PROJECTED DEMAND FOR AUSTRALIAN CARGO SHIPS:

Shipbuilding Implications

by

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1. INTRODUCTION

This report is supplementary to Report Nav/Arch 71/6, 'Preliminary Investigation of the Requirements for an Australian Standard Ship Program' (Ref. 1). The Australian shipping scene is examined with a view to gaining an appreciation of the present position and of making some speculative projections of future developments. The projections made here are designed to give some idea of the possible demand for shipping and shipbuilding in the coming years.

The coastal and the overseas sectors of the Shipping Industry are examined separately and three types of trade, i.e. liquid-bulk, dry-bulk and general-cargo, are considered in each sector. The Department of Shipping & Transport annual publications 'Australian Shipping and Shipbuilding' (Ref. 2), 1964-1971 editions, are used as a source of data for ships in service or on order. A summary of the total Australian Trading Fleet as at 31st December, 1971, as taken from that publication, is given in Table 1.1*.

Trade projections are made, based on simple extrapolation, using several plausible annual growth rates. Some tentative conclusions concerning possible shipbuilding policy are then drawn from these projections. The conclusions are tentative because of the uncertainties in the extrapolation, the assumptions made, and particularly because the effects of different options on the Ship Industry (Ref. 1), and on the national economy, have not been costed. Implementation of the most advanced proposals of this report would require a unique degree of co-operation between trade unions, employers, financiers and government. Nevertheless, it is hoped that the report will help discussion during the present period of uncertainty in the industry.

The several sets of possible demand figures found here may also give some idea of the viability of ship standardisation programs, as discussed in Ref. 1.

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*Relevant tables are given at the end of each Section.

TABLE 1.1

SUMMARY OF THE AUSTRALIAN TRADING FLEET AS AT 31.12.71

VESSELS - 200 GRT AND OVER	NO.	TONS (DWT)	TONS (GRT)
Interstate Vessels			
(a) Australian-owned, Australian-registered vessels	75	925,285	676,741
(b) Overseas-owned, Australian-registered, engaged in Australian coastal trade:			
(i) New Zealand owned	7	21,548	19,205
(ii) Other	10	278,844	177,779
(c) Overseas-owned, overseas-registered vessels on charter, engaged in Australian coastal trade	7	169,328	105,206
Total Interstate Fleet	*99*	*1,395,005*	*979,031*
Intrastate Vessels	23	124,889	83,466
Total Coastal Trading Vessels	*122*	*1,519,894*	*1,062,497*
Overseas Trading Vessels			
(a) Australian owned, Australian registered, operated mainly in overseas services	7	85,219	64,866
(b) Australian owned, overseas registered, operated wholly in overseas services	4	25,203	20,623
Total Overseas Trading Vessels	*111*	*110,422*	*85,489*
Total Australian Trading Vessels	*133*	*1,630,316*	*1,147,986*

Source: Australian Shipping and Shipbuilding Statistics - Supplement to 24th Edition (Ref. 2).

2. AUSTRALIAN COASTAL SHIPPING

2.1 Introduction

The Australian coastal trading fleet consists of 122 vessels over 200 tons gross with a total gross tonnage of 1,062,497 tons and deadweight of 1,519,894 tons, as shown in Table 1.1. Details of these ships are given in Ref. 1 (24th Edition, 1971).

Of these ships, 20 interstate and 4 intrastate vessels (Table 2.1) have been imported and, under present government legislation, are to be re-exported at a later date. The government ship-import restriction policy, designed to afford protection to the Australian shipbuilding industry, is of considerable importance to shipowners and shipbuilders alike and appears to have a marked effect on each of these groups.

The general government attitude is that an owner should be allowed to import a ship to test a trade; i.e. to see if a ship of a given size is suitable for a particular trade or if, in the light of experience, some other size would be more suitable. An example of this is the importation of the three 5,000 DWT Caltex tankers (see Table 2.5). Experience has apparently shown them to be unsuitable for the trade in which they are engaged and an order for a single 24,000 DWT replacement for them may be placed. Ships may also be imported to hold a trade while an Australian replacement is being built. An example of this may be found in the bauxite trade.

The period for which an imported ship may be used may vary. It would tend to be longer for ships operating on routes of longer voyage time as it would then take longer to test the trade and enable the design of the replacement ship to be developed satisfactorily. The general policy is that a ship may be imported provided a replacement ship is built in an Australian shipyard. The imported ship must be re-exported on delivery of the replacement. The imported ship may be retained after delivery of the replacement if a further order is proposed and in due time placed.

