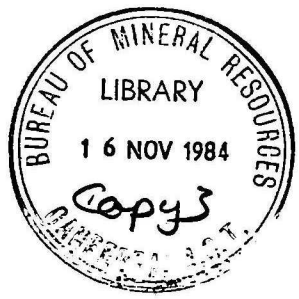

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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PETROLEUM AND MINERALS REVIEW CONFERENCE 1983

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CONTENTS

World petroleum overview and outlook

G.M. Folie, The Shell Company of Australia Ltd

The sharp OPEC price rise of 1973-74 increased enormously the incentive for oil exploration in the consuming areas outside OPEC. Although the mid 1970s saw a major expansion of exploration, it was not until 1979, when the Iraq-Iran war caused a further sharp price rise, that many consumers accepted that oil would permanently remain an expensive and scarce commodity.

The events of the 1970s brought great changes to oil exploration. The attitudes of those involved were altered. Instead of seeking oil where it was geologically most straightforward, there was greater interest in finding and developing oil supplies which were outside OPEC and the Middle East and which would therefore provide long-term security of supply. Ideally these new sources would be located in consuming countries, near to the markets they would supply. These criteria were met in many countries, including Australia, Canada, and much of South America, as well as in the British, Norwegian, and Danish North Sea. Technical changes also occurred. Higher prices provided an incentive to explore for and to produce smaller pockets of oil and gas, and justified more expensive exploration and production methods. There was an increase in offshore exploration, for example, in deeper and more hostile waters such as the North Sea, and in harsh Arctic environments like Alaska. New technologies were developed, e.g. platforms able to withstand extreme weather conditions, and sub-sea completions. New techniques were also developed to exploit small offshore fields which could not justify the expense of fixed platforms and pipelines to shore - these include the use of converted tankers, moored over the field, to store production. Other techniques which benefited from higher oil prices were secondary and tertiary recovery, including the injection of gas, water, and chemicals, to increase the production of oil from a field. The new attitude, which moved exploration attention away from the Middle East and OPEC, to smaller and more inaccessible reservoirs in many areas of the world, was based on the expectation that real oil prices would continue to increase. Since early last year, that expectation has not been fulfilled, and spot-market prices have fallen sharply in response to prolonged over-supply. Pressure on marker prices has therefore increased, and, although the outcome of OPEC's current deliberations is uncertain, a price of between $25 and $30/barrel is likely in the near future.

The difficulty for oil explorers and producers is judging how long this will last. With prolonged low economic growth, the real oil price could decline for the rest of this decade. Even with a conventional recovery in the world economy and growing oil demand, the size of the present oil surplus, and the need for several OPEC members to maintain their oil income, will prevent any tightness in the market and real price rises - for several years. Yet, in both cases, the possibility of a political accident interrupting supply, or a renewed OPEC attempt at production limits, could cause real prices to rise sharply in response to a real or perceived supply shortfall.

Given this strategic supply danger, it is essential that exploration outside OPEC and the Middle East continue, although not at the feverish levels which have recently characterised the industry, but which declined sharply in 1982 in, e.g., Australia, USA, and the North Sea. In 1983, exploration is likely to decline further. To achieve continued exploration, it is essential that the industry be able to operate in conditions of long-term stability. It must be possible to take investment risks which reflect a view of geological conditions and of the oil market, but which do not need to 'play safe' by assuming volatile government taxation or pricing policies. This stability, always important, is absolutely critical in generating sufficient exploration in Australia to replace as much of the declining Bass Strait reserves as possible while the outlook is for a prolonged period of low prices.

Australian petroleum exploration and development

J. A. W. White, BMR

Drilling activity in Australia was at a record high in 1982, a total of 344 wells being drilled for petroleum exploration and development. Of these, 239 were exploratory (187 onshore, 52 offshore) and 105 were development wells (91 onshore, 14 offshore). This represents a record for exploratory wells in Australia in any one year; the previous record was 156 wells in 1965.

The number of seismic surveys carried out was maintained at a high level, although some slackening in activity was noticeable towards the end of the year. In onshore basins, the level of activity was highest in South Australia and Queensland in the Eromanga, Cooper, Surat and Bowen Basins.

Highlights of onshore exploration were gas and oil discoveries in the Denison Trough of the Bowen Basin, and gas discoveries in the Cooper, Perth and Amadeus Basins. Extensions of known fields in the Bowen-Surat, Amadeus, Perth and Cooper-Eromanga Basins were successfully proved by appraisal drilling.

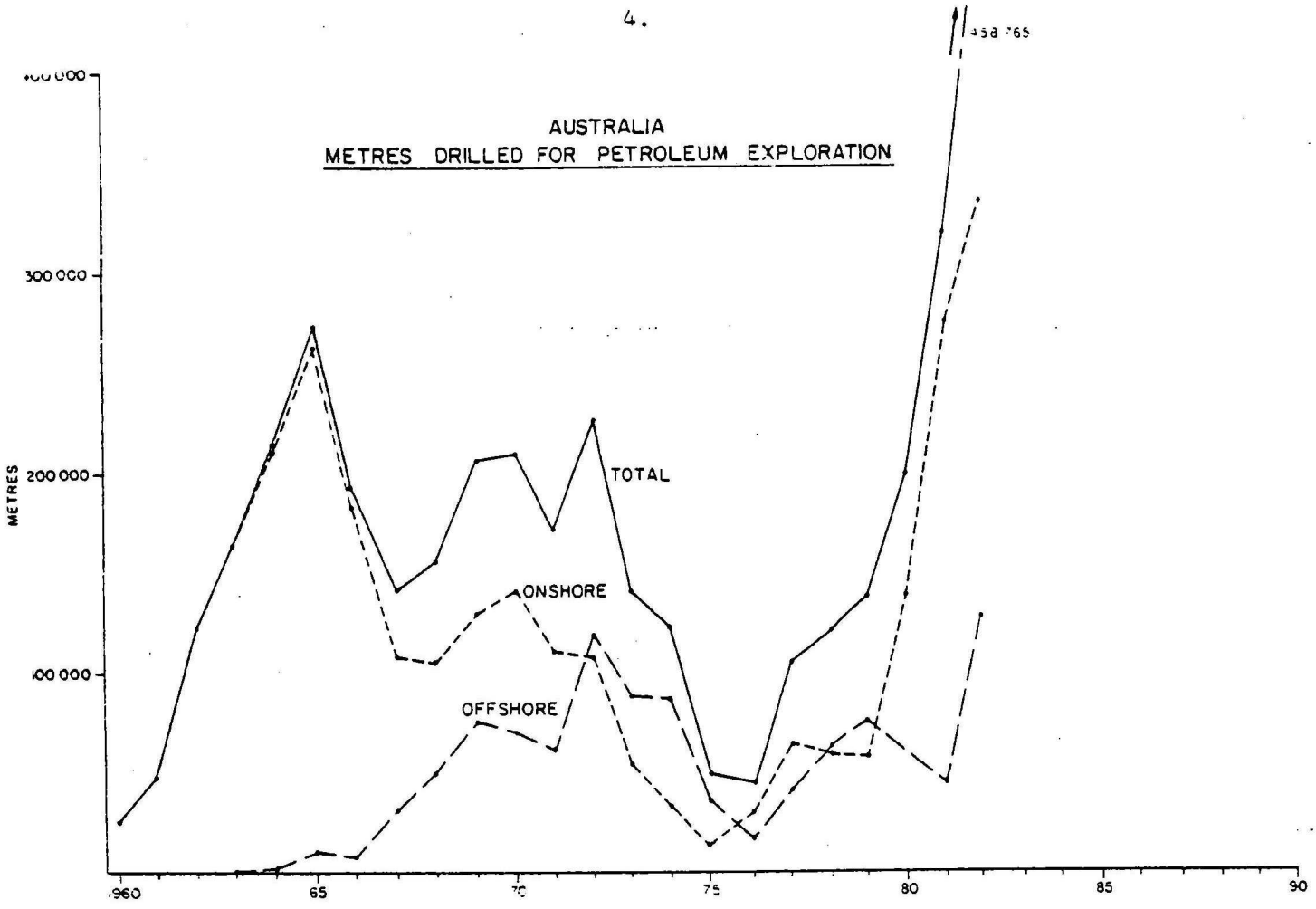
Offshore, exploration activity was greatest in the Gippsland and Carnarvon Basins. The only significant oil discoveries were made in the Gippsland Basin, but substantial new discoveries of gas were made in the Browse and Gippsland Basins.

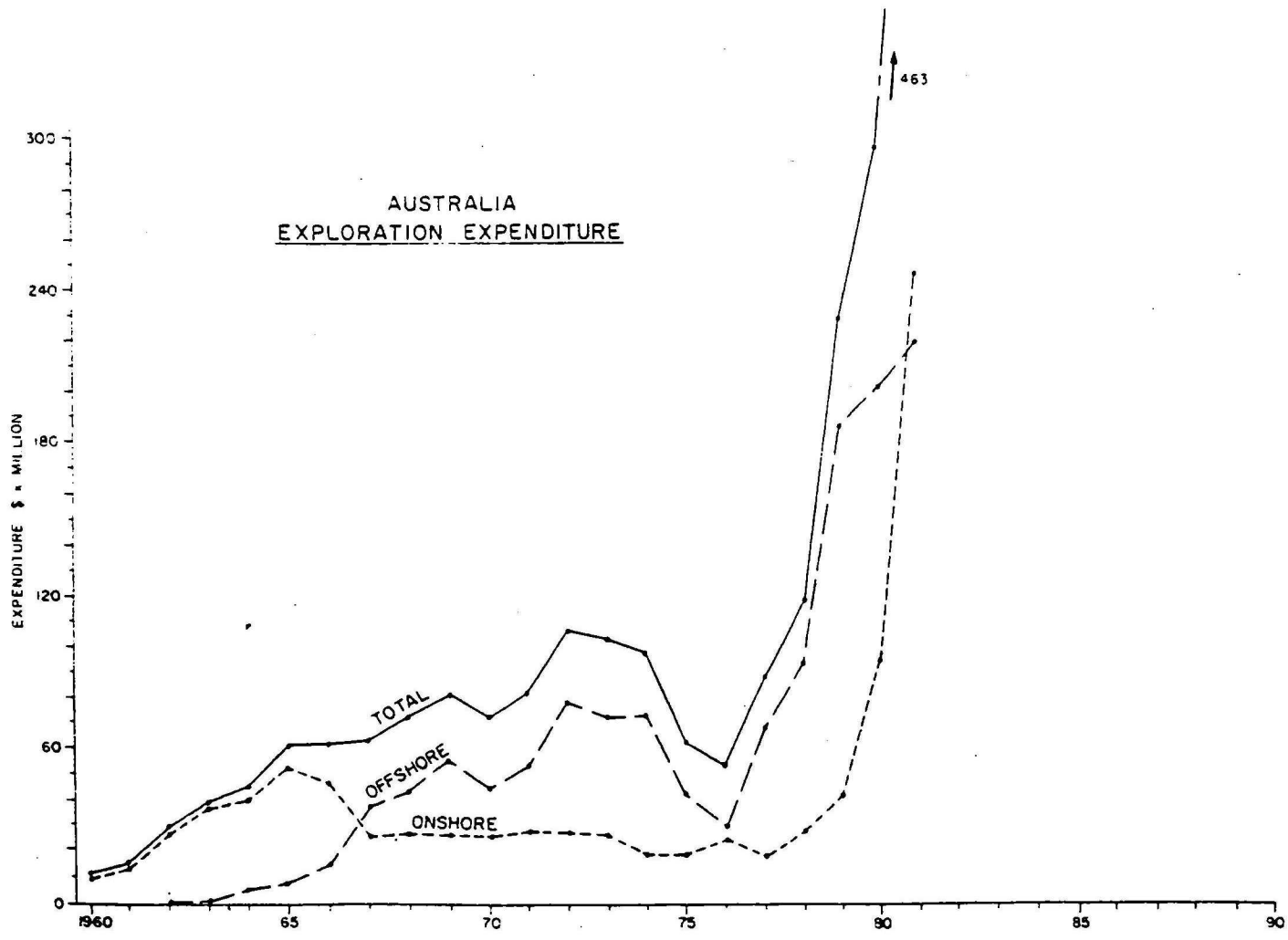
Several development projects were in progress or commissioned during the year, the most important of those located onshore being the Cooper-Eromanga liquids development scheme based on a liquids line from Moomba to Stoney Point which was almost complete at year's end.

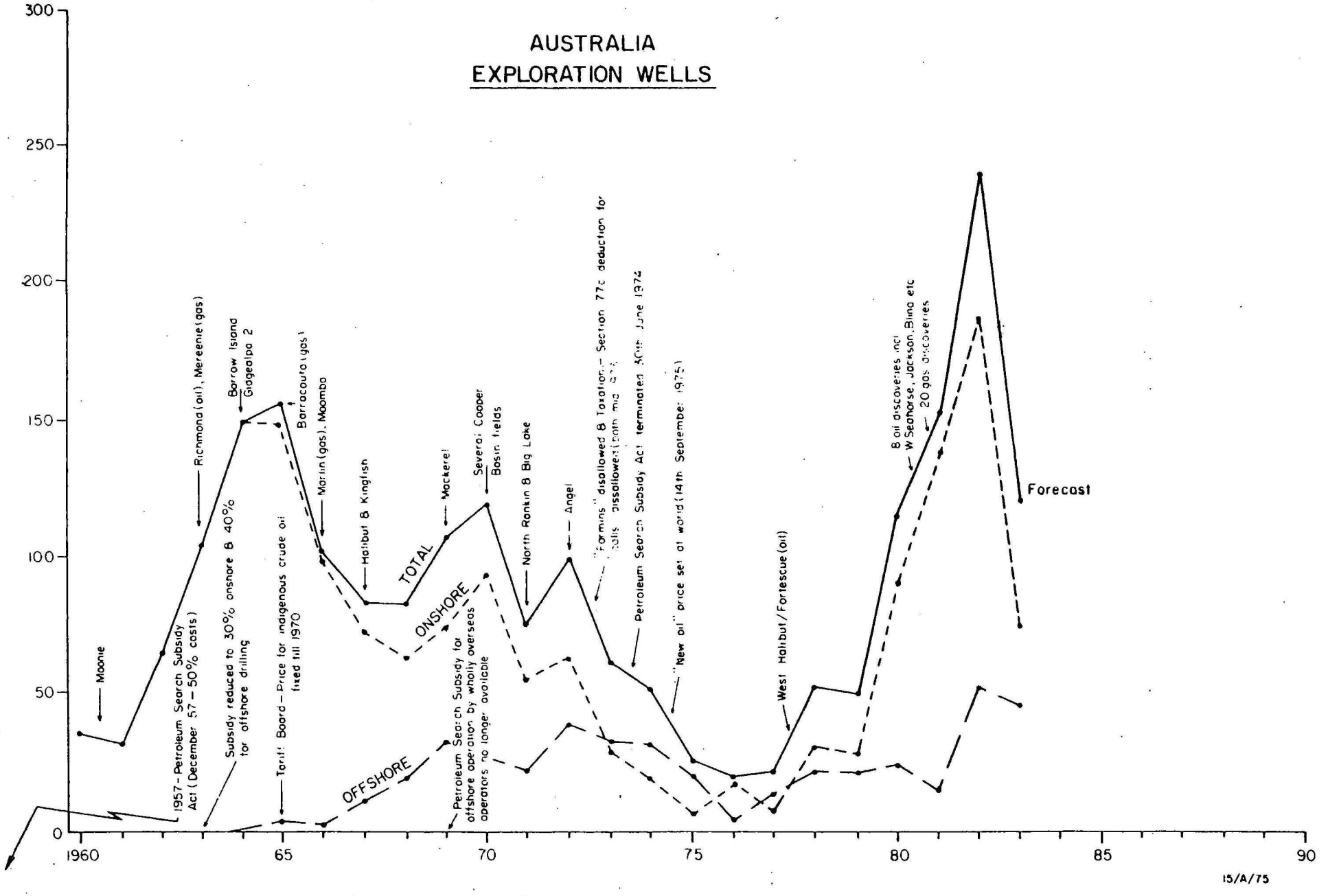
Offshore, large development programs at North Rankin in Western Australia, and in Bass Strait were in progress throughout the year.

