BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 1984/12

RECORD

SUMMARIES

PETROLEUM AND MINERALS REVIEW CONFERENCE 1984

21-22 MARCH

CANBERRA

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World petroleum overview and outlook

R.E. Mitchell
West Australian Petroleum Pty Ltd

An examination of trends and events over the past 10 years that have shaped and influenced the oil and gas industry suggests that by and large the price escalations and accompanying changes in free world producing capabilities and consumption patterns are the result of the interplay of normal market forces punctuated by the occasional outside influences rather than being the product of ill-conceived and largely selfish actions of the OPEC nations. OPEC as an organization remains intact and relatively healthy in spite of the many problems it has had in recent years and gives every sign of remaining a strong force to be reckoned with in the future. OPEC production is and will continue for the foreseeable future to represent the world's marginal oil supply. Thus a forecast of OPEC production in relation to its production capacity can be used with caution to forecast future price trends. Based on this kind of an analysis the Economics Department of Standard Oil Company of California forecast an average growth in Free World oil consumption of 1% per year in the period 1983 to 2000. Real prices are expected to remain relatively flat during the 1980's and to rise slowly in the 1990's to $35 - $50/barrel (1983 dollars).

The so-called world oil glut which currently exists can more properly be described as a cushion of supply over demand and a supply cushion of something of the order of 15 million b/d which we have today is not altogether unhealthy. It is probably greater than needed and is expected to decline slowly over the next few years. But it is essential that it be maintained at a level such that future disrupting forces such as the 1973 embargo and the 1979 Iranian revolution won't have the potential for totally upsetting the relative stability of the industry. Given the anticipated modest 1% per year increase in Free World demand it is important that new reserves be found to replace those being expended. There appears to be sufficient remaining reserve potential within the world sedimentary basins to accomplish this.

Significant changes are taking place in the oil and gas industry as it adjusts and settles into a new pattern of world energy supply and consumption. Gone and probably never to return are the days of rapidly expanding energy use. The industry must strive for greater efficiency in all aspects of its operations in order to maintain continued profitability. Given adequate freedom to act without undue governmental constraints the industry can remain healthy.

Australian petroleum exploration and development

J.A.W. White, BMR

A relatively high level of petroleum drilling activity was maintained in Australia in 1983. A total of 274 wells were drilled for petroleum exploration and development and of these 199 were exploratory (149 onshore, 50 offshore) and 75 development (49 onshore, 26 offshore).

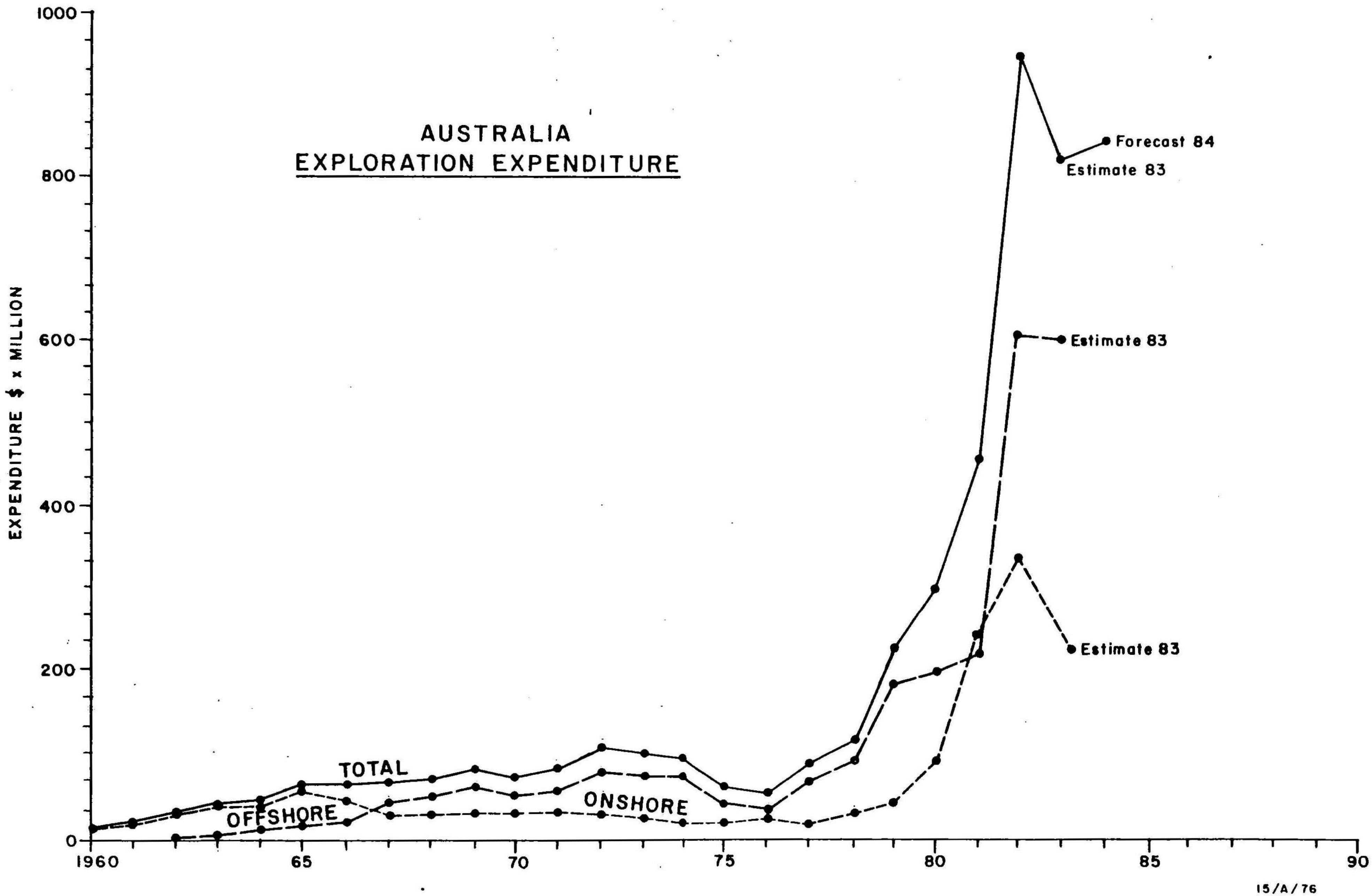
Seismic survey activity during the year was somewhat less than the average over the last few years, indicating that exploration may be concentrated in established producing areas in the immediate future.

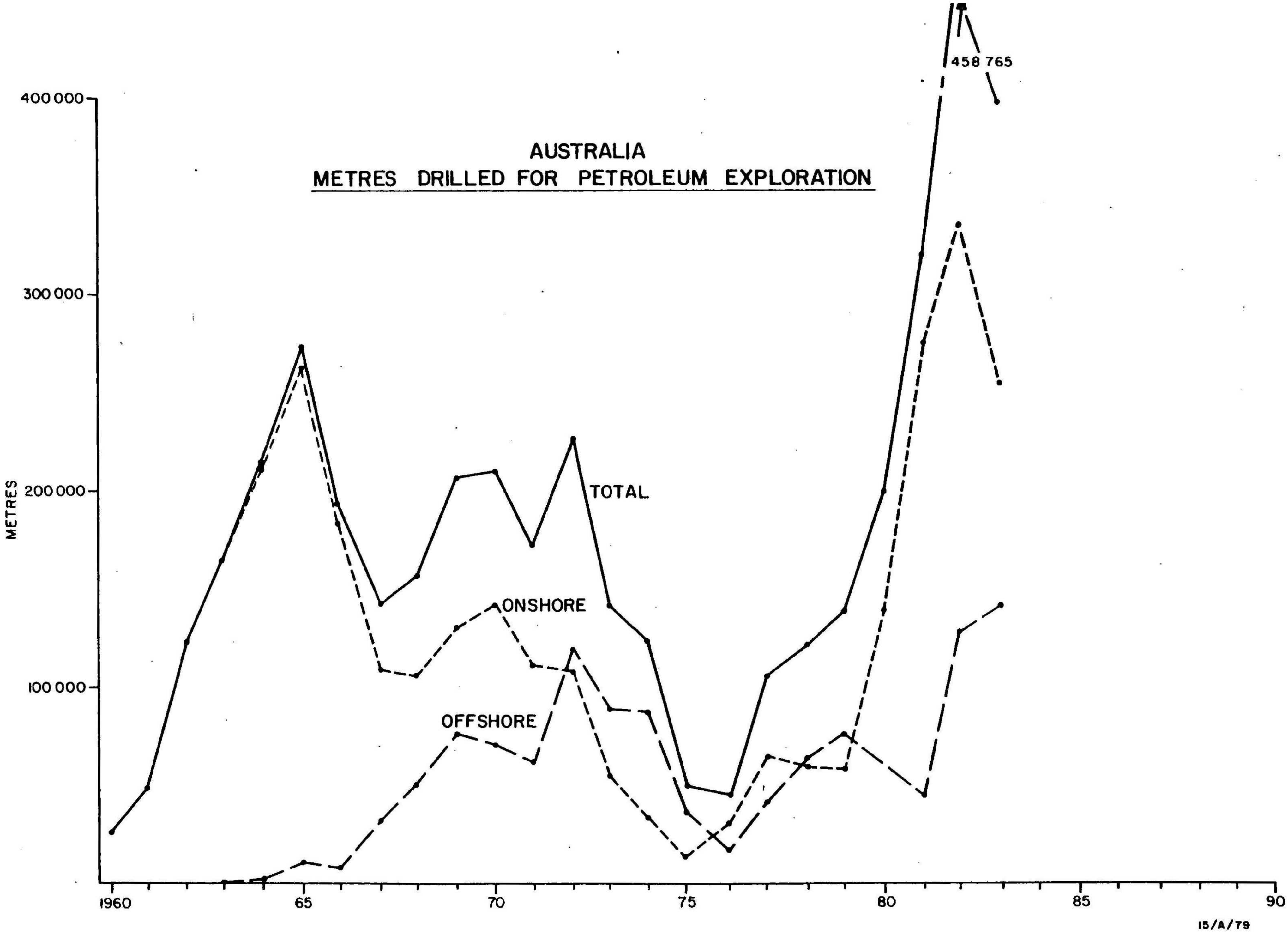
On shore, significant discoveries were made last year around the Jackson field in Queensland, augmenting the known crude oil reserves in the area. Northeast of Jackson, a promising flow of oil from the Hutton Sandstone was produced from Tintaburra No. 1 exploratory well. Exploration drilling activity was at a record level in the Cooper and Eromanga sequences in South Australia, although much of this activity was directed at better delineating earlier discoveries. In Western Australia onshore exploration drilling activity was somewhat less than in recent years, while in the Northern Territory exploration activity was greater than in previous years, but was not particularly successful.

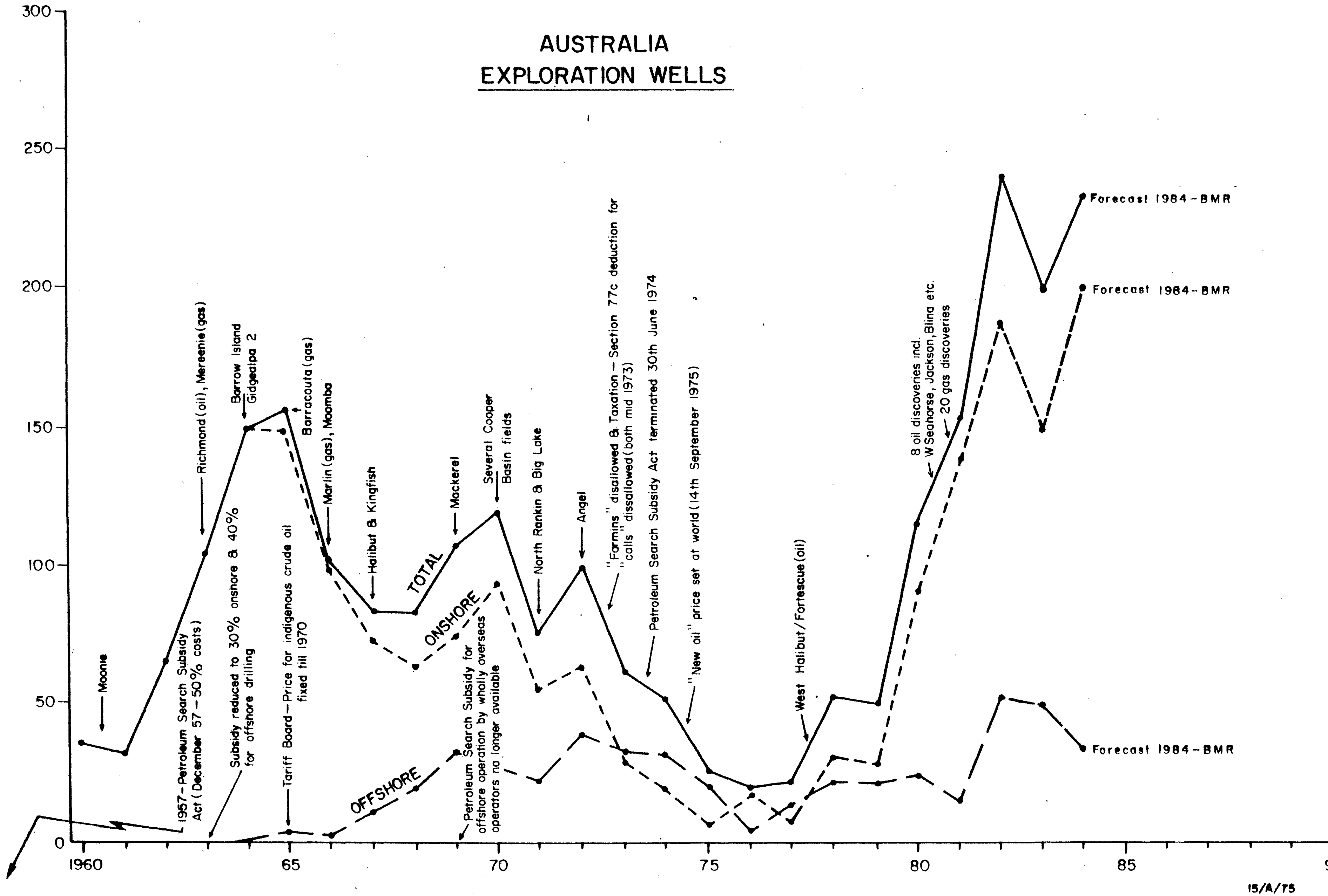
Offshore, a major discovery of oil was made at Jabiru in the Joseph Bonaparte Gulf: this is undoubtedly one of the most significant discoveries in recent years. In Bass Strait, exploration efforts were rewarded by the discovery of two relatively small fields. The most actively explored offshore area was off Western Australia where three oil discoveries were made south of and close to Barrow Island and two to the north of the island. Three significant gas discoveries were also made in the same general area.

Development projects in progress during the year included the construction of the Jackson-Moonie pipeline and associated plant, the further expansion of the Cooper-Eromanga liquids project in South Australia, the laying of the Dampier-Perth natural gas pipeline and the commissioning of the Palm Valley natural gas supply to the Alice Springs Power Station.

BMR estimates that onshore activity will remain very strong in 1984 with 200 exploration wells and 42 development wells to be drilled. Offshore activity is expected to be somewhat lower with the drilling of 32 exploratory wells and 31 development wells. So the grand total of 305 wells is expected to be drilled during the year. Drilling activity is expected to be particularly strong in the Canning Basin of Western Australia and both the Queensland and South Australian portions of the Cooper-Eromanga Basins.


AUSTRALIA
EXPLORATION EXPENDITURE
EXPENDITURE $ x MILLION
1000
800
600
400
200
0
1960
65
70
75
80
85
90
TOTAL
OFFSHORE
ONSHORE
Forecast 84
Estimate 83
Estimate 83
Estimate 83
15/A/76


AUSTRALIA
METRES DRILLED FOR PETROLEUM EXPLORATION
METRES
400 000
300 000
200 000
100 000
TOTAL
ONSHORE
OFFSHORE
458 765
1960
65
70
75
80
85
90
15/A/79


AUSTRALIA
EXPLORATION WELLS
300
250
200
150
100
50
0
1960
65
70
75
80
85
90
TOTAL
ONSHORE
OFFSHORE
Moonie
1957-Petroleum Search Subsidy Act (December 57-50% costs)
Subsidy reduced to 30% onshore & 40% for offshore drilling
Richmond (oil), Mereenie (gas)
Barrow Island
Gidgealpa 2
Tariff Board-Price for indigenous crude oil fixed till 1970
Barracouta (gas)
Marlin (gas), Moomba
Halibut & Kingfish
Mackerel
Petroleum Search Subsidy for offshore operation by wholly overseas operators no longer available
Several Cooper Basin fields
North Rankin & Big Lake
Angel
"Farmins" disallowed & Taxation - Section 77c deduction for "calls" disallowed (both 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, Blina etc.
20 gas discoveries
Forecast 1984-BMR
Forecast 1984-BMR
Forecast 1984-BMR
15/A/75

The uncertainty of Australia's future oil production

B.G. McKay
Esso Australia Limited

Uncertainty about future oil production results from insufficient knowledge in at least four areas: the size of the resource base; the rate of discovery; the rates and lead-times of production; and, government policies.

Esso's most recent estimates of undiscovered resources have average values of 4 billion barrels for oil and 74 TCF for raw gas. However, Diagram 1 shows the wide range of possible outcomes as well as the dominance of gas in Australia. These estimates incorporate results of all exploration drilling to year-end 1983.

Our forecast to the year 2000 shows a 60% chance that between 1.5 and 3.0 billion barrels of those oil resources will be found. Some discoveries will be too small to warrant the cost of development and it may take up to six or more years to achieve maximum production levels from other discoveries. Production for new discoveries is forecast to range from 125 to 340 kbd by the year 2000. When combined with forecasts of production from already discovered pools and demand level, self-sufficiency in the year 2000 could fall anywhere in the range from 30% to 70%. The outcome will remain uncertain until we have drilled a lot more wells.

Since 1950, industry has drilled over 1,800 wildcats to discover about 4 billion barrels of oil and over 50 TCF of gas in 240 hydrocarbon pools. Less than 50 of these discoveries can be considered economic oil pools. Esso's assessment of the undiscovered resource base suggests that, in the average case, another 750 oil and gas pools remain to be discovered but the total resources in these pools will only equal the resources in the already identified 240 pools.

