lupin Executive
Licence Advisory Panel of Rights in Water and Irrigation Act
Mines Department Hazardous Substances Committee
NATA Chemical Testing Registration Advisory Committee
Pesticides Advisory Committee
Poisons Advisory Committee
SAA CH/10/4 - Mineral Standards Board - Precious Metals Sub-committee
SAA MN/- Mineral Standards Board
SAA MN/1/1/7 - Coal and Coke, Trace Elements

SAA MN/2/2 - Chemical Analysis of Iron Ores
SAA MN/3/2 - Analysis of Aluminium Ores
SAA MN/4/2 - Chemical Analysis of Heavy Mineral Sands Sub-committee
State Tender Board - Cleaning Polishing and Maintenance Products
State Tender Board - Cleaning Products - Detergents
State Tender Board Paint Advisory Committee
Toxichem Chemical Information Project - Professional Advisory Group
Veterinary Preparation and Animal Feeding Stuffs Advisory Committee
WA Food Advisory Committee
WAACHA Sub-committee on Organochlorine Use as Termiticides
WARD Grants Assessment Panel (WA Research and Development)
Western Australian Food Advisory Committee
Working Party on Asbestos Cement Products

Explosives and Dangerous Goods

Association of Australian Port and Marine Authorities - Dangerous Goods Committee
Explosives - Dangerous Goods Systems Committee
Explosives Division Operations Planning Committee
Explosives Division Personal Computer Project Planning Committee
Kemerton Industrial Working Committee
Kemerton Park Advisory Board
Kwinana Industrial Co-ordinating Committee - Improvement Plan 14 Working Group
Kwinana Integrated Emergency Management System Executive Co-ordinating Committee
Kwinana Integrated Emergency Management System - Emergency Services Sub-committee
Kwinana Integrated Emergency Management System - Technical Advisory Sub-committee
National Task Force on Hazardous Industry and Land-use Safety Planning Public Safety Sub-committee
SAA CH/9 - Safe Handling of Chemicals
SAA ME/15 - Liquefiable Petroleum Gases
SAA ME/17 - Flammable and Combustible Liquids
SAA ME/50 - Road/Rail Tankers Fluid Transfer Components
SAA ME/57 - Road Tankers for Hazardous Liquids and Gases
SAA ME/70 - Liquefied Natural Gas Storage and Handling
State Government Counter Disaster Advisory Committee
Transport of Dangerous Goods - Competent Authorities Subcommittee
Transport of Dangerous Goods - Drafting Subcommittee
Transport of Dangerous Goods - Explosives Working Group
WA Hazardous Materials Emergency Management Scheme - Preparedness and Response Sub-committee
WA Transport Emergency Assistance Scheme Coordinating Committee

Geological Survey

Australian Earth Science Information System (AESIS) Advisory Committee
Australian Mineral Foundation (AMF) Council
Australian Resources Industry Database (ARID) Advisory Council
Bauxite Subcommittee
Bunbury-Wellington Regional Planning Committee
CSIRO Mindarie Waste Disposal Site Committee
Chamber of Mines and Energy Liaison Group
Coastal Groundwater Schemes Steering Group
Coastal Management Co-ordinating Committee
Cockburn Cement - Dredging and Management Program Working Committee
Cockburn Area Groundwater Pollution Control Technical Committee
Conservation and Rehabilitation in the Mining Industry - Work Party
Environmental Liaison Committee
EPA Red Book Task Force
Extractive Industry Committee
GSWA State Water Resources Information System Steering Committee
GSWA/WAWA Groundwater Liaison Committee
Geological Map Revision Group
Geological Survey Computer Policy Committee
Geological Survey Liaison Committee
Geological Survey Library Advisory Committee
Geology Advisory Committee
Gnangara Mound Technical Advisory Group
Government Geologists' Conference
Government Geosciences Database Policy Advisory Committee
Hydrogeology Sub-committee (of the Geological Survey Liaison Committee)
Implementation Group
Integrated Catchment Management Policy Group
Land Salinisation Sub-committee of RSC
Mining and Conservation Consultative Committee
Petroleum Co-ordinating Committee
RSC Land-use and Groundwater Interactions on the Coastal Plain Sub-committee
RSC Water Resource Catchment Rehabilitation
Research on Land Use and Water Supply Steering Committee
Rockmin Steering Committee
Rottnest Island Authority Environmental Advisory Committee
Rottnest Island Research Committee
South-west Seismic Zone Data Base Program Liaison Committee
State Tender Board Procurement of Motor Vehicles Advisory Sub-committee
Technical Committee for Estimating Recharge for Sub-regions with Multiple Land-use
WA Water Resources Council - Groundwater Management Committee
WAMEX Steering/ Committee

WAMEX Working Group
WAPEX Steering Committee
WAPEX Working Group
WAWA/SWRIS Review Committee
Yilgarn Block Liaison Sub-committee of the Geological Survey Liaison Committee

Petroleum

Committee of Local Industry Participation
Consultative Committee on Safety in the Offshore Petroleum Industry in Australia
Government Regulatory Authorities Pipelines Advisory Group
North West Shelf Security Working Group
Offshore Engineering Program Advisory Panel
Onshore Petroleum Legislation Sub-committee
Petroleum/Fishing Industries - Appeal Meetings
Petroleum Industry Liaison Committee
Standing Committee on Offshore Petroleum Legislation
State Committee for Combating Marine Oil Pollution

Mining Engineering

AXTAT
Board of Examiners (Mine Managers and Underground Supervisors)
Board of Examiners (Quarry Managers)
Coal Miners Welfare Board
Coal Mines Accident Relief Fund Trust
Golden Mile Mining Planning Development Committee
Leonora Mining Development Planning Committee
Mines Radiation Safety Board
Mines Survey Board
Mines Ventilation Board
Mining Contaminants Monitoring System (CONTAM) Steering Committee
Mining Operations Group
WA School of Mines Advisory Committee
Wittenoom Interdepartmental Committee
Yilgarn Mining Development Planning Committee

Royalties and Policy Development

Minedex Steering Committee

Surveys and Mapping

Australian Institute of Cartographers (WA Division)
CSA Cartographic Sub-association
Computer-aided Map Publishing Committee
Geodetic Survey and Computing Technical Subcommittee
Geographic Names Committee
Geographic Information Systems/Land Information Systems Pilot Project Steering Committee
GIS/LIS Steering Committee
MRD Cyber Users' Group
Multiskilling and Job Design Consultative Committee
Surveys and Mapping Divisional Assessment Panel
WA Petroleum Map Steering Committee
WA State Emergency Service - Liaison Officers
WA Survey and Mapping Advisory Committee
WALIS Digital Capture of Cadastral Information Subcommittee
WALIS Project - Restricted Sites Systems
WALIS Technical Subcommittee
WAPMAP Steering Committee
Western Australian Land Information Systems Council (WALIS)

Mining Registration

Exemption Sub-committee
Geoscientific Survey Permit Committee
Mining Registration Divisional Committee
Mining Registration Unit Managers' Committee
Tenement Rentals and Expenditure System (TRAXS)

APPENDIX 7 DEPARTMENTAL DIRECTORY

Head Office

DEPARTMENT OF MINES
MINERAL HOUSE COMPLEX
100 PLAIN STREET (CNR ADELAIDE TERRACE)
EAST PERTH WESTERN AUSTRALIA 6004
TELEPHONE (09) 222 3333
FAX (09) 222 3430
TELEX AA95791 MINEWA

OFFICE OF DIRECTOR GENERAL OF MINES
8TH FLOOR MINERAL HOUSE SOUTH
100 PLAIN STREET (CNR ADELAIDE TERRACE)
EAST PERTH WESTERN AUSTRALIA 6004
TELEPHONE (09) 222 3333
FAX (09) 222 3510
TELEX AA95791 MINEWA

CORPORATE DEVELOPMENT DIVISION
7TH FLOOR MINERAL HOUSE SOUTH
100 PLAIN STREET (CNR ADELAIDE TERRACE)
EAST PERTH WESTERN AUSTRALIA 6004
TELEPHONE (09) 222 3333
FAX (09) 222 3430
TELEX AA95791 MINEWA

FUNCTIONAL DIVISIONS

Chemistry Centre

CHEMISTRY CENTRE
125 HAY STREET
EAST PERTH WESTERN AUSTRALIA 6004
TELEPHONE (09) 325 5544
FAX (09) 325 7767
TELEX AA95791 MINEWA

MINERAL PROCESSING LABORATORY
19 CATHERINE STREET
BENTLEY WESTERN AUSTRALIA 6102
TELEPHONE (09) 458 9088
FAX (09) 351 8197
TELEX AA95791 MINEWA

Regional Office

KALGOORLIE METALLURGICAL LABORATORY
95 EGAN STREET (BOX 881)
KALGOORLIE WESTERN AUSTRALIA 6430
TELEPHONE (090) 220 120
FAX (090) 912 762

Explosives And Dangerous Goods Division

EXPLOSIVES AND DANGEROUS GOODS DIVISION
9TH FLOOR MINERAL HOUSE NORTH
100 PLAIN STREET
EAST PERTH WESTERN AUSTRALIA 6004
TELEPHONE (09) 222 3333
FAX (09) 222 3525
TELEX AA95791 MINEWA

BALDIVIS EXPLOSIVES RESERVE
STAKEHILL ROAD
BALDIVIS WESTERN AUSTRALIA 6171
TELEPHONE (09) 524 1301

Regional Office

KALGOORLIE EXPLOSIVES RESERVE
PICCADILLY STREET WEST
KALGOORLIE WESTERN AUSTRALIA 6430
TELEPHONE (090) 218 246
FAX (090) 913 222

Geological Survey Of Western Australia

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA
5TH FLOOR MINERAL HOUSE NORTH
100 PLAIN STREET (CNR ADELAIDE TERRACE)
EAST PERTH WESTERN AUSTRALIA 6004
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FAX(09) 222 3633
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GEOLOGICAL SURVEY LABORATORIES
40 COHN STREET
CARLISLE WESTERN AUSTRALIA 6101
TELEPHONE (09) 222 3240

GEOLOGICAL SURVEY CORE LIBRARY
15 HAROLD STREET
DIANELLA WESTERN AUSTRALIA 6062
TELEPHONE (09) 222 3277

GEOLOGICAL SURVEY TRANSPORT STORE
137 RUSSELL STREET
MORLEY WESTERN AUSTRALIA 6162
TELEPHONE (09) 276 8855
(09) 222 3297

Regional Office

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA
KALGOORLIE REGIONAL OFFICE
WA SCHOOL OF MINES
EGAN STREET
KALGOORLIE WESTERN AUSTRALIA 6430
TELEPHONE(090) 213 066
FAX(090) 912 428

Mining Engineering Division

MINING ENGINEERING DIVISION
6TH FLOOR MINERAL HOUSE NORTH
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MINING ENGINEERING DIVISION
DRILLING BRANCH
91 BRIGGS STREET
WELSHPOOL WESTERN AUSTRALIA 6101
TELEPHONE (09) 362 3211
FAX (09) 362 5694

Regional Offices

REGIONAL MINING ENGINEER
66 WITTENOOM STREET
COLLIE WESTERN AUSTRALIA 6225
TELEPHONE (097) 341 222
FAX (097) 341 606

REGIONAL MINING ENGINEER
DEPARTMENT OF MINES
BROOKMAN STREET (BOX 671)
KALGOORLIE WESTERN AUSTRALIA 6430
TELEPHONE (090) 213 066
FAX (090) 213 612

COAL INDUSTRIES COUNCIL
UNIT 1 FORREST FORUM
FORREST STREET
COLLIE WESTERN AUSTRALIA 6225
TELEPHONE (097) 344 599
FAX (097) 344 142

REGIONAL MINING ENGINEER
HEDLAND PLACE (BOX 518)
KARRATHA WESTERN AUSTRALIA 6714
TELEPHONE (091) 868 243
FAX (091) 868 251

Mining Registration Division

MINING REGISTRATION DIVISION
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FAX (09) 222 3452
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Regional Offices

MINING REGISTRAR
COURT HOUSE (BOX 28)
BROOME WESTERN AUSTRALIA 6725
TELEPHONE (091) 921 137
FAX (091) 921 878

MINING REGISTRAR
BOHEMIA ROAD (BOX 7)
MARBLE BAR WESTERN AUSTRALIA 6760
TELEPHONE (091) 761 044
FAX (091) 761 048

MINING REGISTRAR
COURT HOUSE (BOX 35)
CARNARVON WESTERN AUSTRALIA 6701
TELEPHONE (099) 411 082
FAX (099) 412 779

MINING REGISTRAR
MAIN STREET (BOX 7)
MEEKATHARRA WESTERN AUSTRALIA 6642
TELEPHONE (099) 811 008
FAX (099) 811 482

MINING REGISTRAR
40 BAYLEY STREET (BOX 41)
COOLGARDIE WESTERN AUSTRALIA 6429
TELEPHONE (090) 266 066
FAX (090) 266 204

MINING REGISTRAR
RICHARDSON STREET (BOX 13)
MT MAGNET WESTERN AUSTRALIA 6638
TELEPHONE (099) 634 040
FAX (099) 634 488

MINING REGISTRAR
BROOKMAN STREET (BOX 364)
KALGOORLIE WESTERN AUSTRALIA 6430
TELEPHONE (090) 213 066
FAX (090) 912 428

MINING REGISTRAR
PRINCEP STREET
NORSEMAN WESTERN AUSTRALIA 6443
TELEPHONE (090) 391 082
FAX (090) 391 657

MINING REGISTRAR
COURT HOUSE (BOX 917)
KUNUNURRA WESTERN AUSTRALIA 6743
TELEPHONE (091) 681 011
FAX (091) 681 103

MINING REGISTRAR
GREAT EASTERN HIGHWAY
SOUTHERN CROSS WESTERN AUSTRALIA 6426
TELEPHONE (090) 491 107
FAX (090) 491 431

MINING REGISTRAR
ROCHESTER STREET (BOX 4)
LEONORA WESTERN AUSTRALIA 6438
TELEPHONE (090) 376 106
FAX (090) 376 248

Petroleum Division

PETROLEUM DIVISION
3RD FLOOR MINERAL HOUSE SOUTH
100 PLAIN STREET (CNR ADELAIDE TCE)
EAST PERTH WESTERN AUSTRALIA 6004
TELEPHONE (09) 222 3333
FAX (09) 222 3515
TELEX AA95791 MINEWA

Royalties And Policy Development Division

ROYALTIES AND POLICY DEVELOPMENT DIVISION
10TH FLOOR MINERAL HOUSE NORTH
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Surveys And Mapping Division

SURVEYS AND MAPPING DIVISION
2ND FLOOR MINERAL HOUSE NORTH
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ANNUAL REVIEW
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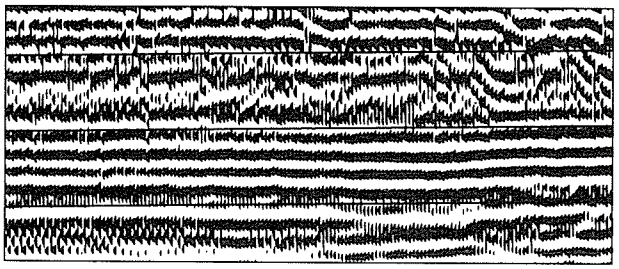
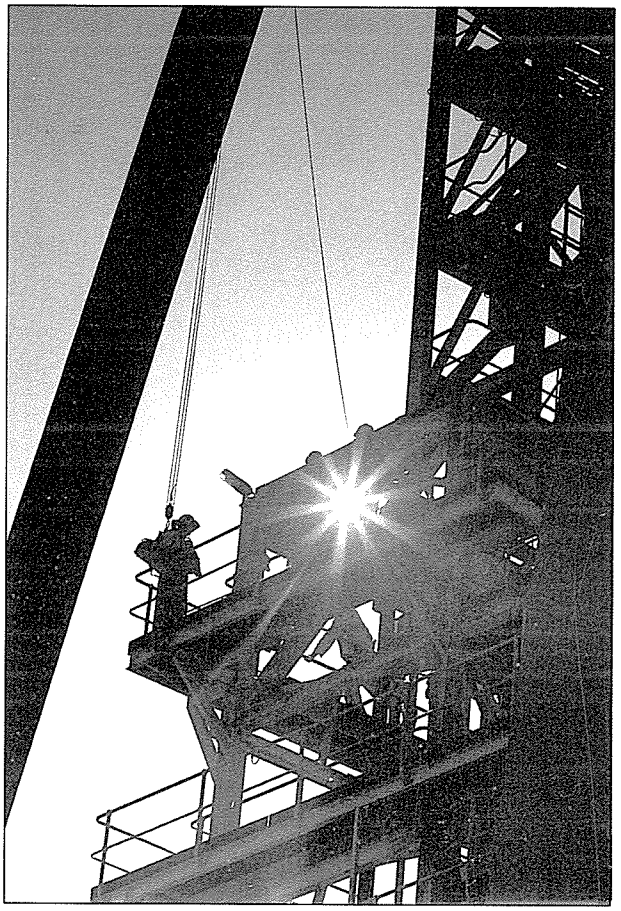
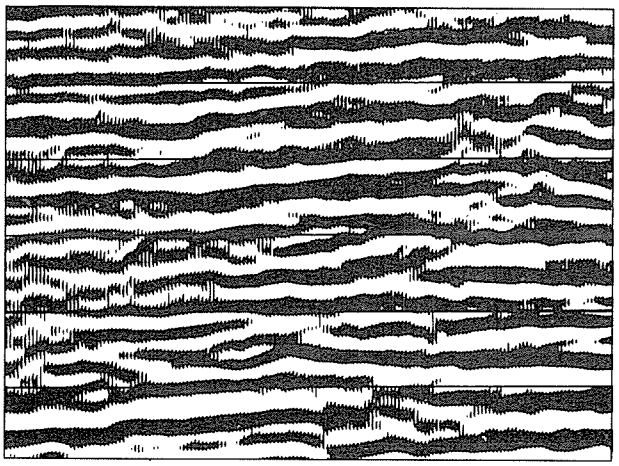
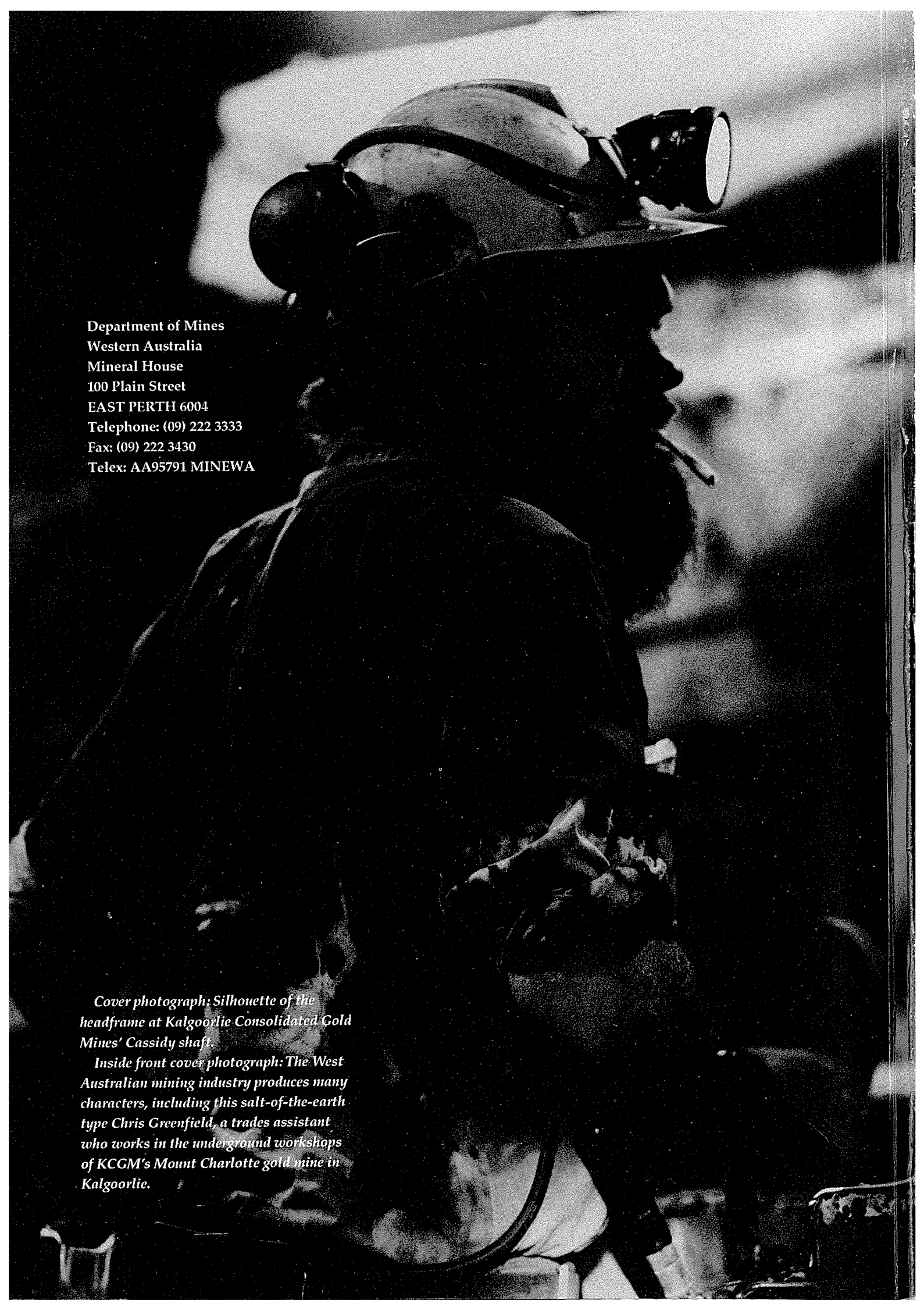






DEPARTMENT
OF MINES
Western Australia



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Cover photograph: Silhouette of the headframe at Kalgoorlie Consolidated Gold Mines' Cassidy shaft.

Inside front cover photograph: The West Australian mining industry produces many characters, including this salt-of-the-earth type Chris Greenfield, a trades assistant who works in the underground workshops of KCGM's Mount Charlotte gold mine in Kalgoorlie.

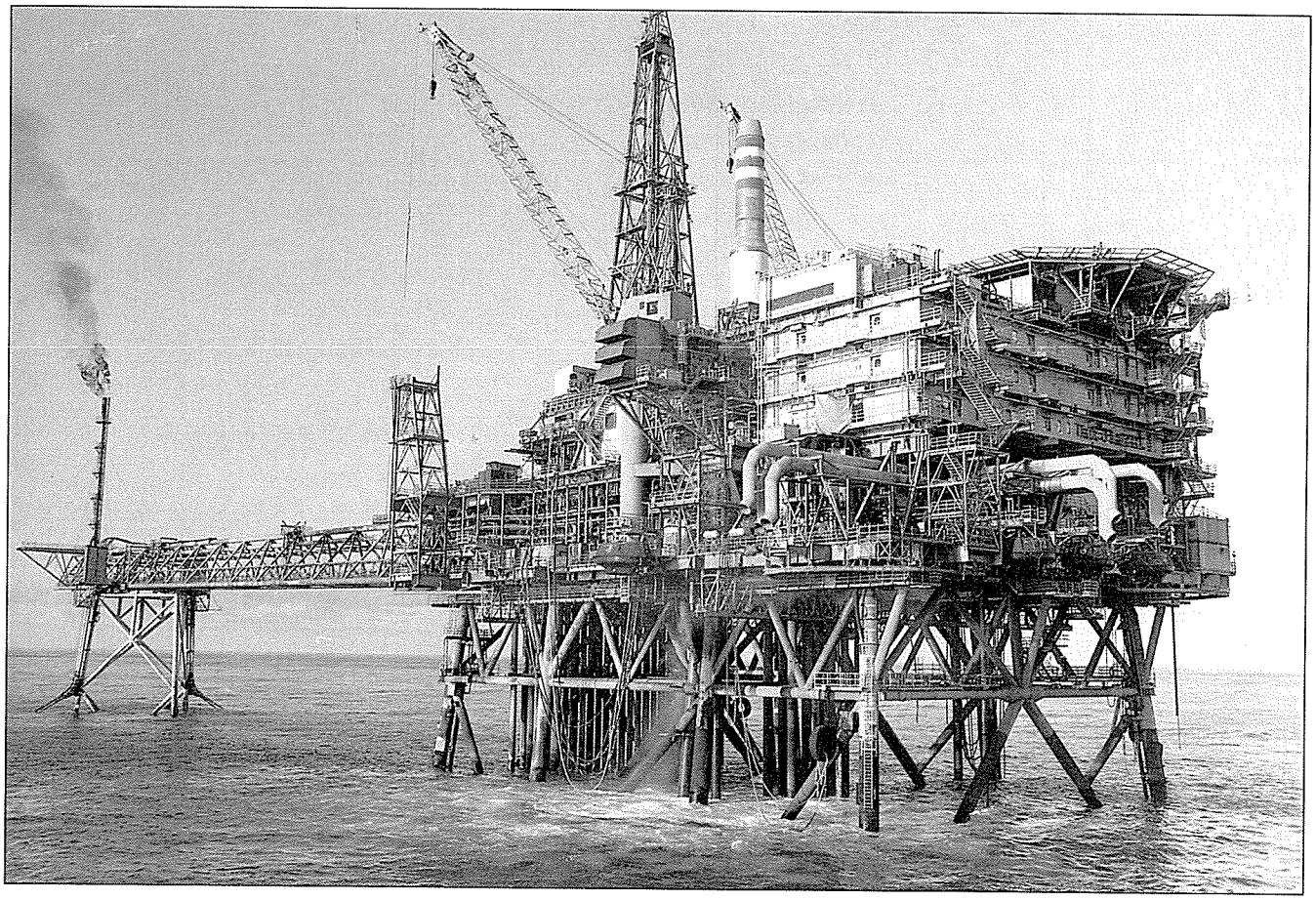
WELCOME

Welcome to the Department of Mines' 1989-90 Annual Review.

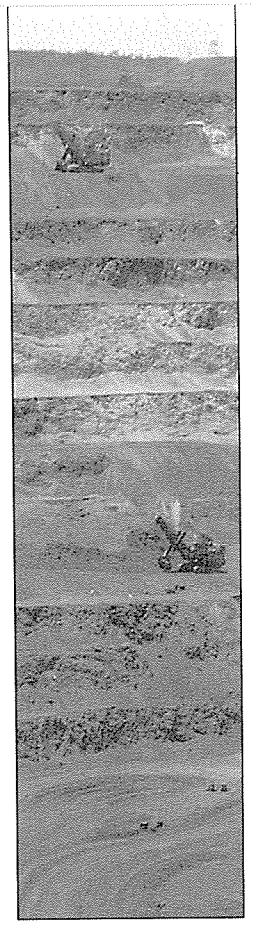
Over many years information in this publication was contained in the Department's Annual Report.

A separate Annual Report was produced and tabled in State Parliament in November 1990. It was designed specifically to meet the Department's statutory obligations as a public service organisation.

By contrast, the Annual Review is designed to appeal to a wider readership. As well as covering the Department's activities and objectives, the review provides a comprehensive outline of industry and community activities which are relevant to the Department's operations.



Woodside Offshore Petroleum's North Rankin A gas production platform — the biggest of its type in Australia.



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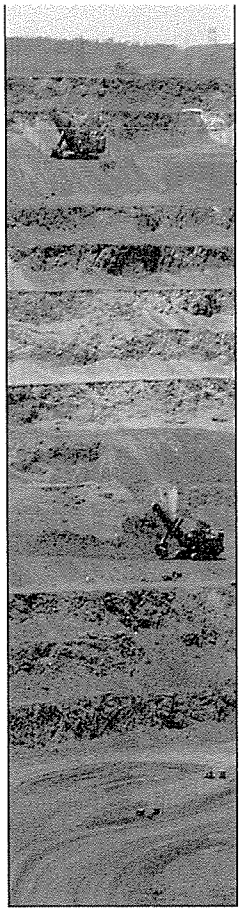


PROFILE

The Department of Mines was established in Western Australia on 1 January 1894 to see that the State's mineral resources were assessed, developed and utilised in a safe, economic and orderly manner.

Not much has changed in that area. However, the role of the Department has since been expanded to include petroleum exploration and development, the State Chemistry Centre, plus functions relating to the assessment of underground water resources and the handling of explosives and dangerous goods in the State.

To carry out these responsibilities the Department employs nearly 800 people and operates on a budget of $45 million.

Its workforce includes geoscientists, mining and petroleum engineers, cartographers, chemists, metallurgists, economists, clerical officers and others who ensure that the duties of the Department are carried out in an efficient and professional manner.

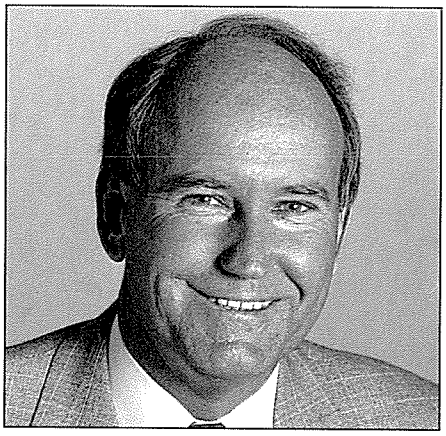
Royalties and rents plus administrative charges collected by the Department from mineral and petroleum activity in W.A. during 1989-90 yielded approximately $319 million.

The Department administers 17 Acts of Parliament, (see Appendix 1), the principal ones being the Mining Act, the Mines Regulations Act and the Petroleum Act.

Through the authority of these Acts, the Department oversees an industry which directly employed more than 33 000 people and achieved production valued at $10 438 million during the 1989-90 financial year.

Two of the friendly staff at the Department of Mines' Kalgoorlie office are District Inspector of Mines Kris Biegaj and receptionist Dawn King.

MINISTER'S FOREWORD



It has been another record year for mineral and petroleum production in Western Australia.

As Minister for Mines this gives me particular pleasure but, more importantly, it is a landmark result for this State's dynamic and all-important resources sector.

Industry can take great pride in the fact that during the year under review we saw a huge jump in value of production, from just under $8 000 million to over $10 000 million.

These figures are significant enough but, when one also considers that the mineral and petroleum industries now provide over 60 per cent of the State's export revenue and 15 per cent of overall State Government revenue, the results are all the more noteworthy.

Not so long ago, it was said that Western Australia "rode on the sheep's back". Today, it would be more appropriate to say that we ride in a Haulpak.

We must, however, be mindful of the impact that changes in international markets can have upon the future success of these industries.

This means that, as a State, we must diversify our industrial and manufacturing base to cushion us from the effects of dramatic price and demand fluctuations. And we must do all we can to add value to what we take from the ground, before we export.

Future growth and prosperity - the creation of jobs and the achievement of a truly balanced economy - will depend heavily upon the "value-added factor".

The Government is also mindful of the need to balance industrial growth with the necessity to protect, in perpetuity, Western Australia's unique natural environment.

We must ensure that our children have jobs when they leave school, but no one of us would wish them to inherit a landscape scarred, disfigured and perhaps even rendered sterile by the effect of industrial activity.

Together we must make wise decisions today to ensure that the legacy we leave future generations will not unduly constrain their options.

As an industry, a community and a State we must confront and debate these issues with a breadth of vision, sensitivity, and judgment - whether they be issues of land access, industrial health and safety, or environmental custodianship.

Finally, I commend this, my Department's 1989-90 Annual Review, to your attention.

I trust you find the following pages of interest and practical use, and wish you, the reader, a successful year ahead.

Jeff Carr, JP, MLA.
MINISTER FOR MINES.

DIRECTOR GENERAL OF MINES' REPORT

The continued prosperity of the mining and petroleum industries is vital to both the State and the nation.

This was never more evident than in early 1990 when, contrary to expectations, Australia's value of gross domestic production actually grew in the first three months.

This unexpected result can be firmly attributed to mining: particularly the boom in gold, iron ore and coal, combined with the commencement of liquefied natural gas exports from the giant North West Shelf Project.

The continuing strength of the Western Australian mining and petroleum sector and its contribution to the national economy will come as no surprise to most West Australians. During 1989-90 the industries enjoyed another record year.

The total value of production, estimated at $10 438 million, was $2 479 million up on 1988-89, an increase of 31%. Export performance was equally impressive, providing over 60% of the State's exports.

The vast revenue from these industries not only profits companies' shareholders but also provides benefits to the community through direct and indirect employment, regional development and payments to government. The mining and petroleum sector is now contributing approximately 15% of State raised revenue.

Two commodities which had a very significant impact on the WA economy in 1989-90 were gold and petroleum.

Gold remains the largest single commodity in terms of value of production, number of operating mines and employment. Gold production continued to break records, partially due to companies fast tracking mining to minimise the impact of the forthcoming gold tax.

Rapid expansion in the gold sector over recent years saw the recruitment of inexperienced personnel and a dilution of experienced supervision across this section of the industry. The result was an increase in accidents and, following a spate of fatalities in underground mines, the Minister for Mines instigated a formal inquiry chaired by the State Mining Engineer.

The Committee included representatives from industry, unions and an independent safety specialist. The Inquiry's report made a range of recommendations, the most critical being the need for improved education and training of all new employees.

In the future, changes in goldmining practise due to increased underground mining and the working out of open pit mines will require an increased emphasis on safety and more specialist mining inspectors. The Department has found it difficult to recruit mining engineers with the necessary experience but hopefully the incentives introduced in 1990 will facilitate future recruitment.

The Department has already partly met this challenge by increasing the size of the Inspectorate and improving its efficiency. In the case of open cut mines, an intense education program was initiated in June 1990 in response to a high incidence of pitwall failures. The goal is to improve open pit

design and promote rapid introduction of site-specific pitwall monitoring.

The high level of mining activity generally has generated an increased volume of company information on exploration which is placing pressure on the Geological Survey of Western Australia's ability to process and ensure access to this information. During the year, 3 160 mineral and 496 petroleum reports were received. Despite the additional workload the Geological Survey was able to complete "Memoir 3", a major reference book on the geology of the State.

To improve access and utilisation of company exploration reports, considerable resources are being devoted to develop a computerised geoscientific database.

A variety of other computer systems is also under development to improve the Department's operations and provide an improved service to industry. These include new systems and expanded databases in the petroleum exploration, mining tenement, mine site and mine safety areas. Some 25 000 on-line transactions are now being handled daily by the computing network which has been expanded to all regional offices. Thirteen centres are now on-line ranging from Collie to Kununurra.

Mapping is another area of the Department where computerisation is having a significant effect. A Geographic Information System pilot study, conducted by the Surveys and Mapping Division in co-operation with the Geological Survey Division demonstrated the capacity of the system to resolve complex geological and land use planning issues. A computer aided design system was acquired to provide for the digital generation of diagrams and figures.

Petroleum production expanded dramatically during the year, more than doubling the value of sales achieved in the previous financial year. Projections indicate it is set to become the State's most valuable primary product. The most significant event in the sector during the year was the commencement of liquefied natural gas shipments from the North West Shelf Project.

During the year the Department continued to provide a diverse range of management, monitoring and consultancy services concerned with protection and rehabilitation of the environment.

The environmental impact of all proposals for mining and petroleum exploration or development are assessed and appropriate environmental management conditions are enforced by the Department's inspectors. Plans are in hand to increase the number of inspectors and to extend their powers. The Department works closely with the Environmental Protection Authority in producing stringent development guidelines and ensuring mutually accepted evaluation procedures.

A working party was convened to examine conservation and rehabilitation in the quarry industry. The Working Party report was released for public comment in May 1990. The Department is hopeful that adoption of the recommendations will improve current quarrying rehabilitation practices.

The Chemistry Centre provided a wide range of analytical and advisory services covering all areas of environmental policy

including public health, safety and pollution. To help improve the Chemistry Centre's operations, a complete review of charging policies was undertaken and Treasury approval for a new fee structure obtained. This involved the development of a new cost accounting framework to establish appropriate hourly charge rates. Standard costings were reviewed for a wide range of services and this has resulted in a significant move towards full cost recovery.

During the year the transport, storage, and use of dangerous goods and explosives came under increased public scrutiny. Revised procedures were introduced covering the implosion of buildings and a temporary ban was placed on the aerial use of fireworks while safety guidelines were revised by the Explosives and Dangerous Goods Division . Inspection services monitoring the transport and storage of dangerous goods were increased and a number of projects commenced covering regional public health and safety issues.

During the year the Department was responsible for the collection of $357 million dollars in revenue (including royalties collected on behalf of the Commonwealth). This was an increase of $112 million or 46% over the preceding year, reflecting buoyant conditions in the resources industries. On the expenditure side, total payments made by, or administered by, the Department for the year amounted to $44.85 million. The net increase in payments from the previous year, excluding some extraordinary items, represented a very small rise of 3% in the Department's major operating expenditure account. This is a very creditable result given the increase in activities in the Department's area of responsibility, and a general rise in costs.

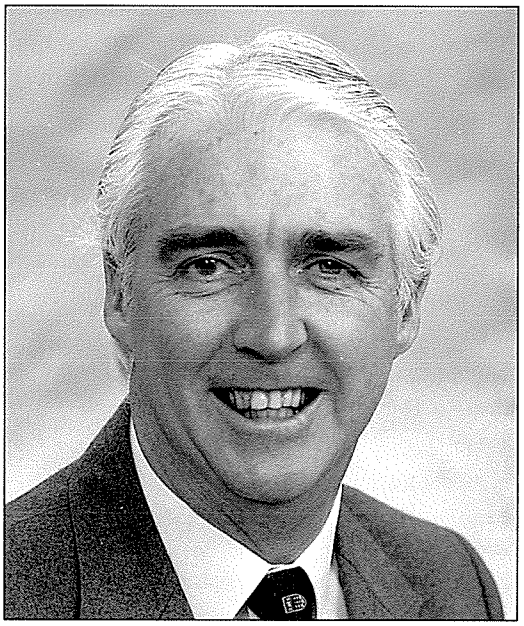
To ensure that staff and financial resources are allocated efficiently the Department completed a three year Corporate Plan and commenced the implementation of Program Management. Integration of the corporate planning and budgeting processes will help to ensure that all resources are allocated to most effectively achieve the Department's objectives.

Faced by reductions in government funding, a buoyant mining sector, and increased pressures in the areas of safety and environmental management, the Department faces a challenging year ahead. I am confident that staff will meet this challenge and continue to provide a high level of professional advice and management . The Department's commitment to training and effective recruitment will help in this regard. Such a commitment is necessary to maintain our standard of excellence and to replace experienced staff who are likely to retire in the next few years. In this regard, the Department bade farewell in June 1990 to Jim Blake, Assistant Director General, who retired from the Department after 40 years of loyal service. His expertise will be sorely missed.

Finally, to improve industry and the public's understanding of the role and functions of the Department, a Communications Branch was established in February 1990. This group is now working on a wide range of projects, all of which are aimed at providing a better flow of information to those interested in the Department's activities.

The Annual Review is an example of the effort being made to provide this better flow of information. The Review is designed to provide an annual report in a style which is easily read and informative. The feature articles included in the section on divisional activities highlight the Department's wide range of responsibilities and the very professional way in which these responsibilities are being tackled.

The Department looks forward to the next year with confidence, certain in the knowledge that it will be able to consolidate the good work that has been performed during the year under review.



D R Kelly
DIRECTOR GENERAL OF MINES

RESPONSIBILITIES AND OBJECTIVES

BACKGROUND

The Department was established on 1 January 1894 as the regulatory body to ensure the safe and orderly development of mineral resources in Western Australia, and to allow the Government and the community to benefit from these activities.

The Geological Survey, which had been founded six years earlier, was incorporated with the Department of Mines, closely followed by the establishment of a system of State gold batteries.

In 1902, the Government Analyst's Laboratory was transferred to the Department, thus creating a new role in the provision of services to the mining industry.

While the major role of the Department continues to be the management of mineral and petroleum exploration and development, the expertise needed to carry this out has led to the logical development of other functions. Hence, the Government Analyst's Laboratory has become the Chemistry Centre (WA) which now provides scientific services in the fields of agriculture, forensic science, materials and health chemistry. The expertise needed to ensure worker health and safety on mine sites and petroleum projects has also led to a wider role in community safety, involving the storage and transport of explosives and dangerous goods.

Thus, the Department now has a range of responsibilities which are spelt out in more detail in the following sections on Role and Broad Objectives. The achievement of these objectives is affected by the environment in which the Department operates and the broad parameters of this environment are outlined in the section on Corporate Environment.

CORPORATE ENVIRONMENT

The Government recognises the importance of the minerals and energy sectors to the economy of the State, and therefore has a policy of encouraging investment in exploration, extraction and utilisation of these resources. Long-term development for the benefit of all West Australians is important with an orderly and balanced exploitation.

Achievement of these policies is affected by the relationships that exist between the Department, the Government, the community, the natural environment and the mining and petroleum industries. These relationships, relevant to the mining and petroleum sectors, are summarised as follows:

Every-day Western Australians —

The State's mining wealth belongs to these people and during 1989-90 the Department of Mines collected more than $319 million in royalties, rents and other charges on their behalf.

ROLE

The role of the Department of Mines is to ensure that the community of Western Australia:

- receives maximum benefit from the exploration for and development of minerals and petroleum;
- is protected from hazards associated with mining, petroleum activities, explosives and dangerous goods;
- has access to independent geoscientific, chemical and engineering consultancy services, and environmental advice relevant to the mining and petroleum industries, for the protection of community standards; and
- is assured that the human and financial resources of the Department are used efficiently and effectively in achieving its objectives.

BROAD OBJECTIVES

1. **To ensure that exploration and development of the State's mineral and petroleum resources are carried out in a fair manner.**

1.1 Provide an equitable system for giving secure exploration and development titles.

1.2 Minimise potential for disputes, but facilitate their prompt settlement when they arise.

2. **To foster mineral, petroleum and groundwater exploration and development, and assist long range planning and decision making by Government.**

2.1 Continually improve and update knowledge relating to the occurrence of mineral, petroleum, and groundwater resources and the geology of the State.

2.2 Make available adequate mineralogical, metallurgical and water analytical services and carry out research in these areas.

2.3 Disseminate geoscientific data from exploration and related activities in a timely and efficient manner.

2.4 Ensure that effective geotechnical, hydrogeological, and mining engineering advice is available as required.

2.5 Maintain a favourable climate for mineral and petroleum exploration and development.

3. **To ensure that the community receives a fair return from the exploitation of the State's mineral and petroleum resources; and that proper attention is given to the environment.**

3.1 See the community benefits from the activities of the mining and petroleum industries.

3.2 Ensure protection and rehabilitation of the environment as it may be affected by mineral and petroleum development.

4. **To ensure that all operations in the mining and petroleum industries and activities involving explosives and dangerous goods are conducted in a manner that is safe for workers and the public.**

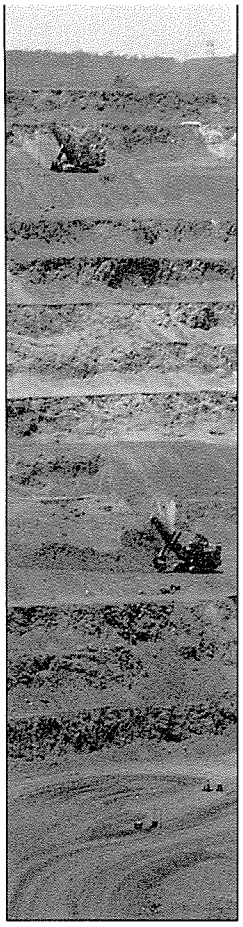
4.1 Improve the safety and health of workers in the mineral and petroleum industries.

4.2 Minimise hazards to the public from activities involving explosives and dangerous goods.

5. **To ensure that the community has access to independent chemical research and consultancy services.**

5.1 Meet the community's need for applied chemical research in the most effective and efficient manner.

5.2 Ensure that the community's need for independent chemical consultancy services is met in the most effective and efficient manner.



THE ORGANISATION

The Department is structured into nine divisions, each largely representing a grouping of professionals specialising in a particular area.

The divisions work together to achieve the five corporate objectives, with all divisions having some input into at least two broad objectives. The relationship between the 13 specific objectives and the divisions is a complex one.

A summary of the work and role of each division follows on pages 14 and 15. A more detailed report on their activities is included in subsequent chapters of this review.

The Geological Survey of Western Australia systematically records and interprets the geology of the State and provides this information to Government, industry and the general public in order to assist the exploration, development and conservation of the State's mineral, petroleum and groundwater resources. It evaluates mineral and petroleum resources as a basis for decision making by Government and assists and advises on a variety of community needs, including urban planning, land-use matters, and engineering developments.

The Petroleum Division facilitates the undertaking by industry of geophysical and drilling programs for the identification and development of oil and gas accumulations. It ensures that sound engineering principles and standards are applied to system design and plant assembly in production facilities and ensures accurate product measurement for royalty calculations. It also maintains an effective title allocation and registration system, monitors and advises on State and Commonwealth legislative amendments, and advises on matters requiring interpretation and application of legislation.

The Chemistry Centre (WA) provides chemical, metallurgical and mineralogical consultancy and analytical services to Government instrumentalities, private industry and the general public. It assists in mineral processing, soil and fertiliser analysis, agricultural trials, water quality assessment, food nutritional quality evaluation, forensic science, environmental monitoring, chemical aspects of occupational and physical environments, materials testing; and undertakes research and development in all these areas.

The Royalties and Policy Development Division develops mineral and petroleum royalty systems which are fair and equitable and administers the collection and audit of royalties paid on behalf of the State and Commonwealth. It also provides economic advice on mining and petroleum industry issues, collects and disseminates statistics and assists in the development and co-ordination of general departmental policies. The division informs staff, industry and the public about the role of the Department and the importance of the mining and petroleum industry.

The Corporate Development Division provides administrative services for the Department. These services include the management of the Department's human resource, finance, computing, corporate planning, auditing, typing and records activities.

The Mining Engineering Division administers mine safety legislation aiming to

safeguard and promote the health and safety of those working in the industry. It provides advice to the Government and to industry on mining engineering matters, including deep mining, open-cut mining, quarrying, drilling, the environment, and rehabilitation. It carries out exploratory drilling and provides associated services for the Department and other Government orgnisations.

The Explosives and Dangerous Goods Division reviews, formulates and administers laws, regulations and policies aimed at the safe manufacture, storage, handling and transport of explosives and dangerous goods; and provides safety advice on these matters and major hazard control.

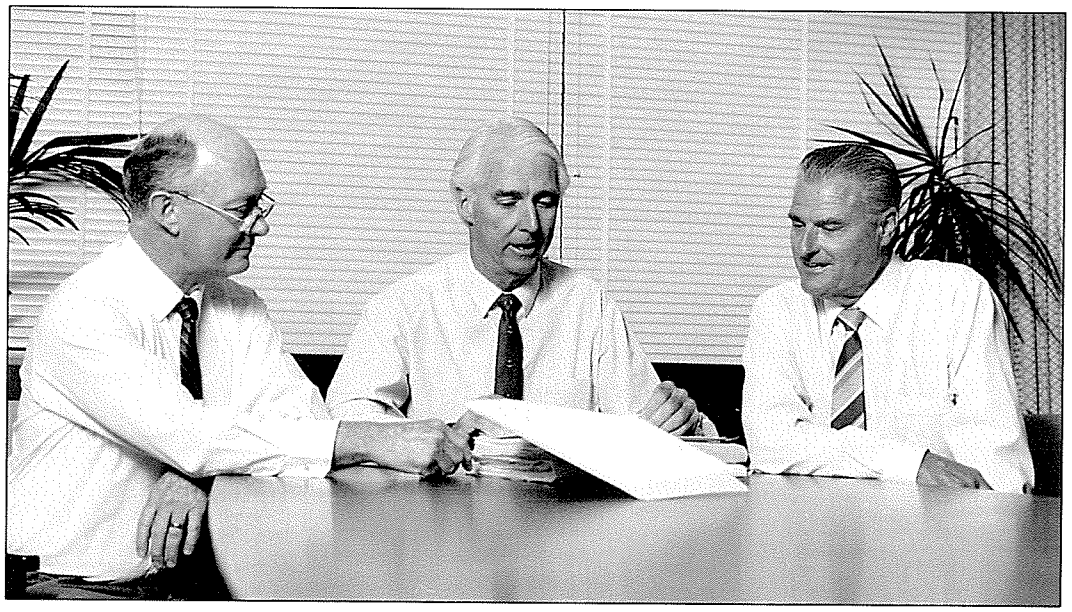
The Mining Registration Division receives applications and allocates titles that give legal rights to explore for and mine minerals in Western Australia pursuant to the Mining Act. It maintains a mining tenement registry which records tenement holders, conditions and term of the grant, and expenditure details from which the division monitors compliance with the provisions of the Act.

The Surveys and Mapping Division determines and documents the boundaries of tenements and produces and updates all maps and plans necessary for the operations of the Department. All functions from primary field survey to final map production are embraced. The range of cartographic activities includes charting, field surveying, computations, drafting, reprographics, maintenance of archival map products, and advice to the public as an integral part of the tenement management process.

The officers of the Department are mostly located in Perth, with some members of the Geological Survey, Mining Engineering, Chemistry Centre, Explosives and Dangerous Goods, and Mining Registration divisions situated in regional centres.

In addition to providing services for land based operations, the Department is also required to administer State and Commonwealth legislation covering offshore oil and gas exploration, exploitation, pipeline transportation; and royalty payments.

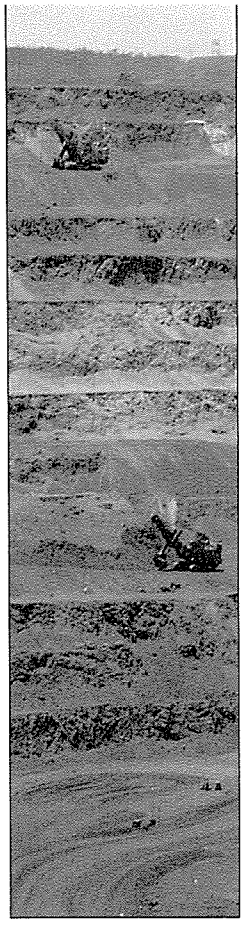
A Department directory and organisation chart are included in Appendix 8.



The Director General of Mines, Dr Des Kelly (centre), with the two Deputy Directors General, Dr ColinBranch (left) and Mr Jim Blake.

OBJECTIVES BROAD	SPECIFIC	GEOLOGICAL SURVEY	MINING ENGINEERING	PETROLEUM
1. To ensure that exploration and development of the State's mineral and petroleum resources are carried out in a fair manner.	1.1 Provide an equitable system for giving secure exploration and development titles.	Provide technical advice in relation to administration of Petroleum and Mining Acts.		Award, maintain and monitor rights to explore and develop petroleum.
	1.2 Minimise potential for disputes, but facilitate their prompt settlement when they arise.	Technical advice on tenement matters.	Technical advice on tenement matters.	Process dealings, assess fees and advise on legislation.
2. To foster mineral, petroleum and groundwater exploration and development, and assist long range planning and decision making by Government.	2.1 Continually improve and update knowledge relating to the occurrence of mineral, petroleum, and groundwater resources and the geology of the State.	Obtain, interpret and evaluate data on all aspects of geoscience and earth based resources (mapping, data collation, evaluation).	Perform exploratory drilling and wireline surveys and associated work.	Petroleum exploration and geology (collate data, production of databases).
	2.2 Make available adequate mineralogical, metalurgical and water analytical services and carry out research in these areas.	Petrological and geochemical studies.		Petroleum engineering and geology (evaluate proposals and study fields and basins).
	2.3 Disseminate geoscientific data from exploration and related activities in a timely and efficient manner.	Publish information and maintain databases (maps, reports).		
	2.4 Ensure that effective geotechnical, hydrogeological, and mining engineering advice is available as required.	Provide geotechnical advice and prepare special maps.	Ensure that effective mining engineering advice is available as required.	Assess discoveries.
	2.5 Maintain a favourable climate for mineral and petroleum exploration and development.	Inform and advise Minister.		Advise Government and liaise with Industry.
3. To ensure that the community receives a fair return from the exploitation of the State's mineral and petroleum resources and that proper attention is given to the environment.	3.1 See the community benefits from the activities of the mining and petroleum industries.	Provide geotechnical advice to assist Royalty determination.	Field checks to assist with royalty determination and collection.	Assist Royalties and Policy Development Division in product measurement.
	3.2 Ensure protection and rehabilitation of the environment affected by mineral and petroleum development.	Review and advise on mining/ extraction proposals.	Ensure protection and rehabilitation of the environment as it may be affected by mineral development.	Environmental monitoring.
4. To ensure that all operations in the mining and petroleum industries and activities involving explosives and dangerous goods are conducted in a manner that is safe for workers and the public.	4.1 Improve the safety and health of workers in the mineral and petroleum industries.		Ensure compliance with the Act and Regulations by regular inspections and advice in metalliferous and coal mines (inspect, advise, test, sample, train).	Engineering surveillance and safety inspections.
	4.2 Minimise hazards to the public from activities involving explosives and dangerous goods.			
5. To ensure that the community has access to independent chemical research and consultancy services.	5.1 Meet the community's need for applied chemical research in the most effective and efficient manner.			
	5.2 Meet the community's need for independent chemical consultancy services.			

CHEMISTRY CENTRE W.A.	EXPLOSIVES/ DANGEROUS GOODS	MINING REGISTRATION	SURVEYS/ MAPPING	ROYALTIES AND POLICY DEVELOPMENT
		Award, maintain and monitor rights to explore and mine minerals.	Provide and maintain maps depicting all mining and petroleum tenure and other land tenure, provide public searching facilities; record and certify position and other land tenure status of tenements; and manage surveying operations to establish tenement boundaries.	
		Operate Warden's Court and process Ministerial Appeals. Monitor effectiveness of legislation.	Provide a means of resolving conflict arising in respect to tenement boundaries, positions or markings.	
Provide an analytical and advisory service on minerals.		Monitor performance of tenement holders in the submission of geoscientific reports.	Provide supporting geographical information systems.	
Conduct research in mineral processing.				
		Record and publish tenement data for industry.	Provide a cartographic and map preparation facility.	
Provide a hydrological analytical service.			Provide a cartographic and map preparation facility.	
		Liaise with Industry.		Inform Government and community.
				Collection of royalties and statistics.
Inspect, test and advise on environmentally sensitive areas.		Issue and monitor titles with due regard to protection and rehabilitation of the environment.	Provide a graphical record.	
Inspect, test and advise on occupational health matters in the mining industry.	Ensure that dangerous goods are transported in a manner that provides maximum protection to the environment.		Provide a repository for information concerning plans of mines and minesites.	
Inspect, test and advise on aspects of dangerous goods handling, storage and transport.	Provide a high level of assurance of public safety at places where explosives and dangerous goods are manufactured, stored or transported.			
Support agricultural research and regulatory programs; support law enforcement by scientific investigation; and solve problems relating to consumers, the environment and chemical industry.				
Support agricultural research and regulatory programs; support law enforcement by scientific investigation; and solve technical problems relating to consumers, the environment, and chemical industry.				



MINING AND PETROLEUM INDUSTRY REVIEW 1989-90

WESTERN AUSTRALIA

In 1989-90 the Western Australian mining and petroleum industry again enjoyed exceptional growth that reinforced its position as the premier industry in this State.

The total value of mining and petroleum production for the financial year is estimated at $10 438 million, an increase of $2 479 million (31%) on the previous financial year.

The petroleum sector was the most significant contributor to this increase, while gold, alumina and iron ore all recorded substantial rises in both quantity produced and value.

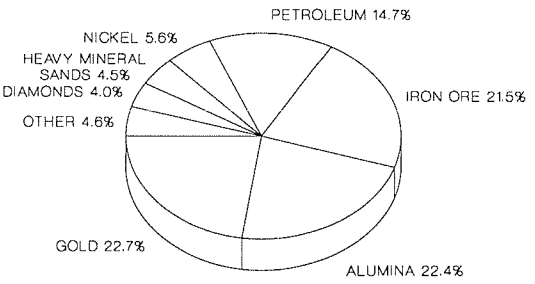
Western Australian production is now dominated by these four major sectors which in total contribute over 80% of the value of the industry.

Mineral exploration activity was less buoyant, largely reflecting lower activity in the gold sector. Expenditure fell to $311 million or less than 3.5% of revenue; and was down 20% on the previous year. On the other hand, petroleum exploration, boosted by remarkably high discovery rates, showed a sharp reversal from the declining expenditure trend experienced throughout the latter half of the 1980s.

THE INTERNATIONAL CONTEXT

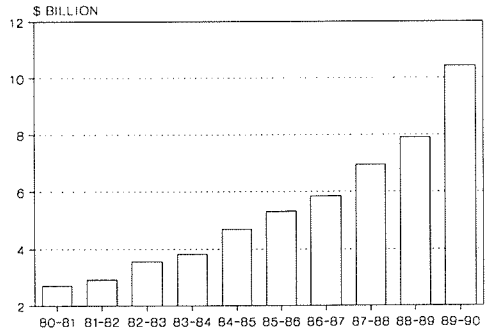
Although industrial growth in the world's major economies was somewhat slower in 1989-90 than for the previous year it was still healthy at an estimated 3%. Particularly important for Western Australia, with its dependence on exports, was the continued strength of overseas private non-residential

1989-90 VALUE OF
MINERAL & PETROLEUM PRODUCTION
TOTAL : $10,437 MILLION (est)



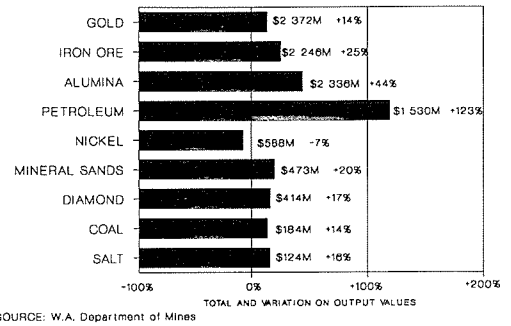
SOURCE: W.A. Department of Mines

VALUE OF MINERAL PRODUCTION IN W.A.



SOURCE: W.A. Department of Mines

CHANGE IN VALUE OF PRODUCTION
1989-90 (MAJOR SECTORS)



SOURCE: W.A. Department of Mines

fixed investment. This sector is one of the main areas generating demand for the primary mineral and energy products such as iron ore, alumina, oil and gas, nickel and mineral sands which are the State's prime exports.

Australia's internal economic conditions are also extremely important to trading relations as they set the financial climate within which producers have to operate. A principal concern remains high domestic interest rates which are having a doubly depressing effect on international competitiveness. The high rates have kept the Australian dollar artificially high, therefore substantially reducing the incomes of producers which generally have their prices nominated in United States dollars. The second effect is to increase the cost of borrowings which lowers local producers' competitiveness relative to their overseas rivals. It is a credit to the industry that, despite these impediments and Australia's higher inflation rate, the overall health of the industry has remained good.

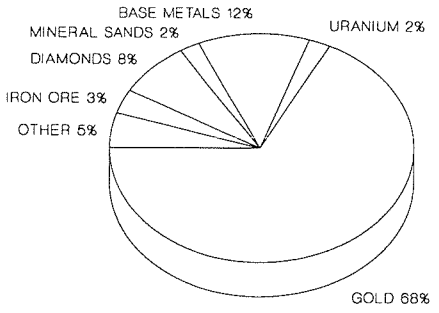
However, signs are already apparent of a slowdown in demand for some commodities, whilst predictions are being made of a further sharp decline in world economic growth. This points to a much more difficult period in 1990-91 but the solid and diverse base of the Western Australian industry could cushion the State, in an overall context, from the most severe effects.

The following sections analyse the major commodities produced in the State and review the main operations.

GOLD

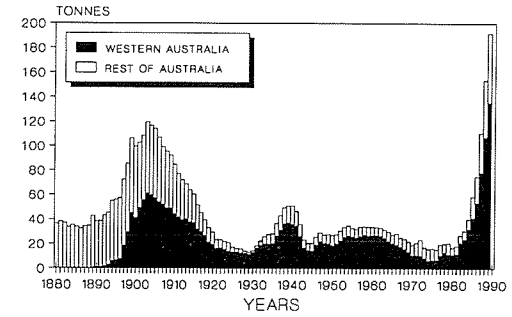
Gold production in 1989-90 showed a further strong rise to yet another record level of an

MINERAL EXPLORATION EXPENDITURE
1989-90



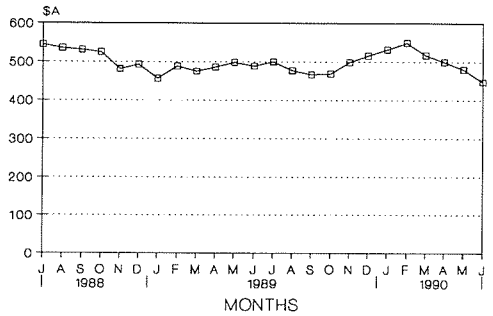
SOURCE: A.B.S. Private Mineral Exploration Expenditure

GOLD PRODUCTION



SOURCES:DEPT OF MINES WESTERN AUSTRALIA, BMR & ABARE

GOLD PRICES: $A/oz.