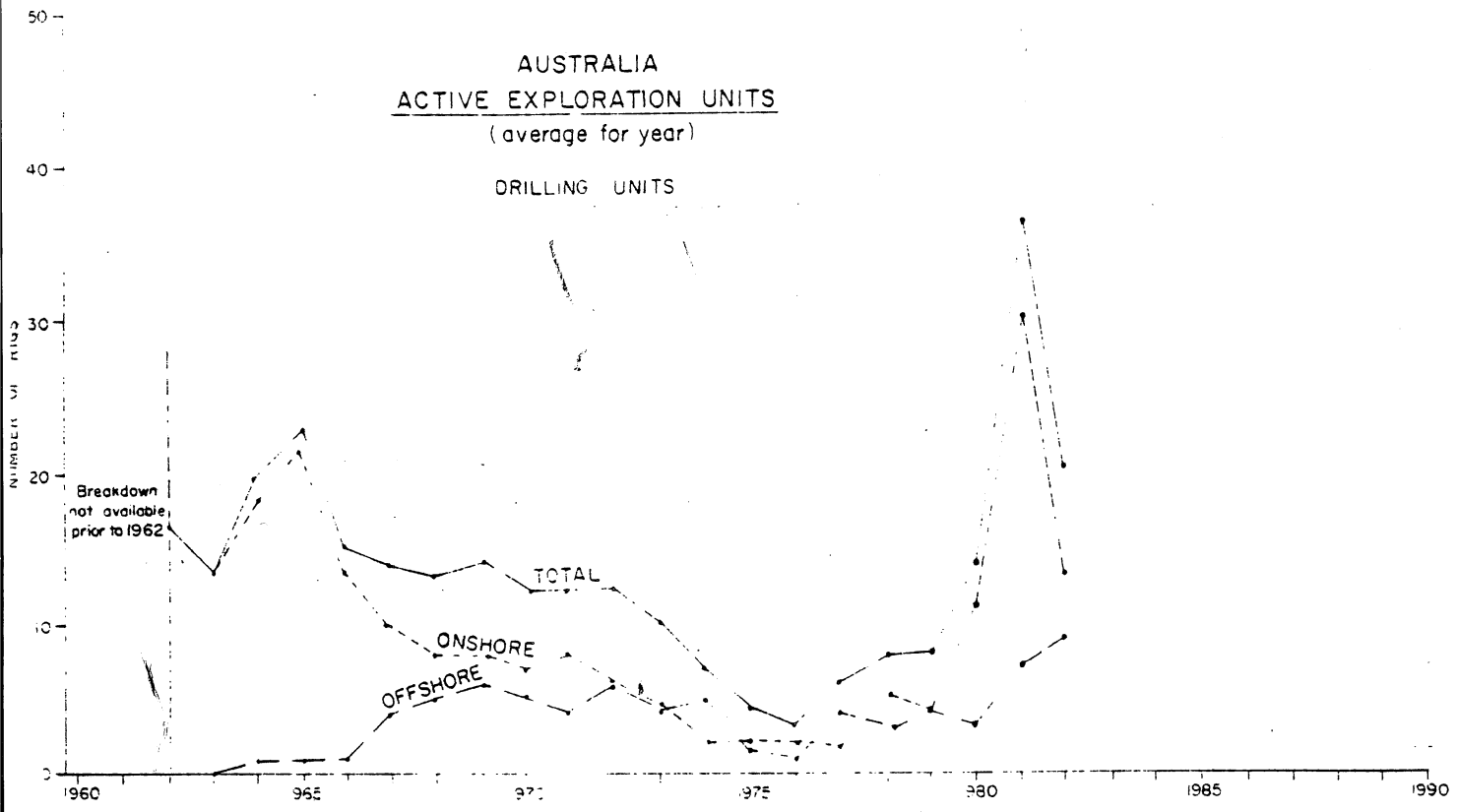
Although some concern must be felt over a decrease in seismic activity during the last quarter of 1982 and the general scarcity of risk capital, exploration activity in 1983, and the following two or so years, should remain strong, although at a level below that of 1982. BMR estimates that between 170 and 205 exploration wells will be drilled in 1983, of which 100 to 135 will be onshore and 70 offshore.

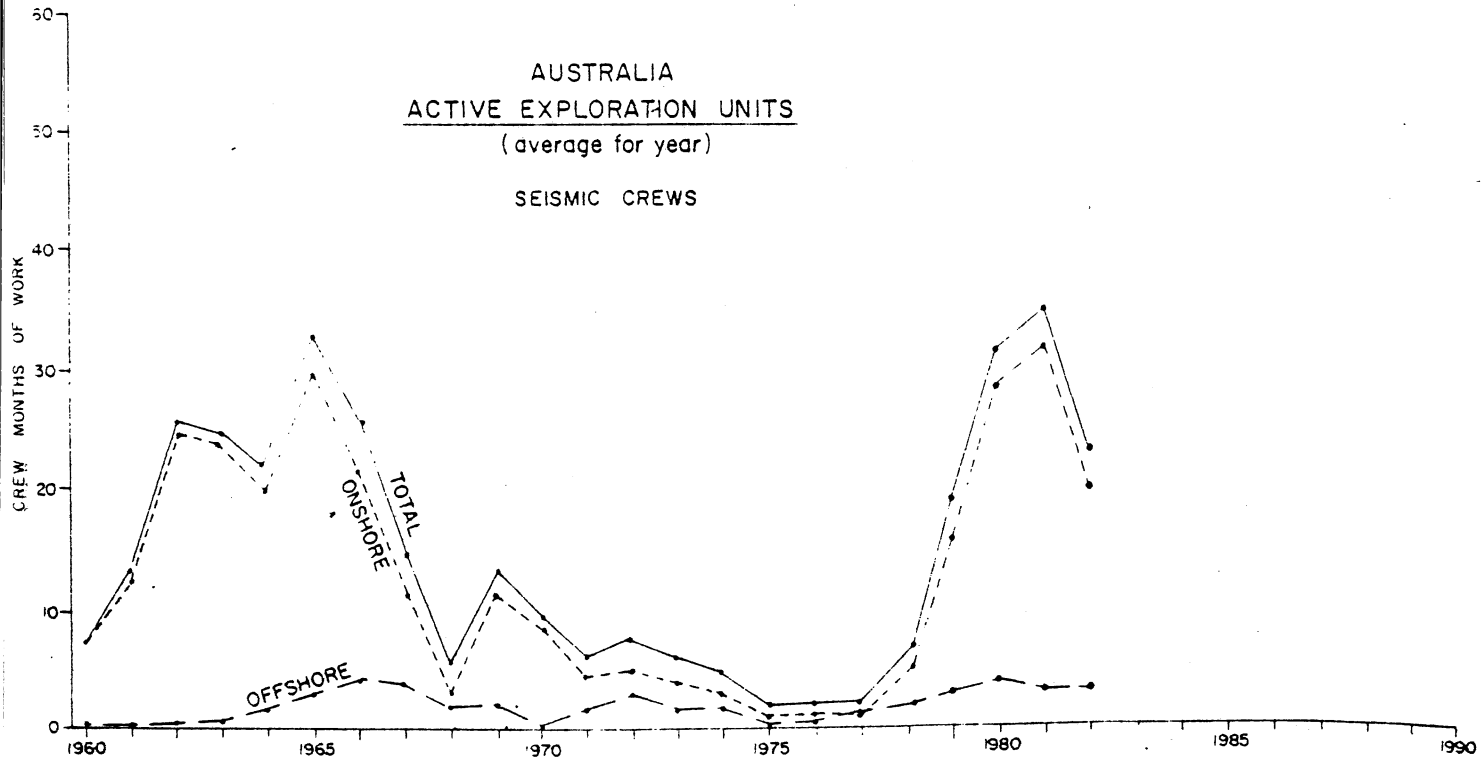
Offshore, exploration activity will be particularly strong in the Gippsland Basin and new areas will be explored in the Arafura and Bass Basins. Onshore, activity will remain at a comparatively high level in the Cooper-Eromanga and Bowen-Surat Basins, while in Central Australia the Amadeus Basin should continue to attract explorers.


AUSTRALIA
METRES DRILLED FOR PETROLEUM EXPLORATION
METRES
300 000
200 000
100 000
TOTAL
ONSHORE
OFFSHORE
1960
65
70
75
80
85
90


AUSTRALIA
EXPLORATION EXPENDITURE
EXPENDITURE $ x MILLION
300
240
180
120
60
0
463
TOTAL
OFFSHORE
ONSHORE
1960
65
70
75
80
85
90


AUSTRALIA
EXPLORATION WELLS
300
250
200
150
100
50
0
1960
65
70
75
80
85
90
Moonie
1957 - Petroleum Search Subsidy Act (December 57 - 50% costs)
Richmond (oil), Mereenie (gas)
Subsidy reduced to 30% onshore & 40% for offshore drilling
Borrow Island
Gidgealpa 2
Tariff Board - Price for indigenous crude oil fixed till 1970
Barracouta (gas)
Marlin (gas), Moomba
Halibut & Kingfish
TOTAL
Mackerel
ONSHORE
Petroleum Search Subsidy for offshore operation by wholly overseas operators no longer available
OFFSHORE
Severai Cooper Basin fields
North Rankin & Big Lake
Angel
Farmins" disallowed & Taxation - Section 77c deduction for bills disallowed from mid 1973
Petroleum Search Subsidy Act terminated 30th June 1974
"New oil" price set at world (14th September 1975)
West Halibut/Fortescue (oil)
8 oil discoveries incl W Seahorse, Jackson, Elina etc
20 gas discoveries
Forecast
15/A/75


AUSTRALIA
ACTIVE EXPLORATION UNITS
(average for year)
DRILLING UNITS
NUMBER OF RIGS
50
40
30
20
10
0
Breakdown not available prior to 1962
TOTAL
ONSHORE
OFFSHORE
1960
1965
1970
1975
1980
1985
1990


AUSTRALIA
ACTIVE EXPLORATION UNITS
(average for year)
SEISMIC CREWS
CREW MONTHS OF WORK
60
50
40
30
20
10
0
TOTAL
ONSHORE
OFFSHORE
1960
1965
1970
1975
1980
1985
1990

Petroleum exploration in Australia - are current levels adequate?

D.J. Forman, BMR & A.L. Hinde, BMR

One method of attempting to answer the question 'Are exploration levels adequate?' is to use statistics on past hydrocarbon discoveries as a basis for extrapolations that will indicate future discoveries and the effort required to make them. Studies prepared in BMR on discoveries in the Cooper, Bowen-Surat, and Gippsland Basins show a growing decline in the size of field discovered and consequently of the amount of petroleum discovered per well drilled in each basin (e.g. Cooper Basin, Fig. 1). These decline curves have been modelled using an adaptation of a method developed by scientists from Shell International Petroleum Co. (Meisner & Demirmen, 1981), and projections indicate a potential for further oil and gas discoveries and the exploration effort required, as summarised in Figures 2-6.

The average projections indicate: (1) that the next 100 new-field wildcats drilled on structures in the Cooper Basin should discover, on average, a total of 190 billion cubic feet (BCF) (5.4×10^9 m^3) of sales gas; (2) that the next 200 new-field wildcats in the Bowen and Surat Basins (after 1981) should discover, on average, a total of 60 BCF (1.7×10^9 m^3) of gas and 1.15 million barrels (MMB) (180 000 kL) of crude oil; and (3) that the next 50 new-field wildcats in the Gippsland Basin should discover, on average, a total of 110 MMB (17 000 000 kL) of crude oil and 110 BCF (3.1×10^9 m^3) of sales gas. More oil and gas will be discovered in new pools within known fields, and additional amounts may become available using enhanced recovery methods. These amounts are omitted from the study and hence the extrapolations probably underestimate the remaining potential of the structural traps.

A decline is evident in the data on discoveries in the Barrow-Dampier Sub-basin, on the shallower parts of the Rankin Trend, and in the Perth Basin, indicating that major discoveries there are now unlikely. However, the data are insufficient to make projections and to quantify the potential.

A study released at the 1982 conference (Forman, 1982) suggested that we will have to discover about 1000 MMB (about 150 million kL) of crude oil to maintain the present level of domestic production of crude oil and condensate until 1995 and that several TCF (trillion (10^{12}) cubic feet)

(about 500 x 10^9 m^3) of gas are needed in new discoveries to guarantee supplies to Sydney and Adelaide through to about 2005. A major conclusion that we draw from the present study is that, with the possible exception of the Eromanga Basin, further exploration of structural traps in Australia's producing areas is likely to find only a small proportion of this petroleum. If we wish to maximise our chances of maintaining present levels of production, it will be necessary to explore stratigraphic traps in the producing areas and structural and stratigraphic traps in other prospective areas of Australia.

A rapid assessment carried out at BMR suggests that 50 to 60 new-field wildcats are needed in each of the next six years to test the potential of other parts of Australia. However, only 39 new-field wildcats were drilled outside of the producing areas in 1982. Considering the results of the assessment and of this study, present levels of exploration appear inadequate to maximise our chances of maintaining present levels of crude oil and condensate production to 1995, or of discovering enough gas in eastern Australia to meet local demand.

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MEISNER, J., & DEMIRMEN, F., 1981 - The creaming method: a Bayesian procedure to forecast future oil and gas discoveries in mature exploration provinces. Journal of the Royal Statistical Society, Series A 144(1), 1-31.

FORMAN, D.J., 1982 - Australia's prospects for future discovery and supply of petroleum. In Papers presented at the Petroleum & Minerals Review Conference, Canberra, 1-2 July 1982. Bureau of Mineral Resources, Australia, Record 1982/21 (unpublished).

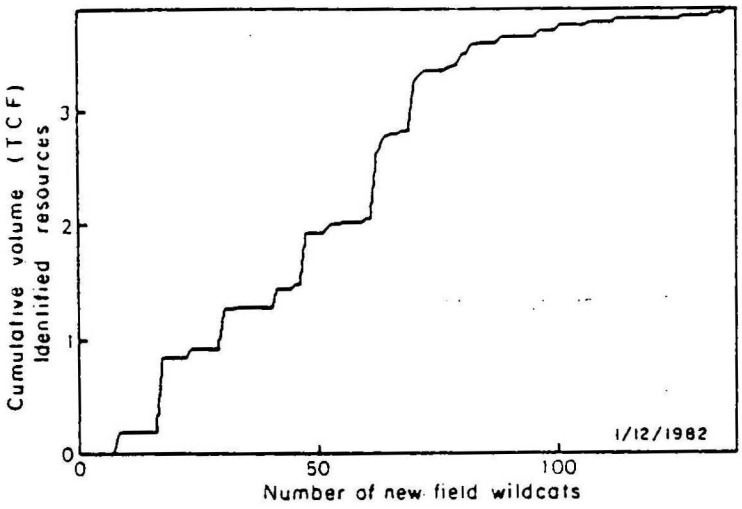

Fig. 1 : Cooper / Eromanga Basins (gas) - discovery decline

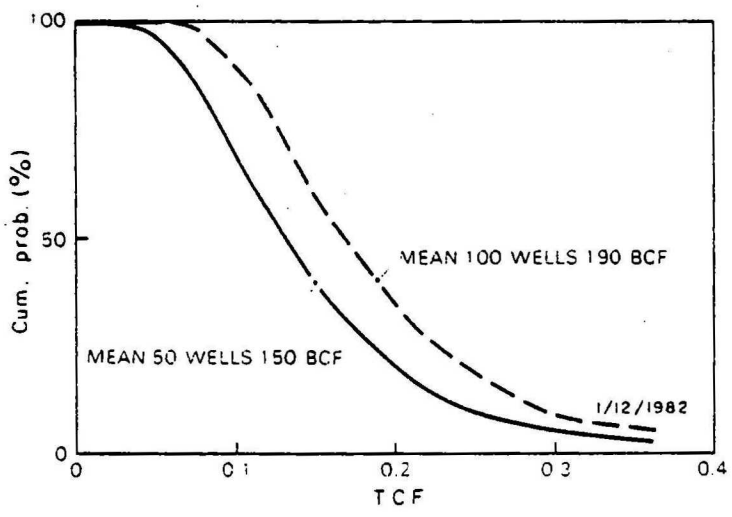

Fig. 2 : Cooper / Eromanga Basins - assessments of hypothetical undiscovered gas resources - average projection

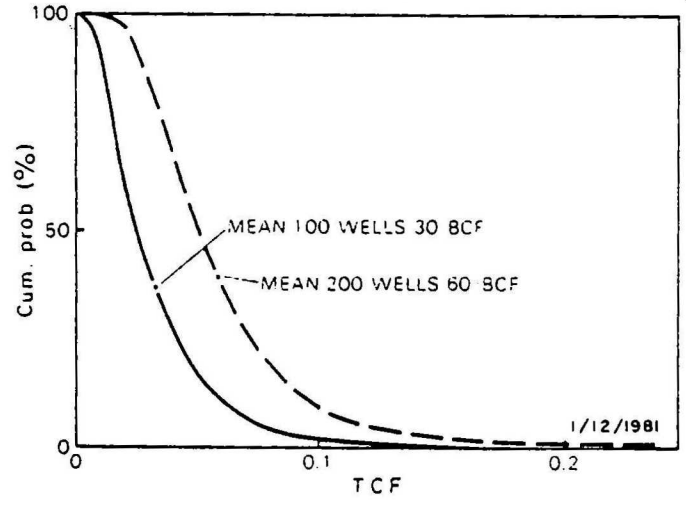

Fig. 3: Bowen / Surat Basins - assessments of hypothetical undiscovered gas resources - average projection

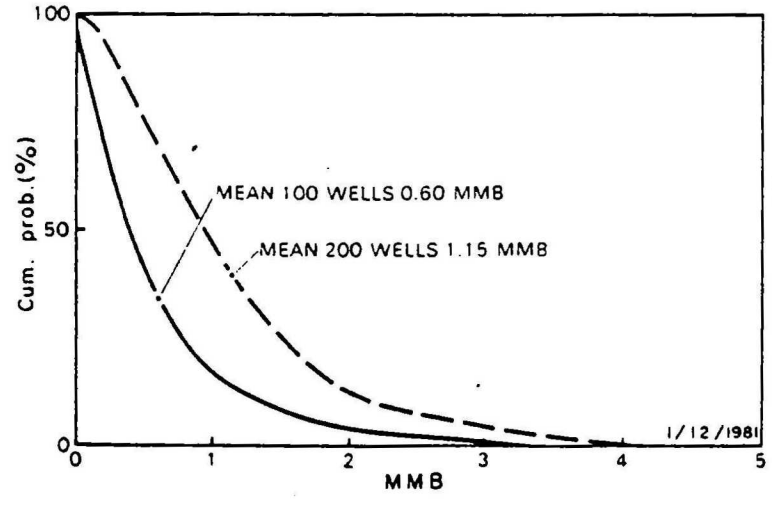

Fig. 4: Bowen / Surat Basins - assessments of hypothetical undiscovered oil resources - average projection