The period between import and placement of an order appears to be about 3 years though it may vary considerably. This policy appears to be reasonable despite a strong reaction by Australian shipbuilders, as it would seem unfair and commercially unwise to force shipowners to build new tonnage immediately, particularly in those cases where there is a degree of uncertainty about the trade.

There are some cases, however, which seem to lend support to the shipbuilders' protests that the importation "loophole" is being exploited by shipowners to avoid building, so that the policy is

not as effective in supporting the builders as it might be. One example of this is the Shell tanker HEMIGLYPTA having been on the coast for 7 years with no replacement being ordered. (CELLANA replaced HEMIPLECTA.) This company also operates the 71,270 DWT SOLEN for which no replacement order has yet been placed.

The shipowners may perhaps argue with some justification that the present lack of information on government policy with respect to the future of the shipbuilding industry is causing them to defer orders. The situation is thus seen to be a difficult one and lack of demonstrably clear and consistent government policy and actions in administration of the import regulations (which are difficult to comprehend, if not themselves the root causes of the problems) make it no easier.

The major components of the coastal trading fleet are now examined in the light of the above outline of the importation problem, and with reference to historical and possible future trends. Table 2.2 shows amounts of various types of cargos carried on the Australian coast over the period 1959/60 to 1968/69. Historical trade figures quoted in later sections are based on those given in this table.

2.2 Coastal Tankers

(a) Historical

The use of Australian registered tankers to ship oil on the Australian coast is a relatively recent practice. As late as June, 1964, there was only one Australian-registered tanker, the 15,330 DWT MILLERS CANOPUS operating on the coast. The 33,150 DWT P.J. ADAMS, built at Whyalla in 1962 and owned by Ampol Petroleum Ltd., was registered in London and was not licensed to trade on the coast. According to the Department of Shipping & Transport publication, Australian Shipping and Shipbuilding Statistics, "there were no overseas vessels with permits to carry coastal cargo for an extended period" but "numerous tankers ... obtain (Single Voyage) permits to carry petroleum products between interstate ports".

By June, 1965, the position had changed considerably. The coastal tanker fleet was as shown in Table 2.3. All these ships were built overseas.

By December, 1971, the variations to the fleet as shown in Table 2.4 had taken place. Thus the fleet as at December 31, 1971, was as shown in Table 2.5. Fig. 2.1 is a graphical representation of the growth of the fleet over this period.