SOURCE: LONDON GOLD PRICE, MONTHLY AVERAGE OF WEDNESDAY PRICES.

estimated 148 tonnes, an 18 tonne increase (14%) over 1988-89. The price of gold varied throughout the period but was, on average lower, and this resulted in a reduced percentage increase in the value of gold production. Despite this, the value of gold production also achieved a record high at $2 372 million, up $299 million (14%) on 1988-89, maintaining its position in value terms as the principal mineral produced in Western Australia.

Major factors contributing to the strong performance of the gold sector were the continuing high level of activity from the operations established in the days of a booming gold price and the bringing forward of production in anticipation of the introduction of a company tax on gold from January 1991. On the negative side was a lack of investment capital for the sector through a depressed stock market which, in turn, has been reacting to the lower gold price and the diminishing role of the speculator in the gold industry. These conditions have led to a decline in exploration effort. In three years, exploration expenditure on gold has fallen from $361 million, to $271 million and now to $211 million in 1989-90. However, this level still captures some 68% of the State's total mineral exploration dollars.

Since the October 1987 stock exchange crash, there has been a progressive and considerable change in the structure of the gold industry. Gold floats have been few and far between. A number of the 'junior' explorers and small developers have disappeared. Many of those still operating are finding that financing new development projects often requires the participation of larger companies. This, together with a number of takeovers, has resulted in an integration of operations and exploration efforts at many of the major gold mining centres. The gold 'miners' have responded to the declining economic climate by developing a more efficient industry structure.

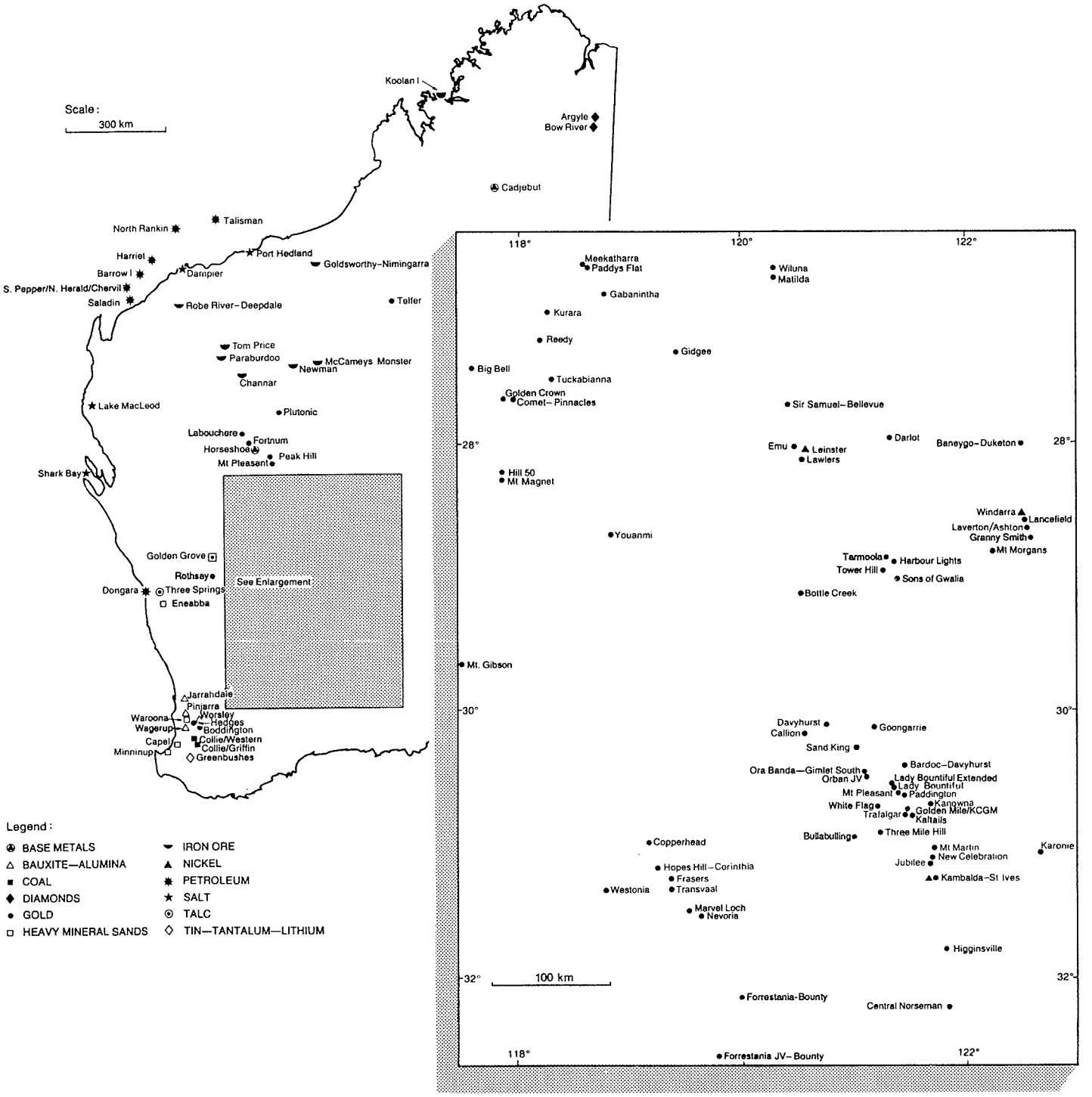
However, this only covers part of the restructuring picture. The physical nature of the industry is also undergoing change. A large number of the multitude of mines which started up in the early-to-mid-1980s were developed on relatively small reserves of low-grade, but cheaply won open cut ore. The reserves have been, or are now being, exhausted and the companies have adopted three different routes. The first is to close down and sell off the plant. The second, and most common, is to draw on 'satellite' orebodies held by themselves or by other mining companies within an acceptable sphere of influence, thus contributing to the concentrated, central plant structure now typifying the industry. The third has been a move to underground development with the higher costs and risks that this entails. At the levels of plant output established from the bulk open cut operations, many of the underground scales, and hence costs, of development are prohibitive to the smaller companies.

Whilst a number of small gold exploration successes are still being recorded, many of these are being developed to maintain feedstock to existing plants. As a result, the number of stand-alone projects has reduced dramatically over the last eighteen months. The major new developments over this period

Gold production reached a record level of 148 tonnes during 1989-90. The Boddington gold mine, south of Perth, was a major producer. The Department of Mines was instrumental in identifying the potential for base and precious metal mineralisation in the Boddington area — currently Australia's biggest gold production centre. Pictured here Boddington Gold Mines' gold recovery supervisor Geoff Carroll.

MAJOR MINERAL AND PETROLEUM PROJECTS IN WA

... those with an annual production value exceeding $10 million



are Granny Smith, Tarmoola/King of the Hills, Three Mile Hill, Higginsville, Bounty-Forrestania JV, Bullabulling, Rothsay, Labouchere, Fortnum and Plutonic. Together they represent a capital investment of $275 million. These developments are discussed further in the operations review in Appendix 3.

The majority of gold mining activity is concentrated in the Eastern Goldfields, Yilgarn and Murchison provinces; the three historical centres of production. However, it is the 'isolated' centres of Boddington, in the South West, and Telfer, to the east of the Pilbara, that are among the larger producers in the State.

The State's biggest producer is now Kalgoorlie Consolidated Gold Mines Ltd's combined operations on the Golden Mile. This company was formed early in 1989 from an amalgamation of four previous producers, all significant in their own right. Combined gold output in 1989-90 was 15 523 kg. Boddington at 13 467 kg was second largest, with Telfer 8 551 kg third, followed by WMC's Kambalda gold operation and Alcoa's Hedges project. There are a number of 2 000 to 5 000 kg pa producers, plus many more exceeding the 1 000 kg pa level (i.e $16 million revenue per year). A review of these operations on a regional basis is given in Appendix 3.

A rapid expansion and accelerated production from open cut mines has resulted in a high incidence of pitwall failures with increased depths. This is being given a high priority in terms of the Department's safety effort. Another problem, brought on by these high levels of activity, has been the high accident rate, especially in the underground sector. However, important measures have been instituted with commendable industry co-operation to curb this problem.

ALUMINA

Alumina has displaced iron ore as Western Australia's second most important mineral in value terms. Its 1989-90 value of $2 336 million fell just short of gold after a huge $717 million (44%) increase over the preceding year. The prime reason for the increase was the strong alumina price flowing on from the increases in aluminium metal prices of previous years.

In response to strong demand, production also increased by about 8% to reach 6.7 million tonnes. Incremental increases in design capacities have taken place at **Pinjarra, Wagerup** and **Worsley** and each of these refineries has been producing at these new capacity levels. Only the **Kwinana** refinery has been slightly down on capacity due to unusual equipment failures. The strong performance has encouraged the Worsley joint venture to make plans to upgrade the capacity at its plant by a further 25% and at a cost of $105 million. However, at the financial year end Alcoa's plans for a further $300 million expansion of its Wagerup refinery were being re-examined.

Although market prices for aluminium declined through the year, the annual average was still the highest on record. The normal delay in response between aluminium and alumina prices could point to a weakening of the alumina price during the 1990-91 year. On the other hand there was a levelling out in price towards year end and alumina supply and demand were in close balance despite high refinery output levels around the world.

In June 1990 Alcoa of Australia Ltd was honoured by the United Nations for 20 years of progress in environmental management and rehabilitation of its bauxite mining in the Darling Range. This was in the form of a listing on the Global 500 Roll of Honour conferred by the United Nations Environment Program. Alcoa is the first Australian company to make this 'Roll' and the only mining company in the world to be formally recognised for this work.

During the year an announcement was made that the recently installed gallium by-product extraction plant at the Pinjarra alumina refinery would be closed down due to a fall in the world demand for gallium metal and a marked decline in price.

IRON ORE

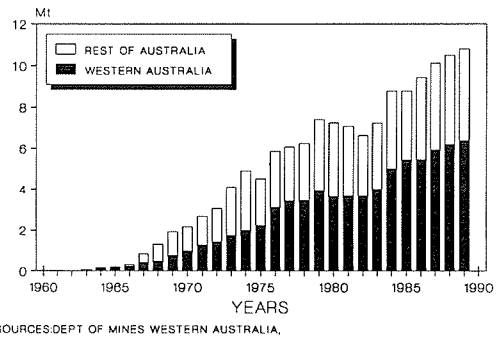
Despite strong growth in demand for iron ore, the third year of price rises and consequent record value of production, iron ore slipped in ranking to be the third most valuable mineral produced in Western Australia.

The strong growth in demand in Australia's iron ore markets in Japan and East Asia helped raise the tonnage of shipments by 6% to 106 Mt. The price rises of the 1989-90 iron ore year were followed by a further 16% average price rise effective from April 1990, the third successive negotiated annual increase, which combined to lift the value of production to a new record of $2 246 million. This represented an increase of $456 million (25%) over the value for the previous year.

Record shipments have left stockpiles low and created an incentive to develop new deposits. In recent years there has been strong demand for high grade lump ore and consequently a number of small scree ore deposits were developed as a supplement to the major production units of Mt Newman Mining Ltd and Hamersley Iron Pty Ltd. Others are at an advanced planning stage. Disruptions in world supplies from some key localities at the same time, has currently created a strong demand for fine ore.

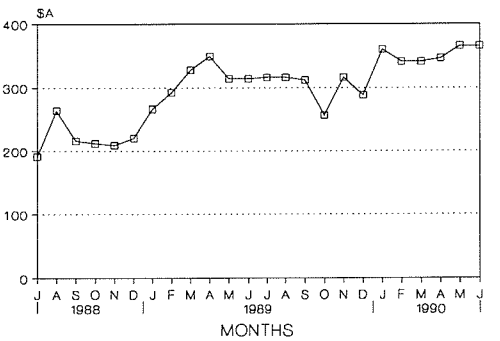
The overall sustained world iron ore demand is encouraging for the development of

ALUMINA PRODUCTION



SOURCES:DEPT OF MINES WESTERN AUSTRALIA, BMR & ABARE.

ALUMINA PRICES: $A/tonne



SOURCE: DERIVED FROM L.M.E. & A.B.S.

deposits such as the large reserves at **Marillana Creek**. BHP-Utah Iron Ore, the developers of the deposit, have recently shipped a large bulk sample of the ore for evaluation in steel mills in Japan. Development is subject to completion of sales arrangements and an agreement being concluded with the Government of Western Australia. Production is scheduled to start in 1992 at a rate up to 5 Mt pa. The ore will provide a pisolitic fines product of similar characteristics to the Robe River product. A new 32 km rail spur will be constructed linking Marillana Creek to the existing Newman to Port Hedland rail line. Existing Newman facilities at Port Hedland are likely to handle the production.

During 1989-90, the operations of **Goldsworthy** Mining Ltd crushed and railed ore at an annual rate of 7.25 Mt. Commissioning of the beneficiation plant at Finucane Island was completed at the beginning of 1989-90, and the plant operated at the design annual rate of 3.0 Mt throughout this year. Enough ore reserves are available in the Nimingarra, Shay Gap, Sunrise Hill and adjacent areas to maintain shipments at current levels for a further 16 years.

The BHP-Utah Iron Ore group assumed full control of the Goldsworthy joint venture during the year with the buying out of the shareholding of its majority partner, the Hanson group. The company has subsequently moved to rationalise its iron ore holdings, with 15% ownership of both Goldsworthy and Marillana Creek being offered to its Japanese partners in the Newman Joint Venture. This will standardise all operations controlled by BHP-Utah to the Mt Newman Joint Venture ownership structure and simplify administratively any joint developments and infrastructure utilisation.

The potential for development of the very large Goldsworthy Mining Area C deposits has increased with BHP-Utah taking control. Infrastructure options requiring the use of the Mt Newman railway and proposed Marillana Creek spur line improve the accessibility of these deposits.

At **Mt Newman Mining** Co's Mt Whaleback mine, ore production was severely disrupted following a slip of the south limits wall in the east pit. No personnel were injured or equipment damaged. As a result, ore production for the year was significantly lower than originally planned. A major additional waste stripping operation is underway to ensure long term access to the ore at depth. It is reported that some 100 Mt of material will be moved this year to provide less than 20 Mt of product.

Following the installation of a modified primary crusher and full operation of the permanent plant at Newman's Orebody 29, the mine recorded a significant increase in production. This has allowed the implementation of the first stand-alone Marra Mamba ore shipments from the State; a contract having being made with the Japanese Nippon Kokan group (NKK). Small quantities of Marra Mamba continued to be added to the Newman fines blend.

Extensions to the spur-lines to both Orebody 25 and Hancock Mining Ltd's **McCamey's Monster** (Ferrogully deposit) were completed

to allow increased handling capacity. Both of these scree ore developments doubled their outputs to supply a combined lump ore supplement to Mt Whaleback of nearly 5 Mt in approximately equal proportion.

At Nelson Point (Port Hedland), major structural repairs to the ore wharf were carried out. Some plant throughput problems were experienced at the port facilities during the early part of the year due to high rates of Marra Mamba type ore and beneficiated material in the product railed from the mine.

At the operations of **Robe River** Iron Associates, new production records were created for ore mined, railed and shipped. Over 23 Mt of ore was produced and nearly 22 Mt shipped, from a mine which has up to recently been rated at 19.8 Mt pa capacity.

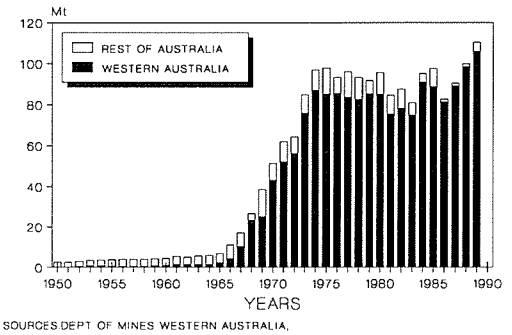
Most of the ore production is now being sourced from the Deepdale 'K' deposit, with remnant operations at the Middle Robe River mesas. A drilling and ore reserve assessment program for Deepdale 'J' deposit commenced in August 1989 to prepare this deposit for the next major development.

At the Cape Lambert plant and port operation, considerable work was carried out on stockpile and conveyor extensions, which allowed for a significant increase in the capacity of No 2 stockpile. A further $26 million program has been announced to double stockpiling areas over the next two years, while the ongoing resleepering and locomotive replacement program is designed to establish Robe River's higher capacity output.

At **Hamersley** Iron Pty Ltd's operations, continued strong market demand for iron ore saw sales increase to a record annual rate of 45.8 Mt. To meet this demand, Hamersley increased its production by some 17% to 43.5 Mt pa. Production comes from Tom Price and nearby Southern Plains Detritals, Paraburdoo and Channar.

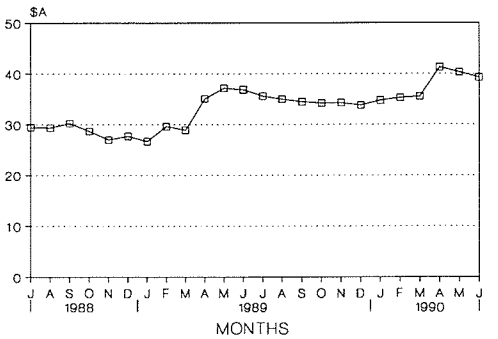
At Tom Price, the purchase of additional loading equipment assisted with achieving higher production targets. In the Tom Price concentrator, output was increased by approximately 20%.

IRON ORE PRODUCTION



SOURCES:DEPT OF MINES WESTERN AUSTRALIA, BMR & ABARE

IRON ORE PRICES: $A/tonne



SOURCE: HIGH GRADE LUMP ORE PRICES.

The Channar operation, approximately 20 km east of Paraburdoo, commenced production in January 1990. Eventual production from this mine will be 10 Mt pa. The mining techniques are similar to those utilised at Paraburdoo with equipment selected to cope with the problems of mining a number of relatively small separate orebodies. In total those collectively amount to a proven in-situ reserve of some 280 Mt at 63% Fe. A 20 km conveying system transports ore from Channar to the Paraburdoo product screening plant.

Hamersley Iron and other subsidiaries of its parent, CRA Ltd, have been evaluating a number of prospects to supplement production further. Development proposals for a scree ore operation at the **Brockman No 2 - Nammuldi** deposit are at an advanced stage, whilst bulk testing is planned for **Koodaideri** and **Yandicoogina**. Planning for the longer term development of **Marandoo**, possibly as the main replacement of Tom Price, is also underway.

At Hamersley's Dampier port operations, ore stocks were reduced from 7.2 Mt to 3.8 Mt. The East Intercourse Island stockpiles were extended.

Operations at BHP-Utah Iron Ore's **Koolan Island** mine saw a record total material movement of some 13 Mt to provide shipments of 3.5 Mt. The overall shipping grade dropped from 66.5 to 65.5% Fe, with consequent increases in silica and alumina.

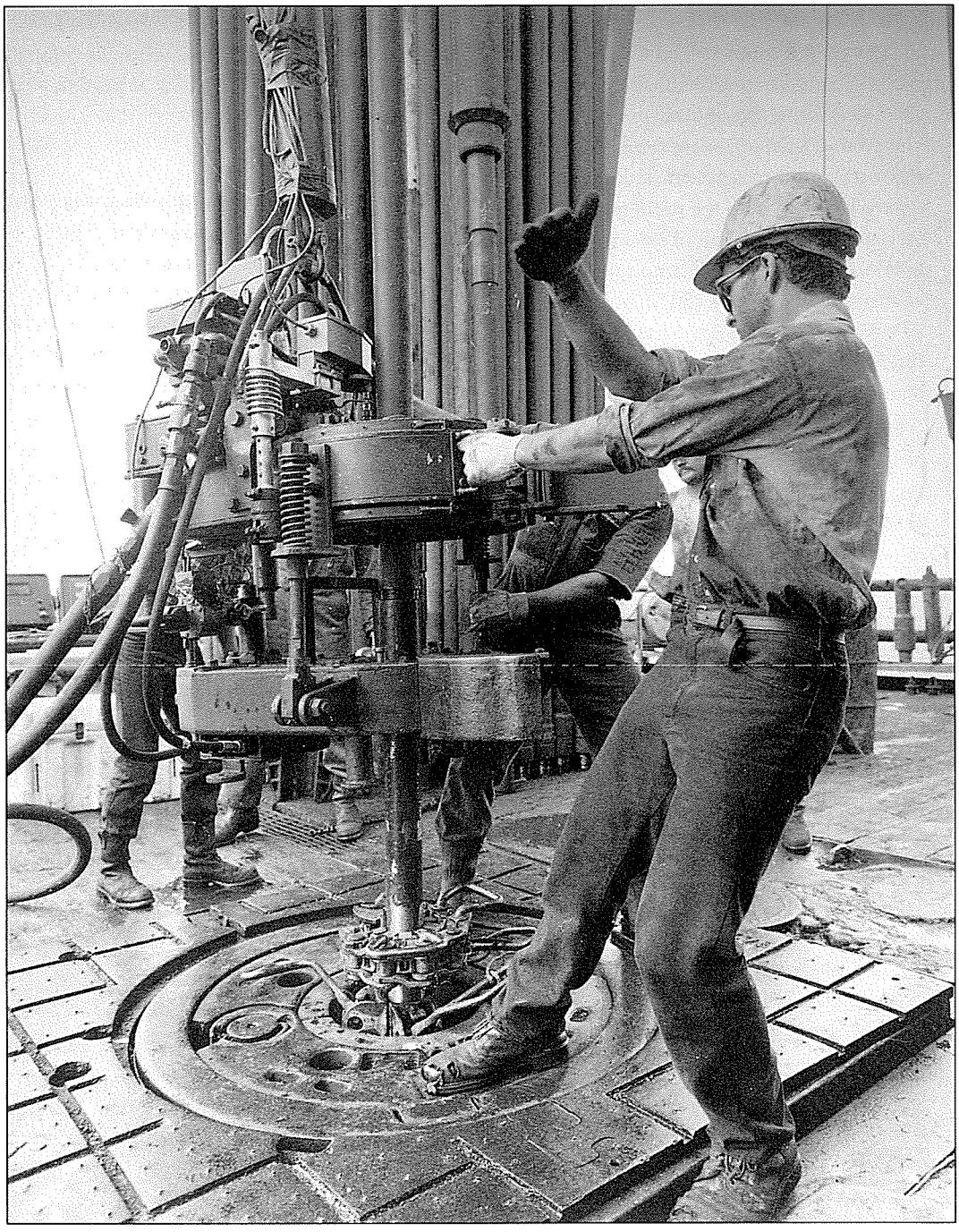
Pre-stripping of the Mullet orebody, the last mineable orebody on Koolan, commenced in 1989. It is expected that ore production from this source will commence in September/October 1990. Currently it is expected that, with the depletion of exploitable reserves, all mining will cease at Koolan Island by mid-1993.

PETROLEUM

Petroleum is the fastest growing sector of the Western Australian minerals industry. During the financial year the value of production more than doubled with the commencement of liquefied natural gas (LNG) exports. World oil prices, which drive the prices for the whole petroleum sector, were higher on average than in the previous year. This enhanced the returns to producers and, in combination with large rises in production, led to spectacular increases in the values of all petroleum products being seen in the year.

Production for each of oil, gas and condensate reached peak levels. Oil production rose by 80% over the previous year to be almost 4.0 million kilolitres. In value terms the rise was 123% to over $600 million for the year. At 1.6 million kilolitres of condensate per annum, the rise in production was 39% and in value 66%. Natural gas production for sale was more or less constant (3% rise), but much of the production was converted to LNG with exports commencing in July 1989. The value of LNG shipments amounted to $336 million for the year and is expected to double in 1990-91 to exceed $600 million. When the North West Shelf project reaches full capacity in 1995, export values from this project should be in the region of $1 500 million per annum.

In January 1982 only four fields, Barrow Island, Dongara, Mondarra and Yardarino,



A number of exciting oil and gas discoveries were made off the Western Australian coast during 1989-90, among them Woodside Offshore Petroleum's Wanaea oil find, about 140 km north of Karratha. Here a crew is hard at work on the drill floor of the semi-submersible drilling rig "Margie" during production testing of the Wanaea discovery.

were producing. By December 1984 this had increased to nine fields with the addition of North Rankin, Woodada, Mt Horner, Blina and Sundown. By June 1990 there were 17 producing fields in Western Australia. These increases are expected to continue well into the 1990s with the Goodwyn development currently underway and from a spectacularly high number of successes over the last three years. New discoveries have been made at Echo, Wanaea, Cossack, Griffin, Chinook, Sinbad, Yammaderry, Cowle, Roller, Scindian and Yodel in the offshore Carnarvon Basin and North Yardanogo and Beharra Springs in the onshore Perth Basin. Other fields with potential for development, largely dependent on future markets, include Gorgon, West Tryal Rocks, Angel and possibly Petrel and Tern.

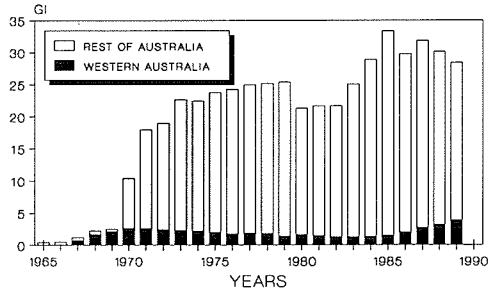
These recent discoveries which for a period in 1989 represented a success rate of 75% in the offshore Carnarvon Basin, have added impetus to the petroleum search. Since the peak drilling period between 1982 and 1985, petroleum exploration expenditure in Western Australia had slumped dramatically until this year. For 1990 APEA has forecast an exploration expenditure of between $240 and 295 million for the State, this being about 35% of the Australian total and in the order of four times higher than that of 1989. Up to 50 exploration wells have been projected for 1990; the highest number since 1985, and subsequent appraisal drilling has been undertaken on several of the discoveries listed above. Whilst the Carnarvon Basin remains the main focus of activity, with about 60% of total expenditure, a renewed impetus is being given to the Perth Basin, while the Bonaparte and Browse Basins maintain a share of the activity with the continuing effort in the Timor Sea.

Of the seven major sedimentary basins in Western Australia, five have known hydrocarbon reserves. However, to date production is limited to the northern Perth Basin, the offshore Carnarvon Basin and the northern margin of the onshore Canning Basin.

Carnarvon Basin

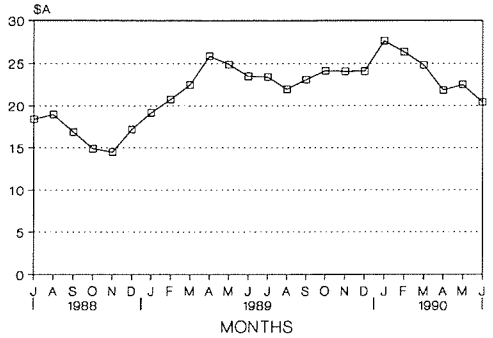
The North West Shelf area is, along with the Timor Sea, the area of greatest potential for petroleum development in Australia. The

CRUDE OIL PRODUCTION
(including CONDENSATE)



SOURCES:DEPT OF MINES WESTERN AUSTRALIA
BMR & ABARE

CRUDE OIL PRICES: $A/bbl



SOURCE: BRENT SPOT, MONTHLY AVERAGE.

recent successes are evidence of strength of the exploration effort in the area and the plans being finalised for development are an indication of the growing importance in terms of Australia's production. Linked to the dwindling oil reserves in Bass Strait, it has been estimated that new Western Australian developments could contribute about half of Australia's daily oil requirements by the mid-1990s; a level considerably above the present and historical contribution.

Producing from the main reservoir in the Upper Triassic Mungaroo Formation, the $12 billion **North West Shelf** partners produced from their North Rankin A and Burrup Peninsula facilities a total of 1.6 million kilolitres of condensate, 3.7 billion cubic metres of natural gas and 2.8 billion cubic metres of LNG in 1989-90.

The confidence of the participants in the project was further demonstrated by their decision during the year to proceed with the Goodwyn A platform. This will cost in the region of $1.6 billion and will include drilling, installation of a production platform and sub-sea pipeline link to North Rankin A. Production is scheduled for 1993 at a peak production rate of 13 million cubic metres of gas and 13 000 kilolitres of condensate per day. It follows the decision to commit over $900 million to the construction of the LNG train at the Burrup treatment facility. The participants are also looking at ways of coordinating development of a further two condensate-rich gas fields to the west of Goodwyn; Echo, discovered in 1988, and Yodel discovered in 1990.

The **Wanaea and Cossack** oil fields, located to the east of North Rankin and discovered by Woodside Petroleum in 1989 and 1990 respectively, could be extremely significant finds. For Wanaea reserves have been conservatively estimated at 100-200 million barrels (16-32 million kilolitres) and for nearby Cossack 50-100 million barrels (8-16 million kilolitres). The company is looking at a floating production unit (Jabiru/Talisman-type) for start up in 1992 at a production level of 3 200 kilolitres of oil per day.

To the east of these discoveries, Marathon Petroleum Australia Ltd's **Talisman** operation started production in July 1989. After the successful discovery in Talisman 1 in 1984, three extension wells failed to intersect the oil column and in 1988 a decision was made to develop the field as a one-well field using a floating production, storage and offloading facility (FPSO). This consists of a converted tanker held on station by a single buoy mooring. Oil is produced through a sub-sea wellhead and flows through flexible lines to on-board separation stabilisation and storage facilities. A quick release system allows the buoy and flowline to be released if the operation is threatened by a tropical cyclone. Modularised crude oil processing facilities are installed on the tanker deck. The tanker provides temporary storage for 57 000 kilolitres of oil. Production for 1989-90 was 542 930 kilolitres of oil.

West Australian Petroleum Ltd (WAPET) commenced production in November 1989 from its 1985 discovery **Saladin**, located 24 km north of Onslow. The $150 million project

entails three offshore platforms, eight sub-sea pipelines and production, storage and offloading facilities on Thevenard Island. The operation has produced at a peak rate of 9 500 kilolitres per day, which immediately puts it as the largest oil producer in the State. In 1989-90 production totalled 1 383 861 kilolitres.

Further discoveries to the west and southwest at Yammaderry (1988), Cowle (1989) and Roller (1990) are planned for further development, with Yammaderry and Cowle scheduled to commence in the first quarter 1991. A $30 million investment will involve two monopod platforms and four sub-sea pipelines linking to the Thevenard Island facilities and with a peak production rate of 5 000 kilolitres per day.

WAPET's **Barrow Island** operation has been relegated to number 2 oil producer in the State, with 815 341 kilolitres being produced in 1989-90. The field contains many reservoirs, however the major production is from the Windalia Sandstone.

The third of the small oilfields developed by Western Mining Corporation south of Barrow Island, the Chervil field, came into production in August 1989. The **South Pepper, North Herald and Chervil** fields have proven difficult to appraise since their discoveries in 1982 and 1983. The company has used innovative technology in their development. Chervil comprises a monopod platform and a mechanically jointed sub-sea pipeline. The oil is processed and stored through a central facility on Airlie Island. A combined output of 589 134 kilolitres of oil in 1989-90 made this operation the third largest for oil in the State.

The State's fourth largest oil producer, the **Harriet** field, located 20 km northeast of Barrow Island, was sold by the Bond Corporation group in January 1990 for $210 million to a consortium headed by Hadson Energy Ltd. The field produced 577 097 kilolitres of oil in 1989-90, being handled through the storage and shipping facilities on the Lowndal Islands (Varanus). The feasibility of gathering gas associated with oil production at Harriet and gas from the nearby Bambra, Campbell, Rosette and recently discovered Sinbad fields has been evaluated. A $90 million development is planned with production facilities located on Varanus Island and a 95 km pipeline will link these to SECWA's onshore gas compressor station No 1. Contingent upon a sales contract with SECWA, this development is planned to produce 1.4 million cubic metres of gas per day.

Further significant oil discoveries have been made 70 km to the northwest of Onslow by BHP Petroleum Ltd. The **Chinook** field discovered in 1989 could be very significant. This was followed up in 1990 with **Griffin**, a 100 million barrel (16 million kilolitres) field on preliminary estimates, and most recently **Scindian**.

A development feasibility study has been completed for the **Tubridgi** gas field, onshore and to the southwest of Onslow. Doral Resources NL plan to fast-track a $25 million, gas gathering and production facility, including an 87 km pipeline linking to SECWA's pipeline compressor station No. 2. Production has been scheduled for July 1991, but is contingent upon a sales contract with

SECWA. Output is planned at 25 terrajoules of gas per day.

Canning Basin

A small amount of oil production was recorded from the northern Canning Basin fields held by the Petroleum Securities group. Total production in 1989-90 was 21 738 kilolitres made up of 13 467 kilolitres from **Blina**, 3 620 kilolitres from **Sundown/West Terrace** and 4 650 kilolitres from **Lloyd**.

In October 1989 extended production tests commenced at the Oil Co of Australia Ltd's field at West Kora.

On the exploration scene, the momentum of 1987 and 1988 has not been sustained for the Canning Basin. Expenditure predictions for the Basin in 1990 are less than $10 million.

North Perth Basin

WAPET is a long-standing producer from the **Dongara, Mondarra and Yardarino** fields. At the end of June 1990 only the Dongara and Mondarra fields were producing from Early Triassic and Permian reservoirs. Total gas production was 139 million cubic metres for 1989-90, with very small quantities of oil and condensate recovered.

The **Woodada** field, near Eneabba, produced 86 million cubic metres of gas and 776 kilolitres of condensate in 1989-90. The field has had a number of difficulties with marketing since its start up in 1982, resulting in shutdown for a period in 1987. The field was producing from six wells on a rotational basis with production limited to 200 000 cubic metres per week until December 1989. Production rates have now been increased to meet a commitment to supply additional gas to SECWA for the next four years.

The production from Barrack Energy Ltd's **Mt Horner** oil field has increased significantly since the early production years of the mid-1980s. Output in 1989-90 was 30 481 kilolitres.

Barrack Energy is the most active petroleum explorer in the North Perth Basin and has indicated that it is carrying out an accelerated seismic and drilling programme to be completed by June 1991 at a cost of about $17 million. Its discovery of oil at **North Yardanogo** early in 1990, although small, is significant. Oil flowed to the surface for the first time in 24 years from a new-field, wildcat well in the Basin. A further discovery of gas at **Beharra Springs** was made earlier in the year.

NICKEL

The nickel price fell during 1989-90 causing the value of nickel production in Western Australia to decline by 10% to $586 million. Nickel production however rose by 25% to 47 830 tonnes of contained nickel emphasising, despite the lower prices, the strong demand for this metal. Western Mining Corporation's (WMC) decision to re-develop the Agnew operation at Leinster was the main contributor to this increase. An additional $16 million revenue is received from the by-products copper, cobalt, gold, platinum and palladium.

WMC operates all of the producing mines in the State, with centres of operations at Kambalda, Leinster and Windarra. At **Kambalda**, there was a reduction in output, mainly due to unforeseen delays in the

preparation of stopes, with particular ground condition problems at the Long and Foster mines. On the Widgiemooltha Dome, the Redross open cut was completed and another commenced at 132 N, while the Mt Edwards mine was reopened. In addition the company announced the potential of the Mariners shoot, with a proposed decline under Lake Zot. The Blair mine, 30 km north of Kambalda, was brought into production, whilst developments at Schmitz and Victor shoots were started to facilitate production in the future. In all, there are eleven mines in the Kambalda area.

The company's **Leinster** nickel operations recovered ore from open cut mining at Rocky's Reward and a new development at Perseverance. A decline was also commenced from the floor of the Rocky's Reward pit. Re-development work continued on the 1130 decline in the Perseverance underground mine.

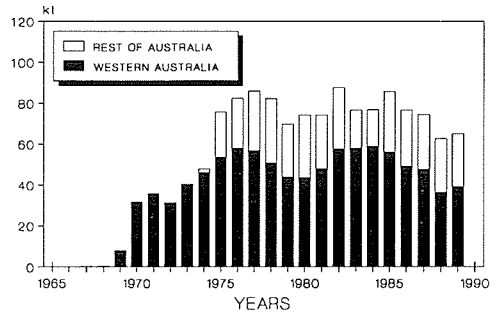
Production ceased at the **Mt Windara** mine near year end as a result of the depletion of exploitable reserves. Mining continued at South Windarra. Surplus plant capacity was utilized to treat some ore from Leinster.

The **Kalgoorlie Nickel Smelter** produced 66 600 t of matte for the year. Investigations continued into long term improvements of the flash furnace operations, with a $45 million rebuild envisaged and additional controls on sulphur dioxide emmissions. The **Kwinana Nickel Refinery** produced 24 130 t of contained nickel in all forms; levels well below capacity.

Towards the end of the financial year, WMC announced that it was carrying out a full review of its whole nickel division, as a result of declining competitiveness. The findings could result in a substantial injection of funds to upgrade all aspects of the operations. Alternatively the conclusion may lead to a curtailment in some of its processing activities.

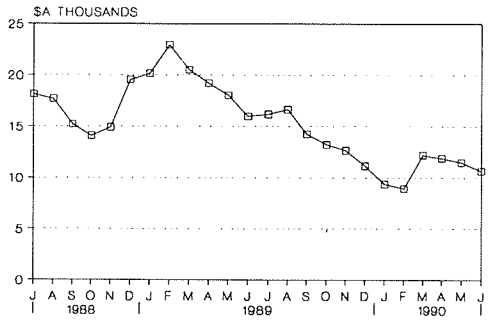
High nickel prices, still two to three times above the lows of 1987, have led to a significant increase in nickel exploration. A large proportion of the effort has involved a re-appraisal of prospects discovered during

NICKEL PRODUCTION



SOURCES:DEPT OF MINES WESTERN AUSTRALIA, BMR & ABARE

NICKEL PRICES: $A/tonne



SOURCE: L.M.E. CASH, MONTHLY AVERAGE.

the nickel boom in the late 1960s-early 1970s. Much of this effort is now coming to fruition with several projects either committed or mooted for development. Final feasibility studies have been undertaken on the **Mt Keith** deposit to be jointly developed by Australian Consolidated Minerals Ltd (ACM) and Outokumpu Oy of Finland. A $330 million development is planned to produce 26 000 t pa of contained nickel in high grade concentrates from 6.6 Mt pa of low grade (0.6% Ni) ore.

Delays, due to foreign ownership approval, have now been overcome to permit the nickel-copper development by Agip Pty Ltd to proceed at **Radio Hill** near Karratha. Tenders for development of an underground decline have been called and the project includes a conventional sulphide flotation plant and 15 tph smelter, using the Isasmelt process, to be built at the minesite.

Feasibility studies are also underway on the Dominion Mines Ltd/CRA's **Yakabindie-Six Mile** project, near Mt Keith; on the **Forrestania-Digger Rocks** project of Outokumpu Oy-Arimco Ltd; and on Defiance Mining's Carr Boyd Rocks. A small private development is underway on the **Spargoville 1A** deposit near Kambalda.

HEAVY MINERAL SANDS

Continuing high prices for mineral sand products have ensured that the sector maintains its strong growth of recent years. In total the value of mineral sands at $473 million in 1989-90 ranks it as the sixth most valuable sector in the State's mining industry.

Greater output if ilmenite, combined with a slight increase in the average price, raised the value of production by $23 million (33%) to $90 million. Synthetic rutile recorded a $36 million increase to reach $131 million for the year. This rise was a combination of a 25% increase in tonnages and a 10% rise in price. The value of rutile production went against the mineral sands trend by recording a fall of $4 million (6%) in value, principally due to an 18% fall in production. Zircon production rose in value by $23 million (15%) to reach $175 million despite a fall of 12% in quantity produced.

There was significant growth in the mineral sands sector during 1989-90. In addition to expansion at **Eneabba** with the development of the Eneabba West orebody, AMC Ltd is involved in a corresponding expansion of its dry plant and a second synthetic rutile plant at Narngulu.

Also in the northern Perth Basin, the **Tiwest joint venture** (previously the Cooljarloo project) commenced operations of its first stage, to produce concentrates, in March 1990. The construction of the second stage, which consists of a synthetic rutile plant at Muchea, is well advanced with completion due by the end of 1990. Construction of stage 3, the titanium dioxide pigment plant at Kwinana, has commenced and is due for completion early in 1991, to give the first fully integrated operation in the State from mine to pigment.

Westralian Sands Ltd, the largest ilmenite producer in the world, produced at a high capacity level at its Capel operations from minesites at Yoganup North (Boyanup), Yoganup Extended and North Capel. The company was considering the development of a second synthetic rutile plant.

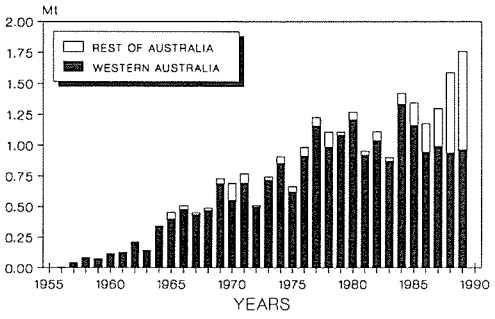
AMC Ltd has its second operation south of **Capel** and is proceeding in a southerly path to currently be operating in the Ludlow area. The company has embarked on the development of a major wetlands wildlife centre through the rehabilitation of its worked out pits near Capel.

At the end of 1989-90, **Cable Sands Ltd** was in the process of transferring from the Minninup Beach site to a new development at **Busselton East**. A highly successful and commendable rehabilitation exercise has been undertaken on the **Minninup** dunes. The company is also in the advanced stage of planning for its new mine at **Jangardup**. Final approvals for the commencement of the project were given, subject to the successful resolution of the problems associated with the transport of concentrate from the site, near the south coast, to Bunbury. The development also involves an expansion of the Bunbury plant.

Late in 1989, **Cable Sands Ltd** was put up for sale by tender, with the successful bidder being Nissho Iwai Corporation of Japan. In April 1990, another Japanese group, Ishihara Sangyo Kaisha, took full control of the recently developed Northern Metal's operation at **Waroona** and plant at **Picton**, near Bunbury.

Western Australia now produces about 30% of the world's ilmenite, 40% of the world's zircon and 50% of the world's monazite, as well as the majority of the world's synthetic rutile. The State's large resources of mineral sands, coupled with steadily increasing world demand, are expected to lead to further development during the 1990s. BHP's **Beenup** deposit, near Augusta, is a major example and is currently being reviewed from an economic and environmental viewpoint.

ILMENITE PRODUCTION



SOURCES:DEPT OF MINES WESTERN AUSTRALIA, BMR & ABARE

Apart from increased mining, there is considerable potential for additional processing, including production of synthetic rutile, titanium dioxide pigment, titanium tetrachloride, titanium metal, zirconia and zirconia products. During the year **SCM Chemicals Ltd** commenced production at its new chloride-route pigment plant at **Kemerton**. Its sulphate-based Australind plant will shortly be closed down. The change however has allowed it to expand its capacity.

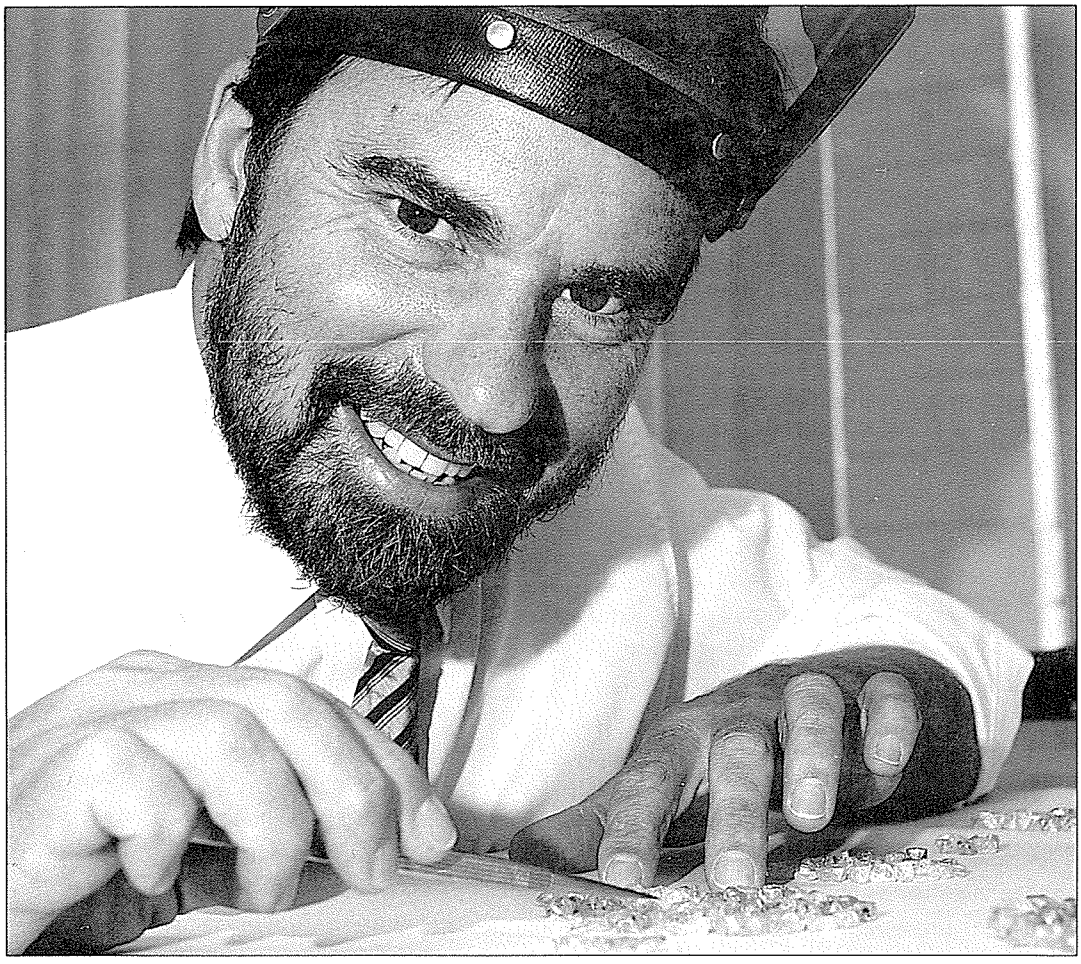
A recent doubling of expenditure on exploration reflects the boom in this industry since the mid-1980s; but the modest level of $7 million per year does not fully reflect this high-profile activity. This is a result of the relative cheapness of exploration, reappraisal of known mineralisation and significant restriction on access to many of the prospective areas. Tenement applications blanket the whole Swan Coastal Plain between Geraldton and Busselton as well as the Scott Coastal Plain and a number of other areas along the south coast. Significant results from this exploration effort are the recognition of

the prospectivity of the Scott Coastal Plain, a new environmental setting for economic mineralisation as delineated at Beenup and a growing potential of the Eocene shoreline for heavy mineral sands along the western boundary of the Eucla Basin.

Being predominantly located in the more sensitive South West and South Coast, the full potential for the heavy mineral sands will only be realised if developments proceed in a manner which is sensitive to the needs of the environment and local communities.

DIAMONDS

In 1989-90 diamond sales dropped marginally (by 7%) but the value rose to $414 million, up $59 million (17%). This was principally due to a sustained price rise in 1989 and an increase in quality through the supplementary exploitation of alluvial deposits at Argyle.



Department diamond valuer Michael Farrer checks the characteristics of Argyle diamonds. During 1989-90 the Department collected $27.2 million in diamond royalties, mostly from the operators of the Argyle mine in the far north of the State.

Overall, treatment at **Argyle** has built up to double the initial design capacity of 3 Mt pa, in order to maintain a constant diamond output of around 35 M carats a year. The diamond concentration in the pipe decreases with depth.

A detailed strategic study of the AK1 operation, including a deep drilling program within the mine, was undertaken with a view to determining the best long-term operating options. This major re-evaluation of the pipe has resulted in an increase in extractable reserves of about 60%.

Alluvial mining has now moved from the Limestone Creek to the Smoke Creek area, and material mined from this source is processed through the original alluvial treatment plant. A review of processing methods is being undertaken with a view to upgrading plant capacity and the use of a mobile screening plant at the mining face is being considered.

At Poseidon's **Bow River** operation the treatment plant achieved increased throughputs, lifting production to 365 tph. This resulted in an annual treatment of 2.8 M tonnes of diamondiferrous gravels compared to a forecast figure of 2.3 M tonnes for the year. Plant modifications were undertaken to achieve the production increase, and included the installation of a new deslimes screen with removal now of +18 and -1.5 mm fractions.

During 1989-90, Poseidon carried out an extensive exploration programme immediately south-southeast and southwest of the main deposits. Forty eight samples, between 100-500 tonnes, were treated through the pilot plant which was used for the original evaluation in 1985. The evaluation has led to an increase in both mining reserves and geological resources in proved and probable categories.

Demand for Bow River diamonds remained buoyant and a marketing agreement with the De Beers' Central Selling Organisation was negotiated in February 1990.

The strong diamond market and the good prices have resulted in a resurgence in exploration for diamonds. Currently the State is attracting an exploration expenditure of over $20 million per year; about 50% of the figure expended immediately after the Argyle discovery in the early 1980s.

Ellendale, the site of the first gem-quality diamond discoveries of the Ashton JV, has been a very active area for a number of joint venture partnerships, including reappraisal work by the Argyle partners.

Early in the year, a bulk sample was treated through the Posiedon Exploration and Triad Minerals NL plant at the **Mt Elizabeth** diamond prospect near the Gibb River Road in the central Kimberley region.

Other areas of interest have been the Bangemall Basin (SE of Newman), eastern Carnarvon Basin and more recently to the northeast of Kalgoorlie. No significant finds have been announced from these areas.

COAL

Coal production, from the two **Collie** producers Western Collieries Ltd and Griffin Coal Mining Co Ltd, rose by 360 000 (10%) to 4.16 M tonnes and value increased by $22 million (14%) to $184 million in 1989-90.

Construction of the new Chicken Creek rail spur, reclaim tunnel and associated loadout

facilities began in March 1990 and work is well advanced. The construction program also covers relocation of the Chicken Creek crushing station, screens and stackers and is scheduled for completion in July 1990.

Western Colleries is currently evaluating its Premier deposit, investigating several mining methods including bucket wheel excavators, trucks and shovel operations and conveyors. The mine is being planned for a 30-year life with tonnages building up to over 3 million tonnes per year by the end of the century.

During 1989, a project team was appointed at Western Collieries Ltd to carry out a feasibility study into the introduction of long-wall mining. The study is progressing well with results expected during 1990. Long-wall mining is regarded as a very safe and productive system of mining coal. A positive result can ensure a competitive future for underground coal.

The Harman Committee's report into consideration of and recommendations for the new, future, base-power supply for the State has brought the domestic energy sector into the limelight. Initially there is the coal versus natural gas debate, with the Committee recommending the latter; then there is the matter of the further development of Collie versus a new field and private power station at **Hill River** (Mt Leseuer) being promoted by a CRA and Barrack Mines consortium. At year end SECWA was assessing the options to place before Government its short list for preferred tenderers.

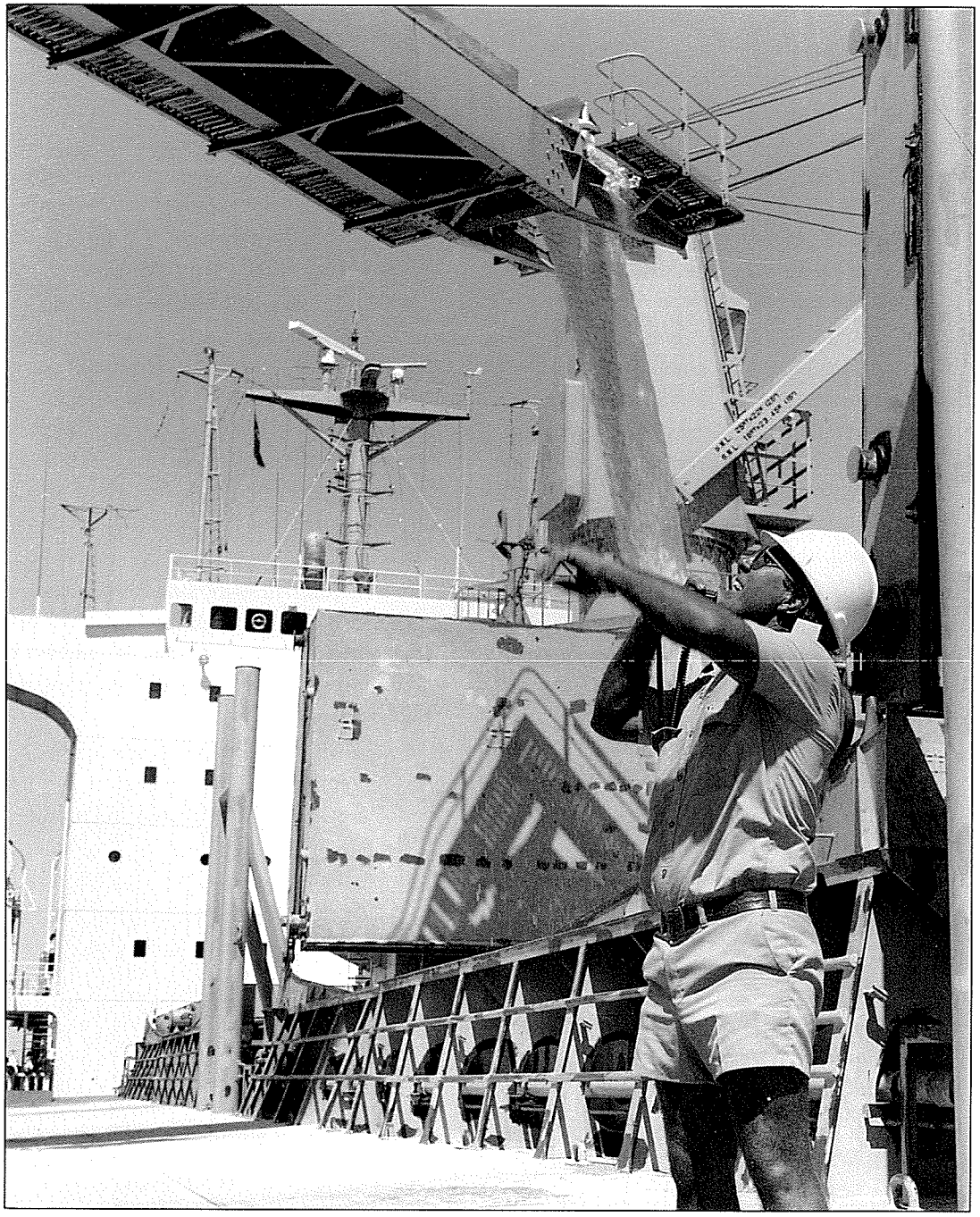
OTHER COMMODITIES

Salt production fell but increases in prices saw the value of production rise to $124 million, up 16%. Improved prices and steady export demand have prompted both **Dampier Salt** at Dampier and **Leslie Salt** at Port Hedland to undertake significant expansion programmes. Additionally Gulf Holdings is promoting a new $80 million development near **Onslow**.

In recent years **base metal** production has been limited to by- and co-product output from nickel and gold mining, until the start-up in early 1988 of the **Cadjebut** zinc-lead mine. This mine, near Fitzroy Crossing, is currently the only primary base metals producer in the State. Mine production increased from the initial 320 000 tpa to over 500 000 tpa with corresponding increases in zinc and lead concentrate output. Substantial modifications to the grinding and flotation sections in the concentrator have been made. Surface-based exploration drilling identified two previously unknown zones of ore-grade mineralisation to the southwest and southeast of the Cadjebut orebody. These zones will be explored extensively during 1990.

The State's copper production comes from by-product output from nickel mining and from the Horseshoe Lights and Telfer gold mines. **Boddington** is currently installing a copper flotation circuit with a view to treating copper-gold supergene-enriched ores from its gold mining operations.

The major base metals' development in the State is the **Golden Grove** project, being undertaken by a joint venture of Murchison Zinc (part of the ACM group), Aztec Mining (subsidiary of Amax) and Esso. The development includes an underground zinc-copper mine and onsite concentrator at **Scuddles**, to the south of Yalgoo. The



Salt worth $124 million, an increase of 16%, was produced in WA during 1989-90.

Pictured here is a consignment being loaded for export to Japan by the State's biggest producer, Dampier Salt.

concentrator has reached the commissioning stage and shipments from the port of Geraldton are expected before the end of 1990. The operation is designed to produce 200 000 t pa of zinc and copper concentrates with significant silver and gold credits.

There are several other base metal prospects being explored and evaluated at present, with WMC's **Nifty** copper prospect in the eastern part if the Pilbara being the most advanced.

The **Greenbushes** operation, producing **tin, tantalum and spodumene**, came under the control of the Gwalia Group during the year and plans were announced to reorganise and inject some capital into the operation to further exploit considerably expanding markets and to bring the long-awaited hardrock operation to fruition.

Greenbushes was joined by the Panwest joint venture (Pancontinental Mining and Goldrim Mining) as a second significant tantalite producer in the State. The joint venture's **Wodgina** project commenced mining in August 1989 with the mill being commissioned in mid-December with a nominal capacity to treat 100 000 t pa of ore. Throughput is already at scheduled rates (82 000 t pa) and higher rates were achieved over shorter periods. Concentrate production was on target and, at capacity, is designed for around 68 000 kg contained Ta_2O_5 in tantalite concentrates per year. Additionally Goldrim Mining continued to operate its small-scale alluvial tantalite operation adjacent to the joint venturers hardrock mine.

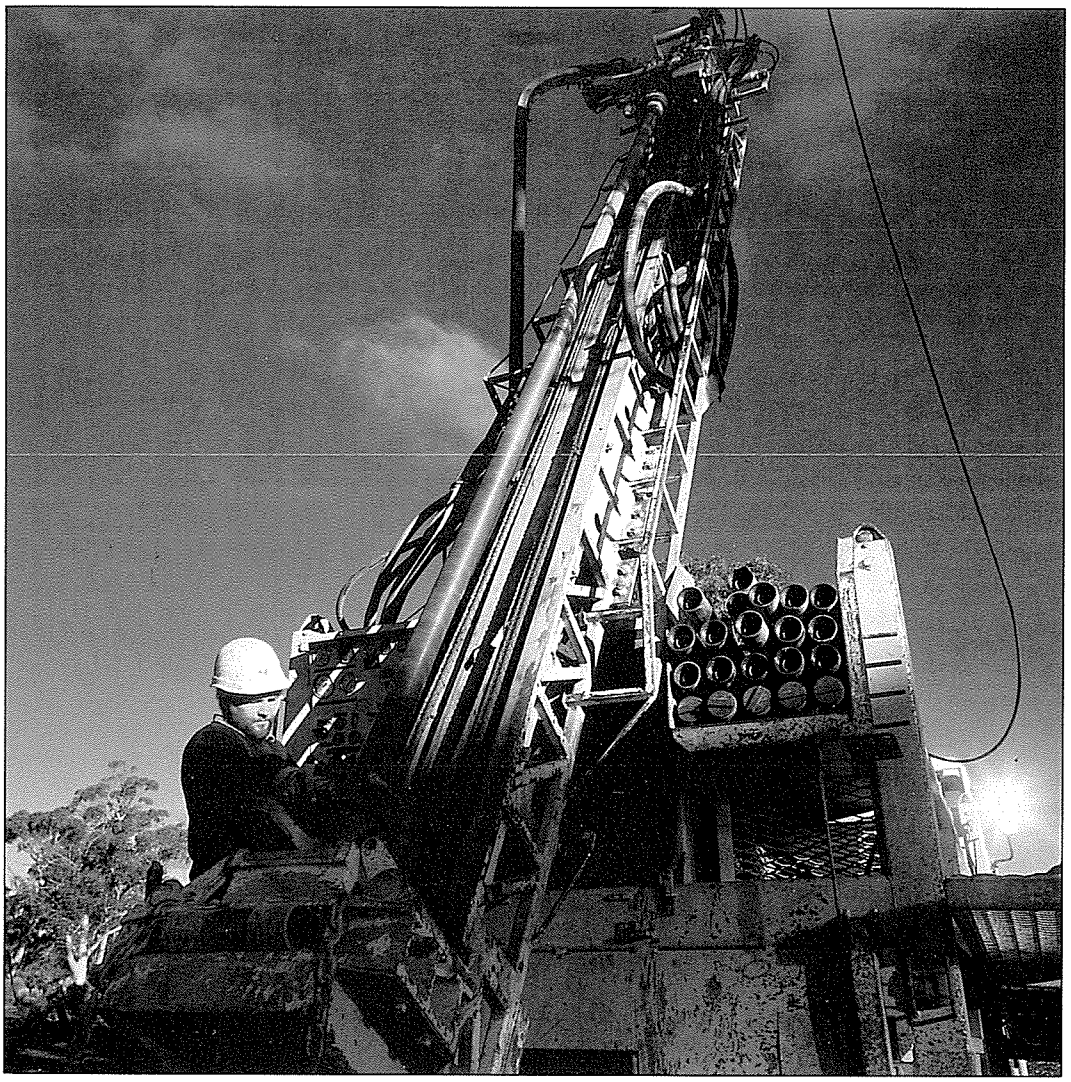
C & D Minerals and Commodities started reworking of old **manganese ore** dumps at **Woodie Woodie**. Previously unsaleable small-size lump ore was rescreened into three separate products for export to China via Port Hedland.