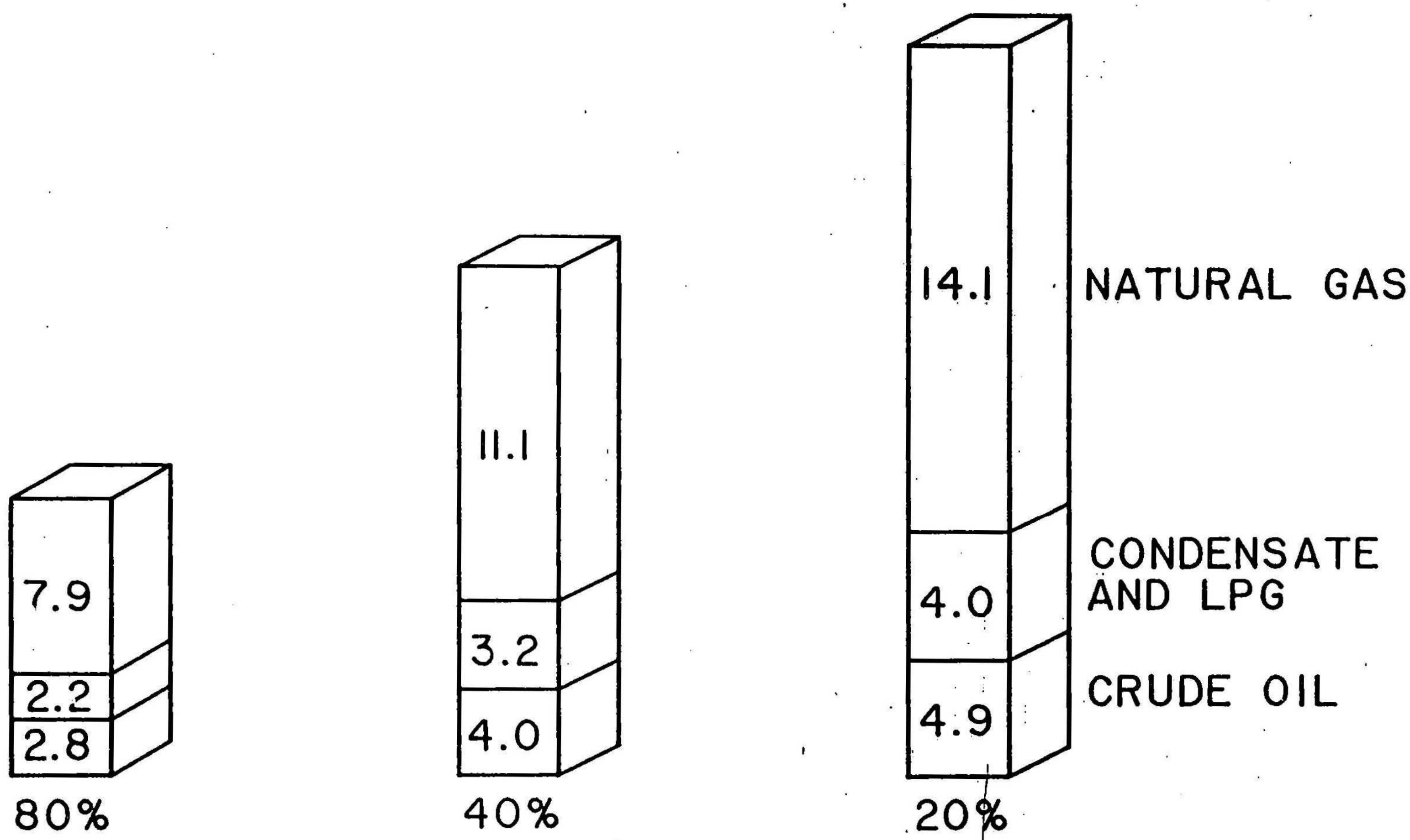
To compensate for the smaller average size of future discoveries more pools need to be discovered each year if historic volumetric discovery rates are to be achieved. We estimate twice as many wells need to be drilled over the period to the year 2000 as have been drilled to date. Government should encourage industry to achieve a target of drilling 4,000 wildcats by the year 2000, that is over 250 wildcats a year. However APEA forecasts that 163 wildcats will be drilled this year, with the prospect of lower rates next year because of the current slowdown in acquisition of seismic data and continued uncertainty about resource taxation.

Significant resources are waiting to be discovered if industry is prepared to invest billions of dollars in exploration drilling. If governments reduce the potential rewards for the industry, they must expect production to fall in the lower volume ranges of our forecast while untapped potential still remains in the ground until well into the next century.

AUSTRALIA

UNDISCOVERED OIL AND GAS RESOURCES

BILLIONS OF BARRELS OF OIL AND OIL EQUIVALENT



PROBABILITY OF ULTIMATE RESOURCES EXCEEDING STATED VOLUME

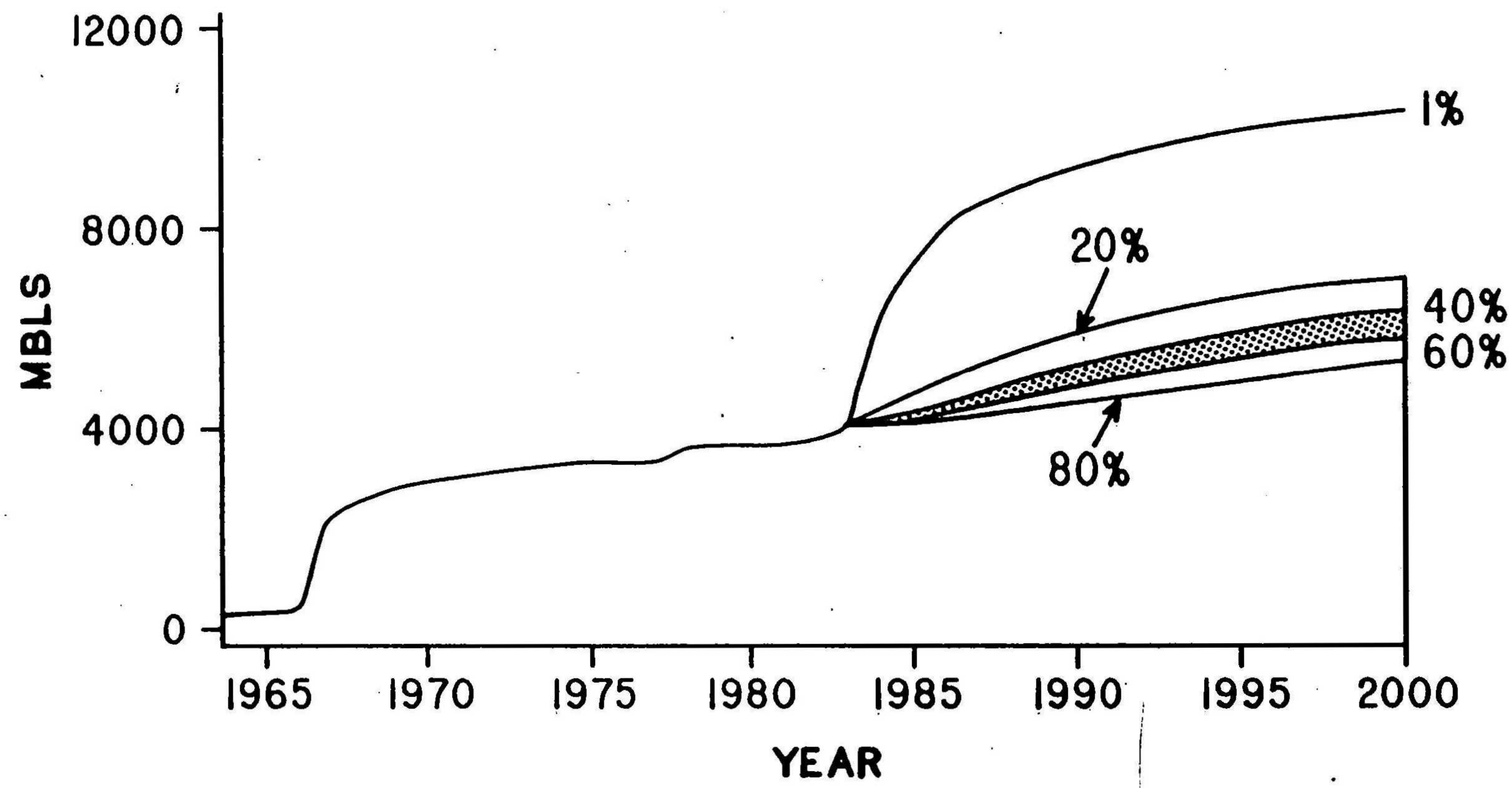
O&G.RES

1358/ V /1632-3/84

ACTUAL AND POTENTIAL OIL DISCOVERIES

MILLIONS OF BARRELS CUMULATIVE

PERCENT PROBABILITY OF EXCEEDING STATED MBLS

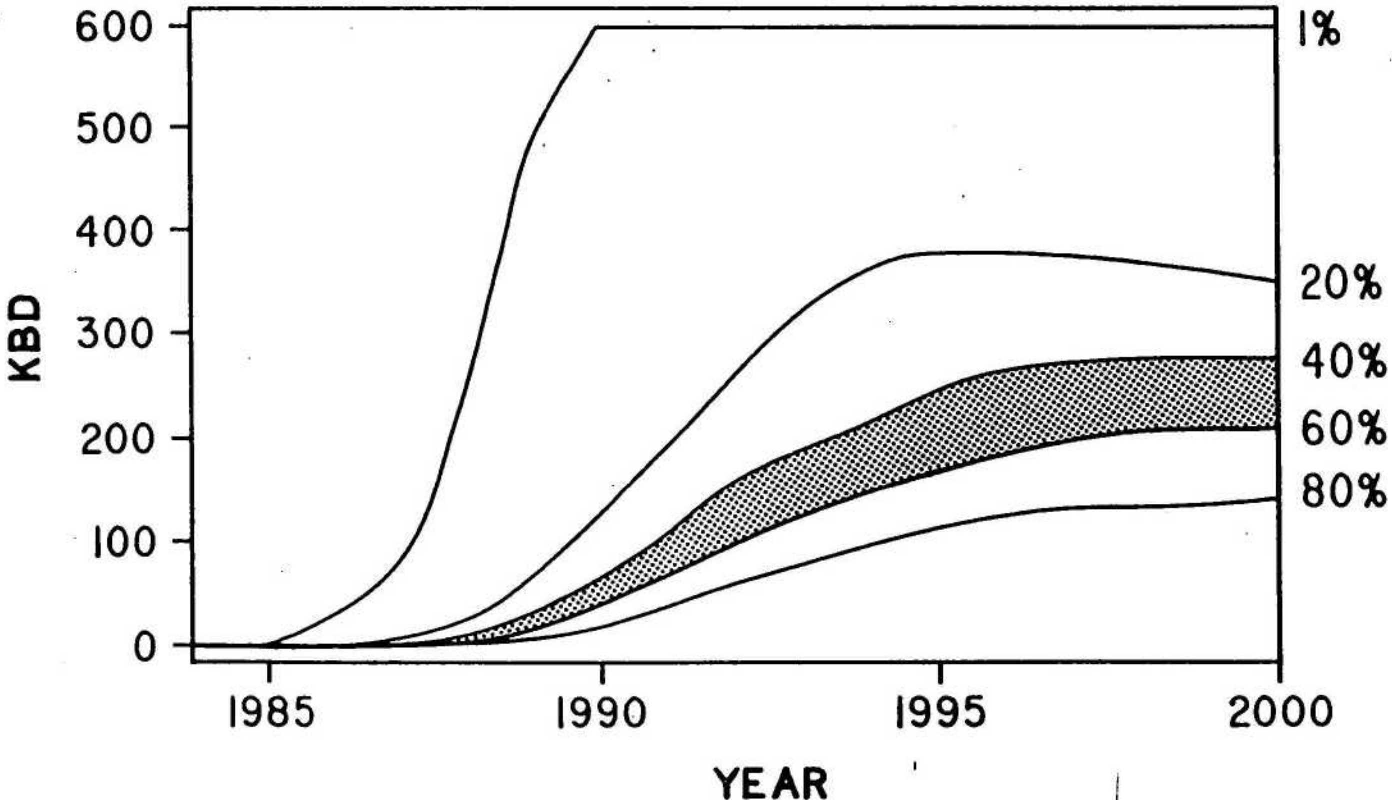


POT.OIL

POTENTIAL PRODUCTION FROM NEW DISCOVERIES (POST JAN. '84)

THOUSANDS OF BARRELS A DAY

PERCENT PROBABILITY OF EXCEEDING STATED KBD



POT.PROD

1358/V/1628-3/84

The future outlook for petroleum in Australia in 1984

D.J. Forman, BMR

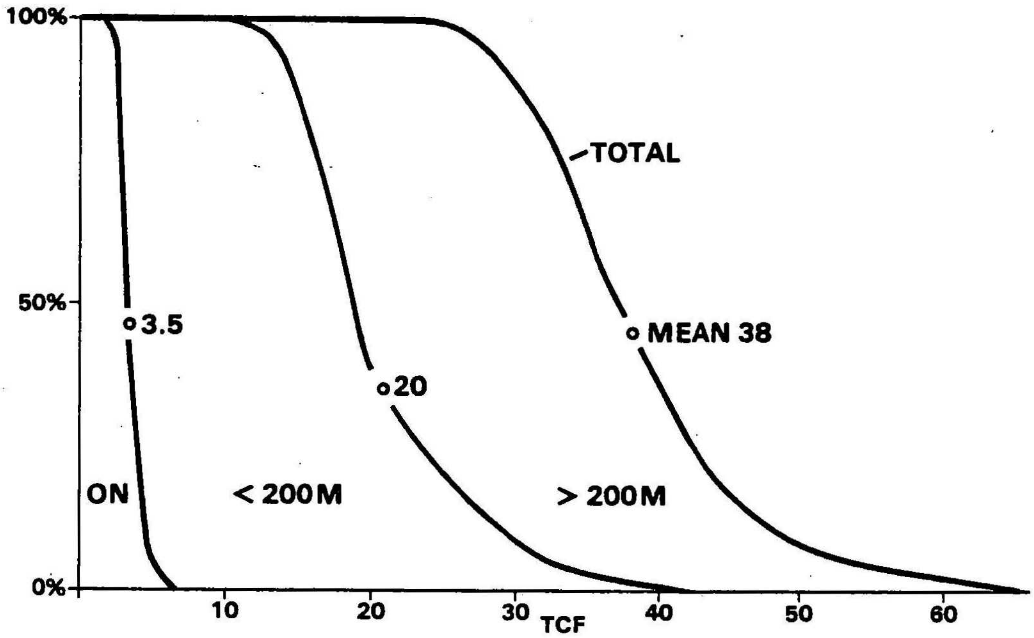
A new assessment of Australia's prospectivity for oil and gas was prepared in BMR towards the end of 1983. The gas assessment (Fig. 1) shows the prospects for further conventional discoveries onshore, for onshore and offshore areas out to the 200 m bathymetric contour, and onshore and offshore areas out to and beyond the 200 m bathymetric contour. The assessment suggests relatively limited potential for conventional gas discoveries onshore and highlights the importance to the Sydney and Adelaide markets of gas in unconventional, tight gas sands - if they can be developed economically.

The discovery of oil at Jabiru No. 1A has confirmed BMR's earlier assessment of the Bonaparte Basin as a prospective area. This discovery and a number of other oil discoveries and oil shows encountered on the Northwest Shelf over the last few years have provided the basis for upgrading the assessment of Australia's undiscovered crude oil potential (Fig. 2). We now estimate that there is an 80 percent chance of finding at least another 1900 million barrels - about equal to our remaining identified oil resources - and a 20 percent chance of finding at least 3900 million barrels of oil - about double our remaining identified resources. The average value of the new assessment is 3000 million barrels. The estimate at the 80 percent level of confidence is about double that of our previous estimate made in 1980, whereas the estimate at the 20 percent level is almost unchanged. The average of the estimate has been increased by 12 percent.

An estimate of crude oil, condensate, and LPG supply and demand to the year 2000 has also been prepared (Fig. 3). The figures for most of the identified fields and for crude oil, condensate, and LPG demand were compiled within the Energy Policy Division of the Department of Resources and Energy. The estimate of possible future production from undiscovered fields was prepared in BMR based on the assessment that there is a 50 percent probability of discovering at least 2600 million barrels of crude oil. The estimate assumes that 1800 million barrels of this will be discovered and brought into production during the period to the year 2000.

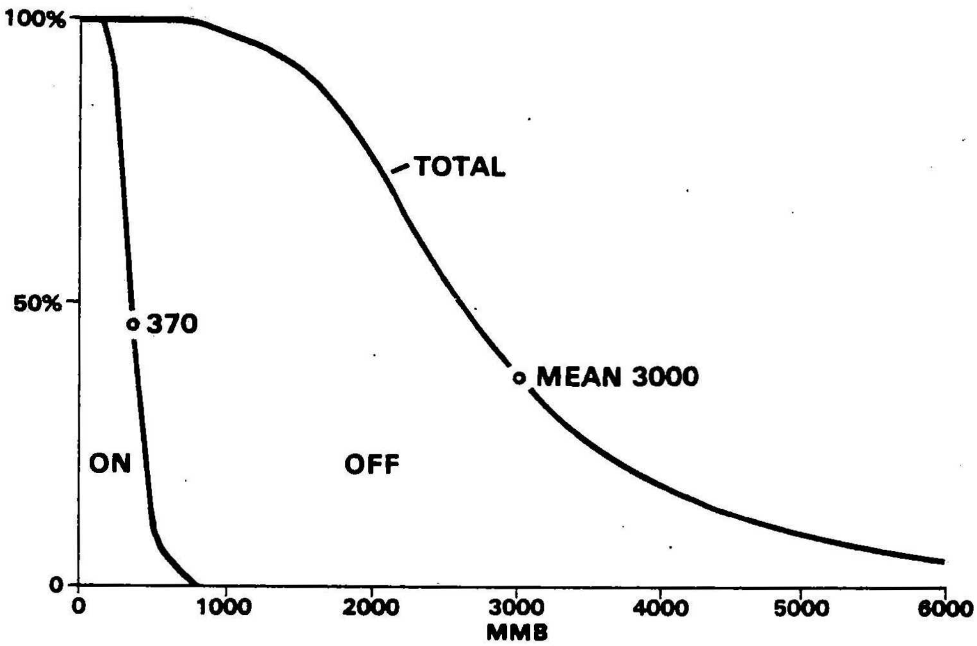
The new estimate of possible supply from undiscovered fields is more optimistic than one prepared by BMR last year, both because of the expectation that larger amounts of crude oil will be discovered and the assessment that shorter lead times will be required to develop some of the undiscovered oil. When combined with future production from identified fields, the estimate suggests a good possibility that crude oil production may rise about 30 percent between now and 1989 and may plateau at about this level before beginning to decline in 1996. It is emphasised that the estimate is based on one set of assumptions including the discovery of over a thousand million barrels of crude oil in the next five years and the maintenance of exploration at high levels.

Fig 1



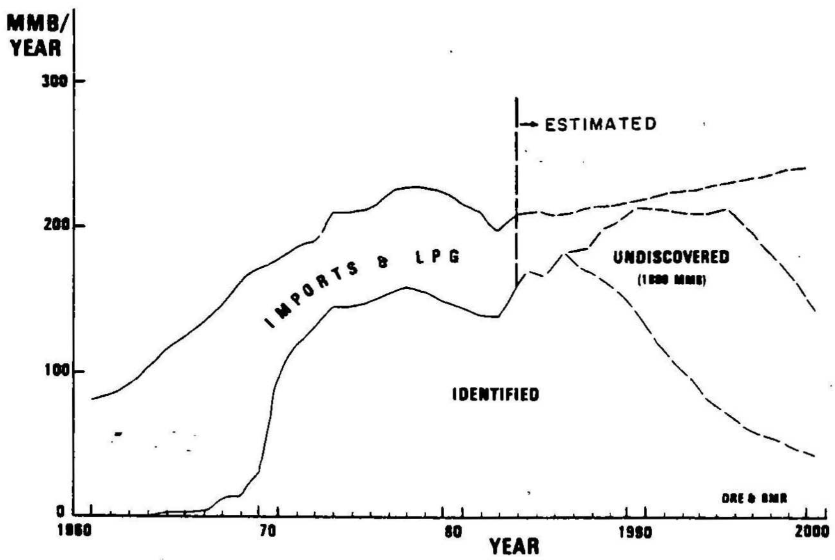
Assessment of Australia's undiscovered recoverable gas resources, Dec 1983.

Fig 2



Assessment of Australia's undiscovered recoverable oil resources, Dec 1983.

Fig 3



Crude oil and condensate supply and demand to 2000. BMR - February 1984.

Options for development of Australia's remote gas resources
Liquid fuel options

G.N. Keith
BHP Petroleum Pty Ltd

Australia has very large reserves of natural gas that are too remote from consumption centres for conventional use as pipelined fuel gas. If these resources could be converted economically to a readily transportable liquid fuel it would add greatly to Australia's energy self-sufficiency in the longer term.

BHP Petroleum, along with most of the major oil companies around the world is putting considerable research and development effort into finding viable processes for production of liquids from gas.

Existing processes include methanol synthesis, Fischer Tropsch, higher molecular weight alcohols, and methanol to gasoline. However, for these processes to be used in remote locations, configurations need to be modified to withstand adverse environmental conditions and to minimise construction and maintenance costs. The product spectrum also needs to be simplified so that a single transportable material is made that can be refined nearer the point of use if required.

The search continues for new processes that will allow simpler operation and give better thermal efficiency. One method that shows promise is to eliminate the synthesis gas step and go directly from methane to olefins and then convert the olefins to a mixture of gasoline and diesel-type materials. BHP has taken out a patent in this area.