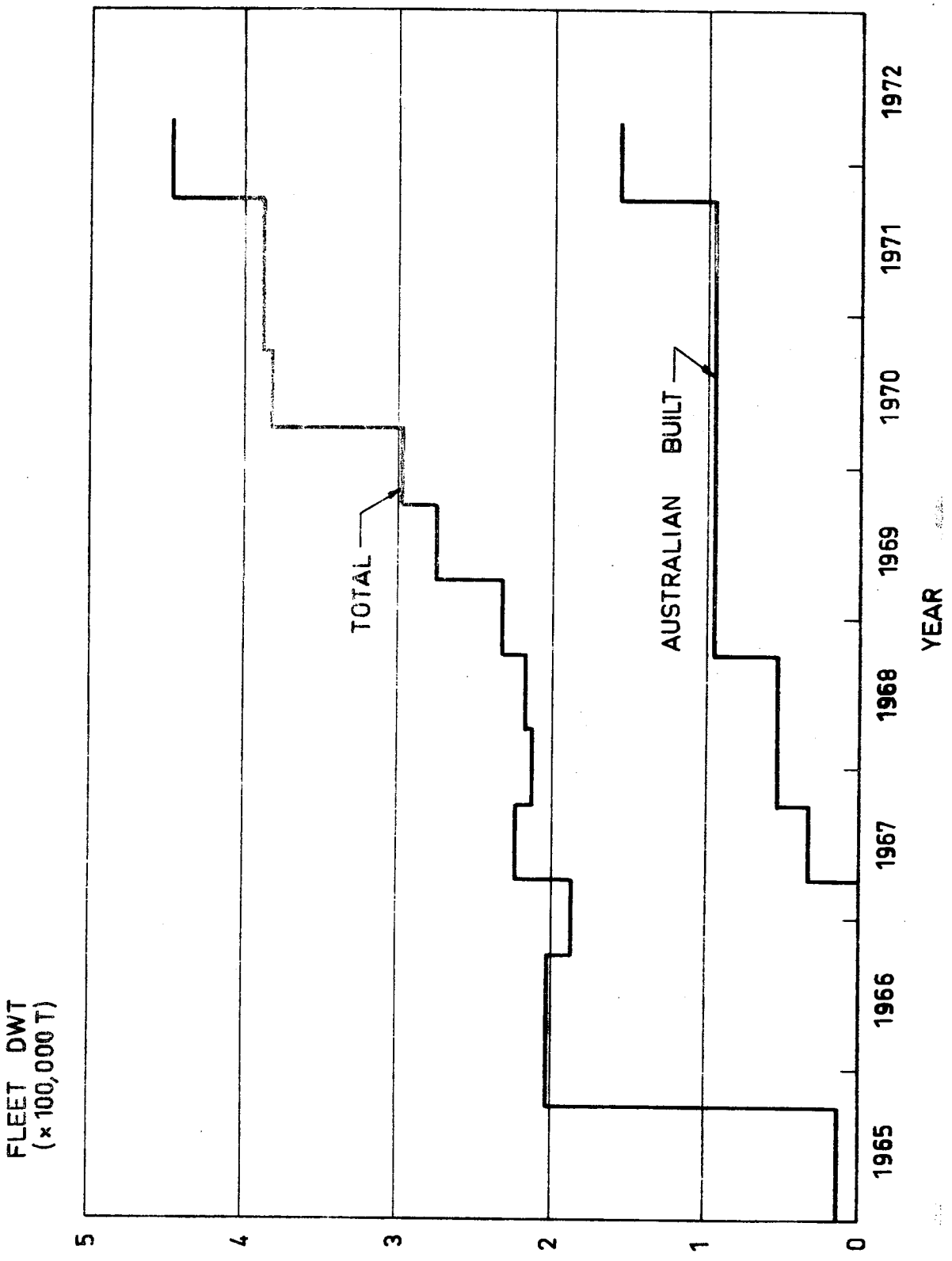


FIG. 2.1. GROWTH OF AUSTRALIAN COASTAL TANKER FLEET 1965 – 1971

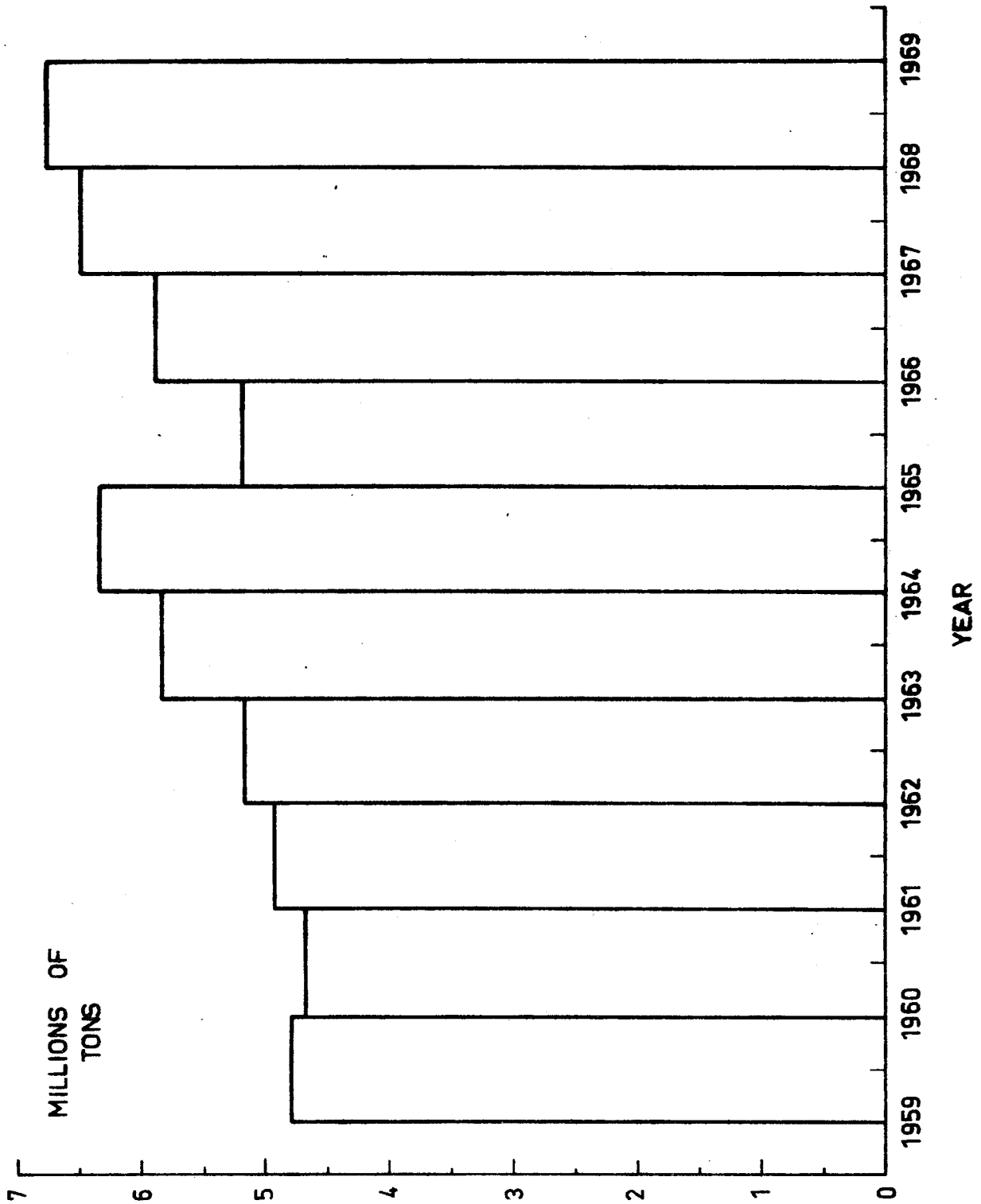


FIG. 2.2. LIQUID BULK CARGO CARRIED ON AUSTRALIAN COAST 1959 – 1969

The amount of liquid bulk cargo carried on the Australian coast between 1959 and 1969 is shown in Fig. 2.2.

(b) Australian-Built Tankers

Table 2.6 gives a summary of tankers built or building in Australia. Note that while P.J. ADAMS was built in 1962, it was registered in London and traded overseas until September, 1966.

(c) Imports

As may be seen from Fig. 2.1 and the preceding tables, Australian-built tonnage on the coast is 158,830 tons (which does not include the 22,560 tons added to P.J. ADAMS in 1969). This amounts to 35.5% of the total. The periods for which the imported ships have been on the coast are shown in Table 2.5. Present Commonwealth Government policy allows the importation of ships provided a replacement is built in an Australian yard.

(d) Projected Demand

The rate of increase of petroleum and oil consumption in Australia over the past decade has been fairly steady at about 9% p.a. Consumption in 1969 was of the order of 20 million tons of which about 10% was from Australian wells (Ref. 3). In the time available, no information could be procured on the likely future development of indigenous production, though this might well be available from the Bureau of Mineral Resources. The effect of increased use of indigenous crude oil on the coastal tanker fleet is not clear though it may produce some increase in the required deadweight.

In an attempt to determine the requirement for tankers to be built in Australian shipyards over the next decade or so, it was assumed that total coastal tanker deadweight would expand at about the same rate as domestic consumption of petroleum and other oil products (i.e. at about 9% p.a.). Fig. 2.3 shows the projected demand for coastal tanker tonnage, given growth rates of 5,8 and 10 percent p.a.

These curves enabled Table 2.7 to be prepared. This table shows, in the column headed "Orders", the total deadweight tonnage on order or building at the end of each three-year period, which would need to be completed within the next three years if the total fleet deadweight at the end of that period is to be that shown in Fig. 2.3 for the appropriate rate of expansion. Thus, for example, if expansion continues at about 8% p.a., by the end of 1974 there would need to be about 150,000 DWT of ships on order