Portman Mining is currently planning to recommence mining primary manganese ore at Woodie Woodie. Development has reached an advanced stage for shipment of large bulk samples overseas for market testing.

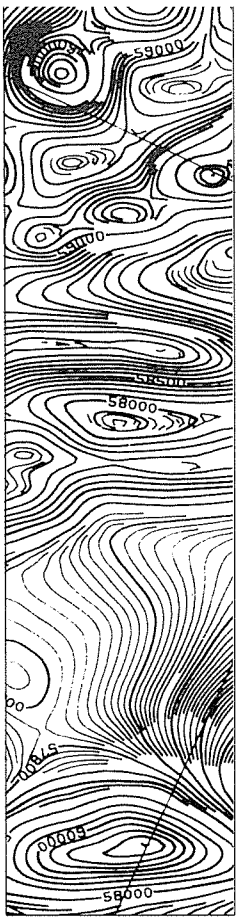
The Silicon Metal Company of Australia (SIMCOA), formerly Barrack Silicon Pty Ltd, commenced operations at its Kemerton **silicon** smelter during January 1990. High purity lump silica is sourced from the company's own minesite at Coomberdale, north of Moora. The demand for silicon metal is already attracting the company to plan further expansion of its output.

Other commodities mined for the export market in Western Australia include talc, silica sand and kaolin, with considerable interest in dimension stone, particularly "black granite", over the last few years.

A number of other minerals are mined predominantly to supply the local manufacturing and construction industries.



Seek and ye shall find ... Indeed, systematic mineral exploration programs are one of the keys to the State's long-term success. Western Mining Corporation has been one of the most active mineral explorers in post-war years in WA. Pictured here is one of the company's exploration drilling rigs at work in the bush near Ora Banda.



Pitwall Safety

The value of gold production in Western Australia has increased a staggering 1 300% during the last decade.

An estimated $2.37 billion worth of gold was produced in W.A. during 1989-90, compared with $163 million 10 years ago.

A factor behind gold's spectacular resurgence has been the extensive development of gold mines by open-pit mining methods.

However, this popular mining technique has caused quite a few headaches for authorities.

Several major wall failures have occurred during the year, including those at the Paddington, Horseshoe, Telfer, Eureka, Lady Robinson and Try Again open-pit gold mines.

Apart from the safety hazard to personnel working in the pits, substantial financial losses from lost production are being incurred by these mines. To date, no one has been seriously injured by a collapse, although a number of near-misses have occurred, and several instances are on record of machinery being buried.

Director of the Geological Survey Division of the Department of Mines, Dr Phil Playford, said it was very fortunate that no one had been killed in any of these incidents.

Over the past 12 months the Department of Mines has thoroughly examined the question of pitwall stability, especially as it relates to operating safety. Joint initiatives have been undertaken by the Mining Engineering and Geological Survey divisions to ensure that the issue is adequately addressed by the mining industry.

Specialist geotechnical advice is being provided to the Mines Inspectorate by the Engineering Geology sub-section of the Geological Survey, headed by Dr Chris Swindells. Engineering geologists have drawn on their specialist knowledge in assessing open pit and underground mine designs and are studying factors that control pit slope stability.

Results of these studies have shown that many of the failures have resulted from inadequate recognition of geotechnical factors in initial pit design.

Dr Playford said mining companies had traditionally spent a lot of money drilling areas to define ore bodies.

"Regrettably, many of them did not assess, in sufficient detail, the geotechnical characteriestics of rocks surrounding the ore body," he said.

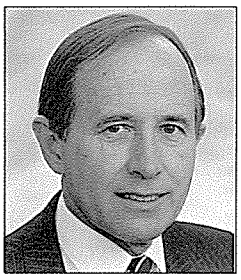
"This is of crucial importance because it is the area where pit walls will be located.

"Down the track this can have a major impact on the stability of the pit, people's safety and the overall economics of the mining operation.

"Indeed, wall failures can be very expensive if access to an ore body is blocked."

Statistics obtained from a random sample of 54 operating gold pits in the Murchison, Yilgarn and Eastern Goldfields areas indicate that:

- 80% of the pits sampled had not undertaken any geotechnical work prior to mining. Of these half had suffered major wall failures during their mining life;



Dr P E (Phil) Playford, BSc (Hons), PhD
Director, Geological Survey of WA

"...mining companies had traditionally spent a lot of money drilling areas to define ore bodies. Regrettably, many of them did not assess, in sufficient detail, the geological characteristics of rocks surrounding the ore body."

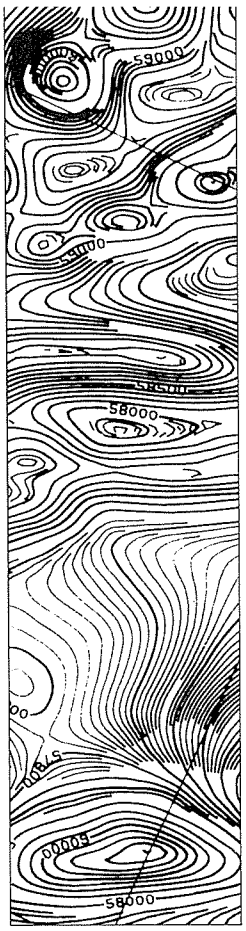
- of the remaining 20% where geotechnical studies were undertaken prior to mining 27% had major failures and these were restricted to pits deeper than 90 metres.

Simply speaking, the statistics suggest that there is a 50/50 chance of a pit experiencing a major wall failure when the geotechnical factors influencing wall stability are ignored at the design stage.

Poor stability conditions during the operation of a pitwall also affect the long term behaviour and the safety of the pit in the future, especially after mining has ceased. This long-term behaviour is being studied so that Departmental guidelines can be prepared to ensure abandoned pits will be safe.

The Department has presented a series of seminars in all the major Goldfields mining centres to alert personnel involved in open-pit mining to the safety hazards posed by pitwall failures. In addition, research programs have been formulated and initiated with the University of WA, Curtin University, CSIRO Division of Geomechanics, and various mining companies to investigate innovative methods of pitwall mapping and monitoring the long-term stability of reinforced open pitwalls.

Pitwall failures, like this one in the Eastern Goldfields, proved a real headache for mining companies and the Department of Mines during 1989-90.



GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

INTRODUCTION

The year under review was one of consolidation for the Geological Survey of Western Australia.

For the first time in many years, staff were brought together under one roof in Mineral House, Perth. No major changes were made to the structure of the Geological Survey.

However, a number of geoscientists were appointed to fill vacancies, including new positions allocated in 1988 to assist with implementation of the Government's new policy on mining and the environment.

Following completion of the Department's new Corporate Plan and the impending introduction of program budgeting, the Division's overall program has now been totally revised, set within the framework of the Department's corporate objectives, and based on fiscal years.

Some of the important activities during 1989-90 are outlined here using the Department's corporate programs.

MINING AND PETROLEUM TITLES

The Mineral Resources and Basin and Fossil Fuels Section provided advice on tenement applications to the Mining Registration and Petroleum Division.

GEOSCIENTIFIC INFORMATION

Geological Data Collection

The Precambrian Geology Section completed fieldwork for the Broadhurst, Davyhurst, and Kanowna 1:100 000 sheets. Work is continuing on the Fortescue group, Paterson and Halls Creek Orogens, north-western part of Yilgarn Craton, and the Eastern Goldfields. Further work in the Rudall River region has been suspended pending a decision on future access.

The Mineral Resources' Economic Geology Subsection continued its major study of gold mineralisation in the northern part of the Eastern Goldfields Province, with field investigations of all significant mines having been completed to the north of the Leonora area up to Wiluna. Field mapping has commenced on the Mulgabbie 1:100 000 sheet, while a study of Archaean mafic-ultramafic volcanic rocks and their associated mineralisation between Menzies and Norseman has largely been completed. Fieldwork is complete on the Broadhurst 1:100 000 sheet and in the Hamersley Range.

The Mineral Resources Section completed field work and commenced compilation of a review of gypsum resources. Deposits have been visited and sampled throughout the Yilgarn and the coastal belt as far north as Lake MacLeod. Work is continuing on high-grade silica resources and updating of Mineral Resources Bulletin 10 on heavy mineral sand deposits of Western Australia. Input was provided to the South West Mineral Sands Industry Report and to the System 5 conservation areas review.

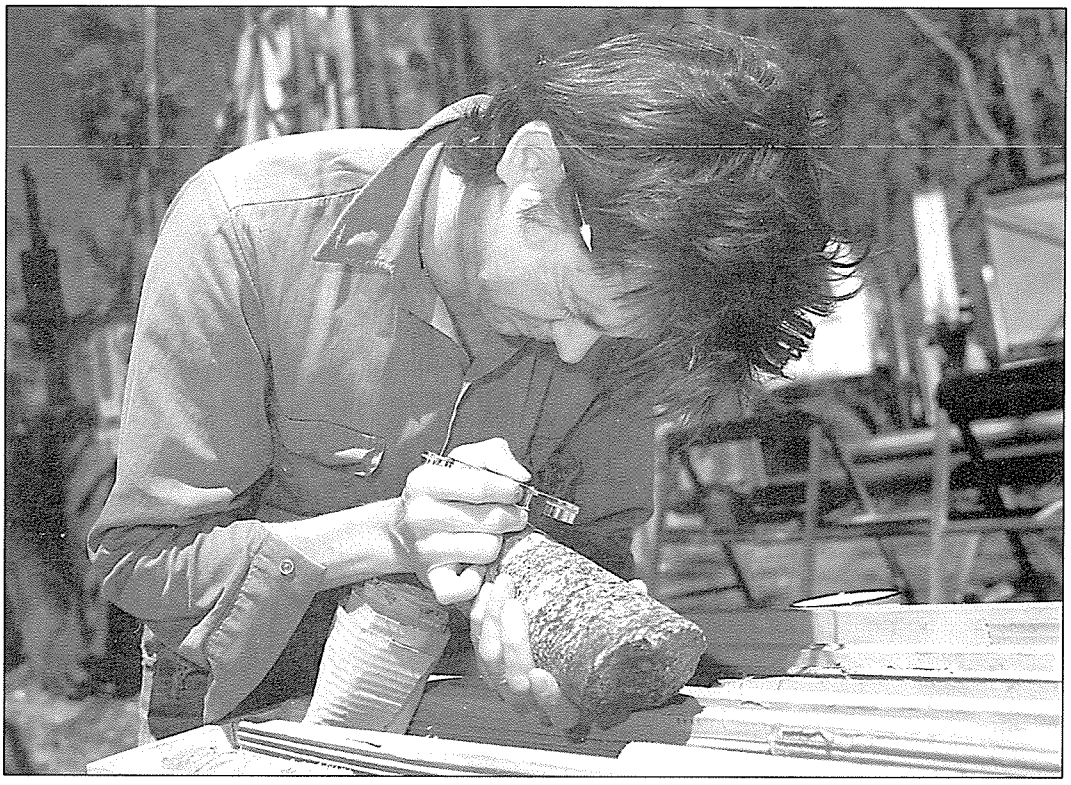
The Exploration Data and Mineral Evaluation Subsection received 3 160 new exploration reports during the year. This brought the total number to 30 352, representing 8 351 projects. Of these, 19 014 reports (4 149 projects) involve, wholly or in part, exploration for gold. During the year 846 volumes on 351 projects were released on microfiche, bringing the total number of open-file reports to 10 621, representing 4 097 projects.

Studies of gold mineralisation continued at the Kalgoorlie office and a manuscript describing all significant gold deposits between Menzies and Kambalda was submitted for editing. Maps to accompany the manuscript were well advanced at the end of the year. Mineralogical, petrological, and geochemical studies were undertaken on granites and pegmatites in the Eastern Goldfields region.

Staff from the Kalgoorlie office continued to provide an input to geological mapping in co-operation with the Precambrian Geology and Mineral Resources Sections.

During the year, mapping commenced on the Melita sheet while field work was completed on Kurnalpi. Final proof corrections were made to the Menzies 1:100 000 sheet to enable its release early in 1990-91. Mapping continued on the Norseman sheet. Final versions of the Davyhurst and Bardoc sheets were also released.

A regolith mapping program is continuing in the Eastern Goldfields. The aim is to map in detail the regolith and other surficial deposits of the Yindarlgooda and Lake Cowan drainage systems and interpret the Cainozoic geomorphological and geological development of the area. Final map compilation is in progress for the Dunnsville and Kalgoorlie 1:100 000 sheets.



Engineering geologist Stephan Kent logging samples during site investigations for a proposed new dam in the North Dandalup area.

An industry-sponsored research project with CSIRO has been instituted to assess the benefits of LANDSAT TM and SPOT satellite data for geomorphological and regolith mapping in the Eastern Goldfields as an aid in the exploration for concealed gold deposits.

The Hydrogeology Section was involved in the drilling of bores for groundwater resources assessment. In the southern Perth Basin, drilling was completed on the Karridale Line, and work commenced on the Scott Coastal Plain project where large fresh groundwater resources have now been discovered in the Lesueur Sandstone. The Leeman shallow drilling project in the northern Perth Basin was commenced in June. A report is being prepared on the assessment of groundwater resources in the Collie Basin.

A study of the age of groundwater in the confined aquifers of the Perth areas has confirmed the location of recharge areas identified from hydrogeological evidence. The study also indicates that rates of groundwater recharge appear to be lower than previously estimated and that much of the groundwater in these aquifers exceeds 35 000 years in age.

A large amount of work was undertaken for the Water Authority with three hydrogeologists on secondment to the authority. Supervision of drilling has been carried out at Horrocks, Piawanning, Exmouth, Kemerton, the northern coastal suburbs of Perth, and Rottnest Island. A numerical model of the Albany borefield was run in conjunction with the Water Authority to predict the position of the seawater interface. A report on groundwater investigations below the Gascoyne River near Carnarvon was completed and an evaluation of the prospects of obtaining artesian water for desalination at Rottnest was carried out. Field inspections for Aboriginal communities in the Kimberley, Mid-West and Central Reserves areas were completed.

The Basins and Fossil Fuels Section continued with a geological study of the Collie Coalfield, with digital borehole data being used to generate basin-wide stratigraphic and structural cross sections. These sections will be included in a report on the stratigraphy, structure, and coal resources of the basin. This project is scheduled for completion in late 1990, and will be followed by reports on the coal resources of the Perth Basin, commencing with the Hill River Coalfield.

The Basin Studies Subsection held a number of field trips and seminars in support of the gazettal of petroleum areas. Following the Perth Basin seminar and field excursion, and the Carnarvon Basin field excursion, a Bonaparte Basin field excursion was held to provide petroleum explorers with an overview of Geological Survey mapping in the basin.

The joint GSWA - Curtin University MERIWA project on the Lower Cretaceous of the southern North West Shelf was completed and a report made available to sponsor companies. This work has resulted in a detailed understanding of the sequence stratigraphy of the Barrow and Winning Groups in the Barrow and Dampier Sub-basins.

Work on integrating surface and subsurface data in the Arrowsmith and Hill River 1:100 000 sheets continued. This will be followed by a review of the stratigraphy, structure, and tectonic history of the northern

Perth Basin, currently the focus of an active petroleum-exploration program.

Arising from the project reviewing the Phanerozoic Basins of WA, computer generated seismic structure contour maps of the Canning Basin at 1:250 000 scale were produced. Regional seismic contour maps for the Southern Perth Basin, offshore Southern Carnarvon Basin, and the Tamar area in the offshore Bonaparte Basin were also prepared during the year.

The Coal Resources Subsection continued to monitor coal-related activities in the State in close association with the State Coal Mining Engineer. The major areas of involvement and advice during the year were related to the Hill River and Collie coalfields. Advice in relation to the coal resources, environmental factors, and land-use planning was provided.

Compilations of Western Australian fossils from the Precambrian, Jurassic, Cretaceous, and Tertiary have been completed by the Palaeontology Section and preparation of compilations on Jurassic, Cretaceous and Tertiary palynomorphs are in progress.

Two Palaeontological papers were published during the year: one dealing with enigmatic trace fossils in rocks 1.1 billion years old and interpreted as impressions of megascopic algae (probably seaweeds), and one describing modern stromatolites and benthic microbial communities from Lake Thetis near Cervantes. Four papers are in press: three papers on Permian palynostratigraphy and one palynological paper reporting a mid-Givetian age for the onset of reef development on the Lennard Shelf of the Canning Basin.

Papers on the Nabberu Basin are in preparation: one revises the stratigraphy of the early Proterozoic Glengarry Group, and two describe stromatolites from the Glengarry and Earaheedy Groups respectively.

Twenty nine petrological reports were completed by the Petrology Section during the year on 537 samples from a variety of settings across the State.

Biotite isotopic studies of post-Archaean thermal effects along the western margin of the Yilgarn Block are continuing. The study of mafic dykes in the southwestern Yilgarn Craton is nearly complete. A long-term project on metamorphism in the Yilgarn Craton is starting with a study of its southwestern section; this is a continuation of previously completed studies of the Murchison and Southern Cross Provinces.

The Geochemistry Section completed a joint study with CSIRO on the origin of laterite at Bottle Creek. Work was also completed on a project at Mount Gibson. A paper on neutron activation analyses of Collie coal is in preparation, and work has commenced on an appraisal of the value of geochemical studies reported to the Mines Department through the "M" series company reports.

Regional gravity mapping of the southwest Yilgarn Craton was continued by the Geophysics Section. A Bouguer anomaly map of the Collie Basin was compiled, and fieldwork for the Dinninup 1:100 000 sheet was completed.

Seismic refraction surveys were conducted for the Water Authority at North Dandalup and at the proposed Ten Mile Brook damsite near Margaret River. Ground magnetic and

frequency domain electromagnetic surveys were carried out for groundwater investigations at Watheroo and Halls Creek.

Vertical electrical soundings as part of an ongoing co-operative project with CSIRO, were continued at waste disposal sites at Morley and Mindarie to monitor pollution.

Interpretation of aeromagnetic data from the Cheritons Find 1:100 000 sheet was carried out to assist regional geological mapping.

Geophysical logging of boreholes drilled for water continued, and 32 bores were logged. During the year this service was transferred to the Drilling Branch.

Updating of the geophysical databases continued and updated disks were made available on request.

The tritium and carbon-14 isotope laboratory in the hydrogeology section processed 48 tritium and 73 carbon-14 samples; 17 samples were of shell or charcoal analysed for Quaternary geochronology studies.

Geoscientific Date Dissemination

The Precambrian Geology Section published second editions of the Newman 1:250 000 sheet and the Albany 1:1 million map during the year. Other completed maps formed part of special stratigraphic and tectonic projects in the Pilbara and Yilgarn Craton. They include two 1:500 000 scale sheets covering the Ashburton Basin and southwestern Hamersley Basin, and 1:100 000 sheets of Lake Lefroy and Cowan. Line compilations for the Turee Creek and Yampi second edition 1:250 000 maps were also released.

Explanatory notes for the Boorabbin, Newman, and Robertson 1:250 000 sheets, and 1:2.5 million State geological map were published. Geochemical data from the Mount Clement prospect (Ashburton Basin) were made available as a record.

Other mineralisation studies include a publication on carbonate-hosted zinc-lead mineralisation in the Kimberley region, final editing and preparation for publication of the Murchison Bulletin, and commencement of a study into the mineralisation on the Albany 1:1 million sheet area were completed by the Mineral Resource Section.

Commodity studies were carried out by both the Economic Geology and Mineral Resources and Economics Subsections. In the final stages of editing are the Bauxite report, covering the deposits of the Darling Range, and a Platinum record, tabulating analyses from samples collected from various layered complexes around the State.

The Mineral Resources and Economics Subsection was engaged extensively in development and data capture for the MINEDEX database and enquiry system for all mines and defined mineral deposits in Western Australia. The MININFORM or mineral resources inventory part of the system is now operative and provides resource figures on individual projects and deposits on a commodity basis.

Development of the rock and mineral data system, ROCKMIN, continued with the establishment of a system for entry of chemical analytical data directly from the Chemistry Centre. The chemical data can now be processed in ROCKMIN or transferred to a personal computer and processed with the geochemical data analysis system developed by

the Bureau of Mineral Resources. Analytical data is now beginning to be accumulated in ROCKMIN to augment the general information on the 49 312 samples in the database.

The Kalgoorlie office made a substantial contribution to a guidebook for the Eastern Goldfields excursion organized in conjunction with the Third International Archaean Symposium. Accompanying maps showing the stratigraphy and structure of the Kalgoorlie terrain were finalized for sale at the symposium.

The Engineering and Enviromental Geology Section completed a pilot project on the use of GIS in land-use planning studies. The work was carried out in conjunction with the Surveys and Mapping Division. The project successfully used ARC/INFO software to manipulate geoscientific information as an aid in land-use planning and other applications.

The Publications and Information Section responded to a large number of inquiries on a wide range of topics such as general geology for school teachers, mining and its environmental implications, and the occurrence of earthquakes in Australia. During the year 34 publications, including 18 maps, were released.

Preparation of an important new publication - Memoir 3: Geology and Mineral Resources of Western Australia - was completed. This volume will be an essential reference for all geoscientists in this State and represents the culmination of 15 years work by the Geological Survey since the publication of Memoir 2 in 1975.

During the year, 4 369 members of the public visited the library, of whom 1 203 used the microfilm reading and printing facilities. Staff loans totalled 820, and 524 inter-library loans were arranged. The library sent 164 items on inter-library loan to other libraries. The WAMEX open-field mineral exploration database was used extensively throughout the year by both the public and Geological Survey staff.

A hydrogeological map of Western Australia at a scale of 1:2.5 million was prepared by the Hydrogeology Section and published during the year. The map shows the distribution of groundwater resources in the sedimentary basins and major alluvial and coastal plain aquifers, and shows for the first time the rock types in the fractured rock provinces. Groundwater salinity distribution and areas prone to land and stream salinization are indicated. The map also shows the major centres of groundwater abstraction and the density of bores throughout the State.

Since the new scale of charges for hydrogeological information was introduced at the beginning of the year, enquiries from the public and consultants have declined. Many of the simpler enquiries from the metropolitan area are now directed to the library where the public can access information from water-table maps.

In November 1989 the Minister for Mines launched WAPEX, the Western Australian petroleum-exploration datasystem which will speed up access to exploration data.

During the year the accessioning, microfilming and release of petroleum exploration data continued with 496 reports

being received from industry and 407 reports being placed on openfile.

Nineteen unpublished reports, dealing mainly with Mesozoic palynology or Precambrian fossils, were prepared by the Palaeontology Section. Ten weeks of field work were carried out by the section, and included stromatolite studies of the middle Proterozoic sequences of the Nabberu Basin, a biostratigraphic comparison of sequences in the Savory Basin and the Amadeus Basin (NT), and the collection of fossils mainly from the Eucla and Carnarvon Basins.

Geotechnical and Mining Engineering Advice

The Engineering Geology Subsection continued to provide professional geological advice to the Mining Engineering Division of the Mines Department, plus other government departments, such as the Water Authority, Westrail, and the Main Roads Department.

Geotechnical and rock mechanics advice was provided to the Mines Inspectorate in the areas of open-pit and underground mine safety. Co-operative research programs with industry, University of W.A., and Curtin University have also been instigated to address aspects of mine safety. Advice given to the Water Authority and Main Roads Department included construction of the Harris dam; preparation of tender documents for new Victoria dam; potential dam sites at North Dandalup, Margaret River, Manjimup, and Conjunurup; quarry sites in the Eucla and Murchison; and materials investigations in the Murchison and Pilbara.

Technical advice on mineral resources matters continued to be provided to other government departments and the public.

COMMUNITY AND THE ENVIRONMENT

The Environmental Geology Subsection has been involved in a wide variety of tasks during the year. A considerable portion of the Subsection's resources was devoted to providing advice on the implementation of government policy on mining and the environment. During the year, detailed submissions were prepared on over 1 000 existing and proposed conservation reserves, and technical input was provided for a number of interdepartmental land-use planning and environmental-management groups. This work continues to increase in response to State Government legislative and administrative initiatives. The Subsection was involved in a major review of environmental aspects of extractive industries.

An increasing amount of work by the Hydrogeology Section is being carried out in the field of groundwater contamination with advice being given to local authorities, the Health Department, and the Environmental Protection Authority on waste-disposal matters.

An inventory of potential contamination sites in the Perth Basin was started as a preliminary to compilation of a groundwater vulnerability map. A new study was commenced to monitor and sample stormwater basins in the Perth metropolitan area in order to determine whether road run-off poses a threat to groundwater quality. Further drilling was carried out at Kwinana to determine the extent of contamination from chemical waste, and an investigation of the dispersion co-efficient applying to the aquifer in the area was also completed.

The investigation into land salinization at Merredin was completed. An integrated catchment management investigation, in co-operation with the Water Authority, Department of Agriculture, and Department of Conservation and Land Management, was started in the Upper Denmark River catchment area to assess the role of shear zones in controlling land and stream salinisation. A report was also completed on the feasibility of pumping away the saline groundwater below Lake Toolibin in order to maintain fresh water in the lake.

CORPORATE SERVICES

A principle role of the Program Planning and Administration Section is to assist the Geological Survey Directorate in the financial and operational management of the five-year geoscientific program. It is also responsible for laboratory, clerical and, word processing services, and the provision of vehicles, equipment and support staff to geological field parties. The section also organises and monitors conferences and training courses attended by Geological Survey staff, and work-experience programs for students.

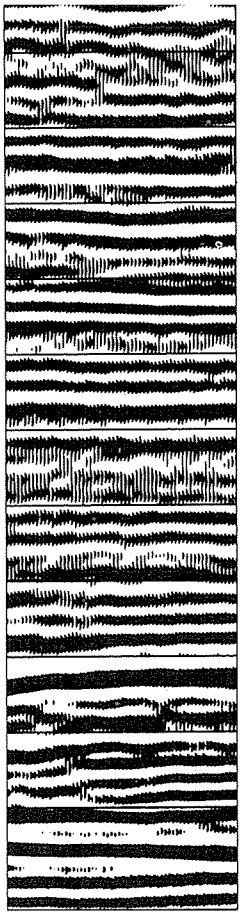
In the light of new Commonwealth Government guidelines relating to staff training, it is necessary to ensure that both professional and support staff attend appropriate training courses and conferences that are both relevant to the individual's career development and necessary for the efficient operation of Geological Survey work programs. To this end a divisional training database is being developed to ensure that all staff receive appropriate training according to their needs and current levels of funding.

Work-experience programs are held between March and early May of each year. A program has been devised to provide senior school students with an insight into geoscientific research. The program involves students in sampling of minerals in the field, followed by specimen preparation in the Carlisle laboratories and examination and analysis of specimens at Mineral House. During their week in the Geological Survey, students also spend time in the Museum and the Palaeontology and Engineering and Environmental Geology sections, while carrying out a variety of geoscientific tasks.

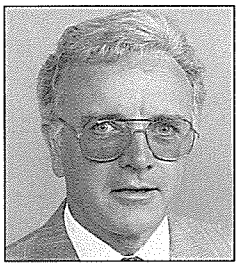
It is hoped that through this program some students may be motivated to embark in tertiary studies specialising in geoscience.

Staff

The approved staff numbers at the end of the year were 69 geoscientists and 45 technical and clerical support staff. Seven new appointments were made during the year with four people leaving the Geological Survey.



Seismic Surveying and the Onshore Environment



Mr I (Ian) Fraser, BSc (Hons)
Director, Petroleum Division

"....the petroleum industry generally has demonstrated an increased awareness of environmental matters "

Over the years, the Department of Mines has had to make many adjustments to meet the changing perceptions and expectations of the community.

One area that has demanded special attention in recent times has been the environment.

In the case of the Petroleum Division, no opportunity has been lost to promote environmental protection during exploration and production operations.

The Division makes regular checks to ensure that its policies are being carried out, and is constantly reviewing strategies to provide an acceptable balance between the demands of industry and the community.

Director of the Petroleum Division, Ian Fraser, said: "I'm pleased to say that the petroleum industry generally has demonstrated an increased awareness of environmental matters and a willingness to address the issues.

"To maintain this momentum, stringent operational guidelines have been put in place for the search and exploitation of the State's oil and gas resources."

In August 1988, the Minister for Mines established a Work Party to examine geophysical (seismic) field operations in regard to preserving the natural environment. The Work Party, chaired by the Assistant Director General of Mines, Dr Colin Branch, represented petroleum, farming and conservation interests.

Seismic surveying is essential for successful petroleum exploration. On average, some 7 500 line kilometres of onshore seismic data is acquired each year in Western Australia.

The main environmental impact of seismic surveying occurs during line clearing. Poor practices can result in:

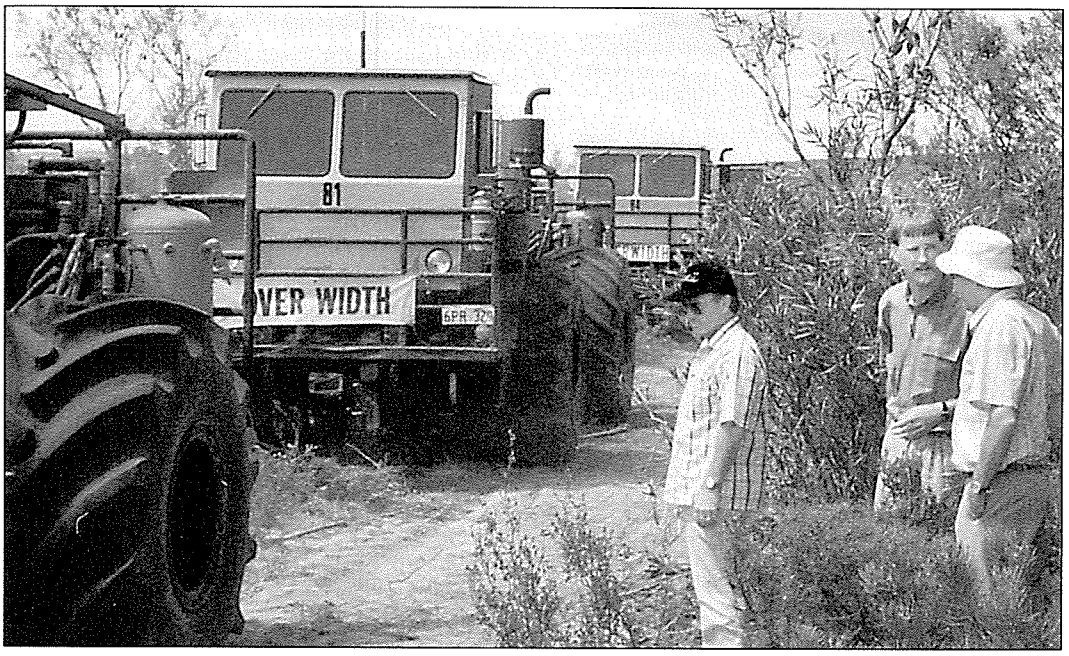
- removal of top soil (and therefore root stock and seeds) slowing regeneration;
- alteration of the topography which may increase both water and wind erosion; and
- increased vehicle and stock access to sensitive areas.

The Work Party emphasized the importance of communication between interested parties and stressed that compromise is possible between short-term land use and long-term environmental conservation.

Seismic survey guidelines established by the Work Party define the techniques and consultation necessary to minimise environmental damage while undertaking acquisition of quality data. This now mandatory code of practice constitutes the minimum level of environmental safeguards presently acceptable to the community.

As guidelines, rather than statutes, the standards can be altered readily if post survey monitoring suggests they fail to meet the community's expectations. They may also be adapted to changing techniques and technology.

While the majority of survey practices to date have been satisfactory in environmentally robust areas the guidelines seek to apply high standards in more fragile environments. They



Protection of the environment is a major consideration during onshore seismic survey work. Here, Petroleum Division Director Ian Fraser (left) leads Mines Minister Jeff Carr (right) on a ministerial visit to one of the northern areas of the Perth Basin to explain some of the special precautions taken while seismic survey work is in progress.

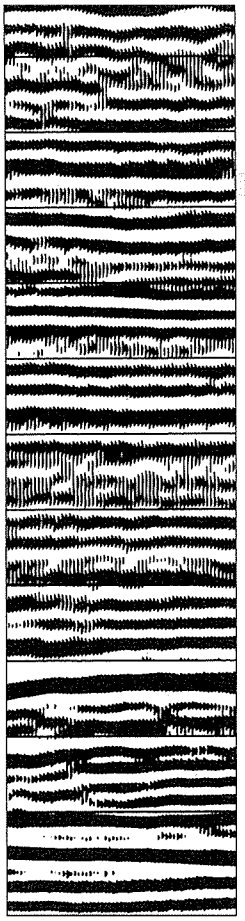
cover line construction and rehabilitation techniques, and the consultation necessary to enable successful and responsible exploration to be undertaken.

The guidelines are detailed in some aspects. However, they are also flexible recognising that practices must be varied to meet the requirements of the environmental zone. This flexibility acknowledges that the environmental impact of using any piece of equipment depends greatly on the knowledge, training and skill of the operator.

An environmental officer has been appointed within the Division to assist in environmental control. Forward planning and monitoring will be key strategies in ensuring that survey guidelines are met.

In this way the community is assured that:

- seismic lines are constructed and rehabilitated in a manner that will encourage regeneration as soon as practicable after completion of operations;
- industry complies with the requirements under the relevant Acts and any rules, regulations, by-laws or directions applicable to Shires or Districts in which operations are performed; and
- that operations are organised and conducted with due regard to good oil field and exploration practice, thus minimising any disturbance to wildlife, livestock, flora and sites of natural, historical or cultural significance.



PETROLEUM DIVISION

THE YEAR IN REVIEW

INTRODUCTION

The string of exploration successes which marked the last few months of 1988-89 has continued with oil discoveries at Cowle, Roller, Griffin, Cossack and North Yardanogo, and gas at Beharra Springs and Sinbad.

The most significant find may have been at Griffin, drilled by BHP near its Chinook success of last year. Griffin 1, spudded in December 1989, intersected a 97 metre gross hydrocarbon column in the Mardie Formation and Barrow Group which is being further tested by the Griffin 2 well currently underway.

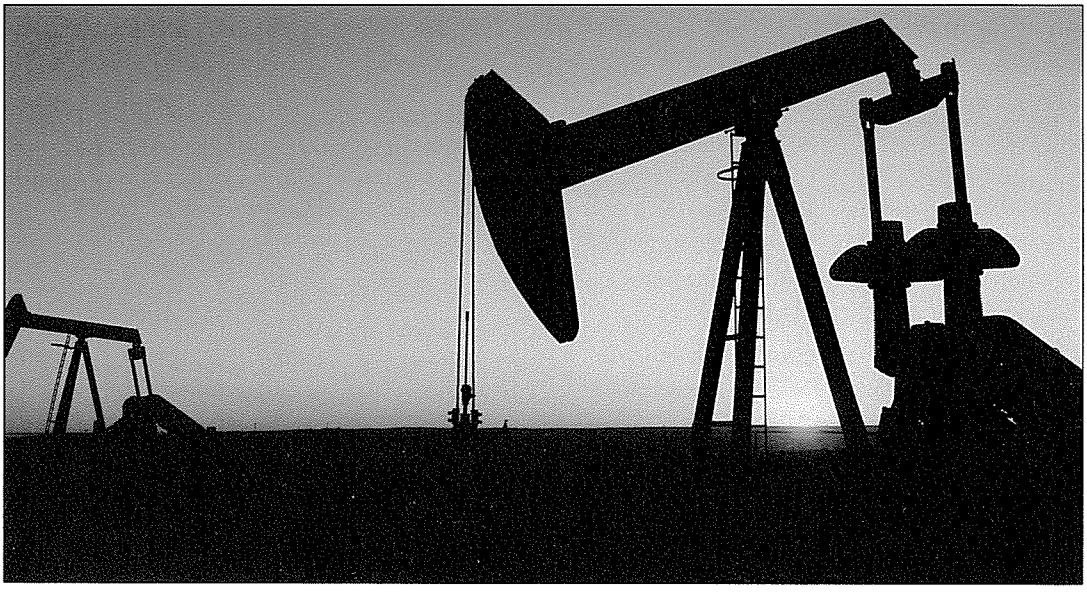
WAPET continued its success in the Saladin Yammaderry trend with two new fields, Cowle and Roller, while Woodside discovered oil at Cossack 1, a separate northeastern extension of the Wanaea field.

A major gas discovery was also made at Sinbad by Hadson Energy Ltd.

Onshore, Barrack Energy was successful in two wells in the Perth Basin with the discovery of oil at North Yardanogo 1 and gas at Beharra Springs 1. These were the first two wells in the company's accelerated exploration program.

Access to exploration continued to be promoted by the Department. In 1989-90, more than 103 000 square kilometres of onshore areas were gazetted for application. Eight new permits were awarded during the year. These gazettals were the result of biannual releases of Commonwealth areas and of industry requests for onshore acreage.

The 1988-89 fiscal year witnessed one of the highest levels of petroleum development activity in the history of the State, which contributed towards the future achievement of our long-term objectives of petroleum self-sufficiency, improving the balance of payments and providing substantial employment. Details of major development



Beam pumps, or 'nodding donkeys' as they are commonly known, silhouette the north-west horizon on WAPET's oilfield at Barrow Island.

projects are outlined in an earlier chapter of this publication titled "The Mining and Petroleum Industry Review 1989-90".

PETROLEUM TITLES

Title Allocation

As at 30 June 1990 there were 140 current petroleum titles in Western Australia, 99 exploration permits, 21 production licences and 20 pipeline licences. Management of these titles includes evaluation of the environmental, safety, technical and administrative effects of all activity within the titles. Computerisation is being considered as a means to improve data handling and customer service.

The policy of gazetting smaller exploration permit areas to encourage more evenly spread exploration is continuing. Twenty five permits were advertised this year, and eight new permits awarded - five onshore and three offshore. Awards for permits advertised in the offshore Perth Basin, an area which has not seen exploration for nearly 10 years, are pending. Surrenders and expiries increased, particularly in the remote onshore regions with the loss of 10 tenements.

Legislative Changes

Substantial amendments to the State's petroleum legislation were introduced into the Spring session of the 1989 Parliament. The amendments were not debated in that session and were carried over to the Autumn 1990 session. Matters addressed by these amendments include:

- provision for explorers to retain tenure over presently noncommercial discoveries by way of Retention Leases;
- streamlining the registration procedure for legal documents concerning interests in titles and consequential amendments to the fees payable on registration;
- improving the administrative processes for the making of regulations and the service of directions which control offshore petroleum exploration and development operations;
- the extension and scope of access and special prospecting authorities to facilitate increased seismic acquisition;
- the earlier release of basic data and interpretative information supplied by title holders;
- release of basic and interpretative data to be made retrospective;
- removal of various minor inconsistencies in the legislation;
- inspection of a precis of a registered instrument, rather than the instrument itself so as to preserve confidentiality of information between parties. Ability for minor errors in the register to be corrected;
- service of documents on two or more title holders to be made to a common address;
- provision for production of petroleum to occur through a surface installation outside of a Production Licence by way of a deviated well;
- deletion of administratively difficult "over the counter" releases of land for exploration purposes;
- nomination of blocks as a location (the forerunner of a Production Licence or Retention Lease) to conform to the boundaries of a field rather than the present artificial nine block square;

- fees, penalties and securities being relocated into regulations so as to facilitate ease of adjustment from time to time. (This has been modified in the final draft of the Acts Amendment (Petroleum) Bill to relate to fees and securities only, as it is not conventionally acceptable to have penalties relegated to subsidiary legislation);
- changes to the Petroleum Registration Fees Acts to reflect appropriate amendments made in the Commonwealth legislation but adapted to overcome certain perceived deficiencies. (The proposed amendment to relocate the advalorem registration fee into regulations has not been adopted in the final drafts of the Registration Fees Bill as it is conventionally unacceptable);
- amendments to the Petroleum Pipelines Act involving delegation of duties, definition of pipelines, registration provisions and the address for service notices so as to reflect the amendments made in the other petroleum legislation;
- peripheral facilities, particularly of a minor processing nature, being adopted into an onshore pipeline. Pipelines in the internal waters areas of the State (including the Barrow Island loading line) being brought under the jurisdiction of the Petroleum (Submerged Lands) Act of WA;
- the relocation of fees, penalties and securities from the Petroleum Pipelines Act into regulations (this has been modified in the final draft of the Bill to refer to fees and securities only as it is conventionally unacceptable to relegate penalties to subsidiary legislation);
- the "Crown Land" definition in the Petroleum Act being clarified by including reference to the submerged lands between the high water mark and the baseline. (This definition has also been expanded in the final draft to align with the definition under the Mining Act);
- the creation of an application fee on Special Prospecting Authorities to cover administrative costs;
- commencement of drafting of further amendments to accommodate Drilling Reservations (DRs). While such amendments are dependent upon the passage of the Bill referred to above, it is anticipated that DR amending legislation will be soon introduced. A DR is intended to allow explorers to drill individual prospects by providing a 12 month exploration right to small prospectsized areas. The DR carries a one well work obligations and offers a production licence in the event of an economic discovery. The ability to acquire exploration acreage without the present encumbrance of a five year financial commitment together with an assurance of a production licence represents a significant incentive to explorers both large and small. The award of a DR will stand primarily on its geological merit. To ensure as far as is practicable that drilling is technically justified and therefore avoid inadvertent downgrading of any area, the Mines Department will scrutinize applications. The Australian Petroleum Exploration Association, individuals and the majority of the 29 petroleum exploration companies which were circularised for comment

responded warmly to the proposal and provided several suggestions to modify and improve the original concept;

Overtures were made by the Department to have the limited partnership legislation amended to make it more compatible to the drilling fund concept which the Department is keen to foster. Drilling funds have the capacity to direct a much higher ratio of funds to exploration than exploration companies can because of the overheads imposed on companies. In this regard the rate of exploration should be enhanced.

EXPLORATION AND DEVELOPMENT

The Petroleum Division encourages exploration for the State's petroleum resources, ensures that exploration and development practices are appropriate and that knowledge of the State's petroleum geology is increased.

Petroleum Geology and State Reserves

The Petroleum Division continues to collate data on new petroleum discoveries and producing fields. These data are analysed to improve knowledge of the State's petroleum resources.

For new discoveries, as enumerated earlier in this volume, fluid and reservoirs have been calculated, and in some cases estimates of potential reserves made. Oil and gas reserves and deliverability have been assessed in detail for reserves at the North Herald, Chervil, South Chervil, Saladin and Mount Horner producing fields.

Collation of production rate data has continued. These data plus evaluation of yet-to-be-developed discoveries are used to show historic trends and estimate future availability of raw petroleum products.

Geotechnical and Engineering Advice

The Petroleum Division coordinates the processing of applications for approval of operations. The number of applications for operational activities (mainly seismic surveys and the drilling of wells) continued at a steady rate with a slight increase over 1988-89. The process of approving these applications has become more lengthy because of the requirements of the Environmental Protection Authority and greater interest by other conservation organisations.

All requests for approval of exploration activity were assessed for safety, technical parameters and suitability of formation evaluation procedures, and referred to agencies for consideration of their potential for environmental impact.

Each of the exploration and development wells drilled this financial year was monitored and requests for testing and completion reviewed. This included petrophysical analysis of wireline logs, approval of testing parameters, evaluation of hydrocarbon columns and engineering surveillance.

The Division has been actively involved in reviewing and monitoring the increasing number of petroleum development projects in the State. Three of these were completed in 1989-90. Talisman, Chervil and Saladin incorporate innovative technology. Discussions with industry have been held regarding the upcoming Goodwyn, Cowle, Yammaderry, Tubridgi, Cossack and Lonverdal Gas Gathering projects.

A document reviewing the State's gas reserves, production trends, gas field developments and future development plan was compiled and submitted to the Review Committee for Power Options for Western Australia.

Dissemination of Information

In order to promote the State's petroleum potential, the division increased efforts to provide current information on exploration activities, development projects, production trends and legislative incentives and changes. An in depth review is being conducted of all petroleum tenement activity, safety monitoring and production information held by the Division in manual and computer databases in order to establish a cohesive information plan with potential for improved customer service. Two issues of the "Petroleum in Western Australia" magazine were published, including details of all current petroleum events and future plans, and editorial comment on important issues such as the impact of seismic surveying on the onshore environment. Articles emphasising the recent successes in the State have also been published in trade journals with national and international circulation.

Acreage newly advertised as available for exploration was promoted by:

- notifying industry of proposed areas up to two years in advance of gazettal to allow more lead time for potential applicants to conduct studies;
- encouraging speculative surveying; and
- conducting seminars and publishing data on these areas.

The Department's policy of encouraging speculative surveying has been a positive move with these nonexclusive surveys being undertaken under Special Prospecting Authorities for both offshore gazettal rounds this year.

COMMUNITY AND THE ENVIRONMENT

Community Benefits

The Petroleum Division undertook inspections of metering devices throughout the year to ensure the accurate measurement of oil, gas and condensate production and provided advice on the calculation of petroleum royalties, which during the year generated total government revenue of $89.4 million.

Production rates and development plans have been monitored for application of good reservoir management practices to ensure maximum long term return on the State's known petroleum resources.

Environmental and Rehabilitation

A study of conservation and rehabilitation in relation to seismic surveying onshore has been completed, resulting in reporting of recommendations and drafting of a set of guidelines to be followed by all companies undertaking surveys.

The Division's Deputy Director attended the Australian National Oil Spill Conference in Sydney in June 1990. This conference was aimed at maintaining the National Oil Spill Plan and exchanging technical information for reducing the risk of spills and minimising environmental impact should a spill occur.

Petroleum Division Assistant Director (Exploration) Keith Crank (left) and exploration geologist Anthea Ryall compare notes for the next issue of "Petroleum in Western Australia" which is published twice a year.

WORKER AND PUBLIC SAFETY

Workers Safety and Health

The Petroleum Division has the responsibility for ensuring that petroleum exploration and development operations are carried out in a safe manner.

Australian and, where appropriate, international safety standards are required to be met or exceeded by the oil and gas industry in this State. Legislation requiring adherence to these safety standards has been enacted and is reviewed and updated by the Petroleum Division as required.

During the fiscal year new directions relating to onshore exploration and production and the installation and operation of pipelines have been prepared and will be issued formally in the next fiscal year after industry comments on the draft documents have been considered.

The Petroleum Division continues to be actively involved in the Consultative Committee on Safety in the Offshore Petroleum Industry, established by the Commonwealth Government to assess the need for new safety standards arising from the Piper Alpha disaster in the North Sea. Local issues such as the fire on the Tuna platform in Bass Strait have also been investigated.

As a result of these investigations the committee is developing guidelines relating to the design and operations of offshore facilities and is recommending changes to the directions to further improve safety requirements in the offshore petroleum industry.

Safety Monitoring

Activities which are regularly monitored to ensure that procedures and equipment meet required safety standards are seismic surveying, well drilling, pipeline laying, underwater diving, production operations and new field developments. The prevention of well blowouts is of primary concern. Standards for courses in blowout prevention have been established and industry participation in the courses is required.

The range of safety monitoring by the Petroleum Division included the following:

- reports were submitted for all inspections and appropriate correspondence entered into with the operating companies inadequacies in adhering to the requirements of the various Acts, directions and schedules;
- emergency response, safety procedures and operating manuals which were submitted by permittees and licencees were reviewed and modifications were requested where appropriate before the manuals were approved for use;
- operating companies were requested to upgrade their oil spill contingency plans to ensure that damage to the environment is minimised should an oil spill occur;
- work permit systems were reviewed on all offshore production facilities and updated where appropriate to meet required safety standards; and
- implementation of a new system for testing and accreditation of offshore crane drivers in conjunction with DOHSWA. This is the

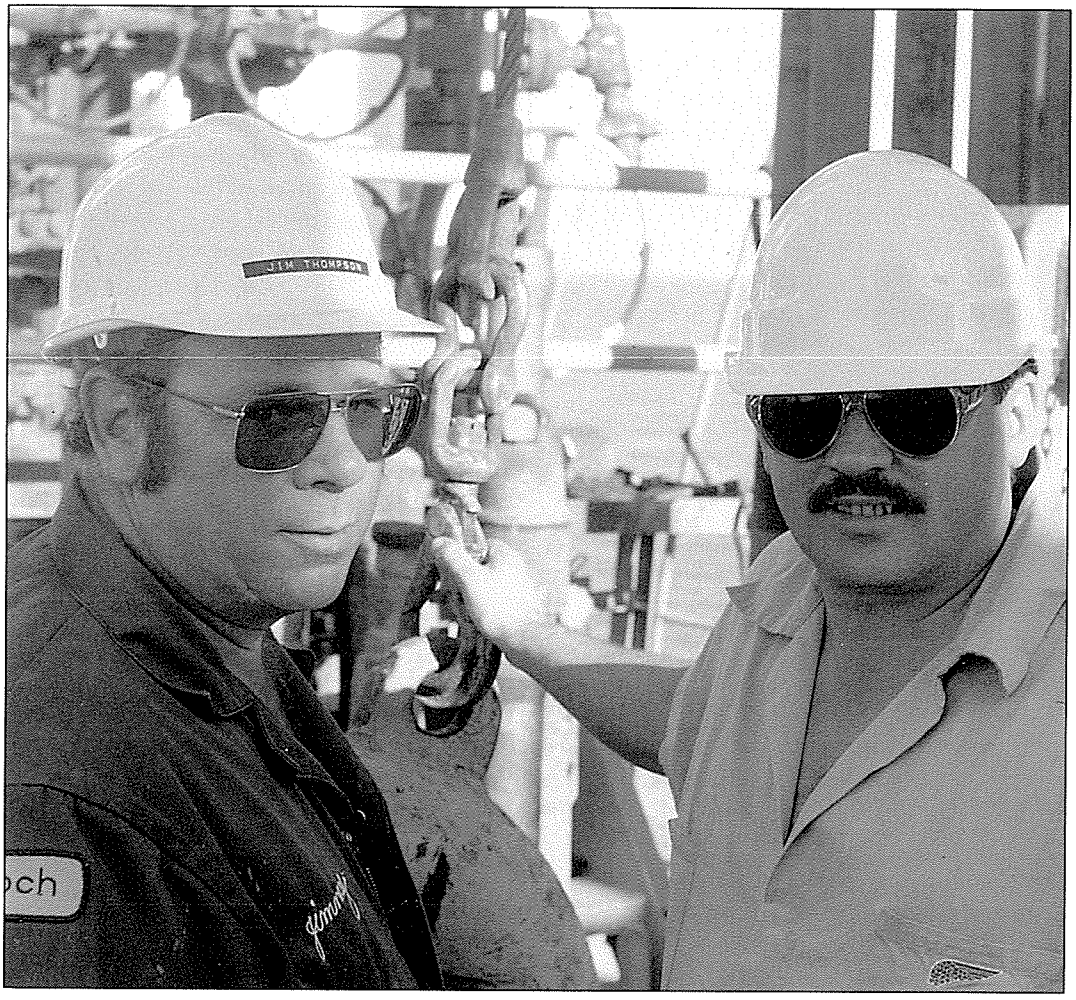
first accreditation of its kind in Australia specifically designed for offshore pedestal cranes.

CORPORATE SERVICES

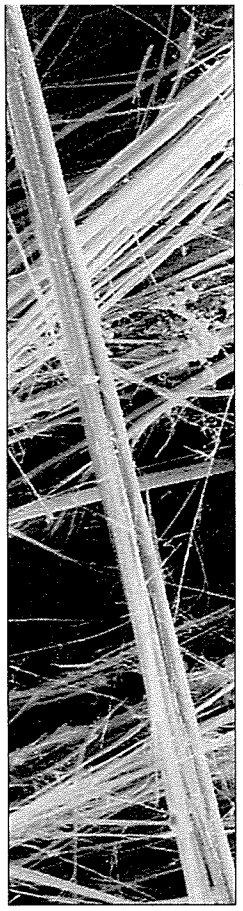
The Director presented a paper entitled "The Australian Offshore Outlook" at the first Pacific Asia Offshore Mechanics Symposium held in Seoul in June 1990.

The division's Exploration Geologist attended the Australian Petroleum Exploration Association Conference in Darwin in June 1990.

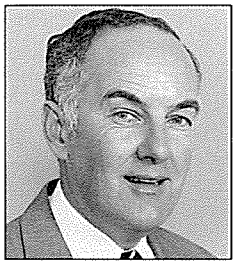
The Assistant Director Construction attended the Offshore Pipeline course run by the Offshore Engineering Program at Monash University in November 1989.



Department petroleum inspector Steve Walsh aboard the semi-submersible drilling rig "Diamond M Epoch" with rig superintendent Jim Thompson checking the integrity of a couplex hook latch.



Asbestos Cement Products — Health Hazard or not?



Dr J W (John) Hosking MSc PhD, FAusIMM,FRACI
Director, Chemistry Centre (WA)

"While nobody disputed the problems and suffering experienced by workers occupationally exposed to asbestos, there was considerable doubt as to whether there was a similar problem for non-occupationally exposed people."

The last year provided a considerable increase in public awareness and concern over the potential hazard of asbestos fibres in the environment.

Of particular concern was the possibility that asbestos, released during the weathering of asbestos cement roofs in schools, could be detrimental to health.

"While nobody disputed the problems and suffering experienced by workers occupationally exposed to asbestos, there was considerable doubt as to whether there was a similar problem for non-occupationally exposed people," said Dr John Hosking, Director of the Chemistry Centre (WA).

To address this question, an expert working party on asbestos cement products was constituted under the auspices of the Western Australian Advisory Committee on Hazardous Substances. This committee was assisted by the Chemistry Centre (WA).

The detection, recognition and measurement of low level asbestos contamination is an expert science which requires the involvement of skilled and experienced personnel. Sophisticated instrumentation is also necessary to ensure positive identification of fibres.

For the last five years, extensive investigations into the development of techniques to accurately identify and quantify asbestos levels in industrial and urban environments have led to the establishment of an expert group of scientists within the Mineral Science Laboratory at the Chemistry Centre. It was this group of scientists which was directed to obtain data on which the committee would base its recommendations.

Samples of airborne dust and bulk samples of asbestos cement were collected by government agencies and the bulk samples scanned using stereo-microscopy. This procedure, while not affording a definitive identification, provided an excellent screening mechanism and helped speed up the subsequent, more detailed, investigations. Confirmation of the nature of suspected asbestos minerals was achieved by examination of a representative sample of fibres from the cement product itself, using a polarized light microscope. The fibres were immersed in a liquid, with a refractive index approximately that of the suspected asbestos mineral. A skilled analyst then compared the morphology and optical properties of the sample to those of the suspected mineral. It was thus possible to positively identify the presence and type of asbestos in the sample.

Samples of airborne dust usually arrived in the laboratory on cellulose acetate or polycarbonate filters. These filters are an integral part of the dust monitoring equipment worn by occupationally-exposed workers. Similar types of samples were taken by trained government personnel, at preselected school sites under strictly controlled conditions. These samples were individually mounted and sputter coated with gold prior to electron microscopic investigation in the Mineral Science Laboratory. Using the centre's new Cambridge Instruments Stereoscan 360 scanning electron microscope, the samples were magnified 4 600 times. Under these conditions it was possible to detect fibres as small as 0.1 micrometres in diameter. Qualitative analysis of fibres was performed

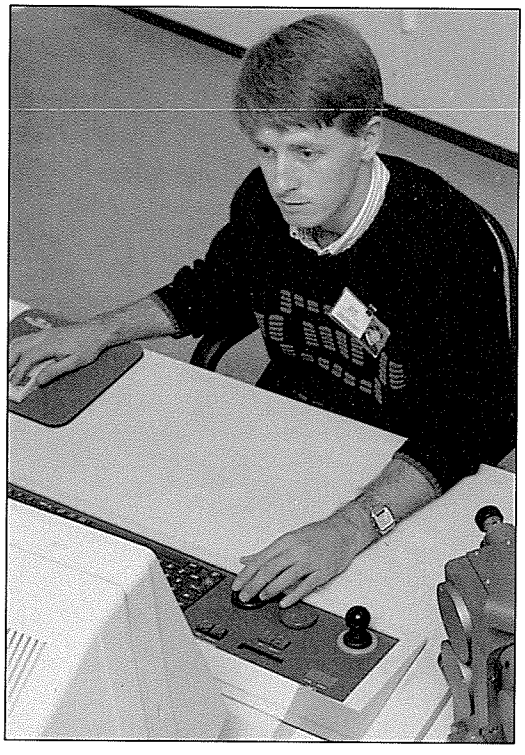
directly on the sample using the energy dispersive X-ray analytical mode of the electron microscope. Major element distribution patterns, thus obtained, further assisted in positively identifying the mineral form of the fibres under investigation.

One of the major fears of the general public is that asbestos fibres are released to the atmosphere during the ageing process of the asbestos cement and are then available, in high numbers, for inhalation by staff and students. If this was indeed the case then removal of the asbestos would seem the logical conclusion. However, the added problem that removal and clean-up of asbestos products may then produce more fibres in the environment than simply leaving the material alone or treating it with some form of coating would also have to be addressed. Consequently, the results from the airborne dust study were critical to the final conclusions of the committee.

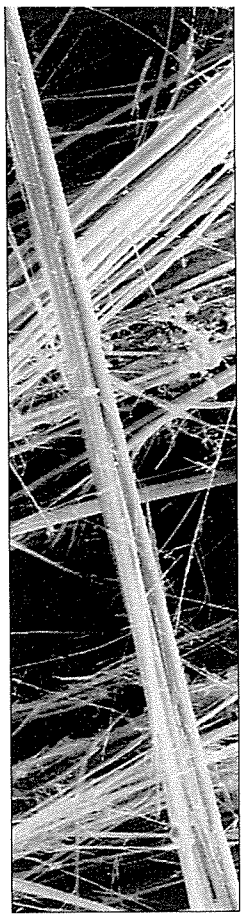
It is considered unacceptable if a fibre count in excess of 0.01 fibres per millilitre of air is achieved for non-occupationally exposed workers and in excess of 0.1 fibres per millilitre of air for occupationally exposed workers. During extensive analysis of filtered ambient air dust samples, from a significant number of schools having widespread asbestos cement products of varying age and physical condition, the level of asbestos found was less than 0.001 fibres/ml (and probably much less).

To put this in perspective, exposure over 10 years at a level around 0.001 fibres/ml has been estimated to produce an annual risk of mesothelioma of less that one per million persons per year averaged over an 80 year life-span.

The committee therefore concluded that it was not necessary, on health grounds, to require the removal of asbestos cement products from schools and other buildings. Nor was it necessary to use coating agents or other similar containment systems on asbestos cement products. However, the use of a penetrative bonding agent to improve durability and appearance, or reduce anxiety, was not discouraged, provided that the application did not lead to the release of asbestos fibres and that care was taken to prevent physical injury during application.



Department technical assistant Graham Horsley is pictured operating a $410 000 computer-controlled microscope. The unit is used for examining many things including asbestos fibres. It is also used for forensic investigations (gunshot residues and glass compositions) as well as a range of mineralogical applications.



CHEMISTRY CENTRE (WA)

INTRODUCTION

During 1989-90 the Chemistry Centre continued to provide a high quality analytical and advisory service to a range of clients, including some 30 government agencies, industry and members of the general public.

