1970/36

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1970 / 36

A History of the Torbanite Industry and of the Search for Hydrocarbons in the Sydney Basin of N.S.W.

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A HISTORY OF THE TORBANITE INDUSTRY AND THE SEARCH FOR HYDROCARBONS IN THE SYDNEY BASIN OF N.S.W.

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THE TORBANITE INDUSTRY

Discovery:

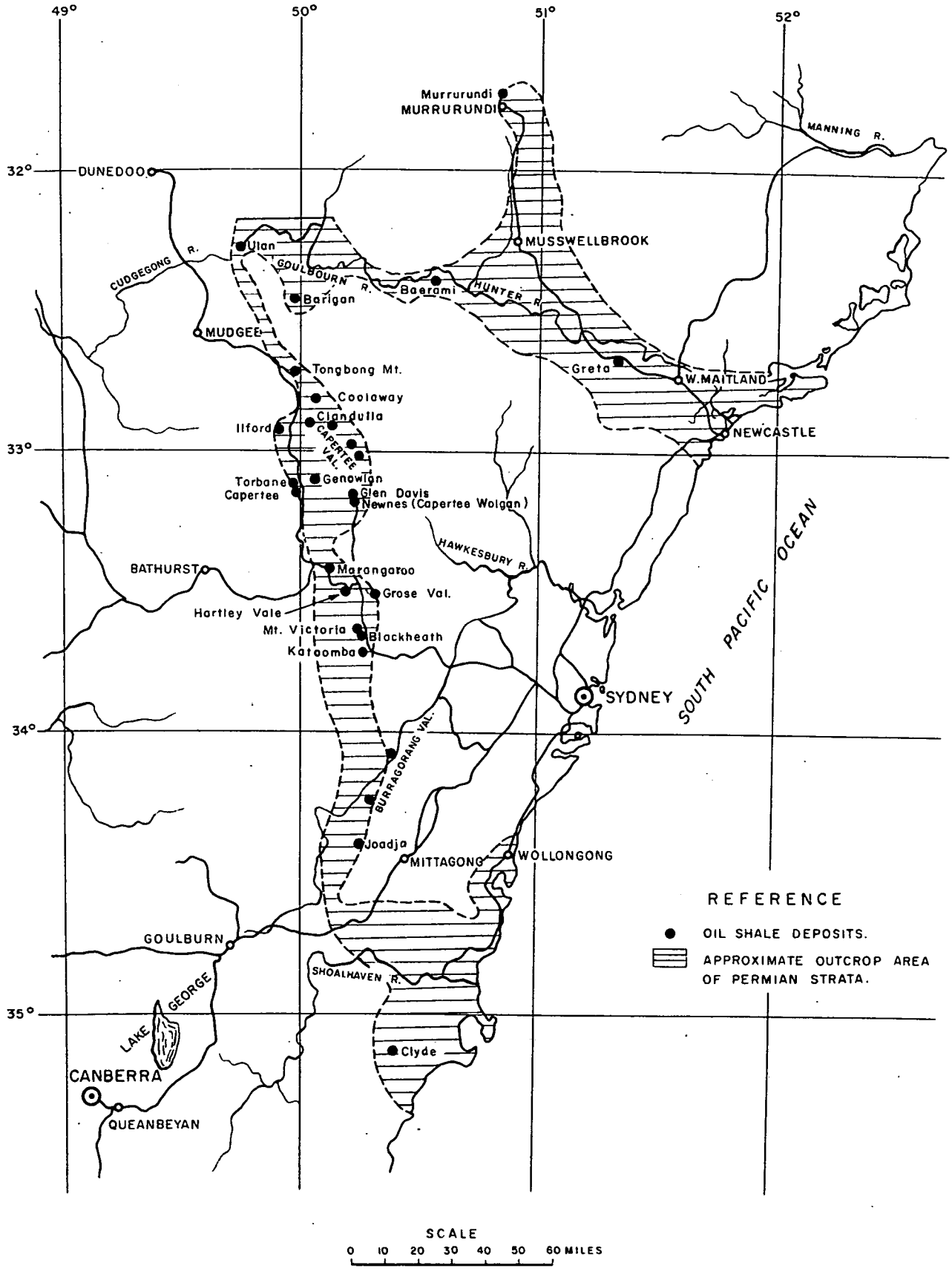
Although "torbanite" is the mineralogical name for the substance mined in N.S.W., for oil production, the terms "oil-shale" or "kerosene-shale" are far more commonly used for it.

The first recroded mention of the occurrence of torbanite in N.S.W. was in 1802, by the Frenchmen Baily and Depuch in Peron and Freycinet's scientific expedition. In 1824 another French scientist, M.P. Lesson, recorded it from the neighbourhood (Hartley) of Mt. York, and in 1839 Count Strzelecki found it in Reedy Creek north of Mt. York. This place is not be confused with the Reedy Creek near Joadja, where torbanite was discovered about 1850. In 1854 oil-shale from Hartley was exhibited at the Paris Exhibition, and in 1862 A. Loder exhibited some in London, from Doughboy Creek near Murrurundi. In 1863 W. Keene wrote of it as occurring 4 miles north of Fourmile Creek, Maitland District and in 1864 T. Frost discovered it at Anvil Creek, Branxton. In 1865 the Rev. W.B. Clarke claimed to have been the first person to suggest (in 1847) the existence of such oil-bearing shales at Mt. York, Mt. Kembla and Stony Creek (Maitland).

Beginnings of the Industry:

The year 1865 was important in so far as it marked the beginning of the Oil-shale industry in N.S.W. In that year the Hartley Kerosene Oil and Paraffine Co. began working Lesson's find in the Blue Mountains, and Graham's Pioneer Kerosene Works started operations at Clarke's discovery at Mt. Kembla, America Creek, Wollongong. Also the Greta Coal and Shale Mine Company was formed to work the coal and kerosene shale at Anvil Creek: in addition to coal, 100 tons of kerosene shale, valued at £3 per ton, were raised. In the last third of the 19th century, many shale deposits were discovered, prospected and worked either for despatch of the shale or for distillation on site.