Australia's larger natural gas reserves are located offshore and those considered remote are long distances from industrial areas even if brought ashore. As a result, consideration has to be given to construction of conversion facilities on floating barges or fixed platforms. The final choice will depend largely on water depths.

The LNG option for development of Australia's remote gas resource

T.W. Oerlemans
The Shell Company of Australia

LNG clearly is an option for development of the large gas reserves in remote locations in Australia, most notably in areas such as the North West Shelf, for which there is no other economic use in the foreseeable future.

But LNG is a high technology, high cost and high risk option for gas development and is not an option which can be approached lightly. An LNG project has certain unavoidable prerequisites for development. These include gas reserves large enough to support LNG production for some 20 years, an investment environment which is both stable and attractive to billion-dollar investments, a project structure which is technically, financially and managerially capable of the investment required and, most important, LNG buyers whose demand is of sufficient size and stability to warrant the project investment. The integrated, closed-loop nature of the production, liquefaction, shipping, and reliquefaction parts of the LNG scheme requires careful project development of all phases in parallel and integrated project control.

The project must have sufficient strength in all of these areas to convince not only the project participants to implement their investment program, but also the prospective LNG buyers to proceed with their multi-million dollar investments in receiving facilities and power stations.

The nature of LNG projects has limited their number and few are in operation or definitely under full development. Japan is the largest LNG market not only in the Pacific Basin but also in the world. And it is likely to provide the greatest prospects for any Australian LNG project following the North West Shelf, although a window for a new supply source may not appear before the mid 1990's. Other prospective markets include the U.S. West Coast and though much smaller, South Korea and Taiwan. None of these smaller markets is likely, by itself, to support an LNG project of economic size but they could provide an attractive supplementary market for a new project based on Japanese demand.

Mineral industry overview and outlook

J. Ward, BMR

During 1983 the Australian mineral industry operated under improved international economic conditions, prices firmed for some commodities and a record ex-mine value of about $10 billion is indicated, slightly down on 1982 in constant dollar terms. The effects of the world recession of the last two years are still being felt and although mine production of base metals, coal, oil and gold increased in 1983 output of many other commodities declined (Table 1). Nor did the processing sector of the industry fare any better. With the notable exception of aluminium for which new production capacity was commissioned, smelter and refinery production of ferrous and base metals in 1983 was generally at or below 1982 levels (Table 2).

While global trade in minerals continues to be adversely affected by reduced demand and low metal prices Australian exports of mineral primary products, on which the industry is so dependent, continued to expand and in 1983 established a new record estimated as $9.7 billion. This increase was achieved mainly by some liquidation of producer stocks and increased prices in terms of other currencies following devaluation of the $A in March 1983. The black coal, aluminium and iron ore industries continue to provide the major contribution to export revenue and together were responsible for almost 70% of total mineral export revenue in 1983 (Table 3). The Australian balance of trade in minerals was further improved by reduction in the value of mineral imports from $3.1 billion in 1982 to $2.1 billion in 1983 (Table 3). This resulted directly from a sharp reduction in crude oil imports which decreased both in quantity and value.

The industry enters 1984 with cautious optimism. World economic recovery is underway, led by the USA; interest rates have tended to ease; the liquidity position of many mining operations has improved; and more and more mining companies are recording operating profits. However, increasing demand and rapid expansion of the 1960s and 1970s are unlikely to be seen again in the short to medium term. Considerable excess production capacity is available around the world for most mineral commodities and this can be quickly recommissioned to meet renewed consumer demand; and so-called 'social minerals' have emerged, the development of which is not governed wholly by basic considerations of supply and demand. While some metal prices, notably those of aluminium, zinc and nickel have firmed, they remain well below those of the 1970s in real terms and lag behind increased development and production costs.

Australian producers are particularly vulnerable to swings and fluctuations in international trade, and maintenance and expansion of our share of world markets is, to a large extent, dependent on the competitiveness of our production costs. Economic conditions being equal, our unit costs will depend largely on the locality, size, grade and metallurgy of our mineral deposits, those delineated and those yet to be discovered.

It is therefore, cause for considerable concern that the upward trend in private expenditure on mineral exploration, a feature of the latter half of the 1970s, levelled out in the early 1980s, was reduced substantially in 1983 and shows signs of decreasing further in 1984. While Australia has major deposits of coal, bauxite, iron ore, uranium, base metals, and now diamonds and petroleum available for development, our long-term position as a major mineral and metal supplier to world markets depends on the discovery of large, strategically located and preferably high-grade deposits and their economic development. This will be achieved only by maintaining adequate levels of mineral exploration, research and development.

TABLE 1. MINE PRODUCTION OF PRINCIPAL MINERALS : AUSTRALIA

Mineral	Unit of Quantity	1980	1981	1982	1983(a)
Bauxite	'000 t	27 179	25 441	23 625	(e) 24 042
Black coal (b)	'000 t	93 664	110 945	119 015	(e) 121 050
Brown coal	'000t	32 894	32 959	37 821	(e) 37 000
Copper (c)	t	243 540	231 339	245 322	(e) 256 000
Gold (c)	kg	17 032	18 374	26 961	(e) 32 200
Ilmenite cons (d)	'000 t	1 385	1 321	1 149	(e) 875
Iron ore and cons (f)	'000 t	95 534	84 661	87 694	(e) 75 000
Lead (c)	t	397 491	388 122	455 338	(e) 477 000
Manganese ore,					
Metallurgical	'000 t	1 999	1 411	1 123	1 353
Nickel (c)	t	74 323	74 355	87 552	(e) 79 800
Petroleum					
Crude oil	'000m3	21 323	21 704	20 652	24 232
Natural gas	mil m3	9 567	11 268	11 594	11 896
Phosphate rock	t	6 621	21 997	211 463	(e) 15 300
Rutile cons	t	311 744	230 817	220 697	(e) 172 000
Silver (c)	kg	766 816	743 557	906 863	(e) 1 000 000
Tin (c)	t	11 588	12 267	12 126	(e) 9 700
Tungsten cons					
(65% WO_3)	t	6 936	6 823	5 079	(e) 4 000
Uranium (U_3O_8)	t	1 841	3 446	5 215	3 795
Zinc (c)	t	495 312	518 297	664 800	(e) 695 000
Zircon cons	t	491 547	434 246	462 476	(e) 383 534

(a) Preliminary, subject to revision; (b) Raw coal; (c) Total metallic content of minerals produced; (d) Excludes leucoxene; (f) Excludes iron oxide not intended for metal extraction.

TABLE 2. SMELTER AND REFINERY PRODUCTION OF PRINCIPAL METALS : AUSTRALIA

Mineral	Unit of Quantity	1980	1981	1982	1983(a)
Alumina	'000 t	7 246	7 079	6 631	7 231
Aluminium	t	303 494	379 427	380 796	(e)485 000
Copper - blister	t	174 920	172 181	175 536	173 620
refined	t	144 828	164 241	160 195	165 492
Gold	kg	14 761	14 991	25 711	29 646
Lead - in bullion for					
export	t	160 286	162 564	181 592	195 696
refined (b)	t	200 454	207 669	218 812	182 594
Pig iron	'000 t	6 960	6 830	5 956	5 045
Raw steel (c)	'000t	7 593	7 635	6 371	5 625
Silver (c)	kg	335 159	373 101	348 019	(e)316 000
Tin	t	4 819	4 286	3 105	2 913
Zinc	t	300 959	295 852	291 390	298 518

(a) Preliminary, subject to revision; (b) Includes lead content of lead alloys from primary sources; (c) Includes recovery from scrap

TABLE 3. AUSTRALIAN OVERSEAS TRADE OF MINERAL PRIMARY PRODUCTS

Minerals	Unit of Quantity	1981 Quantity	1981 Value f.o.b. ($'000)	1982 Quantity	1982 Value f.o.b. ($'000)	1983(a) Quantity	1983(a) Value f.o.b. ($'000)
Principal Exports							
Alumina	'000 t	6 509	1 082 002	5 951	1 103 255	6 356	1 179 763
Aluminium (ingot metal)	t	79 174	96 619	156 068	168 253	220 989	311 348
Coal (black)	'000 t	50 674	2 299 595	46 724	2 526 373	61 046	3 332 100
Copper (b)(c)	t	116 990	201 335	115 664	156 272	158 448	275 506
Gold (b)(c)	kg	7 420	55 577	13 076	135 844	20 614	269 905
Ilmenite concentrates (d)	t	922 865	24 554	893 333	25 188	827 731	25 012
Iron ore and pellets	'000 t	71 146	1 123 141	73 056	1 439 922	74 288	1 577 158
Iron, ingot steel, ferro-alloys	'000 t	576	98 602	457	65 004	903	126 413
Lead (b)(c)	t	343 942	320 005	412 655	336 141	409 732	412 945
LPG	'000 t	n.a.	(e)321 574	1 367	327 970	1 564	460 051
Nickel (c)	t	n.a.p.	389 794	n.a.p.	393 234	n.a.p.	321 052
Rutile concentrates	t	216 048	64 084	199 296	50 876	232 200	56 731
Salt, bulk	'000 t	3 962	43 530	4 124	54 796	4 534	68 842
Tin (b)(c)	t	8 811	98 281	7 792	92 531	8 970	116 800
Tungsten concentrates	t	6 347	49 989	4 939	35 083	3 888	20 289
Uranium and Thorium	t	1 625	120 044	5 459	415 047	3 279	296 008
Zinc (b)(c)	t	417 774	238 405	525 216	318 404	634 870	380 952
Zircon concentrates	t	444 186	36 994	405 215	43 064	382 818	45 046
Other minerals	-	-	359 954	-	318 568	-	388 275
Total	-		7 024 080		(f)8 005 825		(f)9 664 196
Principal Imports							
Aluminium	t	9 261	14 303	13 700	16 653	5 225	8 191
Asbestos, all types	t	20 960	12 112	20 200	14 734	10 114	8 776
Clays, all types	t	108 651	7 181	68 101	6 833	40 396	5 133
Diamonds, gems	m.c	109 774	38 249	167 590	31 608	72 007	30 724
Diamonds, industrial	m.c	1 267 582	7 901	1 026 476	5 620	1 120 615	4 862
Gold	kg	397	5 682	531	5 743	3 161	27 946
Ingot steel, ferro-alloys	t	31 432	24 464	18 564	15 520	17 290	13 197
Nickel - matte, metal	t	844	5 036	1 349	7 858	356	1 957
Oil, crude (g)	'000 m^3	11 049	2 011 304	13 552	2 777 878	8 684	1 764 130
Phosphate rock	'000 t	1 962	98 396	1 924	100 368	2 198	113 573
Potassium fertilisers	t	201 364	22 626	226 459	22 791	189 956	20 064
Sulphur, elemental	t	555 517	42 807	458 933	39 038	392 581	32 930
Other	-	-	82 286	-	53 862	-	53 358
Total	-		2 372 347		3 098 506		2 084 841

(a) Preliminary, subject to revision; (b) The quantity refers to total metallic contents contained in all ores and concentrates, drosses, lead bullion and blister copper and refined metal where applicable; (c) The values shown include the value of ore and concentrate, intermediate products and refined metal; (d) Includes leuxocene; (f) Excludes beneficiated ilmenite (g) Including enriched crude and other refinery feedstock.

Outlook for black coal

M.B. Huleatt, BMR

The coal industry had a difficult year in 1983. Estimated production rose to the record levels of 121 Mt and 99.9 Mt for raw and saleable coal respectively. Exports reached a record of 61 Mt valued at $3332 million. Domestic consumption fell to 36.6 Mt. These favourable factors were offset by a series of unfavourable circumstances including very high stocks, substantial price reductions for some export contracts and continued world oversupply of coal.

About 60% of Australia's saleable coal production is exported making the industry more vulnerable to fluctuations in international demand than any competitor. Although world demand has been flat in recent years there appear to be signs of an economic recovery which should result in its gradual improvement. Before the effects of this growth can have a sustainable beneficial effect on the Australian industry the world oversupply must be reduced, as must the current high stock levels in Australia.

Australia's coal resources are more than adequate to meet demand. Exploration slowed in 1982-83 in both Queensland and New South Wales but appears to have continued at the previous year's level in other States. Continued introduction of longwall mining methods and the trend toward more production from open cut mines will improve overall resource recovery during mining.

Estimated average operating costs for mines producing export coking coal in various Australian locations indicate that open cut mines are, in general, in a more favourable position than underground mines. Comparison of average operating costs (not including replacement costs) with indicative f.o.b. export prices, suggest that the economics of each type of operation is not favourable although underground producers are in a more precarious position.

This suggests that, while export prices remain at current levels, the trend toward greater open cut production will continue. Should export prices decline further producers will have to make major efforts to contain costs if they are to remain viable.

Coal consumption in Australia is dominated by the electricity and steel industries which account for about 90% of total consumption. Most coal for these industries is supplied by captive mines which are able to supply more than is required. Therefore while growth in domestic demand remains low, non-captive mines will have little opportunity to partake in it and will have to rely on the export market to improve their position.

TABLE 1. PROPORTION OF SALEABLE BLACK COAL PRODUCTION EXPORTED

Country	1982	1983(e)
Australia	50.7%	60%
Canada (1)	46.3%	
South Africa	22.2%	
USA	13.2%	10%
Poland	14.9%	

(e) estimated

(1) Canada imports almost as much coal as is exported

TABLE 2. AUSTRALIAN BLACK COAL STOCKPILES AT END DECEMBER

	New South Wales		Australia	
Year	'000 tonnes	% of saleable production	'000 tonnes	% of saleable production
1973	8 786	26.8	10 875	19.6
1974	8 087	24.0	10 483	18.1
1975	7 505	22.0	11 697	19.2
1976	9 618	25.3	14 037	20.6
1977	11 520	28.4	16 544	23.3
1978	12 351	28.9	16 830	23.4
1979	11 782	27.5	16 376	21.8
1980	7 685	18.0	13 425	17.6
1981	12 141	23.2	17 486	19.0
1982	19 118	34.2	28 459	29.0
1983(e)	21 540	37.8	27 200	27.2

(e) estimated

TABLE 3. AUSTRALIAN DEMONSTRATED RESOURCES OF BLACK COAL : DECEMBER 1983

(million tonnes)

	In situ	Recoverable
New South Wales	22 743	12 133
Queensland	29 793	18 015
Tasmania	530	246
South Australia	150	150
Western Australia	741	482
	53 957	31 026

TABLE 4. SHARE OF RAW COAL PRODUCTION DERIVED FROM OPEN CUT MINES (%)

Year	NSW	QLD	Australia
1978	24.0	87.9	51.4
1979	25.4	87.7	53.2
1980	27.5	88.1	55.1
1981	24.1	88.9	53.0
1982	29.3	88.5	55.7
1983(e)	34.3	88.8	58.4

(e) estimated

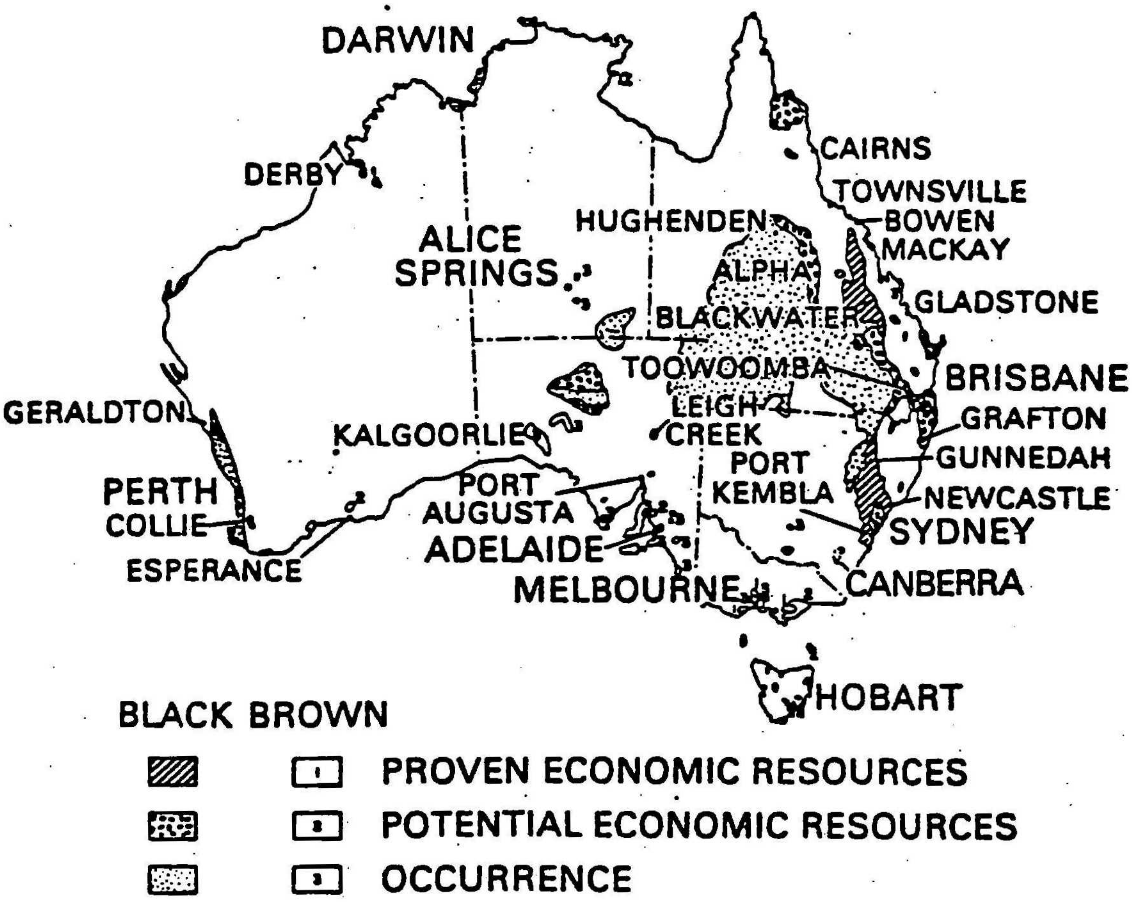
TABLE 5. ESTIMATED AVERAGE COSTS FOR SOME NEW SOUTH WALES COAL MINING AREAS

($A)

Cost/Price	South Underground	Southwest Underground	Hunter Valley Underground	Hunter Valley Open cut New	Hunter Valley Open cut Old
Mining	43.89	33.11	30.14	15.62	21.89
Washing	6.93	5.83	4.73	3.63	4.23
Post Mining Costs	12.90	18.50	20.50	28.00	20.90
Total	63.72	57.44	55.37	47.25	47.52
Indicative Price	60.00	58.56	49.67-50.28		
Cost/Price surplus of Deficit	-3.72	+1.12	-5.70 to -5.09	+2.42 to + 3.03	+2.15 to +2.76

Note: Price converted at rate of $US1 = A$0.90

AUSTRALIAS COAL RESOURCES



Economic aspects and cost trends

John Tysoe
Department of Resources and Energy

Despite record exports of coal in 1983, it is generally accepted that the Australian coal industry faces a number of problems.

This paper examines some of the main international and domestic factors affecting the economic performance of the industry, provides an overview of its cost structure and concludes with a review of Government policies and initiatives relevant to the industry.

Australia ranks second as a coal exporter but surpassed the USA in coal seaborne trade in 1983. Our export coal industry has become the country's largest single earner of export income. Nevertheless, the Australian industry has been subjected to pressures similar to those in the international market, namely oversupply, falling prices for most exporters and cutbacks on contracted tonnages by major buyers. The oversupply situation is likely to be exacerbated by the significant additions to world capacity expected over the next few years from new mines in countries such as Canada, Columbia, China and Australia. Increased stockpiles, retrenchments and reduced profits are also being experienced.

Domestic factors have also influenced the industry's performance, principally the sluggish growth in domestic demand.

It is against this background that the industry has expressed its concern to remain viable and internationally competitive. Data available on industry costs will be examined and comparisons drawn with Australia's major competitors and on the viability of Australian mines.

Government policies have been developed with the aim of facilitating the long-run efficiency of the industry. In recognition of the importance of the industry to the economy, the Government has given special attention to coal industry problems and has established the Australian Coal Consultative Council as the principal forum through which all parties involved in the industry can seek industry-based solutions. The paper concludes by commenting on the performance of the Council to date in achieving its objectives.