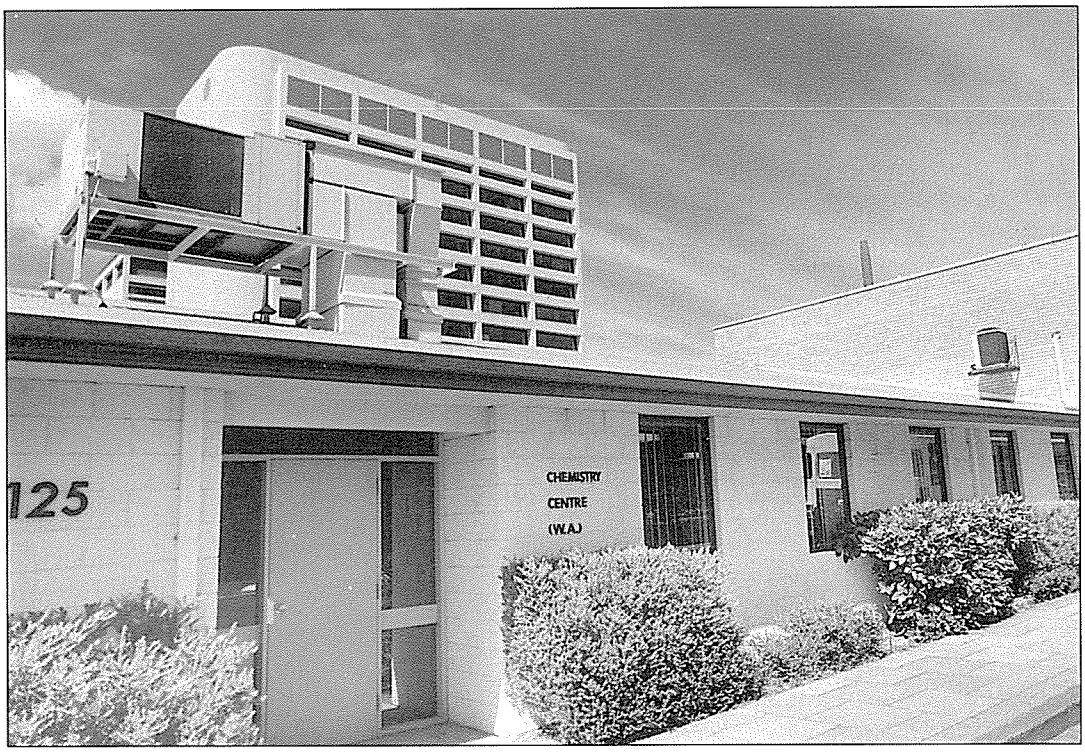
These services included scientific support for law enforcement and racing agencies, plus analytical input towards development of the State's mineral, water and agricultural resources, as well as monitoring of environmental, health and materials standards.

There was an across-the-board increase in services provided by the Chemistry Centre during 1989-90.

Four additional staff were added to the Forensic Science Laboratory to cope with increases in work coming from the Police and the Coroner.

It is expected that community concerns will see a continuing increase in demand for services relating to:

- food monitoring;
- waste disposal, including incineration;
- law enforcement;
- consumer product protection;
- new materials;
- occupational health and safety; and
- environmental concerns.



The Chemistry Centre headquarters — 125 Hay Street, East Perth.

Costing systems used by the Chemistry Centre were reviewed during the year to ensure that all costs were recovered. These include salaries, operating expenses, rent, equipment depreciation and all associated costs.

EXPLORATION AND DEVELOPMENT OF NATURAL RESOURCES

Mineral Science Laboratory

Upgraded Ilmenite Project

A joint project between the Mineral Science and Mineral Processing Laboratories was established on behalf of a commercial client. This project, which operated a seven day-a-week shift system, was designed to provide fast turn around of analytical data in order to better control the feedstock beneficiation process. The project was a success, results indicating that a significant lowering of the content of iron feedstock, prior to further purification to commercial grade titanium dioxide, could be achieved.

Whole Rock Analysis

One of the most important aspects in the study of petrogenesis is the availability of accurate chemical data on the composition of rocks. To this end, the X-ray fluorescence spectrometer in the Laboratory has been completely recalibrated, and upgraded software installed. The system now has the capability to be used for the determination of the 10 major and 30 minor and trace components of normal silicate rocks. This analysis can be achieved automatically in approximately two hours, making the spectrometer one of the most sophisticated and flexible systems in the southern hemisphere. The full impact of this facility on future Geological Survey of Western Australia initiatives is eagerly anticipated.

New Instrumentation

The Cambridge Instruments S360 scanning electron microscope (SEM) was delivered in August 1989 and represents state-of-the-art technology in this field. Examination of a wide variety of samples has taken place since its installation and commissioning. The fully automated capability of the instrument has been used by the Forensic Science Laboratory for the detection of gunshot residues. Quantitative analysis of kiln products has been carried out on samples from a synthetic rutile production plant and extensive use has been made of the system for the identification of asbestos mineral fibres.

Analysis of Pure Metals

Competition on the world's metal markets is fierce and any initiative to add secondary value to our raw products, and thereby earn extra foreign revenue, is to be encouraged. One obvious method to achieve this is to improve the purity of the metal. However, this requires accurate analytical data on the trace metal content of the metal, information often extremely difficult to obtain. Using its inductively coupled plasma spectrometer, the Laboratory has developed methodology to facilitate these determinations.

The first area of interest was the determination of trace impurities in gold and platinum coins. Successful completion of this project has ensured that the coins will retain their internationally high reputation and marketability. The second area of interest was the development of process control

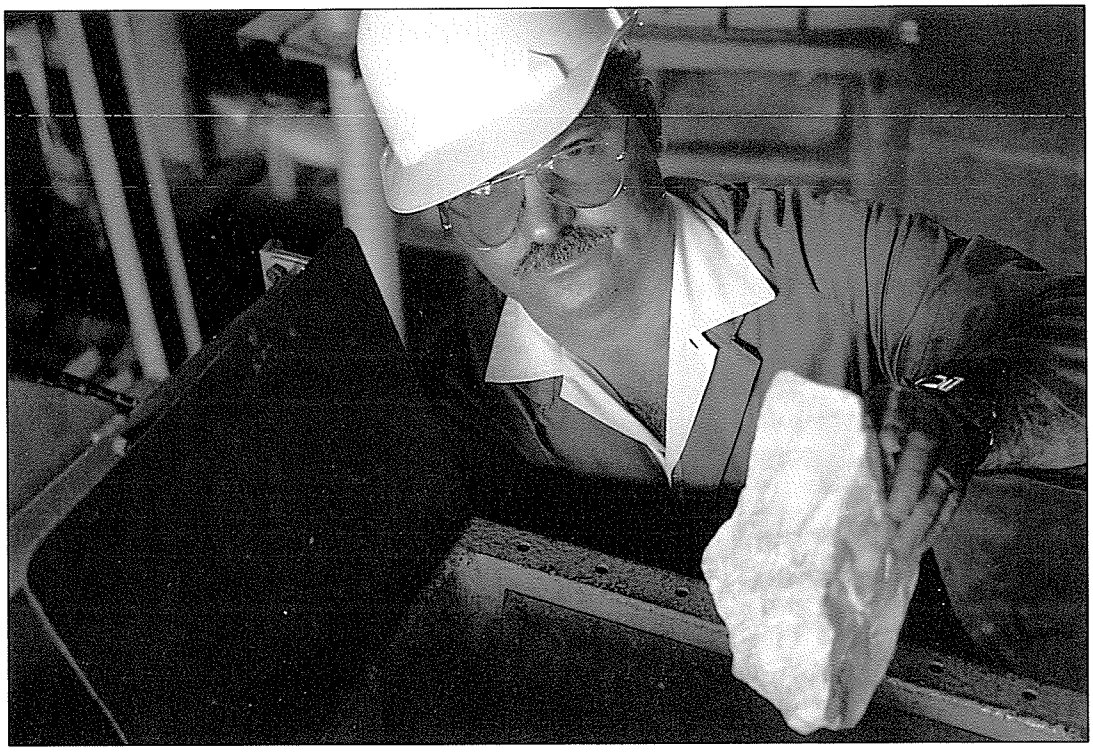
methodology enabling the purity of tantalum to be monitored during its production. Again, this project was successfully completed and the beneficiation process improved to a level where a higher grade tantalum could be produced.

Mineral Processing Laboratory

Sample registrations received by the Mineral Processing Laboratory increased for the fourth year in a row. Both client pay and departmental research projects reflected the continuing activity in the gold and mineral sands industries. As was the case last financial year significant projects were attracted from clients outside the State. This demand for the Laboratory's services reflects the quality of its work and the growing awareness within the Australian mineral industry of its capabilities.

Gold Metallurgy

Troubleshooting work on the carbon-in-pulp process provided a regular source of income for the Laboratory during the year. Knowledge generated over the last five years in the area of activated carbon management and testing has now been incorporated into a computer data base for easier reference. An investigation was completed for an Eastern States client on the application of a novel non-cyanide leaching process for gold. This was carried out with the assistance of Murdoch University.



Laboratory technician Peter Miovski, feeding a rock sample into a jaw crusher — part of the metallurgical test facilities at the Chemistry Centre's Mineral Processing Laboratory, Bentley.

A pilot scale flotation exercise was carried out for a local mining company. Approximately one tonne of ore was processed to produce a gold-rich sulphide concentrate required for testwork on possible methods for recovering gold.

Likely methods for extracting and recovering gold from an arsenopyrite concentrate were tested following an evaluation of the reasons for the refractory nature of the material.

Mineral Sands Testwork

A 15-day continuous pilot scale kiln trial was completed for a mineral sands producer. Several hundred kilograms each of a variety of reduced ilmenites were produced and will be upgraded in the next stage of the work program. Ilmenite samples from a variety of Australian and overseas deposits were batch processed on a kilogram scale to produce acid soluble titanium dioxide product or synthetic rutile.

Other Minerals

The production of pigment suitable for colouring bricks, concrete and paint from various iron oxide sources was the subject of several client requests. Feedstock was either waste red mud derived from bauxite processing or micaceous iron oxide. The techniques involved covered the spectrum from simple physical methods through to wet chemical processing and high temperature roasting. The Laboratory's purpose built fluidized bed calciner was used to roast a sample of alunite in order to render the potassium content soluble in water. The results of the testwork defined the roasting temperature which maximized the extraction of potassium.

Numerous other small to medium-size projects were successfully completed for clients during the year, including:

- pressure melting and refining of sulphur derived from an Indonesian volcanic ash;
- upgrading of a diatomaceous ore for use as a filter aid;
- beneficiation of chalk by electrostatic and magnetic separation;
- recovery of soluble nickel from flotation circuit water;
- assessment of clays for brickmaking;
- leaching of tantalite concentrates with hydrofluoric acid;
- routine size reduction, cyclosizing and bond grindability tests on ores, concentrates and mineral by-products; and
- aspects of transportation of liquid sodium cyanide and handling of spills.

Research Project

One externally funded project was completed during the year and the final report submitted to the sponsors. The MERIWA Report No. 59 details the work carried out in collaboration with Curtin University of Technology and CSIRO on the roasting and extraction of gold from refractory ores and concentrates.

Kalgoorlie Metallurgical Laboratory

Despite the shortage and high turnover of professional metallurgists, the Laboratory was actively involved in carrying out testing and project work on a range of minerals and metallurgical processes applied to various gold and base metal ores of Western Australia. The

Laboratory's facilities and expertise were used to provide a wide range of services which included plant trouble shooting, bullion analysis, umpire gold analysis, assistance in gold stealing cases, a wide range of mineral processing and extractive metallurgical testwork and process optimization.

Metallurgical Testing

Owing to a decline in gold prices and exploration activities, the number of samples coming to the Laboratory for ore characterization and metallurgical testwork was slightly less than last year. A total of 294 ore samples from different mining companies in the Goldfields region were tested for solid-solid and solid-liquid separation, flotation, reactivity and size analysis and cyanidation.

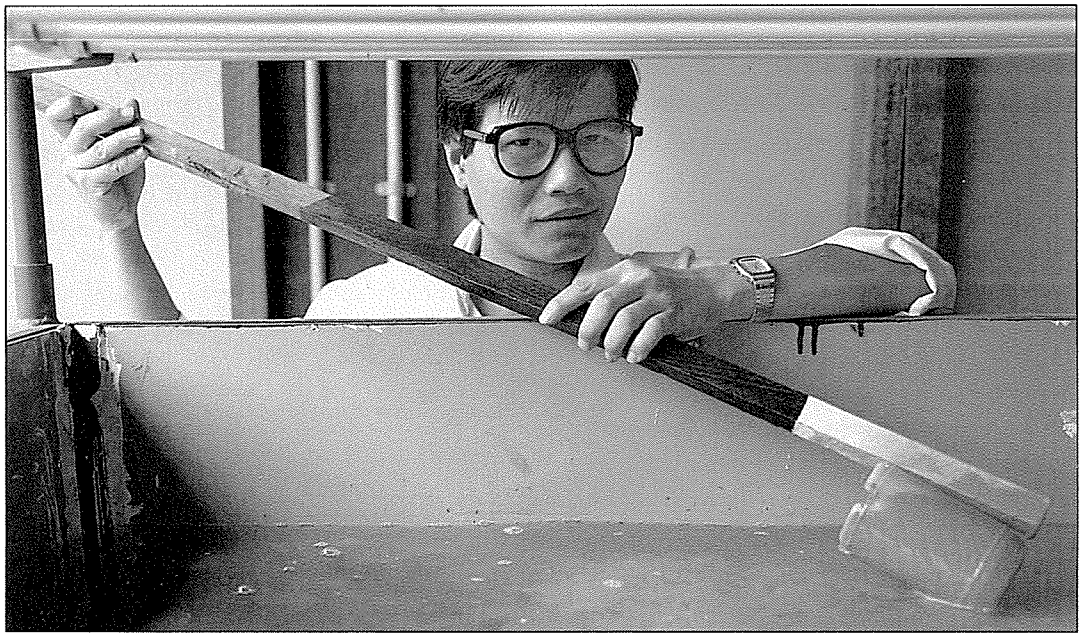
Two large projects involving the gravity method of concentrating gold ore, and cyanidation and extraction using the mini C.I.P. plant were completed. The Laboratory also undertook trouble-shooting exercises at several local plants and carried out development work on a novel gold extraction process for a client.

Bullion Analysis

A total of 3 429 gold samples were received during 1989-90 for gold and silver analysis.

Fire Assay

There were 377 samples received during 1989-90 for fire assay, most of which were for umpire testing.



Chemist Giao Nguyen, taking a sample from a scale model of a gold treatment tailings dam at the Department's Mineral Processing Laboratory at Bentley. The facility is part of an industry-sponsored investigation into the safe disposal of cyanide wastes.

Collaboration with Western Australian School of Mines

The Laboratory's staff members were involved in teaching and research projects for graduate and undergraduate students of metallurgy, besides providing services on metallurgical analysis. Two courses on "Atomic Absorption Spectrophotometry" and "Fire Assaying" were also organized by Laboratory staff in collaboration with the School of Mines. These courses were well attended.

ENVIRONMENTAL PROTECTION AND REHABILITATION

Environmental Chemistry

Staff from the Environmental Chemistry and Mineral Processing Laboratories continued their involvement in a multi-client investigation co-ordinated by AMIRA. This project, "Fate of Cyanide in the Environment Near Mine Tailings", has 13 sponsors and a budget of $240 000 over two years. Two meetings were held with sponsors in Perth at which progress was reported. Visits to all sponsors' mine-sites (in Western Australia, New South Wales, Queensland and the Northern Territory) have been made by Chemistry Centre officers employed on the project.

During 1989-90 the Environmental Chemistry Laboratory also became involved in two other projects relating to the investigation of cyanide residues around mine tailings.

The first involved the development of automatic analytical techniques for cyanide species in water, on behalf of two mining companies which provided $90 000 in sponsorship.

The second related to major investigations of tailings disposal for two gold mining operations in the South West.

CHEMICAL SERVICES

Agricultural Chemistry Laboratory

The Laboratory received 51 187 samples of agricultural materials for the year and reported 140 000 analyses on 63 680 samples.

Improved sample management and computer-tracking procedures, the development of more efficient test methods and the extra effort applied this year by permanent and ancillary staff have achieved a major reduction in the laboratory's backlog of work, now 16 500 samples compared to 29 000 a year ago. The shorter turnaround times on reported data have been noted and appreciated by clients.

Research grants received from rural industries this year totalled $168 656 and provided for continued lupin research and the purchase of a major equipment item (ICP-AES).

Eight submissions for industry funds totalling $200 000 for 1990-91 all received approval.

Lupin Research

An enzyme-linked immunosorbent assay (ELISA) for alkaloids in lupins, developed in collaboration with Curtin University over the past two years, gave excellent agreement with data from the reference gas chromatography procedure. The ELISA also gave good precision on control samples. The test will help speed up the alkaloid screening of some 6 000 samples

Principal Chemist Geoff Ebell (right) with City of Cockburn health surveyor, John Hardy, visit a Spearwood market garden to check on pesiticide residues in a crop of cauliflowers.

selected annually from lupin breeding trials throughout Australia.

The annual survey of the State lupin crop based on sampling of 86 delivery points revealed an unexpected rise in the mean alkaloid content. The susceptibility of the main commercial variety to moisture stress resulting from the season's dry finish is thought to be the primary cause of increase.

Soil Phosphate Research

A report of investigation titled "Chemical Analysis of Phosphorus in Western Australian Soils - Methods, Applications and Interpretation" went to print during the 1989-90 year.

Dr D Allen and Mr R Jeffery compiled this major summary of investigative work carried out by the Soil Chemistry Section of the Agricultural Chemistry Laboratory over the last decade.

The report sets a baseline of knowledge for future research into the movement of phosphorus in the coastal sandy soils of Western Australia.

Red-mud waste from bauxite treatment was used in a leaching column experiment to assess its capacity to retain phosphorus when mixed with sandy soil from the Swan Coastal Plain. The maximum rate of 250 tonnes per hectare of red mud reduced the phosphorus loss by 84%.

Nitrogen and Irrigation

Two horticultural trials at the Medina Agricultural Research Station were monitored for soil mineral nitrogen over a period of one week to assess the leaching of nitrogen from the root zone under sprinkler (conventional) and trickle (modified) irrigation of lettuce.

The trickle system 'pulsed' 12 times each day to maintain the soil at field capacity and to supply nutrients at a steady rate (confirmed by nitrogen analysis).

By comparison approximately one third of the mineral nitrogen was leached from the root zone in only 24 hours, after the total nitrogen requirement for one week was broadcast under sprinkler irrigation.

Conventional irrigation and fertiliser practices appear to result in inefficient use of the mobile plant nutrients.

Natural Products

Procedures were established during the year to determine the yield and composition of essential oils in experimental crops grown at the Ord River (Lemongrass, Cympogon spp. etc). The techniques developed have been used to assess the characteristics of essential oils in Jarrah, Karri, Marri, Tasmanian Bluegum, Tuart and two Melaleucca varieties.

The tannin and sugar contents of carob pods were determined on a range of carob cultivars selected by Murdoch University. The carob tree is being more widely planted on farms to help lower water tables to reduce soil salinity. The carob pod has value also as a stock fodder, a chocolate base and a galactomannan source.

Pesticides in Farm Soils

Since the commencement of a program in 1987 to survey the extent of pesticide contamination of Western Australian farm soils

and to examine the pesticide rundown rate in experimental trials, the Laboratory has conducted 75 000 analyses for organochlorine residues on 15 000 soil samples. This has been the largest analytical operation of its type undertaken in Australia to assist in the management of the beef contamination problem.

The Laboratory's involvement in the program will virtually end in December 1990.

New Equipment

State Wheat, Barley and Grain Research Committees and the Wool Research and Development Fund provided $130 000 this year towards the purchase of an inductively coupled plasma - optical emission spectrometer valued at $280 000.

The instrument is designed to determine up to 30 elements simultaneously in about three minutes or sequentially, and will greatly improve our capacity to provide a multi-element profile on agricultural research materials as well as mineral and water samples.

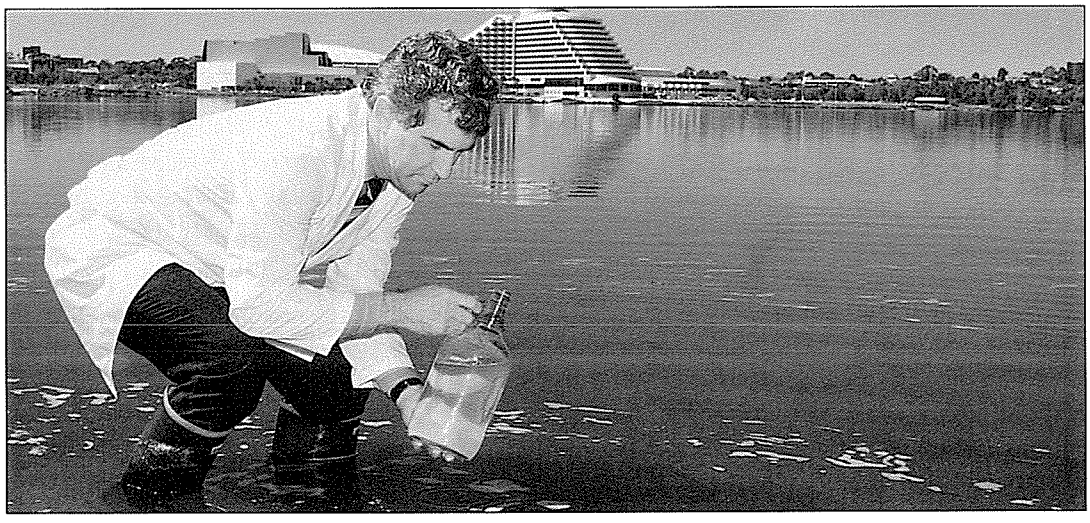
Environmental Chemistry Services

Staff continued to work with officers of other government agencies to monitor, evaluate and advise on the quality of the Western Australian environment. Trends toward community awareness and involvement in environmental matters were typified by a study into the Bayswater main drain catchment involving officers from Chemistry Centre, Waterways Commission, Environmental Protection Authority, Water Authority and local council and community representatives. This study should identify point sources of pollution and informed management strategies necessary to reduce the risk of polluting the Swan River.

Environmental Monitoring

This section commissioned a major instrument, the gas chromatograph/mass spectrometer facility, during the year. Major areas of activity for the section included:

- Atmospheric and water contamination by trace organic compounds;



WA waterways are regularly monitored for environmental pollutants by Chemistry Centre staff. Departmental technician Darryl Collett is pictured taking a sample from the Swan River in East Perth.

- a client survey of water revealed all were within NH&MRC guidelines for 17 specific organic pollutants;
- three cases of atmospheric pollution were investigated, the sources identified and remedial action recommended; and
- monitoring of nutrient pollution in waterways for Health Department, Environmental Protection Authority and Waterways Commission.

Heavy metal contamination in waterways and build up in food chain:

- a survey of air conditioner cooling water discharges and the Swan River failed to reveal evidence of significant chromium and zinc contamination in edible fish. However, some bioaccumulation of these heavy metals is occurring in the gonads of fish from the Swan.

Incinerator emission monitoring:

- an investigation into emissions from a hospital incinerator proved the efficiency of the incineration process after modifications to the afterburner system;

Pesticides

This Section experienced changing emphasis in workloads during the year. Involvement with organochlorine residue monitoring in beef decreased and regulatory work for the Health Department increased.

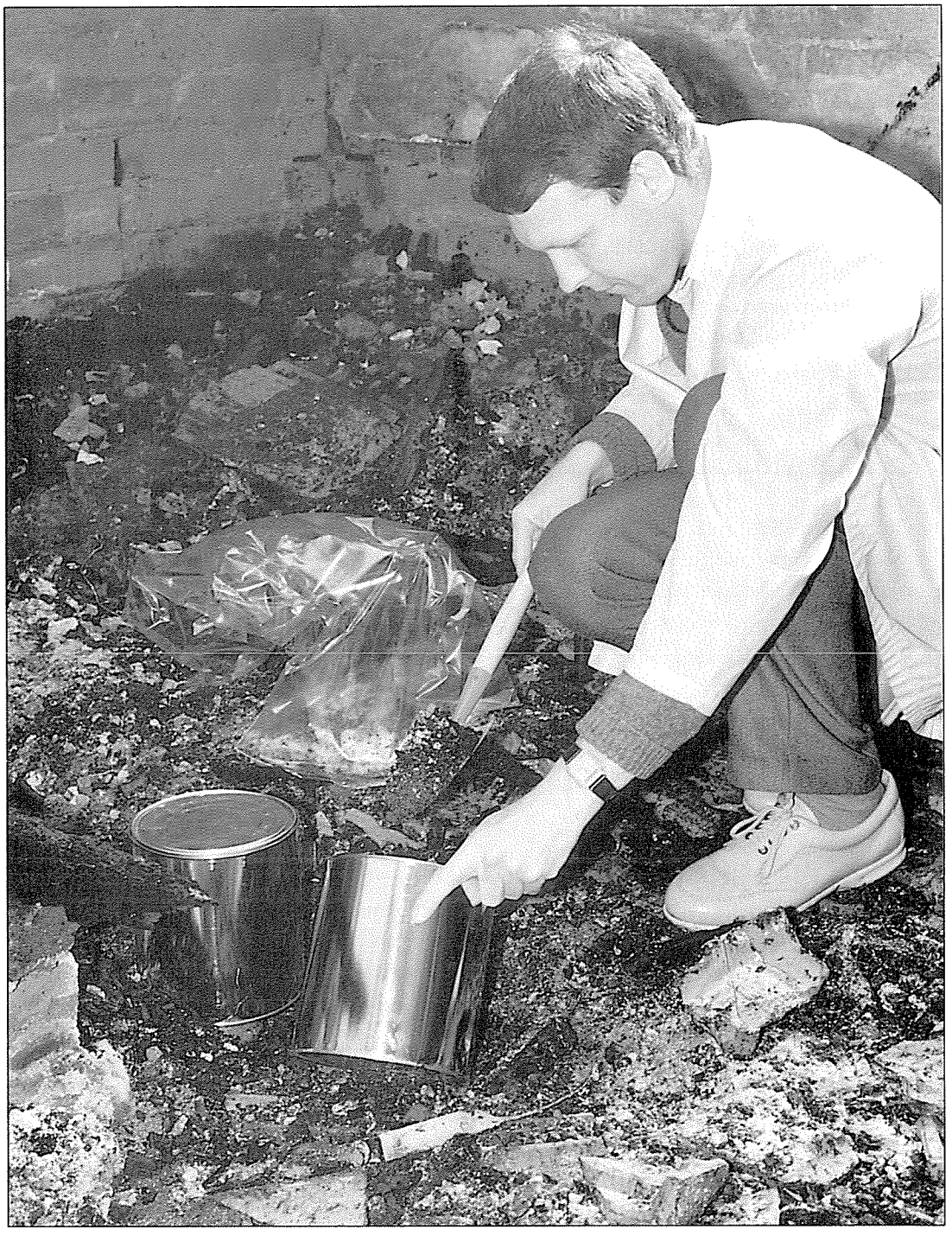
The areas of pest control operator spot checks and monitoring the atmosphere inside residences after pesticide spraying increased markedly. Other areas of activity included:

- a breast milk survey of 40 nursing mothers indicated a trend to lower levels of organochlorine pesticide residues;
- examination of 143 samples of fruits and vegetables indicated general compliance with maximum pesticide residue limits;
- investigations into alternative pesticide application techniques and the effect on the environment;
- regulatory monitoring for the Health Department of pesticide applications from pesticide contractors; and
- monitoring of herbicide run off from plantation areas involved 136 samples from CALM district officers. Low levels of hexazinone and atrazine residues were detected in waterways and further monitoring work is planned to investigate the significance of this run off.

Water Resources

This Section continued to work with the Water Authority and Geological Survey of WA to investigate the quality of potential underground water sources. Other major areas of activity were:

- use of lime to treat the Peel/Harvey phosphorus eutrophication problem. This proved to be effective at high pH but economically unattractive;
- advice to the public on swimming pool treatments, hydroponics, bore waters and corrosion problems (approximately 1 000 enquiries);
- investigation of cooling water problems in major hospital air conditioning systems. Problems include corrosion and algal growth control; and
- examination for the Health Department of commercially available water purifiers.



Forensic chemist David Tranthim-Fryer collecting scene-of-crime exhibits prior to analysis at the Chemistry Centre.

Forensic Science Laboratory

For the fourth consecutive year in a row the Laboratory experienced a significant increase in forensic materials submitted for examination. The overall increase for 1989-90 was 17 per cent.

The intense pressure on this Laboratory was eased slightly with the allocation of four new staff. An experienced chemist from the Environmental Chemistry Laboratory transferred to the Forensic Science Laboratory to fill one of these positions. The remaining positions will be advertised and hopefully filled early in the 1990-91 year.

Visiting research scientist Associate Professor Stanley Kailis joined the Toxicology and Illicit Drugs Section of the Laboratory while on study leave from Curtin University. His areas of interest include cannabinoid metabolism, steroid analysis and free fatty acid methyl esters analysis. Associate Professor Kailis worked with the officers of this section to improve the diagnostic interpretation of cannabinoid assays and implemented some HPLC/mass spectrometric methods for determining steroids.

Toxicology

The number of coronial cases involving unexpected sudden deaths increased by 44% during the year, up from 570 to 825. These cases have now more than doubled in the last three years. Despite the availability of three temporary contract staff, the magnitude of the increase meant that the backlog, and the unsatisfactory turnaround time for these cases remained a source of concern.

In an attempt to cope with this problem the Laboratory further refined and rationalised drug screening strategies. Provided there are no further increases in case numbers and also that the additional staff can be retained it is expected that a reduction of the backlog should be made in 1990-91.

The Laboratory continued to provide an analysis and consulting services to the Police Traffic Branch and the Prison Health Service. In both of these programs, case numbers remained at 1988-89 levels although there was an increase in the consultative aspects of the service.

Illicit Drugs

Police demands on the Laboratory's services for illicit drug analyses increased to another record level, with case numbers exceeding the previous year by 26%. While the majority of the increase was attributable to cannabis cases, the continued higher frequency of amphetamine type drug cases was perhaps the most significant trend. These cases have now increased from seven in 1986 to 107 in the present year.

Physical Evidence

The practice of examining all deaths involving firearms for gunshot residues has resulted in a sustained high level of submissions. During 1988-89, the continued reliance on manual searching for gunshot residue particles using inadequate scanning electron microscopy with limited access caused inefficiencies and unsatisfactory turnaround times. The installation of in-house scanning electron microscope facilities during 1989-90 alleviated the situation considerably, although, the initial installation permitted only manual searching. In the latter part of 1989-90 considerable development effort went into implementing the LINK Feature Scan

automation package which should enable case turnaround times of one-to-two days. The potential of the system was being realised at the end of 1989-90. However, fine tuning is expected to continue for some time.

Debris and other exhibits in relation to suspicious fires continues to comprise the single largest casework activity in terms of case numbers. Although there was a decline in case receivals during 1989-90, this was accompanied by an increase in accelerant residue detection rates in debris samples from 35% in 1988-89 to 39% in 1989-90. A summary of fire cases is shown in the following tables.

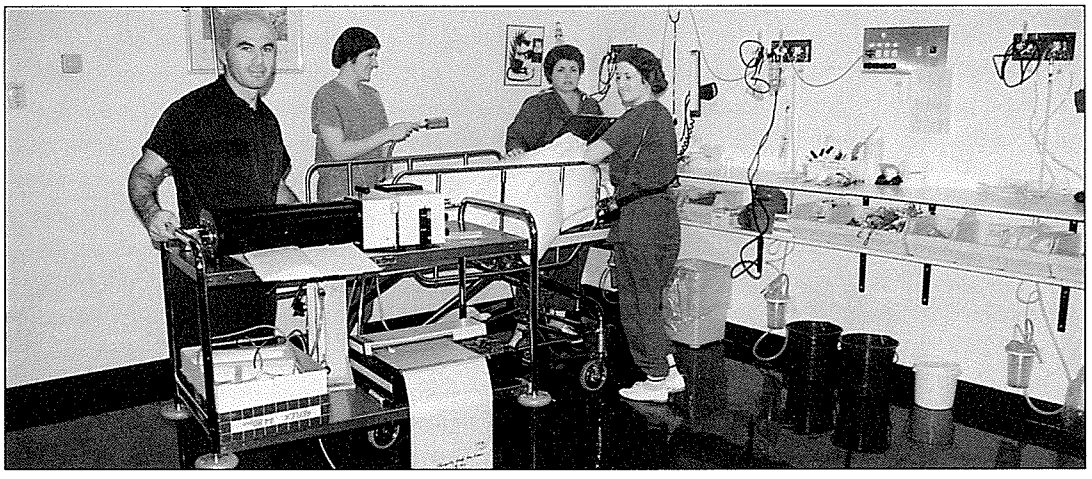
Fire cases	*1988-89*	*1989-90*
House fires	51	41
Commercial and public property	42	39
School fires	6	6
Vehicle fires	9	7
Misc.(sheds, boats, caravans etc)	10	5
Total	118	98
Residue detected	*1988-89*	*1989-90*
Petrol	28	21
Kerosene	6	5
Petrol and kerosene	3	3
Mineral turpentine	2	4
Kerosene and mineral turpentine	33	-
Thinners	2	-
Diesel	1	3
Total	42	39

Gold Stealing

The Mineral Science and Kalgoorlie Metallurgical Laboratories continue to make significant contributions to police gold stealing investigations throughout the State. State-of-the-art scanning electron microscopy, X-ray diffraction and inductively coupled plasma spectrometry combine to provide definitive identification and characterisation of stolen material. A number of samples were also analysed for gold and tellurium.

Research Activities

During 1989-90 research into pyrolysis derivatisation-gas chromatography has continued after success with a wide range of polymeric and macromolecular materials of forensic importance. The procedure is particularly suited to the examination of polymers containing ester groups which are



Chemistry Centre staff regularly monitor operating theatres such as this one to determine the levels of anaesthetic gases.

amenable to hydrolytic cleavage and alkylation. Alkyd resins used in surface coating applications are therefore well suited to this method. An intensive study was made of these resins resulting in publication of the work in the Journal of Analytical and Applied Pyrolysis. The scope of application has been widened to include the analysis of natural waxes used in cosmetics, natural resins applied to works of art, complex esters in drug formulations and UV light absorbers in paints and plastics. There are petroleum geochemistry applications to the profiling of carboxylic acids in kerogens and this procedure is being developed at Curtin University. A paper describing the scope of the pyrolysis derivatisation reactions was presented by invitation to an international meeting in Amsterdam (9th International Conference of Fundamental Aspects, Analytical Techniques, Processes and Applications of Pyrolysis, June 1990).

Concurrently, structure determination of materials of forensic significance by conventional pyrolysis gas chromatography using mass spectrometric identification is continuing on an ever increasing range of polymeric materials. Some of the results were published in a general article on the forensic applications of pyrolysis gas chromatography in 'Chemistry in Australia' in April.

Health Chemistry Laboratory

The rationalisation of activities within the Health Chemistry Laboratory was completed this year with the transfer of environmental activities to the Environmental Chemistry Laboratory. With upgrading of the biological handling area being completed, the responsibility for handling blood samples for pesticide analysis passed to the Health Chemistry Laboratory.

There was an increasing emphasis this year on joint projects with client departments on work relating to community health and public safety in the areas of hospital safety, food additives and explosives composition.

Food Additives

Monosodium glutamate (MSG) is a natural component in many foods (for example cheese and tomatoes) but is also widely used in food preparation as a flavour enhancer. Community concern over the possible health effects from an excessive intake of MSG led to a major survey of foods available in the metropolitan area.

The joint Chemistry Centre/Health Department/Local Authorities survey examined 250 restaurant meals and packaged foods purchased from 135 outlets.

The results showed that MSG levels in the restaurant meals were quite low with 99.5 percent having MSG levels within or below the normal range for flavour enhancement.

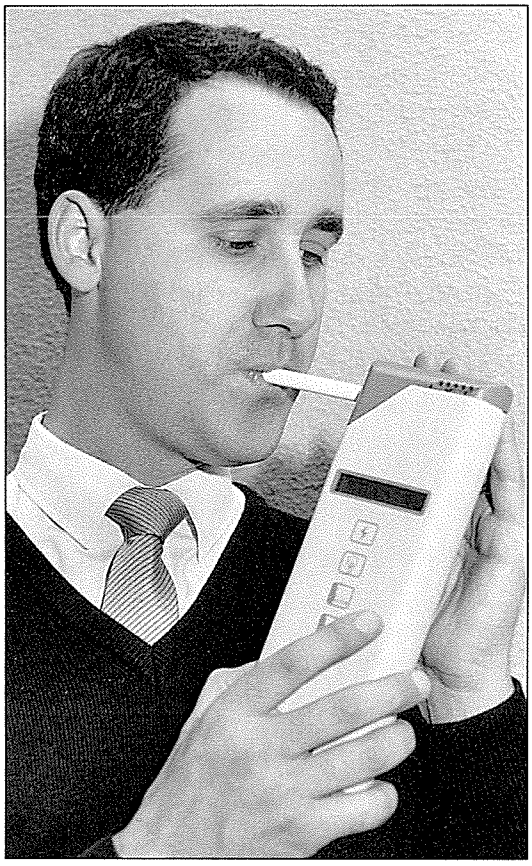
It was concluded that MSG levels found should not present a health risk to the public in general. Copies of the report have been sent to agencies nationally and internationally.

Hospital Safety and Occupational Hygiene

Possible exposure of hospital staff to sterilizing and anaesthetic gases resulted in an extensive survey of hospitals in the metropolitan and country areas. Procedural changes were recommended after consultation with the Health Department to rectify situations where significant exposure was detected.

Other survey work assessed ventilation efficiency and atmospheric levels of processing chemicals in X-ray laboratories. Modifications to fume extraction systems which were recommended by the Laboratory were later found to reduce the production of chemical vapours in these work areas.

An investigation of the amount of anaesthetic vapour delivered by hand-held inhalers was conducted on behalf of the St John Ambulance Brigade. The results showed that patients would receive similar amounts of anaesthetic vapour whether breathing naturally or assisted by an oxy viva kit.



Many interesting items pass through the Chemistry Centre for analysis and appraisal. Here, Chemist and Research Officer Dr David Honey applies his expertise in the development of this on-the-spot breath alcohol analyser for a local company. The unit is presently under evaluation for the WA Police Traffic Branch.

The Laboratory also investigated dust problems in hospital laundry areas and checked the purity of medical gases delivered by newly installed systems.

Projects and consultancy for mining companies covered fumes generated from plastics in underground fires, thermal decomposition products from cutting polyurethanes and fumes in a filter press area.

Minesite inspections were undertaken of Pilbara iron ore mines to assess chemical handling and control, and of the North-West shelf to investigate fibre emissions from a gas flare tower. Worker complaints of sore throats and eye irritation when working in the vicinity of a flare tower located on a beach were investigated. The source of the irritation was found to be due to a highly alkaline dust produced from the calcining of sea shells and limestone near the tower.

New Explosives

There was a large increase in the number of new explosives received from the Explosives and Dangerous Goods Division this year. Each new explosive was checked to determine whether the actual composition matched the claimed formulation. Extensive method development work was required to determine components in new formulations. The Laboratory's expertise in this field has been recognized by the receipt of samples of explosives for analysis from South Australia.

Consumer Products

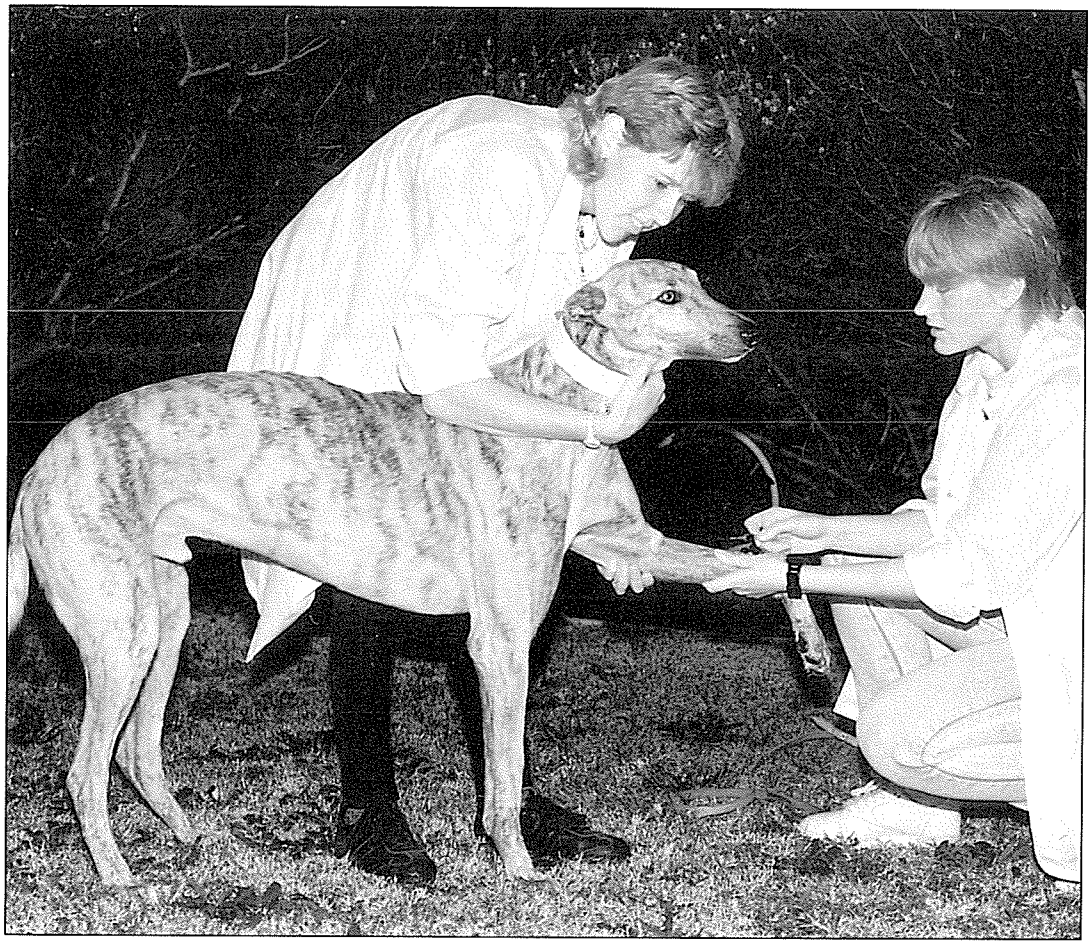
Complaint samples and consumer enquiries continued to grow with an emphasis on child

safety. Parental concern over possible health effects of the exposure of school children to solvents in felt pens led to several practical tests simulating classroom conditions where many felt pens were in use. Very low levels of solvents were found indicating that there was no reason for concern.

A child's chemistry set linked to a death in the United Kingdom was assessed. Recommendations were made on labelling, packaging,the equipment supplied and on the removal of particular hazardous chemicals.

Materials Science Laboratory

A significant trend towards more corrosion failure work was evident in the year. Extensive use of the new scanning electron microscope and the timely employment of a materials engineer has broadened the scope of this Laboratory and enabled a multi-disciplinary approach to material failure problems.



The Chemistry Centre tested 3 300 urine and blood samples from the horse and greyhound racing industries during 1989-90. Here senior veterinarian Jean Ralston (right) and assistant Sharmaine Budd take a blood sample from a greyhound .

With a downturn in the building industry and an increased awareness of environmental issues, the Laboratory has become more involved in consultancy work on plastics and detergents.

Consumers are seeking advice on recycling, photodegradation and biodegradation. Staff of the Materials Science Laboratory have been involved in lecturing, participating in conferences and have offered a valuable service to the community on these topical issues.

A major project was undertaken to investigate manufacturer's claims about photodegradable plastic shopping bags. A trial employing accelerated weathering and natural exposure on photodegradable and non photodegradable bags was conducted. It concluded that photodegradable bags in use in Western Australia at that time degraded only slightly faster than those which were untreated. The bags were withdrawn from use.

A joint project with the Forensic Science Laboratory involved developmental work on fuel cell technology for breath alcohol testing machines for a local company. This work, assisted by a Neville Stanley Studentship resulted in the manufacture of a working fuel cell. This was achieved after extensive experimentation on variables influencing surface activity of the specially prepared platinum electrode. Further assistance is being provided to enable commercialisation of the cell.

Dr G W Richardson, an expert on Fourier Transform Infrared Spectroscopy (FTIR), was invited and sponsored by industry to the 1990 Fourier Transform Infrared Spectroscopy Users Conference in Melbourne in February. He presented several detailed presentations on collaborative pioneering analytical work done by Chemistry Centre (WA) staff on respirable silica quantitation; on a rapid screening method for PCB analysis; and on carboxyhameoglobin quantitation in blood.

The capabilities of the FTIR are continually being enhanced by generation of new libraries of spectra. Libraries now exist for polymers, coatings, drugs, inorganics, surfactants, pollutants, PCBs, fibres, pyrolysates and general organics. Carbon monoxide and hydrogen cyanide poisoning of blood tissue are being investigated by the Forensic Science Laboratory and the Materials Science Laboratory. Respirable silica quantitation is also being investigated by the Mineral Science Laboratory and the Materials Science Laboratory.

Other smaller investigations such as the determination of the heat degradation of epoxy coatings on electrical components and the detection of organic additives in cement based adhesives exemplify the diversity of the applications of the facility.

The Small Claims Tribunal and the Ministry of Consumer Affairs continued to seek assistance in relation to floor covering failures. The problem was usually an unsuitable adhesive or poor laying technique. The Laboratory was called upon to provide scientific evidence for the adhesion failure.

An Aboriginal shield was examined for the WA Museum to determine the nature and age of minute paint splatters. It was important to determine if the paint was original, foreign but old, or a recent application. The use of FTIR,

scanning electron microscopy and pyrolysis gas chromatography established that the paint was applied later than 1960.

Corrosion work is becoming more common in the Materials Science Laboratory. A recent example was the use of the new scanning electron microscope facility to identify the isolated corrosion deposits on a new camera for the Small Claims Tribunal. The results of the investigation indicated a faulty battery and eliminated the possibility of complete immersion in salt water or other corrosive liquid.

Investigation of a circuit breaker in a large Perth building revealed heat induced brittle fracture of the insulation material. The PVC insulation was releasing its plasticizer, becoming brittle and fracturing away from the underlying current carriers.

A recommendation of immediate repair or replacement has been pursued by the building owners.

Racing Chemistry Laboratory

Sample numbers (3 300) were approximately the same as the previous year. Drugs reported during the year were phenylbutazone and oxyphenylbutazone (2), diethylcarbamazine (4), trimethaprim (4), flunixin (2), procaine, caffeine, buprenorphine, morphine and codeine, and methylprednisolone.

Research during the year was aimed at improving immunoassay work. To achieve this, antibodies were raised against several of the more difficult to detect drugs. The use of immunoassays as screening tests has been extended to Enzyme Linked Immunosorbent Assays (ELISA). The WA Trotting Association funded the equipment for this work. Some preliminary developmental work has been aimed at pre-race testing.

The West Australian Greyhound Racing Association funded a program aimed at improving methods for drug detection in greyhounds. The program has been extended to determine metabolites of anabolic steroids and develop techniques which will enable their detection.

CORPORATE SERVICES

Buildings

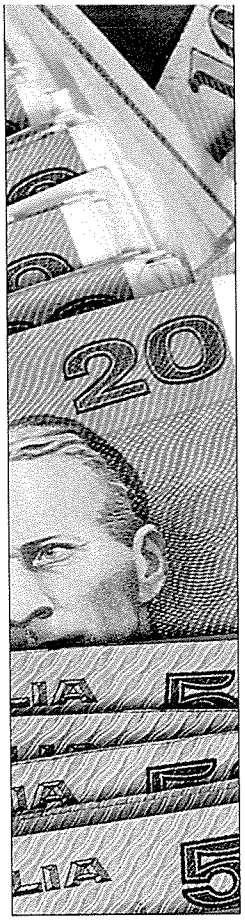
During 1989-90 a schematic plan was developed for a proposed new Chemistry Centre on a site adjacent to the Curtin University of Technology in Bentley.

It is planned that the complex will accommodate the eight Perth-based Laboratories of the Chemistry Centre.

Staff

The shortage of experienced professional staff in the mineral industry continued during 1989-90, with a result that some key vacancies in the mineral-based laboratories remained unfilled.

Staff training with in-house and external courses was increased in recognition of the need to maintain a high level of expertise. A three-day course on quality assurance was run by senior officers from the National Association of Testing Authorities (NATA) for all technical and professional staff. The Chemistry Centre has an extensive range of chemical tests accredited by NATA and many of these were reassessed in 1989-90 to ensure that the Centre meets NATA standards.



ROYALTIES AND POLICY DEVELOPMENT DIVISION

Communicating with the Community

During redrafting of the Department's Corporate Plan, one of the most vital goals identified was the raising of public awareness of the role of the Department.

With strong opposition from a range of single-issue groups to many of the Department's initiatives and programs, and considerable uninformed media comment on a variety of mining industry issues, it was considered crucial that a balanced, coherent and cogent response be made.

Thus was born the Communications Branch in February 1990.

Its brief is to communicate. Communicate with the public, the industry, the media, the Government and, importantly, with Department staff.

Its goal ... to educate and inform. Inform those groups of the Department's commitment to meeting community needs and expectations and to safeguarding their environment and living standards.

One of the first tasks undertaken by the branch was the revival of an irregular staff newsletter that had been published under various titles over a number of years.

The new eight-page monthly paper titled "The Plain Street Post" is produced entirely in-house using a computer-based Ventura desk-top publishing system. It has contributed significantly to the 800 members of staff gaining a broader picture of departmental and divisional activity and has become a vehicle for the exchange, in an entertaining form, of news and information.

Also given high priority by the branch in its first months of operation was a concerted effort to establish a better working relationship between the Department and the media. Consequently, as part of an on-going public affairs strategy, the branch developed a more immediate and responsive approach to media relations. In practical terms, this saw the Department becoming more assertive when stating its case on specific issues, thus ensuring a balanced coverage in the print and electronic media.

This strategy has also meant being pro-active in the dissemination of information to the community. During its first six months the Communications Branch wrote and distributed over 40 media statements which resulted in a considerable increase in positive media coverage of departmental activities and a far stronger public perception of Departmental views and policies.

Safety in the State's underground and open-cut gold mines was the single most important issue confronting the Department in the first half of 1990. This demanded considerable work by the branch and included the organisation of the Department's first full-scale media conference at Mineral House, a media tour to a major underground mining operation, and intensive work in the media relations area.

By the end of June, the branch had drafted the Department's first-ever media relations policy. This important initiative will formalise future procedures and practices for officers when providing information and comment to the media in a wide range of circumstances.

There was also a high level of activity in the publications and promotional area. The branch's graphic designers produced a number

Mr M (Murray) Meaton, BSc (Agric) Hons, BEc

Director, Royalties and Policy Development Division

"...the Communications Branch: Its goal is to educate and inform."

of high standard displays for use not only within the Department to increase inter-divisional awareness but also to highlight important aspects of departmental work at major industry forums such as the WAMEX Mining Expo at the Burswood Function Centre. A photographic competition, featuring the mining and petroleum industries in WA and organised in conjunction with the WA Photographic Federation, attracted considerable State-wide interest and was such a success that it is to become a regular event.

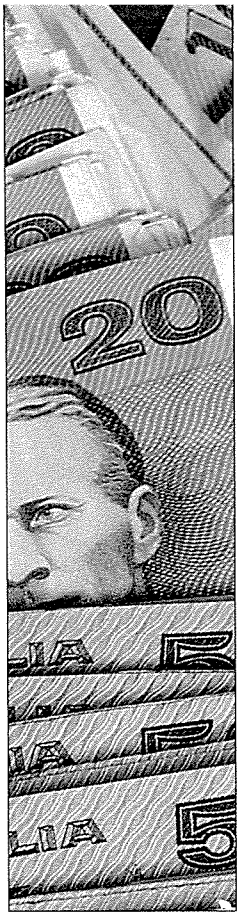
In the publications area a range of quality brochures, pamphlets and reports were produced to increase community awareness of the importance of the mining industry and the varied work of the Department.

Finally, the Branch worked closely with the Minister's Office and the Government Media Office, co-ordinating the release of media statements and providing considerable input into the drafting of Ministerial speeches and briefing notes.

The positive results achieved thus far by the Branch suggest that the initial effort is having the desired effect and that with the current expertise available corporate goals and objectives in the communications sphere will be met.

There is, of course, a long way to go in attaining an ideal outcome and many problems are yet to be confronted and overcome. However, the Department of Mines can look to the future confident that its story is now being told ... accurately and effectively.

Manager Communications Branch Chris Hawkins (right) developed public affairs programs for the Department during 1989-90. He is pictured here at a media interview by Channel 7 reporter Alison Fan of Chemistry Centre Director Dr John Hosking.



ROYALTIES AND POLICY DEVELOPMENT DIVISION

INTRODUCTION

The Royalties and Policy Development Division was established in July 1989 with the creation of two new branches to join the existing Royalties Branch. Now consisting of the Royalties, Policy and Communication Branches, the Division has 21 staff. They come from a diverse background and include accountants, economists, journalists and graphic designers.

Communications

Established in January 1990, the Communications Branch was set up to develop and maintain communications and public relations policies and procedures for the Department. The group's initial emphasis will be on media relations, an internal newsletter, publication of the Department's annual report and annual review, and displays. As procedures are refined and these activities streamlined, more attention will be given to production of departmental publications.

Policy and Research

The Policy Branch was kept busy during the year analysing issues pertaining to exploration and mining development policies in the State. This covers such areas as foreign investment, industry research, exports, and the contribution of mining to the economy. The branch also prepares ministerial and executive speeches, and ministerial briefing notes. Two statistical digests were again published, one for the calender year, the other covering the financial year period. These digests contain figures on individual commodity prices, levels of production, and royalty receipts. They also give details of quantity and value of minerals and petroleum by local government area and by individual mineral fields.

A comprehensive list of principal mineral and petroleum producers is also provided. A general overview of the world economy and the Australian economy is included as well as a brief review of the performance of each of the major commodities included in the digest.

COMMUNITY BENEFITS

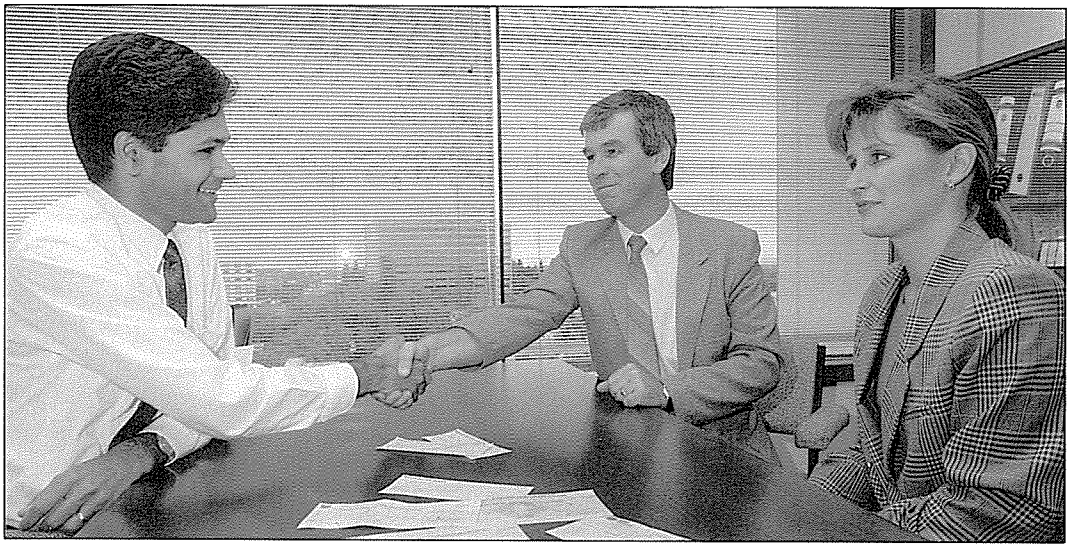
Total mineral and petroleum royalties received by the WA Government amounted to $264.22 million for 1989-90

Mineral Royalties

Mineral royalty payments for the year were $212.44 million, including iron ore additional lease rentals which are levied on tonnes of ore produced. Of the total collection 53% came from iron ore, 16% from alumina, 13% from diamonds, 9% from mineral sands and 5% from nickel.

The year's total was $59 million higher than the previous year due to large increases in the value of production for alumina, iron ore, mineral sands and diamonds. Alumina ($2 336 million) displaced iron ore ($2 242 million) as Western Australia's second most important mineral after gold because of a strong demand and significantly increased prices for alumina. However, the value of iron ore production also reached a new record level for the year. Gold remains the principle mineral produced and showed a further strong rise to yet another record level of an estimated 148 tonnes valued at $2 370 million. No royalty is payable on gold and hence the change in royalty payments did not reflect the increase in production of this commodity.

Two major mineral projects commenced operations during the year. The Channar iron ore project, a joint venture between China Metals Import and Exploration Corporation and Channar Mining Pty, is expected to ship



The Department of Mines gathered royalties worth in excess of $264 million during 1989-90. Here, Senior Royalties Officer Michel Crouche (left) is pictured receiving monthly royalty payments from Woodside Offshore Petroleum representatives Garry Brown and Trish Wilson.

six million tonnes of lump and fine iron ore per year to Chinese steel mills. The Tiwest Joint Venture which was officially opened in February 1990 is the State's first fully integrated mineral sands project. It consists of three stages - the mine and wet concentrator at Cooljarloo, a separation plant and synthetic rutile plant at Chandala and a titanium dioxide plant at Kwinana. These two projects are expected to generate around $9 million additional royalty revenue in 1990-91.

Increased audit activity and surveillance in the industrial and construction minerals area resulted in determination of over $100 000 additional royalty.

Overall a total of 142 inspections were completed at company offices.

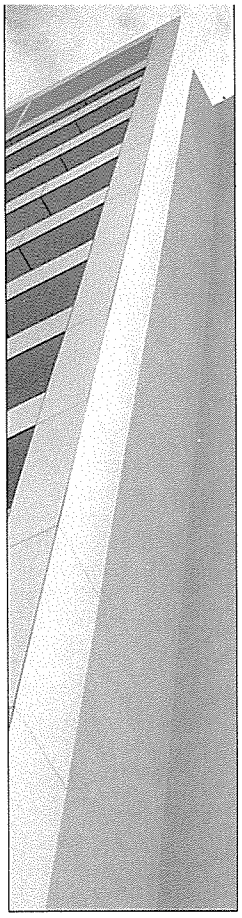
Petroleum Royalties

Total petroleum royalty payments made by petroleum projects based in this State rose from $40 million in 1988-89 to $89.4 million in 1989-90 (an increase of 124%). A combination of higher oil prices, higher production through the commissioning of the Saladin oilfield, lower capital expenditure on Barrow Island and the commencement of the North West Shelf's Liquefied Natural Gas exports to Japan accounted for the substantial increase in royalty payments.

Petroleum royalties paid into the WA Consolidated Revenue Fund (CRF) increased from $20.6 million to $51.80 million (up 152%). Included in the CRF payments is an amount of $12.2 million collected on behalf of the Commonwealth in respect of oil recovered from Harriet, North Herald/South Pepper/Chervil and Saladin. Adjusting for the Commonwealth share leaves a net WA share of $16.5 million in 1988-89 and $39.6 million in 1989-90 (up 140%).

A royalty agreement was finalised for the Harriet oil and the backlog of audit work completed. Agreements for another five projects are at an advanced stage with backlog audits already occurring.

Substantial progress was made in resolving issues which had been outstanding for some time with the North West Shelf participants. Audits of operating costs of this project are now up to date and the Department is maintaining a close liaison with the project operator in updating capital costs.



CORPORATE DEVELOPMENT DIVISION

Survival Awareness Training

New frontiers are broken every year in the continuing search for the mineral and oil treasures that lie trapped beneath the extensive land surface of Western Australia.

But, as geological ground parties push deep into the heart of WA, it is important they are prepared for any emergency that may arise.

Over the years, Mines Department personnel have crossed many frontiers.

In fact, they were among the first servants of the Western Australian Government to get involved in expeditionary work.

This involvement began late last century when temporary government geologist E.T. Hardman accompanied explorer John Forrest on his expedition to the West Kimberleys in 1883.

The trip proved most worthwhile because Hardman was largely responsible for the first commercial gold discovery at Hall's Creek, and this resulted in the government decision to establish the Geological Survey in 1886.

Today, the Mines Department has up to 30 people in the field at any time. They include field crews from the Geological Survey, inspectors and drillers from the Mining Engineering Division and staff from the Surveys and Mapping Division.

No detailed maps exist for some areas they visit, so it is important they are prepared.

As part of developing this preparedness, the Department's Occupational Health Safety and Welfare Committee this year organised a special series of survival awareness training courses for its field personnel.

A three-day course involving a total of 48 people took place last April.

Four divisions participated; the majority from the Geological Survey, with other participants coming from the Surveys and Mapping, Mining Engineering and Explosives and Dangerous Goods divisions.

After a half-day briefing, course participants travelled in convoy to a remote location near Gingin for some practical survival training.

The first lesson centred on basic survival techniques such as first aid and how to combat one of the local nuisances -- kangaroo ticks.

The training also covered map reading, navigation, radio communications as well as motor recovery and maintenance.

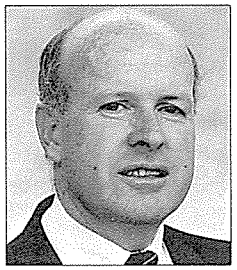
Having two-way radios in the field is considered a must for any remote excursion into the bush.