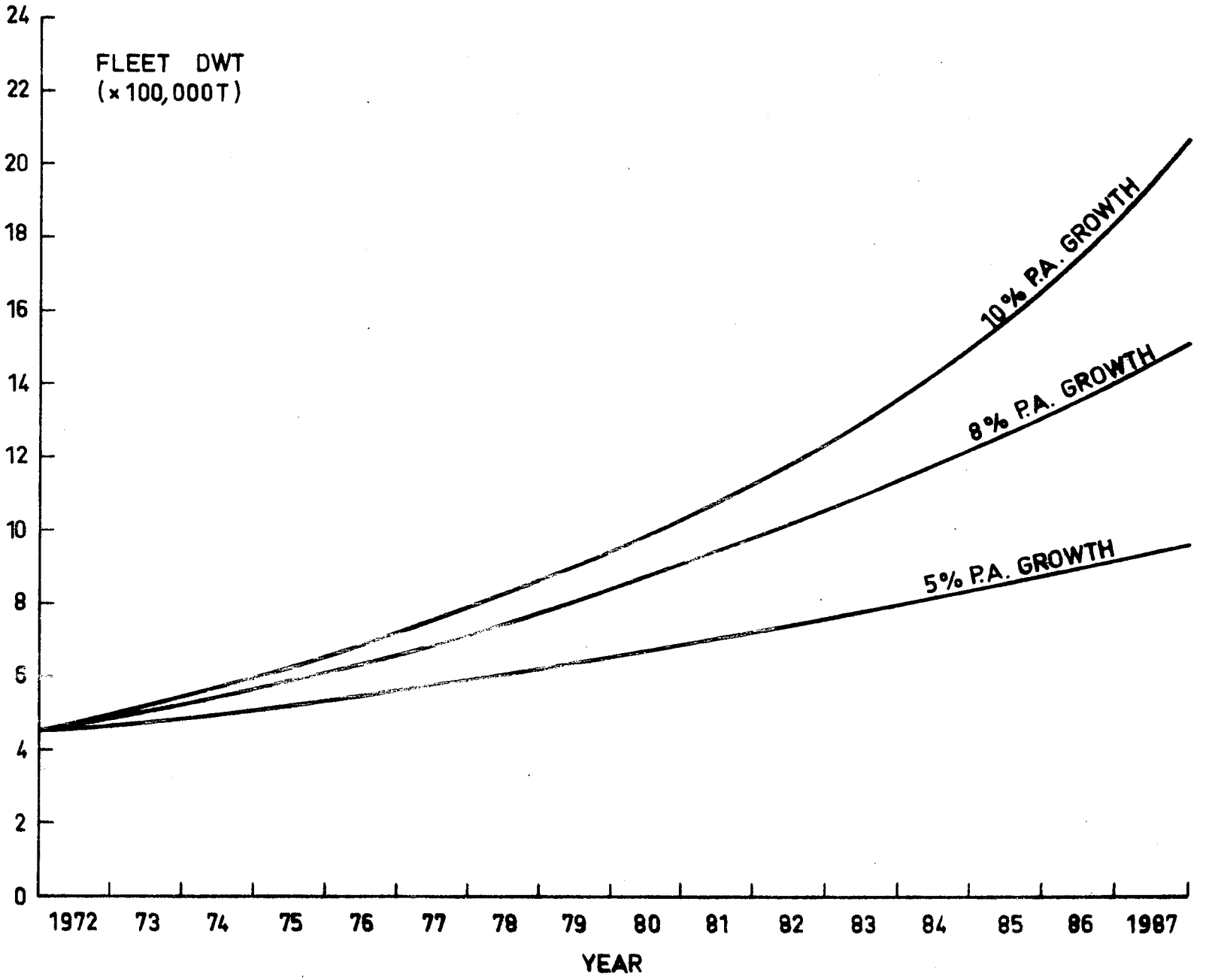


FIG. 2.3. AUSTRALIAN COASTAL TANKERS - PROJECTED DEADWEIGHT DEMAND

or building to be completed within the three years, 1975-77, to bring the fleet deadweight to 720,000 tons by the end of 1977 - this 150,000 DWT may consist merely of one 60,000 DWT and one 85,000 DWT ship.

It must be noted that the sizes of ship and the numbers of ships of each size as shown at the right of this table are only illustrative of what may be the case and do not represent the results of optimisation studies. They serve merely to illustrate what the demand figures mean in more tangible terms. The figures of Table 2.7 do not take into account replacement of present tonnage (Australian-built or imported) but represent only that amount which is necessary to give the required growth rate.

In order to obtain some idea of the total demand, an allowance has to be made for replacement of Australian-built and imported ships.

As 4 of the 5 Australian-built ships are relatively new, they will possibly not need replacement within the period being considered. P.J. ADAMS will be 15 years old in 1977 and may need replacement shortly after that date, so that its replacement will go onto the 1977 3-year order book; it will presumably be somewhat larger than P.J. ADAMS - perhaps of 85,000 DWT.

We are thus primarily concerned with the replacement of the 13 imported ships on the coast.