The future of the Australian coal industry in an international context

J. Yeowart
Australian Coal Association

Coal will play an important role in helping meet the world's future energy requirements. (Tables I and II).

Australia as a coal supplier has logistical supply advantages into Japan and other Asian markets. Demand for coal, particularly steaming coal by these areas is expected to grow significantly between now and the year 2000. (Tables I & II).

Australia has vast reserves of high quality low cost coal very close to the eastern Australian seabord. On top of this Australia has sufficient infrastructure to meet demand requirements to at least 1990.

Although Australia appears to be well placed in terms of supply advantages into strong coal demand growth regions it cannot be assumed that in the future Australia will have some guaranteed portion of the world coal trade at similar levels to what it has at the moment.

Today's and tomorrow's international coal market is one of gross oversupply & fierce competition from South Africa, Canada, Columbia, U.S.A., Poland and potentially China and Russia. Because of this Australia has neither the option nor the capacity to influence price changes. It is probable that by the early 1990's the oversupply situation will have worked itself out. At this time it will be countries which have secured the markets in today's difficult times which will benefit from firming prices and predictable sales in the future.

For Australian producers to be able to secure markets today, they must be permitted to make sufficient returns under prevailing market conditions to justify continuing in the business. To do this several changes are required.

(a) Mines must be able to maximise and therefore optimise production levels.

(b) Government take from the Australian coal industry should be set at levels similar to that of our competitors so that Australia is on an equal footing in this regard.

(c) Consumers and potential consumers must see Australia as a reliable supplier.

TABLE I

REGIONAL THERMAL COAL IMPORTS
(Million Metric Tons)

	1980 Revised	1985	1990	2000	1980-2000 Compound Growth Rates %/Year
W. Europe	67	68	119	180	5.1
Japan	7	23	46	69	12.1
Other Asia	5	18	34	69	14.0
Canada	10	12	10	6	-2.5
Latin America	1	1	3	4	7.2
Others	2	4	11	13	9.8
Sub-Total*	92	126	222	341	6.8
Centrally Planned Europe	21	21	22	25	0.9
Centrally Planned Asia	2	3	3	5	4.7
Total *	115	149	247	371	6.0

Source: Chase Manhattan Bank, March 1983

* Totals may not add due to independent rounding.

TABLE II

REGIONAL METALLURGICAL COAL IMPORTS
(Million Metric Tons)

	1980 Revised	1985	1990	2000	1980-2000 Compound Growth Rates %/Year
W. Europe	45	49	54	68	2.1
Japan	63	62	66	75	0.9
Other Asia	7	12	17	37	8.7
Canada	6	5	6	7	0.8
Latin America	6	8	12	21	6.5
Others	1	3	3	8	11.0
Sub-Total *	128	139	158	216	2.7
Centrally Planned Europe	13	12	13	14	0.4
Centrally Planned Asia	2	2	2	3	2.0
Total *	144	153	173	233	2.4

Source: Chase Manhattan Bank, March 1983

* Totals may not add due to independent rounding.

Mineral exploration in Australia - 1983 review & outlook

D.H. Mackenzie
CRA Exploration Pty Limited

The Australian mineral exploration industry, inclusive of coal and oil shale, operated in calendar 1983 at a reduced expenditure level which in real terms was 28% below 1982 and 36% below the peak year of 1981. The decline of activity accelerated from mid-1982 when metal prices were the lowest for many years. The meterage drilled and the areal coverage of commercial metalliferous airborne geophysical surveys both fell commensurate with expenditure. The reduction in activity was mainly carried by the sectors engaged in coal, oil shale, uranium and tin exploration in response to a variety of economic, technical, political and fiscal factors.

Despite the overall downturn gold exploration took the limelight in a counter-cyclical way with increased activity in all states, but particularly in W.A. The pressure built up by production starts and new discoveries announced in 1982 continued to rise. New reports of significant gold intersections heavily outnumbered discoveries in all other commodities. For the first time in years several new companies were successfully floated to explore for gold. Boom levels of activity prevailed in the Eastern Goldfields of Western Australia where many small- to medium-sized discoveries were made. Their geological settings were varied but the usual pattern was oxidised ore around and within old gold-mining properties.

Significant gold discoveries were also made in all other states except South Australia and resulted in heavy pegging in old gold-mining areas. The most notable discovery made anywhere was Red Dome in north Queensland where a geological resource of some 35t gold metal in skarns and breccias was reported.

Diamond exploration continued at a relatively strong level and was characterised by large title holdings especially in South Australia and the Northern Territory where much work was previously carried out in open-range style. However no significant discoveries were reported.

In the second half of 1983 base metal exploration was given a boost by two discovery announcements. At Nifty in the east Pilbara, W.A., high-grade secondary and primary copper intersections were reported in an area of Proterozoic sediments and heavy ground acquisition resulted. An electrical geophysical survey at Hellyer near Que River, Tasmania, led to discovery of concealed polymetallic massive sulphides in Cambrian acid volcanics and a consequent upsurge in demand for use of the UTEM system.

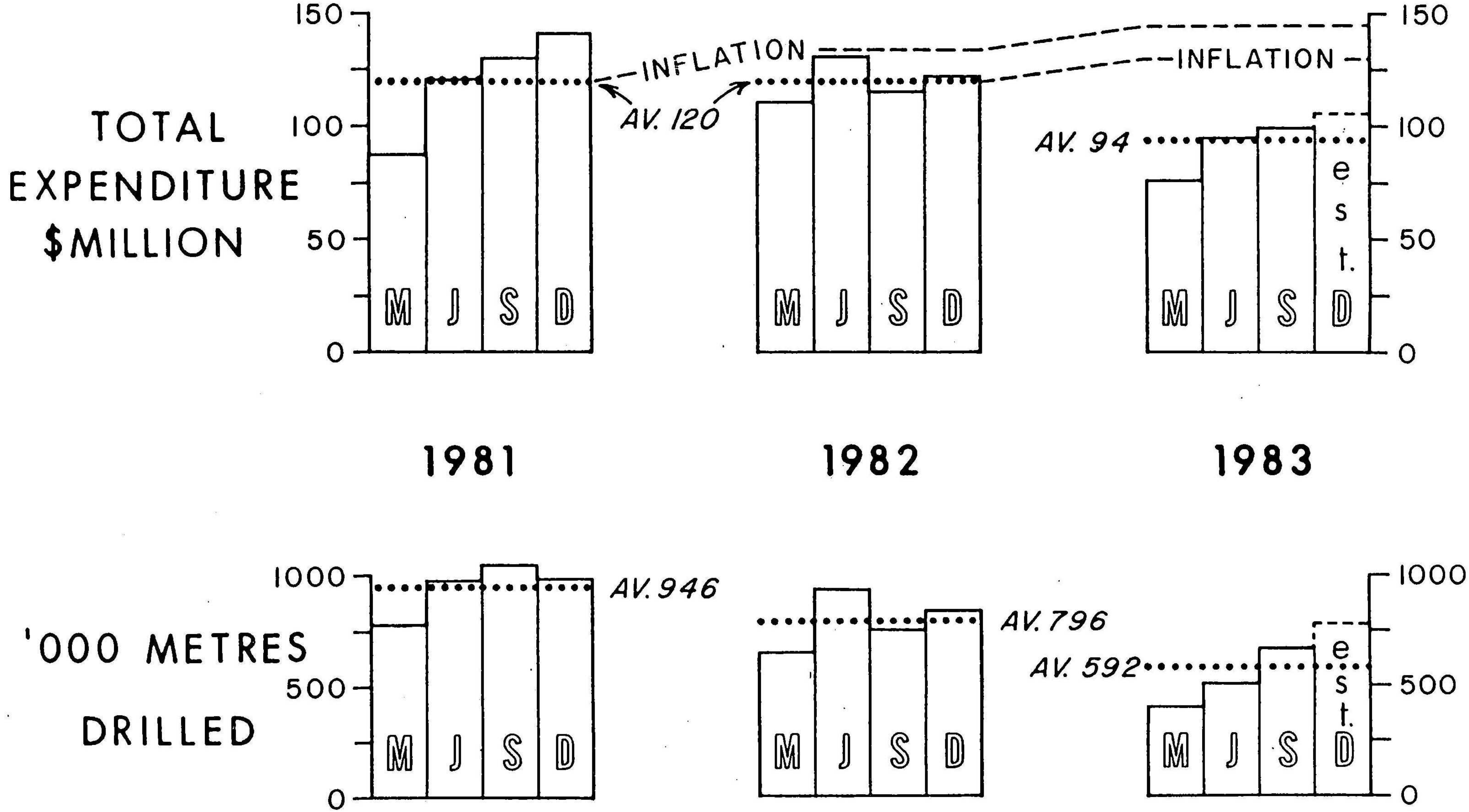
Despite the reduction in grassroots coal exploration there were reports of black coal intersections in the South Perth Basin and new reserves in North-east Tasmania. Ironically the year of virtual collapse of the uranium exploration industry saw the announcement of vastly increased reserves, to some 550,000t U_3O_8 at Olympic Dam, S.A.

Industrial minerals made small headlines with reports of long high-grade magnesite intersections at Arthur and Lyons Rivers in Tasmania.

In geophysics a swing to greater use of electromagnetic methods took place. Reverse circulation drilling was the key to rapid cost-effective gold exploration in oxidised terrain. Various methods were employed to provide cheaper and faster gold assaying and to allow treatment of large volume geochemical samples routinely for gold.

1983 showed that there is no shortage of resources yet to be discovered. The challenge to the industry is to find resources which are economically viable and internationally competitive. Four factors seem critically important to future exploration. The first is access to land, not once but repeatedly. The second is access to the widest possible range of geotechnical information, both public and private. The third is application of suitable techniques which will remotely-sense mineral deposits. The fourth is a rate of return sufficient to encourage exploration to continue bearing in mind that, because Australia's competitive position is declining, we need to discover deposits better than our international competitors to overcome the "quality" differential required.

MINERAL & OIL-SHALE EXPLORATION



Source : A.B.S.

Minerals processing in Australia

K.P. McHugh
Department of Resources & Energy

The objective of further processing of minerals and other raw materials (RMP), has received bipartisan political support over the past few years, at Federal and State levels. The paper looks at the development of RMP industries in Australia since the mid 1970s. It examines some of the reasons why Australia's comparative advantage in this regard may not have been fully exploited and suggests some options that might help to further develop mineral and other processing in Australia.

A Commonwealth/State Joint Study Group was established in November 1978 to identify processing opportunities and to examine the implications for Commonwealth and State policies and the need for new policy initiatives. The Commonwealth has also established bilateral study groups with Japan and Korea to help identify opportunities in these markets.

Some industries have considerably increased their processing activity over the past decade, including alumina/ aluminium, nickel, and to a lesser extent copper, ferromanganese and zinc. However, expectations in relation to RMP have only been partially fulfilled; the average growth rate for RMP industries over the last decade has been less than for the economy as a whole and returns on investment relative to manufacturing industry have been low.

Domestic and international factors have had a significant bearing on the rate and scale of RMP development. The effects of relatively depressed world market conditions and restrictive trade and other policies by major industrialised countries are discussed, together with the impact of transportation and construction costs and other domestic factors, such as Australia's labour productivity and industrial situation.

Looking to the future, only modest rates of growth for processing industries are projected. Factors such as market saturation, metal or product substitution, greater efficiencies in product design and metal utilisation, recycling and environmental constraints are likely to affect demand for metals to an increasing extent, over and above the level of international economic activity and the question of access to markets. Opportunities do exist, however, to sustain and enhance industry competitiveness.

Gemstones

R.G. Dodson, BMR

Diamonds. Although diamonds were mined on a small scale in New South Wales as far back as the 1870s, 1983 was a milestone in the Australian mineral industry in that large-scale diamond mining commenced on the alluvial and residual deposits at Argyle, Kimberley region, WA. Production in 1983 amounted to 6.3 million carats which is estimated to be about 13% of world production. Equally important, a decision was made to mine the AK-1 kimberlitic pipe (Argyle) from 1985 onwards. Estimated production will be about 25 million cts/year, accounting for at least one-third of the world's output of natural diamonds in 1986. Projections of world consumption of industrial diamonds indicate that the increase of production will be readily absorbed; disposal of the gemstones will depend on marketing success. Resources of the AK-1 pipe are estimated to be 60 Mt grading at 6.8 cts/t of which 55% are industrial diamonds, 45% cheap gem and 5% gem quality. Recent discoveries of diamonds, kimberlitic rocks and kimberlite indicator minerals in several parts of the Kimberley region, northwest of Kalgoorlie, in South Australia, and in parts of the Northern Territory, may indicate the presence of other important diamond provinces in Australia. The source of the diamonds in New South Wales has never been established.

Sapphires. Australia's sapphire production in 1983 was estimated to be worth more than $23.8M. Australia produces 70-80% of the world's uncut sapphires including most of the highly-prized golden sapphires and the characteristic ink-blue sapphire. Other sapphires produced are pale blue, greenish, purple, parti-coloured and white. The sapphires occur in alluvial gravels. It is difficult to quantify Australia's sapphire resources but the widespread distribution of sapphires in parts of New South Wales and Queensland and their mineral associations indicate that reaources are adequate to maintain production for many years.

Opal is mined mainly in three fields (Andamooka, Coober Pedy and Mintabie) in South Australia, also at Lightning Ridge, NSW, and from a number of small deposits in central Queensland. Australia accounts for over 80% of the world's opals and 100% of the world's black opal production. The value of Australian production of opal in 1983 is estimated at $42M. However, because of the nature of the industry, production statistics can only be estimated on the basis of mining activity on the opal fields. Although resources of opal are not known, the geological conditions conducive to the deposition of opal apply to extensive areas of South Australia and New South Wales; undiscovered resources are assumed to be very large.

Other gemstones are mined in small quantities in parts of Australia, the more common being rhodonite, nephrite, chrysoprase, garnet, zircon, and amethyst. The known resources of the more common types of gemstones are considered to be adequate for considerable expansion of production providing markets can be established.

Phosphate developments and outlook

A. Driessen, BMR

The Australian and world fertiliser industries have experienced difficult times in recent years. In Australia the downturn was exacerbated by a prolonged drought and lingering inflation. Worldwide, levels of capacity utilisation decreased (in the US, the world's largest phosphate-rock producer accounting for about one-third of world output, average industry-wide capacity utilisation dropped to 59% in 1982) and fertiliser prices were also marked down; signs of a recovery were not evident until the latter part of 1983. The downturn had its effects in Australia:- 1) Queensland Phosphate Ltd (QPL) was unable to renegotiate a satisfactory price for 1982/83 deliveries and the company closed its operation in north Queensland in January 1983; 2) dumping complaints were lodged by various parties in respect of Florida rock imports and imports of manufactured fertiliser; 3) Australian Fertilizers Ltd (AFL), unable to compete with imports, suspended production of compound fertilisers based on ammonium phosphate.

Australia has large resources of phosphate rock (5280 Mt, average grade 15.0% P_2O_5), mostly in northern Australia, but these are presently not commercially viable mainly because of their remote location and Australia's high freight costs, particularly shipping costs. To alleviate this problem QPL and CSIRO have been investigating ways of producing an upgraded product. Recently CSIRO reported that it had developed a new process for upgrading low-grade, high-silica rock to a fertiliser more concentrated in P than conventional single superphosphate. The process produces dicalcium phosphate and calcium sulphite, either separately or as a fertiliser mixture. Dicalcium phosphate, separately, can also be processed further to phosphoric acid. QPL is also investigating the feasibility of producing conventional-process phosphoric acid.

Preliminary, wide-spaced drilling by Union Oil, of a carbonatite-related phosphate prospect at Mount Weld, near Laverton, WA, has outlined an apatite-enriched zone, of medium grade, which could possibly exceed 100 Mt. Insufficient work has been completed to delineate the resource more accurately, but work is continuing. Given the high cost of coastal shipping, any possible long-term development of this prospect should not affect QPL's Phosphate Hill project except for some possible competition in the export market.

World resources of rock exploitable at costs lower than what is presently possible in Australia are not in short supply so that large-scale phosphate-rock mining in Australia is unlikely until sometime in the nineties at which time the deposits on Christmas Island and Nauru will be nearing depletion. Until then Australian fertiliser manufacturers will continue to rely on imported rock.

TABLE OF SALIENT STATISTICS (TONNES)

	1981	1982	1983(p)
Production of phosphate rock	21 997	211 463	15 300
Imports of phosphate rock	1 961 897	1 923 886	2 161 000
Consumption of phosphate rock in manufactured fertiliser (a)	2 403 000	2 156 000	1 806 000
Production of superphosphate (b)	3 665 000	3 337 000	2 700 000
Imports of phosphatic fertilisers, contained P (c)(d)(e)	16 500	14 500	51 000

(a) source Australian Phosphate Corporation Ltd; (b) includes all phosphatic fertilisers in terms of single superphosphate equivalent - 9.6% P basis; (c) fiscal years ended June 1981, 1982 and 1983; (d) comprises items superphosphates, ammonium phosphates, other phosphatic fertilisers, NPK fertilisers, NP fertilisers, and phosphoric acid; (e) estimated by BMR; (p) preliminary figures.

Iron and steel

R. Pratt, BMR

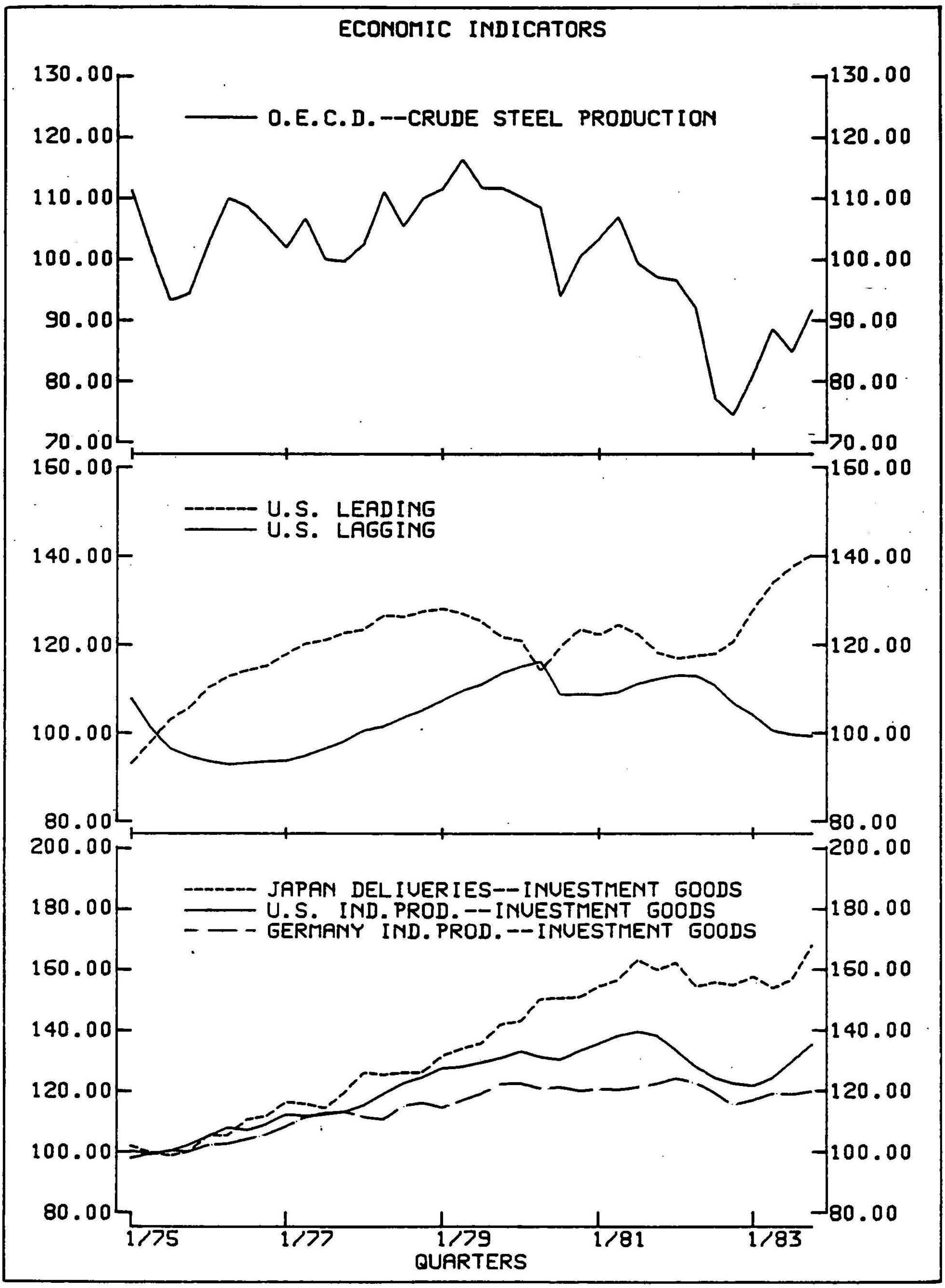
World steel production in 1983 increased slightly in accordance with a consumer led recovery in world economic activity. However, excess capacity continued to characterise world steel and iron ore-mining industries.