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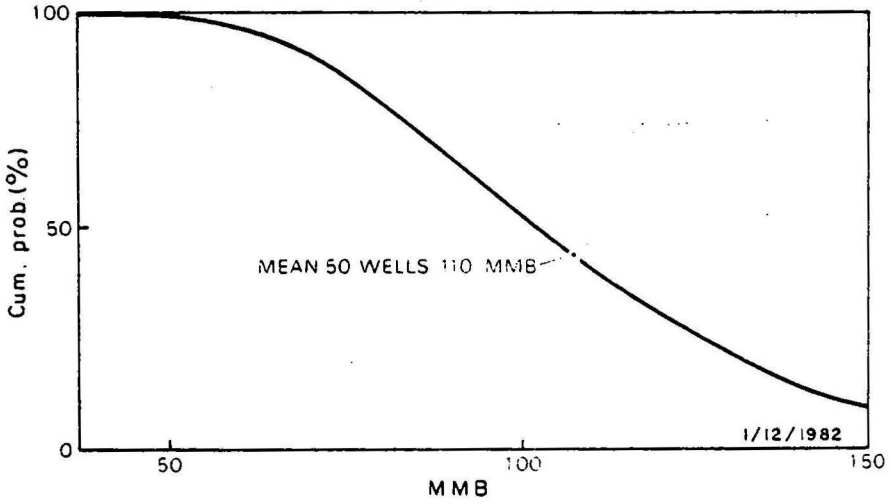


Fig.5: Gippsland Basin(central deep basin) - assessment of hypothetical undiscovered oil resources - average projection

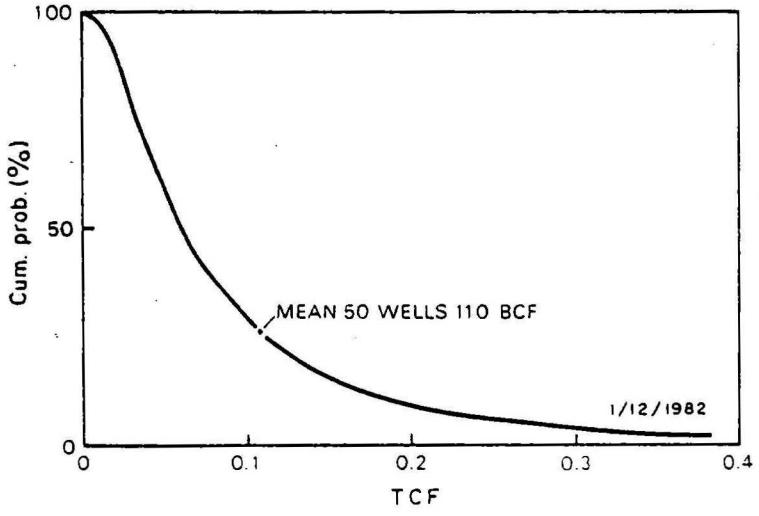


Fig.6: Gippsland Basin (central deep basin) - assessment of hypothetical undiscovered gas resources - average projection

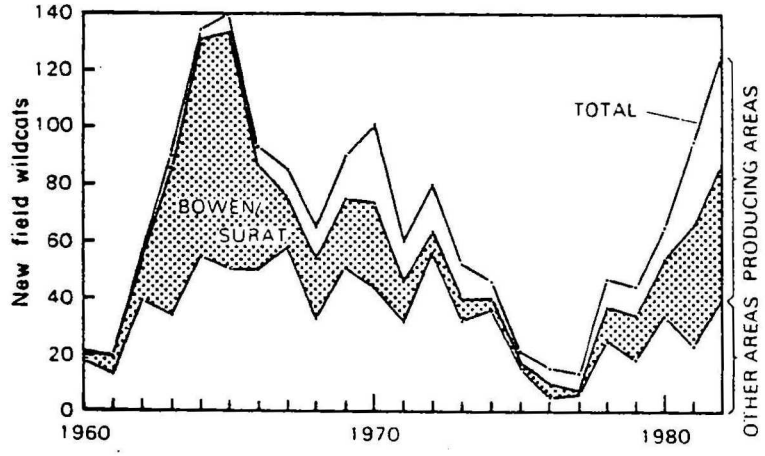


Fig. 7: Australia, new field wildcats 1960-1982

15/A/95

Is Australia's petroleum exploration effort adequate?

John B FitzGerald, APEA

There has been a marked revival in petroleum exploration in the past five years with 580 wildcat and appraisal wells drilled compared with only 188 between 1973 and 1977. Last year, records were established in a number of areas, including the total number of wells drilled. However, the effort is still not perceived as being adequate. Exploration appears likely to contract in 1983 and subsequent years and this is not encouraging for an industry with a target of discovering around 150 million barrels (about 25 million kL) a year of oil to maintain the present level of reserves. Exploration investment of about $1.2 billion per year is required to sustain exploration at a sufficiently high level, and risk capital available to Australian companies has been drying up for the past year because of the general economic situation and adverse sharemarket conditions. The industry, through APEA, is seeking to have the rebate available to investors in exploration companies increased significantly to encourage the provision of capital to Australian companies. Under present circumstances there is a real risk of the level of oil self-sufficiency falling back.

Synfuels opportunities in Australia.

W B Rotsey, Department of Resources and Energy.

This abstract will be provided separately.

The paper first considers the role of synfuels in an emergency situation and concludes that other measures such as increases domestic crude production, drawdown of stocks, fuel substitution (e.g. LGP), and demand restraint, would be more rapid responses than the synfuels option to sudden oil supply shortfalls.

The paper then considers the non-emergency opportunities for synfuels around the year 2000. The approach taken is that direct government intervention in high-risk synfuel ventures requiring large capital investment is unlikely. A more likely course may be for governments to create conditions which would encourage investors to establish synfuels plants in Australia. The paper than considers the range of issues of concern to the pontential investor. The technological factors are discussed and the economic, social, and environmental issues are overlaid, leading to a ranking of opportunities.

The best opportunities are seen, in descending order of attractiveness to be: (1) conversion of natural gas, or gas from coal, through the Mobil MTG process or the Fischer-Tropsch process: (2) shale oil: (3) hydrogenation of coal: and (4) methanol M 100.

Finally the paper discusses the investment climate, the national interest, and the need to encourage appropriate R&D.

Synfuels - where to now?

M J Lye, Esso Australia Limited

The momentum towards commercial development of synthetic fuels which began in the mid 1970s has slowed significantly in the last year or two. The slow-down is mainly due to changed perceptions about oil demand and prices in the short to medium term, and also because of increased uncertainties about the costs and economics of implementing new technologies on a huge scale.

However, there has been no diminution in the three key driving forces that originally inspired increased worldwide activity in synfuels, namely:

- the threat of oil supply disruptions, particularly from a Middle East conflict
- the continuing shortfall between new oil discoveries and consumption
- the rapidly increasing costs of producing conventional crude oil from smaller, more difficult fields in increasingly difficult operating environments.

It is forecast that Australia will be able to sustain a high level of self-sufficiency in liquid fuels supply throughout the 1980s, from indigenous reserves. However, by the 1990s indigenous-sourced supply from known discoveries will decline, and it is during this period that Australia should be prepared to embark on synfuels production, if it becomes necessary.

A long lead time is required before Australia can sensibly make a decision to build its first commercial synfuels plant. In addition to the over-riding issue of cost and economics, there is a complex matrix of issues to resolve:

- the optimum combination of resource type, technology, and product mix
- the choice of synthetic product mix relative to product demand
- the matching of synfuels projects to the existing refinery system
- planning for infrastructure manpower and industrial relations
- establishment by Government of a stable, attractive synfuels climate.

Resolution of these uncertainties will be a lengthy process, and will require cooperation between industry, government and labour on a scale hitherto unprecedented. Fortunately, time is available to work on these issues, so that in the longer term a soundly based synfuels industry can be developed with optimum benefits to Australia.

Mineral industry overview and outlook

J Ward, BMR

The spectacular rate of expansion in the Australian mineral industry, a feature of the 1960s and 1970s, has now levelled off. In 1982 the industry operated against a world backdrop of depressed economic conditions, high interest rates, liquidity problems, metal surpluses, and falling prices. Nevertheless, estimated domestic mine production of mineral commodities was generally higher than in 1981 and new record production levels were established for black coal, brown coal, lead, zinc, silver, nickel, tin, natural gas and uranium. Despite lower prices for lead, copper, aluminium, ferroalloys (nickel, tungsten, and manganese), rutile, gold, and silver, indications are that the ex-mine value of output in 1982 increased to a record level in excess of $9 billion or 5 per cent higher in real terms than in 1981. However, this record level was not reflected in the processing sector of the industry and production of alumina, aluminium, pig iron, steel, silver, tin, and zinc was lower than in 1981.

Although a major world producer of a wide range of minerals, Australia is relatively unimportant as a consumer, and much of its production is of necessity strongly export-oriented. The massive developments in the mineral industry over the last 20 years have been reflected in unparalleled expansion in mineral export revenue, from a modest $100 million in 1960 to $7.1 billion in 1981. Although global trade in minerals was adversely affected by reduced demand and lower prices in 1982, the value of Australian exports of mineral primary products established a new record, estimated as $8.1 billion. The fob value of exports was to some extent enhanced by depreciation of the Australian dollar against the US dollar, and major contributions were provided by coal, iron ore, and the aluminium group, which are responsible for about two-thirds of total mineral export revenue. In particular, exports of black coal contributed a record export value of about $2.6 billion in 1982.

The value of mineral imports was contained to about $3.1 billion, compared with $2.4 billion in 1981. As has been the case for many years, imports of crude oil and other refinery feedstock were by far the largest single category, being responsible for about 87 per cent of our mineral import bill in 1982.

In terms of output, shipments, and use of production capacity, the Australian mineral industry performed well in 1982 compared with that of most other major world producers. In recent months some base and precious metal prices have firmed and there are reports of improvement in company financial

performance. However, the short-term outlook for the mineral industry is not encouraging. Most economists predict an annual increase of no more than 3 per cent in the GDP of the major economies, and industry experts see very little improvement in real terms in metal prices during 1983.

In summary, economic recovery is seen as gradual and the outlook for 1983 is for a 'holding operation' rather than an expansion. Considerable excess production capacity exists for most mineral commodities and can be quickly recommissioned to meet renewed demand. Despite this rather pessimistic short-term outlook Australia is well placed to take advantage of a world recovery in metal consumption. After two years of depressed worldwide economic conditions the Australian industry remains intact. Australia has major deposits of coal, bauxite, iron ore, uranium, lead, zinc, and copper which can be developed; for many minerals Australia ranks in the top five among world producers and exporters and, provided production costs remain competitive, Australian producers can expect to maintain their share of world markets and, in some cases, expand them.

A warning note, however, should be sounded. Low metal prices and under-serviced contracts have greatly reduced company cash flows, sharply cut profits, and in some cases forced companies to operate at a loss. In this climate many companies have cut back exploration; the upward trend in expenditure on mineral exploration has levelled out in the last two years and indications are that this expenditure could be reduced substantially in 1983. Although this will conserve company funds in the short term, Australia's reputation as a long-term mineral supplier to world markets could be jeopardised if the trend is not reversed.

TABLE 1. AUSTRALIAN MINE PRODUCTION OF PRINCIPAL MINERALS

	Unit of Quantity	1979	1980	1981	1982 (e)
Bauxite	'000 t	27 583	27 179	25 541	23 500
Black coal (a)	'000 t	93 043	93 664	100 870	118 000 +
Brown coal	'000 t	32 597	32 894	32 959	37 000 +
Copper (b)	t	237 610	243 540	225 874	244 700
Gold (b)	kg	18 566	17 032	17 661	27 400
Ilmenite cons (c)	'000 t	1 181	1 385	1 332	1 159
Iron ore & cons (d)	'000 t	91 717	95 534	84 718	87 000
Lead (b)	t	421 158	397 491	388 642	464 597 +
Manganese ore, metallurgical	'000 t	1 724	1 999	1 409	1 132
Nickel (b)	t	69 709	74 323	74 475	86 000 +
Petroleum					
Crude oil	'000 kL	25 500	22 240	22 842	21 662
Natural gas	'000 000 m^3	8 289	9 567	11 268	11 594 +
Phosphate rock	t	7 557	6 621	4 937	235 000
Rutile cons	t	274 533	311 744	229 425	222 828
Silver (b)	kg	832 210	766 816	743 239	908 108 +
Tin (b)	t	12 571	11 588	12 267	12 700 +
Tungsten cons (65% WO_3)	t	6 194	6 226	6 017	4 595
Uranium (U_3O_8)	t	832	1 841	3 373	5 300 +
Zinc (b)	t	529 157	495 312	517 405	667 004 +
Zircon cons	t	444 975	491 547	424 688	455 888

(a) Raw coal, (b) Total metallic content of minerals produced, (c) Exludes leucoxene, (d) Excludes iron oxide not intended for metal extraction, (e) Some totals estimated, + new record level

TABLE 2. AUSTRALIAN SMELTER AND REFINERY PRODUCTION OF PRINCIPAL METALS

	Unit of Quantity	1979	1980	1981	1982 (e)
Alumina	'000 t	7 415	7 246	7 079	6 631
Aluminium	t	269 575	303 494	379 427	362 153
Copper - Blister	t	166 260	174 920	173 494	175 862
Refined	t	137 689	144 828	164 241	165 346
Gold	kg	16 603	14 761	14 991	25 980
Lead - In bullion for export	t	169 469	160 286	161 592	170 000
Refined (a)	t	215 734	200 454	207 668	218 808
Pig iron	'000 t	7 811	6 960	6 830	5 956
Raw steel (b)	'000 t	8 125	7 593	7 635	6 370
Silver	kg	320 370	335 159	335 185	316 132
Tin	t	5 423	4 819	4 286	3 114
Zinc	t	305 394	300 959	295 886	290 569

(a) Includes lead content of lead alloys from primary sources, (b) Includes recovery from scrap, (e) Some totals estimated.

TABLE 3. AUSTRALIAN OVERSEAS TRADE IN MINERAL PRIMARY PRODUCTS

	Unit of quantity	1980 Quantity	1980 Value f.o.b. ($'000)	1981 Quantity	1981 Value f.o.b. ($'000)	1982 (e) Quantity	1982 (e) Value f.o.b. ($'000)
Exports							
Alumina	'000 t	6 994	1 021 383	6 509	1 085 725	5 911	1 108 606
Aluminium (ingot metal)	t	46 456	62 417	79 191	96 672	154 032	165 785
Coal (black)	'000 t	42 285	1 688 917	50 813	2 301 238	47 262	2 593 265
Copper (a)(b)	t	123 555	250 769	123 054	210 140	108 464	157 290
Gold (a)(b)	kg	6 729	89 741	7 386	55 577	11 986	133 213
Ilmenite concentrates (c)	t	1 082 919	25 162	922 865	24 554	819 732	23 905
Iron ore and pellets	'000 t	79 753	1 163 590	71 148	1 123 141	74 459	1 449 539
Iron, ingot steel, ferro-alloys	'000 t	854	130 539	576	136 602	286	51 768
Lead (a)(b)	t	349 050	566 022	343 942	320 005	417 187	339 123
Nickel (b)	value	n.a.	428 954	n.a.	389 936	n.a.	403 407
Rutile concentrates	t	315 314	88 799	198 738	58 959	208 668	53 506
Salt, bulk	'000 t	4 514	43 916	3 962	43 530	3 953	52 482
Tin (a)(b)	t	9 121	117 987	8 760	96 706	8 476	92 958
Tungsten concentrates	t	6 026	52 624	6 347	49 989	5 528	34 754
Uranium and thorium	t	1 210	98 391	1 625	120 044	5 364	409 444
Zinc (a)(b)	t	495 493	252 999	416 922	238 405	487 701	310 417
Zircon concentrates	t	501 812	35 058	444 186	36 994	455 556	43 121
Other minerals	value	-	733 614	-	684 079	-	700 000
Total	value	-	6 850 883	-	7 072 296	-	8 122 583
Imports							
Asbestos, all types	t	25 239	13 310	20 960	12 112	19 872	14 289
Clay, all types	t	107 721	7 296	108 651	7 181	64 591	6 400
Diamond, gem	carat	67 415	50 383	109 774	38 249	176 236	32 808
industrial	carat	1 259 233	9 843	1 267 582	7 901	1 027 416	5 835
Gold (a)	kg	1 773	24 675	397	5 682	871	5 643
Ingot steel, ferroalloys	t	77 798	40 877	31 432	24 464	19 196	15 214
Nickel - matte, metal	t	3 295	16 635	844	5 036	1 295	7 509
Oil (d)	'000 m^3	10 977	1 733 960	11 049	2 011 304	13 553	2 709 413
Phosphate rock	'000 t	2 693	111 328	1 962	98 396	2 004	104 356
Potassium fertilisers	t	226 867	19 895	201 364	22 626	207 810	21 272
Sulphur, elemental	t	686 857	45 701	555 517	42 807	491 160	39 513
Other	value	-	82 928	-	96 589	-	100 000
Total	value	-	2 156 832	-	2 372 347	-	3 062 252

(a) Quantities refer to total metallic contents contained in all ores and concentrates, drosses, lead bullion, and blister copper and refined metal where applicable. (b) Values shown include value of ore and concentrate, intermediate products, and refined metal. (c) Includes leucoxene. (d) Crude, enriched crude, and other refinery feedstock. (e) Some totals estimated.

Uranium in Australia

G C Battey, BMR

Uranium production in Australia during 1982 reached a record level of 4497 t U. Total production by Australia to date is 18,640 t U, of which 7800 t was produced between 1955 and 1971 and the remainder since 1976.