Fig. 1.



OIL-SHALE DEPOSITS SYDNEY BASIN

To accompany Record No. 1970/36

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Among these localities may be mentioned Marangaroo, Torbane near Capertee, Joadja and Murrurundi. The general disposition of occurrences was delineated and may now be referred to, in geological setting.

Geological Settings:

All the torbanite deposits are found in the Coal Measures, and of thirty four known occurrences (Dulhunty 1942) thirty are in the Upper Coal Measures and four in the Lower Coal Measures. The latter are situated at Murrurundi (Oxley Basin) Muswellbrook and Greta in the north, and the Clyde Valley in the far south.

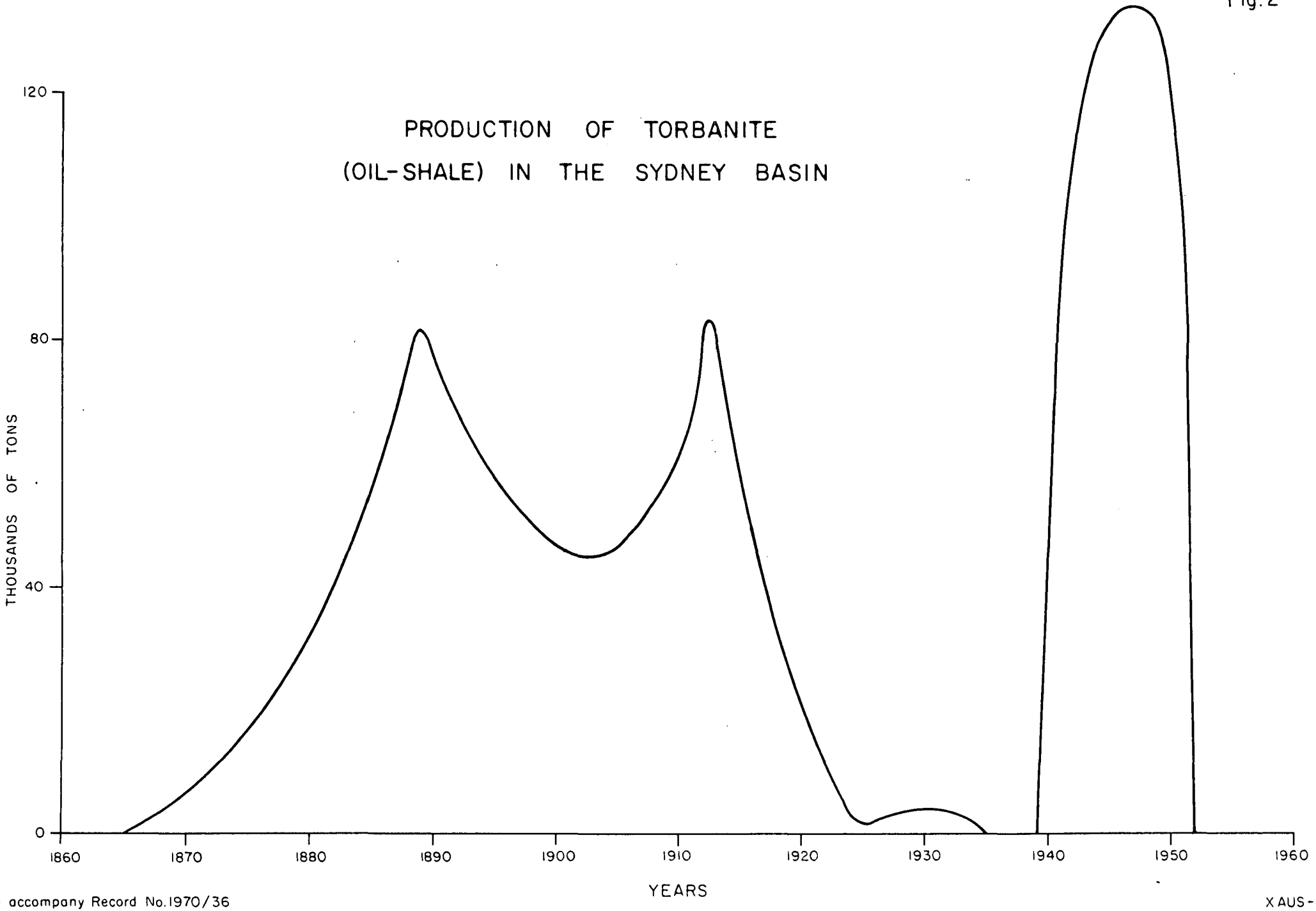
The 30 deposits of the Upper Coal Measures are all situated along the western outcrops of the Measures in a belt which is wide in the north (Ulan to Baerami) but narrows to a point in the south, near Joadja. Dulhunty produced evidence to show that the torbanite was formed over a comparatively small portion of the total area in which the coal measures were deposited, and in successive horizons within that area. It is likely that a great deal of torbanite has been removed by erosion along the western margin of the Basin, between the original shoreline of deposition and the present outcrop of the coal measures. Torbanite deposits may exist in the areas covered by the Triassic immediately to the east of this outcrop, and particularly in the area between Barigan, Baerami and Glen Davis.

The torbanite, which resembles closely the original Scottish torbanite, occurs in lenticular messes often associated with bituminous coal, cannel and carbonaceous shale.

These lenses, which are quite capriciously distributed, thin in all directions towards the margins and are assumed to have accumulated in small lakes. The torbanite seams, whose lateral extent varies from less than half a mile to six miles, have in many cases been largely removed by stream erosion which has produced the steep gorges and valleys of the Blue Mountains.