Mines Department vehicles are fitted with such equipment. Field crews can make radio contact with regional offices during normal work hours and they also have the capacity to telephone other contacts outside normal office hours.

Director of the Department's Corporate Development Division, Kerry O'Neil, described the survival training courses as a great success.

"Everyone learnt something — even some of the old hands who had spent half a lifetime working out in the sticks," Kerry said.

"The course also served a useful purpose in terms of boosting morale and helping staff to get a better understanding of the work of other divisions."



Mr K O (Kerry) O'Neil, MBA, AASA, Dip Pub Admin
Director, Corporate Development Division

"Everyone learnt something - even some of the old hands who had spent a lifetime working out in the sticks."

The Department of Mines has a very impressive safety record. In nearly 100 years of operation, it has never lost an employee in the field, although one person had to be rescued by a helicopter during an emergency situation.

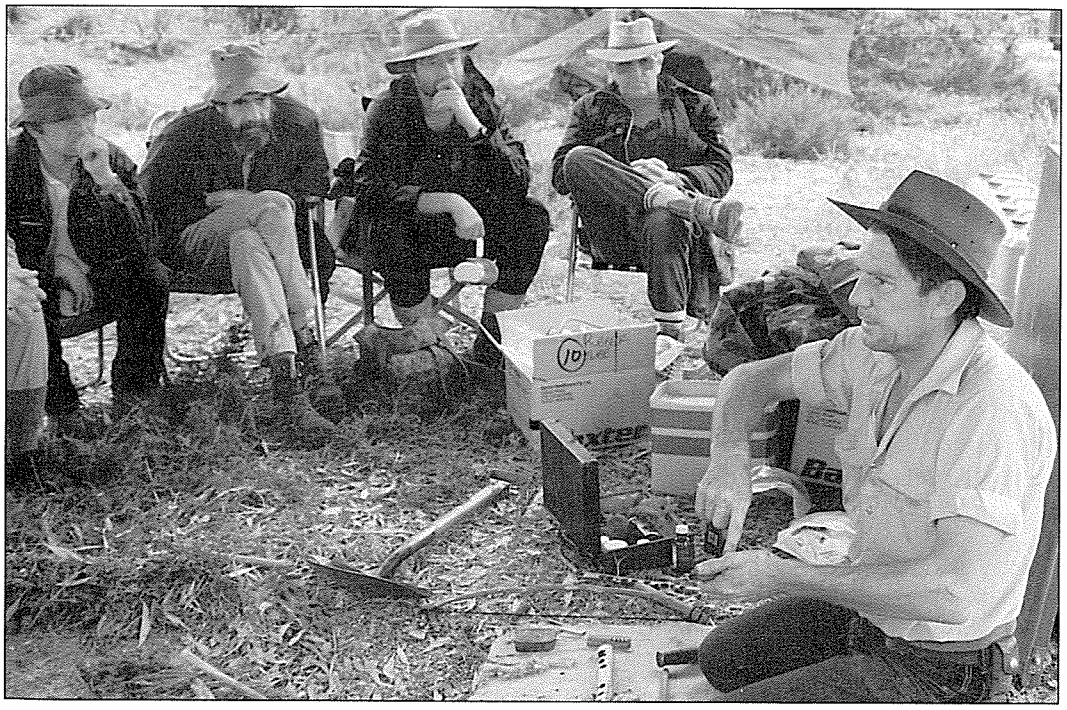
The Department has been keen to accept the many challenges laid down in the new Occupational Health and Safety Act.

Soon after the Act was proclaimed in 1987, a special committee comprising representatives from every division, and executive management, was established to develop a structured approach to occupational health and safety throughout the whole organisation.

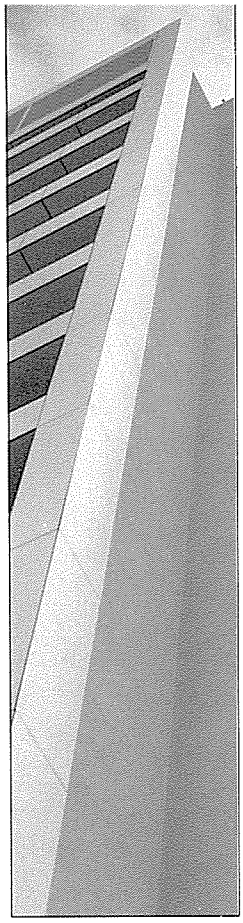
Major activities undertaken by the committee have included:

- the development of an accident/incident reporting system;
- development of a policy relating to smoking in the workplace;
- first aid training and survival training courses; and
- resolving issues such as air conditioning and lighting at head office.

Kerry said the net result was that people within the Department were generally more aware of the need to ensure that their working environment, both indoors or outdoors, was made safe and kept safe.



A professional instructor passes on bush survival skills to a group of Mines Department field workers during a special course last April.



CORPORATE DEVELOPMENT DIVISION

With financial and staff cutbacks occurring throughout Government, the Department has worked hard to improve its resource management.

This has been made more difficult with the delegation of several Government functions to the Corporate Development Division.

New responsibilities acquired by the division include the purchasing function from the Department of Services and certain staffing responsibilities from the Public Service Commission.

The changes have necessitated a particular emphasis in the division's corporate planning, human resource management and financial management activities.

Planning

A Corporate Plan for 1990-93 was developed and printed during the year and distributed to people and companies associated with the mining industry, together with all staff of the Department. Seminars were also conducted to allow members of the Department's executive to advise all staff of the corporate planning process, its relevance, and importance in determining the future direction of the Department.

With the introduction of Program Management into government, the Department has moved to integrate the corporate planning and budgeting processes.

By the end of 1989-90 a framework had been developed for program management based on a cost centre approach. Significant adjustment has been made at the component level of the plan, whilst retaining the program and sub program descriptions as detailed in the Corporate Plan.

A new operational plan will be developed early in 1990-91 based on the revised components of the Corporate Plan and will include the FTE and budget associated with each component.

Progress has been made in the development of performance indicators, with the emphasis being in areas where measures were inadequate. A comprehensive review of performance indicators, and their incorporation into quarterly reports will be pursued during 1990-91.

Human Resource Management

Following the previous two years of development and introduction of a range of human resource initiatives, the year was a period of consolidation.

The Public Service Commission continued its devolution of powers and the Department was able to successfully integrate these new personnel functions.

Staff turnover was reduced by around 25% on the previous year with 157 staff resigning or retiring. On the other hand, consistent recruitment and training efforts have enabled the Department to maintain a high level of expertise and increase its stability with a total of 172 new staff being recruited.

Training initiatives were continued with more than 1 180 staff attendances at various management and technical seminars, workshops and courses.

A new video and computer-based training program was introduced for staff and proved to be very beneficial and well patronised.

The Human Resources Branch continues to work closely with the Office of Executive Personnel. Senior Executive Service representatives within the Department have participated regularly in executive development program and seminars.

For the first time a survival awareness course was conducted for selected field staff.

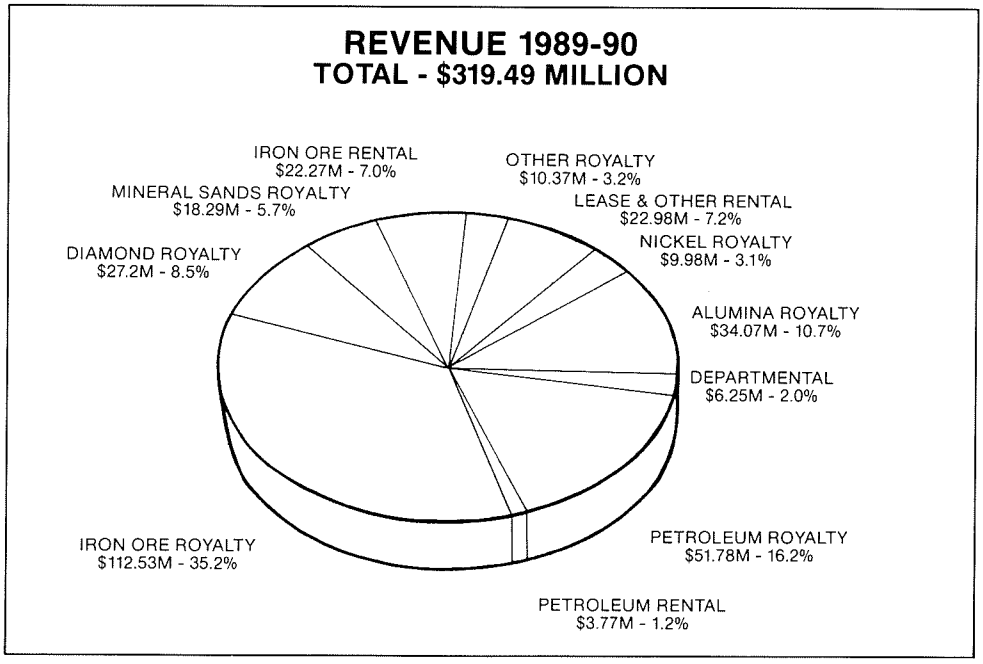
Staff evaluation processes were further developed and performance management systems installed in most divisions.

Through the Health and Safety Committee, considerable emphasis was given to promoting and implementing health, safety and welfare initiatives within the Department. These included training for the first aid attendants and welfare consulting services.

The Department has prepared and implemented an Equal Employment Opportunity Management Plan. This was endorsed by the directorate and action plans implemented.

Financial Management

Significant progress towards the implementation of program management was achieved with the structuring of the Department's budget within discrete programs developed through the corporate planning process. The first phase was completed in April, with the 1990-91 estimates being submitted to Treasury in program format and with the 1989-90 budget estimates redrafted to reflect program budgets. The process of program management will ultimately provide greater flexibility in allowing managers to manage and allow "one line" appropriations, lessening some of the financial constraints and rigidities imposed by the present system of appropriations and, at the same time, increase accountability.



However, as with all State Government departments, the Department of Mines' financial statements are prepared on a cash basis in that only collections received and payments made are included.

Revenue

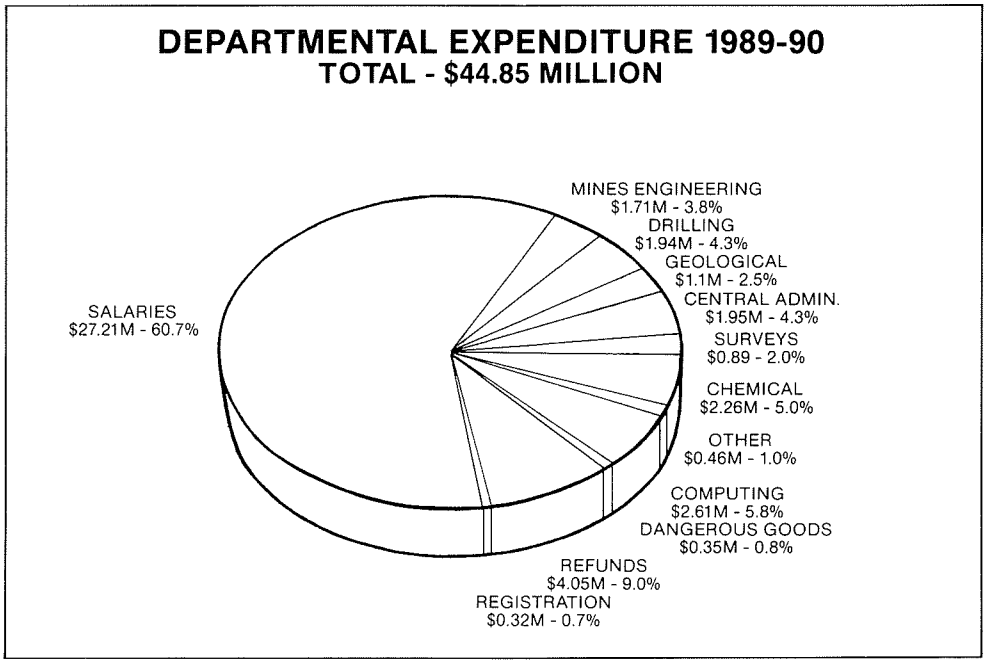
During the financial year the Department was responsible for the collection of $319.49 million through the Consolidated Revenue Fund, this being a substantial increase on the previous financial year's 1988-89 collection of $226.45 million. This comprised largely mineral and petroleum royalties (83%) collected from companies operating under State legislation. Part of the revenue was also payments collected by the State on behalf of the Commonwealth for petroleum produced within Commonwealth waters. These receipts, subsequently, were paid to the Commonwealth by way of special purpose payments.

In addition to royalties, the Department collected lease and other rental charges and departmental revenue. The latter, while considerably less as a proportion (2%) was still significant ($6.3 million) and represented charges for goods and services provided by the Department.

The departmental revenue largely originated from charges associated with the Registration, Explosives and Chemistry Centre divisions.

Expenditure

Funds are appropriated by Parliament through the Consolidated Revenue Fund to provide for the operating costs of the Department. This appropriation includes



provision for minor works as well as refunds of revenue collected in previous financial years, and expenditure relating to activities of the mining and petroleum industries which are not operating costs of the Department. For example, costs associated with the Western Australian Coal Industry Council are included. This Council provides a forum at which unions, coal mining companies and Government meet to gain a better understanding of industry needs.

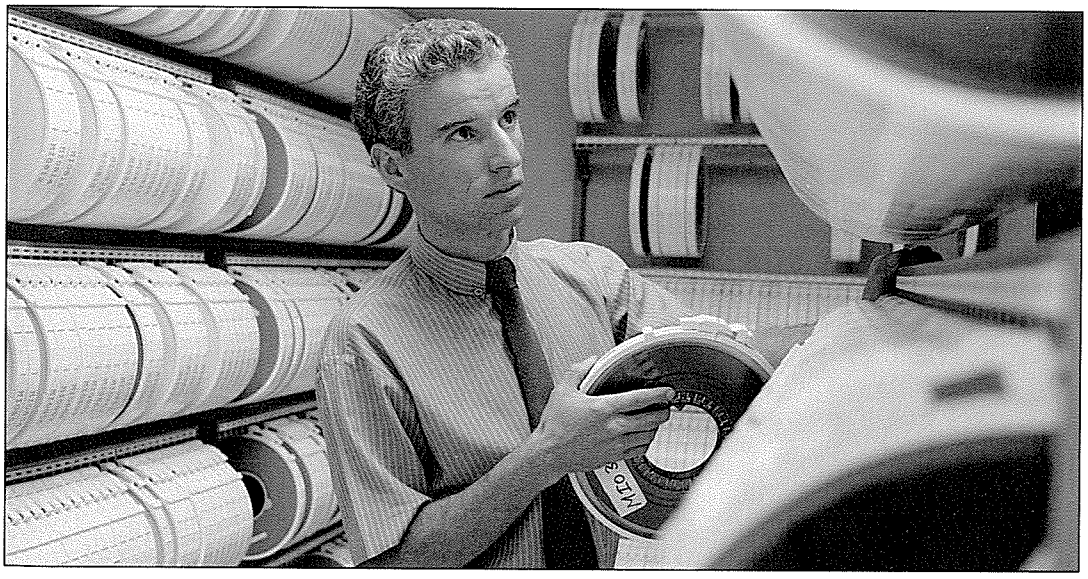
Expenditure of $44.85 million was financed through the Consolidated Revenue Fund in 1989-90. This related mainly to salaries, wages and allowances (60.7%) and central administration (19.4%).

All expenditures incurred by the Department of Mines in the provision of services are not appropriated to the Department. The employer's share of superannuation pensions is met by Treasury. Rental of office accommodation is met by the Office of Government Accommodation. Maintenance of government buildings and some power costs are met by the Building Management Authority. The servicing of the Department's General Loan and Capital Works Fund debt is met by Treasury.

Pricing Policy

The Department has, in the main, adopted a full-cost recovery, user pays approach in determining fees and charges for services provided to the public and industry. With some services, where there is considered to be an element of "service to the general public", a nominal fee has been determined. However, this represents only a small fraction of services provided and has minimal impact on revenue.

To further refine and enhance the full cost recovery, user-pays policy, the Department has begun a comprehensive review process. This will ensure that fees charged are appropriate, and that where necessary, commercial cost



Mainframe computer operator Chris Fielding files away a magnetic tape in the Department's Computer Services Branch.

Information systems clerk Veronica Hall returning one of the new colour-coded files which was introduced by the Department's Records Services Branch this year.

accounting systems are developed and implemented throughout the whole organisation during the 1990-1993 triennium.

During 1989-90, a comprehensive review of fees and charges levied by the Chemistry Centre was conducted. A revised cost accounting framework was developed to determine appropriate hourly charge rates, and standard costings were reviewed for the wide range of services provided for implementation in 1990-91. In addition to charging for services provided to non-government clients and government trading concerns, a system of notional charging has been developed for services provided to other government agencies in 1990-91. This initiative is a precursor to charging for services provided to these agencies by the Chemistry Centre if the government decides to implement this procedure.

Management Services

Support to the Corporate Executive to improve resource management was achieved by changes in the purchasing operations as well as a range of reviews covering existing activities.

From 30 June 1989 the Department assumed responsibility for its own purchasing and disposal of goods and services. This responsibility was devolved by the Department of Services following a successful trial period in the Department. The operations were further reviewed after six months operation with the results fully supporting the devolution decision.

Further improvements in the purchasing process are expected with the introduction of a corporate card to replace the local purchase order system. This will assist in faster payment of creditors and a simplified record monitoring system.

A number of reviews were completed during the year designed to evaluate and improve performance. These included reviews of the Department's Internal Audit Section, computerized Asset Register and procedures for the loss, damage or destruction of Crown property. Planning for the implementation of an energy management plan within the Mineral House complex was also completed.

During the year significant effort was directed at building related occupational health and safety issues within the Department, and $500 000 was allocated for initial planning of the proposed Chemistry Centre complex and associated CSIRO Mineral Research facility at Bentley.

Information Systems

Computing

After three years of planning and progressive development, the Department completed installation of its regional network during the last quarter of the year. Thirteen regional centres ranging from Collie to Kununurra now have direct and rapid access to a number of computer-based systems. This network, which uses the most advanced communications and computing technology, is operational nine-hours per day. It has provided a very high degree of reliability to regional centres.

In addition to the on-line enquiry services originally offered, the Department has now added a direct update facility on a number of

databases. This facility will ensure that systems such as those handling tenement applications, title information, tenement rentals and expenditure data will have the advantage of immediate update from a regional office. This will reduce clerical effort and provide more up-to-date information to the public and industry.

As additional systems are developed and further data added to existing databases the regional network will provide an increasingly important service to the community.

Emphasis has been placed on providing computing systems which service the mining industry better, and during the year the addition of new systems and expanded databases in the petroleum exploration, mining tenement, mine site and mine safety areas has generated a significant increase in the use of departmental computing facilities. Some 25 000 on-line inquiry and update transactions are now being handled daily by the computing network. The expanded mining tenement information system which includes TENDEX, PLANMON and TRAXS now handles over 7 000 transactions per day with a large percentage of these arising from public and industry enquiries.

The Department is confident that with the continuing enhancement of databases covering all areas of its operations the level of service provided to the mining and petroleum industries will further improve. This additional usage of Departmental services by industry, and the resultant generation of direct revenue, will assist on the financial justification of the planned further development and enhancement of computer-based services.

Word Processing

The Department is now committed to phasing out the existing Wordplex word processing System between 1990 and 1992 and replacing it with microcomputers. This will provide a more integrated service throughout the divisions. Microsoft "Word for Windows", an upgraded easy to use version of MS Word, is to be the standardized word processing package for the Department.

Records Management

In 1987-88 substantial increases (13%) were experienced in the amount of incoming correspondence, the number of tenement and general files created and the volume of mail despatched. This level of activity was maintained during 1988-89 and again this fiscal year.

However, during 1989-90, a number of new initiatives have been undertaken to improve records management within the Department and their implementation has significantly impacted on the work volumes within the Records Services Branch.

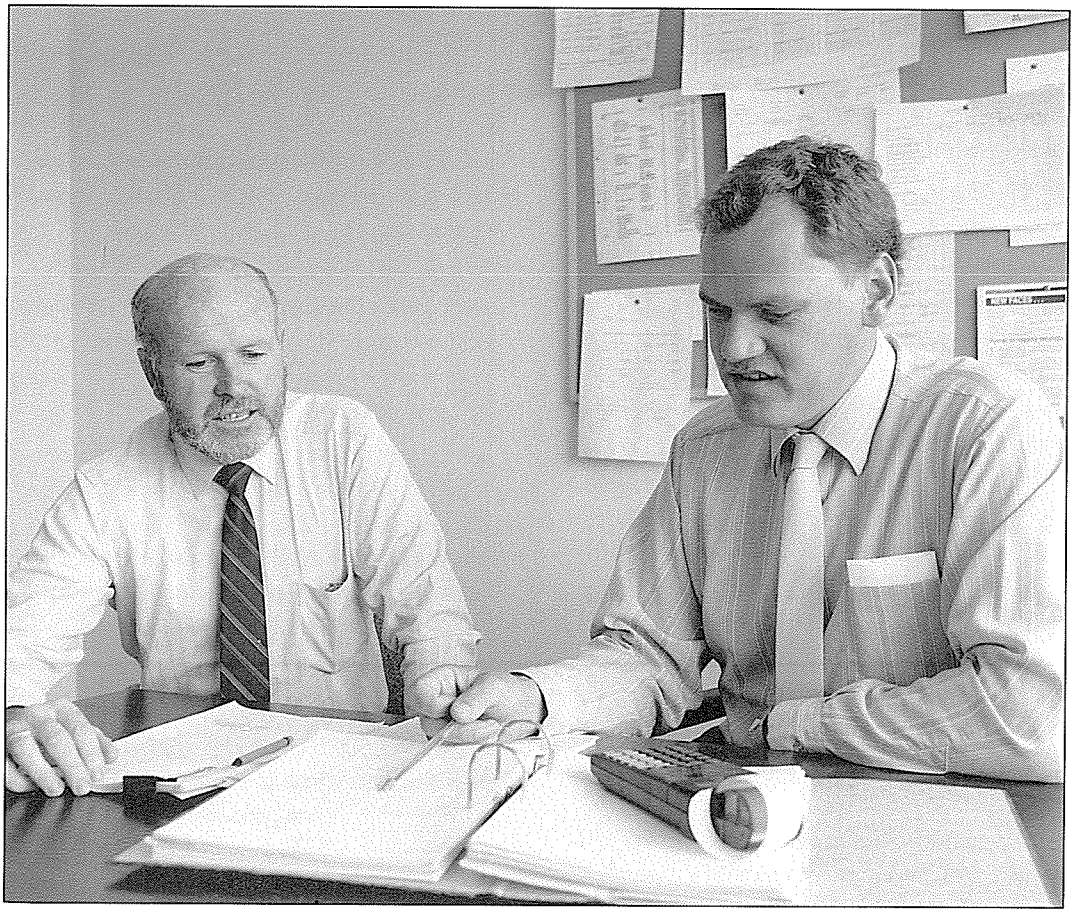
One of these initiatives is the concept of "project files", whereby all correspondence and records dealing with various aspects of a project are classified under the project title and files are created under established protocols. During 1989-90 approximately 30% of files were converted to this system.

Further opportunities to improve records management were identified in a major review of the Department's records services. This review was conducted by consultants in the latter half of 1988-89. As a result, new procedures and practices have been established, the filing classification system is being updated, lateral colour- coded file storage is being introduced, file covers are being converted to include face action sheets and coloured covers are being assigned to project files.

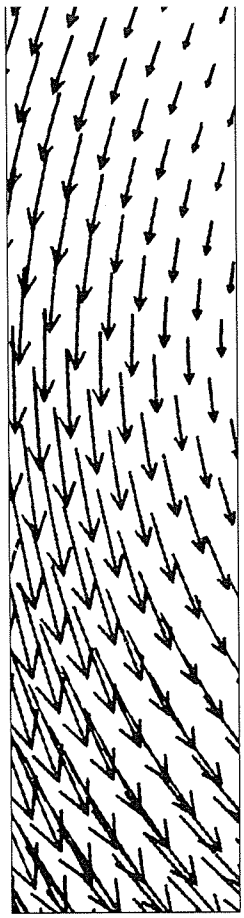
Internal Audit

A strategic audit plan detailing the audits to be conducted over a three-year period was endorsed by the Audit Committee and authorised by the Director General of Mines.

During the year three system-based audits were carried out in accordance with the strategic audit plan. In addition, a value-for-money Audit of the Drilling Branch of the Mining Engineering Division was completed.



Keeping a close eye on the Department's accounting procedures are Corporate Development Director Kerry O'Neil (left) with internal auditor John Roberts.



Underground Gold Mines Safety Inquiry

Mr J M (Jim) Torlach, BE (Min), MAustIMM
Director, Mining Engineering Division

"...a hands-on investigation with people from all quarters of the industry presenting their views - all aimed at finding solutions to the problem."

A number of positive initiatives have been developed or given impetus as a result of the inquiry which was triggered by last year's heavy toll of fatalities in the Western Australian mining industry.

Though last year's spate of deaths came at the end of a decade which had seen a steady improvement in mine safety – for example, there was an all time record low tally of four fatalities in 1986 – the bad run of accidents highlighted problems, and generated an adverse reaction in the community. The Minister for Mines, after consultation with the Department of Mines, instigated a formal inquiry into safety in underground gold mines in Western Australia, as a consequence of the events in 1989 in that sector of the industry.

The inquiry, led by State Mining Engineer Jim Torlach, was the most comprehensive targeted investigation in the State's mining history.

"It was very much a hands-on investigation with people from all quarters of the industry presenting their views — all aimed at finding solutions to the problem," he said.

"Dilution of experience" was evidenced as a problem when iron ore and nickel producers expanded rapidly in the 1970s, and this had obviously been an adverse factor during the gold 'boom' of the eighties. However, this was not the only factor. The full range of matters impacting on safety performance was brought out in the Inquiry Report. One of these factors was the need for increased resources for the Mines Inspectorate.

The inquiry that followed in February 1990 was conducted in two stages. The first involved key officers from the Department of Mines gathering information from individuals and groups involved in the industry.

This was used to develop the second stage of the inquiry which involved conducting formal interviews with statutorily appointed management officials, supervisors, contractors, safety representatives, unions and workers in the mining industry.

Mr Torlach said the conduct of the inquiry in itself had a substantial effect on the level of safety awareness in the underground sector of the gold mining industry.

He said the inquiry had hit home the point that good safety management performance could only be achieved by allocating the same level of resources and effort required to plan, schedule, organise and control the economics of a successful mining operation.

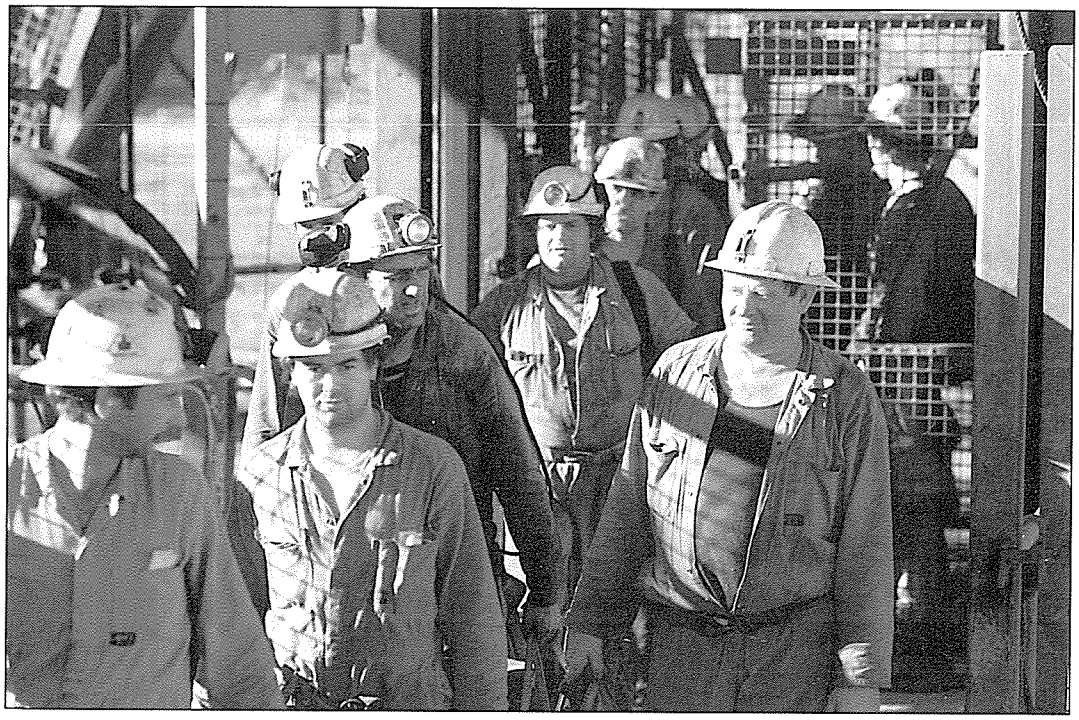
A report on the inquiry was distributed throughout the industry. It had been widely acknowledged as a very relevant and practical report, not only in WA, but also in the Eastern states and overseas.

Up until 30 June 1990 there had been insufficient time for many of the 72 recommendations to be implemented. However, Mr Torlach said a systematic approach was being taken regarding the implementation and monitoring of the recommendations.

These programs included:

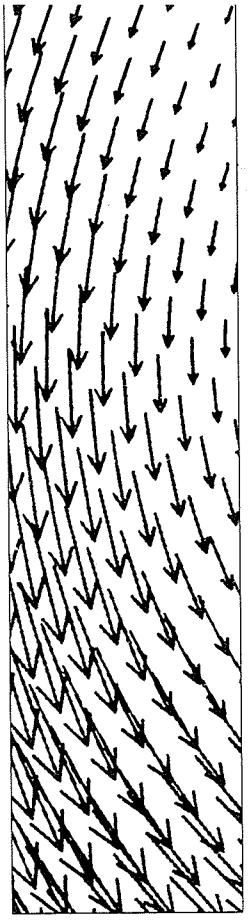
- the strengthening of resources and staffing within the Mines Inspectorate, to provide the level of service required by an expanded industry;

- efforts to promote better communication and consultation between management and mining workforces;
- the acceleration of education and training programs, including refresher training, for all mining personnel; and
- the publication of a regular safety newsletter and a range of documentation on specific issues for more than 33 000 people employed in the WA mining industry.



Above: One of the dedicated teams participating in the first-aid phase of the annual mines rescue competition in Kalgoorlie.

Left: Underground miners emerging from ACM Gold Limited's Golden Crown mine at Cue. Their safety, like that of 33 000 other people working in the WA mining industry, is of vital concern to the Department of Mines.



MINING ENGINEERING DIVISION

INTRODUCTION

The tragic run of fatal mining accidents in Western Australia — 19 for the 11 month period to middle of February 1989 — brought a sober reminder of potential dangers within the industry. The government responded by agreeing to a detailed inquiry into safety in underground gold mines. Government established a consultative steering committee to guide the inquiry which was conducted by the State Mining Engineer, Jim Torlach and the Senior Inspector for the State, Dave Collie. The report was released at the end of June 1990 and contained many recommendations.

EXPLORATION AND DEVELOPMENT

Geological Data Collection

In 1989-90 the Drilling Branch drilled 143 bores totalling 12 191 metres and administered contract drilling of 37 bores totalling 820 metres to give a total production of 180 bores and 13 011 metres. Aquifers were intersected in most of the bores.

Of the total, 138 bores (11 234 metres) were funded from the departmental budget. The remainder were paid for by other government departments and instrumentalities.

A major part of the year's work was exploratory drilling to provide basic data for assessment of the State's groundwater resources, and for stratigraphic mapping.

Other work was carried out on land salinisation studies and groundwater pollution monitoring.

The Branch also supervised the construction by contractors of multiport pollution monitoring bores for local government bodies at six sites .

Wireline operations of various types were carried out as follows:

- Major aquifer pump testing — two, long-duration tests
- Borehole TV scanning — 11 bore scans
- Casing perforating — 17 strata intervals
- Sidewall coring — 11 bore sections
- Geophysical logging — 15 bore surveys.

Members of the inquiry group that investigated safety in the State's underground gold mines. From left to right are: Secretary Karen Buxton; Chamber of Mines and Energy representative Jack McDermott; Jim Torlach; the AWU's Joe Isherwood and health and safety specialist Cam Gilmour.

During the year the Department's geophysical logging equipment was transferred from Geological Survey Division to the Drilling Branch, which combined all the wireline operations into one service unit.

A notable event was a pumping test of an aquifer in the Merredin district which was conducted in conjunction with land salinisation investigations. The test was controlled and information recorded with electronic equipment using computer software developed for the purpose. Water levels in 34 bores were measured continuously and recorded along with pumping rates, water conductivity and temperatures, ambient temperatures and barometric pressures. Data from the seven-day test was recorded on a computer disc for analysis.

Geotechnical and Mining Engineering Advice

During the year considerable formal and informal advice was given to various mining operators and industry bodies. Details regarding many of these are given later in this review.

COMMUNITY AND THE ENVIRONMENT

The planning development committees in the Yilgarn and Leonora continue to operate. The informal group in Laverton meets on a six-monthly basis. The Yilgarn Committee commissioned a consultant's report on the physical environmental effects of mining in and around the Southern Cross township. The final report is being reviewed by a subcommittee and will be presented to the full committee in late 1990.

The Leonora Committee is examining proposals for both a by-pass road around the township, and solutions to water supply problems in the region.

The Division continued its representation on land conservation committees in the pastoral zone.

The Western Australian Coal Industry Council (WACIC) was set up in 1987 to provide a means of consultation between all parties involved in the State's coal mining industry.

The Council met on four occasions during the 1989/90 financial year. At the August meeting, the final report from the consultants carrying out a study into the future development of the Collie coalfield was tabled.

Following adoption of recommendations contained within the Bird/Shoebridge report into mines rescue on the coalfield, the Council agreed to its Mines Rescue subcommittee being abolished.

The Council's Economics subcommittee met seven times during the year, and the Occupational Health Safety and Welfare Subcommittee met on six occasions.

The number of submitted Notices of Intent rose from 126 in 1988-89 to 186 in 1989-90 an increase of 48%. The total number of operating mines rose from 289 to 435.

Proposals were reviewed for 146 new mining operations, with 40 mines applying for approval to expand. The following table lists the number of proposals by mineral type:

	NEW	EXPANSION	TOTAL
Gold	93	31	124
Mineral sands	2	2	4
Silica and lime sands	-	9	9
Gypsum	-	8	8

	NEW	EXPANSION	TOTAL
Iron ore	3	2	5
Nickel	4	-	4
Diamonds	1	-	1
Coal	1	-	1
Others	26	4	30
TOTAL	146	40	186

The figures above include 11 projects which were formally assessed by the Environmental Protection Authority: five Environmental Review and Management Programs, four Public Environment Reviews and two Consultative Environmental Reviews. The Division co-ordinated the departmental responses to these documents.

The Division chairs a liaison group to guide the research work being undertaken through the Department of Agriculture for a MERIWA project jointly funded by industry and MERIWA. The research group, based in Kalgoorlie, has increased the scope of the Kalgoorlie waste dumps/tailings research work and broadened it to include the Northern Goldfields and Mt Magnet areas. The research group continues to investigate revegetation of saline waste dumps using chenopods and other native species.

A video titled "A Stake in the Future" was produced by a commercial film group and will assist the industry with planning and management of the environmental aspects of mining operations. The video was funded by the Chamber of Mines of Western Australia, AMIC, EPA, CALM and the Department of Mines. The video is used to promote environmental management to mine managers and environmental officers. A video on environmental management of exploration projects is also being produced.

Environmentally, the effectiveness of the Division's emphasis on rehabilitation programs is now evident in most gold mining centres with the progressive transformation of steep-sided waste dumps into gently rounded hills sprouting native shrubs and trees. During the year a firm stand was taken to ensure that money will be available for rehabilitation in default of a proponent, and a policy of "no bond, no start" is now in place.

WORKER AND PUBLIC SAFETY

Mine Safety Legislation

The Mines Regulation Amendment Bill 1989, incorporating the essential provisions of the Occupational Health Safety and Welfare Act (involving the general duty of care provisions and the requirements for health and safety representatives and committees), passed through the Legislative Assembly on 6 December 1989. The Bill awaits the second reading debate in the Legislative Council.

The Coal Mines Regulation Amendment Bill 1990 passed through both houses of Parliament in June 1990. The Amendment Bill:

- creates the statutory management position of Opencast Mine Undermanager and prescribes minimum qualifications necessary to satisfy the Board of Examiners.
- provides for recognition by the Board of Examiners of experience gained in opencast mines and quarries other than coal mines.
- requires all candidates and applicants for statutory certificates of competency issued by the Board of Examiners to pass an examination on WA mining laws, and
- deletes the prohibition of employees from working more than seven consecutive hours

or more than 42 hours per week in underground mines.

A new Bill titled The Coal Mines Bill 1990 is currently being drafted. The Bill is a complete re-write of the Coal Mines Regulation Act 1946-76 and will replace the current Act and Regulations.

Ventilation

A total of 334 new permits for underground use of diesel engines were issued during 1989-90. Thirty were issued in Karratha Inspectorate, 247 in Kalgoorlie and 57 in Perth.

Fibrous material was discovered in an open-cut gold mine and positively identified as actinolite (asbestos). As a result, safe work procedures at the mine were established by a tripartite group and successfully implemented. Subsequent fibre sampling indicated that the procedures imposed are effective in reducing the risk of asbestos exposure to within the limits specified by Worksafe Australia.

A review of safe work procedures for handling of compressed asbestos fibre gaskets within various alumina refineries was carried out during the year.

A number of variations were made in atmospheric contaminant sampling quotas to reflect changes in the mining operations. The changes prompted mining companies to appoint additional ventilation officers assisting the managers to meet the requirements of Parts 8 and 14 of the Regulations.

Four meetings of the tripartite Ventilation Board, established under the Mines Regulation Act, were held during the year. The board visited sites at Leinster, Windarra, Kambalda, Norseman and Kemerton to observe and discuss specific matters relating to ventilation and atmospheric contaminant controls.

The Mines Medical Officer presented the following data from the Perth Chest Clinic:

- New applicants for Miners Health Certificates 7 315
- Re-examinations 5 473
- New cases of silicosis identified at re-examination. 0

Occupational Noise

Draft regulations relating to hearing conservation in the mining industry have reached an advanced stage of development. It is intended that these regulations will be written into Part 9 of the Mines Regulation Act Regulations.

The proposal is consistent with the intent and meaning of the DOHSWA regulations, except for the introduction of modifications to conform with the Mines Regulations Act provisions for statutory responsibility and application.

Guidelines will accompany the proposed regulations. The aim is to promote the implementation of effective hearing conservation programs in mines to prevent mine workers from noise induced hearing loss.

Electrical

Special Inspectors of Mines (Electricity) carried out a record 935 inspections of mining operations during the year and submitted 447 notifications of electrical defects to registered mine managers. The level of inspection activity represented a 13.5% increase over the

previous year. Inspectors endeavoured to ensure that mining operations were inspected at least twice a year.

A total of 256 submissions from mining companies relating to approvals, exemptions and appointments were received and processed.

Mechanical - Structural

The amended regulations for classified machinery in mines resulted in a substantial increase in the need to assess repairs and modifications. More than 50 submissions relating to repairs and modifications were processed and approved, and a new data base developed for the recording of associated information.

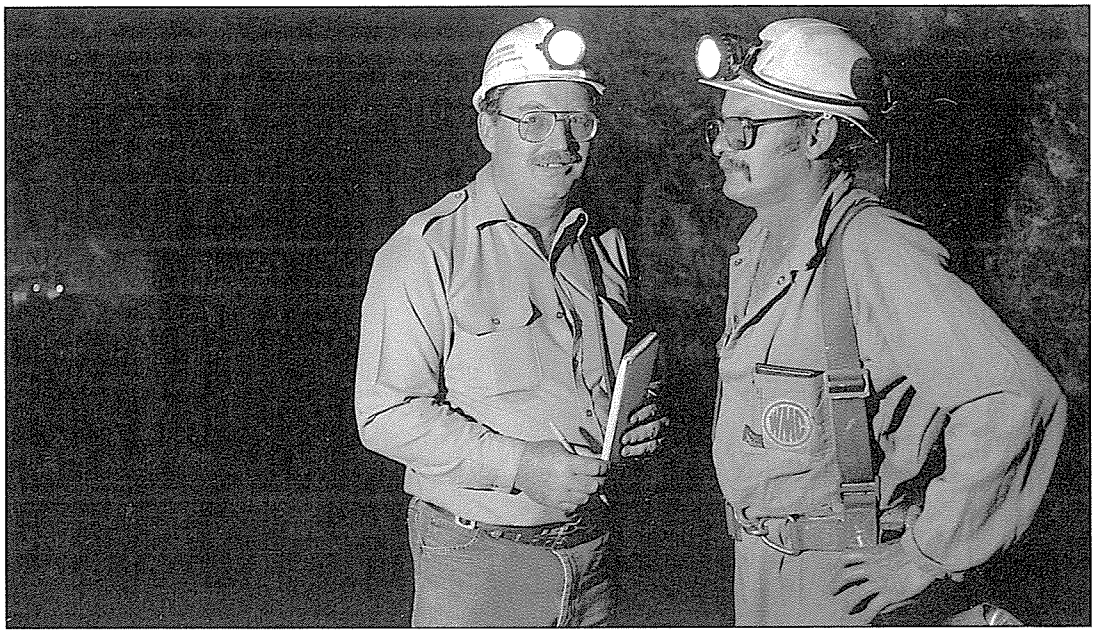
A new "approved persons" system for statutorily required inspections of classified machinery on mine sites was established. A total of 25 people, other than departmental inspectors, have been approved to carry out these statutory inspections on six specific mines.

A total of 12 hoists and winders were assessed and approvals granted. Six fixed-head frames, six transportable head frames and 15 associated structures were checked and approved.

Chemical - Metallurgical

Chemical inspections of over 100 processing plants were carried out during the year. Practices and operating conditions were assessed, and action taken to ensure that safety standards were complied with by those handling chemicals on mine sites.

Guidelines for the handling of cyanide solution have been issued, and actions taken to improve the storage of cyanide in anticipation of impending Dangerous Goods Regulations.



The Department's Principal Mining Engineer Terry Fisher (left) chats with WMC's Mine Foreman Charlie Cullen at the Lanfranchi nickel mine at Kambalda.

Problems arising from arsenic and mercury as by-products in the gold industry were successfully overcome following advice from divisional officers.

Chemistry Centre officers assisted in chemical inspections of the iron ore and salt mines in the Pilbara.

Railways

The transfer of responsibility for regulating locomotive engine drivers on mines from DOHSWA resulted in 47 Certificates of Competency being issued by the Department.

Robe River Iron Associates introduced single-manning of their ore trains during the year. This policy met with some resistance, and Robe River decided to adopt the policy on an "as-required" basis.

Both Mt Newman Mining Co and Goldsworthy Mining undertook the task of revising their respective railway operating rules.

Radiation

The Radiation Secretariat Section continued its work on education, promotion and related activities. The administration of the Mines Radiation Safety Board also absorbed a considerable proportion of section resources.

Formal radiation inspections were carried out at mineral sands mining and processing sites, with inspections focussing on dry separation plants. Major defects observed in the operation of the separation plants related to dust and spillage control. All plant sites are engaged in extensive capital works programs which involve the installation of sophisticated dust extraction and spillage control equipment. These programs are nearing completion and considerable reduction in the concentrations of airborne dust is expected across the industry.

Work continued on characterising the particle size of dust at mineral sands plants which confirmed that the dust is of a relatively coarse nature and is typically greater than 10 microns. Research work was also undertaken on the effectiveness of respiratory protection in a workplace setting. Research work confirmed that significant protection is afforded against airborne dust when dust masks are worn, even when the masks are worn intermittently. While values based on rigorous scientific measurement will provide the basis to replace default values based on judgement, the application of an alternative particle size factor and the use of protection factors for dust masks proved controversial. The research implies that present assessments of internal radiation doses may overstate the actual radiation dose received.

Data verification and quality assurance checks on industry's monitoring techniques and analytical procedures are an important aspect of the section's work. These checks provide assurance that the measurement protocols used by the industry are valid.

Apart from routine surveillance activities, monitoring of the remedial clean up work being conducted at Wonnerup and beach mining at Minninup continued. Inspection confirmed that these operations have been successful in restoring radiation levels to "background" values.

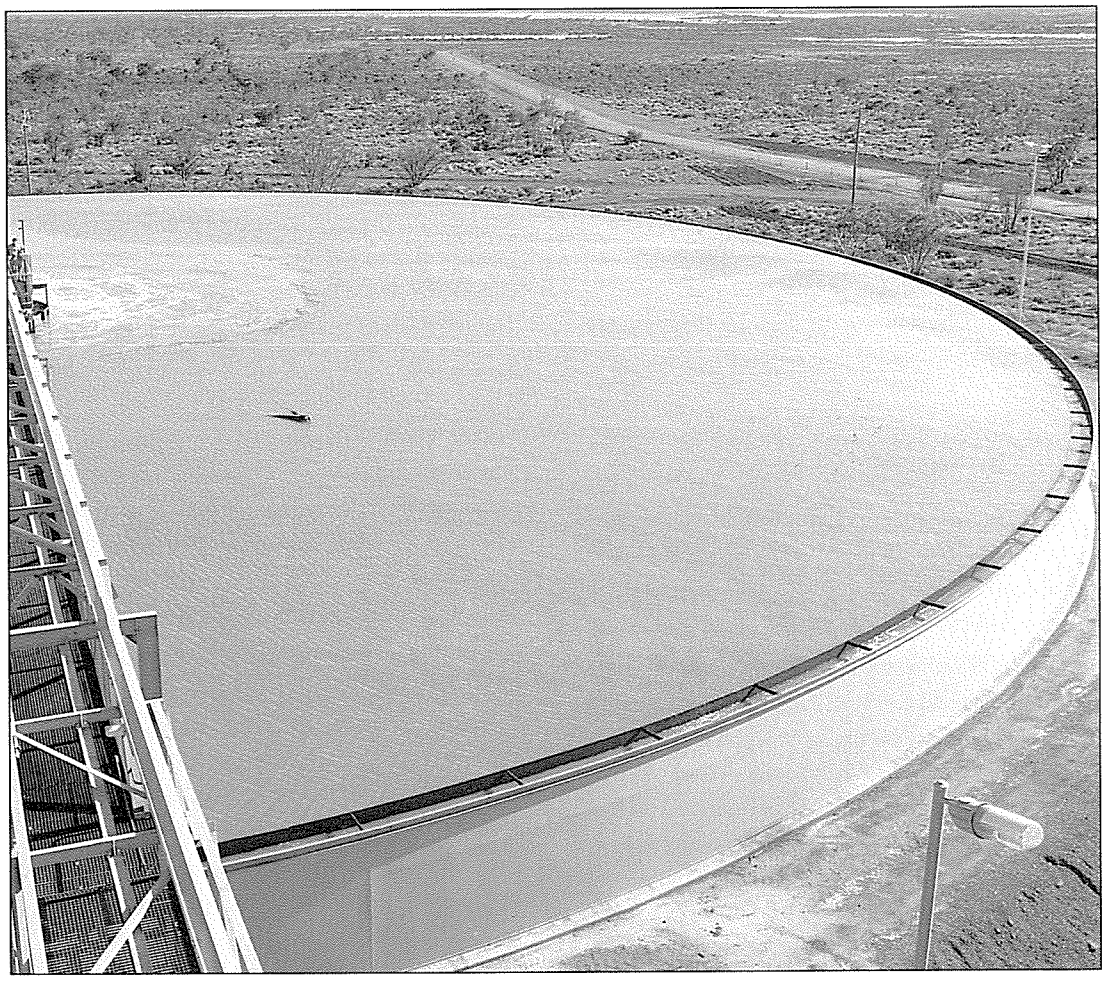
The technical audit of radiation safety in the mineral sands industry, commissioned by the Minister for Mines last year, was not

completed at the time of writing. A final report is expected to be with the Minister before the end of July 1990.

AXTAT

The AXTAT computerised accident recording system managed by the Research and Technical Services Branch, has been in operation for three and a half years. The system, installed on the Department's mainframe computer, contains information on all the accidents that resulted in work days being lost in W.A. mines since January 1987.

The report, now named "Fatal and Lost-Time Injuries in Western Australian Mines", is published every six months, and gives a statistical breakdown of all lost-time injuries.



A thickening tank, part of the big Kaltails slime dump retreatment project on the southern outskirts of Kalgoorlie-Boulder.

CONTAM

The CONTAM system, which monitors atmospheric contaminants, had more than 39 000 samples added to its data base for the year. Results were reviewed by the Ventilation Board to assess exposure to gas, fumes and dust by mine employees.

The redevelopment of the CONTAM System to CONTAM 2 continued during the year. It is anticipated that CONTAM 2 will be fully operational by January 1991. The main advantage of CONTAM 2 over CONTAM is its simplicity and flexibility of operation.

Pitwall Failures

As the year progressed, an increasing incidence of open-pit wall failures also became a matter for concern. A random survey of 54 operating gold mine pits (representing approximately 25% of the total gold pits being worked in the State) revealed that pre-mining geotechnical studies had been undertaken on only 20%. Of these, approximately one quarter suffered major wall failures. Of the remaining 80% of pits that carried out no geotechnical studies, approximately half suffered major wall failures.

During June, plans for a campaign designed to alert the industry to the problems associated with inadequate pit design were drawn up. Geotechnical experts from the Geological Survey Division commenced a series of lectures and seminars for mine managers. Seminars for supervisors, geologists and other interested personnel will follow.

Geotechnical experts also accompanied district mining engineers and inspectors on a number of inspections to provide in-depth expertise in the field. In the course of the year, several pits were closed until remedial measures had been effected.

Board of Examiners - Coal

The board met four times during the financial year and issued 13 certificates of competency including three for first-class mine managers, one for second-class mine managers, four for third-class deputies, two for open-cut mine managers, and three for open-cut deputies.

Board of Examiners - Metalliferous

The Board of Examiners met seven times during the financial year: four times in Kalgoorlie (first-class and underground supervisors) and three times in Perth (quarry managers).

A total of 457 candidates sat for examinations during 1989-90, but not all had been assessed at the end of June.

During the year the boards issued the following Certificates of Competency:

First class	41
Underground supervisors	96
Quarry managers	34
Restricted quarry managers	32

Mines Survey Board

The board met four times during 1989-90 and 14 Authorised Mine Surveyor's Certificates were issued.

Additional details relevant to the certificates issued by the various boards are incorporated in the statistical summary.

Information Initiatives

Two ventilation officers' courses were conducted during the year. Both courses were designed for surface ventilation officers and were conducted in Perth. The courses were presented by divisional officers and were attended by 53 people.

A short seminar on asbestos products handling and removal was conducted by the divisional occupational hygienist in the workshop of Griffin Coal Mining Co. The course was attended by 95 participants. The division also assisted in the development of training programs for future Radiation Safety Officers to be conducted by the WA Chamber of Mines and Energy.

Fatal Accidents

There were 10 fatalities in the mining industry for the year to the end of June 1990. All persons killed worked in metalliferous mines. These are detailed in the statistical summary.

Prosecutions

There were nine prosecutions for offences against mining legislation during the year ended June 30 1990. Details are in the statistical summary.

CORPORATE SERVICES

Staff

Mr Ian Loxton, Regional Mining Engineer in Kalgoorlie, retired on 27 October 1989 after 28 years of service with the Department. Mr Jim Boucaut was appointed Regional Mining Engineer (Kalgoorlie) in December 1989.

During the year there were 11 resignations and 16 new appointments (13 professional/technical and three clerical support staff). The shortage of inspectorate staff impacted adversely on the Divison's ability to fulfil its functions adequately during the year, in particular the conduct of regular and thorough inspections on mine sites. However, following the inquiry into underground gold mine safety, a six-day week was introduced for inspectors of

Exploding truck tyres caused concern to the Department of Mines during the year. Although no one was killed in WA, three people died in the UK last year when a tyre rim exploded in a workshop. Evidence shows that exploding steel rims can be propelled up to 400 metres.

mines. This move partially compensated for staff shortages and increased inspectorate presence in the field, particularly over weekends.

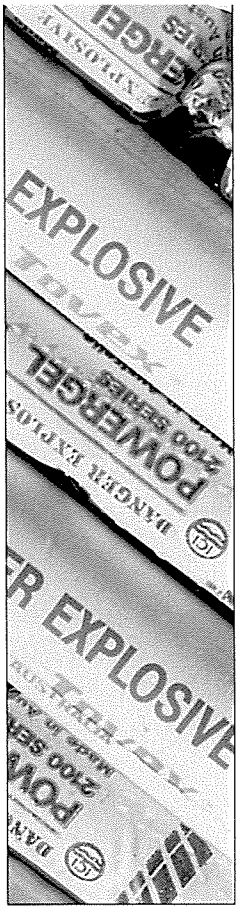
To better meet the needs of a growing and more technologically-developed industry, the Research and Technical Services Branch was restructured to include computer management specialists and an additional environmental officer.

In an effort to attract suitably qualified, experienced personnel, the government approved special allowances for country-based mining engineers. At the same time, the government also approved the appointment of three additional district mining engineers. These initiatives resulted in a better response to advertised vacancies and by the end of the year only one vacancy for a district mining engineer remained unfilled.

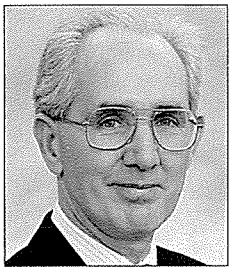
Training and Advice to Industry

Continued emphasis on training, induction and safety awareness education was maintained by the Division. Activities included distributing significant incident reports, safety guidelines and publications such as "Minesafe". A number of seminars on specific facets of the mining industry were also conducted.

The Griffin open-cut coal mine near Collie.



CAMEO: No Small Role in Major Hazards Control



Mr H (Harry) Douglas, APTC (Chem), C CHEM, ARACI, MAustIMM
Director, Explosives and Dangerous Goods Division

"That makes CAMEO very powerful, and a standard assistance facility for both industry and government ..."

What happens if a big chemical production plant in Kwinana accidently starts belching poisonous gas into the atmosphere, or a ruptured fuel line causes a polystyrene factory in Kewdale to go up in smoke?

Who do the victims turn to for help? Who decides on the best approach for controlling the hazard? And what measures need to be taken to advise neighbouring businesses and residents about the incident?

Emergency authorities like the Fire Brigade and State Emergency Service have developed response procedures covering the vast majority of potential disasters.

In addition, the Department of Mines, which is the controlling authority for explosives and dangerous goods in this State, has just installed a computer program that will further assist the all-important process of major hazards control.

The program – known as CAMEO – which stands for the computer-aided management of emergency operations, is a comprehensive software package developed by the National Oceanic and Atmospheric Administration of the US Department of Commerce.

Its main purpose is to provide planners and those likely to respond to major hazards emergencies with relevant details about the likely risks, as well as other useful background information.

Authorities in Western Australia saw a definite need for such a facility, especially to cover potential disasters in and around the Kwinana industrial strip.

On that basis, the government-appointed Kwinana Integrated Emergency Management Scheme (KIEMS) taskforce readily endorsed the CAMEO system.

CAMEO will not only provide an extensive library of information covering industries at Kwinana, but will also be able to assist the Mines Department's Explosives and Dangerous Goods Division with a broad perspective of major hazard sites throughout the State.

Most of the raw data will come from the Department's existing Dangerous Goods and Explosives (DANEX) licensing database.

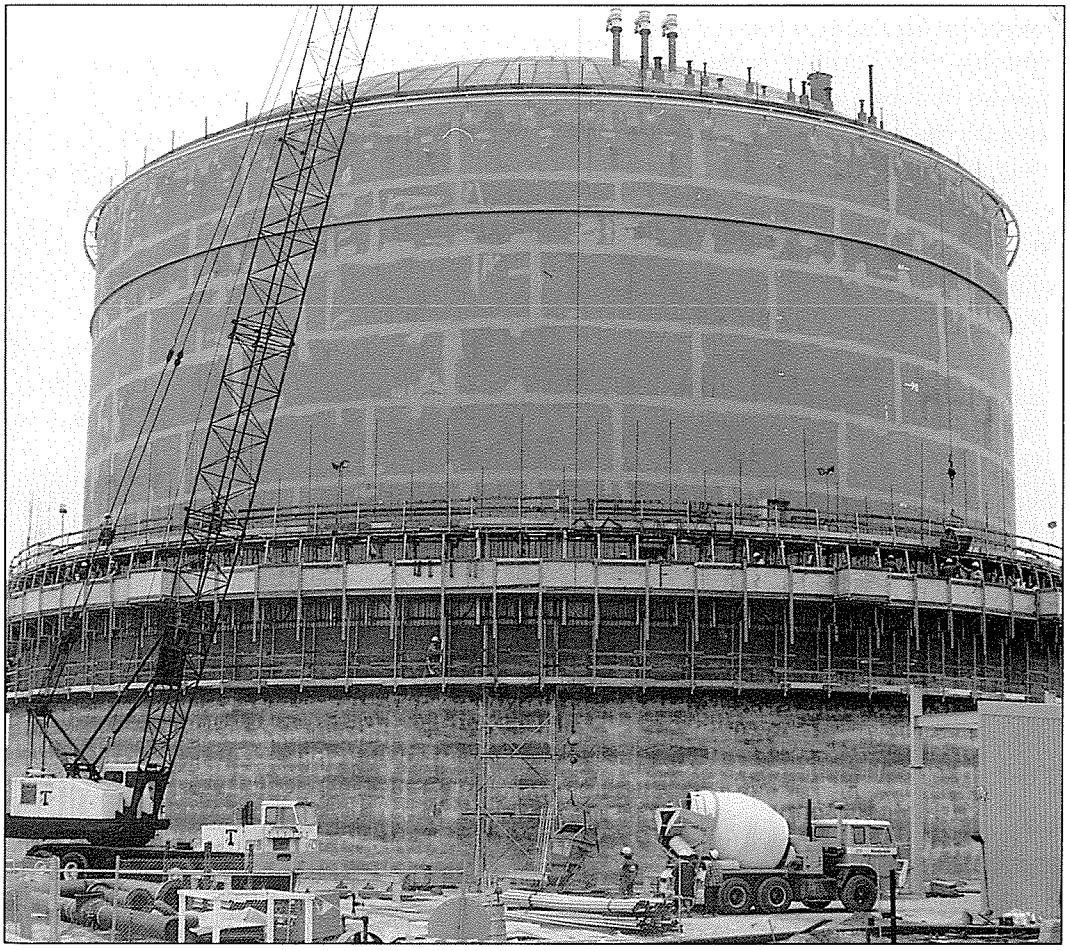
There are 5 000 premises listed on the DANEX system. However, this number is expected to double when new regulations covering the storage, handling and transportation of dangerous goods come into force during 1990-91.

One of the limitations of the DANEX system is that it can provide only textual information. By contrast, the CAMEO system can capture graphic images of any premises where dangerous goods are stored. Things like the exact positioning of dangerous goods within a building, known quantities of goods in storage, the likely dispersion pattern of pollutants into the atmosphere, and problem-solving recommendations, are all portrayed graphically to those accessing the CAMEO computer program.

"That makes CAMEO very powerful, and a standard assistance facility for both industry and government parties involved in dangerous goods management," said Harry Douglas, who is the Department's Director of the Explosives and Dangerous Goods Division.

Among some of the other features of CAMEO are:

- Its ability to "codebreak" (identify chemicals when given a limited description of the substance) more than 50 000 trade chemicals;
- A response resource file which provides a list of names and phone numbers of emergency service units and other experts in the area of any dangerous goods incident;
- A mapping facility capable of displaying areas that could be affected by airborne toxic chemical releases;
- Catalogues of information on population densities, even down to the names of people who are sensitive to certain chemicals; and
- The provision of vulnerability and risk screening information including calculations for worst-case scenarios.



A 30 000 tonne ammonia storage tank under construction at Kwinana features a reinforced concrete safety wall, just in case a leak develops.

EXPLOSIVES AND DANGEROUS GOODS DIVISION

WORKER AND PUBLIC SAFETY

Dangerous Goods Vehicle Routing

The Director of Explosives and Dangerous Goods chaired a working party set up to investigate and make recommendations on the feasibility of prescribing routes for the transport of dangerous goods so as to maximise public safety and protection of the environment.

The core membership of the working group consists of representatives from key government departments with accountability in the field of study, with co-option of members from local government and industry as considered necessary.

The scope of the working party is to investigate particular phases of transport, the first phase being limited to:

- the road transport of flammable and combustible liquids and sodium cyanide; and
- the protection of water resources/catchment areas and environmentally-sensitive wetland areas in metropolitan and nearby regions of the Swan coastal plain and associated catchment areas between the Moore and Murray rivers.