Estimates of Australia's uranium resources, as at December 1982, are at record levels. It is estimated that Australian resources in the Reasonably Assured Resources (RAR) category recoverable at a cost of less than US$30/lb U_3O_8 are 314,000 t U. This represents an increase of 20,000 t during the last 18 months compared with production of 6451 t during this period. It is estimated that the Western world's uranium resources in this category total 1,563,800 t; thus Australia has some 20% of the Western world's reserves. Western world reserves have decreased by about 10% in the past 18 months, owing primarily to a substantial decrease in the estimates for the USA as a result of production and the transfer of resources to higher cost categories because of increased production and capital costs. In the Estimated Additional Resources (EAR) category, recoverable at costs below US$30/lb U_3O_8, Australia's resources have increased by 105,000 t to a total of 369,000 t U, and represent about 25% of the estimates of the Western world in this category. In addition to resources in the above categories, it is considered there is a 75% probability that Australia's speculative resources exceed 2,600,000 t U and a 50% probability that they exceed 3,900,000 t U.

During 1982 Western Mining Corporation Ltd announced that mineralisation at Olympic Dam, SA, extends over an area of 7 km x 4 km, and the mineralised rock within an area drilled on a 200 m grid is estimated as 2000 million tonnes at an average grade of 1.6% Cu, 0.06% U_3O_8, and 0.6 g/t Au. It was stated that the drilling density is still insufficient to enable any part of the mineralised zone to be classified as ore reserves.

Production continued at both Ranger and Nabarlek throughout the year but production at Mary Kathleen ceased in October. At Mary Kathleen enough yellowcake was produced to satisfy existing contracts, but further contracts could not be secured at prices which would justify the exploitation of the remaining resource.

Draft environmental impact statements for the Beverley and Olympic Dam deposits and a final environmental impact statement for the Honeymoon deposit were published during the year.

Australian uranium perspectives 1983 - reality or mirage?

P Stork, Oratom Consulting

The paper describes present and likely future market forces by forecasting the growth of the Free world nuclear generating program to 1996, the associated consumption, and the foreseeable adjustments of production, capacity, and changes in inventories.

Forecast growth in world nuclear generating capacity is being further reduced as utilities continue to cancel or defer more planned nuclear power plants. As a result, uranium production continues to outpace consumption; in 1982 the difference amounted to 40 million pounds of U_3O_8.

Uranium inventories have now grown to 440 million pounds of U_3O_8 or five years' forward consumption. This surplus is being redistributed through a secondary, unstable market at low prices, sensitive to even small volumes.

Uranium demand will begin to grow gradually from the end of this decade. The market is moving slowly towards a new equilibrium by reducing supply. Consequently, further mine closures in the USA are expected together with a decline in production in Central Africa, and deferral and cancellation of projects in Canada and Australia. Bringing inventories down to desirable levels may take more than 10 years.

Because uranium demand will rise first in the USA, US utilities may become more willing to buy uranium from non-US sources, initially from Canada, and after 1990 increasingly from Australia. In response, existing Australian producers may expand production but projects still in the planning stage will be deferred; their potential market share can be supplied by existing producers at lower prices.

Construction of new uranium mines will probably materialise only after 1990.

Coal

M B Huleatt, BMR

Despite the difficult circumstances encountered during 1982, the Australian coal industry maintained a high level of production and, although exports fell slightly, they were the second highest total every recorded. Private expenditure on coal exploration in 1981-82 rose by almost $34 million to a record $109 million, although indications are that exploration is now slowing down. During 1982 Australia's in-situ demonstrated economic resources rose by 1370 Mt to 52 670 Mt, of which 30 790 Mt is recoverable.

There appears to be little scope for rapid growth in demand for coal on the domestic market, where greatest consumption is for electricity generation and in the iron and steel industry. The lower-than-expected increase in aluminium smelter capacity will effectively reduce the predicted growth in demand for coal for electricity generation. Difficulties facing the Australian steel industry suggest that there will probably be little, if any, growth in domestic demand for coking coal in the near future. A revival in the Australian economy will increase coal requirements, but demand will not reach the previously anticipated levels unless there are unexpected developments in an Australian energy-intensive industry.

Japan will continue to be the major international market for Australian coal, although it is expected to take a declining proportion of Australia's exports as producers diversify markets. The continuing recession in Japan's steel industry will restrict trade in coking coal. Australian suppliers will face increasingly difficult negotiations with Japanese buyers as a result of growing oversupply in that market. In the prevailing buyers' market there will be strong resistance to price rises with a distinct possibility of reductions and factors within Australia will determine the competitiveness of Australian coking coal.

Prospects for international trade in thermal coal are more encouraging than for coking coal. However, in the immediate future the ready availability of oil supplies and stable or falling oil prices will tend to limit growth in demand for thermal coal. In the longer term there remain uncertainties which could cause some consumers to turn to coal.

When economic recovery does boost coal demand, Australia will be well placed to take part in the growth because of abundant resources of coal, ample production capacity, and increased port capacity, provided it is able to maintain competitive prices and reliable supply.

Coal

R. Austen (Austen and Butta Ltd)

No abstract provided.

Mineral exploration in Australia - past performance and future outlook

J H Lalor, Western Mining Corporation Limited

Expenditure on mineral exploration in Australia has generally followed the ups and downs of the mining industry. The peak of 1970 ($550 million in 1982 dollars) is still well above any subsequent expenditure, although the increase from 1976 to 1982 was strong and positive.

In 1982 there was a small decrease in exploration expenditure, and in 1983 there will be a substantial and significant reduction. This reduction follows the steep decline in company revenues brought about by a collapse in commodity prices on world markets and increasing domestic costs, notably wages and salaries.

In real terms base-metal prices generally are at a 30-year low, and some are at a 50-year low. If there had not been substantial increases in prices for gold and other precious metals, the downturn would be much steeper. The slump in exploration expenditure is worldwide, and in many countries is much more pronounced than in Australia. Exploration is a very-high-risk, highly speculative activity, especially as far as any one particular company is concerned. As incomes and profitability decline, corporate survival becomes the major priority, and all discretionary expenditure is closely scrutinised.

When we consider aggregate expenditures and returns, a recent study by Western Mining Corporation analysing the economics of exploration investment in Australia from 1955 to 1978, shows the average cost of making an economic discovery was $38 million (1980 dollars) pre-tax, and $26 million post-tax.

The rate of return on exploration is calculated as 11 per cent before tax or 9 per cent after tax.

Whilst calculations can be made of exploration expenditure and ultimate return on such expenditure, the essential feature of mineral exploration is that most discoveries will yield unspectacular returns. It is essential, therefore, in order to keep up investment in exploration, that some mines should make very substantial returns on the investments. Unless there are some spectacular successes, the incentive to take subsequent risks will wither away.

Recent diamond exploration in Australia, resource development and future outlook

W.J. Atkinson, CRA Exploration Pty Ltd

Alluvial diamonds have been known and exploited for over 3000 years.

In New South Wales diamond was first discovered in 1851 as a result of mining alluvial gold. By the end of last century diamond occurrences had been recorded in most States, including Western Australia.

Major kimberlite pipe discoveries in Africa from 1870 ensured Africa's dominance of world production, until similar discoveries were made in Siberia in the mid 1950s and USSR was able to achieve a market share of some 29%.

In Australia, despite the early discoveries, diamond exploration using modern techniques did not commence until the early 1960s, and only after eight years of planned exploration by CRA Exploration and the Ashton Joint Venture in the Kimberleys was the first economic pipe discovered in late 1979.

Production of alluvial diamond derived from the Argyle (AK-1) pipe began just over three years from the date of discovery. Major kimberlite diamond production is planned for late 1985 at the rate of 25 000 000 carats/year. This should increase world production by 40% in volume terms and by 4-5% in terms of value.

This paper relates the exploration process leading to the Argyle discovery, the testing of the deposits, and the current apparent state of diamond exploration in Australia, and speculates on the future outlook.

Tin

I R McLeod, BMR

The price of tin fell sharply in late February 1982 upon cessation of buying by the unidentified buyers who began operations in mid-1981. The International Tin Council's buffer stock manager was obliged to support the price heavily, particularly in the first half of the year; his holdings rose from 2490 t at the beginning of the year to 54 326 t at the end of September. The ITC applied export quotas to its producer members on 27 April; the quotas represented a cutback of about 10% in the June quarter, increasing to 36% for succeeding quarters.

The Penang price was at the ITC's buffer-stock floor price from mid-June 1982, except from late August to the end of September, and briefly in late October and early November. However, the Australian price increased relative to the Penang price during most of this period as the Australian dollar depreciated against the Malaysian ringgit.

The fall in prices from those prevailing in the second half of 1981 and the export quotas, coupled in some cases with other factors, led to temporary closure of several operations and deferment of decisions on some proposed developments.

Of longer-term significance was the announcement during 1982 of increased resources at some operations and prospects. Although some undeveloped deposits are large, most of Australia's demonstrated economic resources are in one deposit.

World tin consumption in 1982 is estimated to have been about the same as that of 1981 (162 800 t). Despite the export quotas, availability probably exceed consumption by a few thousand tonnes. If export controls are continued at the present rate, a statistical deficit of about 20 000 t of tin is likely for 1983. However, this is unlikely to cause a marked rise in prices; the buffer-stock manager will be seeking to dispose of over 20 000 t of metal, acquired during the Fifth International Tin Agreement; his ability to do this could be impaired by an automatic easing of export controls triggered by certain circumstances when the price rises into the middle price sector of the buffer stock. Consequently he is likely to sell tin while the price is in the lower sector (ie below M$32.06/kg), until the Fifth Agreement buffer stock is liquidated. Furthermore, USA has about 20 000 t of tin available for sale from its stockpile, and may become a more active seller once the tin price rises much above the ITC floor price. Because of these two influences, it is probable that, in general, prices will stay in the ITC's lower price sector for 1983 at least, the production shortfall against consumption being made up by sales from ITC and US stocks.

Tungsten

N D Knight, BMR

The tungsten market, perhaps even more than most of the other metal markets, was very badly affected during 1982 by lack of demand, oversupply, and falling prices. The 1982 average price for tungsten concentrate was US$106.00/mtu WO_3, lower than any year since 1975. In constant dollar terms it was at its lowest since 1965.

The main reason for the pronounced fall in the price was reduced demand for tungsten products by major end-use sections such as oil and gas drilling, mining, the automotive and steel industries, and the production of capital goods, in response to the general recession and reduced industrial activity. BMR estimates that Western world consumption in 1982, at 19,000 t contained W, was about 15% less than in 1981. As stocks built up and prices fell, production was cut back and some mines were temporarily closed. Western world mine production for 1982 is estimated to have been about 18,000 t, making the amount of tungsten available for consumption, including net imports, about 19% less than in 1981. Although China and USSR are major influences on the world supply/demand scene, reliable statistics for these countries are not available.

Australia probably retained its position as the Western world's leading tungsten producer in 1982, mine production being 2590 t W, compared with 3504 t in 1981. Australia's two major producers - Peko-Wallsend at King Island and Queensland Wolfram at Mount Carbine - each reported production cutbacks of around 30%, effected by temporary mine closures and reduced production shifts.

The outlook for 1983 does not appear to be much brighter than 1982. Prices have continued to fall since January, although there are indications that this trend may have been arrested. No increase in demand is expected, and Western world consumption will be the same as or lower than in 1982. Western world mine production will be lower than in 1982, although Australian production may be about the same.

In the longer term, tungsten prices should move upwards as supply and demand move back into balance in response to a general economic upturn and replenishment of stocks. From then on the growth rate of consumption will be slow because of competition by substitutes, such as ceramics for tungsten carbides, depleted uranium in armaments, and molybdenum in steels, as well as the development of more wear-resistant tungsten carbides and the increasing use of scrap. Australia will continue to supply a substantial proportion of the world's tungsten: its total known resources are around 467 000 t, which represent 17% of the Western world's estimated resources and 6% of the whole world. In resources, Australia ranks fifth after China, Canada, USA, and USSR.

TUNGSTEN — WORLD MINE PRODUCTION 1981

WORLD MINE PRODUCTION OF TUNGSTEN

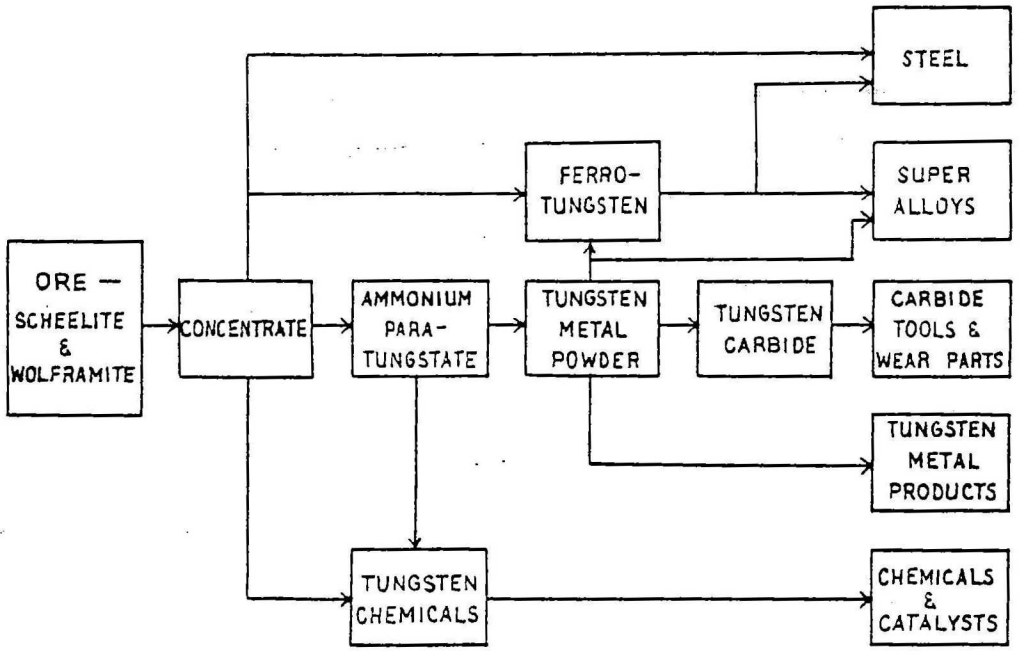
(t, W content)

	1978	1979	1980	1981
Argentina	97	59	40	60
Australia	2 697	3 181	3 561	3 504
Bolivia	3 170	3 006	3 355	3 449
Brazil	1 165	1 177	1 392	1 179
Burma	323	413	476	680
Canada	2 288	2 597	3 178	2 052
Korea, Rep.	2 589	2 617	2 607	2 634
Mexico	185	200	211	168
Portugal	1 088	1 370	1 557	1 389
Spain	341	395	447	409
Thailand	3 186	1 826	1 615	1 210
USA (a)	3 128	3 013	2 754	3 175
Others	3 521	3 351	6 928	6 202
(b) Total	23 778	23 205	28 121	27 624

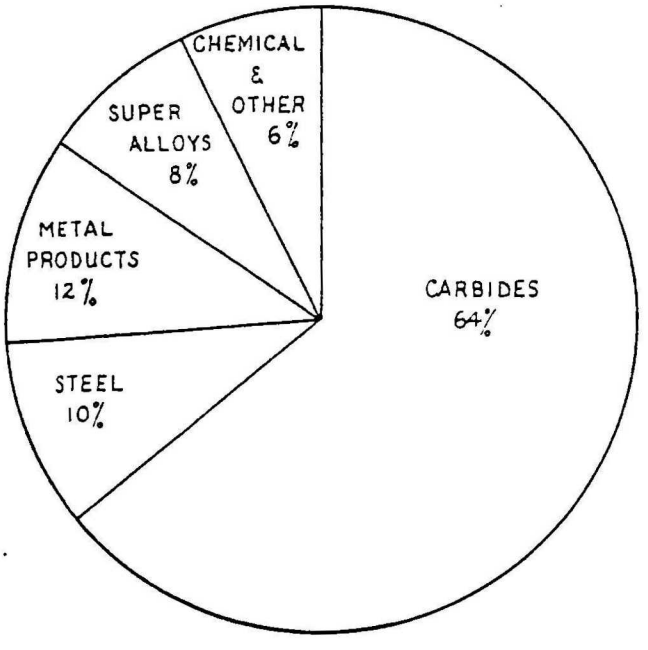
Sources: USBM and UN Tungsten Committee.

(a) Shipments,
(b) Estimated, and excluding USSR, China (1981 estimated production 13 000t) and Democratic People's Republic of Korea.