Fig. 2

PRODUCTION OF TORBANITE (OIL-SHALE) IN THE SYDNEY BASIN



To accompany Record No. 1970/36

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Later Developments:

From the simplified production-graph (Fig. 2) it may be seen that torbanite production in N.S.W. falls into two main periods, a forty-year long span from 1880 to 1920 and a brief Indian Summer in the decade 1940-1950. The first period, marked by erratic production figures, shows two peaks, one about 1890 and the second about 1910. In the earlier period the torbanite was used chiefly for gas-enrichment (much was sent overseas), whilst the "seconds" were used for making paraffin wax, kerosene and other byproducts. The increasing use of electricity for lighting caused a decline in the demand for gas at the turn of the century, but later the rise in importance of the petrol engine resulted in a corresponding increase in demand for torbanite products. Increasing costs, the upsets caused by World War I, the exhaustion of various torbanite seams, and the competition of the big oil companies caused the "oil-shale" industry to all but close down in about 1922, the state of stagnation lasting until the beginning of World War II. What little work there was, was connected with deposits near Mittagong, Barigan, Torbane and Baerami.

Newnes and Glen Davis:

The largest of all the N.S.W. torbanite fields is exposed in the Wolgan Valley at Newnes and the Capertee Valley at Glen Davis. It was opened in 1873 and worked until 1922 in the Newnes area, with a final burst of activity based on unemployment relief in 1932. In 1933 the Newnes Investigation Committee inquired into the shale-oil industry and eventually was able to recommend that crude oil from the shale should be refined by cracking to motor fuel and fuel oil. The National Oil Pty. Co. Ltd., formed with Commonwealth and State backing, moved a lot of equipment from Newnes to Glen Davis, built a new refinery and established a company town. Operations began in 1940, and petrol was conveyed in a 3-inch pipeline for 30 miles to the railway at Newnes. From 1945 until 1952 this company operated the only oil-shale plant in Australia, and a considerable amount of research work of all kinds was carried out by the staff. The plant had a capacity of 10,000,000 gallons a year of motor spirit, but the best year's production, in 1947, was only some 4,000,000 gallons. Although the Glen Davis torbanite

assayed 120 to 150 gal/ton, the assay of the shale entering the retorts, due to the mechanical mining of barren and rich material together, was only 55 gal/ton.

The success of the project was hampered by high mining costs and inability to mine enough shale to keep the retort-batteries operating at full capacity and to operate the refinery as much as half-time. This reduced scale of operation also increased the unit costs of marketable products.

The cost of torbanite petrol was very much higher than imported petrol and operating losses were so high that the $10,000,000 investment was closed in May, 1952.

Mention must also be made of the 2,000,000 gallons of crude oil produced in 1943-1945 by the Lithgow Oil Pty. Ltd., at Marangaroo and refined at Glen Davis.

At present (1969) the oil-shale industry in N.S.W. can only be described as, at the best, dormant with little prospect of rejuvenation.

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THE SEARCH FOR HYDROCARBONS.

PHASE 1. THE EARLY DAYS

The region now known as the Sydney Basin may be regarded as the cradle of Australian geology, for it attracted the attention not only of the curious in the earliest days of settlement but of scientists and savants at the turn of the 18th century and in the first decades of the 19th. Especially to be noted is "the father of Australian geology" the Reverend Mr. W.B. Clarke who arrived in Sydney in 1839. To this enthusiastic cleric, who became virtually the government geologist of the period, belongs the credit of being the first to recognise the existence of the coalmeasure basin.

The occurrence of these measures within a comparatively short distance of the capital, and their importance in the well-being of the colony resulted in their being one of the chief targets for investigation by the officers of the Geological Survey of N.S.W., by academics of the University of Sydney, and by other citizens both interested and disinterested. To list them would be to list a goodly proportion of the honour-roll of Australian geologists.

Coalmine workings and numerous shallow bores sunk over a period of many years by various bodies engaged in the search for coal have provided near-surface structural information concerning the Basin, and it was in the course of such work that the first discovery of hydrocarbons was made (if torbanite be excluded). This was in 1885, in the wells now known as Narrabeen Nos. 1 and 2, the gas occurring in sandstones of the Narrabeen Group of Triassic age. Such occurrences of gas in sandstones, and as emanations from coal seams, gradually led some to the belief that the Sydney Basin was a potential oil-field, and in the years 1910-1916 a Mr. Duke was encouraged to sink three wells at Richmond in the hope of striking a gusher. His deepest well was only 877' and nothing but a trace of gas was found.

PHASE 2. POST WORLD WAR I ACTIVITIES

After World War I interest in oil prospecting increased to the extent that some local residents went to the trouble of forming syndicates to drill bores at Penrith and at Yerrinbool. The site of neither was dictated by any great geological knowledge, and, though both penetrated to more than 2,000', only traces of gas were obtained.

In 1924 Dr. A. Wade wrote an encouraging report on the chances of finding oil in the Sydney Basin and in 1925 the Prime Minister wrote to the Government of N.S.W. offering to subsidize boring on a £ for £ basis provided that the bores were put down as described in Dr. Wade's report, within the Belford Dome in the Hunter River district, and that the Commonwealth pay no more than £22,500. In the same year E.C. Andrews wrote that there was no evidence that any of the domes in the Hunter Valley contained commercial oil or gas.

The era of science-based investigations now began with H.C. Millard, geologist of the Hunter River Oil Company, accurately locating the Belford Dome by mapping key beds. In 1926-27 one well was drilled on the Loder Dome and three on the Belford Dome but only traces of gas were obtained. This lack of success resulted in a lull in drilling activities for seven years. In 1935 Mr. Tyler's well at Bargo on the central axis of the Sydney Basin and Mr. W.J. Maskell's at Farley on the Lochinvar Dome in the Hunter Valley were commenced, but met with no greater success although drilled to greater depths, than hitherto.

Three more deep wells, Kulnura No. 1 on the Lochinvar - Kulnura Anticline, Mulgoa No. 1 on the central axis, and Balmain No. 1 in the Balmain colliery were sunk before World War II put an end to all petroleum exploration. Gas shows were met in all these wells, but nothing of economic importance - except that gas from Balmain was sold for use in automobiles in Sydney during the War.

PHASE 3. POST-WORLD WAR II ACTIVITIES.