Table 2.8 shows those ships for which replacements had been ordered at December 31, 1971, and Table 2.9 shows those for which no replacement order had yet been placed at that date.

It is impossible to say what will happen here, but for present purposes let us suppose that in cases 1 to 5 of Table 2.8 the imported ships are disposed of when the replacements are built but that in case 6, that the import is retained and an order for, say, a T60 class (60,000 DWT) replacement is placed shortly, appearing on the 1974 3-year order book, HOWARD SMITH being exported on delivery of this new ship. If present import restrictions hold, orders would need to be placed soon for the ships in Table 2.9. These ships have been on the coast for the periods shown there.

A 24,000 DWT ship is being considered to replace the 3 Caltex ships. For present purposes, let us call this a "T25 Class" (25,000 DWT) ship and suppose that before long a T25 class ship is ordered to replace HEMIGLYPTA, and a "T85 Class" (85,000 DWT) is ordered to replace SOLEN. The 2 smaller ships would probably be replaced by similar small ships; let us assume two at 10,000 DWT here, for the sake of simplicity. The above mentioned ships should appear on the 1974 3-year order book. These assumptions are not entirely unreasonable and are the most advantageous the shipbuilding industry could expect. We assume for the moment that all the

present imported ships are exported on delivery of their replacements, i.e. before the end of 1977.

Assuming no more imports and the replacement new-building program outlined above, together with present orders - but excluding orders suggested by expansion needs, Table 2.7 - the fleet capacity at end of 1977 may be determined as follows:

Current Orders	218,800*DWT	
Possible Orders	+215,000 DWT	
Total Orders		433,800 DWT
Exports		-267,500 DWT
Nett Tonnage		166,300 DWT
Present Capacity		+448,900 DWT
Capacity - December, 1977		615,200 DWT

The state of the fleet (i.e. ships in service) at end of 1974 would appear to be:

Current Orders	218,000*		
Possible other Orders	+Nil		
Total Orders		= 218,000	
Exports		- 87,100	(1-5 Table 2.8)
Nett Tonnage		= 130,900	
Present Tonnage		+ 448,900	
Capacity - December, 1974		579,800	

It will be seen from the December 1974 figures above, the nett DWT tonnage is 130,900; i.e. a little above the 8% expansion estimate of 120,000 DWT.

Subtracting the nett tonnage for the 1971-74 period from that of the 1971-77 period (taken from the above calculations) we have 166,300 - 130,900 = 35,400 expansion in total fleet deadweight due to replacement of imports with slightly larger ships. If to this figure is added that due to the construction of one T60 class and one T85 class ship, as suggested previously when describing the use of Table 2.7, the nett fleet deadweight increase for the period 1974-77 would be 35,400 + 145,000 = 180,400, which is somewhat above the estimate of 150,000 DWT for an 8% growth rate, but is reasonably close.

From the above analysis, it is seen that given the current order book as the 1971 3-year order book, a 1974 3-year order book

*excludes contemplated Caltex ship.

to give 8% growth can be derived. It would be as shown in case (b) of Table 2.10. The results, given 5% and 10% fleet deadweight expansion rates, are given as cases (a) and (c) in Table 2.10. Case (b) is perhaps the most reasonable one for extrapolation.