Reduced Australian iron ore production (79 Mt) reflected depressed domestic and overseas demand and the effects of industrial disputes. Exports (74.3 Mt) increased slightly on 1982 figures but their value rose to a record ($1577 million) partly because of a depreciation of the A$ relative to the US$, in which most contract prices are expressed, as well as contract price increases negotiated in 1982 which were only partly offset by 1983 price decreases. Iron ore exploration activity was reduced substantially as part of cost reduction measures; producers ceased programs completely or concentrated on particular aspects of exploration. The total of identified iron ore resources therefore changed little during 1983. Australia's demonstrated economic resources decreased slightly as a result of the reclassification of some resources but are sufficient for about 200 years at the current production rate.

Australian iron and steel output fell in 1983 compared with 1982. However, production rates continued to increase in the June and September quarters from the low level early in 1983 mainly because of a recovery in domestic sales, but then declined slightly at the end of the year. An increase in iron and steel exports resulted mainly from a resumption of pig iron shipments. A plan aimed at restoring the Australian industry's international competitive position was announced and will include capital investment of $800 million over the next four years and bounty payments on domestic sales of particular products.

World steel output in 1984 seems likely to continue the modest recovery which began in 1983. Similarly Australian steel consumption and output should continue to increase as the Australian economy recovers, but is unlikely to attain the pre-1982 level in 1984. Low demand, particularly from Japan, and falling prices will cause iron ore producers to continue to concentrate on cost reductions and competitive ability, and increased exploration expenditure is unlikely. Prospects exist in 1984 for a further increase in iron ore exports to markets outside Japan. However, any increase in total export sales is likely to be offset by reduced f.o.b. returns because of price decreases in 1983 and 1984.

Steel output by major Western world steel producers is not expected to recover to the levels attained in the early 1970s in the immediate future, and over-capacity in world iron ore supply is likely to continue. Australian iron ore production capacity at some 125 Mt/year would appear sufficient for a number of years and it seems unlikely that any additional capacity from a new producer will be required until well into the 1990s.


ECONOMIC INDICATORS
130.00
120.00
110.00
100.00
90.00
80.00
70.00
O.E.C.D.--CRUDE STEEL PRODUCTION
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140.00
120.00
100.00
80.00
U.S. LEADING
U.S. LAGGING
200.00
180.00
160.00
140.00
120.00
100.00
80.00
JAPAN DELIVERIES--INVESTMENT GOODS
U.S. IND.PROD.--INVESTMENT GOODS
GERMANY IND.PROD.--INVESTMENT GOODS
1/75
1/77
1/79
1/81
1/83
QUARTERS

Future prospects for Australian iron ore

M.D.A. Gregson
The Broken Hill Pty Co. Ltd

INTRODUCTION

Future sales prospects for Australian iron ores will depend upon a range of economic, political and technical factors.

WHO USES AUSTRALIAN IRON ORE?

From the table showing major export markets for Australian iron ore (TABLE 1) we can see that Japan is by far our largest market and that Asia in total accounts for between 80-85% of our annual iron ore exports. Blast furnace based steelmakers in Asia (Japan, R.O.K., R.O.C. P.R.C.) are the major consumers of Australian iron ores.

OUTLOOK FOR WORLD STEEL PRODUCTION

We believe that overall growth in world steel production will be of the order of 1% p.a. between 1985-1990. This growth will be uneven however - industrialised countries are expected to have an average growth rate of only 0.7% p.a. while in developing countries steel production will grow at a rate of 3.8% p.a. Where steel is made - and whether it is made via the blast furnace route or the scrap/EAF route will obviously affect our iron ore sales .

From the table (TABLE 2) on forecast steel production we can see that for our major market areas, growth in steel production is only expected to occur in R.O.K., R.O.C. and P.R.C. - with virtually static production in Japan and Europe.

TECHNICAL AND ECONOMIC FACTORS AFFECTING STEEL DEMAND

A) Product life cycles - Saturation of the steel market.

B) Scrap availability.

C) Improved design.

D) Improved manufacturing technology.

E) Steel substitution.

F) Better systems management.

TECHNICAL FACTORS AFFECTING ORE DEMAND

A) Chemical composition of ores.

B) Production requirements of steelmakers.

C) DRI production.

ECONOMIC & POLITICAL CONSIDERATIONS IN ORE DEMAND

SUMMARY

As long as Australian iron ore producers remain competitive with respect to price, quality, and delivery; and Australia remains a socially and politically reliable supplier then the Australian iron ore industry should continue to grow at a pedestrian rate in what is now a mature industry.

TABLE 1.

MAJOR MARKETS FOR AUSTRALIAN IRON ORE EXPORTS

(% share)

Dest./Yr.	1973	74	75	76	77	78	79	80	81	82	83
Japan	84	79	77	77	79	70	71	73	76	73	69
Other Asia	1	3	3	4	5	13	14	14	10	12	14
Europe	14	17	19	19	16	17	16	13	13	15	17
Total Exports (10^6 tonnes)	74	84	80	81	79	75	78	80	72	73	70

Source: Department of Trade

TABLE 2.

CRUDE STEEL PRODUCTION FORECASTS

(Million tonnes)

	1982	1983	1984	1985	1990	Av. Growth Rate 1985-1990 % p.a.
Japan	100	97.2	101.5	102	107	1.0
ROK	11.8	11.9	12.0	13	17	6.0
PRC	37.2	39.9	41.1	42.1	49.1	3.3
ROC	4.2	5.0	5.0	5.2	8.5	13.0
W. Europe	144	143.4	147	160	165	0.6
World	645	663.9	693.5	715	760	1.2

Source: BHP Economics Department, February 1984

Tin

I.R. McLeod, BMR

Although export quotas representing a 38% reduction of annual production applied to International Tin Council (ITC) producer members for the whole of 1983, estimated world production (160 000 t) exceeded estimated world consumption by 4000 t ('World' figures exclude USSR and China). Production did not decrease as much as expected, mainly because of estimated increased production of 5000 t by Brazil which is not a member of the ITC, and a large increase in the amount of tin smuggled out of Southeast Asian countries (estimated by the ITC as 16 500 t in the 12 months ending June 1983).

However, demand - world consumption plus imports by USSR (1600 t) minus exports by China (4000 t) - exceeded supply - world production plus sales by the US General Services Administration (3000 t) - by an estimated 5000 t. Commercial stocks are 20 000 to 30 000 t higher than normal and in addition, the ITC buffer stock manager holds more than 50 000 t and the GSA has more than 20 000 t available for disposal.

Looking ahead, Brazilian production could increase further by 3000 t over the next three years. Production by UK and Canada could increase also, although both are consumer members of the ITC. UK production could increase by over 1000 t and a mine with an output of over 4000 t of tin-in-concentrates is expected to come on stream in Canada in late 1985. So world production in 1986 conservatively could be more than 7000 t greater than in 1983. Consumption is unlikely to increase by more than 2000 to 3000 t. Assuming the amount of smuggled tin can be reduced by 7000 t/year and that net imports by Communist countries and GSA disposals are similar to the amounts in 1983, demand is likely to exceed supply by only about 8000 t despite the 40% cut in production by ITC producer members. The small excess of demand over supply and the large stock levels overhanging the market, especially the large buffer stock holdings, indicate that export controls are likely to be necessary for several years.

In Australia, mine production fell 20% to an estimated 9700 t because of the quotas. Most producers have continued operations despite the quotas, mine capacity is not much less than it was two or three years ago, and total demonstrated economic resources have not changed much. Prolonged export quotas may see more closures; alternatively producers may turn to working the higher grade parts of deposits with possible consequences of reduced mine life and, from the national point of view, loss of workable resources. The uncertain outlook will inhibit capital expenditure, and operators will have increasing difficulty in containing rising costs, so contraction rather than growth is likely in the medium term.

Tin

Estimated world supply and demand for 1983 and 1984

('000 t)

		1983	1986
1.	Mine production (at quota levels for ITC producer members; excluding USSR and China; including smuggled tin)	160	160
2.	Consumption (excluding USSR and China)	156	159
3.	Net imports by USSR and China (China exports 4; USSR imports 16)	12	12
4.	GSA sales -	3	3
5.	Production surplus (1-2)	4	1
6.	Supply (1+4)	163	163
7.	Demand (2+3)	168	171
8.	Supply deficit (7-6)	5	8

Tantalum

N.D. Knight, BMR

After two years of very depressed market conditions, the tantalum industry in 1983 gave some indications that recovery was underway - at least on the demand side. Processers' stocks, which have been overhanging the market since 1980, began to fall and prices began moving upwards from levels to which they had so precipitously fallen in 1981 and 1982.

Western world production is estimated to have been about 1.4 Mlbs of Ta_2O_5 (520 t Ta) contained in concentrates and tin smelter slags, 26% less than 1982 due to continued mine closures and lower slag production because of International Tin Council tin quotas. Australia's production continued to represent about 8% of this total and, at 100 000 lbs Ta_2O_5 (37 t Ta), it fell by 27% compared with 1982.

Western world demand is estimated to have increased by about 26% to 2.4 Mlbs Ta_2O_5 (892 t Ta) in response to an upturn in the electronics and, to a lesser degree, in the capital goods sectors. Processers' stocks are thought to have decreased by about 22% to 4Mlbs (1 490 t Ta) but old low-grade slag stocks still remain at about 5 Mlbs (1 860 t Ta). Prices rose to $US28-30/lb Ta_2O_5, mainly in response to an acquisition of 244 200 lbs Ta_2O_5 (90 t Ta) contained in concentrates by the US General Services Administration for the stockpile, but prices are still below cost levels for a large number of producers.

Escalating prices and anticipated increased demand in the period 1978-80 prompted the search for new deposits and the assessment of known deposits resulting in an increase in resources. However, there has been little incentive for exploration for the last 3 years and no major additions were made to Western world reserves during 1983. Demonstrated resources remain at about 194 Mlbs of Ta_2O_5 (72 000 t Ta) of which Australia has about 15%, nearly all in the Greenbushes deposit.

The outlook for 1984 should be a little better than 1983; Western world production is expected to increase to 1.6 Mlb Ta_2O_5 (590 t Ta); demand is likely to be about 2.5 Mlbs (930 t Ta); and prices are expected to move upwards to $US35-40/lb Ta_2O_5.

Demand is expected to exceed 4 Mlb Ta_2O_5/year (1 490 t Ta) by 2000. In order to meet the anticipated demand, production from primary tantalite deposits will increase, because sources of slags are limited. Australia, with its large, relatively high-grade, resources of tantalum is in a good position to become an increasingly important tantalum supplier.

WORLD MINE PRODUCTION OF TANTALUM (a)(t)

	Tantalum content			
	1979	1980	1981	1982(e)
Australia	54	69	87	50
Brazil	9	127	135	122
Canada	130	104	102	86
Malaysia	4	4	-	-
Mozambique	30	32	n.a.	n.a.
Nigeria	32	34	22	18
Thailand	16	85	75	68
Zaire	7	9	21	18
Others	24	18	30	23
Total (b)	388	482	472	385

Source: USBM

(a) Concentrates only - in 1983 about 64% of total tantalum produced came from tin slags.

(b) Excludes Communist countries.

(e) Estimated

PROJECTED PRODUCTION FROM VARIOUS SOURCES

Ta_2O_5 lbs derived from	1983	1986	1990	Production 1990 - 2000	Cost of Production($)
Slag > 10	780	990	970	Steady	5-15
Slag < 10	230	330	420	Steady	22-40
Tin mines co-product	220	420	300	Decreasing	29-32
Secondary deposits	170	610	140	Decreasing	10-45
Primary deposits		370	800	Increasing	26-36
	1400	2720	2630		

Source: Linden, T.I.C. Bulletin, '83

AUSTRALIAN TANTALITE-COLUMBITE PRODUCTION (kg)

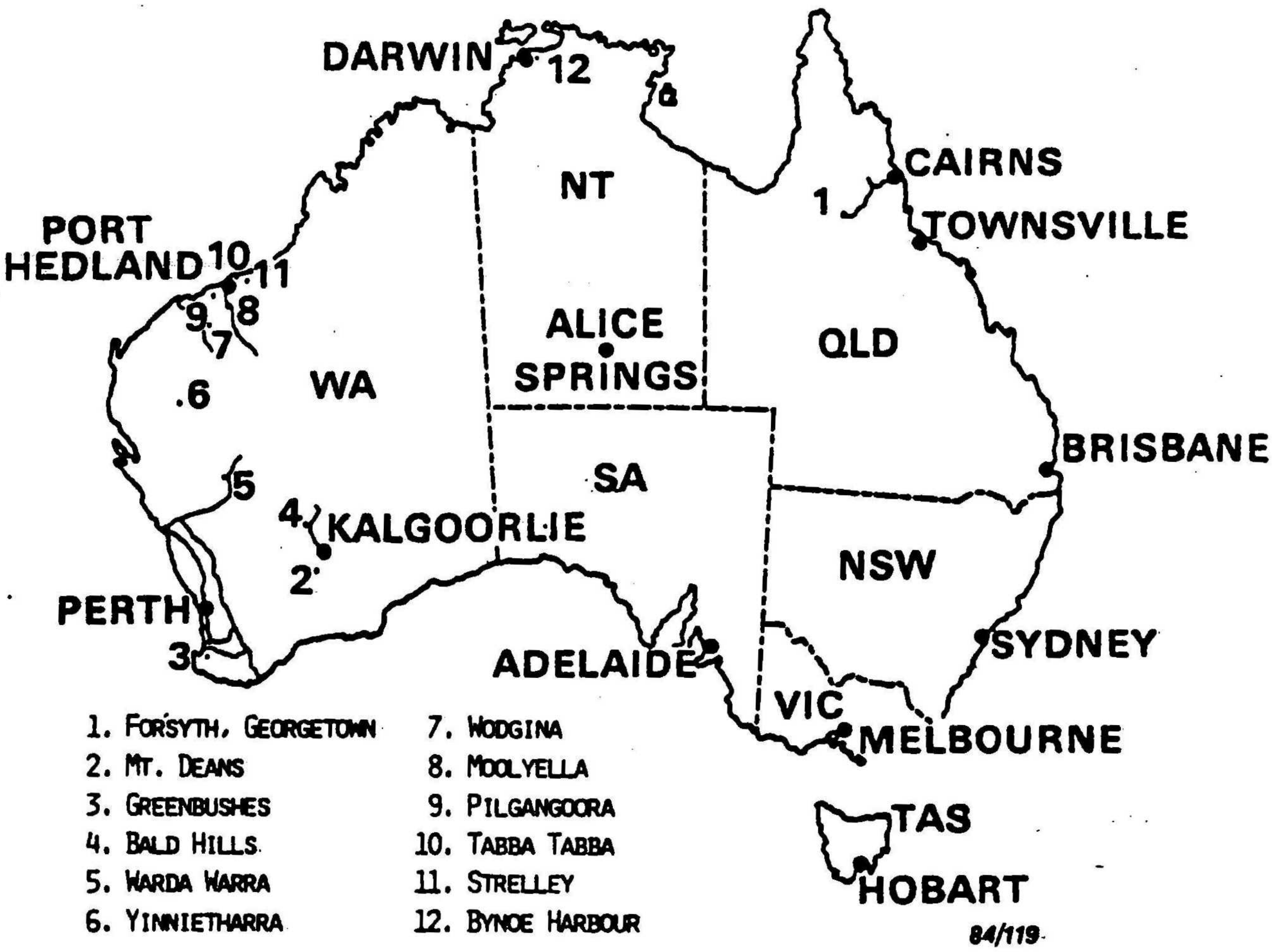
	1980	1981	1982	1983(e)
Tantalite-columbite concentrate	202 219	263 857	162 022	77 500
Ta_2O_5 + Nb_2O_5 content of mine products	84 409	106 947	62 081	31 000
Value ($'000)	(a) 16 248	(a) 14 822	(a) 3 879	4 100

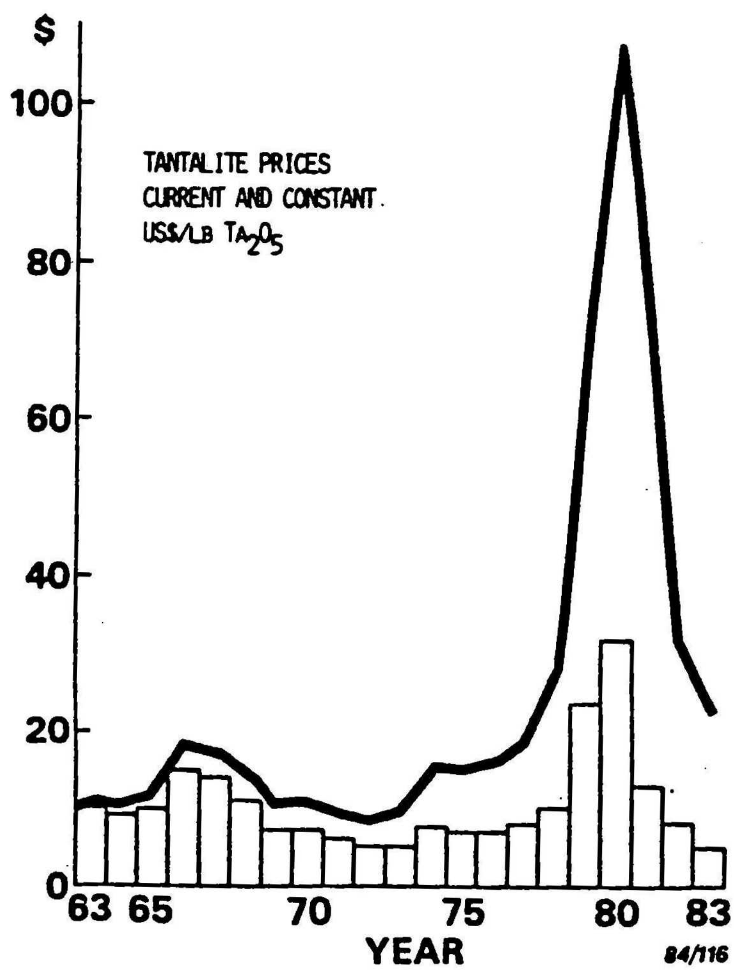
(a) Excludes content of tin concentrates (e) estimated

AUSTRALIAN EXPORTS OF TANTALUM AND NIOBIUM ORES AND CONCENTRATES (t)

	1980	1981	1982	1983
Austria	-	-	-	34
Germany, FR	4	-	57	1
Japan	-	-	-	2
Korea, Rep.	-	-	-	36
Netherlands	48	11	11	18
Singapore	-	40	44	59
USA	289	106	71	58
Other	32	1	-	
Total	373	158	184	226
Value f.o.b. ($'000)	16 575	9 204	4 413	4 631

TANTALITE LOCALITIES





Aluminium

T.K. McDonald
Comalco Ltd

In 1960 Australia produced no alumina and token quantities of bauxite and primary aluminium. Australia's first aluminium smelter, established in the 1950s by the Commonwealth and Tasmanian Governments as a post-war response to the strategic significance of aluminium, was small, inefficient, highly protected and dependent on bauxite imported from Asia, as Australia had no known commercial reserves.