The discovery in 1953 of oil at Rough Range in Western Australia and of gas in 1954 at Moonie in Queensland sparked off new interest in the prospects of the Sydney Basin. Veritably a new era dawned, marked by the activities of substantial companies with sophisticated techniques at their disposal, and by the interest shown by the Commonwealth Government over the whole field of petroleum exploration. The Australian Oil and Gas Company (A.O.G.) in particular is associated with this phase of operations (Table 1). The Commonwealth's interest has taken the form, on the scientific side, of running a number of seismic surveys (Bigg-Wither, 1970) and on the economic side of introducing the scheme of Commonwealth Subsidies in 1957.

Oil company geologists ransacked the Sydney Basin literature including logs and records belonging to the various coal-mining and other companies and the Joint Coal Board. Further field work was undertaken and much photo-geologic interpretation carried out. In particular the aid of geophysics was sought to help decipher the underground conditions prevailing in the Basin. All known geophysical surveys are listed in Table 2.

The Australian Oil and Gas Corporation Ltd.

This company was formed to conduct geological and geophysical investigations in the Sydney Basin (although its operations have by no means been confined to that area) and to test likely structures for hydrocarbon content). Operations began in 1954 with the drilling of the company's first borehole at Kurrajong Heights. This was on the Hingeline of the Sydney Basin on the Lapstone Monocline immediately to the east of the Kurrajong Fault, but, although it was a deep well penetrating to the Lower Marine Series only small shows of gas were reported. In this same initial period, too, A.O.G. launched a comprehensive geophysical survey to serve as a basis for future work: an aeromagnetic survey of the Sydney Basin was carried out in 1954-1955, and a gravity survey in 1954-1956.

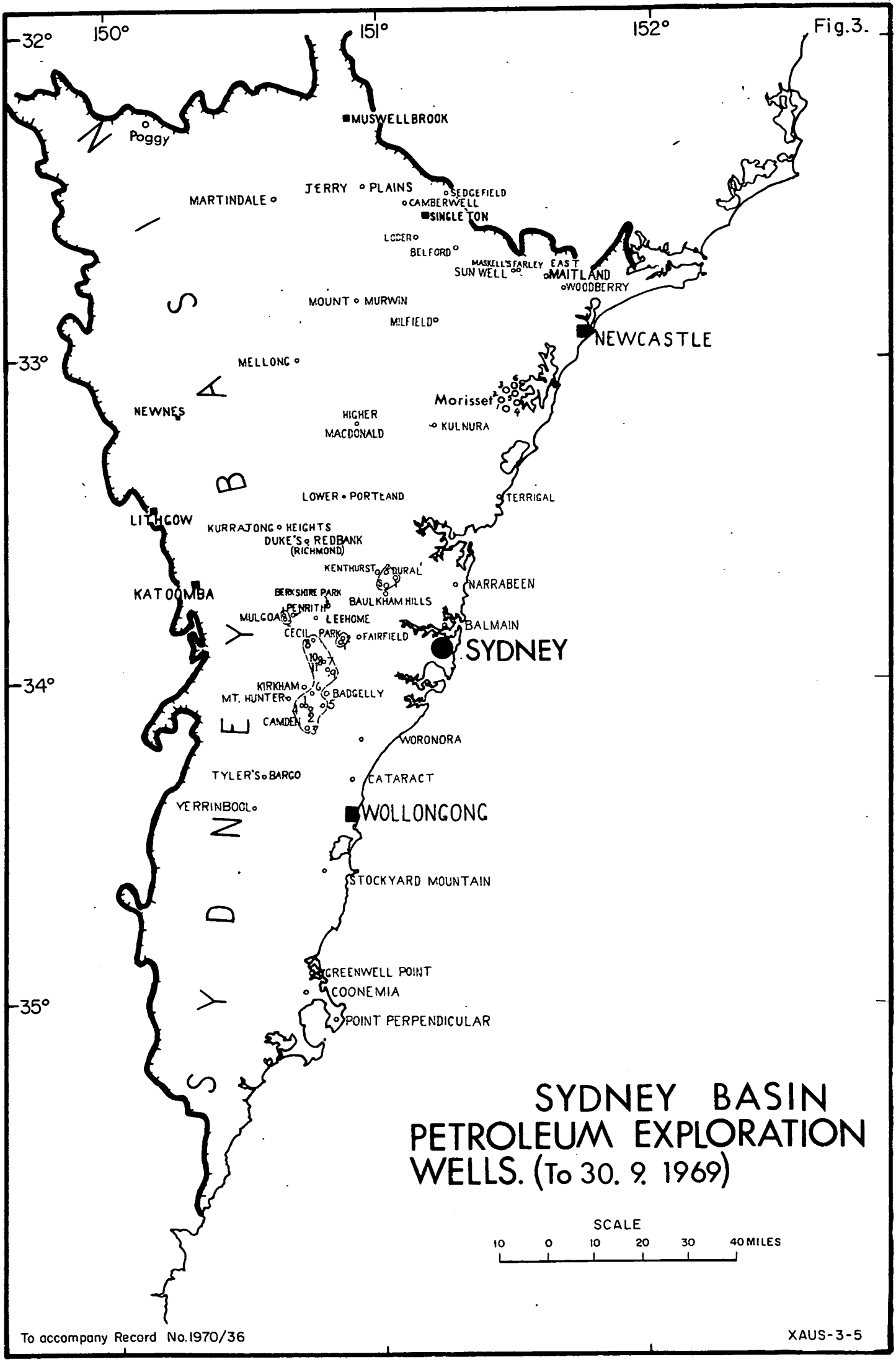
The Year 1957: The year 1957 is important as it marks both the inauguration of the Commonwealth Government's Subsidy Scheme and the Bureau of Mineral Resources introduction of the seismic method of surveying to the Sydney Basin. This work was done on the application of the A.O.G. supported by the N.S.W. Department of Mines and it demonstrated the usefulness of the seismic method in investigating the sedimentary section of the Basin, and showed especially that the coal-bearing strata are good reflectors of seismic energy.

A.O.G. meanwhile had drilled Dural No. 1 to over 5,000' on an attractive-looking anticlinal feature on the line of the Lochinvan-Kulnura anticline. Small gas shows were met and the company, encouraged by the results of the B.M.R.'s seismic survey in the area, drilled Dural No. 2 to over 6,000 feet but with little better success.