TUNGSTEN — PRODUCT FLOW



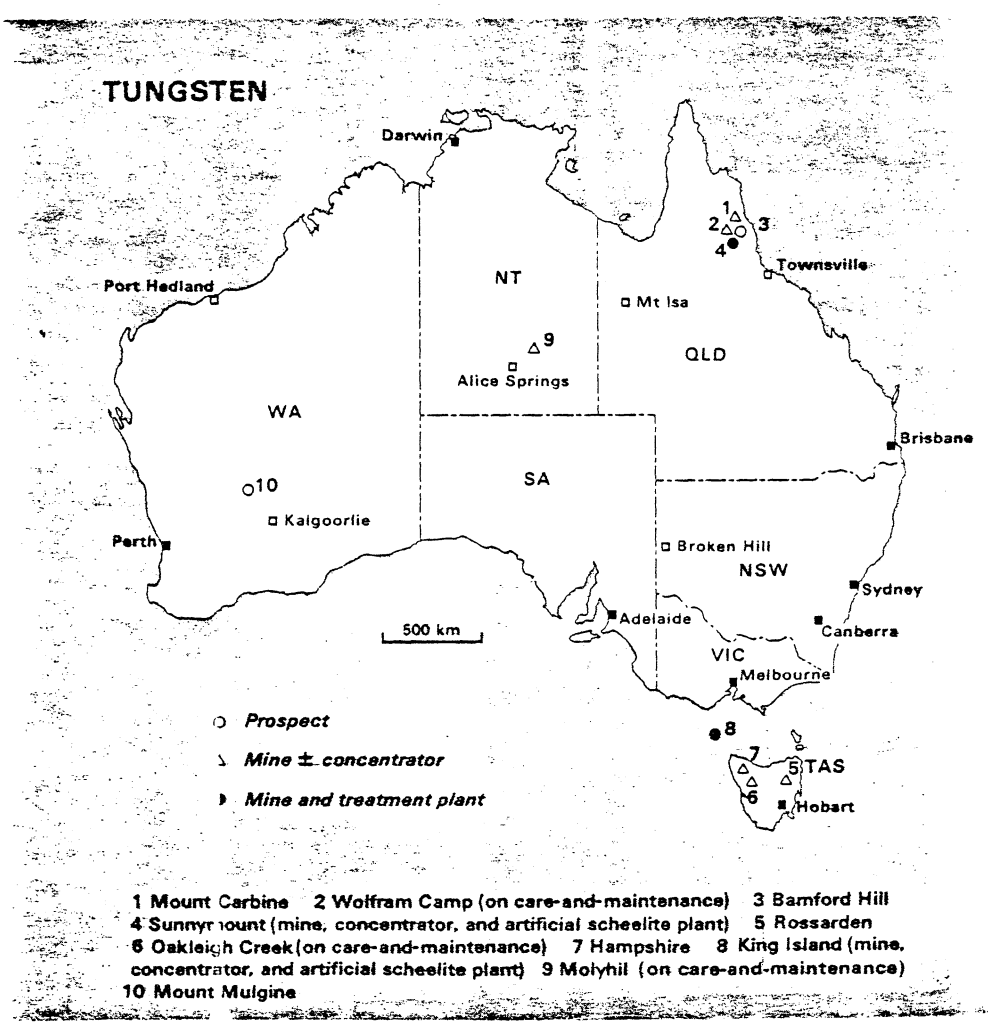
TUNGSTEN — END USE



WESTERN WORLD'S MAJOR TUNGSTEN MINES

Mine	Country	Ore	Production ('000 t W) 1981
Sang Dong	Korea, Rep.	Scheelite	2.2
Can Tung	Canada	Scheelite	2.0
King Island	Australia	Scheelite	2.0
Pine Creek	USA	Scheelite	1.3
Mittersill	Austria	Scheelite	1.2
Panasqueira	Portugal	Wolframite	1.1
Climax	USA	Wolframite	1.0
Mount Carbine	Australia	Wolframite	0.9
Chojlla	Bolivia	Wolframite	0.7
Salau	France	Scheelite	0.6
		Total	12.8

Source: Mining Annual Review.



Mineral sands

J Ward, BMR

Australian production of mineral sands is the single most important factor in world mineral-sands markets: in 1982 Australia produced 60% of the world's rutile, 25% of the ilmenite, and 70% of the zircon. Exports represent a very high proportion of Australian production because only 1% of the rutile, 20% of the ilmenite, and 4% of the zircon is consumed locally.

Although the level of activity in the mineral sands industry in 1982 was similar to that in 1981, there were marked differences in the performance of individual minerals, reflecting differences in their supply/demand positions and resulting market strengths. World markets remained depressed for TiO_2 pigment, as were the other main outlets for titaniferous ores, viz welding rods and titanium metal. This put increasing pressure on Australian rutile and ilmenite producers, particularly as they were forced to compete for reduced markets with Richards Bay (S Africa) titanium slag which became available both for TiO_2 pigment production and for welding-rod coatings. In addition to this, supplies of high-TiO_2 feedstock for welding rods and titanium metal were augmented by production of natural rutile both from Richards Bay and Sierra Leone, and synthetic rutile particularly in USA, the leading world producer and consumer of this product. London Metal Bulletin prices for bagged rutile were reduced from the range \$300-\$320/t to \$260-\$270/t fob, Australian rutile exports were severely cut, average unit export values fell from \$300/t in 1981 to \$256/t in 1982, and export revenue, particularly for east coast producers, was reduced substantially. Australian ilmenite producers fared somewhat better. Although production and exports were reduced particularly from operations in southwest Western Australia, ilmenite prices were held at 1981 levels in real terms.

Demand for zircon concentrates, particularly for the Japanese refractory industry, remained firm in 1982, notwithstanding the economic recession and increased supplies from mineral sands operations at Richards Bay and Florida. The London Metal Bulletin quotation for standard-grade zircon was increased from the range \$100-\$105/t fob to \$115-\$120/t during the year. Australian producers were able to maintain exports close to 1981 levels; unit export values increased from \$83/t to \$96/t and revenue from zircon exports increased by about 15 per cent to \$43 million, the highest since the boom days of 1975-76.

In 1983 the Australian mineral-sands industry is expected to operate at

a level similar to that of last year. The health of the industry and demand for its products are intrinsically bound up with the world's industrial activity, and indications for economic recovery are not encouraging for the short term. Australian ilmenite producers are to some extent buffered against the vagaries of world markets: about half of domestic production is directed to integrated pigment producers in USA and UK, and to captive pigment and synthetic-rutile producers in Australia. In contrast, Australia consumes very little of its rutile output, and east coast producers, who continue to provide the bulk of Australia's output, have to contend not only with reduced world demand and new sources of supply, but also with falling grades and mining restrictions imposed because of environmental considerations. Australian zircon production is dependent jointly on output of rutile and ilmenite. About 95 per cent of Australia's zircon output is directed to overseas markets. Although world demand for zircon has remained remarkably firm in the face of the economic recession, demand could ease in the coming year when consumers have re-stocked.

Australia remains the major world supplier of mineral-sand concentrates and the current recession underscores the industry's dependence on overseas markets and its vulnerability to downturns in the world economy. It is suggested that diversification of markets, and value added to concentrates by further domestic processing, could improve the competitive position of Australian producers and modify the adverse effects of violent fluctuations in export demand by making available a wider range of products to established and potential consumers.

TABLE 1. AUSTRALIAN PRODUCTION OF MINERAL-SAND CONCENTRATES (t)

	1978	1979	1980	1981	1982(p)
ILMENITE					
Queensland (a)	55 600	2 983	27 927	6 411	4 200
New South Wales (a)	67 743	24 096	33 453	26 372	32 707
Western Australia	1 131 651	1 123 386	1 323 183	1 288 354	1 124 839
Total Australia	1 254 994	1 150 465	1 384 563	1 321 137	1 161 746
RUTILE (b)					
Queensland	52 645	92 946	119 751	85 195	87 617
New South Wales	104 583	84 794	91 872	66 954	47 670
Western Australia	99 847	101 161	100 121	78 668	84 078
Total Australia	257 075	278 901	311 744	230 817	219 365
ZIRCON (b)					
Queensland	62 994	79 740	102 430	74 141	71 639
New South Wales	109 923	96 888	105 087	84 797	65 728
Western Australia	218 689	270 352	284 030	275 308	314 186
Total Australia	391 606	446 980	491 547	434 246	451 553

(a) Despatches from separation plant. (b) Details of mixed concentrates shipped interstate for separation are included as the separated concentrate in the State in which separation took place. (p) Preliminary.

TABLE 2. EXPORT DESTINATIONS OF AUSTRALIAN MINERAL-SAND CONCENTRATES

	1979		1980		1981		1982(p)	
	Quantity (t)	Value ($'000 f.o.b.)	Quantity (t)	Value ($'000 f.o.b.)	Quantity (t)	Value ($'000 f.o.b.)	Quantity (t)	Value ($'000 f.o.b.)
ILMENITE (a)								
Brazil	56 437	981	55 036	984	69 408	1 434	59 510	1 517
France	82 292	1 501	53 632	1 116	53 020	1 233	37 145	966
Italy	58 010	983	4	1	-	-	-	-
Japan	53 004	1 169	59 071	1 525	39 454	1 914	65 000	2 259
Netherlands	11 437	554	28 704	952	26 940	677	36	8
Spain	93 511	1 662	35 075	706	87 543	1 987	80 466	2 132
UK	200 854	4 026	183 982	3 451	176 408	3 911	161 524	4 203
USA	165 738	4 462	358 655	10 143	262 038	8 474	281 744	9 029
Yugoslavia	62 400	1 103	20 902	379	64 615	1 311	21 000	504
Other	148 022	2 417	287 858	5 905	143 439	3 613	111 324	3 064
Total	931 705	18 858	1 082 919	25 162	922 865	24 554	817 749	23 682
RUTILE (b)								
Belgium-Luxembourg	144	53	2 850	971	18	7	18	6
Canada	351	116	506	153	1 005	311	460	133
Germany F.R.	16 880	3 754	5 037	1 440	-	-	2 202	445
Italy	2 240	582	4 974	1 745	378	132	144	50
Japan	26 879	5 827	34 998	10 598	31 063	9 581	28 483	7 659
Netherlands	22 088	5 866	35 107	10 206	13 423	3 804	7 757	1 964
Poland	5 550	1 188	4 204	1 454	4 779	1 512	5 377	1 414
UK	81 422	17 322	55 002	17 056	41 728	12 126	59 441	14 696
USA	121 123	23 311	129 700	30 148	83 637	23 645	71 201	17 455
Other	41 103	11 323	42 936	15 028	40 017	12 966	22 860	6 925
Total	317 780	69 342	315 314	88 799	216 048	64 084	197 943	50 747
ZIRCON (b)								
Belgium-Luxembourg	8 122	554	12 233	896	216	27	36	5
France	17 792	1 275	23 784	1 718	34 588	2 682	17 120	2 018
Germany F.R.	15 553	1 056	107	13	36	4	3 457	91
Italy	64 774	4 100	81 189	5 497	56 836	5 044	59 291	5 263
Japan	188 080	13 136	176 442	12 460	155 536	12 528	156 337	16 399
Netherlands	35 237	2 128	50 798	3 334	53 257	4 169	37 997	4 181
Spain	19 332	1 310	11 207	745	24 759	1 824	16 213	1 751
UK	23 458	1 575	21 874	1 489	20 532	1 770	16 348	1 725
USA	65 911	4 272	94 129	5 743	63 597	5 034	60 793	5 707
Other	41 181	3 709	30 049	1 163	34 829	3 912	37 611	5 613
Total	479 440	33 115	501 812	33 058	444 186	36 994	405 203	42 753

(a) Includes leucoxene concentrates. (b) Includes 'flour'. (p) Preliminary

Copper

D.J. Perkin, BMR

After continuing low prices and oversupply in 1981 and much of 1982, recent mine closures and cutbacks in world mine production have led to an apparent restoration of the balance between supply and demand for copper in early 1983. Preliminary figures indicate that, because of cutbacks, total world mine output in 1982 will not substantially exceed demand in spite of the 4% estimated decrease in western world consumption in 1982.

Australian mine production, despite a decline in the world economy in 1982 and depressed demand for copper, is estimated to have reached a near record 245 000 t of contained copper. This compares with 223 000 t in 1981 but is still 2% below the peak of 251 000 t of copper produced in 1974. Increased mine production at Mount Isa, Teutonic Bore, Cobar, Mount Gunson and Woodlawn was partly offset by reduced output from the Warrego mine at Tennant Creek, and the closure of the Dianne and Mount Chalmers mines in Queensland. As a world copper producer, Australia ranks only about 10th and contributes about 3% to world production. The larger producers are USA, USSR, Chile, Canada, Zambia, Zaire, Peru, Poland, and the Philippines.

Copper prices fell slightly in early 1982 and remained depressed throughout most of the year. The Australian price opened in January at $1460/t, and rose slightly in the last quarter to end the year at $1540/t. The 1982 Australian average price was $1475 ($1536/t in 1981).

Australian production in 1983 should remain at about current levels. Although no new mines are scheduled to begin production, it is unlikely that there will be any further mine closures.

With current world mine production at about 8 Mt, and estimated world refined production and consumption in approximate balance, the recent 20% build-up in total commercial stocks to 1.23 Mt Cu from their low in 1980 should have a dampening effect on an upward price trend. However, some increase in the current price for copper is indicated because of continuing increases in production costs and hence prices in 1983 should be steady to slightly higher than the 1982 average.

Although increases in the current-dollar copper price will lead to fuller use of capacity at existing mines, a sustained increase in price in real terms to a level equivalent to the average long-term price will lead to new projects being commissioned, although most new projects are likely to be only those potentially low-cost producers with relatively

high-grade ores.

In a world supply context there is the continuing problem of increases in production, despite weak demand, by the newly industrializing countries dependent on copper sales for foreign exchange. However, Australia's competitive position in a world context should be sustainable, because of relatively high grades and by-product/co-product revenues, and because most mining projects have been amortized.

Australia's demonstrated economic copper resources are sufficient to support mining at current production rates to beyond 2000. Substantial additional resources of copper have been identified such as at Olympic Dam and at Parkes and Golden Grove and these may become economic in the future.

Nickel

C.R. Pratt, BMR

World consumption of nickel fell for the third successive year in 1982 and resulted in extensive further reductions in output by many producers. A large part of production capacity in Canada, the major producer for many years, was closed after mid-year.

In an attempt to hold prices at an economic level the quoted producer price was unchanged throughout the year at US$3.20-3.29/lb; however, most sales were at lower prices more closely indicated by free-market quotations, which fell below US$1.50/lb towards the end of the year.

Despite world oversupply, Australian production and sales of nickel increased in 1982, according to preliminary statistics. Western Australian production increased because of continuation or completion of planned expansions, higher ore grades mined, and improved recovery of nickel in concentrates. However, declining prices caused the closure of one small mine (Nepean) despite the introduction of more mechanised mining and pre-concentration plant. The value of nickel exports increased slightly in 1982, despite lower prices (which were only partly offset by a fall in the exchange rate).

Long-term contracts held by producers for sales of nickel matte and oxide as well as demand for nickel matte and oxide by Japan (where nickel consumption fell less than in other markets), helped to maintain Australian sales in 1982.

Unless there is a recovery in the US economy, world nickel consumption in 1983 is likely to be similar to that in 1982. Australian nickel sales seem likely to fall in 1983 following closure of the Nepean mine, completion of some small nickel-oxide contracts, and particularly if producers agree to reduce deliveries of nickel oxide to major customers. Programs implemented in 1982 point to some restraint in mine production in 1983.

Australia's nickel resources have increased steadily in recent years and are adequate for many years at the current rate of production. Additionally, in contrast to the rest of the world where the bulk of

resources are contained in laterite deposits, most of Australia's nickel resources are in sulphide deposits from which nickel is recoverable at lower cost. With potential for substantial expansion in both mine and smelter/refinery production Australia is favourably placed to meet any substantial demand recovery as well as longer-term market requirements.

Gold

C M Mock, BMR

Gold has been an open-market commodity for less than a decade. The strong increase in its price in that period is evidence that, although gold is no longer a monetary standard, it is still seen as a fundamental store of value and the best hedge against economic and political instability.

The Australian gold industry has benefitted in three ways from the higher price levels of the last four years: much-needed revenue became available for mine development and exploration, and for mine and plant improvements; incentive was provided for gold exploration; and funds and incentive were supplied for research programs into all aspects of the occurrence, mining and treatment of gold.

Since 1979 capital investment in gold mining has resulted in the widespread introduction of modern, more cost-efficient technology; in particular, lower-grade ores and tailings can now be economically treated or re-treated. The average grade of ore treated in Western Australia fell from 10.3 g/t in 1978 to 5.8 g/t in 1982. Greater flexibility has been introduced in many operations - for example, at Kambalda and Lancefield-Windarra, gold mining and processing have been successfully integrated with nickel mining and processing.

The full effects of the modernisation of operating mines, and of the construction or reopening of others, were reflected in a mine and refinery production increase of over 50 per cent in 1982. By the end of 1983 production is expected to be running at about twice the average rate of the last 10 years.

Exploration over the last four years has more than doubled both demonstrated economic gold resources, which now exceed 300 t contained Au, and sub-economic gold resources, currently estimated at 250 t contained Au.

Many exploration projects are at an advanced stage of feasibility study. Because of rising costs - in particular, labour costs - their development is contingent upon a sustained increase in the gold price. On the basis of future expected gold supply and demand, many price analysts forecast an annual increase in prices of between 15 and 25 per cent. Thus the outlook is favourable for the development of more new projects. Looking to the longer term, research should lead to further improvements in operating efficiency, introduction of new techniques, increased exploration success, and greater knowledge of resources.

TABLE 1. WESTERN WORLD GOLD SUPPLY (t)

	Western world mine production	Net acquisition from Eastern Bloc	Net Govt/IMF Sales	Net private Sales	Total
1970	1273	- 3	-	342	1612
1971	1236	54	96	2.	1388
1972	1182	213	-	101	1496
1973	1116	275	6	-	1397
1974	1005	220	20	-	1245
1975	953	149	9	-	1111
1976	969	412	58	-	1439
1977	970	401	269	-	1640
1978	975	410	362	-	1747
1979	960	199	544	-	1703
1980	946	90	-	-	1036
1981	962	283	-	51	1296

Source: Consolidated Gold Fields PLC

TABLE 2. WESTERN WORLD GOLD CONSUMPTION (t)

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	Total
1970	1066	89	59	62	54	46	236	-	1612
1971	1064	86	63	68	52	54	-	-	1388
1972	999	105	66	70	42	63	151	-	1496
1973	518	127	68	71	22	54	-	537	1397
1974	224	92	57	67	8	287	-	510.	1245
1975	523	67	62	59	21	251	-	128	1111
1976	935	76	77	63	51	182	-	55	1439
1977	1003	77	82	64	52	142	-	220	1640
1978	1008	90	89	78	51	287	-	144	1747
1979	738	99	86	77	34	290	-	379	1703
1980	123	86	62	70	16	185	230	264	1036
1981	594	85	62	66	28	201	260	-	1296

(a) carat jewellery (b) electronics (c) dentistry (d) other industrial/decorative (e) medals, medallions (f) official coins (g) net govt/IMF purchases (h) net rivate purchases.