Associated with this, in May, the Deputy Director attended a conference in North America which covered key aspects of dangerous goods vehicle routing. Typical criteria applied in the US are that designated routes must be:

- feasible, practical and not unreasonably expensive;
- continuous within and between jurisdictions;
- safer than other feasible routes;
- not unreasonably burdensome to commerce;
- not arbitrary or intended merely to divert dangerous goods to other communities; and
- not interfere with the pick-up or delivery of dangerous goods (i.e. local operations).

Several models were also brought back from North America and it is felt that each of these will have useful application in Western Australia.

MANAGEMENT OF DANGEROUS GOODS

Regulations

During the year the Division worked extensively with the Public Safety Subcommittee and the Parliamentary Draftsman reviewing drafts of the proposed Dangerous Goods Regulations, acting on comments received from the public following the public review and preparing instructions for Parliamentary Counsel.

Following receipt of Parliamentary Counsel's draft the document will be audited to ensure all of the instructions of the Public Safety Subcommittee have been met.

After endorsement by the subcommittee it is intended that the regulations be forwarded through the Western Australian Advisory Committee for Hazardous Substances, and the Minister, to Parliament for promulgation. This will see the commencement of a six month introductory period before the regulations come into effect.

During this time the Division will advise people storing dangerous goods of the specific impact the regulations will have.

Amendments to Act

Implementation of the requirements of the Public Safety Subcommittee through the dangerous goods regulations has necessitated amendments to the Explosives and Dangerous Goods Act.

In late June the Amending Bill was introduced to Parliament.

The Bill provides for:

- the control of pipelines and exemption of pipelines already controlled;
- the Minister to require the preparation of total hazard control plans and emergency response training:
- good samaritan clauses to protect the participants providing aid at an emergency involving dangerous goods; and
- authority to call up codes of practice or standards as requirements with equivalent force of law to that contained in the regulations.

The Bill also calls for penalties for breaches of the Act to be increased to $50 000, and contains general administrative clauses to simplify the processes for:

- the appointment of inspectors;
- the classification of dangerous goods;
- the authorisation of explosives; and
- the presentation of evidence in court.

Chemical spillages like these require careful handling, and often specialists working within the Department are called upon to provide expert advice.

Kemerton Industrial Parklands

Over the past four years the Western Australian Government has procured 3 500 hectares of Crown Land as the development site of the proposed South West aluminium smelter and for the purpose of establishing an industrial parkland at Kemerton east of Australind and 15 km north of Bunbury.

Feilman Planning Consultants were commissioned to prepare a draft structure plan to provide for the development of a parkland style industrial area for heavy and light industries within an encompassing buffer zone. Adverse environmental and social impacts within the Kemerton area are expected to be minimised by this planned approach.

In August 1989 Cabinet accepted the Feilman structure plan for Kemerton and established the Kemerton Advisory Board to advise administering departments, DRD and CALM, on the development of industrial land infrastructure and on the management and development of parklands.

The Minister for Mines nominated the Chief Inspector of Explosives and Dangerous Goods as his representative on the Board to advise on industrial hazards and risks and on the development of emergency plans for the now burgeoning industrial area. Three plants are now located within the area; the SCM titanium dioxide plant, Nufarm's chlorine plant and the Barrack silicon plant, the former of which has developed a total hazard control plan to meet criteria of the Explosives and Dangerous Goods Act.

The Kemerton Park Board is now finalising the appointment of a risks assessment consultant who will collate data in accordance with terms of reference prepared by the Department of Mines. These data will then be used to run the SAFETI software, which has the capability to evaluate optimal land use planning in terms of public safety. The results will then be sent to the consultant for analysis and inclusion in the consultant's final report and recommendations to the board.

In this manner the Government and the people of Western Australia are being assured of optimal industrial planning with minimised risks to public safety and property, and of the development of industrial parklands within the Kemerton area which will be a model for other developers throughout Australia.

Kwinana Integrated Emergency Management System

The Division has made a significant contribution towards the development of the Kwinana Integrated Emergency Management System (KIEMS).

Three officers have been made available to provide expert advice on dangerous goods and the management of emergencies involving dangerous goods.

The Division has installed the latest version of the CAMEO software.

CAMEO (Computer Aided Management of Emergency Operations) has been exhaustively trialled by the Division during the year, and demonstrations of the system have been provided for all the members of the various KIEMS committees to assist those committees in the process of selecting suitable software for the KIEMS plan.

The taskforce set up to accelerate the preparation of the plan includes a member of the Division on full time secondment to the taskforce.

Woodside Offshore Petroleum's LNG Plant

The hazard control plan for this operation was completed and a third party auditor, A D Little, of the USA, reviewed the audit and reported to the Department on the adequacy of the total hazard control plan (THCP). This audit is currently being assessed.

Du Pont Sodium Cyanide Plant

The Division had a significant role in the assessment of the company's proposal. This role will continue with the division providing advice to the Minister for Environment on the completion of the hazard and operability study, as part of the THCP.

Tiwest Pigment Plant

The hazard and operability study conducted by the company using consultants from Holland, was rejected by the Division as technically incorrect and of insufficient depth. Officers of the division have spent some 300 man hours assisting the company and providing technical advice on the resolution of the unacceptable HAZOP report. This work will continue and lead to the preparation of a THCP.

Liquid Air Oxygen Plant

Due to the close proximity of the plant to the Wesfarmers LPG extraction plant, detailed assessments of the plant were conducted. This involved mathematical modelling of both the plant and the potential interaction with the Wesfarmers plant. The plant will not be subject to a THCP but will be regulated under the proposed Dangerous Goods Regulations, to maintain safety of the public and minimise the potential for domino effects.

Wesfarmers LPG Plant

The THCP for the LPG plant was completed and audited by a third-party auditor. Assessment of this audit has not yet been completed by the Division. The parts of the plan which address occupational safety have been accepted by DOSHWA and following the resolution of some public safety issues of concern to the Division, the company continued operations.

Nufarm Chlorine Plants

Nufarm have opted not to prepare a THCP for the Kemerton site. Therefore, until the proposed Dangerous Goods Regulations have been implemented, the issues of public safety cannot be audited by the department.

Work is progressing with the company on the preparation of a THCP for a proposed plant at Kwinana under conditions set out by the Minister for Environment.

Bulk Liquid Terminal

The study conducted by Dames and Moore for the Kwinana Industries Co-ordinating Committee (KICC) incorporates a suggestion that: "One of the management approaches which warrants further study is the concept of establishing a central terminal management facility within the IP14 area.

"Such a facility could manage the storage and transport to and from the port of all hazardous materials and products associated with plants in the IP14 area. This would allow individual plants to maintain minimum inventories of hazardous materials within their property boundaries and maintain a high degree of safety and control over the handling of these substances."

This issue was raised by the Division and is seen as a means to significantly reduce the risk to the public by locating the terminal away from the public, thereby allowing industrial development with minimal impact.

SCM Pigment Plant

The THCP for the plant is in its final drafting stage, the process of selecting an acceptable third party auditor has commenced and the terms of reference for the audit have been agreed.

Public Display of Fireworks

Fireworks displays have been controlled under the Explosives and Dangerous Goods Act since about 1969. Any person wishing to conduct such a display must make application to the Chief Inspector of Explosives. The application must include endorsement from the Local Authority, Fire Brigade and Police responsible for the area, that there is no objection to the holding of the display.

This system has worked very well generally; there have been very few reports of damage as a result of fireworks displays.

However, during the 1990 Melbourne "Moomba" Festival, damage to property and disastrous performance of fireworks pieces prompted the Victorian Authority to ban the display of fireworks pending a full enquiry into the mishaps at both the opening and closing displays of the Moomba Festival.

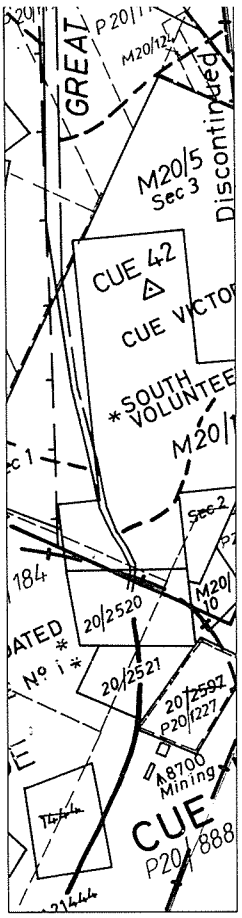
Because the fireworks used in Victoria and the regulations governing such displays were virtually the same as those in Western Australia, a similar ban on aerial fireworks displays was put in place in WA from late March 1990.

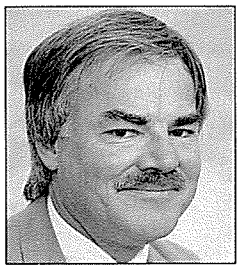
Following a review of the findings of the Victorian enquiry, the moratorium on displays was lifted in June 1990, subject to proposed displays complying with more stringent rules and regulations in accordance with the US National Fire Protection Association "Code for the Outdoor Display of Fireworks."

To date the revised rules have not restricted the holding of displays. However, it is anticipated that some metropolitan venues will be affected by having a requirement to restrict the size of aerial pieces that can be fired.

The use of fireworks, such as those at Perth's 96FM annual Skyshow, is monitored by Department inspectors.

Photo courtesy of West Australian Newspapers.





Mr W (Bill) Phillips, Dip Pub Admin. Director, Mining Registration Division

"For almost a century now, mining registrars have been the closest point of contact that the Department has had with the mining industry."

MINING REGISTRATION DIVISION

True Blue Goldfielders

The considerable dust whipped up by the nickel boom had hardly settled when three young men joined the Mines Department workforce – several hundred kilometres apart in the Goldfields.

It was the mid 1970s and they, like their employer, were a little nervous about their ability to cope with the next mining boom which, as history now records, was to involve gold.

The trio, Ross Collins who started at the Leonora Mines Department office in 1974, David Brooks (at Coolgardie in 1976) and Jeff Hayles (Meekatharra also in 1976) are now veterans in their field.

They are now the three most senior mining registrars in Western Australia – with Ross heading up our mining registration team in Kalgoorlie, David in Coolgardie and Jeff in Leonora.

Even though their work can at times be very demanding, their level of job satisfaction is high. This helps explain why none of them has any immediate plans to leave the Goldfields.

Director of the Mining Registration Division, Mr Bill Phillips, said: "For almost a century now, mining registrars have been the closest point of contact that the Department has had with the mining industry."

Variety is certainly a big part of a mining registrar's life.

Apart from servicing the needs of the mining industry, they are also called upon to provide a wide range of State Government services in their district.

The most significant of these additional duties is that of Clerk of Courts. Here, the registrar is responsible to the Crown Law Department for organising and maintaining the Court of Petty Sessions, Local Court, Children's Court and Coroner's Court. In this role they work closely with the local police and other government departments such as Community Services.

Other duties include acting as agents for Homeswest, Police Licensing and the Public Trustee.

As agent for the Registrar-General, the mining registrar maintains the Births and Deaths Registers and, when called upon, performs the occasional marriage.

The latter duty of marriage celebrant is sometimes filled with trepidation. In fact, over the years, registrars have been called upon to perform marriages in some very unusual places such as backyards, picnic spots — and even mine sites.

Theoretically, a mining registrar may be required to marry a happy couple one day, register the birth of their child months later and, at other times, dispose of the estate of an elderly relative.

Away from their daily work routine, the majority of registrars play active roles within their own communities.

For example, Ross Collins plays hockey for a local Kalgoorlie club and also has served on his local P & C Association.

Dave has been a member of the P & C (when he didn't even have any kids), while Jeff Hayles has spent many years as a member of the Leonora volunteer fire brigade.

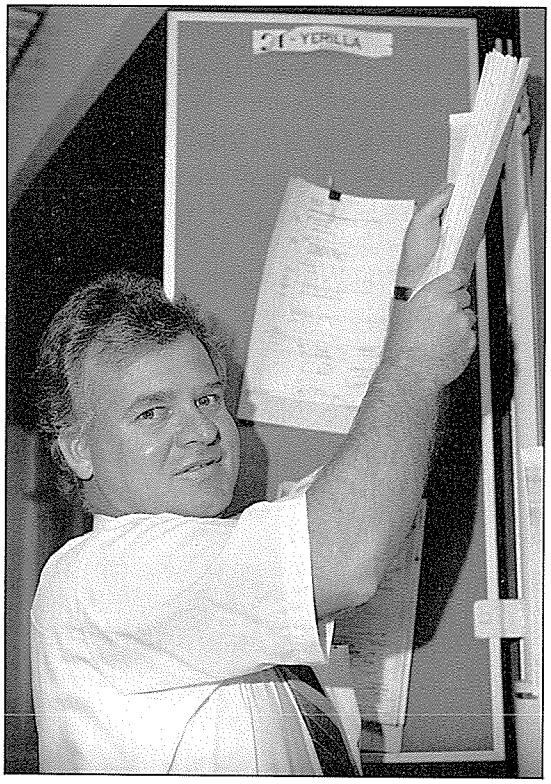
In May of this year Jim Blake, one of the two Assistant Directors General of Mines, retired.

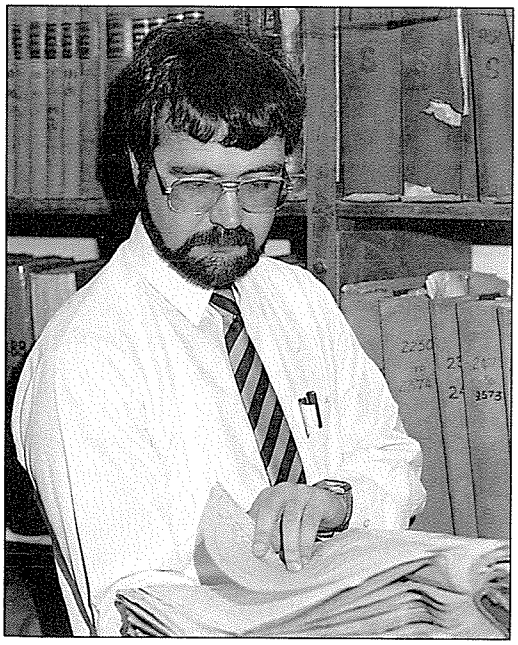
Jim's career commenced in Kalgoorlie in 1948 and 21 of his 42 years were spent in outstation offices -- a large proportion of this time as a mining registrar.

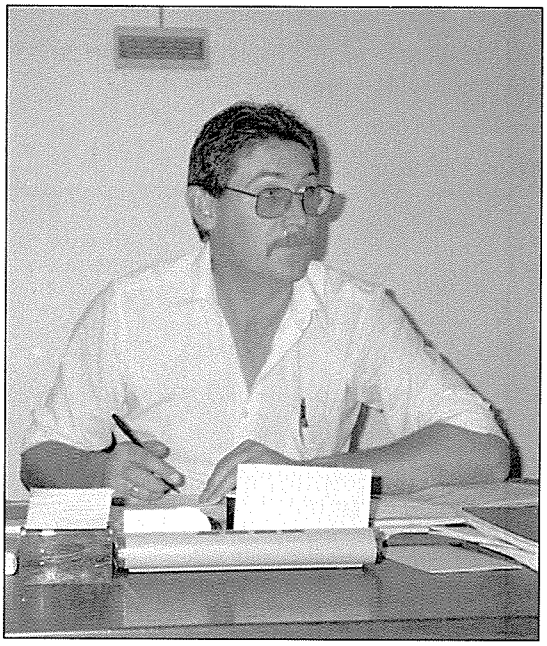
Prior to his retirement, Jim said:

"It's a good Department, the best. For services to the public it is unsurpassed. Look at the outstations and the services they provide -- no other Public Service Department can beat that ... and I'm proud of that."

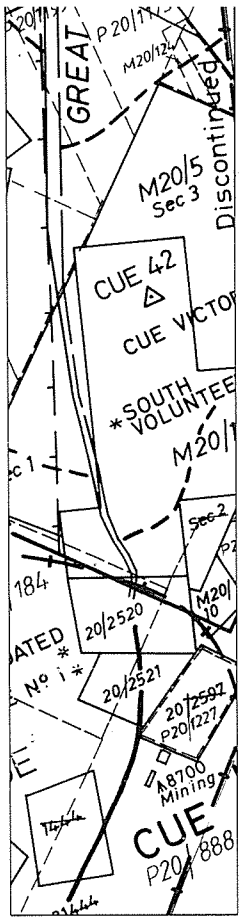
While people in other Government departments may dispute some of this,there is no doubting the pride in the level of the service provided by mining registrars. The present registrars and their staff continue to uphold the traditions established by previous registrars, such as Jim, and it is hoped these traditions will be maintained.







Three long-serving Mining Registrars working in the Eastern Goldfields: Ross Collins, Kalgoorlie, (pictured above right); Jeff Hayles, Leonora, (pictured bottom right) and David Brooks, Coolgardie, (bottom left).



MINING REGISTRATION DIVISION

INTRODUCTION

Work in the Mining Registration Division began returning to normal during 1989-90 after the record levels experienced during the boom years from 1986 to 1988. The reduced number of mining title applications received during 1989-90 allowed the division to continue to clear accumulated application backlogs.

Notwithstanding this, the high level of mining titles held is expected to be maintained in the coming year. As at 1 July over 22 million hectares of the State was covered by granted mining title, this level being more than 80% of the record high of almost 27 million hectares held in 1987-88.

This year saw the completion of the Tendex Regional Computer Network with the installation of computer equipment in the Norseman, Broome and Carnarvon offices.

MINERAL TITLES

Tenement Applications

A total of 5 076 mining tenement applications were received during the year and 4 212 titles were granted, this being approximately a 20% decrease in both instances over the previous year's figure. A comparison of applications received in recent years is shown below:

	1986-87	1987-88	1988-89	1989-90
Prospecting Licence	7 045	5 361	3 367	2 426
Exploration Licence	1 927	1 671	1 420	1 451
Mining Lease	1 089	1 838	1 243	998
Other	255	406	367	201
Total	**10 316**	**9 267**	**6 397**	**5 076**

The total number of applications in force, decreased from 21 792 as at 30 June 1989 to 17 449 on 30 June 1990.

There have been major changes in the percentage of tenement types that constitute the total number of tenements. Prospecting licences which comprised 63% of the total titles in force in 1987-88 made up only 44% of the year's total. In contrast, the percentage of mining leases increased from 24% to 40%. This change in emphasis is the result of the large number of prospecting licences reaching the end of their four-year term and being converted to mining leases.

Another interesting aspect has been the increase in the average size of titles. The average size of a mining lease is now 298 hectares compared with 200 hectares three years ago.

The impasse involving exploration of nature and conservation reserves was not resolved and, as a result, a significant number of applications were not finalised.

Prospecting Licence Extensions

On average, 136 applications for extension were received each month during the year for a total of 1 632 extension applications which represents approximately 60% of the total received in the previous year.

Dealings

There were 12 988 dealings received during the year. While the number of dealings received decreased, many of the agreements and transfers related to complex transactions. Some 25% of these dealings were lodged at the Department's outstation offices, with the

remainder being received at the Perth office.

The Division's executive and managers took part in a seminar with the Insolvency Practitioners Association to increase the division's knowledge of insolvency practices and procedures. The need for this arose from an increase in the number of mining companies facing financial difficulties.

Tenement Surveillance

This year 3 356 applications for exemption from expenditure provisions of the Mining Act were received. This record number again reflects the problems tenement holders are having in meeting their expenditure obligations.

The ongoing monitoring of compliance by tenement holders of their obligations resulted in a total of 1 317 titles being forfeited for breach of conditions. The increased workload in the tenement surveillance area continued and the high level of exemption applications and forfeitures will require additional resources being allocated to the work area.

Review of Fees and Charges

Applications for mining tenements and dealings charges were reviewed and increased by 7% from 1 July 1989. Rentals on mining tenements were increased by 7% on 1 May 1990.

Tendex

The Mining Registration Division's regional computer network was completed during 1989-90. With the installation of computer hardware at Norseman, Broome and Carnarvon all 11 mining registrars' offices are now able to access the Tendex database.

With completion of this network, members of the industry and the public can now access details of any tenement throughout the State in any mining registrar's office. In addition to Tendex access it is also possible to access other departmental systems with the installed equipment. This will allow field officers from other divisions such as Mining Engineering and the Geological Survey access to their divisional systems in the field.

The project to include rental, expenditure and exemption details onto the Tendex database continued during the year with the historical data entry phase commencing in June. Once this phase is completed the Division's regional offices will be given access to the new system.

Some 110 000 pages of Tendex information were printed during the year.

Dispute Management

The new Perth Warden's Court complex has been operational for just one year and is proving a success with members of the mining industry and legal fraternity. Regular hearings are ensuring that outstanding matters are being heard as soon as possible, thus minimising any inconvenience to the mining industry.

COMMUNITY RELATIONS

The Mining Information Centre located on the 1st floor of Mineral House has now been operating for over two years and is succeeding in its original concept as a "one-stop shop" where members of the public and mining industry can access a wide range of departmental services and information in the one area.

To enhance the level of service provided by the facility a telephone centre has been set up.

The facility is staffed by two officers who answer some 90 calls per day. The nature of the calls include:

- Mining Act enquiries
- Tenement details
- Map and plan orders
- Geological Survey publication orders, and
- General information regarding the Department and its operations.

Since its inception, the telephone centre has taken pressure off the counter staff allowing them to better service customers.

At the counter, on a daily basis throughout the year, an average of 100 customers were served, 90 plan orders received and 120 mining tenement register searches provided.

CORPORATE SERVICES

A total of 97 staff were employed in the Division, 62 in head office and 35 at the outstations.

During the year the Division undertook a number of new initiatives in relation to staff training. In order to enhance levels of service within the Division a video training program

For 96 years the Department has provided friendly and helpful assistance to the mining community. Head office counter clerk Amanda Honey exemplifies this service as she displays a mining tenement map to exploration company representative, Brian Zani, of Arimco.

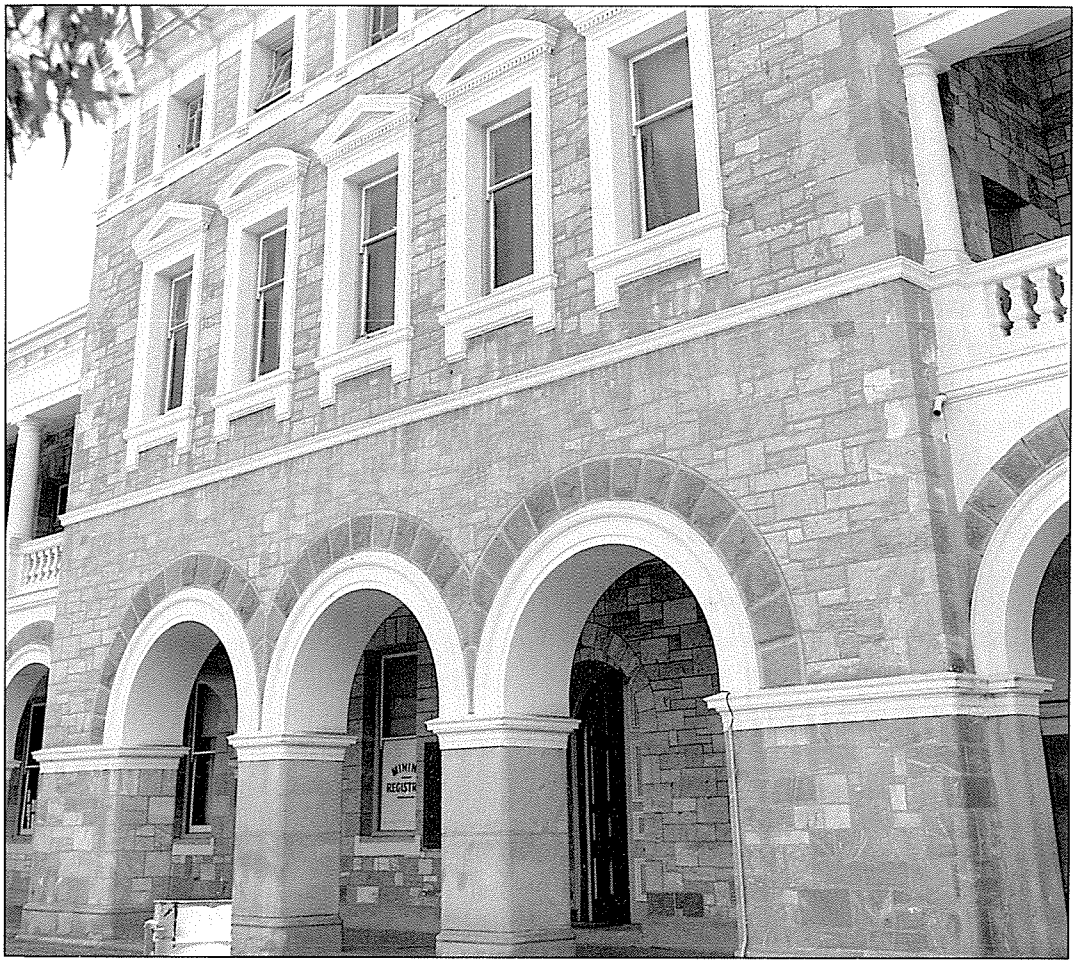
was undertaken. This video training session included topics on telephone technique, time and quality management and were well received by the staff who attended.

This year also saw the Division increase its training levels to ensure new staff members received proper training in all aspects of their duties.

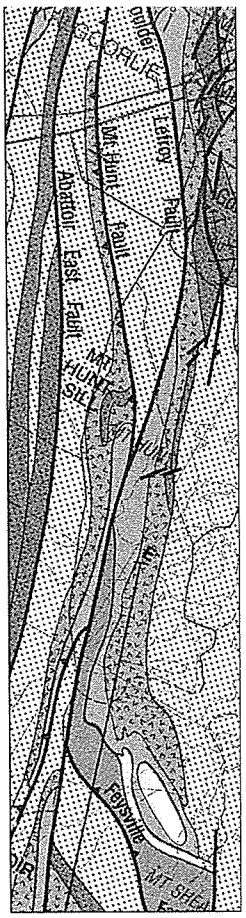
The Division also helped organise and supply speakers for a presentation on certain aspects of mining law in Western Australia for Chinese and Malaysian government delegations.

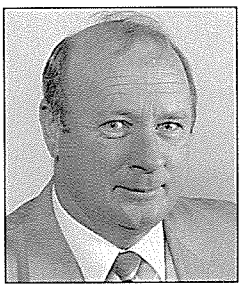
This type of activity was well received and seen to be a fruitful exchange of ideas.

Divisional officers also addressed post-graduate geology students from Curtin University and members of Garrett Metal Detector Club of Western Australia concerning administration of the Mining Act.



The majestic Mining Registrar's Office at Coolgardie.





Mr L (Les) Annison, LS Director, Surveys and Mapping Division

"... a new on-line graphics enquiry system to enable us to capture the graphic representation of mining tenements in WA"

Tenement Graphics

During the nickel boom in the late 1960s and early 1970s it was not uncommon to see people standing four and six deep at Mines Department counters in Kalgoorlie, Coolgardie and Leonora waiting to get their hands on certain mining tenement maps.

Long delays were common, and tempers often became frayed when some fastidious and single-minded customers would spend an hour or more hand tracing the boundaries of mining tenements, as well as other details, from a master map.

Mines Department staff were also frustrated — to the extent that they sometimes found it difficult retrieving their own maps from studious mineral prospectors.

There was no easy solution to the problem. Certainly there were no photocopying machines available to run off a quick copy of, say, the Windarra, Broad Arrow or Widgiemooltha mining tenement sheets.

In the wake of the nickel boom, the system of plotting tenements and accessing details from Mines Department maps became much more streamlined.

In December 1986 the Department introduced a computer-based tenement indexing system, known as Tendex, which provided up-to-date information about the ownership, location and status of every mining tenement in Western Australia.

It was a powerful tool, part of the Department's so-called "public plan" and tenement registry system. However, its main shortcoming was that it offered only textual information for those accessing the database.

"In other words, there were no pictures to match the words," said Les Annison, Director of the Surveys and Mapping Division.

"But," he added, "we have just laid the foundations for a new on-line graphics enquiry system to enable us to capture the graphic representation of mining tenements in WA"

"It's an exciting new initiative by the Mines Department, and one of the most modern systems for this application in the world."

At the touch of a button users will be able to scan cultural details such as roads, bridges and towns; topographical features such as rivers and mountains; plus cadastral details such as mining tenement boundaries.

Eventually, the system will have the capacity to show the history of mining activity in certain areas. This will be a tremendous aid to prospectors and mining companies anxious to research geological details and other background of areas.

People accessing the system will be able to have a look at the whole State. In other words, someone at Southern Cross will be able to check details of a mining area, for example at Hall's Creek.

Current estimates indicate that the "tenement graphics" feature, also known as Tengraph, will take about five years to develop and introduce.

Les said it would benefit the whole mining community, as well as provide valuable information for government agencies such as the Department of Land Administration, the Environmental Protection Authority and the Department of Conservation and Land Management.

The system would be integrated with a survey data input (SDI) support facility which is part of an extensive computerised land information package being developed by the Department of Land Administration.

The capture of this information on a computer base supports the whole-of-government approach to the integration of land information in this State, as defined by the Western Australian Land Information System (WALIS) Taskforce.

Les said the Eastern Goldfields region had been identified as the first priority zone for the development of the tenement graphics system.

He said a special project team would initially capture all live surveyed tenements in the area and subsequently provide an adjusted framework for the positioning of unsurveyed tenements.

The capture program would then proceed throughout the entire State on a user driven/development priority basis.

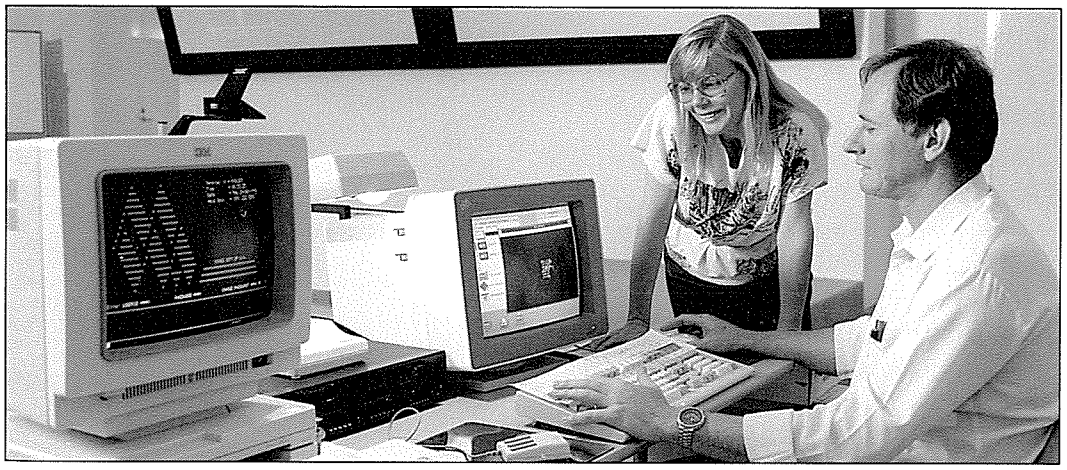
It's intended that the Tengraph system will operate in parallel with the exisiting public plan tenement mapping system until Mines Department personnel and client users became fully acquainted with the new graphics system.

The Department of Mines presently maintains about 1 300 conventional public plan tenement maps covering the State.

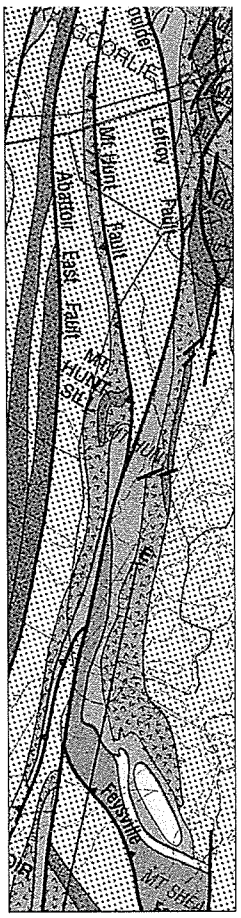
According to Les, the Tengraph system would fill a growing demand for computer-based data from the mining industry.

"Apart from providing an on-line facility to serve across-the-counter needs at the Mines Department offices in Perth and at the 11 outstations located between Kununurra and Norseman, I believe there is great potential to market Tengraph on a commercial basis," Les said.

"In fact, the possibility of allowing mining companies and tenement service firms to tap directly into this facility — for a modest price — is currently being explored by the Department of Mines."



Ian Robertson, chief liaison officer in computing within the Surveys and Mapping Branch, demonstrates to secretary Pam Thompson the capabilities of the newly-installed SDI software.



SURVEYS AND MAPPING DIVISION

INTRODUCTION

The past year featured significant changes in management and the introduction of new technologies aimed at supporting the Department's corporate objectives.

The impact of mining on Aboriginal interests and environmental concerns also received considerable attention and involved the Division in the preparation of a new series of conservation and Aboriginal reserves maps.

Several staff attended training courses as part of a continuing professional development program. Topics included management and information technology, in-house RMS, Landcap/Landraw, first aid and even outback survival.

A highlight for the year was the successful, professionally prepared and presented divisional expo. This reflected the very positive attitude by staff and clearly projected their pride in the products and services provided by the Division.

The strategy to introduce a personal computer based time management/job costing system is now at an advanced stage. This will provide a lead for the Department, allowing full and notional charges to be assessed in job costings.

Working groups have been formed to achieve the introduction of Survey Data Input (SDI), tenement graphics, automation of geological mapping, and Global Positioning Systems (GPS). This program of work will carry the division into a new and significant phase of operation in support of the Department's corporate objectives.

MINERAL AND PETROLEUM TITLES

A total of 334 mining tenement surveys were completed at a boundary component cost of $1 340 compared with $1 243 in 1988-89. The number of completed surveys represented the total which could be accommodated within the constraints of a substantially reduced survey budget.

The average length of boundary per tenement surveyed increased from 3.38 km in 1988-89 to 7.4 km.

The number of tenements awaiting survey has risen to 2 912, inviting a further consideration of survey techniques and costing represented by limited marking, global positioning systems and user pays.

The State Petroleum map base was re-mapped to incorporate new and additional information including the Commonwealth Petroleum tenements in Ashmore Cartier Island and around Darwin.

During the year 123 petroleum tenements were charted, 29 areas advertised and 252 dealings processed.

EXPLORATION AND DEVELOPMENT — DATA COLLECTION

Landcap/Landraw

A Department of Land Administration (DOLA) initiated software package was refurbished to the requirements of the Department's Survey Branch.

Essentially, Landcap is a data entry, capture and analysis program which allows for the mathematical validation of all dimensions shown on survey documents. Landraw, which is dependent on the Landcap file, enables the

branch to produce hard copy survey documents at any nominated scale.

Both Landcap and Landraw are now in production within the Division and will eventually replace all the contract drafting currently undertaken by survey companies on behalf of the Department.

A personal computer-based interactive graphics input system designed by DOLA to facilitate the input of digital survey data, and production of survey documents for certification was re-scheduled for introduction in September 1990. Divisional commitments to convert existing Mines Department data into the required new format have been accomplished along with the placement of an officer within DOLA to assist with design specifications and final implementation.

GPS - Global Positioning Systems

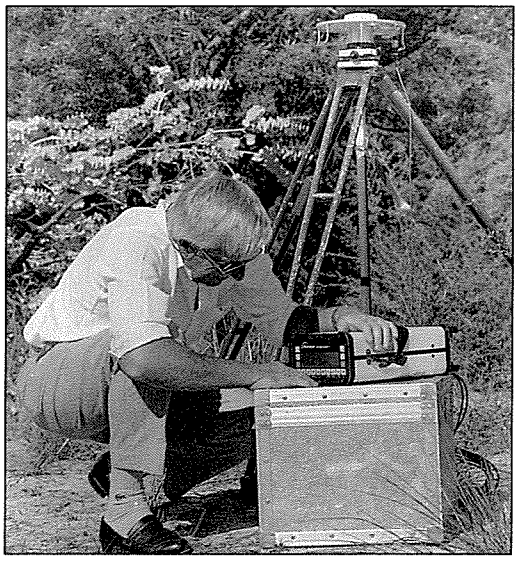
This technology allows points to be positioned on the Earth's surface by decoding data from satellites. The division has a commitment to the introduction of GPS to mining tenement boundary depiction and is currently evaluating hardware, assessing techniques and specifications along with addressing possible implications for the Mining and Licensed Surveyors Acts and Regulations.

Geographic Information System (GIS) Pilot Study

A pilot study, covering part of the Perth Metropolitan North-West Corridor, was put forward as a joint proposal by the Geological Survey and Surveys and Mapping Divisions in the Department's 1989-90 Information Technology Plan. It aimed to resolve, using GIS technology, some of the more difficult geoscientific and planning issues facing the Department.

Negotiations were held with ESRI Australia Pty Ltd in which a program of training and consultancy using the ARC/INFO GIS system was proposed. The five-month project commenced in February 1990, and successfully demonstrated the application of GIS within the Department. It also provided one of the priority programs for the WALIS ILIP (integrated land information plan) task force, focussing on LIS/GIS needs for planning within the North-West corridor. The Department of Planning and Urban Development has now transferred some of the data into its system for further analysis and planning.

Also, in association with the Geological Surveys Division, Surveys Branch personnel attended to several water bore hole levelling projects throughout the year.



Surveys Branch chief draftsman Dave Stewart setting up a GPS receiver. The device enables the Department to accurately pinpoint survey positions from satellite signals.

DATA DISSEMINATION

Twenty one geological map sheets were scheduled for production during the year with nine being published. Two thematic maps were also published, the first being a continuation of the series showing petroleum tenements in WA in four colours and the other a special map covering the North West Shelf oil and gas production installations.

Additionally, eight maps (1:250 000) were laser scanned and reprinted to replenish diminishing stocks.

A new series, showing Precambrian geology, was initiated with Lake Lefroy and Cowan being produced to complement the already printed 1:100 000 maps of the same name. Another highlight was the completion of the hydrogeological map of the State at 1:2 500 000.

Both these map series add to the geoscientific data available to the mining industry, to scientific organisations and the community at large in the development of our mineral and water resources.

Publications

Of particular importance for the year was the completion of the gazetteer supporting the Western Australian localities map produced in 1988. This record of all names on the map has been compiled on computer and categorized into a feature code suitable for additional use by the public. It has also attracted interest throughout the State with launch publicity details appearing in local and Goldfields newspapers.

Fifteen hundred figures, diagrams, slides and overheads were produced for bulletins, reports, Communications Branch support plus the needs of chemists, mining engineers and geologists as well as the Survey and Mapping Division.

Computer-Assisted Drafting (CAD)

An evaluation of the requirements to develop a personal computer-based graphics system to automate the production of various graphics products continued and resulted in the purchase of a CAD system for the Mapping Branch.

The system allows for the digital generation of many figures, diagrams and slides, and, in the long run, will produce an invaluable archive of data which will allow for quick updating.

Reprographics

This area identifies directly with the increasing divisional and corporate demands for graphical information provided from our photographic/reprographic facilities.

Over the year, there has been a 100% increase to 34 000 copies produced on the Canon colour laser copier and a 70% increase in photographic assignments throughout the State. These assignments range from city implosion sites to coronial enquiries in the mining industry.

The year saw a very satisfactory production figure of 241 public plans together with 61 offshore graticular plans introduced.

All quarterly editions of the Petroleum Tenements Map and booklet and petroleum tenement transactions were completed on schedule.

Computer Generated Maps

A total of 146 computer-generated plots

were output from the WAPMAP system during the year to meet a variety of specialised requirements, mainly in the Geological Survey and Petroleum Divisions. Some of these were base plots for a series of specially produced seismic structure maps.

Industry Liaison

Close ties were maintained with the industry, chiefly through regular discussions with the Association of Consulting Surveyors and other allied professional bodies.

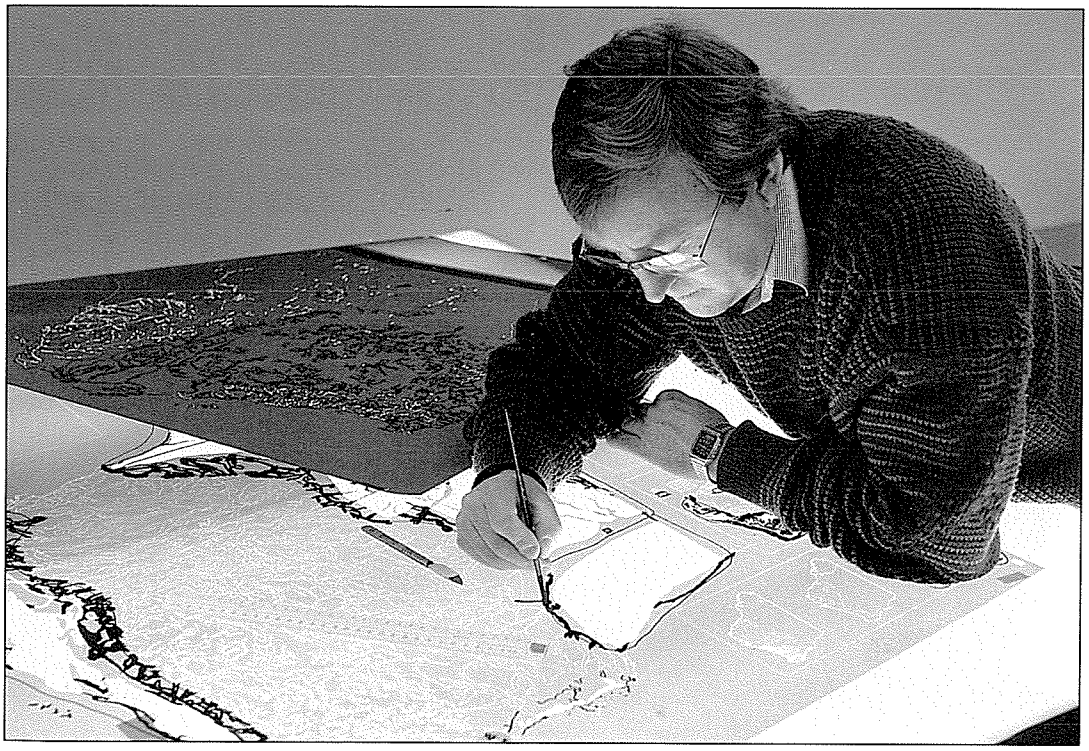
The main issues raised were:

- contract survey work
- policy guidelines
- GPS, and
- user pay policy

COMMUNITY AND THE ENVIRONMENT

Increased community and government interest in the environment and Aboriginal matters led to the release of the following three thematic maps:

- Conservation Reserves of Western Australia, State Map, 1:2 500 000, showing all the Environmental Protection Authority Red Book Systems and recommendations, and all Crown Reserves of conservation and environmental significance;
- Conservation Reserves of Western Australia, South West Region 1:1 000 000 portraying the same information as the above map but only of the South West region and at a larger scale; and



Cartographer Peter Taylor working on final plates for the State's first hydro geological map.

- Aboriginal Reserves of Western Australia, State Map, 1: 2 500 000, showing Crown Reserves of Aboriginal significance and proposed or gazetted protected areas under the Aboriginal Heritage Act.

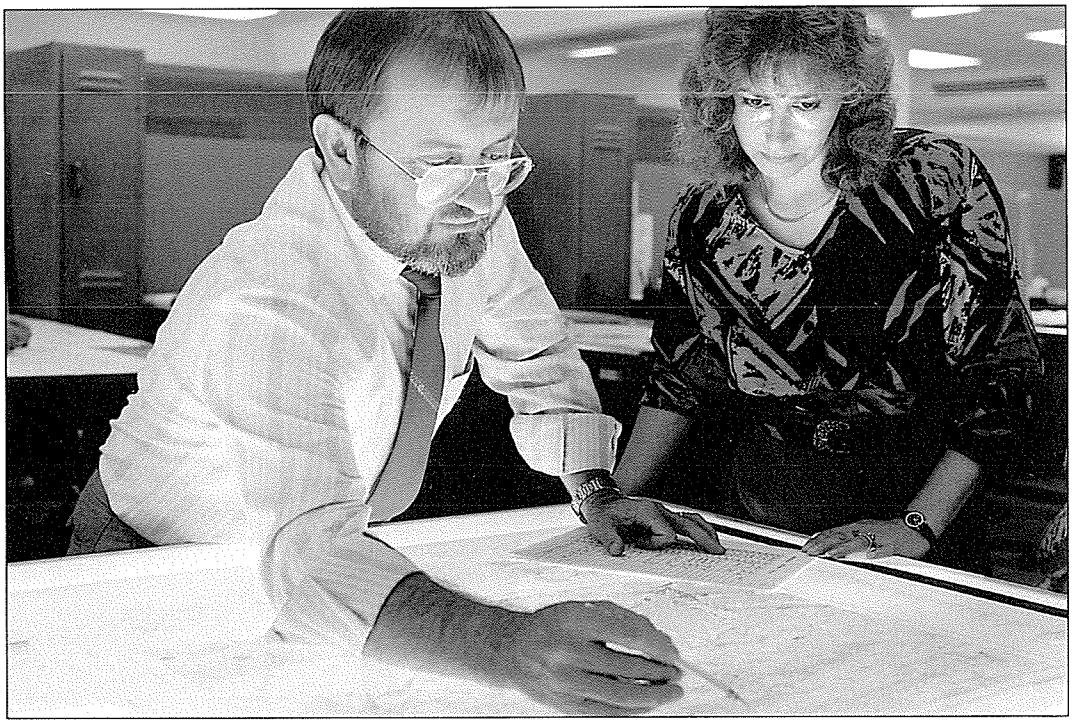
CORPORATE SERVICES

All branches within the division participated in separate one-day strategic planning sessions followed by progress reviews at later dates.

The sessions concentrated on identification of prime objectives to support the corporate plan and developed prioritised strategic plans for both a 12-month and three-year period.

Several seminars and conferences were attended by staff during the year, including:

- An executive, corporate planning seminar held at Mandurah which was attended by the Director Mr L Annison;
- The 14th International Cartographic Conference in Budapest, Hungary which was attended by Mr P Walby during his European vacation;
- The ESRI Users Conference, Perth, Mr P Walby;
- The URPIS Conference, Perth, Mr P Shaw;
- The 8th Australian Cartographic Conference, Darwin, Messrs L Annison, P Shaw and F Martin during his vacation; and
- The Mining Industry Seminar, Curtin University, attended by 16 staff for varying periods ranging from half a day to three days.



Map editor Geoff Loan being assisted by Kay Greenberg in checking colour specifications on a geological map.

STATISTICS

MINING ENGINEERING DIVISION

PETROLEUM DIVISION

ROYALTIES AND POLICY DEVELOPMENT DIVISION

MINING REGISTRATION DIVISION

MINING ENGINEERING DIVISION

Mines	No. of Employees	No. of LTIs	Incidence	Frequency	Duration	Injury Index	Days Lost
Metalliferous Surface Metalliferous U/Ground	29 227 2 582	1 586 384	54 149	25 74	12.1 13.5	302 1 004	19 182 5 194
Metalliferous Total	31 809	1 970	62	29	12.4	355	24 376
Coal Surface Coal U/Ground	963 302	129 110	134 364	80 218	7.6 8.9	609 1 931	982 975
Coal Total	1 265	239	189	113	8.2	924	1 957
TOTAL MINING	**33 074**	**2 209**	**67**	**31**	**11.9**	**372**	**26 333**

NOTE: Duration in this table does not take into consideration time lost after 30 June 1990 by persons still off work at the end of the financial year, time lost by persons with carry-over injuries from before June 1989, or time lost from recurrent injuries.

DEFINITIONS:

Lost Time Injury (LTI)
A work injury which results in inability to work for at least one full day or shift any time after the day or shift on which the injury occurred.

Incidence
The number of lost time injuries per thousand employees for a 12 month period.

Duration
The average number of work days lost per injury.

Frequency
The number of lost time injuries per million hours worked.

Injury Index
The number of work days lost per million hours worked.

Mineral	Number of Persons Employed	Accidents		
		Fatal	Serious	Minor
Gold and Nickel	13 348	10	351	741
Iron	9 034		105	361
Bauxite, Alumina	5 086		38	62
Mineral Sands	1 789		20	58
Coal	1 265		41	198
Diamond	897		19	24
Salt	496		1	36
Construction Materials	228		-	12
Other Minerals	931		40	102
TOTALS	**33 074**	**10**	**615**	**1 594**

Description of Fatal Accidents in 1989-90

There were ten fatalities in the mining industry during the 1989/90 financial year. All persons killed worked in metalliferous mines.

*A machine miner was fatally injured when struck by a fall of ground during rock bolting operations.

*A surface driller received fatal injuries when the pit floor collapsed in the area being drilled, and he fell into an abandoned underground working.

*A contract truck driver was killed when the road train vehicle he was driving collided head on with a haul truck on a mine road.

*A member of a charge up crew sustained fatal injuries when he was struck on the head by the flexible slurry hose discharging from an isotainer of slurry explosives into a truck.

*A crusher operator died when he was crushed between a conveyor belt and a roller at a gold treatment plant.

*A long hole driller was fatally injured when struck by a fall of ground during drilling operations.

*A machine miner died after being asphyxiated by carbon monoxide gas in an unventilated raise.

*Two mining contractors were killed whilst raising a water ring in a raise-bore hole. A block of concrete fell into the raise and struck the conveyance in which the men were present.

*A maintenance fitter was fatally injured when he fell down a stope opening.

*A registered manager was charged for failing to enforce Regulation 12.8 relating to mine workings not being effectively scaled. He entered a plea of guilty and was fined $1000 with $26.70 costs or 42 days imprisonment in default.

*A miner was charged with a breach of Regulation 8.23(1) for failing to install ventilating equipment. He pleaded guilty and was fined $500 with $28.70 costs.

*A mobile crane operator was charged for an offence under Regulation 6.2 and Section 54 of the Mines Regulation Act for failure to set out-riggers on a Hiab truck when lifting a load. He pleaded guilty and was fined $250 with $28.70 costs.

*A mining company was prosecuted on two counts for failing to enforce the requirements of Section 39(1)(b) of the Act. The company was fined a total of $4 000 with $97.40 costs.

*A contracting mining company was charged with three breaches against Sections 39(1)(a), 39(1)(b) and 42 of the Act. The Company was fined $1000 for each offence with $146.10 costs.

*A Registered Manager was charged with three breaches for failing to enforce the requirements of sections 39(1)(a), 39(1)(b) and 42 of the Act. He was fined a total of $1000 with $146.10 costs.

*A mining company and its Registered Manager were prosecuted for a number of breaches of Sections 38(1)(c) and 39(1)(b) of the Mines Regulation Act. The company was fined $70 on each count and the Registered Manager $50 on the first complaint and $40 for the other. The Department is considering appealing against the leniency of the sentence.

*A Registered Manager was fined $450 for a breach of Section 38(1)(c) of the Mines Regulation Act. The magistrate dismissed the three other charges against the Manager for the same offence.

*A successful prosecution was instituted against a contracting mining company for two offences under the Mining Act. The offences were related to illegal mining on two expired tenements. A plea of guilty was entered in respect of each offence and the court imposed a fine of $350 for each offence with $138.70 costs.

Job Name	Purpose	Type of Work	No. of Bores	Metres Drilled
Karridale	Groundwater Invest'n	Mud Rotary	6	4825.47
Collie Basin	Groundwater Invest'n	Reverse Circ. Mud Rotary	37 12	819.70 839.81
Scott Coastal Plain	Groundwater Invest'n	Mud Rotary	24	3215.06
Merredin Catchment	Salinity Studies	Wireline Coring	9	277.24
Keysbrook	Geophysical Calibration Logging Bore	Mud Rotary	1	221.00
Kemerton	Groundwater Invest'n	Mud Rotary	2	628.00
Metro Stormwater Basins	Monitoring Environmental Pollution	Hollow Auger	11	179.00
Pinjar (SECWA)	Installation of earth probes	Mud Rotary	3	794.50
Denmark River Catchment	Salinity Studies	Wireline Coring	19	331.55
Kwinana (Nufarm)	Monitoring of sub-surface contaminants	Hollow Auger	24	252.80
Leeman Shallow	Groundwater Invest'n	Mud Rotary	6	460.95
Lake Toolibin	Dewatering Invest'n	Hollow Auger	10	65.77
Hamelin Pool	Geological Research	Hollow Auger	13	64.14
Upper Hay River Catchment	Hydrological Study	Wireline Coring	3	36.27
TOTAL			**180**	**13 011.26**

FIRST CLASS MINE MANAGER

	Certificate No.
McCRACKEN, Michael Grant	282
JORDINSON, Richard	283
BIEGAJ, Krzysztof Maria	284
PELCHEN, David Paul	285
CHARMAN, Paul Alexander	286
CERNOTTA, Nicola Luigi	287
COLE, Russell Leigh	288
COTTON, James Alan	289
LOVITT, Michael Brian	290
LUXFORD, Kevin Joseph	291
MILLER, David Gareth	292
OZGA, Wojciech	293
ROGAN, Kevin Patrick	294
SHIPP, John	295
PTSCHELINZEW, Peter Klaus	296
RAYNER, James Leonard	297
ROSE, David Malcolm	298
MILLER, John Angus MacDonald	299
BOTTING, Michael David	300
FAIRLEY, Hugh Thomas	301
LAW, Andrew Gerald Morgan	302
MICHALSKI, Robert Romuald	303
McLEOD, Hamish Ian	304
CAMPBELL, Francis Robin	305
MORLAND, Richard Llewellyn	306
PRATT, Adrian George Landon	307
SLEZIAK, Grzegorz	308
LIDDY, Terence John	309
JORDAN, Leigh William	310
BLAIR, Allan Harry	311
LAWRENCE, David James	312
GRAHAM, Robert Michael	313
SHELDON, Scott Beresford	314
RICHARDSON, Mark	315
CARROLL, Ian Ross	316
CLARK, David Murray	317
GOODWILL, Neil Stephen	318
LAW, Simon Richard	319
LEEDHAM, David Geoffrey	320
NORCOTT, John Humphrey	321
TONKIN, Luke	322

UNDERGROUND SUPERVISORS

	Certificate No.
CLUNE, Donald Watson	A592
COPE, Brendan Leslie	A593
GUY, Shane Edward	A594
McDOUALL, Rawdon Angus	A595
BRITO BUGUENO, Bernardo Enrique	A596
ANDERSON, Brett Rohan	A597
BARNETT, Peter	A598
BLAKE, Ernest Charles	A599
BOREHAM, Christopher George	A600
BROWN, Benjaman Christiansen	A601
BULLER, Kenneth George	A602
BUTLER, David John	A603
CHEW, Lawrence Kok Cheong	A604
CLIFFORD, Kenneth William	A605
CRESEY, Donald Arthur	A606
CULLINAN, Peter Thomas	A607
ELLIS, Ronald Helmut Jack	A608
FISHER, Garry Arthur	A609
FOYSTER, Darryl Glen	A610
GORZKOS, Richard Paul	A611
GOUGH, Wayne Bruce	A612
GRAY, Shane Mervyn	A613
GREEN, Michael Leslie	A614
GUY, Shane Edward	A615
HARKUP, Trevor Sidney	A616
KAESTNER, Konrad Horst	A617
KITCHIN, Dale Herbert	A618
LACCO, Colin Geoffrey	A619
LINDLEY, Brett Andrew	A620
LINDON, George James	A621
McCAHON, Vincent	A622
McCREED, Paul Shane	A623
MARCHEGIANI, Antonio	A624
MARTIN, Gary Max	A625
MARTIN, John Charles	A626
NAYLOR, Michael	A627
O'CONNELL, Niall Anthony	A628
PETTERSEN, Robert	A629
PETTIT, Philip James	A630
PLAVSIC, Mirko Edwin	A631
PORTER, Peter Robert	A632

PROUD, Michael Jay	A633
PTOLEMY, David Victor Jonas	A634
RENTON, Peter George	A635
RIBARICH, Silvano	A636
RODGERS, Stephen John	A637
SANDS, Maxwell John	A638
SHEPPARD, Ian Kingsley	A639
STEPHENSON, Wade Thomas	A640
SYME, Douglas Leonard	A641
THOMAS, Nigel Llewelyn	A642
WATTS, Daniel Mathew John	A643
WOOD, Clinton John	A644
MILLER, Stephen Jeffery	A645
MATTHEWS, James Anthony	A646
SPORER, Albert	A647
HAMPEL, Brett William	A648
PEDEN, Gordon Poole Graham	A649
SHANNON, Russell James Picton	A650
CASSIN, John Norris	A651
NEDIN, Paul Robert	A652
NOORT, David John	A653
PICKARD, Christopher Gerard O'Brien	A654
ANSONS, Givido Argot	A655
BIRCH, Frederick George	A656
BOYLE, Gary Allan	A657
BROWN, John Francis	A658
CHIDLOW, James Anthony	A659
CLARIDGE, Dominic Christopher	A660
DOLAN, Kym Matthew	A661
EDWARDS, Rodney David	A662
FARINA, Peter John Colin	A663
COLLOPY, David Robert	A664
FLACK, Geoffrey William	A665
GARNET, Gregory John	A666
GIBNEY, Fergus Paul	A667
GRAHAM, Ross John	A668
HERON, Bruce Anthony	A669
HOGAN, Kevin Raymond	A670
HOWARD, Gary Walter	A671
KELLY, John William	A672
KUMAR, Atish	A673
McLAREN, Hector Smith	A674
MARTIN, Daniel Gerrard	A675
MILNE, Peter Ronald George	A676
MOLONEY, Kenneth Ross	A677
NORREGAARD, Johannes Stig	A678
SAVATOVIC, Zeljko	A679
SEBO, Steven Thomas	A680
SHEPPARD, Maxwell Carl	A681
SILVA, Hector Sergio	A682
SINTON, Kevin Barry	A683
SPROULL, David John	A684
WICKS, Anthony Marston	A685
ZVORC, Drago Dennis	A686
YOUD, Simon Peter Royale	A687

QUARRY MANAGERS

	Certificate No.
THOMSON, Robert Peter	195
WEARING, Iain Richard	196
DANIEL, John Denis	197
JONES, Glen Robert	198
PFEFFER, Warren John	199
POVEY, Michael George Frederick	200
ROBJOHNS, Neil Francis	201
SCHIPKE, Paul Harold	202
DONNELLY, James Clifton	203
HOLLAND, Peter John	204
KERMOND, Mitchell John	205
McNEIL, Ian Martin	206
MENDHAM, Garrick Allen	207
RIDLEY, Simon	208
CHRISTOFIS, Michael Peter	209
ARCHER, Jeffery William	210
INNES, Jeffrey Thomas	211
COMB, Gary Ernest	212
HORNE, Adrian John	213
LANGDALE, Neil Vernon	214
MORRIS, Florian Christopher	215
ROGAN, Kevin Patrick	216
WHITE, Jeffrey Dean	217
BOYD, David Frederick	218
BUTTERS, Stephen Edmund	219

CHARE, Paul Arthur	220
DENCH, Shaun Peter	221
HARGREAVES, Stephen Gerald	222
MENDEZ, Gabriela Alejandra	223
PIGNAT, Anthony John	224
WILSON, Craig Andrew	225
WILSON, John Christian	226
O'LEARY, Bernard Daryl	227
GOOCH, Timothy John	228

RESTRICTED QUARRY MANAGERS

	Certificate No.
CARTER, Ian John	298
COCKRAM, John Robert	299
DRAPER, Graeme John	300
DUELL, Rodney John	301
DUNCAN, Stuart Andrew Ormond	302
McFARLAND, Alan Malcolm	303
MORTIMORE, Graham Scott	304
MOURITZ, Noel Wayne	305
MYERS, Charles Henry	306
TAYLOR, Norman Leslie	307
BLACKWELL, William David	308
BALZER, Oswald Kenneth	309
COLEMAN, Elizabeth Anne	310
WALKER, Mark Steven	311
ANNESLEY, Christopher George	312
DORPH-PETERSEN, Steven Charles.	313
DUNN, Cynthia Jane	314
HOOD, Douglas Wayne	315
JOLLEY, Quenten Douglas	316
MAY, Paul Richard Aaron	317
SAVAGE, Richard Charles	318
ALEXANDER, Brian Errol	319
MOAR, Russell William	320
GMEINDER, Edgar Lorenz	321
KIMBER, Phillip Bruce	322
MATHIESON, Farquhar Fraser	323
POZNIAKOV, Nicolas Michaelis	324
HACK, Bryan Anthony	325
ROBERTS, Glen Allan	326
LOUW, Derek Rowan	327
BOOTH, Peter Alan	328
SPEHR, Mark Kevin	329

AUTHORISED MINE SURVEYORS

	Certificate No.
JACKSON, Anthony James	120
KIELY, Eric Lewis	121
SWEET, Kimball Albert	122
McINTOSH, Peter Maxwel	123
SHEPHERD, Luke John	124
BLUETT, Graham John	125
DAWSON, Craig	126
EDMEADES, Christopher Peter	127
HAIGH, Russell Ernest	128
ROUTLEY, Stephen Alexander	129
SPECK, Raymond Gordon	130
TURNER, Geoffrey Paul	131
MASON, Alan Neil	132
BELKNER, Richard Steven	133

FIRST CLASS MINE MANAGER

LUXFORD, Kevin Joseph	A-3-89
KELLY, Geoffrey Eugene	A-4-89
KAPUSNIAK, Stefan Stanislaw	A-1-90

SECOND CLASS MINE MANAGER

THOMPSON, Gary Wayne	B-1-89

THIRD CLASS (DEPUTY)

ELLIS-SMITH, Dennis Hugill	C-4-89
GRAHAM, Robert John	C-5-89
McCORMICK, Trevor John	C-6-89
MURRAY, Gregory William	C-7-89

OPEN CUT MINE MANAGER

SHALDERS, David Barry	D-1-90
GRAHAM, Trevor Henry	D-2-90

OPEN CUT (DEPUTY)

HINDLE, Arthur	F-1-89
DAVENPORT, Kerry Ray	F-1-90
McGILL, Barry Ernest	F-2-90

Class	Name	Operator	Tenement	Latitude	Longitude	Ground Elev.	KB Elev.	Depth @ 30.6.90	Spud Date	Rig Release Date	Status 30.6.90
					Bonaparte Basin						
NFW	Fulica 1	BOND	WA-199-P	11 05 20	125 52 31	-111	25	2674	2.07.89	27.07.89	P & A
	Garganey 1	BOND	WA-199-P	11 21 24	125 54 59	-100	25	2481	26.08.89	19.09.89	P & A
	Kite 1	WMC	WA-147-P	12 04 04	126 26 12			782	25.06.90		DRILLING
EXT	Avocet 2	BOND	WA-199-P	11 22 12	125 45 00	-100	25	2000	27.07.89	26.08.89	P & A
					Browse Basin						
NFW	Buccaneer 1	SHELL	WA-35-P	13 39 44	123 57 21	-171	15	3574	26.02.90	12.04.90	P & A
					Canning Basin						
NFW	Cudalgarra Nth 1	COMMAND	EP 164	19 10 15	122 17 50	147	151	1220	12.07.89	24.07.89	P & A
	Lovells Pocket 1	KUFPEC	EP 103	18 30 57	123 26 09		7	1729	4.06.90		DRILLING
EXT	Great Sandy 2	WMC	EP 164	19 12 49	122 21 17		87	1576	2.05.90		DRILLING
					Carnarvon Basin						
NFW	Cossack 1	WOOD	WA-28-P	19 33 22	116 29 45	-82	24	3030	16.11.89	30.01.90	O SUSP
	Cowle 1	WAPET	TL4	21 31 25	114 58 05	-13	32	1180	11.12.89	4.01.90	O SUSP
	Cygnus 1	ARCO	WA-202-P	19 42 44	116 54 33	-73	30	2470	8.07.89	9.08.89	P & A
	Griffin 1	BHP	WA-210-P	21 14 08	114 37 12	-138	18	3400	15.12.89	18.03.90	O SUSP
	Lauchie 1	PHILIPS	WA-208-P	19 46 32	116 31 23	-67	23	3310	2.05.90		DRILLING
	Montebello 1	BHP	WA-209-P	20 05 21	116 17 23	-57	18	3018	6.11.89	13.12.89	P & A
	Nares 1	WMC	TP/7	21 18 38	115 20 37	-12	46	1190	26.01.90	11.02.90	P & A
	Rivoli 1	MINORA	EP325	21 58 58	114 10 49	-19	32	1975	19.08.89	15.09.89	P & A
	Roller 1	WAPET	TP/3	21 38 06	114 55 33	-12		1332	4.01.90	1.02.90	O SUSP
	Sinbad 1	HADSON	TP/8	20 29 02	115 42 36	-37		2898	21.02.90	3.04.90	G SUSP
	Bullara 1	AMPOL	EP 41	22 42 12	113 53 18			1300	1.03.90	2.12.90	P & A
	Sandalwood 1	SRL EXP	EP 166	22 45 47	113 51 04			1350	16.02.90	27.02.90	P & A
EXT	Griffin 2	BHP	WA-210-P	21 13 28	114 37 22			2725	25.06.90		DRILLING
	Roller 2	WAPET	TP/3	21 38 06	114 55 33			1340	2.02.90	18.02.90	O SUSP
	South Pepper 9	WMC	TP/7	21 07 45	115 16 36	-18	32	1609	6.03.90	20.03.90	P & A
	Wanaea 2	WOOD	WA-28-P	19 36 49	116 24 40	-78	103	3000	2.02.90	7.04.90	O SUSP
	Wanaea 3	WOODSIDE	WA-28-P	19 34 46	116 26 55			2988	28.05.90		DRILLING

Class	Name	Operator	Tenement	Latitude	Longitude	Ground Elev.	KB Elev.	Depth @ 30.6.90	Spud Date	Rig Release Date	Status 30.6.90
Carnarvon Basin (cont'd)											
DEV	Angel 4	WOOD	WA-3-L	19 28 57	116 36 43	-830		2825	7.04.90	27.05.90	G SUSP
	Harriet A7	HADSON	TL/1	20 36 19	115 36 46			2300	12.05.90	2.06.90	O
	Harriet B4	HADSON	TL/1	20 34 35	115 38 10	-24	43	2160	14.06.90	29.06.90	P & A
	Harriet C3	HADSON	TL/1	20 35 25	115 37 33	-24		2161	5.04.90	5.05.90	O
	NRA18	WOOD	WA-1-L	19 35 08	116 08 12	-125	46	3243	16.10.89	24.12.89	G
	NRA19	WOOD	WA-1-L	19 35 08	116 08 12	-125	46	4222	30.11.89	19.02.90	G
	NRA20	WOOD	WA-1-L	19 35 08	116 08 12	-125	46	3567	28.04.90		DRILLING
	NRA21	WOODSIDE	WA-1-L	19 35 08	116 08 12			585	24.05.90		SUSP
	Saladin 8	WAPET	TP3	21 26 30	115 03 11			1326	18.11.89	31.01.90	O
	South Pepper 10	WMC	TP/7	21 07 18	115 16 36	-18	31	1410	21.03.90	19.04.90	O
	South Pepper 11	WMC	TP/7	21 07 43	115 16 49	-18	31	1625	27.03.90	7.04.90	P & A
					Perth Basin						
NFW	Beharra Springs 1	BARRACK	EP 320	29 27 55	115 08 23	42	49	3700	12.03.90	13.05.90	G TEST
	Nth Yardanogo 1	BARRACK	EP 320	29 28 03	115 06 04	35		2387	3.02.90	7.03.90	O SUSP
	Rakrani 1	LASSOC	EP 201	29 10 22	114 53 52		8	1200	22.02.90	11.03.90	P & A
EXT	Dongara 26	WAPET	L2	29 14 47	114 58 17	30	39	1830	27.03.90	18.04.90	P & A
	Mt Horner 11	BARRACK	PL7	29 07 53	115 05 42	209	212	1408	16.10.89	2.11.89	P & A
DEV	Dongara 27	WAPET	L2	29 12 05	115 01 18	34	38	1730	20.02.90	23.03.90	P & A
	Mt Horner 10	BARRACK	PL7	29 07 42	115 05 50	226	217	1450	1.09.89	21.09.89	O

KEY

KB	Kelly bushing	NFW	New field wildcat	O	Oil
		EXT	Extention	G	Gas
		DEV	Development	P & A	Plugged and abandoned
				SUSP	Suspended

NOTE: a negative ground elevation implies depth below sealevel, ie approximate water depth.