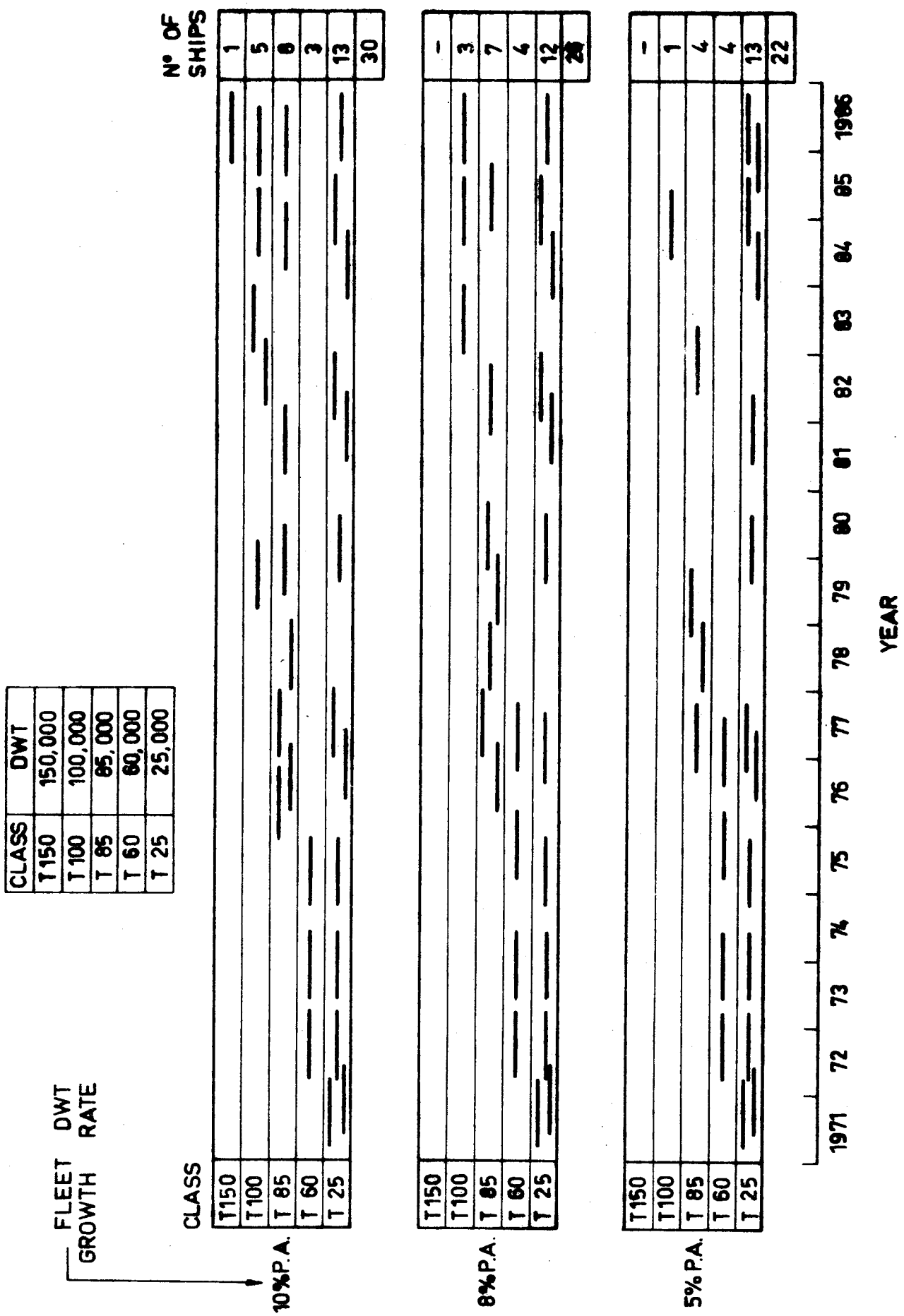
What happens after 1974 depends heavily upon the policy towards importation. If a "No Import" regulation is imposed, by the end of 1977, all imported ships will have been removed from the coast, leaving an entirely Australian-built fleet. The sizes of subsequent order books would then, presumably, follow a curve appropriate to the expansion of trade, Table 2.7, Fig. 2.3, with due consideration being given to replacement of the then old Australian ships, viz. P.J. ADAMS on the 1977 3-year book, B.P. ENDEAVOUR, B.P. ENTERPRISE and CELLANA on the 1983 3-year book.

If the present system continues, by which a ship may be imported and a replacement order placed within about 3 years, and if owners import ships to absorb expansion of the trade and wait for the maximum period before re-ordering, then perhaps the 1974 3-year order book may consist solely of replacements for present imports; i.e. 6 ships totalling 215,000 tons in the above example. If an 8% growth rate persists, the 60,000 and the 85,000 ton ships which are listed above on the 1974 book to cater for trade expansion would be imported, and would be replaced by ships placed on the 1977 3-year book. Thus we see that, under this policy, the 3-year order books will lag behind those listed in Table 2.7 by one 3-year period.

If, as is at present the case, the proportion of imported ships continues to decrease, the situation should be somewhere between the above alternatives, even if the 3-year import period remains, as some owners are tending to replace small ships with much larger ones. The Miller ships illustrate this point.

It is almost impossible even to predict what the case might be if import restrictions are lifted entirely as the whole structure of the industry, both building and operating, would be drastically changed.