Six shallow test holes were sunk in the Morisset area in 1957 near Lake Macquarie to test the nature of the Upper Coal Measures between the Yarramalong and Macquarie Synclines. Some gas was encountered. In the same year was started the Camden series of holes in an area on the central axis zone where the Nepean Fault of the Hingline peters out and where it was anticipated that gas horizons might exist in the Narrabeen. Drilling continued in the Camden area through to 1960 when Camden No. 11 was abandoned. Gas occurred in all wells but not in commercial quantities, the least unsuccessful being Camden No. 1, No. 6 and especially No. 7 which yielded 1,000,000 c.f.p.d.

As the tempo of petroleum exploration in Australia increased the Sydney Basin came in for its share of attention, and by 1958 the whole area had been taken up by petroleum tenement holders. The first company other than A.O.G. to undertake operations was Sun Oil which drilled in 1958 on unsuccessful well (Sun Oil No. 1) on the Ravensfield Dome not far from Maskell's Farley. The next year Sun Oil drilled another, also unsuccessful, well (Ravensfield No. 1) in the same neighbourhood. Australian Iron and Steel also drilled two unsuccessful bores, whilst Central Coast Oils started Terrigal No. 1. This latter operation continued right on till 1968 when the well was suspended at over 6,000' having claimed to have encountered shows of

Fig.3.



SYDNEY BASIN PETROLEUM EXPLORATION WELLS. (To 30. 9. 1969)

SCALE

10 0 10 20 30 40 MILES

To accompany Record No.1970/36

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asphaltic oil from the lower Trias, lighter oil from the Permian Coal Measures and several gas shows. A.O.G. finished their Camden series and two other wells in this period, but with no results of economic importance. The Period 1962-1967:- In 1961 oil was discovered in the Moonie fields in Queensland and the following five years saw the flood-tide of activity in the Sydney Basin. Six major oil companies in addition to A.O.G. entered the field, all spurred on by the gigantic prize of finding oil on the fringe of Australia's greatest concentration of population and industry. A score of geophysical surveys were conducted including some over the continental shelf. These latter however gave no great hope that any worthwhile structures existed there, and all drilling was onshore. A.O.G. drilled seventeen holes and other companies together drilled twelve.

The information obtained from several seismic surveys led to many boreholes being drilled, as may been seen from the following summary:

From the	1961	Wallacia Survey resulted	Mt. Hunter (A.O.G.) No. 1
" "	1962	Singleton-Loder Survey "	Belford (A.O.G.) No. 1,
			Loder (A.O.G.) No. 1,
			Camberwell (A.O.G.) No. 1,
		and	Sedgefield (A.O.G.) No. 1
" "	1962	South Sydney Basin Survey resulted	Kirkham (A.O.G.) No. 1
			Woronora (.A.O.G.) No. 1
" "	1966	Denman Survey "	Martindale (A.O.G.) No. 1
" "	1966	Richmond Cessnock Survey "	South Dural (Shell) No. 1

Mt. Hunter No. 1, it may be mentioned, was the first subsidized well in the Sydney Basin. A.O.G. also deepened the old Kulnura No. 1 (abandoned by the Kamillaroi Oil Co. in 1938) and broke new ground at Mt. Murwin and Mellong.

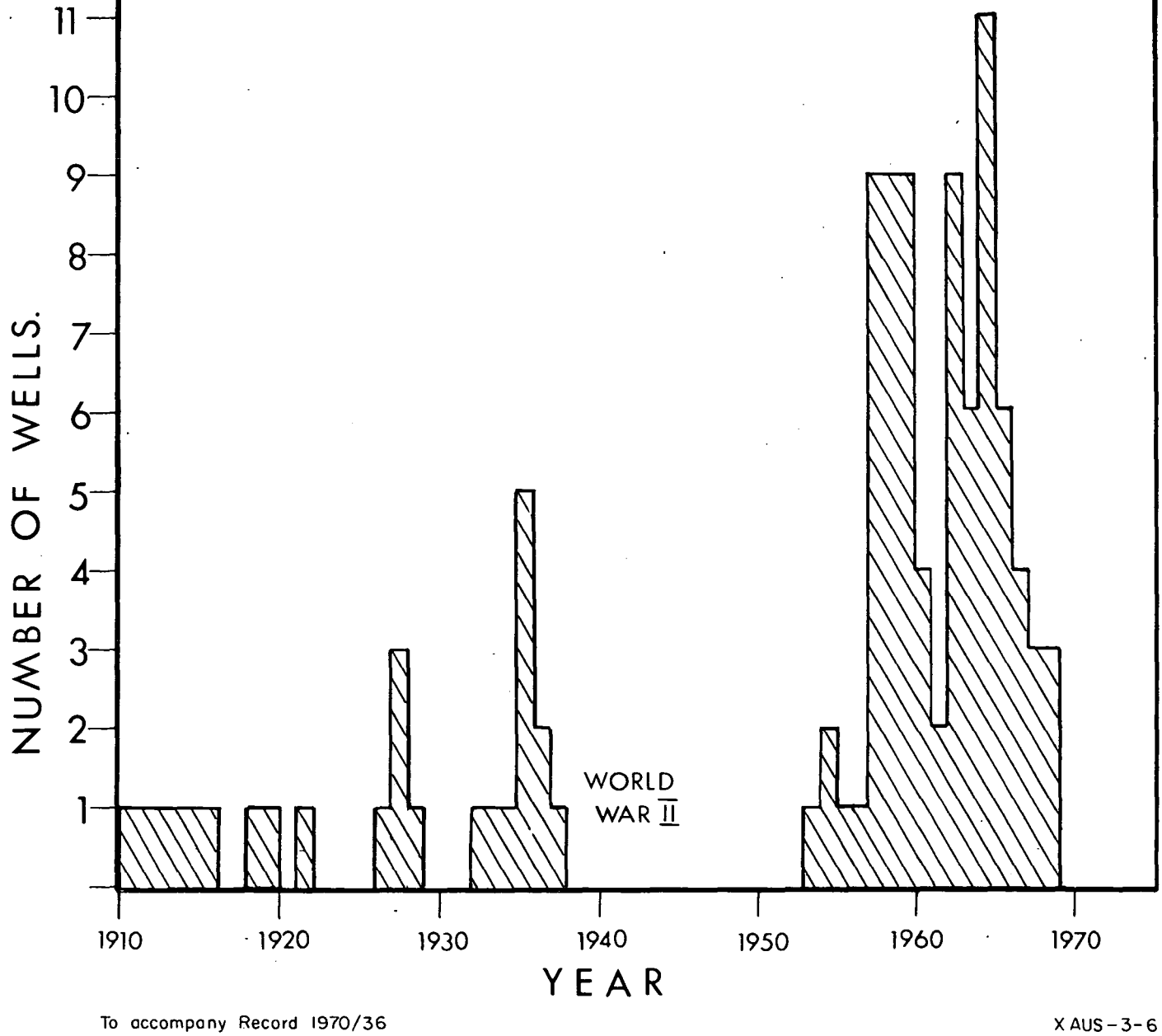
Among the activities of the other companies may be mentioned the deepening of Kurrajong Heights by Exoil to over 9,000', the drilling of East Maitland No. 1 to almost 10,000 by Planet Oil and of Dural South No. 1 to over 10,000 by Shell. This latter is the deepest well in the Sydney Basin. Despite all this expenditure of money and effort no wells produced any economically valuable yields of hydrocarbons, and some indeed produced none at all.