Summary Comparison of Petroleum Exploration Permit Dealings 1989-90

	1988-89		1989-90	
	No.	AREA (KM)	No.	AREA (KM)
AREA ADVERTISED				
Onshore	21	44 329	8	14 774
Offshore	10	36 863	17	88 861
TOTALS	**31**	**81 192**	**25**	**103 635**
PERMITS GRANTED				
Onshore	9	15 674	5	11 609
Offshore	8	21 215	3	18 207
TOTALS	**17**	**36 889**	**8**	**29 816**
PERMIT APPLICATIONS (pending at year end)				
Onshore	5		4	
Offshore	-		2	
TOTALS	**5**		**6**	
PERMITS HELD				
Onshore	66	338 209	57	226 980
Offshore	41	133 582	42	160 196
TOTALS	**107**	**471 791**	**99**	**387 176**
PERMITS SURRENDERED				
Onshore	7	66 846	10	47 182
Offshore	3	22 503	2	5 980
TOTALS	**10**	**89 349**	**12**	**53 162**
PERMIT RENEWALS				
Onshore	1	5 452	5	14 878
Offshore	1	7 541	-	-
TOTALS	**2**	**12 993**	**5**	**14 878**
PERMITS CANCELLED				
Onshore				
Offshore				
TOTALS				
PERMITS EXPIRED				
Onshore	-	-	3	21 764
Offshore	1	2 570	2	3 851
TOTALS	**1**	**2 570**	**5**	**25 615**
LICENCES HELD (including pipelines)				
Onshore			21	3110
Offshore			20	3381
TOTALS			**41**	**6491**

Summary of Remaining Identified Reserves at June 30,1990.						
	OIL C_{7+} (10^6kL)		GAS C_1-C_4 (10^9m^3)		CONDENSATE C_5+C_6 (10^6kL)	
Status Probability of recovery	90%	50%	90%	50%	90%	50%
Proved (Developed)						
Barrow Island	7.546	15.514	0.066	0.164		
Blina	0.021	0.351				
Chervil	0.293	0.478	0.117	0.129		
Dongara #	0.002	0.015	0.505	0.505		
Harriet	1.877	3.617	0.391	0.741		
Lloyd	0.010	0.010				
Mt Horner	0.450	0.450				
North Herald	0.212	0.404	0.013	0.035		
North Rankin			177.454	204.456	17.350	22.150
Rosette	0.030	0.080	0.604	0.730	0.081	0.098
Saladin	1.796	2.492	0.010	0.010		
South Pepper	0.260	0.335	0.187	0.192		
Sundown	0.013	0.013				
Talisman	0.068	0.720		0.005		
W.Kora	0.002	0.002				
West Terrace	0.010	0.042				
Woodada			1.207	2.567	0.002	0.005
TOTAL	12.590	21.523	180.554	209.534	17.433	22.253
Proved (Undeveloped)						
Campbell			1.056	1.408	0.122	0.162
Cowle	0.045	0.045				
Goodwyn Main	1.000	1.800	70.600	82.700	14.300	16.700
Goodwyn North			36.500	45.800	18.600	23.400
Goodwyn South	1.600	2.500				
North Rankin West			2.100	7.400	0.200	0.800
Tubridgi			2.140	2.160		
Yammaderry	0.082	0.082				
TOTAL	2.727	4.427	112.396	139.468	33.222	41.062
Probable						
Angel			14.900	35.900	4.400	11.000
Bambra	0.040	0.130	0.260	0.380	0.012	0.019
Brecknock			92.000	141.000	5.200	7.900
Brewster				23.500		
Central Gorgon			1.680	45.570	0.020	0.400
Dockrell	0.500	0.800				
Eaglehawk	0.200	0.200				
Egret	1.100	1.100				
Gorgon			4.690	57.190	0.010	0.160
North Gorgon			11.130	130.890	0.140	1.660
Rankin			5.500	5.500		
Scarborough			70.000	350.000		
Scott Reef			306.000	499.000	22.200	34.300
Spar			1.930	7.040	0.220	0.790
Tern			15.080	17.810		
Tidepole	1.000	1.100	12.800	14.800	1.600	1.700
West Tryal Rocks			11.300	80.770	0.550	3.940
Wilcox			7.000	9.500	2.400	3.400
TOTAL	2.840	3.330	554.270	1 418.850	36.752	65.269
TOTAL RESERVES	18.157	32.280	847.220	1 767.852	87.407	128.584
# : Includes Dongara, Mondarra and Yardarino Fields.						

Summary of Identified Recoverable Petroleum Reserves at 30 June 1990

	1988-89			1989-90		
	Onshore	Offshore	Total	Onshore	Offshore	Total
Part of Body						
Eye	6	3	9	1	4	5
Ear	0	0	0	0	0	0
Face	0	0	0	2	0	2
Head, Neck	1	3	4	1	2	3
Trunk	27	3	30	10	9	19
Spine	0	0	0	1	1	2
Internal Organs	0	2	2	0	0	0
Shoulder, upper arm	4	7	11	3	1	4
Elbow, lower arm	0	3	3	0	1	1
Wrist, hand, finger	13	15	28	6	12	18
Hip, Thigh, groin	6	1	7	0	0	0
Leg, foot, toes	9	13	22	3	9	12
Skin	0	0	0	0	2	2
Multiple	0	1	1	0	0	0
Other	3	1	4	2	0	2
Magnitude						
Minor	41	18	59	27	31	58
Serious	25	19	44	2	10	12
Fatal	0	0	0	0	0	0
Time Factor						
Manhours Exposure	949 243	1 542 403	2 491 646	819 464	1 788 217	2 607 681
Manhours Lost	11 179	8 408	19 587	1 821	5 957	7 778
Frequency Rate	47	19	30	35	23	27
According to Australian Standard C6-1966, a fatality should receive a scheduled charge of 6 000 days. this has not been included here as there is no mention of charges in the later edition (1885-1976) of the same standard.						

Survey	Tenement	Company	Start Date	End Date	Line Kms
		Bonaparte Basin			
1990 BP Bon'te Basin Gulf MSS	WA-219-P	BP	13-May-90	25-Jun-90	4,159
Bobbie MSS	WA-128-P	WMC	16-Nov-89	29-Nov-89	484
HCB90A MSS	WA-218-P	BHP	15-Apr-90	15-May-90	1,930
Kaye MSS	WA-147-P	WMC	9-Sep-89	14-Sep-89	528
Kuhuma MSS	WA-217-P	Kufpec	23-May-90		2,942
N90A MSS	WA-216-P	Norcen	11-Jun-90	20-Jun-90	740
Roxanne MSS	WA-211-P	WMC	21-Jul-89	24-Jul-89	441
SPA 2SL/89-90	Vacant	Elf A.	16-Sep-89	25-Sep-89	685
SPA 5SL/88-89	Vacant	Aust. Seis. Br.	30-Sep-89	18-Oct-89	3,012
				Total	14,921
		Browse Basin			
Enneidra MSS	WA-212-P	Ampol	10-Jul-89	26-Jul-89	2,64
Loretta MSS	WA-206-P	Ampol	23-Oct-89	27-Oct-89	341
				Total	2,905
		Canning Basin			
Elsa SS	EP335/6	WMC	31-Jul-89	25-Aug-89	153
Fitzroy Basin 1989 (Ph 1) SS	EP 101	Kufpec	4-Jul-89	6-Aug-89	198
Moorak Detail SS	EP 330	Barrack	28-Aug-89	7-Sep-89	100
				Total	451
		Carnarvon Basin			
Abdul's Dam SS	EP 100	Pan Pacific	23-May-90	6-Jun-90	140
Angel-Wanaea-Goodwyn MSS	Various	Woodside	28-Dec-89	8-Jun-90	18,509
Barrow Deep (466)	L-1-H	WAPET	13-Jul-89	24-Jul-89	24
Chelonia SS	EP 342/TP9	Lasmo	27-Dec-89	23-Mar-90	2,213
Echo-Dixon S Test	WA-28-P	Woodside	9-Jun-90	9-Jun-90	94
Gorgon 3 (465) MSS	WA-25/205/214/192-P	WAPET	5-Sept-89	29-Sep-89	1,515
Gumnut MSS	WA-191-P	Marathon	5-Apr-90	8-Apr-90	365

Survey	Tenement	Company	Start Date	End Date	Line Kms
		Carnarvon Basin (Cont'd)			
HH90A MSS	WA-210-P	BHP	13-Jan-90	25-Jan-90	1,114
Jacqueline Exp.	WA-149-P	WMC	4-Sep-89	4-Sep-89	35
Jacqueline MSS	WA-149-P	WMC	11-Oct-89	24-Oct-89	1,875
Narwhale MSS	WA-208-P	Command	9-Apr-90	10-Apr-90	89
Patricia MSS	TP/7	WMC	26-Mar-90	2-Apr-90	287
Rosily Shoals MSS	TP/3,TP/7	WAPET	10-Dec-89	10-Dec-89	36
Vlaming (467) MSS	WA-213/210/155-P	WAPET	30-Sept-89	9-Oct-89	644
				Total	26,940
		Perth Basin			
Badamina SS	EP 337	Barrack	9-Mar-90	23-Mar-90	72
Coomallo Detail SS	EP 320	Barrack	4-Feb-90	22-Feb-90	118
Coomallo Hill SS	EP 320	Barrack	28-Nov-89	8-Dec-89	76
Correy SS	EP 320	Barrack	17-Nov-89	27-Nov-89	80
Eurangoa SS	L7	Barrack	28-Feb-90	7-Mar-90	34
Georgina SS	PL 7	Barrack	21-Oct-89	25-Oct-89	68
Heelans SS	EP 111	Vic. Int. Petro.	24-Apr-90	2-May-90	56
North Yardanogo SS	EP 320	Barrack	6-Apr-90	12-Apr-90	45
Skipper SS	EP 320	Barrack	26-Mar-90	5-Apr-90	78
SPA 9SL/88-89 & 3T/88-89	Vacant	GSI	11-Aug-89	29-Aug-89	1588
Thompkin SS	EP 320	Barrack	27-Oct-89	9-Nov-89	78
West Erregulla SS	EP 23	Barrack	9-Nov-89	17-Nov-89	48
Woolka SS	EP 323	Barrack	3-Jan-90	26-Feb-90	225
				Total	2,566

Gross petroleum production in Western Australia for the 12 months ending 30th June, 1990			
Field	**Crude Oil (kL)**	**Condensate (kL)**	**Gas (10^3m^3)**
Barrow Island	855 976.000		84 901.243
Blina	13 377.538		
Chervil	150 038.200		36 036.200
Dongara	217.100	516.310	134 720.600
Harriet	630 686.800		78 755.300
Lloyd	3 662.869		
Mondarra		112.800	9 708.600
Mt Horner	30 651.106		
North Herald	125 200.800		15 434.800
North Rankin		1 630 272.140	11 315 007.877
North Yardanogo	245.317		
Rosette			
Saladin	1 492 376.000		113 631.000
South Pepper	331 895.200		114 863.700
Sundown	1 231.655		
Talisman	552 230.500		6 128.100
West Kora	2 623.818		
West Terrace	1 940.527		
Woodada		837.430	87 841.020
Yardarino			
TOTAL	**4 192 353.430**	**1 631 738.680**	**11 997 028.440**

Note: These are gross production not sales figures. Of the North Rankin gross gas production approximately $3.8*10^9m^3$ were reinjected and $2.8*10^9m^3$ were used for LNG.

Employees in the WA Mining and Petroleum Industries as at 30 June 1990

MINERAL Company	LOCATION	1988-89	1989-90
BASE METALS			
BHP Minerals Ltd	Cadjebut	154	186
Murchison Zinc Co. Pty Ltd	Golden Grove	99	284
		253	**470**
BAUXITE - ALUMINA			
Alcoa of Australia Ltd	Del Park-Huntley/Pinjarra	1 780	1 853
	Jarrahdale/Kwinana	2 006	1 620
	Wagerup/Willow Dale	644	558
Worsley Alumina Pty Ltd	Boddington/Worsley	963	1 110
		5 393	**5 141**
COAL			
Griffin Coal Mining Co. Ltd	Collie	552	558
Western Collieries Ltd	Collie	719	748
		1 271	**1 306**
DIAMOND			
Argyle Diamond Mines Pty Ltd	Lake Argyle	729	828
Poseidon Ltd	Bow River	95	119
		824	**947**
GOLD			
Ashton Gold	Cork Tree Well	102	124
Australian Cons. Minerals Ltd	Golden Crown	75	91
	Westonia	120	60
	Mt Pleasant	111	119
Australian Mine Mgmt Pty Ltd	Racetrack/Royal Standard	-	11
Aztec Mining Co. Ltd	Bounty	95	108
Barrack Mine Management	Horseshoe Lights	140	63
	Wiluna	124	184
BHP Minerals Ltd	Gimlet South/Orban JV	85	111
Big Bell Mines Pty Ltd	Big Bell	232	275
Broken Hill Metals NL	Hopes Hill	151	144
Central Norseman Gold Corp. NL	Central Norseman	384	399
Coolgardie Gold NL	Greenfield	89	101
Dominion Mining Ltd	Labourchere/Nathans	-	70
	Meekatharra	298	297
	Mt Morgans	97	163
	Tower Hill	77	81
East Murchison Mining Pty Ltd	Gidgee	97	139
Forsayth Pty Ltd	Lawlers	95	90
	Mt Gibson	143	277
Hedges Gold Pty Ltd	Hedges	114	113
Hill 50 Gold Mine NL	Mt Magnet	233	233
Kalgoorlie Cons. Gold Mines P/L	Kalgoorlie	1 369	1 507
Mawson Pacific Ltd	Edwards Find	21	27
	Marvel Loch	110	138
	Transvaal	74	56
Metana Minerals	Mt Magnet	145	138
	Reedy	117	144
	Rothsay	51	77
Newmont Holdings Pty Ltd	New Celebration	216	310
	Telfer	492	525
Pancontinental Goldmining Pty Ltd	Paddington	211	184
Placer (Granny Smith) Pty Ltd	Granny Smith	-	157
Poseidon Ltd	Kaltails	56	289
	Karonie	52	60
Ross Atkins Mining	Ingliston	129	141
Sons of Gwalia NL	Sons of Gwalia	103	152
Spargos Mining Pty Ltd	Bellevue	219	178

MINERAL Company	LOCATION	1988-89	1989-90
GOLD - continued			
Western Mining Corporation Ltd	Emu	111	120
	Kambalda	182	190
	Lancefield	111	115
	Sand King	50	-
Worsley Alumina Pty Ltd	Boddington	496	402
All Other Operators		2 738	2 669
		9 915	**10 832**
HEAVY MINERAL SANDS			
Allied Eneabba Pty Ltd	Eneabba	112	131
Associated Minerals Consolidated Ltd	Capel	195	237
	Eneabba/Narngulu	483	610
Cable Sands Pty Ltd	Capel	236	243
Northern Metals and Oil Pty Ltd	Picton	60	69
Target Minerals NL	Port Gregory/Narngulu	15	17
TiWest Pty Ltd	Cooljarloo/Cataby	-	178
Westralian Sands Ltd	Capel	477	530
		1 578	**2 015**
IRON ORE			
BHP Minerals Ltd	Yampi	432	422
Goldsworthy Mining Ltd	Pilbara/Port Hedland	865	906
Hamersley Iron Pty Ltd	Tom Price - Paraburdoo/Dampier	2 906	3 168
Hancock Mining Ltd	McCamey's	37	56
Mt Newman Mining Co. Ltd	Newman/Port Hedland	3 585	3 657
Robe River Mining Co. Pty Ltd	Pannawonica/Cape Lambert	1 024	981
		8 849	**9 190**
NICKEL			
Western Mining Corporation Ltd	Kalgoorlie	371	384
	Kambalda	1 806	1 810
	Kwinana Refinery	326	338
	Leinster	336	551
	Mt Windarra	432	344
All Other Operators		-	11
		3 271	**3 438**
PETROLEUM PRODUCTS			
Barrack Energy Ltd	Mt Horner	3	3
Consolidated Gas Pty ltd	Woodada	6	6
Eromanga Energy Ltd	Blina/Sundown/Lloyd	2	2
Hadson Energy Pty Ltd	Harriet/Rosette	80	74
Marathon Petroleum Australia Ltd	Talisman	-	4
Oil Company of Australia NL	West Kora	-	4
West Australian Petroleum Pty Ltd	Barrow Island	165	179
	Dongara	10	8
	Saladin	-	28
Western Mining Corporation Ltd	North Herald/South Pepper	27	157
Woodside Offshore Petroleum Pty Ltd	North Rankin A/Burrup Peninsula	1 381	1 404
		1 674	**1 869**
SALT			
Dampier Salt Ltd	Dampier	179	178
	Lake MacLeod	99	114
Leslie Salt Co.	Port Hedland	112	120
Shark Bay Salt JV	Useless Loop	92	86
		482	**498**
ALL OTHER MATERIALS (including Rock Quarries)		**866**	**841**
TOTAL		**34 376**	**36 547**

(SOURCE: AXTAT REPORTING SYSTEM, MINING ENGINEERING DIVISION)

MINERAL	UNIT	1988-89 QUANTITY	1988-89 VALUE($A)	1989-90 QUANTITY	1989-90 VALUE($A)
BARYTES	t	0	0	**7 521**	**1 006 603**
BASE METALS					
Copper	t	13 083	31 374 188	**14 979**	**23 922 443**
Lead	t	2 431	920 073	**13 171**	**7 604 934**
Zinc	t	28 799	26 786 585	**45 878**	**59 754 974**
TOTAL BASE METALS			59 080 846		**91 282 351**
BAUXITE-ALUMINA					
Alumina	t	6 171 962	1 619 228 331	**6 651 028**	**2 335 697 184**
CLAYS					
Attapulgite	t	44 065	3 527 557	**28 137**	**3 988 107**
Cement Clay	t	24 007	60 020	**21 952**	**54 880**
Clayshale	t	383	765	**0**	**0**
Fire Clay	t	171 189	205 570	**279 538**	**511 780**
Kaolin	t	3 706	186 553	**7 701**	**472 291**
White Clay	t	1 709	20 503	**32 401**	**324 010**
TOTAL CLAYS			4 000 968		**5 351 068**
COAL	t	3 800 228	161 240 819	**4 160 646**	**183 698 442**
CONSTRUCTION MATERIALS					
Aggregate	t	170 838	1 134 173	**150 814**	**754 854**
Gravel	t	24 643	114 215	**44 981**	**213 086**
Rock	t	180 494	1 672 350	**108 198**	**800 585**
Sand	t	757 976	2 142 695	**729 863**	**2 693 633**
TOTAL CONSTRUCTION MATERIALS			5 063 433		**4 462 158**
DIAMOND	ct	36 470 380	354 745 556	**33 854 620**	**413 583 727**
DIMENSION STONE					
Black Granite	t	0	0	**1 239**	**1 789 485**
Quartz Rock	t	1 088	48 977	**994**	**43 341**
Quartzite	t	0	0	**59**	**2 360**
Spongolite	t	0	0	**2 280**	**145 354**
TOTAL DIMENSION STONE			48 977		**1 980 540**
GEM, SEMI-PRECIOUS AND ORNAMENTAL STONE					
Amethyst	kg	41 064	198 426	**14 594**	**67 958**
Emerald	grams	1 930	2 200	**550**	**2 020**
Zebra Rock	kg	1 260	12 600	**0**	**0**
TOTAL GEM, SEMI-PRECIOUS AND ORNAMENTAL STONE			213 226		**69 978**
GOLD	kg	130 565	2 072 691 840	**148 420**	**2 371 725 626**
GYPSUM	t	165 967	1 326 387	**154 809**	**995 281**
HEAVY MINERAL SANDS					
Garnet	t	26 069	977 265	**27 768**	**1 152 128**
Ilmenite	t	874 782	67 183 462	**1 071 845**	**89 606 326**
Upgraded Ilmenite (a)	t	227 979	95 474 088	**284 109**	**131 107 248**
Leucoxene	t	18 297	7 781 578	**15 023**	**7 902 766**
Monazite	t	10 133	7 445 827	**13 358**	**9 731 111**
Rutile	t	100 484	62 491 492	**82 232**	**58 541 710**
Xenotime	t	20	105 840	**0**	**0**
Zircon	t	340 140	151 609 319	**300 256**	**175 190 729**
TOTAL HEAVY MINERAL SANDS			393 068 871		**473 232 018**
INDUSTRIAL PEGMATITE MINERALS					
Felspar	t	18 358	739 627	**9 692**	**437 909**
Mica	t	3 513	916 814	**0**	**0**
TOTAL INDUSTRIAL PEGMATITE MINERALS			1 656 441		**437 909**
IRON ORE					
Domestic	t	4 914 588	78 446 430	**5 255 037**	**103 517 251**
Exported	t	95 502 782	1 712 003 160	**101 017 156**	**2 142 510 771**
TOTAL IRON ORE		100 417 370	1 790 449 590	**106 272 193**	**2 246 028 022**

MINERAL	UNIT	1988-89 QUANTITY	1988-89 VALUE($A)	1989-90 QUANTITY	1989-90 VALUE($A)
LIMESAND-LIMESTONE-DOLOMITE					
Dolomite	t	360	7 200	**333**	**6 660**
Limesand-Limestone	t	1 739 324	8 325 470	**16 98 820**	**7 868 870**
TOTAL LIMESAND-LIMESTONE-DOLOMITE			8 332 670		**7 875 530**
MANGANESE ORE	t	0	0	**273 000**	**1 200 000**
NICKEL					
Cobalt by-product	t	266	3 681 889	**268**	**4 600 916**
Nickel Concentrate	t	353 850	633 839 033	**446 453**	**565 370 341**
Nickel Ore	t	0	0	**37 084**	**20 598 342**
Palladium by-product	kg	280	1 622 806	**431**	**1 631 497**
Platinum by-product	kg	70	1 504 088	**66**	**1 049 022**
TOTAL NICKEL INDUSTRY			640 647 816		**593 250 118**
PEAT	t	1 338	78 504	**1 111**	**68 546**
PETROLEUM					
Condensate	kl	1 154 116	141 799 395	**1 601 163**	**235 653 383**
Crude Oil	kl	2 198 943	269 860 578	**3 962 739**	**601 471 936**
LNG	MMBtu	0	0	**104 167 480**	**336 091 222**
Natural Gas	'000m3	3 642 292	284 641 291	**3 847 731**	**356 846 939**
TOTAL PETROLEUM			696 301 264		**1 530 063 480**
RARE EARTHS					
Gallium	kg	1 767	60 641	**42 986**	**1 454 998**
SALT	t	6 023 426	106 705 667	**5 924 943**	**124 110 422**
SILICA-SILICA SAND					
Silica	t	0	0	**32 544**	**325 435**
Silica Sand	t	364 453	3 051 841	**445 874**	**3 662 014**
TOTAL SILICA-SILICA SAND			3 051 841		**3 987 449**
SILVER	kg	30 426	4 362 975	**34 561**	**5 621 356**
TALC	t	195 307	14 991 613	**220 263**	**15 223 112**
TIN-TANTULUM-LITHIUM					
Spodumene	t	32 812	5 742 022	**47 428**	**8 305 325**
Tantalite	t	548	13 352 435	**439**	**16 169 644**
Tin	t	365	2 253 656	**237**	**1 298 492**
TOTAL TIN-TANTULUM-LITHIUM			21 348 113		**25 773 461**
VERMICULITE	t	651	114 410	**105**	**18 528**
TOTAL VALUE			**7 958 813 399**		**10 438 197 907**

Note: (a) Also known as synthetic rutile

Mineral	1988-89 $A	1989-90 $A	Value $A Variance	%up (%down)
BASE METALS				
Copper	1 466 901.31	**1 116 113.23**	(350 788.08)	(24)
Lead	0.00	**227 916.33**	227 916.33	n.ap.
Zinc	1 105 668.33	**2 974 086.58**	1 868 418.25	169
BAUXITE-ALUMINA				
Alumina	20 797 429.97	**34 072 745.00**	13 275 315.03	64
CLAYS	124 514.20	**185 929.14**	61 414.94	49
COAL	1 683 307.75	**2 148 206.66**	464 898.91	27
CONSTRUCTION MATERIALS				
Aggregate	61 439.70	**50 214.90**	(11224.80)	(18)
Gravel	7 537.80	**11 843.75**	4 305.95	57
Rock	60 591.46	**32 548.66**	(28 042.80)	(46)
Sand	196 408.42	**239 062.06**	42 653.64	21
DIAMOND	12 055 670.43	**27 202 475.86**	15 146 805.43	125
DIMENSION STONE	432.94	**782.86**	349.92	80
GEM, SEMI-PRECIOUS AND ORNAMENTAL STONE	22 139.41	**6 996.00**	(15 143.41)	(68)
GOLD	219 610.41	**199 362.36**	(20 248.05)	(9)
GYPSUM	44 948.55	**49 867.89**	4 919.34	11
HEAVY MINERAL SANDS				
Garnet	45 270.22	**52 912.63**	7 642.41	17
Ilmenite	3 505 728.24	**4 678 380.34**	1 172 652.10	33
Leucoxene	152 358.84	**500 469.64**	348 110.80	228
Monazite	350 230.95	**516 417.37**	166 186.42	47
Rutile	2 622 307.52	**3 101 789.38**	479 481.86	18
Xenotime	0.00	**5292.00**	5292.00	n.ap.
Zircon	6 324 381.30	**9 490 837.53**	3 166 456.23	50
TOTAL HEAVY MINERAL SANDS	13 000 277.07	**18 346 098.89**	5 345 821.82	41
INDUSTRIAL PEGMATITE MINERALS	58 257.74	**39 427.66**	(18 830.08)	(32)
IRON ORE	92 722 782.67	**112 532 211.41**	19 809 428.74	21
LIMESAND-LIMESTONE-DOLOMITE				
Dolomite	39.00	**99.90**	60.90	156
Limesand-Limestone	103 808.71	**139 160.12**	35 351.41	34
MANGANESE	0.00	**90 000.00**	90 000.00	n.ap.
NICKEL				
Cobalt by-product	73 857.83	**82 543.36**	8 685.53	12
Nickel	9 523 120.87	**9 978 061.91**	454 941.04	5
Palladium by-product	18 248.10	**27 351.53**	9 103.43	50
Platinum by-product	18 248.10	**26 651.04**	8 402.94	46
PEAT	2535.02	**2602.21**	67.19	3
PETROLEUM				
Condensate	1 126 652.24	**2 068 390.85**	941 738.61	84
LNG	0.00	**2 265 012.95**	2 265 012.95	n.ap.
Natural gas	3 143 794.05	**5 204 344.62**	2 060 550.57	66
Oil	16 309 160.89	**42 239 570.30**	25 930 409.41	159
TOTAL PETROLEUM	20 579 607.18	**51 777 318.72**	31 197 711.54	152
RARE EARTHS				
Gallium	0.00	**276 769.61**	276 769.61	n.ap.
SALT	1 057 214.07	**1 075 787.77**	18 573.70	2
SILICA SAND	208 488.68	**216 768.32**	8 279.64	4
SILVER	144 965.78	**145 976.57**	1 010.79	1
TALC	94 048.21	**100 002.00**	5 953.79	7
TIN-TANTALUM-LITHIUM				
Spodumene	355 611.41	**341 091.87**	(14 519.54)	(4)
Tantalite	166 197.13	**444 982.14**	278 785.01	168
Tin	53 080.01	**50 242.60**	(2837.41)	(5)
VERMICULITE	16 534.07	**10 696.95**	(5 837.12)	(35)
Total Value	176 043 522.33	**264 221 995.86**	88 178 473.53	50

Note: **All Royalty Receipts above are only those paid to Consolidated Revenue Fund**

MINING REGISTRATION DIVISION

Mining Tenements in Force as at 30 June 1990

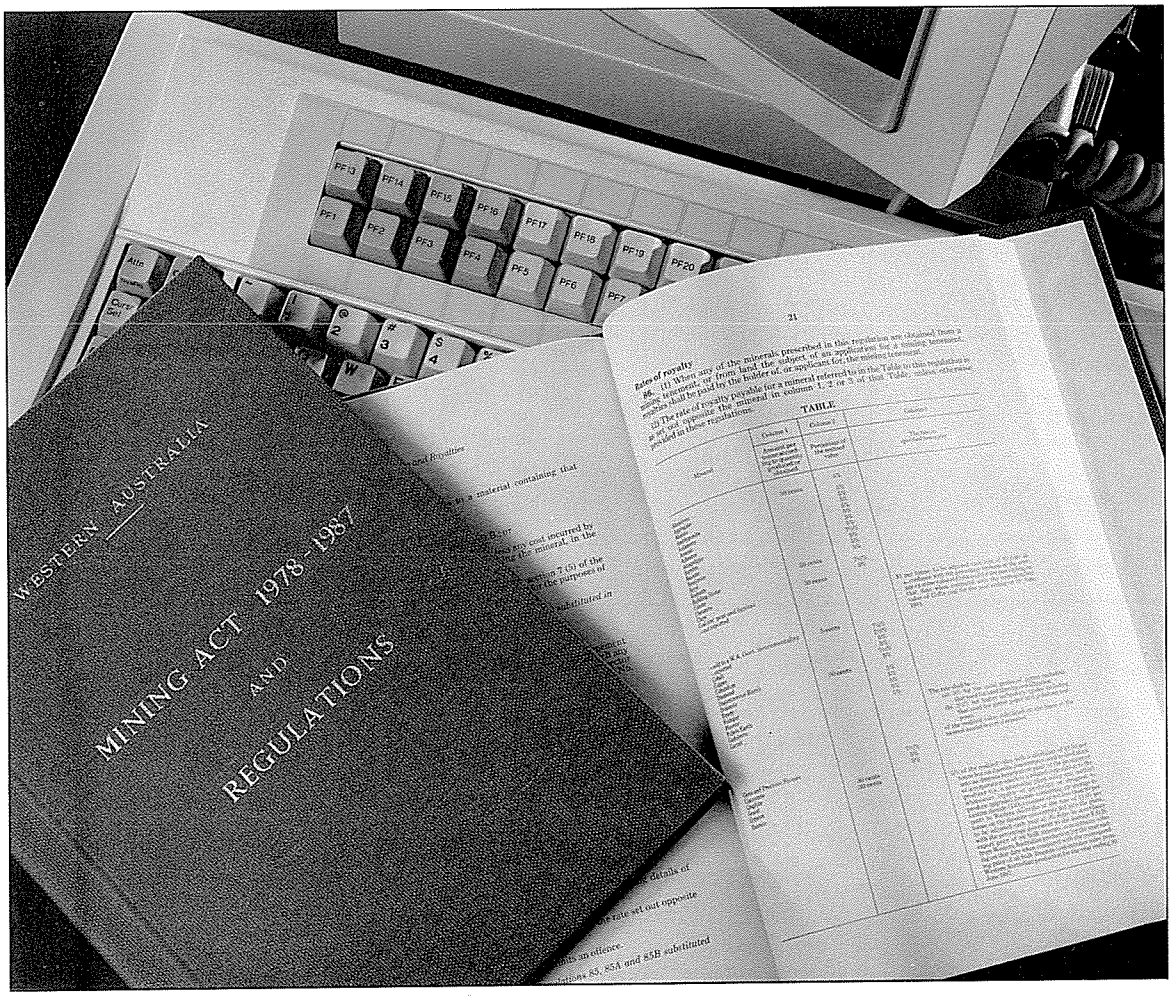
MINERAL FIELD DISTRICT	1978 MINING ACT			1904 MINING ACT
	PROSPECTING LICENCES	EXPLORATION LICENCES	MINING LEASES AND OTHERS	MINERAL CLAIMS AND OTHERS
01 Greenbushes	-	-	14	-
04 West Kimberley	44	141	176	233
08 Ashburton	56	112	50	-
09 Gascoyne	30	80	40	-
12 Collie	-	-	109	-
15 Coolgardie	644	47	944	-
16 Kunanalling	301	17	138	-
20 Cue	272	40	183	-
21 Day Dawn	116	6	48	-
24 Broad Arrow	377	9	370	2
25 Bulong	167	14	59	10
26 East Coolgardie	362	10	356	-
27 Kanowna	144	10	104	-
28 Kurnalpi	91	50	60	-
29 Menzies	197	22	128	-
30 Ularring	70	7	98	-
31 Yerilla	129	16	85	-
36 Lawlers	285	56	157	25
37 Mt Malcolm	669	59	247	-
38 Mt Margaret	392	84	208	2
39 Mt Morgans	504	74	170	-
40 Niagara	105	9	76	-
45 Pilbara	293	174	346	1
46 Nullagine	155	28	83	-
47 West Pilbara	110	112	214	-
51 Meekatharra	319	89	317	-
52 Peak Hill	117	162	189	-
53 Wiluna	176	77	189	161
57 Black Range	173	59	122	-
58 Mt Magnet	147	28	177	-
59 Yalgoo	175	125	195	-
63 Dundas	130	49	188	-
66 Northampton	1	3	1	-
69 Warburton	-	41	1	-
70 South West	154	155	476	72
74 Phillips River	15	23	45	1
77 Yilgarn	682	126	425	-
80 Kimberley	123	150	168	-
TOTAL	**7725**	**2264**	**6953**	**507**

Total Area of Mining Tenements in Force

As at	Area (hectares)
Dec 82	12 756 046
Dec 83	10 505 270
Dec 84	17 308 525
June 85	18 414 443
June 86	17 496 124
June 87	22 232 171
June 88	26 998 964
June 89	26 278 115
June 90	22 107 826

APPENDICES

1. Legislation Administered
2. Changes to Legislation
3. Gold Operations Review
4. Research and Development Projects
5. Publications
6. Public Relations, Displays and Marketing Activities
7. Boards and Committees of the Department of Mines
8. Departmental Directory and Organisation Chart



The Department is responsible to the Minister for Mines for the administration of 17 individual Acts of Parliament.

Principal Acts

Mining Act

Petroleum Act

Other Acts

Coal Mines Regulation Act

Coal Mine Workers (Pensions) Act

Coal Miners' Welfare Act

Coal Mining Industry Long Service Leave Act

Explosives and Dangerous Goods Act

Mines Regulation Act

Mine Workers' Relief Act

Miners' Phthisis Act

Mining Development Act

Mining on Private Property Act

Petroleum Pipelines Act

Petroleum (Registration Fees) Act

Petroleum (Submerged Lands) Act

Petroleum (Submerged Lands) Registration Fees Act

Western Australian Coal Industry Tribunal Act

The following Commonwealth legislation is administered in the Western Australian adjacent area by the State and through the Commonwealth/Western Australian Offshore Petroleum Joint Authorities:

Commonwealth Petroleum (Submerged Lands) Act

Commonwealth Petroleum (Submerged Lands) (Registration Fees) Act

Commonwealth Petroleum (Submerged Lands) (Royalty) Act

Commonwealth Petroleum (Submerged Lands) (Retention Lease Fees) Act

Commonwealth Petroleum (Submerged Lands) (Exploration Permit Fees) Act

Commonwealth Petroleum (Submerged Lands) (Production Licence Fees) Act

Commonwealth Petroleum (Submerged Lands) (Pipeline Licence Fees) Act

Commonwealth Minerals (Submerged Lands) Act

In addition to its responsibilities under the above Acts, the Department undertakes various functions in relation to a number of special Agreement Acts:

Barrow Island Royalty Trust Account Act

Barrow Island Royalty Variation Agreement Act

Mining (Validation and Amendment) Act.

Explosives and Dangerous Goods Act 1961

(a) Explosives and Dangerous Goods (Third Schedule) Amendment Order 1989.

This amendment to the Third Schedule to the Act was necessary in order to make the classification of dangerous goods in Western Australia consistent with Australian standards and to provide new categories for Chronic Hazardous Substances and Restricted Dangerous Substances.

(b) Explosives and Dangerous Goods (Classification of Dangerous Goods) Amendment Order 1989.

This amendment was required to declare particular substances to be dangerous goods and to classify those substances by reference to the system specified in the Third Schedule to the Act.

Coal Mine Regulation Amendment Act 1990

This Amendment Act creates the statutory management position of Opencut Mine Undermanager, and prescribes the minimum qualifications necessary to satisfy the Board of Examiners.

It provides for the recognition by the Board of Examiners of experience gained in open cut mines and quarries, other than coal mines. Additionally, it introduces a requirement for all applicants for Certificates of Competency to pass an examination on the mining laws of Western Australia.

Finally, this amendment Act removes the prohibition of employees working more than seven consecutive hours, or more than forty two hours per week in the underground mines.

This amendment Act passed through both houses of Parliament by late June 1990, and was assented to and proclaimed to come into effect in early July 1990.

Coal Industry Superannuation Act 1989

The Coal Industry Superannuation Act 1989 was assented to on 12 December 1989 and was proclaimed on 1 July 1990, at the same time repealing the Coal Mine Workers Pensions Act 1943-1988.

The new Act was implemented after extensive consultation amongst coal mining companies, coal mining unions, the Coal Mine Workers Pensions Tribunal and the Government Actuary to provide a more modern superannuation fund for persons employed in the coal mining industry, and to replace the Coal Mine Workers Pensions Fund.

Regulations by which the Fund is structured and operated were also brought into being from 1 July 1990.

Barrow Island Royalty Variation Agreement Act, 1985

Barrow Island Royalty Variation Agreement Amendment.

This amendment enables WAPET to calculate quarterly royalty payments using estimates of current quarters, costs and sales details, rather than details for the previous quarter. Also to move the payment schedule for May 23 each year to June 23.

The tabling period expired in the Assembly on 25 October 1989 and in the Council 24 October 1989. Therefore the Variation Agreement is now operative.

Mining Act 1978 - Regulations

Mining Amendment Regulations 1990, gazetted 22 June 1990

These amendments deleted the concessionary five cents per tonne royalty rate for coal sold to a WA Government instrumentality. To reduce the impact, the rate for coal not exported will be phased in to apply to those sales. For the 1990-91 financial year the rate will be thiry-three and one-third percent, for the 1991-92 year sixty-six and two-thirds percent, and from 1 July, 1992 one hundred percent of the not exported coal rate.

The amendments came into effect from 1 July 1990.

The following review provides a regional appraisal of the significant gold operations in the State in 1989-90.

South West

The Boddington deposit is operated as two independent developments; Alcoa's Hedges operation and the Worsley JV's Boddington mine. Hedges contributed 5 200 kg out of a combined total of 18 700 kg of fine gold produced from the deposit in 1989-90. At 13 500 kg of gold output the Boddington mine is the second largest producer in Australia; being exceeded only by the consolidated operations on the Golden Mile at Kalgoorlie.

Boddington has been in an expansion mode ever since its start up in October 1987. The expansion to 6 million tpa capacity was completed during the year and the current consideration is to add a copper flotation circuit to the plant to recover copper concentrates from the supergene enriched ores planned for exploitation in the near future. Corresponding to the expansion plans, reserves have been upgraded so that the remaining 95 000 kg of contained gold in mineable reserves is almost the same as at start up in 1987. On this basis, at current production levels, Boddington has remaining at least a seven year life and the potential in-depth resources could extend this considerably.

Pilbara

Telfer ranks third in the State's gold production list with an output of 8 600 kg of gold in 1989-90, of which nearly 1 000 kg is credited to the copper circuit. Over the past year, gold production from heap-leach processing of low-grade ores has reached full potential and production from this source now stands at just under 3 000 kg of gold per year. The heap-leach ore production rate now stands at 4.5 million tpa making the Telfer heap-leach operation the largest of its kind in Australia.

The Telfer oxide ore milling and CIP circuits have reached their treatment capacity of 2 million tpa, and in fact, now surpass design capacity. This has been possible because of major metallurgical input into the crushing and grinding circuits. Considerable cost reductions were also effected in treatment through the use of latest technology in the control of reagent additions to the circuit. An additional 42 000 t of high grade sulphide ore (4.7% Cu and 20.8g/t Au) was treated through the sulphide circuit, as part of the company's ongoing copper concentrate sales commitment.

In July 1989, a major failure involving some 150 000 t of material occurred in a cable-supported and strapped face in the 1A Pit of the Telfer Main Dome. This resulted in a re-evaluation of future mining options and initial underground development was brought forward, with work commencing on a decline on 1 March 1990. A 25 ,000 trial parcel of ore has been taken. The company's plan is to develop a selective mining operation of 250 000 tpa on high grade sulphides for four years. The declining output from the Main Dome pit is being counterbalanced by a steady build up of production on the West Dome.

Extensive exploration has identified additional resources in the main production areas as well as surrounding prospects. Total resources have been upgraded to nearly 220 000 kg of contained gold from 155 000 kg a year ago and the province is thought to contain over 300 000 kg.

Elsewhere in the Pilbara region gold production is minor in a State context. There are a number of small, individual prospector-sized operations in the Nullagine, Marble Bar and Roebourne districts. Only Bamboo Creek and Normay, both predominantly underground operations, are of any size. Bamboo Creek has long struggled to achieve design output levels and a new management, management practice and largely new workforce were installed during the year. Development of a decline at the Bamboo Queen was commenced. The plant also treated parcels of high grade ore from the North Shaw operation. Normay, although maintaining production throughout the year, is experiencing difficulties with one of the joint venture partners, Goult Pro Partners, going into receivership.

Peak Hill District

To the south of the Pilbara, the southeastern part of the Peak Hill district has received considerable attention. The discovery of the Plutonic deposit, in the Marymia Dome, has attracted considerable exploration activity in this previously and largely ignored greenstone belt. At year end the Plutonic project was at an advanced stage of development of a 1.2 million tpa carbon-in-leach operation costing $44 million. Gold output is planned at about 5 000 kg per annum.

Two other significant developments to the northwest of Peak Hill started production in October 1989. These are Dominion Mining Ltd's Labouchere project and Homestake Australia Ltd's Fortnum project. Both are similar in characteristics, with capital costs of $18-21 million, design outputs of 1 500-1 750 kg pa, mine lives of four-and-a-half to six years and open cut developments with carbon-in-leach process circuits.

The Peko-Wallsend-Grants Patch joint venture at Peak Hill and Barrack Mines' Horseshoe operation are other significant producers from this district, although the Horseshoe open pit suffered a major pit wall collapse in

June 1990 and others were to be expected. The company planned to continue milling for a six-month period from stockpiled ore, whilst further geotechnical appraisal was being undertaken. The Horseshoe mine can now be termed both a copper and gold producer.

Murchison

Rationalisation of operations in 1988-89 and subsequent acquisitions this year have resulted in two major operators dominating the Meekatharra area. Ross Atkins Mining Ltd operates between Nannine and Meekatharra with a central base on the Bluebird plant. Dominion Mining, having acquired Whim Creek Consolidated NL, operates the Haveluck and Paddys Flat plants and a number of minesites in the immediate vicinity of Meekatharra. Together with Gabanintha and Labouchere, Dominion now has a considerable presence in the district and, following extensive exploration and new acquisitions, has a total resource base of over 20 million tonnes containing nearly 45 000 kg of gold.

Elsewhere in the Murchison, ownership changes have been prevalent. Newmont Australia Ltd acquired Australmin Holdings, in the process adding the 2 300 kg pa Tuckabianna operation to its already substantial gold holdings in the State (Telfer and New Celebration).

In March 1990 Brunswick NL ceased operations at Galtee More, to the north of Mt Magnet; the treatment plant being acquired by Paragon Resources for reassembly at its Comet-Pinnacles operation near Cue. The mines and deposits portfolio was picked up by Metana Minerals NL for its Mt Magnet operations. However, Metana has subsequently been forced to reduce its debt and the sale has been announced of the whole of its Mt Magnet operation, including the Parkinson Pit and Black Cat II plant, to Western Mining Corporation's Hill 50 Gold NL for $15.1 million. Hill 50 is in the process of integrating its existing operations with its new acquisitions. Underground production has ceased at Hill 50 for the time being. Any future underground development is likely to be by decline.

Metana has retained its Reedy operation where record production of about 1 850 kg was reported for 1989-90. It also operates the Rothsay mine where open pit operations were phased out in May 1990. All production is now from underground.

The remaining major producers in the Murchison have had a difficult year for various reasons. At Day Dawn, the Big Bell open pit has not been able to supply the forecast feed grades to the plant causing production costs to rise dramatically. The joint venture partners, ACM Ltd and Placer Pacific, have, as a result, revised the mine plan by reducing the life of the open cut operations from four to six years. ACM's other operation in the area, Golden Crown, continued to produce high grade ore from its underground development.

The Forsayth NL/Reynolds operation at Mt Gibson has similarly had grade problems. The development of supergene areas (as opposed to laterite) from the Hornet zone resulted in the predicted high grade feedstocks to the plant in the first half of the year, but much lower grades than anticipated have subsequently been encountered, with operations on the Hornet zone temporarily suspended in February 1990. Production from the Kurara mine was affected by flooding early in 1990.

Yilgarn/Southern Cross

The Yilgarn or Southern Cross province has two significant producers to the north of Sandstone, Gidgee and Herald Resource's Montague-Boulder operation. Production from the Boulder pit ceased in June 1990 and ore feed to the plant continued from stockpile. The company has recently entered into an innovative arrangement with a nearby developer, Polaris Pacific NL, whereby the process plant is to be hired by Polaris for an 18 month period to treat ore from its Whistler deposit. This will allow time for Herald to appraise its remaining properties in the area.

In the Bullfinch-Southern Cross-Marvel Loch belt there are five significant producers. The largest, Mawson Pacific Ltd with operations at Marvel Loch and Transvaal, to the south of Southern Cross, produced 3 200 kg in 1989-90. The Broken Hill Metals operation at Hopes Hill - Corinthia suffered from erratic grades in its Corinthia pit and is now concentrating on higher grade zones. The Hopes Hill plant also toll-treated some of Golden Valley NL's Frasers mine ore from Southern Cross. The rest was trucked to its Radio plant north of Bullfinch. The other main producers in the district are Copperhead at Bullfinch and the Nevoria joint venture near Marvel Loch. The Great Victoria operator went into receivership in November 1989 and the plant, near Marvel Loch, has been acquired by Orion Resources NL with a view to developing the nearby promising Yilgarn Star prospect.

After commencing operations in April 1989, the Forrestania Gold NL/Aztec Mining Co Ltd joint venture quickly moved to capacity production at its Bounty and North Bounty open cut operations in the Forrestania belt. In 1989-90 the project produced 2 228 kg and by year end was preparing to move to underground production, with the pits schedule to close in September 1990. In the southern part of the belt Nova Resources commissioned its smaller 100 000 tpa gold treatment plant at its Hatters Hill project.

North Eastern Goldfields

The Wiluna project posted record gold output in 1989-90 of 4 607 kg as a result of plant expansions over the last 18 months. A significant upgrade in resources to 2 million tonnes of oxide ore, a further 4 million tonnes of low grade ore and 10 million tonnes of sulphide, plus feasibility studies on sulphide ore treatment and a roaster development should ensure long term operations at the site. However, the recent financial difficulties of the Barrack Mines group has resulted in its 50% ownership being put up for sale.

Asarco, the other partner at Wiluna is in a better situation and proceeded with development of the Cox's Lode (under the Miranda project) during the year in conjunction with Forsayth NL. Ore is being treated through the existing Lawler's plant of Forsayth. This plant has developed as a significant centralised plant in the area for custom milling, joint venture operations and treating Forsayth's own ores. Asarco is also considering development of a new prospect at Jundee, to the northeast of Wiluna. Through its subsidiary, Sundowner Minerals, Forsayth NL also has the Darlot operation to the northeast of Lawlers.

Other significant operations in the Lawlers area are Spargos' Sir Samuel-Bellevue underground operations and Western Mining Corporation's Leinster gold operations (formerly Emu project).

Eon Metal's Matilda project to the south of Wiluna was the other significant development during the year. This is a redevelopment of Chevron's former Mt Wilkinson deposits after Eon had taken over ownership in June 1989.

Leonora District

Leonora is the centre for some of the earliest project developments of the 1980s gold boom, including Tower Hill, Harbour Lights and Sons of Gwalia. Each has subsequently suffered problems with depletion of the initial ore reserves, but has maintained production through acquisition, custom milling or further definition of exploitable resources in the vicinity. The low grades and recoveries feeding the Tower Hill plant led to very high unit costs and Dominion Mining considering to sell off the operation. However, a decision was made to selectively mine high grade ore to maintain operations for a further 9 months. Subsequently the company has purchased the Bannockburn project from Arboyne NL. This will provide feed to the Tower Hill plant allowing operations to continue for the medium term. Dominion also operates the Mt Morgans project in the area, which has been recently upgraded to treat 1.2 million tpa. The expansion involved installation of a second SAG mill and additional leach tanks.

The cessation of operations at the Harbour Lights and Mertondale open cuts meant that the Harbour Lights plant was operating for a time on stockpiled ore. However, the Mertondale operation has now resumed. The company also commenced Australia's first full-scale commercial trial of a bacterial leaching process for gold, with a view to exploiting sulphide resources from the Harbour Lights pit.

The Sons of Gwalia operation has become the major success story of the area. It produced very profitably for the year, with forward sales reported to have been secured at an average of $750/ounce to cover the whole open pit life of another 5 years. Reserve estimates have been revised at a 1 g/t cut off to be 3.65 million tonnes to a pit depth of 190 metres giving nearly 10 000 kg of contained gold. A further 2 million tonnes of inferred resource has been quoted below this depth. The company also commenced production from the smaller Barnicoat project near Laverton. A significant exploration presence in the Laverton area is designed to build on this initial development.

Following acquisition of the former operations of Arboyne NL at the King of Hills to add to its adjacent resource-base, Mt Edon Gold Mines NL proceeded with the development of its Tarmoola project, 30 km north of Leonora. Open cut mining and the 450 000 tpa rated CIP treatment plant commenced production in May 1990.

Sir Samuel Mines NL ceased production at Murrin Murrin during the year.

Laverton District

A significant improvement in output of some 56% to 2 995 kg was recorded at Western Mining's Lancefield operation. Reserve depletion at the Beasley Creek open cut resulted in closure of this operation during the year, with ore now sourced totally from the Eyers Shaft/Perry Decline underground operation.

Ashton Mining progressively improved its performance from its Laverton operation through the year with a higher throughput despite lower grades. The Cork Tree Well plant is fed by a series of open cuts to the north and south of Laverton, with the Bulldog and Lancefield North pits being new developments during the year. Additionally Ashton bought the Baneygo-Duketon project from the official receiver and manager for Golconda Ltd. Golconda Ltd had commenced mining and milling at the site, 70 km north of Laverton, only in July 1989.

Probably the most significant gold development in the State in 1989-90 is Placer Pacific/Delta Gold joint venture's Granny Smith project, located 20 km south of

Laverton. The project, costing $83 million, is being developed as a large low grade bulk mining operation based on a mineable reserve of 21 million tonnes at 1.7 g/t gold. Gold production commenced in January 1990 and by 30 June 1990, 3 403 kg had been produced. Plant feed is designed for a 3 million tpa rate.

Menzies to Kalgoorlie

The area to the north and northwest of Kalgoorlie has a proliferation of medium- and large-scale gold operations, many of which were developed in the early- to mid-1980s and are now operating on second and third-stage satellite orebodies some distance from the initial development and the established plant. BHP's Ora Banda operation is one such with ore supplied from pits up to 25 km from the Gimlet South plant, which produced 2 396 kg in 1989-90. The Golden Kilometer plant at Mt Pleasant is fed by a number of different mines with varying ownerships. This did create a problem in initially getting the development off the ground, but has bedded-down subsequently, especially with some recent rationalisations in ownership. Others in this diverse operation category include the Bardoc joint venture, Lady Bountiful and Lady Bountiful Extended.

The largest operation in this area is Pancontinental Mining's Paddington project. In 1989-90 2 826 kg of gold was produced from operations at Paddington I, Paddington II, Mt Corlac and Rona Lucil. A pit wall collapse in May 1990 cut off the main haul ramp in the Paddington I pit and created a short term restriction on production. Bulk sampling was completed for the future Panglo pit development and approvals are being sought for this and another pit at the Golden Arrow deposit.

Pancontinental Mining also finalised its 100% takeover of the White Flag-Kundana project, after protracted negotiations. Formal acquisition was to be finalised in July 1990 with the company preparing for extensive mill refurbishment, mine rehabilitation and operational planning before recommending production later in the year.

Open cut ore at Sand King and Theil Well, Western Mining's two operations feeding the Goongarrie plant, was nearing depletion by year end. The company has deferred the underground developments on these orebodies and it was expected that the Goongarrie operation would be closed shortly after the end of the financial year.

The Peko Gold-Delta Gold joint venture continued production at its QED mine at Kanowna. Just 2 km from the minesite spectacular high grade intersections of ore were made at the Kanowna Belle prospect. The joint venture are already contemplating a possible CIP/CIL plant development.