Source: Consolidated Gold Fields PLC.

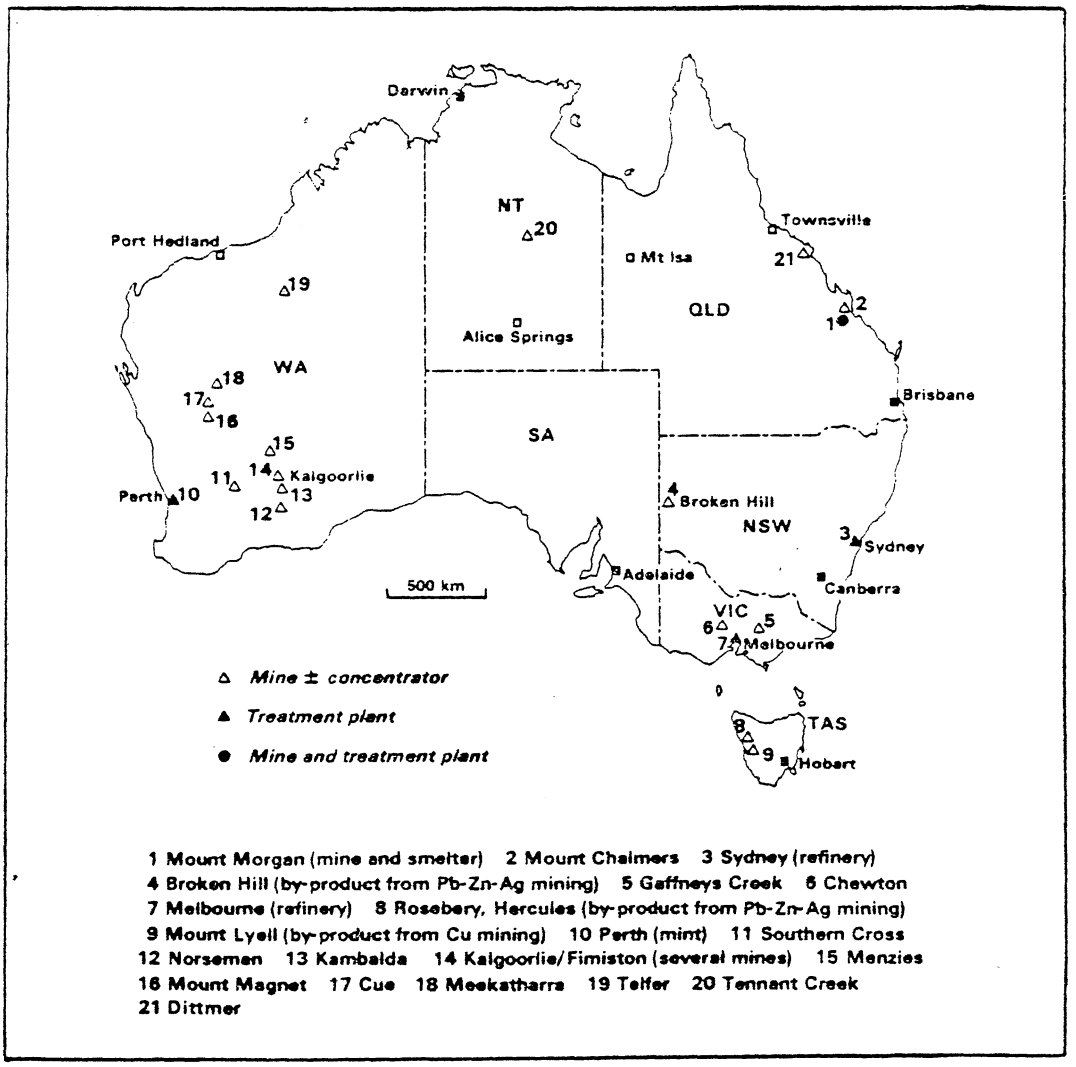
TABLE 3. AUSTRALIAN MINE PRODUCTION OF GOLD (kg)

	Qld	NSW	Vic.	Tas.	SA	WA	NT	Total
1970	2589	325	253	1335	16	10 898	3865	19 282
1971	2824	305	122	1793	17	10 734	5124	20 918
1972	2239	310	210	2021	78	10 471	8032	23 361
1973	1391	297	100	1511	70	8 587	5218	17 174
974	1984	282	126	1585	67	6 584	5316	15 944
1975	1395	389	216	1669	64	7 105	5548	16 386
1976	1439	502	61	1495	42	7 479	4619	15 637
1977	1084	430	11	1891	3	10 747	5251	19 417
1978	607	422	12	1892	1	13 332	3876	20 142
1979	515	471	23	1747	6	11 582	4221	18 566
. 80	675	573	36	1311	16	11 233	3191	17 035
1981	1510	587	75	1950	32	11 724	2495	18 374
1982(e)	300	600	100	2100	-	21 000	3300	27 400

TABLE 4. MINE PRODUCTION OF GOLD, WESTERN AUSTRALIA

	Ore treated (t)	Mine production (kg)	Average grade (g/t)
1970	1 767 948	10 886	6.16
1971	1 701 995	10 724	6.30
1972	1 660 842	10 466	6.30
1973	1 630 737	8 574	5.26
1974	1 378 990	6 559	4.76
1975	1 270 168	6 864	5.40
1976	951 028	7 085	7.45
1977	1 071 980	10 716	10.00
1978	1 280 172	13 185	10.30
1979	1 370 878	11 499	8.39
1980	1 883 737	11 026	5.85
1981	2 412 377	11 933	4.95
1982(e)	3 600 000	21 000	5.83

FIGURE 1. LOCATION MAP, AUSTRALIAN GOLD INDUSTRY



1 Mount Morgan (mine and smelter) 2 Mount Chalmers 3 Sydney (refinery)
4 Broken Hill (by-product from Pb-Zn-Ag mining) 5 Gaffneys Creek 6 Chewton
7 Melbourne (refinery) 8 Rosebery, Hercules (by-product from Pb-Zn-Ag mining)
9 Mount Lyell (by-product from Cu mining) 10 Perth (mint) 11 Southern Cross
12 Norseman 13 Kambalda 14 Kalgoorlie/Fimiston (several mines) 15 Menzies
16 Mount Magnet 17 Cue 18 Meekatharra 19 Telfer 20 Tennant Creek
21 Dittmer

TABLE 5. WESTERN WORLD MINE PRODUCTION OF GOLD (t)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Australia	19.3	21.0	23.4	17.2	16.0	16.4	15.6	19.4	20.1	18.6	17.0	18.4
Brazil	9.0	9.0	9.5	11.0	13.8	12.5	13.6	15.9	22.0	25.0	35.0	37.3
Canada	74.9	68.7	64.7	60.0	52.2	51.4	52.4	54.0	54.0	51.1	50.6	49.5
Chile	n.s.r.	n.s.r.	n.s.r.	3.2	3.7	4.1	3.0	3.0	3.3	4.3	6.5	11.4
Colombia	6.8	5.9	6.3	6.7	8.2	10.8	10.3	9.2	9.0	10.0	17.0	17.7
Dominican Republic	-	-	-	-	-	3.0	12.7	10.7	10.8	11.0	11.5	12.8
Ghana	21.9	21.7	22.5	25.0	19.1	16.3	16.6	16.9	14.2	11.5	12.8	13.6
India	3.2	3.7	3.3	3.3	3.2	3.0	3.3	2.9	2.8	2.7	2.6	2.6
Japan	8.4	7.7	7.8	6.2	4.5	4.7	4.5	4.8	4.7	4.2	3.4	3.1
Mexico	6.2	4.7	4.6	4.2	3.9	4.7	5.4	6.7	6.2	5.5	5.9	5.0
Papua New Guinea	0.7	0.7	12.7	20.3	20.5	17.9	20.5	22.3	23.4	19.7	14.3	16.8
Peru	3.2	3.0	2.6	2.6	2.7	2.9	3.0	3.4	3.9	4.7	5.0	7.2
Philippines	18.7	19.7	18.9	18.1	17.3	16.1	16.3	19.4	20.2	19.1	22.0	24.9
South Africa, Rep.	1000.4	976.3	909.6	855.2	758.6	713.4	713.4	699.9	706.4	705.4	675.1	657.6
USA	54.2	46.4	45.1	36.2	35.1	32.4	32.2	32.2	31.1	30.2	29.6	41.9
Zaire	5.5	5.4	2.5	2.5	4.4	3.6	4.0	3.0	1.0	2.3	3.0	3.2
Zimbabwe	15.0	15.0	15.6	15.6	18.6	18.6	17.1	20.0	17.0	12.0	11.4	11.6
Others	26.2	26.7	32.7	29.0	22.8	21.1	25.0	26.1	25.2	22.3	26.6	29.3
Total	1273.6	1235.6	1181.8	1116.3	1004.6	952.9	968.9	969.8	975.3	959.6	946.3	961.6

Sources: Consolidated Gold Fields PLC, American Bureau of Metal Statistics. n.s.r. separately recorded.

Lead and zinc

M T Roarty, BMR

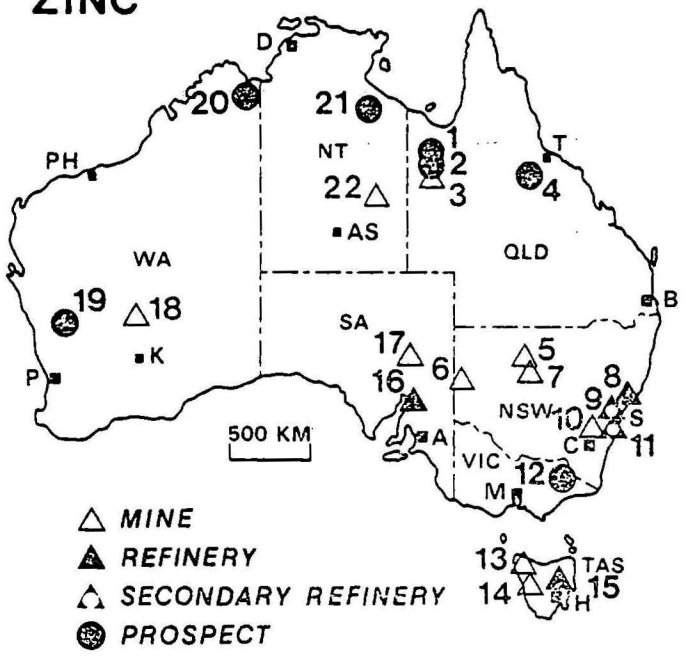
Despite the downturn in the world's lead-zinc industry accompanying the world recession and the fact that the price of lead and zinc in 1982 in real terms was the lowest for several years, Australian mine production of lead and zinc in 1982 was the highest for a decade and is expected to increase further in 1983. In contrast to some other producer countries, in Australia no mine or smelter has closed down or curtailed production. Australian metal production has been static in the last decade and is projected to remain at the same level at least in the short term. Metal consumption also has changed little over the last decade.

The bulk of Australian production is exported and in world terms Australia occupies a major position in the lead-zinc industry. This position is expected to be maintained or even improved in the short to medium term because Australian mine production comes largely from relatively high-grade deposits (which also contain high values of silver), provided production costs remain competitive with overseas producers. Consumption of lead is unlikely to increase under present economic conditions, although prospects are slightly better for zinc. Australia is well placed to take advantage of any increase in world demand that may accompany an upturn in the world's economy.

Australia, with some 10 per cent of world demonstrated economic resources of lead, zinc, and silver has the capacity to expand both mine and metal production. Demonstrated economic resources of about 15 Mt of lead, 21 Mt of zinc, and 25,000 t of silver are adequate for many years. These figures can be more than doubled if inferred and sub-economic resources are included. Australia also has large resources of coal to supply energy in the form of electric power or coke for its current and any future smelting and refining processes.

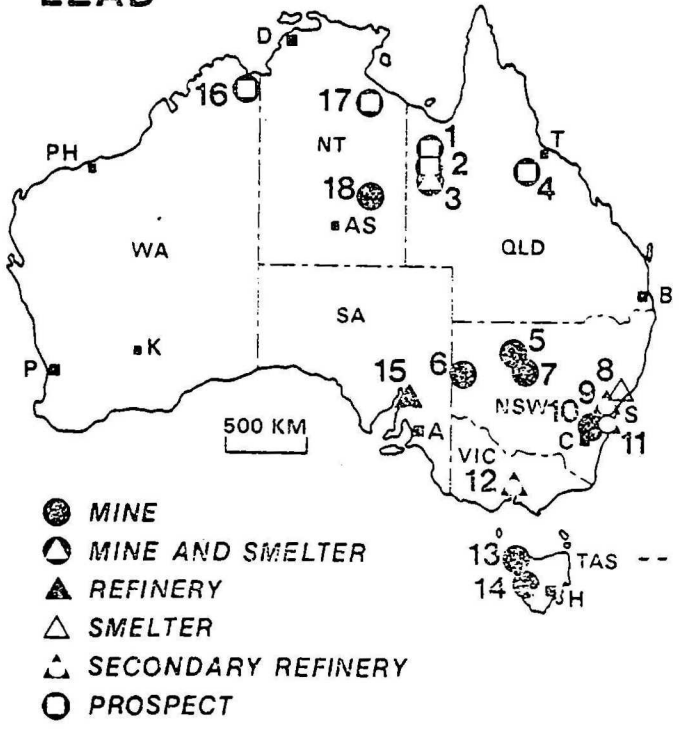
A number of significant developments occurred in 1982. MIM Holdings Ltd increased its mine capacity at Mount Isa substantially and increased its holdings in Asarco Incorporated, one of the world's leading producers of non-ferrous metals. MIM Holdings Ltd also purchased its first direct interest in zinc refining during the year. Australian Mining and Smelting Ltd increased production capacity largely because of the completion in 1981 of concentrator capacity that permitted the mining of larger quantities of lower grade ore. EZ Industries Ltd began production at Elura in the early part of 1983; the plant is not expected to be commissioned until June.

ZINC



1 L LOR
2 HILL/H NTH
3 MT ISA
4 THAL
5 EL
6 BR HILL
7 COB
8 C CK
9 SYD
10 WOOD
11 PT K
12 BEN
13 Q RIV
14 ROS
15 RIS
16 PT P
17 BEL
18 TE B
19 G GR
20 SOR H
21 McA R
22 ATT

LEAD



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14 ROS
15 PT P
16 SOR H
17 McA R
18 ATT

Aluminium

R R Towner, BMR

In 1982 Australia, with about 20% of the Western world's total bauxite resources, provided 29% of world bauxite production; about 19 Mt was processed domestically and some 4.5 Mt was exported. About 22% of world alumina output was from Australia; over 90% of this, valued at about $1090 million fob, was exported. In contrast to Australia's importance in bauxite and alumina, its smelting industry which, despite cutbacks at the Kurri Kurri smelter, operated at an average of 97% of capacity in 1982, accounts for only 1.8% of the world's primary aluminium production capacity.

Australia's primary aluminium price fell in late 1981 to $1370/t and remained at this level throughout 1982.

In 1982 depressed demand because of the general economic recession led to lower production and the first fall in prices for many years. Western world production of primary aluminium was 16% less than in 1981, and correspondingly average capacity utilisation was only about 70%. Stocks of primary aluminium remained unchanged at about 3.0 Mt.

The depressed short-to-medium-term outlook and increasing Australian energy and construction costs led to reviews of plans initiated in 1979 which would have increased total Australian smelting capacity from 280,000 t to 1.3 Mt by 1985. Abandonment or deferral of some proposed smelters means that total capacity will be restricted to 840,000 t by 1985.

Because the Australian aluminium industry is export-oriented, full use of Australia's capacity in the future is dependent on a Western world recovery in the demand for aluminium. A return to a 3% growth rate in demand (reflecting the late 1970s situation) with a return to 90% worldwide average operating rate of smelters, requires a 1.58 Mt increase in the Western world smelting capacity by 1985. Australia's planned 470,000 t increase from 1982 capacity represents 30% of this. However, a 1% growth rate with 90% operating rate, requires only about 510,000 t of additonal capacity in the Western world. This latter scenario suggests that in the short term there could be an oversupply of primary metal in the world market or, more likely, that the present low operating rates by some smelters will continue, and more smelters will close.

Markets for increased Australian production should open in Japan, USA and Western Europe, augmented by development of markets in Southeast Asia.