Post 1967:- By 1967 the Sydney Basin had been largely written off by the Companies, and only A.O.G. was left, to drill three more wells, again unsuccessfully, in 1968.

The year 1969 saw a slight resurgence of interest in the Basin. Esso drilled Jerry Plains No. 1 (in association the A.O.G.) in the hope of finding hydrocarbons in shoreline sands fronting the Muswellbrook Dome. Nothing was found. The Genoa Company drilled Coonemia No. 1 hoping to strike hydrocarbons in the Permian Berry or Nowra Formations. The bore was dry and the structure was only a basement high. In 1970 Esso drilled Howes Swamp No. 1 to over 8,000' in the vain hope of finding hydrocarbons in shore sands of the Lower Marine Series.

Fig. 4

GRAPH OF DRILLING ACTIVITY, SYDNEY BASIN, 1910—1969.



To accompany Record 1970/36

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TABLE 1

PETROLEUM EXPLORATION WELLS, SYDNEY BASIN (to 30.9.1969)

Company	Well Name and No.	Co-ordinates	Date Drilled	Total Depth (feet)	Hydrocarbons	Status	+ Stratigraphy (feet)
PHASE 1 1910-1916							
	Narrabeen 1	10 m. N. of Sydney	1885	1,200	Gas show at 650'	Abandoned	H.O.-397, N.397-1,985
	" 2	" " "	"	1,985	Gas at 700'	"	
	Dukes 1, 2, 3	At Redbank W at Richmond	1910-1916	877 (deepest of about 8)	Gas traces; Paraffin trace in No. 3	"	No log
PHASE 2 1918-1938							
	Penrith	33°48'S 150°39'E	1918-20	2,700	Gas traces	"	W.O-50, H, 50-1000- N. 1,000-2,523, U.C.M. 2,523-
Yerrinbool Oil Prospecting Syndicate	Yerrinbool	34°23'S 150°31'E	1921-1922	2,238	No record	"	H.O.-439, N.439-882, U.C.M. 882-1,188, S, 1,188-
Oil and Gas Investigations Ltd.	Loder Dome	32°38'S 151°08'E	1926-1927	2,391	Gas trace	"	
Belford Dome Ltd.	Belford Dome 1 " " 2 " " 3	32°39'S 151°17'E	1927	1,550	Gas trace	"	
Mr. W.J. Maskell	Farley or Lochinvar Dome	32°45'S 151°31'E	1935-1936	5,364	18000 Cu ft p.d. gas, and oil traces	"	L.M. (Dalwood) 0-5,364
Mr. Tyler	Bargo	34°18'S 151°31'E	1935	3,550	Gas traces	"	
Gas Drillers Ltd. (Oil Search Ltd.)	Mulgoa No. 1	33°48'S 150°38'E	1935	3,119	Numerous gas traces	"	H.O.-190, N190-2070, U.C.M. 2,070-3,119

Natural Gas and Oil Corporation Ltd.	Balmain	North Sydney	1932-1937	2,937 coal shaft 2,000 bore hole 4,937 T.D.	Gas withdrawn at 120,000 Cu ft. per week, from between 4,180' and 4530'	Abandoned	U.C.M.2,937-? 4,543, S ?4,543-4,935
Kamilaroi Oil Coy. Ltd. (Oil Search Ltd.)	Kulnura No. 1	33°13'S 151°12'E	1935-1938	6,293	Small gas shows	"	H.O-310, N.310-2701, U.C.M.2701-4,745 M. 4745-6,293
PHASE 3 1954-1970							
I A.O.G.	Kurrajong Heights No. 1	33°32'S 150°37'E	1954	4,755 (later deepened by Exoil)	Gas trace at 2000'	"	H.O-740, N.740-2,915, U.C.M.2,915-4,495, C.4,495-4,755
"	Dural (East) No. 1	33°41'S 151°03'E	1956-1957	5,203	Gas at 3,063' and 3,521	"	H.O-865, N.865-2,760, U.C.M.2,760-4,986, Dolerite Sill 4,986-5,203
"	Dural (East) No. 2	33°40'S 151°01'E	1957-1958	6,465	20,000 cu.ft. p.d. at 3,325'	"	H.O-907, N907-2,870 U.C.M,2,870-5,490 (dol. sill 4,980-5,107) S,5,490-6,465
"	Morisset No. 1	33°10'S 151°29'E	1957	571	Gas trace	"	T.O-369, U.C.M.369-571
"	" No. 2	33°10'S 151°27'E	1957	734		"	T.O-652, U.C.M.652-734
"	" No. 3	33°08'S 151°29'E	1957	519		"	T.O-423, U.C.M.423-519
"	" No. 4	33°09'S 151°31'E	1957	726		"	T.O-261, U.C.M.261-726
"	" No. 5	33°07'S 151°30'E	1957	272		"	T.O-154, U.C.M.154-272