Kalgoorlie-Boulder

With the consolidation of the four separate operations on the Golden Mile, namely Fimiston, Norkal-Paringa, Mt Charlotte and Mt Percy, under the operating company Kalgoorlie Consolidated Gold Mines Ltd (KCGM) in April 1989, this 'conglomerate' became the largest single gold production group in the State. In 1989-90 a gold production of 15 523 kg was recorded, 2 000 kg above the Boddington output. In addition to the four existing plants, a new Fimiston mill with capacity 2.1 million tpa and satellite roasting facility at Gidgi, north of Kalgoorlie, were officially opened in October 1989 at a development cost of $120 million. The Gidgi roaster allowed the Paringa and Croesus roasters to be closed and planned expansions at Gidgi will ultimately allow all roasting facilities to be terminated on the Golden Mile. As part of the planned progressive expansion of the "Superpit" to 6 million tpa by 1992, a further $50 million commitment was made to doubling the Fimiston plant to a capacity of 4 million tpa. In view of the current low gold price and after a review of costs at the various operations, KCGM announced late in the year, a wind-down of deep underground operations at Fimiston, which will result in a loss of 200 jobs.

KCGM is a 50:50 joint venture between Homestake Gold and Gold Mines of Kalgoorlie Ltd (GMK). Poseidon now holds the largest single interest in GMK when it acquired part of Bond International Gold's shares in the company in August 1983. As a result Mr Alan Bond stepped down as Chairman of GMK and its associate North Kalgurli Mines Ltd, thus ending his personal association with the Golden Mile, for which he was instrumental in the consolidation process.

Poseidon Ltd, with a 90% interest in the joint venture, also controls the Kaltails project designed initially to treat 52 million tonnes of old tailings from the Golden Mile. The project commenced production in June 1989 and in the year to June 1990, 1 323 kg of gold was recovered. Expansion plans from 4 million tpa to the full design of 6 million tpa of tailings treated were initiated during the year.

Coolgardie District

After a number of years producing in the Bayleys Reward-Greenfields area, adjacent to and to the east and south of Coolgardie township, Coolgardie Gold NL made a significant move to exploit the underground potential of the area with the development of the William Ford decline, officially opened in April 1990. However, a restriction of ore from the underground development plus lower grades than expected from the

recently developed Lindsays pit, gave a severe shortfall in gold output for the year to 703 kg. Some 1 240 kg is being budgetted for the forthcoming year.

Two mines commissioned in late 1989-early 1990 have both suffered from initial problems at startup. Herald Resources' Three Mile Hill project, 5 km to the northeast of Coolgardie, has had problems with the SAG milling circuit and is reverting to 2 stage crushing and ball milling. The project was developed at a cost of $26 million and was planned for an output of around 2 000 - 2 300 kg per annum. CKGM's Bullabulling 1.2 million tpa laterite - heap leach operation, located 25 km west of Coolgardie, was fast-tracked to exploit as much gold as possible before the introduction of the Gold Tax. Lower milling and leaching rates than anticipated were encountered in the initial period. The operation is designed to produce 1 100 kg per annum.

Kambalda District

The Kambalda-St Ives operation, despite dropping 9.2% in gold production in 1989-90 to 6 148 kg, is still the major contributor to maintaining Western Mining Corporation as Australia's largest gold producer. On a State basis Kambalda-St Ives ranks fourth in size. The decline in production was caused by disruptions to treatment and lower head grades.

Treatment of gold ore finally terminated at the Kambalda plant in September 1989 and all subsequent treatment was carried out at the St Ives plant, closer to the centres of gold mining, south of Lake Lefroy. The St Ives plant has reached a throughput level of 2.7 million tpa.

Whilst most production was sourced from open cuts close to the Lake in 1989-90, underground development was proceeding at Victory and Junction. In the future more ore will be sourced from underground. A significant discovery called Conqueror, an underground extension of the Defiance lode system, was made during the year. Surface mining commenced at the Revenge open cut on Lake Lefroy. After extensive testing, the operation proceeded with the requirement of a keyway sealed with a heavy duty liner and an earth retaining bund to be first installed around the perimeter in order to prevent lake water from flooding the pit.

Significant rationalisations in ownership were undertaken on the Hampton Location operations during this year. In October 1989 Hampton Australia Ltd (a Poseidon subsidiary) sold out of the New Celebration project and the remaining two partners reorganised a number of their prospects in the area to provide a common 80:20 Newmont Australia: Mt Martin Gold Mines Ltd ownership throughout. Hampton Australia retained the moderate-sized Jubilee operation.

The New Celebration operation maintained production similar to last year's level of 3 339 kg of gold output, despite temporary problems with the installation of the second ball mill, and the plant is now operating at its full 1.7 million tpa capacity. A substantial cut back of the major pit, the Hampton-Boulder pit, commenced after a 5 km realignment at the Kalgoorlie-Kambalda road. This is part of the company's developments to maintain open cut operations over the next five years, before tapping the large underground resource of the area.

The move into receivership of AUR Ltd has resulted in the closure of its leased operations at the Mt Martin open pit and plant. However the owner, Mt Martin Gold Mines Ltd, has repossessed the operations and continues production of high grade ore from underground only with processing being carried out at the New Celebration plant.

There are a number of small prospects being developed at Mt Monger, to the east of these larger operations. Additionally, further to the east at Karonie, Poseidon continues to operate its medium-sized mine with output slightly lower than anticipated.

Norseman District

Samantha Gold NL's Higginsville project, 50 km north of Norseman, is one of the major success stories in its first full year of production. An output of 1 514 kg for 1989-90 is well above target. Exploration is continuing to identify more resources with potential to extend the operation's medium to short term life span.

Central Norseman Gold Corporation's operation, one of the stalwarts of the State with continuous production since 1935, has suffered large losses over the last two years, despite a high output of 2 597 kg for 1989-90. Traditionally a high grade producer, the operation has progressively moved into an increasing proportion of lower grade open cut developments, as well as treatment of large quantities of ore from low grade stockpiles. The company has announced a dramatic cut back in operations which will halve output to about 1 300 kg, but concentrating on three high grade, underground operations only at Scotia, OK and North Royal. Ore treatment will be cut to a quarter, 150 000 tpa, with some 150-200 job losses; a halving of the workforce.

Australis Mining NL, the other significant producer at Norseman, went into liquidation with the suspension of its operations.

Chemistry Centre (W.A.)

❑ **Completed**

Treatment of eutrophic natural waters with lime based chemicals

Analytical variations in the determination of the total meat content of processed meat samples

The determination of transferable arsenic in preserved animal specimens from the W.A. Museum

Ethanol fuel cell development for roadside breath screening

UV-radiation induced physico/chemical changes in thermoplastics

Glaze faults in ceramic tiles

Roasting of refractory gold concentrates; joint project with CSIRO and Curtin University funded by industry and MERIWA

Carbon-in-Pulp technology: joint project with Murdoch and Curtin Universities funded by industry through AMIRA

Transport and spillage of liquid sodium cyanide

Evaluation of essential oil bearing plants for commercial planting in the Kimberleys

Characterising oils generated from distillation of sewage sludge

❑ **Commenced and Continuing**

Evaluation of a locally developed compound vortex cyclonic scrubber

Alkaloid trends in commercial lupins funded by research grant

Chemistry of acid soils

Development and calibration of a phosphate test for WA soils

Chemical and engineering properties of Harvey soil used for WA cricket pitches

Soil tests to predict phosphorus and sulphur requirements of WA sandy soils

FFungicide (iprodione) translocation in lupin seedlings

Collection and curation of mineral specimens from the 'Big Pit' at Kalgoorlie

Comparison of XRD and FTIR methods of quartz dust analysis using direct and indirect sample preparation

AMIRA project: Fate of cyanide near mine tailings involving speciation and quantification of metal cyanide complexes

Investigation of organochlorine pesticide residues in human breast milk

Development of automated cyanide analysis methods in environmental waters

Investigation of malodorous organic chemical emissions from industrial sources

Drug Evaluation Programme in relation to the control of drugs in racing

The determination of thallium in urine by Zeeman graphite furnace atomic absorption spectrophotometry

The simultaneous determination of sulphuric acid and creatinine in urine by liquid chromatography

Quantitation of respirable silica by FTIR spectroscopy

Analysis of historical leather by FTIR spectroscopy

Explosives And Dangerous Goods

❑ **Completed, or not requiring Total Hazard Control plans**

ICI Australia Operations new Emulsion Explosives Plant at Kalgoorlie

Kemerton Parkland Study

Proposed Integrated Hazardous Wastes Plant to be operated by the Health Department

- **Completed to Third Party Audit and under review**
  Wesfarmers' LPG Plant, Kwinana

  Woodside, LNG Plant
- **Awaiting development of Total Hazard Control plan**

  CSBP Chlorine Plant, Kwinana

  CSBP Sodium Cyanide Plant, Kwinana

  CSBP Ammonia Storage Facility, Kwinana

  Nu-Farm Chlorine Plant, Kemerton

  Nu-Farm Chlorine Plant, Kwinana

  SCM Titanium Dioxide Pigment Plant, Kemerton

  TiWest Titanium Dioxide Plant, Kwinana

  Liquid Air Separation Plant and associated storage of cryogenic gases, Kwinana.

Geological Survey

Most of the work of the Geological Survey is involved in research and development projects to investigate, interpret and record the geology of Western Australia; relate the mineral, petroleum and groundwater occurrences and potential to that geology; and evaluate the mineral, fossil fuels and groundwater resources of the State. For a full listing of current and proposed projects see "Record 1990-91 Summary of Progress of the Geological Survey of Western Australia during 1989 and plans for 1990 to 1994-95" available from the 1st Floor counter in Mineral House. Some of the highlights of the program are:

Pilbara Craton geological mapping

Geoscientific investigations in the Eastern Goldfields region

Jurassic rocks of the southern North West Shelf

Seismic-horizon mapping in Phanerozoic basins
Drilling for groundwater in the northern Perth Basin

Perth Basin contamination-site inventory

Development of WAMEX Phase 2 mineral exploration database

Geotechnical studies relating to open-pit mines

Salinization studies relating to land-use

Mining Engineering

- **Completed**

  Survey of Tailings Dams characteristics.

  Review of Tailings Dams operating practice.

- **Commenced and Continuing**

  Open Pit wall stability.

  CONTAM: Contaminant Sampling in the Mining Workplace (computerised).

  Review of Underground Fire Precautions and Procedures.

  Development of MINEOPS system.

  Statistical analysis of AXTAT and CONTAM data.

Royalties & Statistics

Financial modelling analysis of major resource projects was performed with particular attention given to iron ore, coal and petroleum royalties. Analysis also continued to assist in negotiation of revenue sharing arrangements between the State and Commonwealth Governments for royalties recovered from offshore petroleum projects. A submission to the Commonwealth review of petroleum excise and royalty regimes was completed during the year. A review of specific rate royalties commenced.

Petroleum

❑ **Completed**

Reservoir engineering studies on fields including Chervil, South Chervil, Saladin, Mount Horner

Possibility of Oil Production from sub economic reservoirs in WA using non-conventional methods

Submission to the Harman Power Options Review Committee

❑ **Commenced and Continuing**

Development of regulations covering onshore drilling, production and surveying

Amendments to the Petroleum Acts

Planning for the Goodwyn, Cowle and Yammaderry, Tubridgi, Lowendal and Cossack projects

Supervision of construction projects for the development of the Talisman, Chervil and Saladin oilfields.

Surveys and Mapping

❑ **Completed**

Geographic Information System (GIS) pilot study over the Perth Northwest Metropolitan Region to determine the capability of off-the-shelf GIS software to resolve complex geophysical problems.

Modification, installation and testing of specialised software (Landcap and Landraw) for the automation of the examination, and certification of survey documents.

❑ **Commenced and Continuing**

TENEMENT GRAPHICS: The digital capture of all unsurveyed live mining tenements under the Mines Act 1978.

SDI: The capture, examination, certification and integration of all surveyed tenement boundaries.

GPS - GLOBAL POSITIONING SYSTEMS: The development of a strategy to increase the use of GPS in mining tenement boundary depiction. Geological Mapping: The implementation of automated techniques.

Graphical Digital Data Base: Development of a database for EPA System 5 to facilitate ongoing analysis and evaluation of resource and environmental information.

The Department produces a wide range of printed matter to meet the diverse needs of Divisions. These are listed as promotional, informative, or technical. The material must serve all levels of the community; from basic information for the general public, for secondary students, through all levels of industry, and government. The information supplied must be aimed at the appropriate audience.

The promotional publications contain more generally worded material aimed at encouraging awareness of the industries the Department monitors, and to publicise and promote the philosophies behind the Department of Mines. It is only from awareness that knowledge can be acquired. The second is informative — material that can be general information as well as mildly technical such as mineral resources bulletins, which not only promote a subject but also inform a reader about the subject matter in slightly more detail and technical terms. The technical material produced is based on applied science and is of a particular and technical nature which is specifically aimed at the audience which would require and understand such information.

Chemistry Centre (W.A.)

❑ **Technical**

Agricultural Chemistry Laboratory

"Phosphorus Retention Of Sandy Horticultural Soils On The Swan Coastal Plain" I. McPharlin, N. Delroy, R. Jeffery, G. Dellar and M. Eales, 'W.A. Journal of Agriculture', Vol 31, 1990.

"Response of Carrots to Rate and Time of Phosphorus Applications Under Two Irrigation Regimes" I. McPharlin, G. J. Luke and R. C. Jeffery, W.A. Department of Agriculture Workshop.

"Method for Analysis of Phosphorus in Western Australian Soils" D. G. Allen and R. C. Jeffery, Chemistry Centre Report of Investigation No. 37, 1990.

"Field Trip : Soils and Land Uses in The Gingin Region" Australian Society of Soil Science (Inc.), W.A. Branch, 1989.

"Anti Nutritional Factors in Sweet Lupinseed" D. G. Allen, B. N. Greirson and D. J. Harris. Proceedings: 10th Australian Symposium on Analytical Chemistry, Brisbane, Queensland, 1989.

"Enzyme Linked Immunosorbent Assay for Lupin Alkaloids" B. N. Grierson, D. G. Allen, S. C. Baseden, N. F. Gare and I. M. Watson. Proceedings: 10th Australian Symposium on Analytical Chemistry, Brisbane, Queensland, 1989.

Environmental Chemistry Laboratory

"Monitoring of Gold Mine Tailing Sites for Cyanides" R. S. Schulz, W. Staunton and K. Jones. Proceedings: Chemistry International Conference, Brisbane, August, 1989.

"Impact of Air-Conditioner Discharges on the Swan River, Perth, WA" R. S. Schulz and V. Hossa. Proceedings: Chemistry International Conference, Brisbane, August, 1989.

"Marine Sampling for Heavy Metals", R. S. Schulz Proceedings: An Indio-Pacific Workshop on Analysis of Heavy Metals in Marine Samples - Validation and Quality Assurance, 1990.

"Iron Stain and Blockage Prevention" R. D. Taylor and T. A. Webb. Chemistry Centre Brochure No 6 August, 1989.

Forensic Science Laboratory

"A Pyrolysis-Derivatisation - Gas Chromatography Technique for the Structural Elucidation of some Synthetic Polymers" J. M. Challinor. Journal of Analytical and Applied Pyrolysis, 16 (1989) 323-333

"The Application of a Simple and Inexpensive Modified Carbon Wire/Solvent Extraction Technique to the Analysis of Accelerants and Volatile Organic Compounds in Arson Debris" D. J. Tranthim-Fryer. Journal of Forensic Science, 35, 2, March, 1990, 271-280.

"Pyrolysis Gas Chromatography - Some Forensic Applications" J. M. Challinor. Chemistry in Australia, April 1990.

Health Chemistry Laboratory

"Thallium in Urine by GFAAS" S. Jones, Proceedings: 10th Analytical Chemistry Conference (10AC), Brisbane, August, 1989.

"Aluminium in Foods" S Jones Proceedings: Australasian Food Analysts Meeting, Brisbane, August, 1989.

"Laboratory Safety and Disposal of Chemicals" M. Rowe, Proceedings: RACI Gold and Platinum Group Analysis Seminar, Perth, May, 1990.

Kalgoorlie Metallurgical Laboratory

"Gold Bullion Analyses" B. C. Das, Chemistry in Australia, November 1989.

"Carbothermic Reduction Kinetics of Tin Concentrate Pellets" V. N. Misra, Proceedings: International Symposium on Production and Technology in the Metallurgical Industries, Cologne, West Germany, September 17 - 22, 1989.

"Extraction of Zinc from Complex Polymetallic Sulphide Concentrates" V. N. Misra, Proceedings: International Symposium on Productivity and Technology in the Metallurgical Industries Cologne, West Germany, September 17 - 22, 1989.

"Hydrometallurgical Processing of Complex Polymetallic Sulphide Ores" V. N. Misra, Proceedings: MMIJ/IMM Joint Symposium on Today's Technology for Mining and Metallurgy, Kyoto, Japan,2 - 4 October, 1989.

"The Environmental Engineering Course at WASM" J. H. Kyle and T. N. Little. Proceedings: AMIC Workshop, Ballarat, Victoria, September, 1989.

"The pressure aqueous pre-oxidation of a refractory gold ore from the golden mile, Kalgoorlie, Western Australia" J. H. Kyle, G. Dziurdzak and R. C. Dunne. Proceedings: World Gold '89 Conference, Reno, Nevada, November, 1989.

"The pulp rheology of some Australian gold ores" J. H. Kyle and J. L. Beazley. Proceedings: World Gold '89 Conference, Reno, Nevada, November, 1989.

Materials Science Laboratory

"Building Conservation - Consolidation of Natural Stone", G.M. Ferguson, Proceedings: RACI Polymers and Building Technology Seminar, April, 1990

"Analysis of Ceramic Flooring Materials" G.M. Ferguson, Proceedings: RACI Polymers and Building Technology Seminar, April, 1990

"Analysis of Polymers by Fourier Transform Infrared Spectroscopy" G.W. Richardson, Proceedings: RACI Polymers and Building Technology Seminar, April, 1990

Mineral Processing Laboratory

"Changing Trends in Gold Ore Treatment in Western Australia. The Problem of Refractory Ores" J. Avraamides, Proceedings: World Gold '89, Joint AIME-AusIMM Conference, Reno, Nevada, October, 1989. (Editors R. S. Bhappu and R. J. Harden).

"CIP Carbons - Selection Testing and Plant Monitoring" J. Avraamides, Proceedings: World Gold '89, Joint AIME-AusIMM Conference, Reno, Nevada, October, 1989. (Editors R. S. Bhappu and R. J. Harden).

"Transportation of Liquid sodium Cyanide - Response Strategies for Spills" W. P. Staunton, S. Formby, R. S. Schulz* and J. Avraamides. Proceedings: World Gold '89, Joint AIME-AusIMM Conference, Reno, Nevada, October, 1989. (Editors R. S. Bhappu and R. J. Harden).

"Analysis of Carbon from the Carbon-In-Pulp Process" J. Avraamides and W. P. Staunton. Proceedings: Seminar Gold and Platinum Group Analysis - Problems and Solutions, Perth, May 9 - 10, 1990. (RACI WA Branch Analytical Chemistry Group).

"Gold Processing - R & D into the Nineties" J. Avraamides, Asia Pacific Mining, March 1990.

"Relationships Between Mineralogy, Roasting and Extraction of Gold from Refractory Pyritic and Arsenopyritic Gold Ores and Concentrates" J. G. Dunn, J. Graham and J. Avraamides, Report No. 59 Minerals and Energy Research Institute of Western Australia, April, 1990.

"Practical Aspects Affecting Gold Adsorption and Carbon Fouling" S. R. LaBrooy and J. J. Robinson, Proceedings: Randol Conference, Gold and Silver Recovery Innovations, Phase IV, Sacramento, California, November, 1989.

"Disposal of Cyanide - Containing Tailings" W. P. Staunton and K. Jones, Proceedings: Australian Mining Industry Council Environmental Workshop, Ballarat, Victoria, Vol.1, 1989.

Mineral Science Laboratory

"Interferences in Gold Determination by Flame Atomic Absorption Spectroscopy (FAAS)" B. Price

and C. Dodd Chemistry Centre (WA) Report of Investigations No 36, 1989

"P-T Estimate of Metamorphism of Palaeo - Pacific Oceanic Crust, Western New England, N.S.W" H. K. Herbert Proceedings: Pacific Rim Congress 90. Australasian Institute of Mining and Metallurgy, Melbourne, 1990.

"Geological Data from the Mount Clement Gold and Lead Prospects, Ashburton Basin, Western Australia" R. Davy, R. M. Clarke and D. B. Seymour. Western Australia Geological Survey : Record 1989/16.

"Gold Bearing Ilmenite Profiles at Mt. Gibson, Murchison Province - Analytical and Mineralogical Data" R. Davy, R. M. Clarke and M. Sale. Western Australia Geological Survey : Record 1989/18.

"Review of Analytical Methods for Determining Trace Amounts of Gold in Ores and Process Streams" J. Hosking and D. Herring Proceedings: Gold and Platinum Group Analysis Problems and Solutions, RACI Symposium, 1989.

"Dissolution of Samples for Determination of Gold by Wet Chemical Procedures" C. Dodd Proceedings: Gold and Platinum Group Analysis Problems and Solutions, RACI Symposium, 1989.

"Safety in the use of FAAS" C. Dodd Proceedings: Gold and Platinum Group Analysis Problems and Solutions, RACI Symposium, 1989.

"Solvent Extraction" B. Price Proceedings: Gold and Platinum Group Analysis Problems and Solutions, RACI Symposium, 1989.

"XRF - A Review of the Basics; Historical Background Review of X-ray Theory and Development in Modern Instrumentation" A. G. Thomas. Proceedings: AXAA90, Eighth Australian School and Conference on X-ray Analysis and Surface Analysis, University of Melbourne, 11 - 16 February, 1990.

Racing Chemistry Laboratory

"Detection of Methylpredinsolone" J. M. Ralston and A. M. Stenhouse Proceedings: 8th International Conference of Racing Analysts and Veterinarians, Harare, Zimbabwe, February 1990.

"The Detection of Lupin Alkaloids in Horse Urine" A. M. Stenhouse, S. F. Lucks and J. M. Ralston. Proceedings: 8th International Conference of Racing Analysts and Veterinarians, Harare, Zimbabwe, February 1990.

"The Analysis of Morphine and Codeine in Horse Urine" A. M. Stenhouse, J. M. Ralston and C. I. Russo. Proceedings: 8th International Conference of Racing Analysts and Veterinarians, Harare, Zimbabwe, February 1990.

"An Oxycodone Administration of the Horse - A Short Communication" A. M. Stenhouse, J. M. Ralston and C. I. Russo. Proceedings: 8th International Conference of Racing Analysts and Veterinarians, Harare, Zimbabwe, February 1990.

"Cortisol Concentrations in Urine - Comparison of RIA versus GCMS (A Short Communication)" J. M. Ralston, A. M. Stenhouse and C. I. Russo. Proceedings: 8th International Conference of Racing Analysts and Veterinarians, Harare, Zimbabwe, February 1990.

Explosives And Dangerous Goods

- **Informative**
  Notes for the Shotfirer
  Summary of Accident Reports
  Numerous guideline documents on many aspects of the Explosives,Flammable Liquids, Dangerous Goods (Road Transport) Regulations and Risks and Hazards.

Geological Survey

Publications Issued during 1989-1990

❑ **Reports**

Report No. 24 Studies of selected carbonated-hosted lead-zinc deposits in the Kimberley region; by Ringrose, C.R.

Report No. 26 Professional papers, with contents as follows:

(a) **Geochemical study of inorganic components of the Collie Coal Measures;** by Davy, R., and Wilson, A.C.

(b) **Geology and groundwater resources of the superficial formations between Pinjarra and Bunbury, Perth Basin;** by Deeney, A.C.

(c) **Hydrogeology of the Harvey Borehole Line, Perth Basin;** by Deeney, A.C.

(d) **A major thrust in the King Leopold Orogen, West Kimberley region;** by Griffin, T.J.

(e) **Chemistry of plutonic felsic alkaline rocks in the Eastern Goldfields Province;** by Libby, W.G.

(f) **Hydrogeology of the Gillingara Borehole Line, Perth Basin;** by Moncrieff, J.S.

(g) **Thrust sheets on the southern foreland of the Capricorn Orogen, Robinson Range, Western Australia;** by Myers, J.S.

❑ **Records**

Record No. 1989/3 **Explanatory notes on the Boorabbin 1:250 000 geological sheet, Western Australia (second edition);** by Hunter, W.M.

1989/5 **Explanatory notes on the Robertson 1:250 000 geological sheet, Western Australia (second edition);** by Williams, I.R., and Tyler, I.M.

1989/6 **Explanatory notes on the Newman 1:250 000 geological sheet, Western Australia (second edition);** by Tyler, I.M., Hunter, W.M. and Williams, I.R.

1989/8 **Groundwater in the northern wheatbelt, the Winchester Catchment Study;** by McGowan, R.J.

1989/11 **Reported resources of West Australian gold deposits as at May 1989;** by GSWA staff.

1989/12 **The Derby regional groundwater investigation 1987;** by Laws, A.T., and Smith, R.A.

1989/13 **Orientation geochemical study, Fitzgerald River National Park;** by Leonhard, E.L.

1989/15 **Revised stratigraphic nomenclature in Western Australian Phanerozoic basins;** by Cockbain, A.E., and Hocking, R.M.

1989/16 **Geochemical Data from the Mt Clement Gold and Lead Prospects, Ashburton Basin, Western Australia;** by Davy, R., Clarke, R.M., and Seymour, D.B.

1989/17 **Chemical analyses of samples from the Collie Coal Measures;** by Wilson, A.

1989/18 **Gold Bearing Lateritic Profiles at Mt Gibson, Murchison Province-Analytical and Mineralogical Data;** by Davy, R., Clarke, R.M., and Sale, M.

1990/1 **Summary of progress of the Geological Survey of Western Australia during 1989 and plans for 1990 to 1994-1995;** by Playford, P.E.

1990/2 **Geology of the Dunnsville 1: 100 000 sheet Western Australia;** by Swager, C.P.

1990/6 **Meckering Earthquake;** by Lewis, J.D.

1990/7 **Mineral and petroleum developments and prospects WA 1989;** by Preston, W.

❑ **Geological Maps 1:1 000 000 scale**

Albany; by Myers, J.S.

- **Geological Maps 1:250 000 scale**

  Robertson (second edition); by Tyler, I.M., and Williams, I.R.

  Newman (second edition); by Hunter, W., Williams, I.R., and Tyler, I.R.

- **Geological Maps 1:250 000 scale** explanatory notes

  Balfour Downs (second edition); by Williams, I.R.

  Widgiemooltha (second edition); by Griffin, T.J.

- **Geological line compilation sheets (black and white) for 1:250 000 scale**

  Turee Creek; by Thorne, A.M., Seymour, D.B., Tyler, I.M., and Hunter, W.M.

  Yampi; by Tyler, I.M., and Griffin, T.J.

- **Geological Maps 1:100 000 scale**

  Bardoc; by Witt, W.K. and Swager, C.P.

  Dunnsville; by Swager, C.P.

- **Environmental geology maps 1:50 000 scale**

  Gleneagle; by Smurthwaite, A.J.

  Albany; by Gozzard, J.R.

  Torbay; by Gozzard, J.R.

- **Special Publications**

  Hydrogeology map of Western Australia 1:2 500 000 scale; by Commander, D.P.

  Geological map of Western Australia (centennial edition) 1:2 500 000 Explanatory Notes; by Myers, J.S., and Hocking, R.M.

  Ashburton Basin maps (plates 1 and 2 of Bulletin 139 in press) by Thorne, A.M., Seymour, D.B., Tyler, I.M., and Hunter, W.M.

  Phanerozoic Correlation Chart.

  Seismic time structure maps of Perth Basin 1:250 000; by Luck, G.R.

  Bullfinch - Porter Range maps (plates 1 & 2 of Report 28 in press) by Keats, W.

  Lake Lefroy and Cowan maps (plates 1 & 2 of Report 32 in press); by Griffin, T.J.

- **Papers published elsewhere by Geological Survey Staff** *(Survey staff are identified by italics)*

  Blockley, J.G., Trendall, A.F., and *Thorne, A.M.,* 1989, Early Precambrian crustal evolution and mineral deposits, Pilbara Craton and adjacent Ashburton Trough, *in* Origin and evolution of sedimentary basins and their energy and mineral resources *edited by* R.A. Price: American Geophysical Union, Geophysical Monograph 48, p.159-167.

  Clarke, G.L., Collins, W.J., and Vernon, R., 1989, Successive overprinting granulite facies events in the Anmatjira Range, central Australia: Journal of Metamorphic Geology, v.8, p.65-88.

  Clarke, G.L., and Powell, R., 1989, Basement-cover interaction in the Adelaide Foldbelt, South Australia -- the development of an arcuate foldbelt: Tectonophysics, v.158, p.209-226.

  Clarke, G.L., Powell, R., and Guiraud, M., 1989, Low-pressure granulite facies metapelitic assemblages and corona textures from MacRobertson Land, east Antarctica – the importance of Fe_2O_3 and TiO_2 in accounting for spinel-bearing assemblages: Journal of Metamorphic Geology, v.7, p.323-335.

  Cockbain, A.E., 1988, The geology and potential of the Carnarvon and Bonaparte Basins: Erdöl & Kohle - Hydrocarbon Technology, v.41, no.11, p.445-448.

Cockbain, A.E., 1989, Petroleum-related activities of the Geological Survey of Western Australia, *in* Petroleum in Western Australia: Oil & Gas Australia, February 1989, p.56-59.

Cockbain, A.E., 1989, The North West Shelf: The APEA Journal, v.29, pt.1, p.529-545.

Cockbain, A.E., 1989, Distribution of Frasnian and Famennian stromatoporoids, *in* Fossil Cnidaria 5, *edited by* P.A. Jell and J.W. Pickett: Association of Australasian Palaeontologists, Memoir 8, p.339-345.

Cockbain, A.E. and *Playford, P.E.*, 1988, The Devonian of Western Australia -- a review, *in* Devonian of the World, Volume 1. Regional Syntheses *edited by* N.J. McMillan, A.F. Embry, and D.J. Glass: Canadian Society of Petroleum Geologists; International Symposium on the Devonian System, 2nd, Calgary, Canada, 1987, Proceedings, p.743-754.

Commander, D.P., 1989, The contribution of hydrogeological maps to public education, and to development, planning and land use in Western Australia: Memories of the International Symposium on Hydrogeological Maps as Tools for Economic and Social Development, Hanover, Federal Republic of Germany, 1989, p.229-231.

Dunn, P.R., 1989, Geoscience mapping in Western Australia, *in* Geoscience Mapping Towards the 21st Century: BMR Research Symposium, Canberra, 1989, Papers, 2p.

Gamble, J.A., and *Morris, P.A.*, 1989, Sub-Antarctic and Chatham Islands, *in* Intraplate Volcanism in Eastern Australia and New Zealand *edited by* R.W. Johnson: Cambridge, Cambridge University Press; Australian Academy of Science, p.169-171.

Gozzard, J.R., and Mouritz, M.J., 1989, Mineral resources and mining of the Spearwood and Bassendean dune systems: Royal Society of Western Australia, Journal, v.71, p.109-110.

Hirschberg, K-J.B., 1989, Groundwater contamination in the Perth Metropolitan Region: Swan Coastal Plain Groundwater Management Conference, Perth, W.A., 1988, Proceedings; Western Australian Water Resources Council, Publication 1/89, p.121-134.

McNaughton, N., *Nelson, D.*, de Laeter, J., and *Fletcher, I.*, 1989, The Bunbury Basalt -- Kerguelen-Heard Island hot-spot volcanism along the continental margin of SW Australia: Second Australian Conference on Geochronology, Sydney, N.S.W., 1989, Abstracts.

Middleton, M.F., 1989, A model for the formation of intracratonic sag basins: Geophysical Journal of Royal Astronomical Society, v.99, p.665-676.

Middleton, M.F., and Hunt, J.W., 1989, Influence of tectonics on coal rank patterns in Australia: International Journal of Coal Geology, v.13, p.391-411.

Middleton, M.F., 1989, A sag basin model -- early Paleozoic Canning Basin: International Geological Convention, 28th, Washington, 1989, Abstracts, v.2, p.424.

Middleton, M.F., 1989, Tectonic influence on vitrinite reflectance: International Geological Convention, 28th, Washington, 1989, Abstracts, v.2, p.425.

Morris, P.A., Itaya, T., Watanabe, T., Yamauchi, Y., 1989, K/Ar ages of igneous rocks from Eastern Shimane Prefecture -- Oki Dozen Island, and geological implications: Journal of Southeast Asian Earth Sciences, v.4, p.125-131.

Morris, P.A., and Kagami, H., 1989, Nd and Sr isotope systematics of Miocene to Holocene volcanic rocks from southwest Japan -- volcanism since the opening of the Japan Sea: Earth and Planetary Science Letters, v.92, p.335-346.

Nelson, D., Trendall, A.F., and de Laeter, J.R., 1989, Sm-Nd isotopic complexities in Archaean mafic lavas and implications for Sm-Nd geochronology: Second Australian Conference on Geochronology, Sydney, N.S.W., 1989, Abstracts.

Playford, P.E., and *Cockbain, A.E.*, 1989, Devonian reef complexes, Canning Basin, Western Australia -- a review, *in* Fossil Cnidaria 5 *edited by* P.A. Jell and J.W. Pickett: Association of Australasian Palaeontologists, Memoir 8, p.401-412.

Playford, P.E., Hurley, N.F., Kerans, C., and *Middleton, M.F.*, 1989, Reefal platform development, Devonian of the Canning Basin, Western Australia, *in* Controls on Carbonate Platform and Basin Development *edited by* P.D. Crevello, J.L. Sarg, J.L. Wilson, and J.F. Read: Society of Economic Paleontologists and Mineralogists, Special Publication, no. 44, p.187-202.

Ranford, L.C., 1989, Mineral development in progress, and prospects, Western Australia: National Minerals

and Energy Outlook Conference, Canberra, 1989; Australia BMR, Record 1989/9, p.93-104.

Skwarko, S.K., and Thieloy, J.P., 1989, Early Barremian (Early Cretaceous) Mollusca from Western Irian Jaya, Indonesia: Geological Research and Development Centre, Bandung, Indonesia, Palaeontological Series, no. 6, p.26-43.

Skwarko, S.K., and Hasibuan, F., 1989, A brief review of literature on the larger marine invertebrates in the Cretaceous of Indonesia: Geological Research and Development Centre, Bandung, Indonesia, Palaeontological Series, no. 6, p.44-52.

Street, G.J., 1989, BMR surveys for the location of palaeochannels in the Eastern Goldfields, Western Australia: Exploration Geophysics, v.20(1/2), p.123-130.

Svalbe, A.K., 1989, Petroleum exploration in Western Australia, *in* Energy options for the 1990s: Chamber of Mines and Energy of Western Australia, and Energy Policy and Planning Bureau, August 1989, Section 4.

Thorpe, P.M., 1989, Tritium as an indicator of groundwater recharge to the Gnangara groundwater mound on the Swan Coastal Plain, Perth, Western Australia, *in* Groundwater Recharge *edited by* M.L. Sharma: Symposium on Groundwater Recharge, Mandurah, W.A., 1987, Proceedings, p.41-55.

Thorpe, P.M., 1989, The dating game, *in* The Growing Scope of Human Biology *edited by* L.H. Freedman and N.W. Bruce: Proceedings of the Australasian Society for Human Biology, no. 2, p.139.

Trendall, A.F., Blockley, J.G., Middleton, M.F., and *Myers, J.S.*, 1989, The tectonic evolution of Western Australia and its control of mineralisation (Poster Paper): International Geological Convention, 28th, Washington, 1989, Abstracts, v.3, p.249-250.

Tyler, I.M., and *Griffin, T.J.*, 1989, Tectonic evolution of the King Leopold Orogen, Kimberley region, Western Australia, *in* Australian Tectonics: Geological Society of Australia, Abstracts series, no. 24, p.157-158.

Warren, R.G., Shaw, R.D., Hensen, B.J., Vernon, R.H., *Clarke, G.L.*, Collins, W.J., and Oliver, R.L., 1989, Guidebook -- Arunta Block, Central Australia; IGCP Project 235 -- Metamorphism and Geodynamics Field Conference on Granulite Facies Metamorphism: Australia BMR, Record 1989/22.

Weaver, S.D., Smith, I.E.M., Sewell, R.J., Gamble, J.A., and *Morris, P.A.*, 1989, New Zealand intraplate volcanism -- petrology and major element chemistry, *in* Intraplate Volcanism in Eastern Australia and New Zealand *edited by* R.W. Johnson: Cambridge, Cambridge University Press; Australian Academy of Science, p.172-180.

Weaver, S.D., Smith, I.E.M., Sewell, R.J., and Gamble, J.A., *Morris, P.A.*, and Gibson, I.L., 1989, New Zealand intraplate volcanism -- trace element geochemistry, *in* Intraplate Volcanism in Eastern Australia and New Zealand *edited by* R.W. Johnson: Cambridge, Cambridge University Press; Australian Academy of Science, p.180-184.

Witt, W.K., and Harrison, N., 1989, Volcanic rocks and bounding shear zones of the Ora Banda greenstone sequence, *in* The 1989 Kalgoorlie Gold Workshops *edited by* I.M. Glacken: Australasian Institute of Mining and Metallurgy/Eastern Goldfields Geological Discussion Group, Kalgoorlie Gold Workshops, Kalgoorlie, W.A., 1989, p.A2-A7.

Witt, W.K., and *Swager, C.P.*, 1989, Structural setting and geochemistry of Archaean I-type granites in the Bardoc - Coolgardie area of the Norseman - Wiluna belt, Western Australia: Precambrian Research, v.44, p.323-351.

Witt, W.K., Swager, C.P., Williams, P., and Whittaker, A., 1989, Accretionary tectonics in the Eastern Goldfields Province of Western Australia?, *in* Geoscience Mapping Towards the 21st Century: BMR Research Symposium, Canberra, 1989, Papers, 9p.

Mining Engineering

❑ **Informative:**

Fatal and lost time injuries in Western Australia Mines 1988-89 (October 1989). Fatal and lost time injuries in Western Australian Mines 1989 (May 1990).

Conceptual Plan for Mining Developments on the Golden Mile.

Guidelines for Mining Project Approval in WA.

Guidelines for the preparation of a Notice of Intent and Works Approval Application for new or extensions to tailings dams.

Guidelines for Environmental Management of Mining in Arid Areas.

Guidelines for Waste Dump Design and Rehabilitation.

Guidelines for Heap Leach Projects.

Guidelines for Vat Leach Projects.

Interim Guidelines on Safety Bund Walls Around Abandoned Open Pits.

List of operating mines in WA.

List of gold producers in WA.

The Western Australian Mineral Sands Industry Radiation Protection.

A review of Uncertainties in Internal Dose Assessment for Inhaled Thorium.

Radiation Exposure Status of Mineral Sands Industry Workers (1983-1988).

Guideline: Management of Radioactive Waste Arising in the Mineral Sands Industry.

❑ **Promotional**

Surface Ventilation Officers Course 1990 Perth

Cyanide handling manual 1989

Mining Registration

❑ **Informative**

Information Pamphlets

Basic Provisions

Guidelines on Reporting Requirements

Miner's Rights

Marking Out and Applying for Mining Tenement

Private Land Provisions

Transitional Provisions

Prospecting Exploration and Mining on Pastoral Leases

Prospecting Licences - A guide to Holders

Exploration Licence - Compulsory Partial Surrender

❑ **Promotional**

"TENDEX" - Computerised Mining Tenement Index System.

Petroleum Division

❑ **Informative**

Directions as to Drilling Operations.

Directions as to Geological and Geophysical Surveys.

List of Permittee/Licensee/Lessee Companies and titles.

Petroleum in Western Australia magazine.

Schedule of Specific Requirements as to Offshore Petroleum exploration and production - 1985.

Industry Safety memorandums.

Royalties & Statistics

❑ **Informative**

Principal Gold Producers (produced twice a year for calendar and financial years).
Statistical Digest of Mineral Production (published twice a year to cover calendar and financial years).

Surveys And Mapping

❑ **Informative Maps**

Mineral Tenement Maps

Department Public Plans
Index to Public Plans
Mining Act - Section 57(4) Areas
Graticular Section Plans

Petroleum Tenement Maps

Brochure of Petroleum Tenements
Petroleum Tenement Map of the State
Petroleum Act Graticular Section Maps
Petroleum Tenement Maps

Thematic Maps

Areas which have been held under Gold Mining Leases
Administrative Divisions
Historic Map - Wiluna to Kimberley Stock route
Index to Special Agreement Acts
Map Sheet Index
Mineral Production
Petroleum in Western Australia Tenement Map
Western Australian Localities Map
Conservation Reserves of Western Australia, State Map
Conservation Reserves of Western Australia, South West Region
Aboriginal Reserves of Western Australia, State Map

Corporate Development

❑ **Informative**

Computer User Handbook

Computer Systems Standards

Departmental Directory - general purpose

February 1990 saw the formation of a Departmental Communications Branch to manage the organisation's publications and public affairs needs.

Immediate priority was given to improving the Department's communications with various external publics and to improving communications within the Department itself.

Activities of the Communications Branch during the first half of 1990 included:

- The preparation and dissemination of 30 media releases on a wide variety of topics including mine safety, new explosives and dangerous goods regulations, the discovery of the world's oldest fossil seaweed, the rehabilitation of quarries and the acquisition of a sophisticated scanning electron microscope by the Chemistry Centre.

  Considerable positive media coverage of Departmental activities was achieved across a wide range of media through the State and also overseas.

- The drafting of new Departmental media policy guidelines.

- The drafting of a media training manual for Departmental Staff.

- Processing in excess of 400 direct media inquiries for comment or information.

- Arranging Departmental participation in excess of 40 electronic media news programmes.

- Designing and producing a number of major displays for special events and expositions including: WAMEX, WA Heritage Week, Mining and Petroleum Industry Photographic Competition, In-house Divisional expositions and Media Conference (mine safety).

- Establishing a new monthly in-house newsletter for staff called "Plain Street Post."

- Organising a mining and resource industry photographic competition in association with the WA Photographic Federation.

- Producing and circulating a number of "Information Brief" background circulars for Departmental staff on topical or controversial issues.

- Producing editorial content for special daily newspaper and magazine supplements on a variety of topics including the centenary of the discovery of gold in the Murchison District.

- Producing a wide variety of brochures, pamphlets, booklets and reports using the Branch's Desk Top Publishing System.

- Organising and co-ordinating the Department's first major media conference at Mineral House for the release of the report of The Special Inquiry into Safety in Underground Gold Mines.

- Organising and planning special public displays at museums e.g. Museum of WA (special fossil discovery); Museum of the Goldfields, Kalgoorlie (History of the Department of Mines), Marble Bar State Battery Museum (History of the Department of Mines).

- Planning a programme of special events to mark the Department's centenary in 1994.

- Planning an attitudinal research survey of Departmental staff.

- Designing, writing and placing a number of public information advertisements.

- Participating in the drafting of 15 Ministerial speeches.

- Collection and analysis of media monitoring data.

- Design and completion of a wide variety of posters and signage.

Other public relations initiatives by individual Divisions of the Department included:

- Mounting a series of in-house Divisional expositions to increase inter-Divisional awareness of the Department's widely diverse services and professional disciplines.

- Arranging tours of the Chemistry Centre for school groups and tertiary institutions.

- Completion of a brochure outlining the activities and services of the Kalgoorlie Metallurgical Laboratory.

- Presentations by the Explosives and Dangerous Goods Division to transport industry and community groups on the safe handling, packaging and labelling of dangerous goods.

- Participation by the Surveys and Mapping Division in the State Map Display in Darwin as part of the Australian Institute of Cartographers Conference. The Division also drafted a Products and Services Guide to enhance and promote its operations.

- An all-day seminar reviewing geology, geophysics and petroleum potential of the Perth Basin in October 1989, held by the Geological Survey and Petroleum Division. The Geological Survey also ran field excursions in the Perth, Carnarvon and Bonaparte basins for industry personnel.

- Chemistry Centre staff from a range of laboratories presented talks on many diverse topics throughout the year. These included cyanide analysis, heavy metal sampling, organics in water, environmental monitoring, occupational hazards, FTIR techniques and laboratory safety. Staff also attended and presented papers at many professional conferences. A series of lectures to third year chemistry students at the University of WA involved a range of staff from several laboratories lecturing on various topics in applied analytical chemistry.

- Other Chemistry Centre activities included: Australian Mineral Foundation course on Carbon-in-pulp and Gold Processing Technology (two officers presented parts of the course); presentation of 1990 Bayliss Youth Lecture to Year 12 chemistry students by Dr J. Avraamides in Perth, Bunbury, Albany, Geraldton and Karratha; a contribution to the "Women in Science and Engineering Project" by Ms K. Jones through several talks to year 11 and 12 female high school students; and staff from the Kalgoorlie Metallurgical Laboratory and the Mineral Science Laboratory running a course on Atomic Absorption Spectroscopy for 33 participants from the gold industry in Kalgoorlie.

Statutory

Board of Examiners for Mine Managers and Underground Supervisors (Metalliferous)

Boards of Examiners, Mine Managers and Deputies (Coal)

Board of Examiners for Quarry Managers

Coal Mines Accident Relief Fund Committee

Coal Mines Accident Relief Fund Trust

Coal Miners Welfare Board

Coal Mine Workers' Pension Tribunal

Mine Workers Relief Fund Board

Radiation Safety Board

Selection Committee for Inspectors of Mines

Mines Survey Board

Ventilation Board

Boards, Committees and Councils on which the Department has representation

Directorate

Australasian Institute of Mining and Metallurgy

Australian Ionising Radiation Advisory Council

Australian Minerals and Energy Council (AMEC) - Standing Committee of Officials

Carlisle Development Working Group

Chemistry Centre Accountability Steering Committee

Chemistry Centre Advisory Council

Chemistry Centre Steering Group

Corporate Executive Committee

Country Planning Council

Gold Producers' Association Ltd

Government Management Policy Advisory Council

Information Technology Advisory Committee

Land Information Plan Committee

MTIS Steering Committee

Microfilm Steering Committee

Mines Department Computer Co-ordinating Committee

Mines Department Finance Committee

Mining Act Steering Committee

Mining Industry Liaison Committee

Mining Tenement Information System (MTIS) Steering Committee

Publications Review Committee

Quarry Rehabilitation Work Party

W.A. Advisory Committee on Hazardous Substances

W.A. Mining Education Consultative Committee

W.A. Water Resources Council

W.A. Water Resources Council - Conservation Committee

Working Party on Conservation and Rehabilitation in the Mining Industry - Seismic Lines.

Corporate Development Division

Audit Committee

Coal Mine Workers Pension Tribunal

Common Use Purchasing System (CUPS)

Equal Employment Opportunity Consultative Committee

Health and Safety Committee - Mineral House Complex

Hedland College Council

Hedland College Finance and Staff Committee

Human Resource Planning Committee

Mines/BMA Monthly Review Committee

National RMS Users Group

Purchasing System Working Group

RMS Management Committee for WA Government

RMS Users' Working Group

Reclassification Review Committee

Records Management Liaison Committee

Records Management Steering Committee

Staff Development Officers Network Coordinating Committee

W.A. Government Task Force on Information Technology Establishments

Chemistry Centre of W.A.

Advisory Committee for the Purity of Water

AMIRA Cyanide Project

Australian Society of Soil Science (WA) Branch Committee

Brodie-Hall Mining Research and Consultancy Centre, WA School of Mines

Chemistry Centre - Computer Advisory Committee

Chemistry Centre - Occupational Health and Safety Committee

Chemistry Centre Complex - Bentley Construction and

Fitout Project Control Group

Chemistry Centre-Geological Survey Liaison Committee

Drug Advisory Committee

Fluoridation of Public Water Supplies Advisory Committee

Grain Pool Legume Advisory Committee

Harding Dam Water Quality Committee

Hazardous Substances Advisory Committee

Hazardous Substances Advisory Committee Working Party - Termiticides

International Lupin Executive

Licence Advisory Panel of Rights in Water and Irrigation Act

Mines Department Hazardous Substances Committee

NATA Chemical Testing Registration Advisory Committee

Pesticides Advisory Committee

Poisons Advisory Committee

SAA CH/10/4 - Mineral Standards Board - Precious Metals Sub-committee

SAA MN/- Mineral Standards Board

SAA MN/1/1/7 - Coal and Coke, Trace Elements

SAA MN/2/2 - Chemical Analysis of Iron Ores

SAA MN/3/2 - Analysis of Aluminium Ores

SAA MN/4/2 - Chemical Analysis of Heavy Mineral Sands Sub-committee

State Tender Board - Cleaning Polishing and Maintenance Products

State Tender Board - Cleaning Products - Detergents

State Tender Board Paint Advisory Committee

Toxichem Chemical Information Project - Professional Advisory Group

Veterinary Preparation and Animal Feeding Stuffs Advisory Committee

WA Food Advisory Committee

WAACHA Sub-committee on Organochlorine Use as Termiticides

WARD Grants Assessment Panel (WA Research and Development)

Western Australian Food Advisory Committee

Working Party on Asbestos Cement Products

Explosives and Dangerous Goods

Association of Australian Port and Marine Authorities - Dangerous Goods Committee

Explosives - Dangerous Goods Systems Committee

Explosives Division Operations Planning Committee

Explosives Division Personal Computer Project Planning Committee

Kemerton Industrial Working Committee

Kemerton Park Advisory Board

Kwinana Industrial Co-ordinating Committee - Improvement Plan 14 Working Group

Kwinana Integrated Emergency Management System Executive Co-ordinating Committee

Kwinana Integrated Emergency Management System - Emergency Services Sub-committee

Kwinana Integrated Emergency Management System - Technical Advisory Sub-committee

National Task Force on Hazardous Industry and Land-use Safety Planning Public Safety Sub-committee

SAA CH/9 - Safe Handling of Chemicals

SAA ME/15 - Liquefiable Petroleum Gases

SAA ME/17 - Flammable and Combustible Liquids

SAA ME/50 - Road/Rail Tankers Fluid Transfer Components

SAA ME/57 - Road Tankers for Hazardous Liquids and Gases

SAA ME/70 - Liquefied Natural Gas Storage and Handling

State Government Counter Disaster Advisory Committee

Transport of Dangerous Goods - Competent Authorities Subcommittee

Transport of Dangerous Goods - Drafting Subcommittee

Transport of Dangerous Goods - Explosives Working Group

WA Hazardous Materials Emergency Management Scheme - Preparedness and Response Sub-committee

WA Transport Emergency Assistance Scheme Coordinating Committee

Geological Survey

Australian Earth Science Information System (AESIS) Advisory Committee

Australian Mineral Foundation (AMF) Council

Australian Resources Industry Database (ARID) Advisory Council

Bauxite Subcommittee

BMR Advisory Council

Bunbury-Wellington Regional Planning Committee

CSIRO Exploration Geoscience Advisory Council

CSIRO Mindarie Waste Disposal Site Committee

Coastal Management Co-ordinating Committee

Cockburn Area Groundwater Pollution Control Technical Committee

Conservation and Rehabilitation in the Mining Industry - Work Party

Environmental Liaison Committee

EPA Red Book Task Force

Extractive Industry Committee

GSWA/WAWA Groundwater Liaison Committee

Geological Survey Liaison Committee

Geological Survey Library Advisory Committee

Gnangara Mound Technical Advisory Group

Government Geologists' Conference

Government Geosciences Database Policy Advisory Committee

Hydrogeology Sub-committee (of the Geological Survey Liaison Committee)

Integrated Catchment Management Policy Group

Land Salinisation Sub-committee of RSC

RSC Land-use and Groundwater Interactions on the Coastal Plain Sub-committee

RSC Water Resource Catchment Rehabilitation

Research on Land Use and Water Supply Steering Committee

Rottnest Island Authority Environmental Advisory Committee

Rottnest Island Research Committee

State Tender Board Procurement of Motor Vehicles Advisory Sub-committee

WA Water Resources Council - Groundwater Management Committee

WAMEX Steering Committee

WAMEX Working Group

WAPEX Steering Committee

WAPEX Working Group

Yilgarn Block Liaison Sub-committee of the Geological Survey Liaison Committee

Petroleum

Committee of Local Industry Participation

Consultative Committee on Safety in the Offshore Petroleum Industry in Australia

Government Regulatory Authorities Pipelines Advisory Group

North West Shelf Security Working Group

Offshore Engineering Program Advisory Panel

Onshore Petroleum Legislation Sub-committee

Petroleum/Fishing Industries - Appeal Meetings

Petroleum Industry Liaison Committee

Standing Committee on Offshore Petroleum Legislation

State Committee for Combating Marine Oil Pollution

Mining Engineering

AXTAT

Board of Examiners (Mine Managers and Underground Supervisors)

Board of Examiners (Quarry Managers)

Coal Miners Welfare Board

Coal Mines Accident Relief Fund Trust

Golden Mile Mining Planning Development Committee

Leonora Mining Development Planning Committee

Mines Radiation Safety Board

Mines Survey Board

Mines Ventilation Board

Mining Contaminants Monitoring System (CONTAM) Steering Committee

Mining Operations Group

WA School of Mines Advisory Committee

Wittenoom Interdepartmental Committee

Yilgarn Mining Development Planning Committee

Royalties and Policy Development

Minedex Steering Committee

Surveys and Mapping

Australian Institute of Cartographers (WA Division)

CSA Cartographic Sub-association

Computer-aided Map Publishing Committee

Geodetic Survey and Computing Technical Subcommittee

Geographic Names Committee

Geographic Information Systems/Land Information Systems Pilot Project Steering Committee

GIS/LIS Steering Committee

MRD Cyber Users' Group

Multiskilling and Job Design Consultative Committee

Surveys and Mapping Divisional Assessment Panel

WA Petroleum Map Steering Committee

WA State Emergency Service - Liaison Officers

WA Survey and Mapping Advisory Committee

WALIS Digital Capture of Cadastral Information Subcommittee

WALIS Project - Restricted Sites Systems

WALIS Technical Subcommittee

WAPMAP Steering Committee

Western Australian Land Information Systems Council (WALIS)

Mining Registration

Exemption Sub-committee

Geoscientific Survey Permit Committee

Mining Registration Divisional Committee

Mining Registration Unit Managers' Committee

Tenement Rentals and Expenditure System (TRAXS)

Head Office

DEPARTMENT OF MINES
MINERAL HOUSE COMPLEX
100 PLAIN STREET (CNR ADELAIDE TERRACE)
EAST PERTH WESTERN AUSTRALIA 6004
TELEPHONE (09) 222 3333
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Chemistry Centre (WA)

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MINERAL PROCESSING LABORATORY
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Regional Office

KALGOORLIE METALLURGICAL LABORATORY
95 EGAN STREET (BOX 881)
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Explosives And Dangerous Goods Division

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BALDIVIS EXPLOSIVES RESERVE
STAKEHILL ROAD
BALDIVIS WESTERN AUSTRALIA 6171
TELEPHONE (09) 524 1301

Regional Office

KALGOORLIE EXPLOSIVES RESERVE
PICCADILLY STREET WEST
KALGOORLIE WESTERN AUSTRALIA 6430
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FAX (090) 913 222

Geological Survey Of Western Australia

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GEOLOGICAL SURVEY LABORATORIES
40 COHN STREET
CARLISLE WESTERN AUSTRALIA 6101
TELEPHONE (09) 222 3240
GEOLOGICAL SURVEY CORE LIBRARY
15 HAROLD STREET
DIANELLA WESTERN AUSTRALIA 6062
TELEPHONE (09) 222 3277

GEOLOGICAL SURVEY TRANSPORT STORE
137 RUSSELL STREET
MORLEY WESTERN AUSTRALIA 6162
TELEPHONE (09) 276 8855
(09) 222 3297

Regional Office

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA
KALGOORLIE REGIONAL OFFICE
WA SCHOOL OF MINES
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Mining Engineering Division

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DRILLING BRANCH
91 BRIGGS STREET
WELSHPOOL WESTERN AUSTRALIA 6101
TELEPHONE (09) 362 3211
FAX (09) 362 5694

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REGIONAL MINING ENGINEER
66 WITTENOOM STREET
COLLIE WESTERN AUSTRALIA 6225
TELEPHONE (097) 341 222
FAX (097) 341 606

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DEPARTMENT OF MINES
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UNIT 1 FORREST FORUM
FORREST STREET
COLLIE WESTERN AUSTRALIA 6225
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REGIONAL MINING ENGINEER
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CARNARVON WESTERN AUSTRALIA 6701
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MT MAGNET WESTERN AUSTRALIA 6638
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PRINCEP STREET
NORSEMAN WESTERN AUSTRALIA 6443
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FAX (090) 391 657

MINING REGISTRAR
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KUNUNURRA WESTERN AUSTRALIA 6743
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FAX (091) 681 103

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SOUTHERN CROSS WESTERN AUSTRALIA 6426
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Royalties And Policy Development Division

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Surveys And Mapping Division

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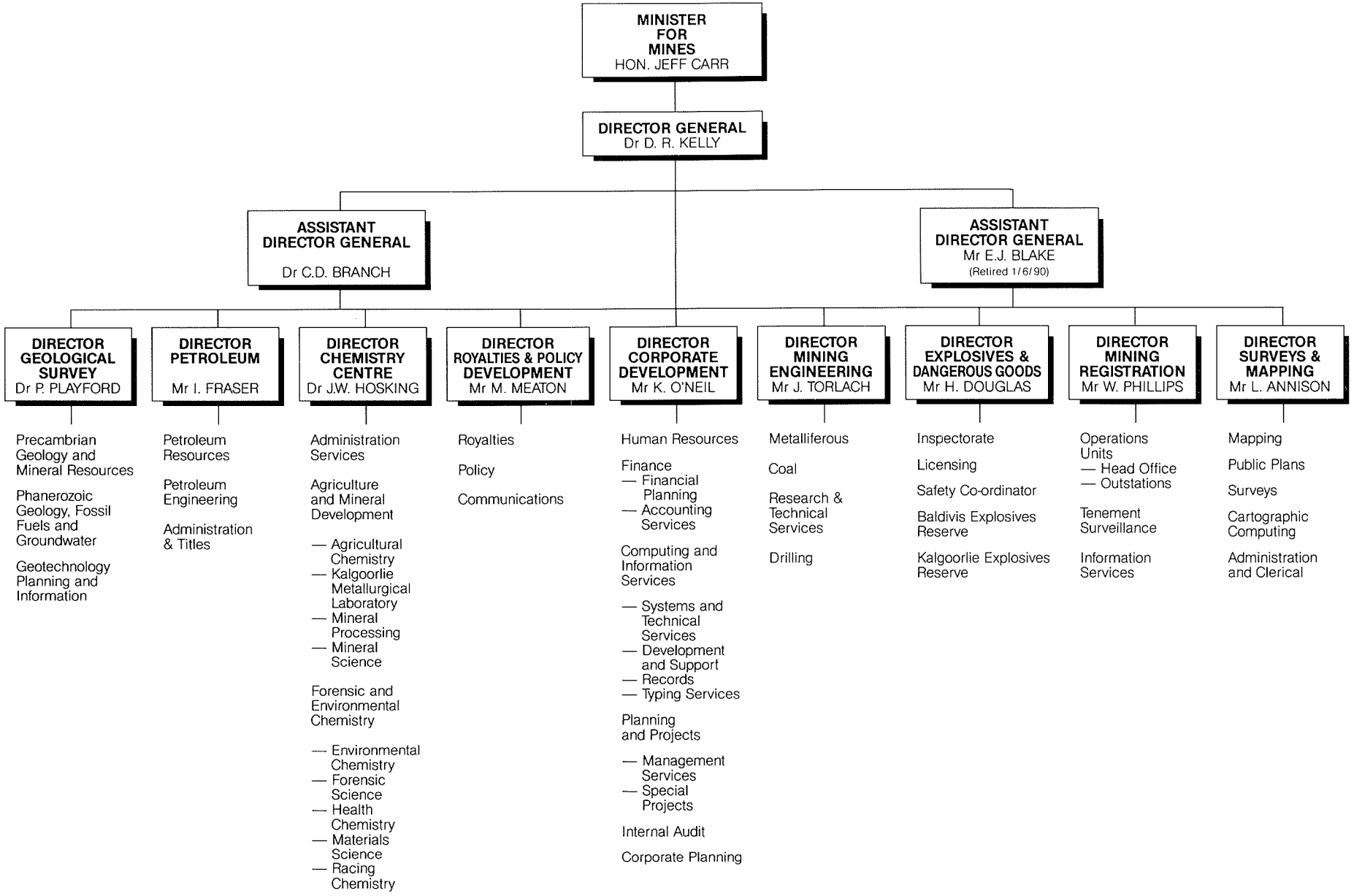
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Photo right: Western Mining Corporation's senior environmental officer, Colin Woolard inspects the regrowth of vegetation on mullock dumps from nickel mining operations.
Back cover: Haulpaks unloading iron ore at Robe River Iron Ore Associates Pannawonica operations.