Two decades later Australia produces about 30% of the world's bauxite and about 25% of the world's alumina but only about 3% of the world's primary aluminium.

Expansion in bauxite and alumina production was dramatic, based on the rapid growth in world demand and Australia's capacity for large scale, low cost production. In the late 1970s higher oil prices, which increased shipping costs and cut Japanese aluminium production, together with the opening of new bauxite mines in Africa and South America, severely curtailed the export prospects for Australian bauxite.

Australia's alumina production capacity has continued to expand, reflecting a competitive cost structure, but the world market is currently oversupplied, prices are depressed, and growth prospects are now more limited by relatively slow economic and aluminium demand growth rates.

While the Australian bauxite and alumina industries grew rapidly after 1960, as internationally competitve export-oriented operations, primary aluminium production has only recently displayed similar characteristics. Australian smelters established in 1955, 1963 and 1968 were relatively small and domestic market-oriented, although there have been subsequent substantial expansions and improvements.

However, in 1982 and 1983 two large new world-scale smelters started production in Australia, at Boyne Island and Tomago. These developments reflected the combined impact of a number of particularly favourable influences. However, these are the only two projects, of some eight, mooted in 1979-80 which have proceeded to production, thus far.

Since 1979-80 a range of influences, particularly in the construction, mining and State electricity sectors, have had a serious negative impact on the competitiveness of aluminium production in Australia. At the same time the competitiveness of new projects in several overseas locations has been strengthened.

Aluminium smelters have a well established capacity to contribute to economic growth and living standards but future development prospects in Australia are now limited by slower world economic and aluminium demand growth and strong competition from other countries, given the adverse influences on the competitiveness of aluminium industry projects in Australia.

Valuable prospects remain, but they will be tougher to bring to fruition. The key influence will be a concerted effort to boost the competitiveness of Australian aluminium projects.

Gold

D.M. Morley
Western Mining Corporation Limited

During 1983 the gold price was high in real terms relative to historical trends and the prices of other metals. As a result active gold exploration and production continued in Australia and other parts of the world. The devaluation of the Australian dollar early in the year improved returns to Australian producers and partly offset the gradual decline in the gold price expressed in US dollars later in the year.

Mine production continues to expand on a world scale and it is expected total Western World production should exceed 1,200 tonnes by 1985. In Australia, production is growing at a faster rate but the total output is still in the order of 3-4% of world production. Mining costs, both capital and operating, have been rising sharply in recent years, so offsetting some of the gain to producers from higher prices.

Though final figures are not yet available, it would appear that gold demand for jewellery and investment were both lower in 1983 than 1982, presumably as a result of the higher average gold prices, particularly when expressed in terms of local currencies. Recently major political and economic events seem to have far less influence on the gold price than in previous years. For example, the Korean airlines disaster in 1983 had no apparent effect on the price of gold. Price volatility was less in 1983 than in previous years.

Sophisticated facilities have been developed to inte grate sales of gold with financial markets. Gold producers can and do commit to sell gold forward for long periods, sometimes even before commencement of mining operations. The development of futures markets have encouraged new market participants sometimes resulting in volatile price movements.

Copper

D.J. Perkin, BMR

A continuation of depressed economic conditions, weak demand and relatively low copper prices in 1983 caused a decrease in Western World mine production of copper by 3% to an estimated 6.0 Mt because of a combination of cutbacks, closures and industrial and transport problems in many of the major producing countries. The trend towards increased production despite weak demand by some countries dependent on copper sales for foreign exchange was not so manifest in 1983. However, Western World production of refined copper increased by 3% to an estimated 7.3 Mt.

Western World consumption decreased a further 1% during 1983 to 6.7 Mt. The apparent 600 000 t excess of production over consumption was balanced mainly by an increase in commercial stocks and the net export of copper to the Centrally Planned Economies (mainly China).

In contrast to the decrease in output by seven of the leading Western World copper producing countries, Australian mine production of copper in 1983 rose by 4% to a record 256 000 t because of increased output at most mines. Australia ranks about 10th as a world copper producer and contributes about 3% to world production. The largest producers are Chile, USSR, USA, Canada, Zambia, Zaire, Poland, Peru and the Philippines. Australia's relative position as an important producer of copper should be sustained in 1984 because of by-product/co-product revenues and relatively high grades.

After a steady rise from $1540/t to a peak of $2040/t in May prices declined in the second half of the year to close at $1600/t. The 1983 Australian average price was $1790/t, about 20% higher than the $1475/t in 1982. The continuing build-up of commercial stocks will dampen any real increases in the copper price in the short term and hence until consumption increases to a level in line with production, no substantial increase in the price of copper is expected. In 1983, the US copper price averaged 76.5 US cents/lb, which is 35% below the imputed long-term average price calculated for the period 1960-1983. In the next few years, fuller use of existing capacity should occur before most new projects are commissioned although certain low-cost potential new mines with high-grade ores may start up in the event of renewed demand for copper.

Australia's demonstrated economic copper resources, about 5 Mt, are sufficient to last beyond 2000 at current production rates. Furthermore, company announcements during the year gave indications of a substantial broadening of Australia's resource base in copper. Apart from reporting higher-grade copper resources at Olympic Dam, Western Mining Corporation Holdings Ltd announced the discovery of economically significant secondary and primary copper mineralisation at their Nifty prospect in the Throssell Ranges about 200 km ESE of Marble Bar, WA, possibly part of a new Australian copper province. Along with other discoveries like Parkes in NSW and Golden/Grove Scuddles in WA, these may contain substantial economic tonnages of copper resources.

Nickel

B. Elliott, BMR

Preliminary figures indicate that total world primary nickel production (649 700 t) and consumption (635 600 t) both increased in 1983. Australia contributed 12% of total production.

Demand improved in the first quarter as consumers replenished stocks. Canadian producers reopened operations after shutdowns during the second half of 1982 and early 1983. Prices recovered from the low of November 1982 but despite the improvement few producers operated at a profit.

Supply again moved ahead of demand later in the year. Demand slowed, exports to western consumers from the USSR were at a high level and resumed Canadian production led to increased supplies. However, towards the end of 1983, prospects for additional demand again improved. Economic indicators, particularly in USA, now show favourable trends and steel production is increasing.

Even with strong and sustained recovery in industrial activity, it could be some time before there is a marked improvement in demand for nickel. A large proportion of nickel is consumed in the production of capital goods and a recovery in these markets will lag behind a recovery in consumer markets. Also if, in response to a small improvement in demand, the large unused production capacity available at established nickel mines and plants is brought back on stream too quickly, over-production will drive market prices down again. This could develop into a more serious problem for market-oriented producers in the long-term if production from non-market producers such as Cuba and USSR continues to increase.

Australia is well placed to share in any substantial recovery in demand. Demonstrated economic resources are sufficient for 24 years at current production rates and known resources in deposits currently considered to be subeconomic are very large. Most economic resources are in sulphide deposits which are relatively low-cost; because most operations are working below capacity at present and because production capacity could be expanded at short notice, there is potential for substantial expansion in both mine and smelter production to meet long-term as well as short-term increases in demand.

Lead and zinc

M.J. Roarty, BMR

Mine production in Australia of both lead (477 000 t) and zinc (695 000 t) increased again in 1983 to record levels. Most of the production is co-product lead and zinc with one exception - Teutonic Bore in Western Australia. Silver is a by-product at all mines. The bulk of production comes from two areas - Mount Isa and Broken Hill. Production has increased substantially at both in the last two years and increased total production in 1983 also resulted from the phasing in of Elura early in 1983. Mine production of both lead and zinc is forecast to increase slightly again in 1984. Production of refined lead and zinc have remained reasonably static over the last decade and major changes are not expected in the immediate future. Domestic consumption of both lead and zinc has also remained static over the last decade although levels were particularly low in 1982. Slight increases are forecast for both 1983 and 1984.

On the world scene, the International Lead Zinc Study Group has indicated that although lead consumption in the western world remained depressed in 1983 it should improve slightly in 1984. It has indicated also that there was a recovery in zinc consumption in 1983, particularly in North America and to some extent in Japan and the Federal Republic of Germany; for 1984, continuing strong growth in zinc consumption was forecast. Zinc demand has also been buoyed by exports of both metal and concentrates to the Communist countries particularly China.

The Australian price for lead remained at low levels in 1983 and by the end of the year had reached the lowest price in real terms for the last ten years. So far there has been no increase in the price of lead in 1984. Zinc prices, on the other hand, increased throughout 1983 and have continued to do so in 1984, although in real terms, the price of zinc has remained relatively constant over the last three years.

As a result of exploration programs, significant lead-zinc-silver mineralisation was intersected at Conjuboy near the Balcooma copper deposit in North Queensland; and at the Hellyer prospect north of the Que River mine in Western Tasmania.

Australia's demonstrated economic resources of lead, zinc and silver constitute about 10% of the world's demonstrated economic resources. Nearly all are in lead and zinc sulphide deposits and the bulk of demonstrated economic resources are contained in the Mount Isa and Broken Hill regions. Demonstrated economic resources of lead, zinc and silver have declined slightly over the last five years, although total identified resources over the same period have increased slightly. Australia has substantial resources in the inferred and subeconomic categories that could be reclassified into the demonstrated economic category with some upturn in the price levels.

TABLE 1. END USE, REFINED LEAD PRODUCED AT PORT PIRIE (t)

	1979	1980	1981	1982	1983*
Storage battery grids	7 083	5 783	5 726	6 829	7 125
Storage battery oxides	22 619	17 351	19 551	15 640	15 602
Cable sheathing	2 758	3 052	3 241	3 356	3 213
Pipe and sheet	4 569	5 118	4 636	4 766	5 294
Pigments and chemicals	5 552	5 444	5 021	3 486	5 808
Ammunition	(a)	2 233	2 003	1 614	1 489
Solder	(a)	3 486	3 089	2 256	2 112
Alloys (other)	7 308	2 607	1 117	1 410	1 459
Other (unclassified)	2 057	910	1 630	1 651	877
Total	51 946	45 984	46 014	41 008	42 979

Source: Australian Lead Development Association

(a) Included in 'Alloys (other)'

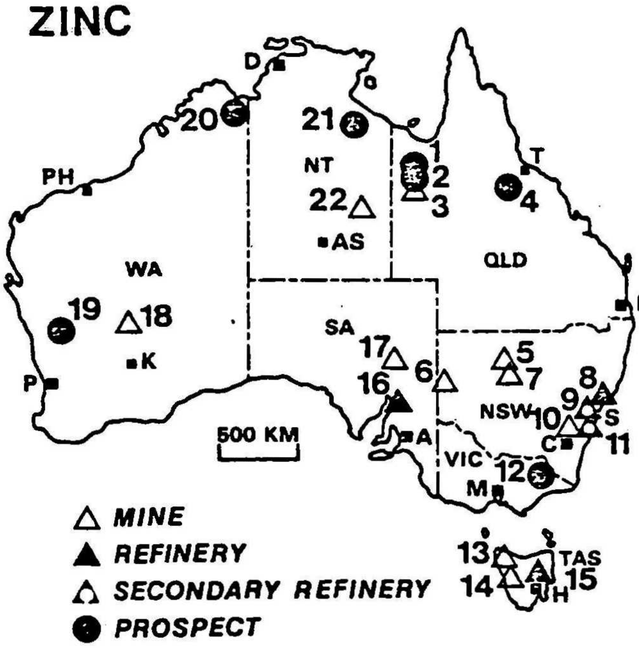
* 12 months to 30 September 1983

TABLE 2. END USE, PRIMARY REFINED ZINC (t)

	1979	1980	1981	1982	1983
Galvanising	67 659	67 675	60 454	52 712	56 030
Zinc oxide	4 261	3 991	4 978	4 778	4 338
Brass and Bronze	8 557	7 574	9 299	5 930	5 383
Rolled zinc	2 680	2 444	1 941	1 630	1 739
Die-casting	9 051	8 479	8 718	7 039	6 800
Zinc dust	2 785	2 571	2 698	2 643	2 503
Miscellaneous	2 265	2 284	3 276	2 347	2 092
Total	97 258	95 018	91 364	77 080	78 885

Source: Australian Zinc Development Association

ZINC



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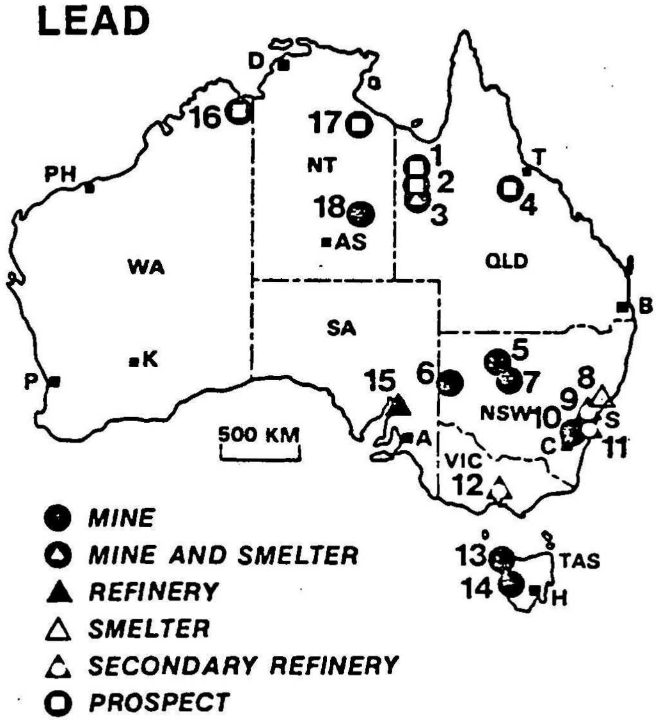
3 MOUNT ISA
4 THALANGA
5 ELURA
6 BROKEN HILL
7 COBAR
8 COCKLE CREEK
9 SYDNEY
10 WOODLAWN
11 PORT KEMBLA
12 BENAMBRA
13 QUE RIVER
14 ROSEBERY
15 RISDON
16 PORT PIRIE
17 BELTANA
18 TEUTONIC BORE
19 GOLDEN GROVE
20 SORBY HILLS
21 McARTHUR RIVER
22 ATTUTRA

LEAD



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14 ROSEBERY
15 PORT PIRIE
16 SORBY HILLS
17 McARTHUR RIVER
18 ATTUTRA

Lead, zinc and silver - World scene

K.A. Richards
North Broken Hill Ltd

Current situation - Production and consumption of zinc has been well matched for the past 10 years but lead has had a consistent small overproduction since 1979 which has had a strong cumulative effect on stocks. Real prices have slumped 70% in four years. Real zinc prices are currently at reasonable levels closely approximating the long term average.

Recycled lead forms close to 40% of total Western World production and the price of collection and treatment of scrap lead is a major feature of the market.

Australia is the Western World's largest miner of lead, and second to Canada in zinc mine production. Australia supplies 40% of the Western World's lead exports and 24% of its zinc exports. Two countries, Australia and Canada, supply over 60% of total lead and zinc exports.

Strong markets have developed for lead acid batteries and zinc galvanised products. Both industries are well poised to take advantage of increased industrial activity.

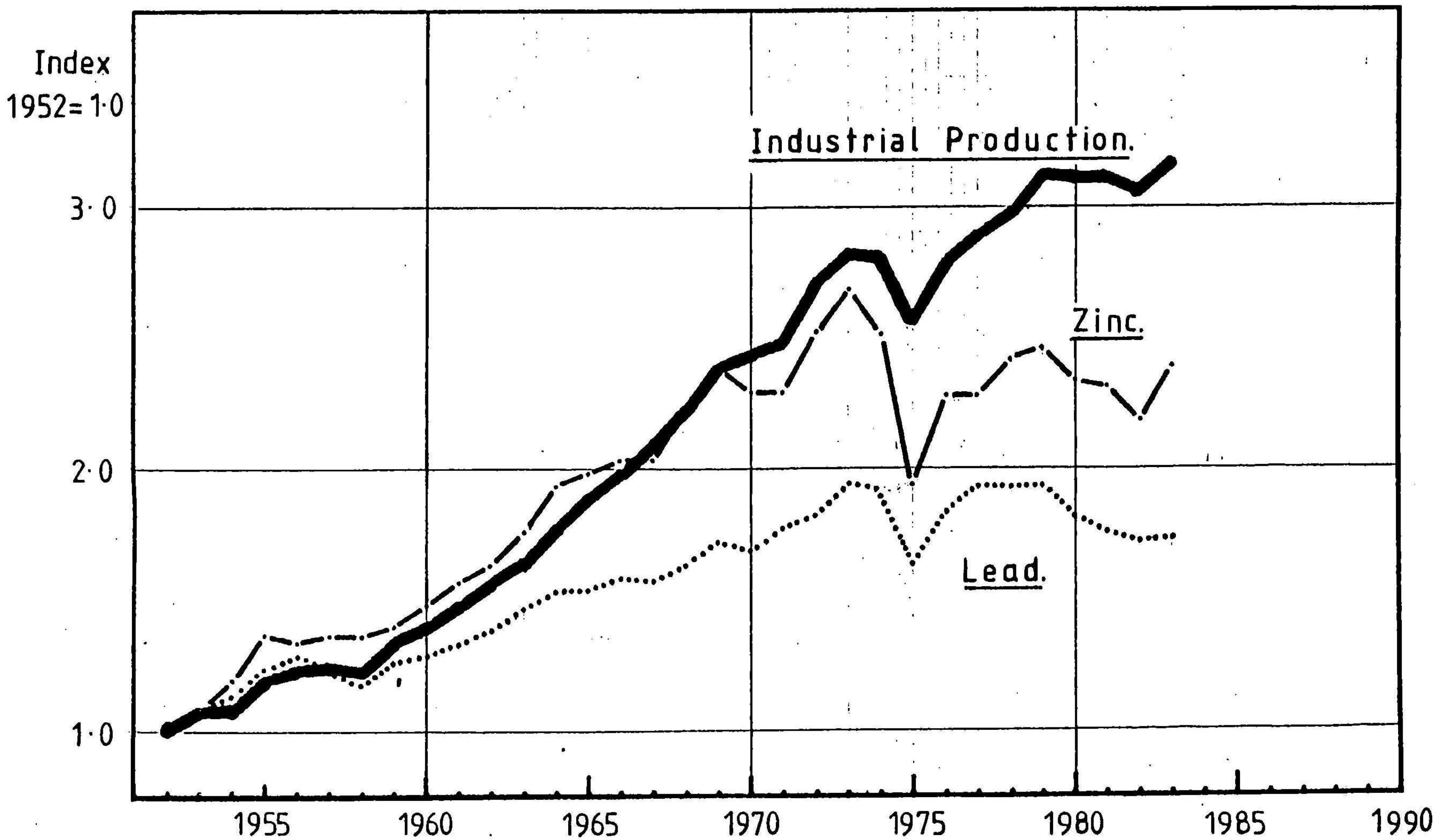
Silver speculators in the late 1970's have caused a fundamental change in the industrial consumption of silver. Levels are down by 150 million ounces p.a. and only slight increases in consumption have occurred over the past few years. Production of refined silver however is increasing at a steady rate. Despite the overproduction, silver prices are well above average long term real prices.

Outlook - The short-term future for lead and zinc appears reasonable, provided the recent strong increases in demand for both metals in the U.S.A. are followed by Japan and Europe. Indications are that this will occur.

Growing alarm over the debt problems of many developing countries and the threat to the World's monetary system could cause silver prices to increase. However, with such a large annual surplus overhanging the market most Australian miners should not be too unhappy with current prices.