A.O.G.	Morisset	No. 6	33°06'S 151°31'E	1958	303		"	T.0-153, U.C.M.153-303
"	Camden	No. 1	34°05'S 150°43'E	1957	2,272	Dry gas at 1,173' 1209' and 1,355' 50,000 cu.ft.p.d.	"	T.?
"	"	No. 2	34°05'S 150°44'E	1958	2,230	Dry gas at 1,076' and 1,699'	"	T.?
"	"	No. 3	34°09'S 150°43'E	1958	1,830	Dry gas at 914'	"	T.?
"	"	No. 4	34°05'S 150°42'E	1958	1,890	Dry gas at 1,167' and 1,209'	"	T.?
"	"	No. 5	34°05'S 150°46'E	1958	1,939	Dry gas at 829, 908, 1,220, 1254, 1,562'	"	T.?
"	"	No. 6	34°02'S 150°45'E	1959	1,981	880' downwards several gas shows. 1947' gave 70,000 cu.ft.p.d.	"	W.0-365, H.365-1,022, N.1,022-1,705
"	"	No. 7	33°57'S 150°47'E	1959	1,705	1,350' gave 70,000 cu.ft. p.d. and 1,000,000 cu.f.t.p.d. at bottom	"	
"	"	No. 8	33°53'S 150°44'E	1959	2,102	1742' dry gas	"	W.0-286, H.286-981, N.981-2,102
"	"	No. 9	33°58'S 150°48'E	1959	2,104	Dry gas at 1,346, 1,390, 1800'	"	W.0-390, H.390-1.061, N.1,061-2,104
"	"	No. 10	33°56'S 150°46'E	1959	1,743	1740' gave 500,000 cu.ft.p.d.	"	W.0-335, H.335-980, N.980-1,743
"	"	No. 11	33°57'S 150°45'E	1960	2,029	Dry gas at 1646' and 1753'	"	W.0-275, H.275-890, N.890-2,029
"	Mulgoa	No. 2*	33°49'S 150°38'E	1958-1959	5,630	12 gas shows below 1,300' yielding 40,000 cu.ft.p.d. waning to 10,000 cu.ft.p.d.	"	W.0-70, H.70-850, N.850-2,498, U.C.M.-2,498-3597, S.3,597-5,630

A.O.G.	Baulkham Hills No. 1	33°45'S 151°01'E	1960-1961	3,508	Minor gas shows	"	H.O-800, N.800-2,728, U.C.M. 2,728-3,508
"	Mt. Hunter No. 1*	34°04'S 150°39'E	1962	3,512	14 gas horizons yielding 40,000 cu.ft.p.d. waning	"	Base of N.2,100 . U.C.M.2,100-3,20C , S.3,200-3,512?
"	Loder No. 1*	32°38'S 151°08'E	1963	6,767	Oil and Gas shows recorded in Branxton, Farley and Rutherford	"	M.O-2,258, G.C.M. 2,258-2,580, D. 2,580-6,767
"	Mt. Murwin No. 1*	32°51'S 150°55'E	1963	2,910	Minor gas shows from coal seam	"	H.O-270, N.270-2,533, U.C.M.2,533-2910
"	Mellong No. 1	33°00'S 150°42'E	1964	2,970	Minor gas shows	"	H.O-370, N.370-2,480, U.C.M.2,480-2,970
"	Woronora No. 1*	34°12'S 150°55'E	1963-1964	7,587	Minor gas shows	"	H.O-550,N.550-1,710, U.C.M.1,710-3,420 S.3420-7473, B.7,473-7,587
"	Kenthurst No. 1	33°40'S 150°59'E	1963	3,497	1,432 gave 11,500 cu.ft. p.d.	"	H.O-846, N.846-2,805, U.C.M.2,805-3,497
"	Fairfield No. 1	33°52'S 150°55'E	1964	2,803	Gas at 1,784' and 2,740'	"	W.O-238, H.238-1,021, N.1,021-2,803
"	Kulnura No. 1	33°13'S 151°12'E	1964	Started at 6,293 T.D. at 8,112	Gas at 7,274' Outburst at 7,680'	"	M.6,293-8,112
"	Sedgefield No. 1	32°31'S 151°15'E	1964	2,254		"	M.O-1,450 , G.C.M. 1,450-1,625, D. 1,625-2,254
"	Cecil Park No. 1	33°52'S 150°51'E	1964-1965	2,286	2,026'-2,045' gave 200,000 cu.ft. p.d. waning	"	W.O-527, H.527-1,277, N.1,277-2,286
"	Cecil Park No. 2	½m. S of No. 1	1964	2,262	Minor gas	"	W.O-458, H.458-1,171, N.1,171-2,262

A.O.G.	Kirkham No. 1	34°02'S 150°42'E	1964	8,406	Dry	"	WO-370, H.370-1016, N.1,016-2,453, U.C.M.2453-3,877 S.3,877-8,356, B. 8,256-8,406.
"	Badgelly No. 1	34°03'S 150°48'E	1964	2,166	Gas at 1,199 and 1,251'	"	
"	Leehome No. 1	33°49'S 150°45'E	1965	2,179		"	W.O-317, H.317-997, N.997-2,179
"	Belford No. 1*	32°39'S 151°17'E	1964-1965	3,854	Gas shows at 13 levels	"	M.O-1,426, G.C.M. 1,426-1,606, D. 1,606-3,854
"	Camberwell No. 1*	32°32'S 151°06'E	1965	6,256	Oil trace at about 2,400'	"	M.O-3,435, G.C.M. 3,435-3,890, D. 3,890-6,256
"	Milfield No. 1	32°53'S 151°12'E	1966	2,114		"	
"	Martindale No. 1 and 1A*	32°30'S 150°37'E	1967	3,876 (1A)	Dry	"	U.C.M.O-2,127, M. 2,127-3,426, M.C.M. 3,426-3,774, D. - 3,774-3,876
"	Berkshire Park No. 1	33°46'S 150°47'E	1968	3,580	Dry	"	W.O-40C H.400-1060 N.1060-3,36C U.C.M. 3,360-3,58C
"	Higher Macdonald No. 1*	33°12'S 150°55'E	1968	2,060	Dry	"	N.80-1,932, U.C.M. 1,932-2,060
"	Lower Portland No. 1	18 m. N of Windsor	1968	2,918	Dry	"	H.O-465 ,N.465-2,705 , U.C.M. 2,705-2,918
II COMPANIES OTHER THAN A.O.G.							
Sun Oil Coy.	Sunwell No. 1	32°44'S 151°30'E	1953	2,074	Minor gas show	"	