MAJOR BAUXITE PRODUCING COUNTRIES (MT)

	1980	1981	1982 (e)
Australia	27.2	25.5	23.5
Guinea	11.8	11.8	12.8
Jamaica	12.1	11.7	9.0
Russia	6.4	6.5	6.4
Surinam	4.9	4.1	3.2
Brazil	4.2	3.6	4.4
Greece	3.3	3.5	3.0
Yugoslavia	3.1	3.2	3.4
Guyana	3.1	2.1	1.9
Hungary	3.0	2.9	2.9
Others	12.1	12.4	10.0
WORLD	91.1	87.4	80.0

Smelter Developments

Location	Production Capacity - '000 t/year		
	1979	1985 - based on 1979 proposals	Current Status
1. Existing			
Bell Bay, Tas.	112	117	117
Point Henry, Vic.	100	165	165
Kurri Kurri, NSW	68	135	90
Sub-total	280	417	372
2. Proposed			
Boyne Island, Qld	-	206	103
Bundaberg, Qld	-	100	deferred indefinitely
Tomago, NSW	-	220	under construction
Lochinvar, NSW	-	236	abandoned
Portland, Vic.	-	132	delayed
Total	280	1311	475
3. Mooted			
Westal (Worsley)			abandoned
Alcoa			abandoned
Alcoa/Republic of Korea			studies continuing

Additional Western World Smelter Capacity required to meet Projected Growth in Consumption

Projected Annual Growth in Consumption	Additional Production Capacity (Mt) for 1985
at 1%	0.51
2%	1.03
3%	1.58
4%	2.12

Iron

C R Pratt, BMR

World demand for steel declined further in 1982 as economic activity continued to contract. A further substantial fall brought world steel output below that of nearly a decade ago and reflected massive oversupply in the steel industries of major market-economic countries.

A 17 per cent fall in Australian steel output in 1982 largely reflected a continued decline in domestic steel orders and deliveries as a result of a reduction in economic activity and in the number of development projects, and to a lesser extent increased imports and reduced export demand. Major plant was taken out of service at all manufacturing centres, and rolling mill closures and cutbacks substantially reduced steel product output. At the end of the year reduced domestic orders caused Newcastle steelworks to be shut down for 10 days and parts of Port Kembla steelworks were also closed temporarily.

Australian production and exports of iron ore increased in 1982, according to preliminary statistics. Increased production partly reflected less industrial disruption compared with 1981 and resulted in some stock accumulation. A high rate of shipments to Europe early in the year coincided with a temporary rise in steel output there and shipments to Taiwan and South Korea increased as steel output, in contrast to the world trend, continued to expand. Increased prices negotiated to offset mining cost increases, and devaluation of the Australian dollar resulted in a substantial increase in the value of exports in 1982.

The Australian iron ore industry is largely dependent on demand for steel in its major export markets. In Japan, the principal market, a further fall in iron ore requirements is likely in 1983 because of a further projected decrease in steel output. Continued growth in the proportion of scrap steel used in steel making could prevent an upturn in Japanese iron ore demand even if steel output recovers to pre-1981 levels by 1985, as now predicted. Reduced iron ore production is expected in Australia in 1983 because of a likely fall in Australian exports, high iron ore stocks, and lower domestic steel industry requirements.

Major expenditure carried out in the Pilbara in the late 1970s to increase production capacity and beneficiate lower-grade ores provides a sound base from which Australia may meet any upturn in iron ore demand during the 1980s. Australia's high-grade iron ore resources are amongst the world's largest and exploration during the last three or four years has increased them considerably.

The continuing depressed demand and large surplus of production capacity is likely to result in a restructuring of steel industries of many countries in the next few years. The declining trend in steel deliveries to Australian consumers is expected to level out in 1983 following a reduction in consumer stocks in 1982 but demand is expected to remain depressed in both 1983 and 1984.

Mineral prices

D.J. Perkin, BMR

The quadrupling of oil prices late in 1973 and subsequent increases in 1979-80 have resulted in a worldwide decrease in demand for goods and are reflected in an overall decline in the rate of growth of Western economies as measured by their GDP. The rate of growth in metal demand and supply has decreased in response to the lower economic growth rate and a slower longer-term trend in rate of growth of demand for most metals is now indicated.

In spite of the decrease in the growth rate of metal demand and supply since 1973, metal prices, measured in constant dollars, did not fall below their long-run average in the period up to mid 1980. However, in the last two years, metal prices in constant-dollar terms have fallen to historically low values in response to a continued low level of demand, combined with more than adequate supply capacity.

Mines have closed and production has been reduced because of low prices, and supply should come into balance with demand again in the short to medium term. Moreover, with the prospect of decreases in the price of oil, a higher growth rate for the Western-world economy is predicted for the period 1983-85 and a return to former long-run average price levels (in constant dollars) is forecast in the medium term. Renewed cash flows to operating companies will no doubt stimulate exploration activity and result in the identification of additional mineral resources.

Short term outlook for metal prices

W S Etheridge, Renison Goldfields Consolidated Ltd

Short-term forecasting of metal prices and other economic variables is often more uncertain than the forecasting of longer-term conditions.

Metals addressed here are the 'old' non-ferrous base metals (copper, lead, zinc, and tin), the major 'new' non-ferrous base metals (aluminium and nickel), and the major precious metals (gold and silver).

1982 was a dismal year in base metal markets, at least from the producers' viewpoint, with further falls in metal demand, and in real average annual metal prices. Real prices for lead, aluminium and nickel all fell significantly, and real average annual prices for each of these metals, and copper as well, reached record or near record post-war lows.

Cyclical recovery of world economic growth will at last materialise during 1983. As with the post-1975 recovery, it will be led by the United States economy, which will probably recover faster during 1983 than many observers expect. Economic recovery will be the key common factor bearing on the outlook for metal prices over the next year.

Sectors of the economy leading the recovery will be housing and consumer durables, including motor cars. Recovery in business fixed investment will lag. Because consumer stocks are generally low for most metals, increases in end consumption of metals will flow quickly through to producers.

Base metal prices will generally not begin to recover strongly until producer stocks are clearly falling, and this will tend to happen sooner for copper, aluminium, zinc and lead, but later for tin and nickel. Price recovery for the former metals will be well under way by end 1983, but less so for the latter group.

The fear that rapid reactivation of idle capacity in the face of metal price increases will prematurely arrest the rate of recovery of metal prices is probably unfounded.

The outlook for precious metals is also strongly linked to general economic conditions, but in ways which differ importantly from the base metals. Prices for both gold and silver will probably experience a significant setback during mid-1983, but finish the year well above levels at the start.

The Western economy remains beset by major structural problems in both the 'real' and financial sectors, and the near term response to this will be further reflation.

TABLE 1

RECENT ECONOMIC GROWTH FORECASTING PERFORMANCE BY THE OECD SECRETARIAT

VARIABLE	EDITION OF "OECD ECONOMIC OUTLOOK" SOURCED	PERCENTAGE CHANGE FROM PREVIOUS PERIOD AT ANNUAL RATE (Note: A = actual. All other data are forecasts)										
		1979 I	1979 II	1980 I	1980 II	1981 I	1981 II	1982 I	1982 II	1983 I	1983 II	1984 I
REAL GNP - United States	No. 27, July 1980	1.7A	2.3A	-¾	-4	0						
	No. 28, Dec. 1980			-1.6A	-1¾	1	2½	3½				
	No. 29, July 1981				-0.6A	5	½	½	2½			
	No. 30, Dec. 1981					4.6A	-1½	-2	4	3		
	No. 31, July 1982						-0.6A	-3½	2	2	2¾	
	No. 32, Dec. 1982							-3.4A	0	2	4	3½
- Seven Major OECD countries	No. 27 July 1980	3.0A	3.0A	1½	-1½	¾						
	No. 28 Dec. 1980			0.6A	-1¼	1¼	2¼	3				
	No. 29, July 1981				-0.4A	-½	-½	2	2¾			
	No. 30, Dec. 1981					3.0A	0	1½	2½	2¾		
	No. 31, July 1982						0.0A	1½	2¼	2½	2¾	
	No. 32, Dec. 1982							-0.9A	-1½	¾	1½	1½
PRIVATE CONSUMPTION DEFLATOR - United States	No. 27, July 1980	9.4A	9.6A	11½	11	9						
	No. 28, Dec. 1980			11.4	9¾	10½	9½	9½				
	No. 29, July 1981				9.2	8¼	8	8¼	7½			
	No. 30, Dec. 1981					8.0	8	7¼	7	7½		
	No. 31, July 1982						8.1	5¼	4¾	5¾	5¾	
	No. 32, Dec. 1982							5.1	5½	5½	5¼	5½
- Seven major OECD countries	No. 27, July 1980	7.6A	9.9A	11½	10½	8¾						
	No. 28, Dec. 1980			11.0	9¾	9½	8½	8¼				
	No. 29, July 1981				9.6	9¼	8¾	8¼	7¾			
	No. 30, Dec. 1981					8.9	9	8½	7¾	7¾		
	No. 31, July 1982						9.0	7	6½	7		
	No. 32, Dec. 1982							6.3	6	5¾	6	

Sources and definitions for Table 2

1. SOURCES

(a) 1976 - 1981 metals data: "Metals Analysis and Outlook", published quarterly by Metals and Minerals Research Services Ltd., London.

(b) 1960, 1970 metals data, and 1982 estimates: various.

(c) Economic data: OECD.

2. DEFINITION OF TERMS

(a) Supply: This is generally defined as:
primary refined production (non-Communist countries): plus
secondary refined production (non-Communist countries): plus
net imports from East bloc: plus
official (government) stockpile sales (eg GSA, and also the ITC in the case of tin).

For gold the definition is free world mine production plus net East bloc sales to West (ie. chiefly from the USSR) plus net official sales (ie. Western central banks).

Both supply and demand refer to the category of non-Communist countries, which usually is defined to include Yugoslavia. For tin ITC data is used, and this excludes only the USSR, East Germany and P R of China, from world data.

(b) Demand: This is defined as total deliveries of refined metal to consumers in non-Communist countries, and as such is not true end, or downstream, consumption, which varies according to intervening downstream stock changes.

For gold the definition of identified private demand is fabrication (jewellery and industrial), plus coins and medals, plus identified large bar hoarding. It therefore excludes much bar demand, including all small bar demand, and large bar demand in North America and Western Europe.

For silver the definition is fabrication plus coins and medals.

(c) Stocks: These are defined as total private stocks and therefore exclude government stocks. They also exclude downsteam consumer stocks (ie fabricators, etc). For tin they also exclude ITC stocks. They are expressed as months of annual demand.

(d) Price: All prices are free-market prices, eg. LME or US (eg Comex). Much, or most, copper, zinc, aluminium, and nickel is sold at producer prices which generally bear a close, but fluctuating relationship with free-market prices. The 1960 and 1970 prices quoted for nickel and aluminium are producer prices.

TABLE 2

MAJOR NON-FERROUS METALS: HISTORIC SUPPLY/DEMAND DATA FOR NON-COMMUNIST COUNTRIES

(See notes below for sources and definitions)

ECONOMIC BACKGROUND		1960	1970	1975	1976	1977	1978	1979	1980	1981	1982 (estimate)
Real GDP - United States	% change, yr/yr			-0.7	4.9	5.2	4.7	2.4	-0.3	2.3	-1¼
- Total OECD	"			-0.2	4.8	3.8	4.0	3.1	1.2	1.5	-¼
Industrial) - United States	"			- 9	10½	6	6	4	-3	2½	-8
production) - Total OECD	"			- 7½	9	3½	3½	5	0	1	-4
Consumer prices - United States	"			9.1	5.8	6.5	7.7	11.3	13.5	10.4	6.2
	1975 = 100	55.0	72.1	100.0	105.8	112.7	121.2	135.0	153.2	169.0	179.5E
- Total OECD	"			11.3	8.7	8.9	8.0	9.8	12.9	10.6	8.0
Oil price (official)	$US per bbl.			11.0	11.9	13.0	13.0	19.0	31.5	35.1	33½

METALS DATA		1960	1970	1975	1976	1977	1978	1979	1980	1981	1982 (estimate)	Current Price (15/2/83)
COPPER												
Supply	million tonnes			6.30	6.65	6.95	6.90	7.10	7.09	7.41	6.91	
Demand	"	3.84	5.84	5.50	6.45	6.90	7.30	7.60	7.20	7.28	7.00	
Surplus/(Deficit)	"			0.80	0.20	0.05	(0.40)	(0.50)	(0.11)	0.13	(0.09)	
Stocks (end period)	months			3.8	3.6	3.6	2.5	2.1	2.0	2.2	2.1	
Price (LME cash)												
- actual	US cents/lb	31	64	56	64	60	62	90	99	79	67.2	76.3
- real (1982 prices)	"	101	159	101	109	96	92	120	116	84	67.2	
% change demand					18.4	7.0	5.8	4.1	-5.3	0.8	-3.6	
LEAD												
Supply	million tonnes			3.30	3.75	4.05	4.05	4.10	3.90	3.90	3.69	
Demand	"	2.60	3.70	3.25	3.82	4.10	4.15	4.20	3.95	3.88	3.69	
Surplus/(Deficit)				0.05	(0.07)	(0.05)	(0.10)	(0.10)	0.05	0.02	0.00	
Stocks (end period)	months			2.1	1.5	1.4	1.1	1.3	1.6	1.7	1.8	
Price (LME cash)												
- actual	US cents/lb	9.0	13.8	19	21	31	30	55	41	33	24.7	20.9
- real	"	29	34	34	36	49	44	73	48	39	24.7	
% change demand					17.5	7.3	1.2	1.2	-6.0	-1.8	-4.9	

TABLE 2 (cont.)

		1960	1970	1975	1976	1977	1978	1979	1980	1981	1982 (estimate)	Current Price (15/2/83)
ZINC												
Supply	million tonnes			3.80	4.15	4.25	4.15	4.65	4.50	4.54	4.11	
Demand	"	2.44	3.89	3.55	4.15	4.25	4.65	4.75	4.50	4.42	4.13	
Surplus/deficit	"			0.25	-	-	(0.50)	(0.10)	-	0.12	(0.02)	
Stocks (end period)	months			3.8	3.3	3.4	2.1	2.2	2.1	2.4	2.6	
Price (LME cash)												
- actual	US cents/lb	11.2	13.4	34	32	27	27	34	35	38	33.7	31.0
- real (1982 prices)	"	37	33	61	54	43	40	45	41	45	33.7	
% change demand					16.9	2.4	9.4	2.2	-5.3	-1.8	-6.6	
TIN												
Supply	'000 tonnes			162	204	178	185	191	187	190	112	
Demand	"	183	186	174	194	184	186	186	175	163	160	
Surplus/(Deficit)				(12)	10	(6)	(1)	5	12	27	(48)	
Price (Penang)												
- actual	$US/lb	1.01	1.74	3.01	3.38	4.84	5.64	6.72	7.44	6.37	5.87	5.86
- real (1982 prices)	"	3.30	4.33	5.40	5.73	7.71	8.35	8.94	8.72	7.46	5.87	
% change demand					11.5	-5.2	1.1	0	-5.9	-6.9	-1.8	
ALUMINIUM												
Supply	million tonnes			9.55	10.05	11.26	11.55	11.93	12.31	12.44	10.74	
Demand	"	3.33	7.94	8.50	10.95	11.20	11.87	12.43	11.43	11.15	10.69	
Surplus/(Deficit)	"			1.05	(0.90)	0.06	(0.32)	(0.50)	0.88	1.29	0.05	
Stocks (end period)	months			3.0	3.6	2.5	2.1	1.5	2.2	3.9	3.5	
Price (free market)												
- actual	US cents/lb	26	29	31	38	45	47	70	81	57	45	56.4
- real (1982 prices)	"	85	72	56	64	72	70	93	95	67	45	
% change demand					28.8	2.3	6.0	4.7	-8.0	-2.4	-4.1	

TABLE 2 (cont.)