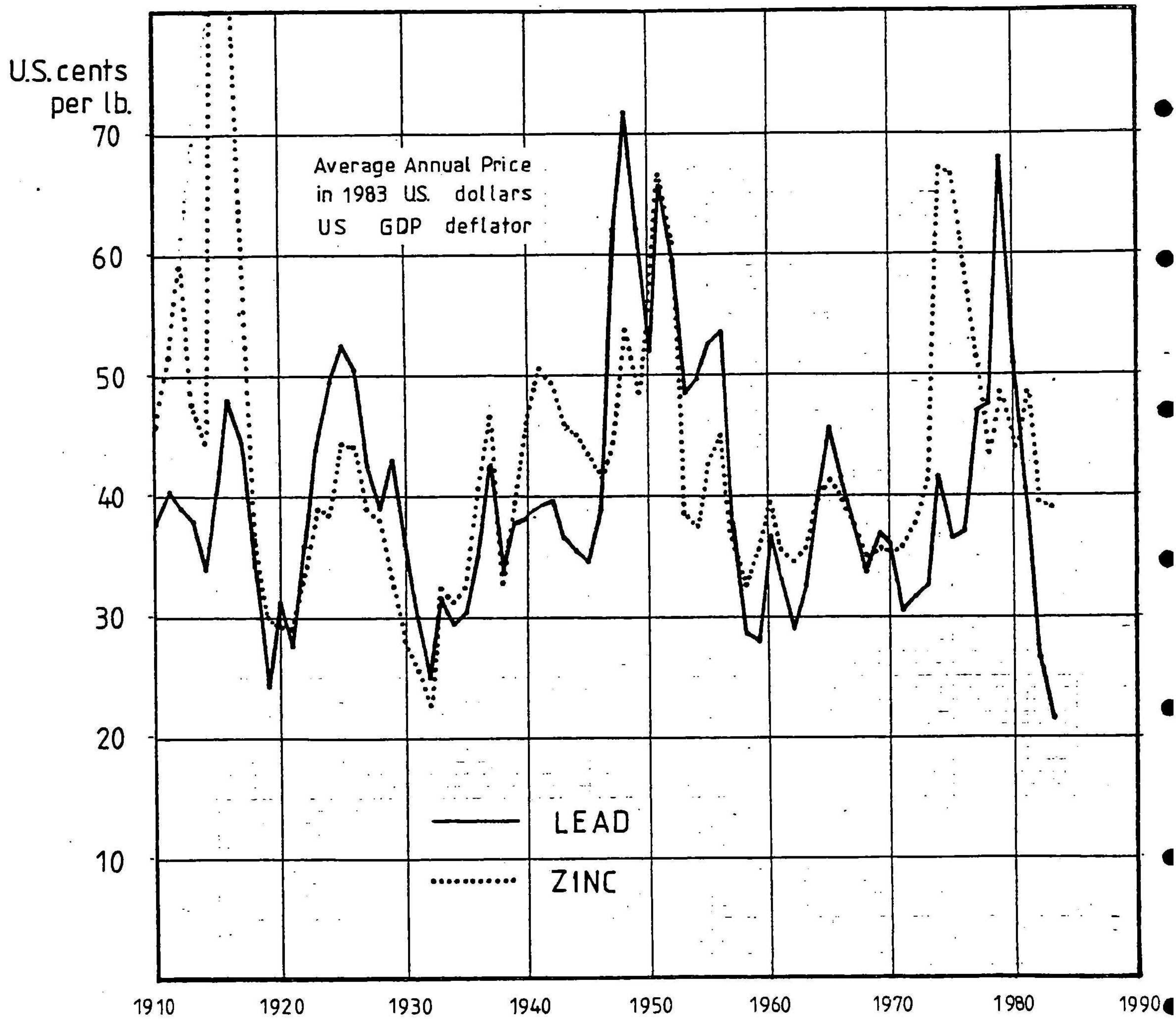
Lead and zinc consumption will continue to follow the rate of general industrial production but at reduced growth rates as ceramics, plastics, carbon fibres and composite materials claim their share of what were traditional metal markets. It is up to the Australian and the World's lead and zinc industry to protect its long-term prospects by competing with these new materials in both cost and performance as well as find new uses for lead and zinc.

COMPARISON OF O.E.C.D. INDUSTRIAL PRODUCTION INDEX WITH LEAD AND ZINC CONSUMPTION.

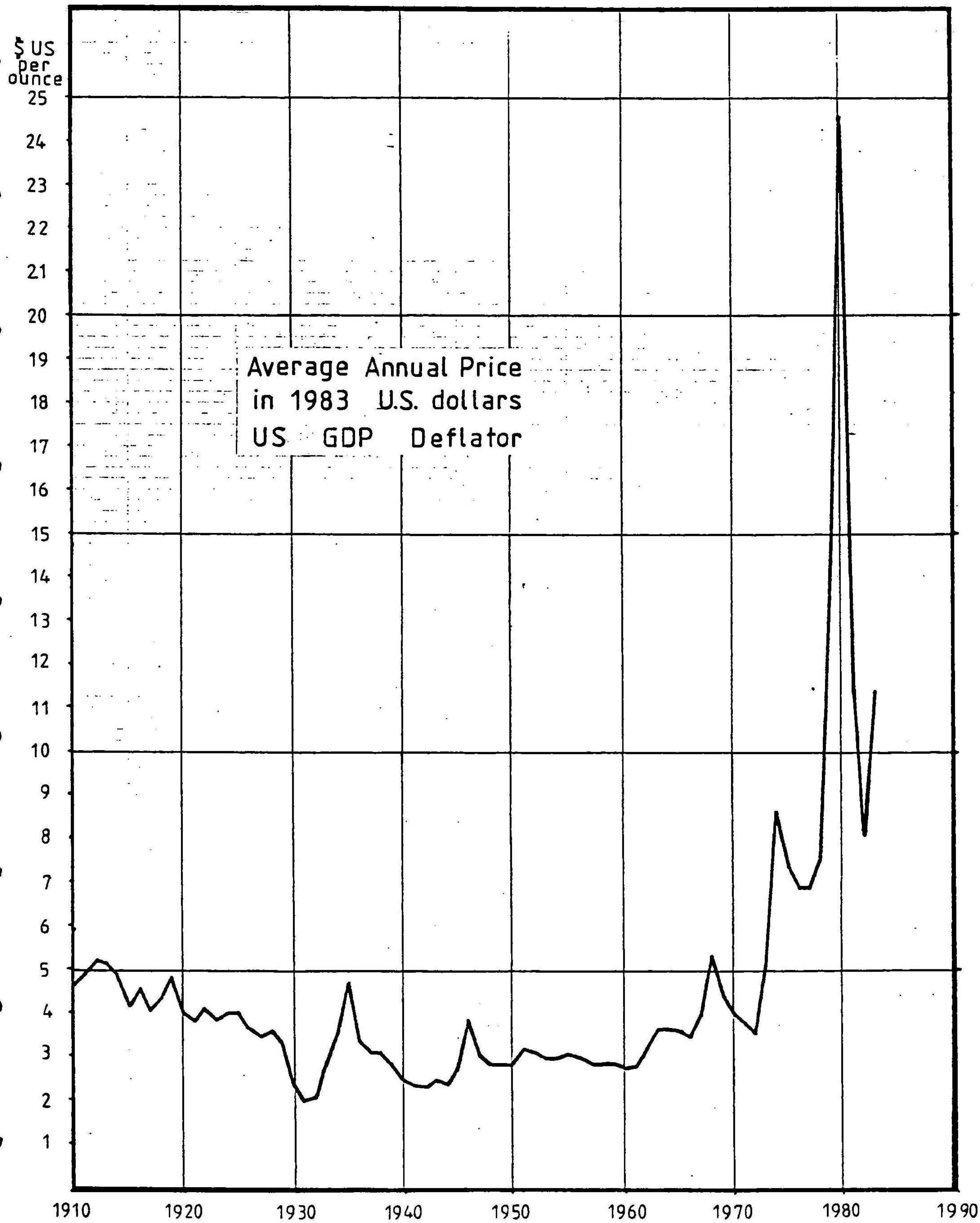


Source: 'Metals Analysis & Outlook.'

'REAL' LEAD AND ZINC PRICES



'REAL' SILVER PRICE



Near term outlook for metal prices

W.S. Etheridge
Mining Investment Services P/L

After about two years of recession for the Western economies, output growth picked up significantly in 1983 led by a strong recovery in the United States economy. Japan maintained moderate growth, while West Europe tended to lag. Economic growth led to strong growth in consumption for aluminium and zinc, in particular, and this flowed through to a sharp pick up in prices for these metals. Prices for all other metals were weak.

For 1984 the economic upswing for the Western economies is expected to continue at a brisk rate. Growth will slow a little in the United States, but accelerate in Europe and Japan. Recovery in capital spending will also be a feature. Capacity utilisation rates are not as low as official data suggest and there is an ongoing impetus for capital spending from the need to replace obsolete plant and equipment, as well as meet net increases in demand.

Consumption growth for all base metals should be fairly strong in 1984, and this will probably include an element of consumer stock building, especially for copper and lead.

Further increases in aluminium and zinc prices are likely during 1984, in line with their recent strong performance, and demand remaining ahead of supply.

Recovery in copper prices is at last likely by end 1984, but mainly in the second half of the year. Lead prices are also likely to recover in 1984. Recent metal stock trends for copper, and particularly lead, have been encouraging.

Nickel prices should increase modestly during 1984 as strong growth in consumption is almost matched by significant increases in production.

Tin remains in a state of extreme surplus, with ITC arrangements to support the market being undermined by tin smuggling and increases in non-ITC production. Prices will remain flat at best, and there is a chance the ITC support arrangements may eventually break down.

1984 should be a positive year for precious metals prices, with prices for gold and silver likely to increase, if not startlingly.

The present economic upswing for the Western economies should extend through until at least 1986, with corresponding growth in metals consumption.

TABLE 1

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

Data are annual averages for the calendar years shown.
Real prices are in constant 1982 prices.

			RECENT PEAK (for year shown)	TROUGH (1982, estimate)	PERCENTAGE CHANGE Demand	PERCENTAGE CHANGE real price
ALUMINIUM	- demand	million tonnes	12.72 (1979)	10.51	17.4	
	- real price	US cents per lb.	95 (1980)	45		-53
COPPER	- demand	million tonnes	7.52 (1979)	6.76	-10.1	
	- real price	US cents per lb.	120 (")	67		-44
LEAD	- demand	million tonnes	4.20 (")	3.79	-9.8	
	- real price	US cents per lb.	73 (")	19 (1983)		-74
NICKEL	- demand	'000 tonnes	586 (1979)	434	-26	
	- real price	US cents per lb.	346 (1980)	205 (1983)		-41
TIN	- demand	'000 tonnes	194 (1976)	160	-17.5	
	- real price	$US per lb.	8.9 (1979)	5.7 (1983)		-36
ZINC	- demand	million tonnes	4.75 (")	4.24	10.7	
	- real price	US cents per lb.	45 (")	34		-25

TABLE 2 METALS: LONG TERM ANNUAL MARKET DATA

(See notes below table for definitions of 'supply' and 'demand' and for sources.)

ALUMINIUM		1960	1970	1981	1982	1983
Primary smelter capacity	million t.p.a.			13.92	13.89	13.87
Supply				12.46	10.51	10.91
Demand		3.33	7.84	11.07	10.66	11.64
Surplus/(deficit)				1.39	(0.15)	(0.73)
Stocks (end period)	months			3.9	3.3	2.1
Primary capacity utilisation				88	76	77
Price (free market)						
- actual	cents/lb	26	29	57.2	45.0	65.2
- real (1982 prices)		85	72	60.7	45.0	63.0
% change demand				-6.6	-3.7	9

COPPER		1960	1970	1981	1982	1983
Mine capacity (mid year)	million t.p.a.			7.81	7.85	8.03
Supply				7.41	7.17	7.26
Demand		3.84	5.84	7.23	6.76	6.82
Surplus/(deficit)				0.18	0.41	0.44
Stocks (end period)	months			2.4	3.3	4.1
Mine capacity utilisation				83.4	79.5	75.4
Price (LME cash)						
- actual	US/lb	31	64	79.5	67.2	72.3
- real (1982 prices)		101	159	84.3	67.2	69.8
% change demand				1.7	-6.5	1

LEAD		1960	1970	1981	1982	1983
Mine capacity	million t.p.a.			2.85	2.89	3.02
Supply				3.91	3.82	3.85
Demand		2.60	3.60	3.88	3.79	3.82
Surplus/(deficit)				0.03	0.03	0.03
Stocks (end period)	months			1.6	2.9	2.6
Mine capacity utilisation				86	88	82
Price (LME cash)						
- actual	US/lb	9.0	13.3	33.3	24.7	19.3
- real (1982 prices)		29	34	35.3	24.7	18.6
% change demand				-1.8	2.3	1

NICKEL		1960	1970	1981	1982	1983
Mine capacity	'000 t.p.a.			700	735	745
Supply				525	422	430
Demand		226	451	469	434	460
Surplus/(deficit)				56	(12)	(30)
Stocks (end period)	months			5.6	5.6	4.0
Mine capacity utilisation				73	54	57
Price (free market)						
- actual	US/lb	74	129	270	218	212
- real (1982 prices)		242	321	286	218	205
% change demand				-11.2	-7.5	6

TIN		1960	1970	1981	1982	1983
Mine production	'000 t.p.a.			204	190	171
Supply				190	118	162
Demand		183	186	164	160	162
Surplus/(deficit)				26	(42)	0
Price (Penang)						
- actual	$US/lb	1.01	1.74	6.37	5.87	5.91
- real (1982 prices)		3.30	4.33	6.76	5.87	5.73
% change demand				-6.9	-1.8	1.3

ZINC		1960	1970	1981	1982	1983
Mine capacity	Million t.p.a.			5.37	5.44	5.51
Supply				4.53	4.16	4.39
Demand		2.44	3.89	4.42	4.24	4.45
Surplus/(deficit)				0.11	(0.08)	(0.06)
Stocks (end period)	months			2.4	2.3	2.0
Mine capacity utilisation				83	88	86
Price (LME cash)						
- actual	US/lb	11.2	13.4	38.9	33.7	34.7
- real (1982 prices)		37	33	41.3	33.7	33.5
% change demand				-1.8	-4.1	5

GOLD		1960	1970	1981	1982	1983
Western mine production	tonnes	1049	1273	971	1013	1065
Communist net sales/(purch)		177	(3)	283	207	72
Central bank net sales/(purch)		(262)	236	(276)	(98)	50
Supply		964	1034	975	1122	1185
Identified private demand		n.a.	1464	1316	1356	1035
Surplus/(deficit)		n.a.	(430)	(341)	(234)	150
Price (London)						
- actual	$US/tr.oz	35	36	460	376	424
- real (1982 prices)		114	90	488	376	411

SILVER		1960	1970	1981	1982	1983
Supply	'000 tonnes	n.a.	12.58	14.05	13.35	14.10
Demand		n.a.	11.26	11.25	11.50	11.70
Surplus/(deficit)		n.a.	1.32	2.80	1.85	2.40
Price (Free market)						
- actual	$US/tr.oz	0.91	1.77	10.51	7.95	11.44
- real (1982 prices)		2.97	4.40	11.15	7.95	11.08

SOURCES AND DEFINITIONS FOR TABLE 2

1. SOURCES:

(a) 1975-1982 metals data: chiefly from 'Metals Analysis and Outlook', published quarterly by Metals and Minerals Research Services Ltd., London.

(b) 1960, 1970 metals data, and 1983 estimates: various.

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/minus:	net imports/exports from East bloc
plus/minus:	official (government) stockpile sales/purchases (e.g. G.S.A., and also the I.T.C. in the case of tin)

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

Both supply and demand refer to the category of non-communist countries, which usually is defined to include Yugoslavia. For tin I.T.C. 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.

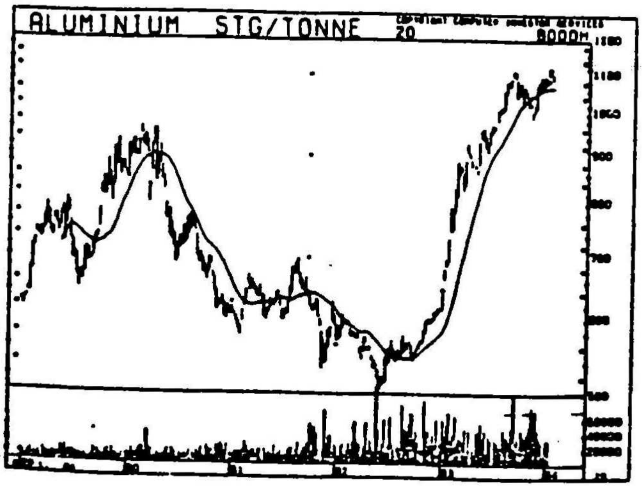
(c) Stocks: These are defined as total private stocks and therefore exclude government stocks. They also exclude downstream consumer stocks (i.e. fabricators etc). For tin they also exclude ITC stocks. They are expressed as months of annual demand.

(d) Price: All prices are free-market prices, e.g. L.M.E. or US (e.g. Comex),.

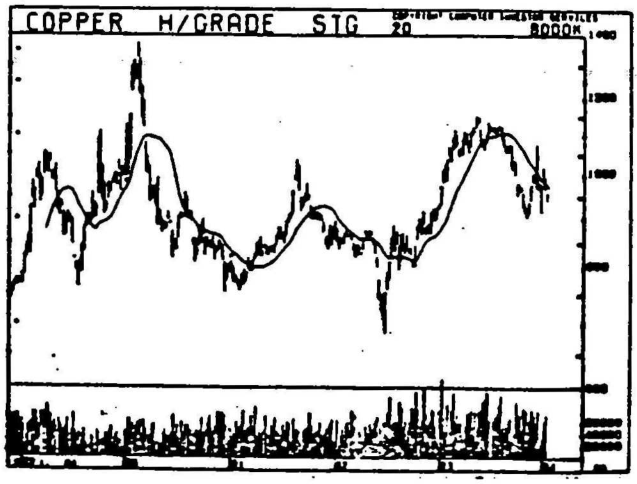
Much, or most, copper, zinc, aluminium, and nickel is sold at producer prices which generally bear a close, but fluctuating, relationship with free-market prices. The 1960 and 1970 prices quoted for nickel and aluminium are producer prices.