Central Coast Oils N.L. = Alkane Exploration Terrigal N.L.	Terrigal No. 1	33°26'S 151°26'E	1959	6,186 in 1968	Some oil and gas claimed	Suspended in 1968	N.O-1,908, U.C.M. 1,908-2,130
Planet Oil	E. Maitland No. 1*	32°46'S 151°37'E	1962	10,004	Gas show	Abandoned	UC.M.O.-190, M. 190-4,649, G.C.M. 4,649-4,793, D.4,793-10,004
L.H. Smart Oil C/L	Greenwell Point No. 1	34°45'S 150°43'E	1962	170	Dry	"	S.O-170
L.H. Smart Oil C/L	Greenwell Point No. 2	"	"	459	Dry	"	S.25 -459
Exoil	Kurrajong Heights No. 1*	33°32'S 150°37'E	"	Started at 4,755, T.D. 9,132	Dry	"	C.4,755-7,865, B.7,865-9,132
Smart Oil Exploration	Point Perpendicular No. 1	35°00'S 150°48'E	"	582	Dry	"	S.10v582
Farmout Drillers	Stockyard Mt. No. 1*	34°36'S 150°47'E	"	3,516	Gas trace	"	S.O-3,297, B.3,297-3,516
Alliance Oil Devt.	Cataract No. 1	34°19'S 150°53'E	1964-1965	4,090	Dry	"	H.O-380, N.380-780, U.C.M.780-1,980, S.1980-4090-4½"
A.J. Wood	Poggy No. 1	32°16'S 150°08'E	1964-1967	2,407		Suspended	
Planet Oil Coy.	Woodberry No. 1	32°47'S 151°41'E	1965-1966	3,003	Dry	Abandoned	
Shell Development (Aust.) Ltd.	Dural South No. 1*	33°43'S 151°01'E	1966	10,035	Dry	"	W.O-120, H.120-900, N.900-2,730, U.C.M.2,730-5,296, M.5,296-10,005, B.10,005-10,035

Esso	Jerry Plains No. 1*	32°28'S 150°56'E	1969	5,204	Dry	Abandoned	U.C.M.0-530, M.530-2,520, G.C.M. 2,520-3,254, D. 3,254-5,204
Genoa	Coonemia No. 1*	34°58'S 150°42'E	1969	2,614	Gas trace	"	S.O.-1,705, C.C.M. 1,705-1,840, Permian aged 1,840-2,096, Unconformity 2,096-2,116, B.2,116-2,614
Esso	Howes Swamp No. 1	33°07'53"S 150°41'32"E	1970	8,400			

* - Subsidised Wells

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W - Wianamatta

H - Hawkesbury

N - Narrabeen

U.C.M. - Upper Coal Measures

M - Maitland

S - Shoalhaven

G.C.M. - Greta Coal Measures

M.C.M. - Muswellbrook Coal Measures

D - Dalwood

B - Basement

TABLE 2

GEOPHYSICAL SURVEYS IN THE SYDNEY BASIN

AEROMAGNETIC SURVEYS

Name/Place of Survey	Date	Company and/or Notes
Sydney Basin Test	1954	A.O.G.
Sydney Basin	1955	A.O.G.
West Maitland	1958	P.E. Gauld
Sydney - Nowra	1962 - 1963	L.H. Smart Oil Exploration C/L
Sydney Offshore 1	1964	Central Coast Oil Pty. Ltd.
Sydney Offshore 2	1966	Shell Development (Aust.) Pty. Ltd.
GRAVITY SURVEYS		
Sydney Basin	1954 - 1956	A.O.G.
Singleton - Putty, Morrissett - Camberwell	1955 - 1963	A.O.G.
Nowra	1961	L.H. Smart Oil Exploration C/L
Shellharbour	1964	Consolidated Oil Ltd.
SEISMIC SURVEYS		
Central Sydney Basin	1957	B.M.R.
Wallacia	1961	A.O.G.
Newcastle - Maitland	1962	Planet Exploration C/L
Morissett - Lochinvar - Kulnura	1962 - 1963	A.O.G.
Nowra	1962	L.H. Smart Oil Exploration C/L
Singleton - Loder	1962 - 1963	A.O.G.
South Sydney Basin	1962 - 1963	A.O.G.
Caroona (Oxley Basin)	1963 - 1964	Alliance
Sydney Offshore 1	1964 - 1965	Shell Development (Aust.) P/L.
Otway - Sydney Basin Vibroseis	1964	B.M.R.
Drake's Forest	1964	Coal Cliff Collieries
Sydney Basin	1964 - 1965	A.O.G.
Camberwell	1965	A.O.G.
Richmond - Cessnock	1965 - 1966	Shell Development (Aust.) P/L
Werombi	1965 - 1966	R.A.N. with H.M.A.S. Kanimbla
Putty - Oakdale	1965 - 1966	A.O.G.
Denman	1966	A.O.G.
Stanwell Park	1966	Coal Cliff Collieries P/L
Girvan	1966	A.O.G.
Sydney Offshore 2	1967	Shell Development (Aust.) P/L
Port Jackson	1967	Sydney University
Mossy Point	1967	N.S.W. Govt., B.M.R. and Sydney University, with "Oceanographer"
Currumbene	1969	Genoa Oil N.L.
Broken Bay Offshore	1969	Magellan
Tasman/Bass St. Marine Seismic and Magnetic Survey	1969	Magellan

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