		1960	1970	1975	1976	1977	1978	1979	1980	1981	1982 (estimate)	Current Price (15/2/83)
NICKEL												
Supply	'000 tonnes			540	564	557	440	520	567	521	440	
Demand	"	226	451	403	486	460	523	610	522	476	450	
Surplus/(Deficit)	"			137	78	97	(83)	(90)	45	45	(10)	
Price (free market)												
- actual	US cents/lb	74	129	186	208	204	187	255	295	270	218	199
- real (1982 prices)	"	242	321	334	353	325	277	339	346	316	218	
% change demand					20.6	-5.3	13.7	16.6	-14.4	-8.8	-5.5	
GOLD												
Supply	tonnes	964	1034	1112	1439	1640	1747	1703	806	985	1226	
Identified private demand	"	n.a.	1464	983	1558	1495	1716	1497	550	1316	1356	
Surplus/(Deficit)	"	n.a.	(430)	129	(119)	145	31	206	256	(331)	(130)	
Price (London)												
- actual	$US/tr.oz	35	36	161	125	148	193	307	613	460	376	509
- real (1982 prices)	"	114	90	289	212	236	286	408	718	539	376	
SILVER												
Supply	'000 tonnes	n.a.	12.58	13.45	15.35	14.00	13.85	14.45	17.25	14.25	13.45	
Demand	"	n.a.	11.26	13.30	15.35	14.65	15.45	14.80	11.75	11.80	11.85	
Surplus/(Deficit)		n.a.	1.32	0.15	0	(0.65)	(1.60)	(0.35)	5.50	2.45	1.60	
Price (free market)												
- actual	$US/tr.oz.	0.91	1.77	4.42	4.35	4.62	5.40	10.89	20.60	10.51	7.95	14.66
- real (1982 prices)	"	2.97	4.40	7.93	7.38	7.36	8.00	14.48	24.14	12.31	7.95	

TABLE 3

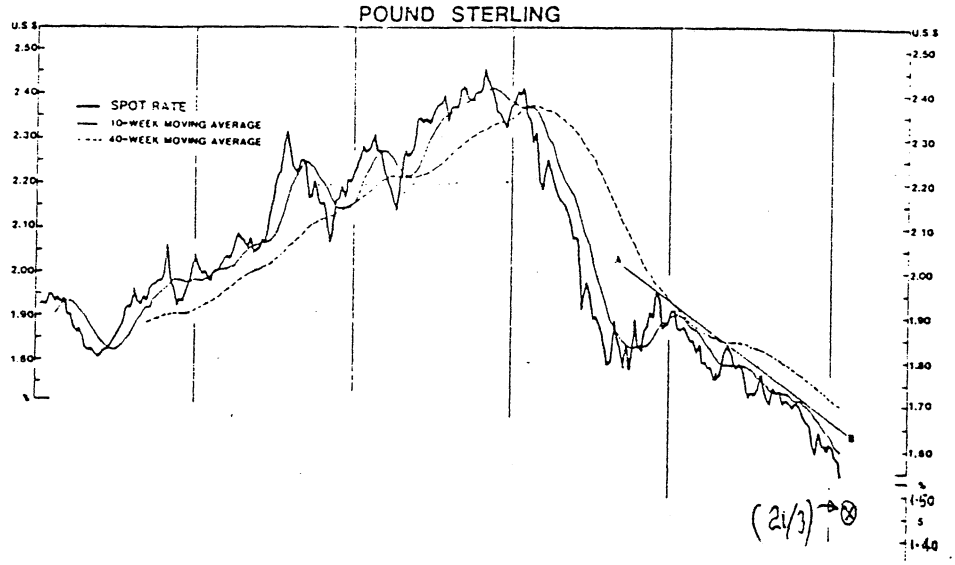
NON-FERROUS BASE METALS: RECENT PEAK TO TROUGH DEMAND AND PRICE FALLS

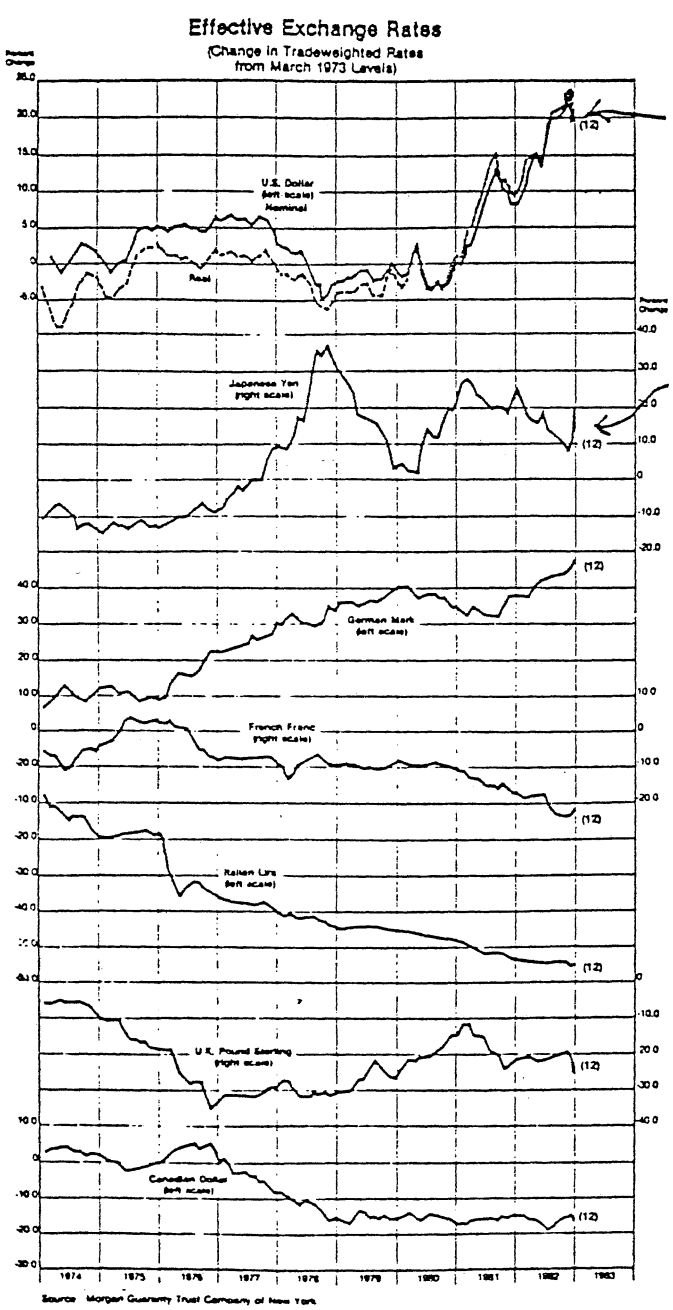
NOTE: Data are annual averages for the calendar years shown. They are extracted from Table 2.

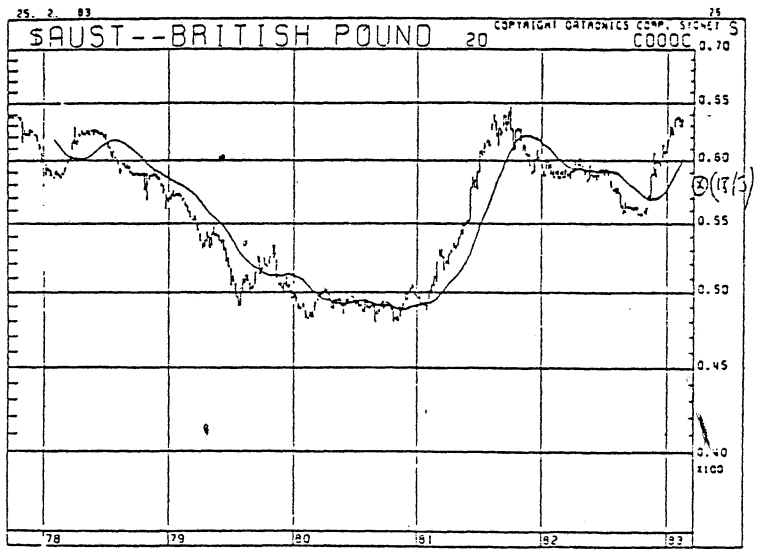
			RECENT PEAK (for year shown)	TROUGH (1982, estimate)	PERCENTAGE CHANGE - Demand	- Real price
COPPER	- demand	million tonnes	7.60 (1979)	7.00	-7.9	
	- real price (1982 values)	US cents per lb.	120 (")	67		-44
LEAD	- demand	million tonnes	4.20 (")	3.69	-12.1	
	- real price	US cents per lb.	73 (")	24.7		-66
ZINC	- demand	million tonnes	4.75 (")	4.13	-13.1	
	- real price	US cents per lb.	45 (")	33.7		-25
TIN	- demand	'000 tonnes	194 (1976)	160	-17.5	
	- real price	$US per lb.	8.94 (1979)	5.87		-34
ALUMINIUM	- demand	million tonnes	12.43 (1979)	10.69	-14.0	
	- real price	US cents per lb.	95 (1980)	45		-53
NICKEL	- demand	'000 tonnes	610 (1979)	450	-26	
	- real price	US cents per lb.	346 (1980)	218		-37

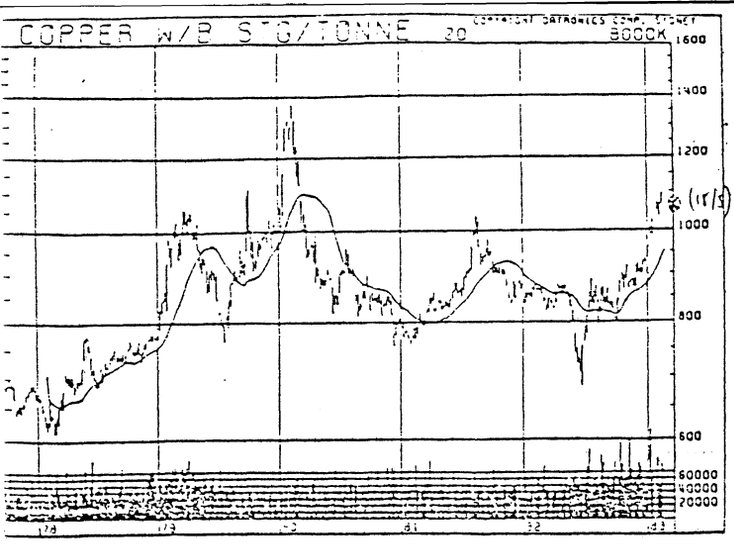
CHARTS FOR METAL PRICES & EXCHANGE RATES

(To accompany "Short Term Outlook for Metal Prices", W.S. Etheridge, B.M.R. "Petroleum and Minerals Review Conference, 1983", March 1983)





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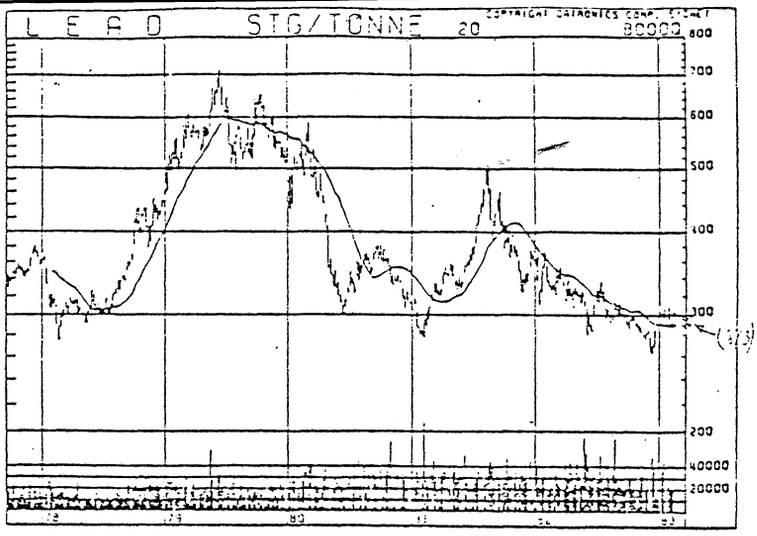
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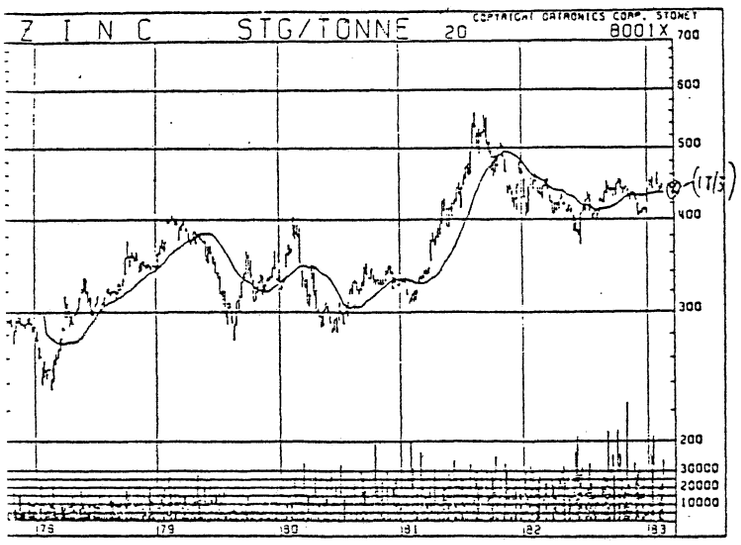
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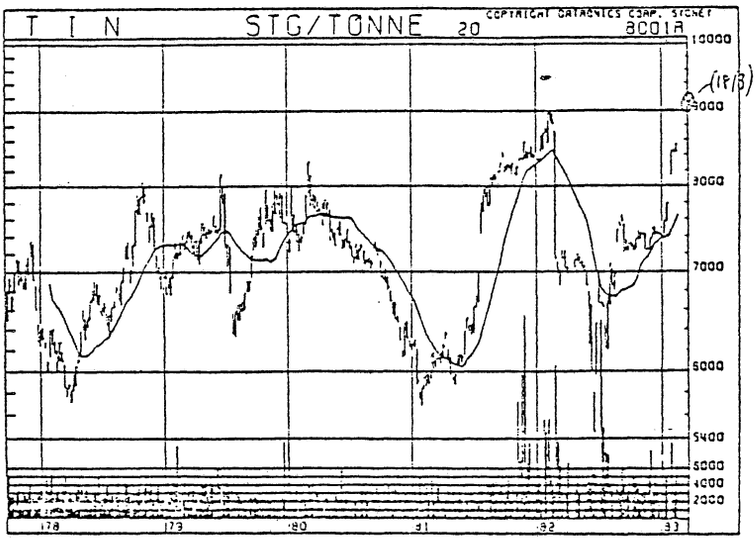
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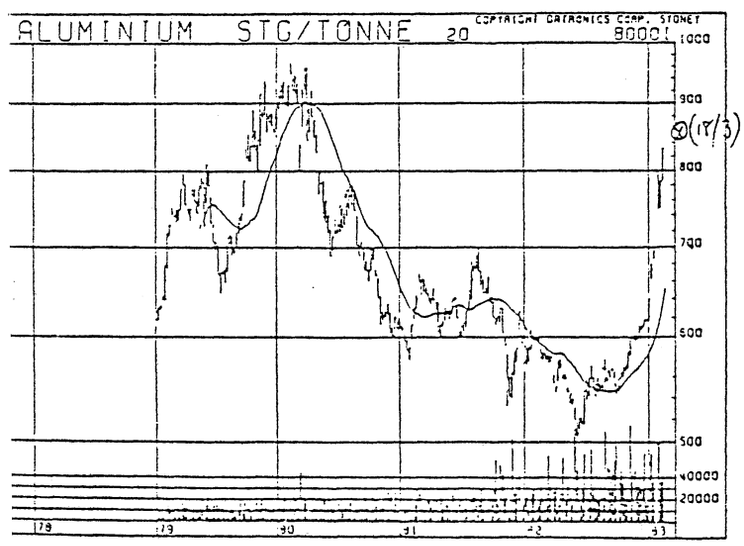
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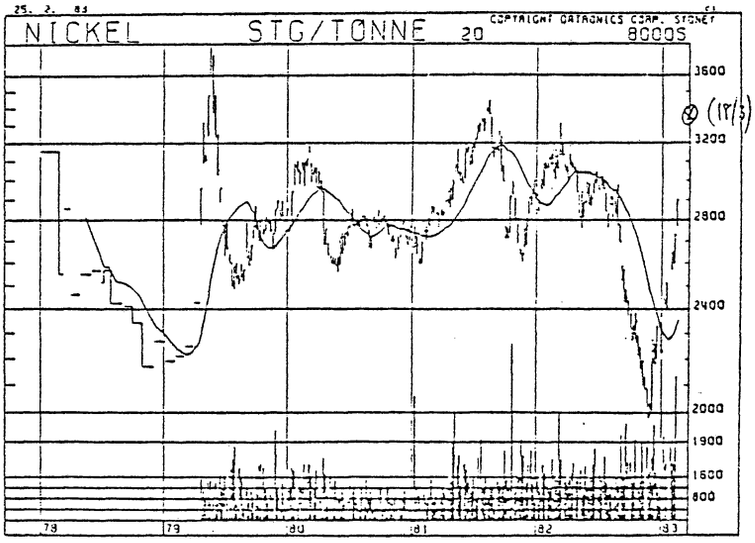
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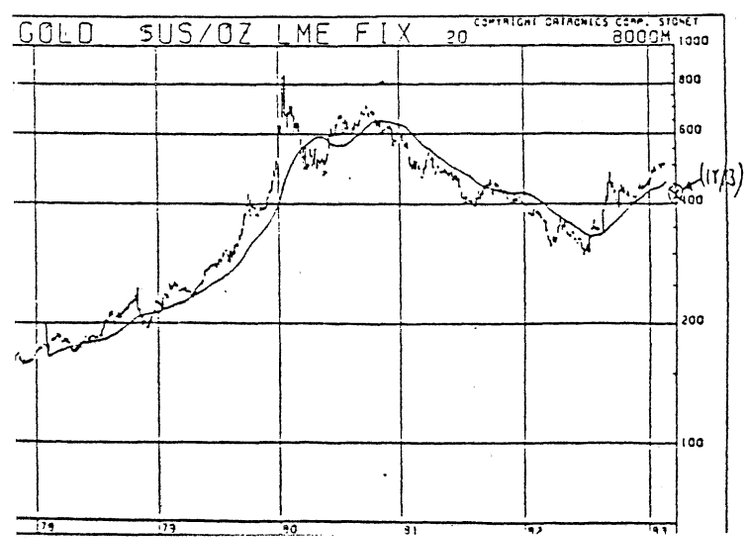
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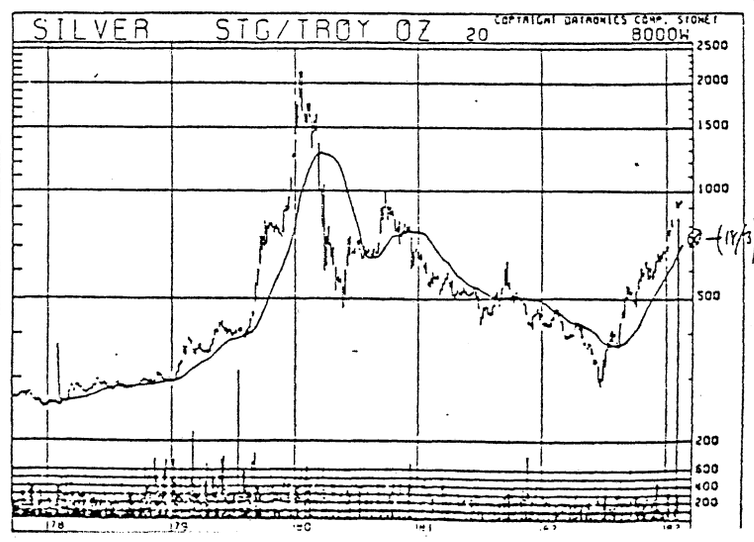
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