FIG.1 METAL PRICE & EXCHANGE RATES

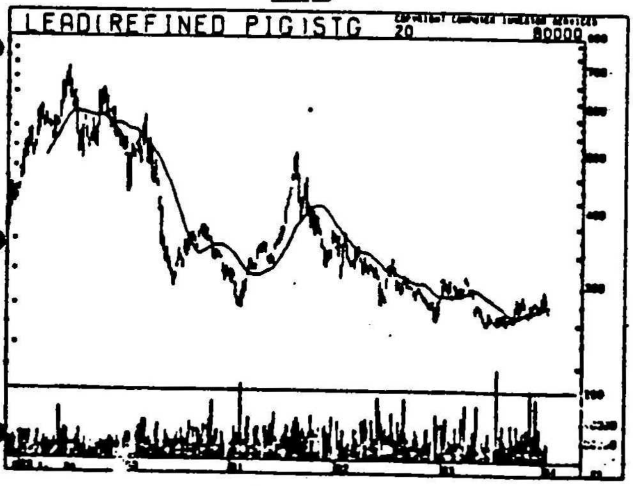
ALUMINIUM



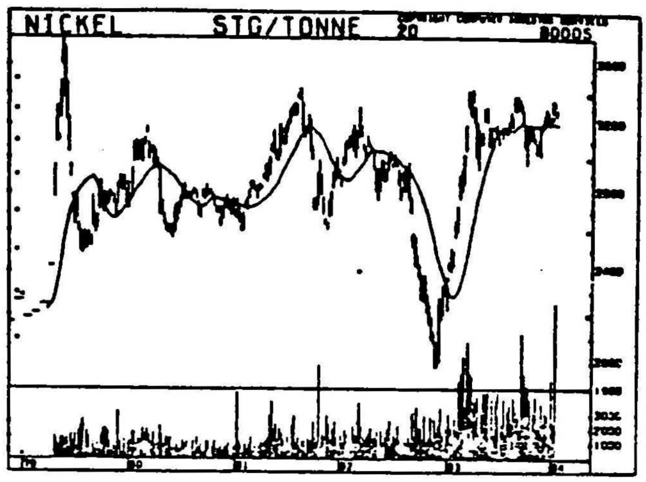
COPPER



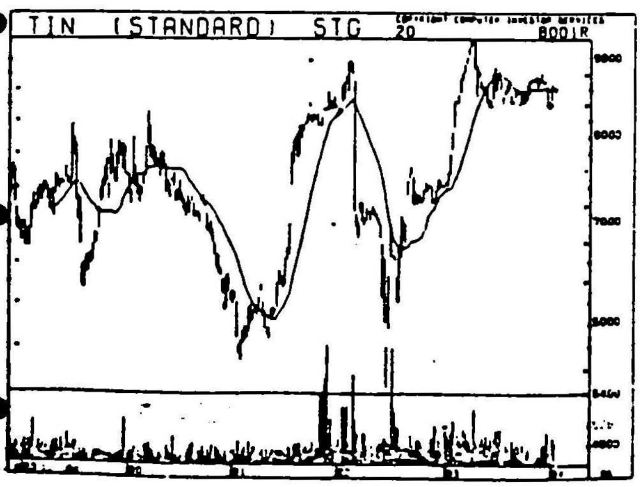
LEAD



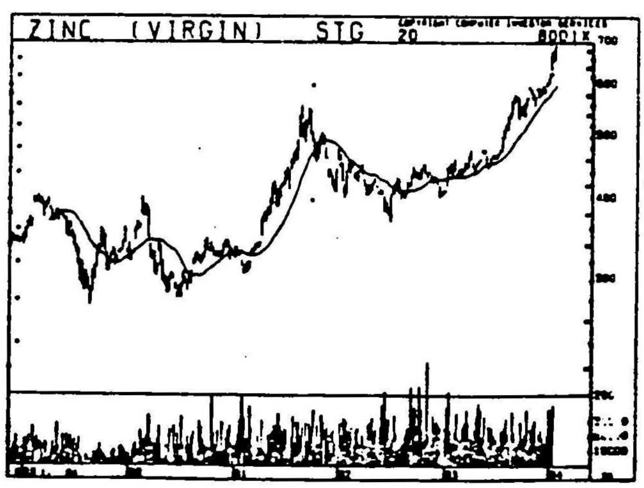
NICKEL



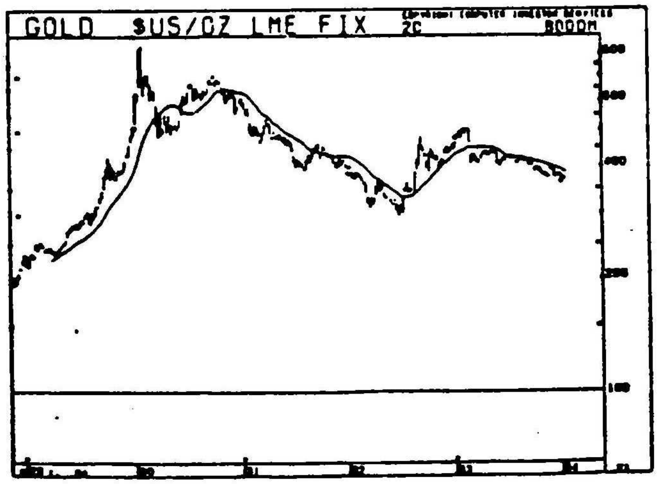
TIN



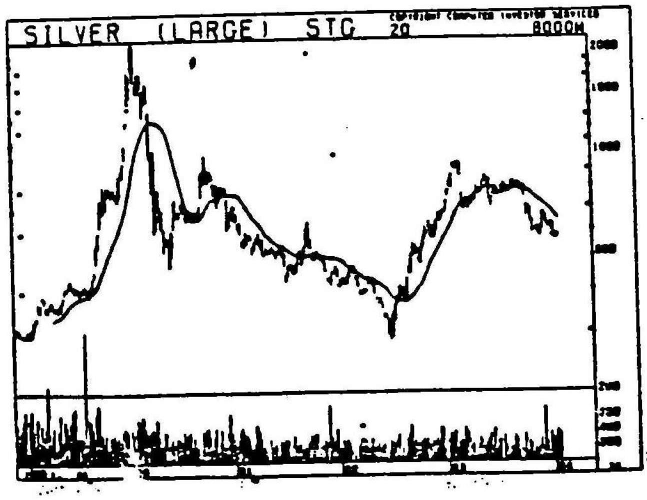
ZINC



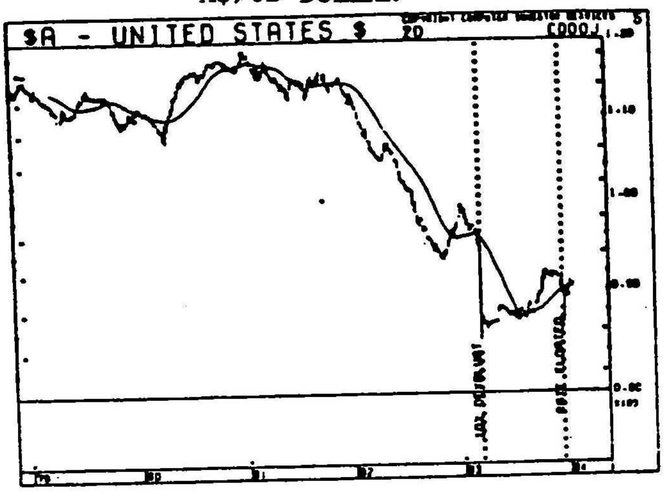
GOLD



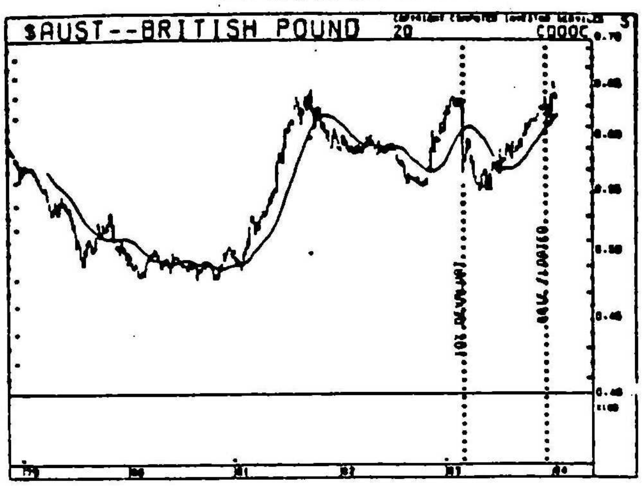
SILVER



A$/US DOLLAR



A$/BRITISH POUND



BIOGRAPHICAL NOTES ON THE SPEAKERS

R.G. DODSON, BMR

Dick Dodson is a Commodity Specialist (gemstones and gold) in the Minerals Branch of the Resource Assessment Division. He graduated with a B.Sc (Hons) and later a Ph.D. degree, and worked for H.M. Overseas Colonial Survey in Kenya from 1950-63. He joined BMR in 1963 and was head of the Resident Geological Section, Northern Territory, between 1965-70. He returned to Canberra in 1970, to the Geological Branch, and joined the Minerals Branch in 1983.

AERT DRIESSEN, BMR

Aert Driessen graduated from Sydney University in 1960 with a B.Sc. with a double major in geology. After 3 years with Consolidated Gold Fields and 4 years with Selection Trust, as exploration geologist, he moved to Fiji to work as mine geologist for Emperor Gold Mining Co.; he was subsequently appointed Chief Geologist. After two brief periods of employment with Sampey Exploration Services and Getty Oil, he joined BMR's Operations Branch in 1972. In 1974 he transferred to Minerals Branch, subsequently graduated B.Ec. from the Australian National University, and is presently Commodity Specialist, industrial minerals.

B.G. ELLIOTT, BMR

Brian Elliott is Commodity Specialist in the Minerals Branch of the Resource Assessment Division. He graduated with qualifications in Mining Geology and after some years in the mining and exploration industry in Canada and Australia, joined BMR in 1972. In 1978 he transferred to the Department of Niational Development and Energy where he worked as oil shale specialist with the Oil and Gas Division, and in the Research and Development Division before rejoining BMR in 1983 as commodity specialist for nickel, cobalt and oil shale.

W.S. ETHERIDGE, MINING INVESTMENT SERVICES PTY LTD

W. Etheridge graduated 1969 from Melbourne University in Mining Engineering, and later from Cambridge University in 1983 in Economics. Past employers include Hamersley Iron P/L at Tom Price, Consolidated Gold Fields PLC in London, Australian Mineral Economics P/L in Sydney, and Renison Goldfields Consolidated Ltd in Sydney. Resigned from Renison Goldfields Consolidated in mid-1983 and formed Mining Investment Services P/L. Currently consulting on mineral industry investment and economic matters to clients including T.C. Powell and Partners, a Sydney stock-broking firm.

D.J. FORMAN, BMR

David Forman graduated with a B.Sc (Hons) degree in geology from the University of Western Australia in 1958. Except for a year with the former Petroleum and Minerals Authority in 1975, he gained experience in field mapping, sedimentary basin studies, and assessment of undiscovered petroleum resources with BMR. He gained an A.M. in 1967 and a Ph.D. in structural geology in 1968 from Harvard University. He is Principal Research Scientist in the Petroleum Branch of the Resource Assessment Division, in charge of a research group responsible for the assesement of undiscovered petroleum resources and the estimation of possible future supply.

M.D.A. GREGSON, THE BROKEN HILL PTY CO. LTD

Mike Gregson joined BHP as Technical Cadet in 1958 and worked on blast furnaces in a number of BHP centres. He obtained his M.A. degree in metallurgy from Cambridge. In 1969 he moved to Head Office in the Mineral Division where he held a number of positions in the Planning and Development area. From 1971 to 1975 he spent 4 years managing BHP's tin operation in Indonesia. Immediately before his current appointment as General Manager-Iron Ore, he was the General Manager-Marketing Minerals division, responsible for the marketing of all BHP's minerals.

M.B. HULEATT, BMR

Mike Huleatt is Commodity Specialist (coal) in the Minerals Branch of the Resource Assessment Division, He is a graduate in geology of the Australian National and Macquarie Universities. Prior to joining BMR in 1974 he worked for four years as a geologist with the Mount Newman Mining Co. Ltd in Western Australia. From 1976 to early 1980 he worked in the Departments of National Resources, and Trade and Resources on policy and economic matters relating to Australia's iron ore, uranium and coal industries. Since rejoining BMR in 1980 his main interest has been the assessment of Australia's coal resources and the factors that govern their development.

G.N. KEITH, BHP PETROLEUM PTY LTD

G.N. (Norm) Keith is currently Project Development Manager for BHP Petroleum Pty Ltd. He graduated with qualifications in both Chemistry and Chemical Engineering and after some years in the Petroleum Refining industry joined the Fuel Branch, Department of National Development in the field of petroleum and energy utilisation policy. Since joining BHP in 1970, he has worked on the development of coal liquefaction in Australia, processing of oil shale, and more recently, conversion of natural gas. He heads up a team that is carrying out research, engineering and economic assessments of potential projects for both medium and longer-term processing of natural gas to marketable liquid products. Last year he made an extensive tour of USA and Europe to evaluate current trends in production and utilisation of these materials.

N.D. KNIGHT, BMR

Nerida Knight is the Commodity Specialist for aluminium, tungsten, and tantalum in the Minerals Branch, Resource Assessment Division. She graduated from the Australian National University in 1963 with qualifications in Geology and Biochemistry. After working for some years in the field of medical biochemistry she joined the Exploration Department of The Broken Hill Pty Co. Ltd as a research assistant in the base metals area. In 1973 she joined the Geological Branch of BMR and in 1978 moved to her present position.

D.H. MACKENZIE, CRA EXPLORATION LTD

David Mackenzie studied geology at the University of Edinburgh, graduating Ph.D. in 1957. He worked as a field geologist in Sierra Leone before coming to Australia to join the CRA Group in 1961 as an exploration geologist. He has worked since in exploration for a wide range of base and precious metals in several states and overseas, including a spell in mining geology at Broken Hill. Since 1977 he has been Chief Geologist responsible for CRA Exploration's Mineral Exploration Research Group, based in Canberra.

K. McDONALD, COMALCO LTD.

Kerry Mcdonald is chief economist of Comalco Limited in Melbourne. He was previously Director, NZ Institute of Economic Research. His experience includes involvement in research and consulting products on a wide range of topics including; economic development and structural adjustment policies; resource allocation and pricing policies, particularly in relation to energy; the techniques and practice of public and private sector investment evaluation, particularly in large-scale energy-producing and consuming projects and in shipping, air, and urban transport systems; and the aluminium industry.

K.P. McHUGH, DEPARTMENT OF RESOURCES AND ENERGY

Kerry McHugh is the Principal Adviser and Acting First Assistant Secretary in the Coal and Minerals Division. Prior to taking up his current position he was involved in energy policy development in the Department. He joined the Department in 1970 from the Department of the Treasury where he had been involved in minerals and energy policy issues and foreign investment matters. He holds a Bachelor of Commerce (Hons) degree from Melbourne University.

I.R. McLEOD, BMR

Ian McLeod is Chief Commodity specialist in the Minerals Branch, Resource Assessment Division, and is responsible also for tin commodity studies. He graduated with an M.Sc. in geology from the University of Queensland. After a period in industry he joined BMR and was seconded as geologist to the Australian National Antarctic Research Expeditions. After returning to BMR he worked mainly on Australian mineral resources, Antarctic geology, and information servives before taking up his present position.

B.G. McKAY, ESSO AUSTRALIA LTD

Bruce McKay graduated B.Sc (Hons) Sydney in geology and joined Esso Australia Ltd in 1968. He worked in a variety of geological and operations positions in Australia, Singapore, Japan and the UK, and was trasferred to Houston in 1978. Here he was Geological Adviser to the Exxon Manager at Esso Eastern, and in Exxon's Production & Corporate Planning Departments. He returned to Sydney and Esso Australia Ltd in 1981 as Exploration Manager.

R.B. (BOB) MITCHELL, WEST AUSTRALIAN PETROLEUM PTY LTD

Bob Mitchell graduated from the University of Toronto, Canada, in 1949, with a Bachelor of Science degree in geology. That same year he joined the Calgary office of Chevron Standard Company (now Chevron Canada Resources), the Canadian operating company for Standard Oil Company of California (Socal), and has been with Socal and affiliated companies ever since. After three years in Western Canada he transferred to Trinidad in the West Indies in 1952. In 1957 he moved to San Francisco and was involved with exploration efforts in Latin America, Africa and the Middle East. From 1960 to 1965 he was in charge of Chevron's exploration in the Bahamas, Jamaica and the northeastern Caribbean working out of Coral Gables, Florida. Returned to San Francisco in 1965 and for the better part of the next 16 years was Exploration Manager for Chevron's interests in the Asia/Pacific region. He was appointed Managing Director of WAPET in September 1981. Presently he is Western Australian Chairman of APEA and is a member of the WA Council of AMMA.

D.M. MORLEY, WESTERN MINING CORPORATION HOLDINGS LTD

Bachelor of Science in Metallurgy - University of NSW, 1965; Master of Business Administration - University of Chicago, 1970. Donald Morley worked as a metallurgist in Australia, Canada and the United States prior to attending business school. He joined Western Mining in 1970 in the role of Corporate Analyst. Subsequently he was assigned to different positions in the Company, and appointed Director of Finance in 1983.

THEOL W. OERLEMANS, THE SHELL COMPANY OF AUSTRALIA LTD

Theo Oerlemans graduated from the University of Delft in The Netherlands. He did Military Service as Lieutenant Royal Netherlands Navy. He worked for Shell since 1965 in The Netherlands and in England. Since 1977 he worked in the Natural Gas field and in several jobs related to Shell's internationsl gas business, namely ad Project Manager, Nigerian LNG Project; Manager Business Development Africa; and Manager Business Development Europe, North and South America. Since October 1982 he has filled the position of General Manager, Natural Gas Division, Shell Australia, in which capacity he is responsible for Shell's involvement in the North West Shelf Project.

D.J. PERKIN, BMR

Don Perkin is the copper Commodity Specialist in the Minerals Branch, Resource Assessment Division. He graduated from the University of Sydney with a BA (Geology) and worked for a number of years with a range of mining and exploration companies throughout Australia. He graduated in Economics from James Cook University in 1975. Since joining BMR in 1978 he has worked as the tin, uranium, and copper, commodity specialist. He is currently completing his M.Sc. in Exploration and Mining Geology with James Cook University of North Queensland.

C.R. PRATT, BMR

Roger Pratt is a Commodity Specialist in the Minerals Branch of the Resource Assessment Division. After graduating from the University of New England he worked as a geologist in iron ore mining and exploration for several years. He has worked for short periods in mineral policy and BMR planning but since joining BMR in 1965 has been mainly involved in mineral industry commodity work specialising in iron and steel and ferroalloy metal studies. Most recently he was responsible for BMR's assessment of Australian chromite resources.

KENNETH A. RICHARDS, A.A.S.A. (Sen) A.C.I.S., NORTH BROKEN HILL HOLDINGS LTD

Kenneth Richards has been involved with the lead, zinc, and silver industry for 39 years and has held various accounting, financial, administrative, marketing and managerial positions with North Broken Hill Limited. During the late 1960's and early 1970's he was Operations Manager of North's Exploration Division. He currently holds the position of Manager - Administration, of the North Group of companies. In addition, he is an alternate Director of Alcoa of Australia Limited, Chairman of the Australian Lead and Zinc Development Associations, and Vice-Chairman of the New York based International Lead, Zinc Research Organisation Inc. (ILZRO)

M. ROARTY, BMR

Mike Roarty is the lead-zinc-silver Commodity Specialist with the Minerals Branch of the Resource Assessment Division. He graduated from the University of New South Wales in Science in 1968 and has since graduated in Economics from the University of Queensland. He worked with a consultant from 1969-73 on base metal and petroleum prospects throughout Australia and Papua New Guinea, and with Amoco Minerals in the Mount Isa area in 1974. He worked for the NT Department of Mines and Energy from 1975-80 on regional geological mapping projects, and in administration, and joined BMR Mineral Economics Section in 1981.

JOHN TYSOE, DEPARTMENT OF RESOURCES & ENERGY

John Tysoe is Assistant Secretary of the Coal Industry Branch. He is a Master of Economics from Sydney University 1966, majoring in monetary policy theory. Formerly in the Departments of the Treasury, and Prime Minister and Cabinet, John was head of the Energy Economics Branch in the then Department of National Development and Energy for 3½ years before his promotion to head the Coal Industry Branch in September last year. The establishment of the Coal Industry Branch followed the handing over of resources responsibilities from the former Department of Trade and Resources, which resulted in the new Department of Resources and Energy being responsible for domestic policy aspects of resource development, including the major export earner, coal.

J. WARD, BMR

Jack Ward graduated in Science from the University of Queensland in the mid-1940's. He was employed by Zinc Corporation Limited in connection with the development of mineral sand deposits on North Stradbroke Island before joining BMR in charge of laboratory investigations on mineral sands along the east coast from Fraser Island to Coffs Harbour. From 1952-1957 he was engaged mainly on the assessment of uranium reserves in the Northern Territory. He also acted as Resident Geologist in Darwin and was responsible for the day-to-day planning and direction of geological reserves to the Northern Territory Administration before transferring to the Mineral Economics Section (BMR) in 1958. He studied economics at the Australian National University during 1960-61 and specialised in the economic aspects of tin, titanium and tungsten in which connection he travelled widely through North America, Africa and Southeast Asia. He is Assistant Director, Minerals Branch, Resource Assessment Division, whose main task is the assessment of Australia's mineral resources and monitoring the development and problems of the Australian minerals industry.

J.A.W. WHITE, BMR

John White graduated in Oil Technology at the Royal School of Mines, Imperial College, London. After graduation he worked in many parts of the world with the Schlumberger group of companies before joining the Subsidy Section of the Petroleum Exploration Branch of BMR in 1964. During 1975 he was with the Petroleum and Minerals Authority before rejoining BMR. He is currently Assistant Director, Petroleum Branch of the Resource Assessment Division.

J. YEOWART, AUSTRALIAN COAL ASSOCIATION

John Yeowart is currently in his third term as Chairman of the Australian Coal Association. He holds and has held for the last 15 years, the position of Chairman, Queensland Coal Association and is Deputy General Manager in charge of Marketing for New Hope Collieries Pty Ltd. He has had 32 years experience in the coal mining industry and is the holder of a First Class Mine Manager's Ticket. He is an Associate of the Australasian Institute of Mining and Metallurgy and the Australian Society of Accountants.