In order to illustrate the projections proposed here more tangibly, Fig. 2.4 has been prepared. This figure shows a possible order schedule for all Australian-built tankers up to the 1983 3-year order book. The figure is based on the present order book (1971 3-year), the 1974 book outlined above and the assumption that there will be virtually no long-term (3-year) imports. An 85,000 DWT replacement for P.J. ADAMS is included in 1978 and 3 x 25,000 ton product carriers are included in the 1983 orders to replace B.P. ENDEAVOUR, B.P. ENTERPRISE and CELLANA. The length of line in the figure is taken to represent the time during which work proceeds on each ship in the shipyard. For simplicity this time is assumed to be one year for all ships.



CLASS	DWT
T 150	150,000
T 100	100,000
T 85	85,000
T 60	60,000
T 25	25,000

FIG. 2.4. PROJECTED AUSTRALIAN COASTAL TANKER PRODUCTION SCHEDULE

2.3 Coastal Dry Bulk Carriers

(a) Definition

It is not always a simple matter to say whether a ship is a bulk-carrier or whether it should be considered to be a general cargo carrier engaged to some extent in a bulk trade. This problem is confined more to smaller ships of up to, say, 15,000 DWT. Ships larger than this may be considered as bulk-carriers.

As statistics for this matter are based on data contained in the Department of Shipping & Transport publication, Australian Shipping and Shipbuilding Statistics (Ref. 2), the classifications adopted in that publication will be used here.

For data up to the end of 1968 the Australian coastal shipping fleet was considered under the following divisions:

(i) the Heavy Trades
(ii) the Tanker Trade
(iii) General Cargo
(iv) Passenger

For data after 1968 the classification is:

(i) Tankers
(ii) Bulk Carriers
(iii) Bulk/General Cargo
(iv) General Cargo
(v) Passenger/General Cargo
(vi) Special Purpose

In Section 2.2 we considered ships listed under "The Tanker Trade" and "Tankers". In the present section we consider ships listed under "The Heavy Trades" and "Bulk Carriers". This will include those ships carrying most bulk minerals, some steel products and sugar. The ships which are not considered, and which, because of the cargos they carry, one might argue should be included, are those in the more recent data listed as "Bulk/General Cargo". These ships are engaged in a wide variety of trades, some being of a bulk nature, but as their sizes are relatively small and for convenience of analysis, they are not included here.

(b) Historical

The carriage of dry bulk cargos on the Australian coast, notably coal and those materials required by the iron and steel industry, has been performed for some time. For the purposes of this study developments in the trading fleet since 1964 are examined in some detail.

The bulk-carrier (Heavy Trades) fleet as at the end of June, 1964 is shown in Table 2.11. Table 2.12 shows the variations in the fleet between that date and the end of December, 1971, resulting in the fleet shown in Table 2.13. Fig. 2.5 is a graphical representation of the growth of the fleet over this period.

Fig. 2.6 shows the amount of certain dry bulk cargos, excluding steel products, carried on the Australian coast between 1959 and 1969. It might be noted that in 1968/69, 16,724,000 tons of bulk cargos accounted for 57.8% by weight of all cargos carried on the coast.

(c) Australian-Built Bulk-Carriers

As may be seen from Tables 2.11 to 2.13 and Fig. 2.5, a considerable proportion of the Australian bulk-carrier fleet has been built in Australian shipyards. Table 2.14 shows Australian bulk-carrier production since 1955.

(d) Imports

Fig. 2.5 and Table 2.15 indicate the amount of imported tonnage on the coast. The 3 ships in Section (b) of Table 2.15 are not liable to re-export and so, for purposes of replacement due to re-export, these need not be considered. IRON SOMERSBY was added early in 1972 and tends to distort the data of other sections which refers to end of 1971 conditions but its size - 10.8% of the fleet when it is included - makes its presence difficult to ignore. For the moment, however, let us consider those ships in part (a) of Table 2.15 together with ORE REGENT as Imported Ships, as these were brought onto the coast before December 31, 1971, and are to be re-exported. They represent a total of 248,320 DWT which is 28.6% of the fleet deadweight. As will be seen, the proportion of imports has increased greatly in recent years and, as there is only one ship on order, it is very difficult to say anything about future trends.

(e) Projected Demand

It is quite difficult to make any reasonable predictions with regard to future bulk-carrier requirements on the Australian coast as there does not appear to be any readily obtainable indication to which this may be pegged.

Demand for tonnage will depend heavily on industrial development and particularly on developments in the iron and steel industry. Development in bauxite/alumina treatment, etc., may also affect demand significantly. The amount of tonnage added to the fleet in successive 3-year periods for some time past is shown in Fig. 2.7.

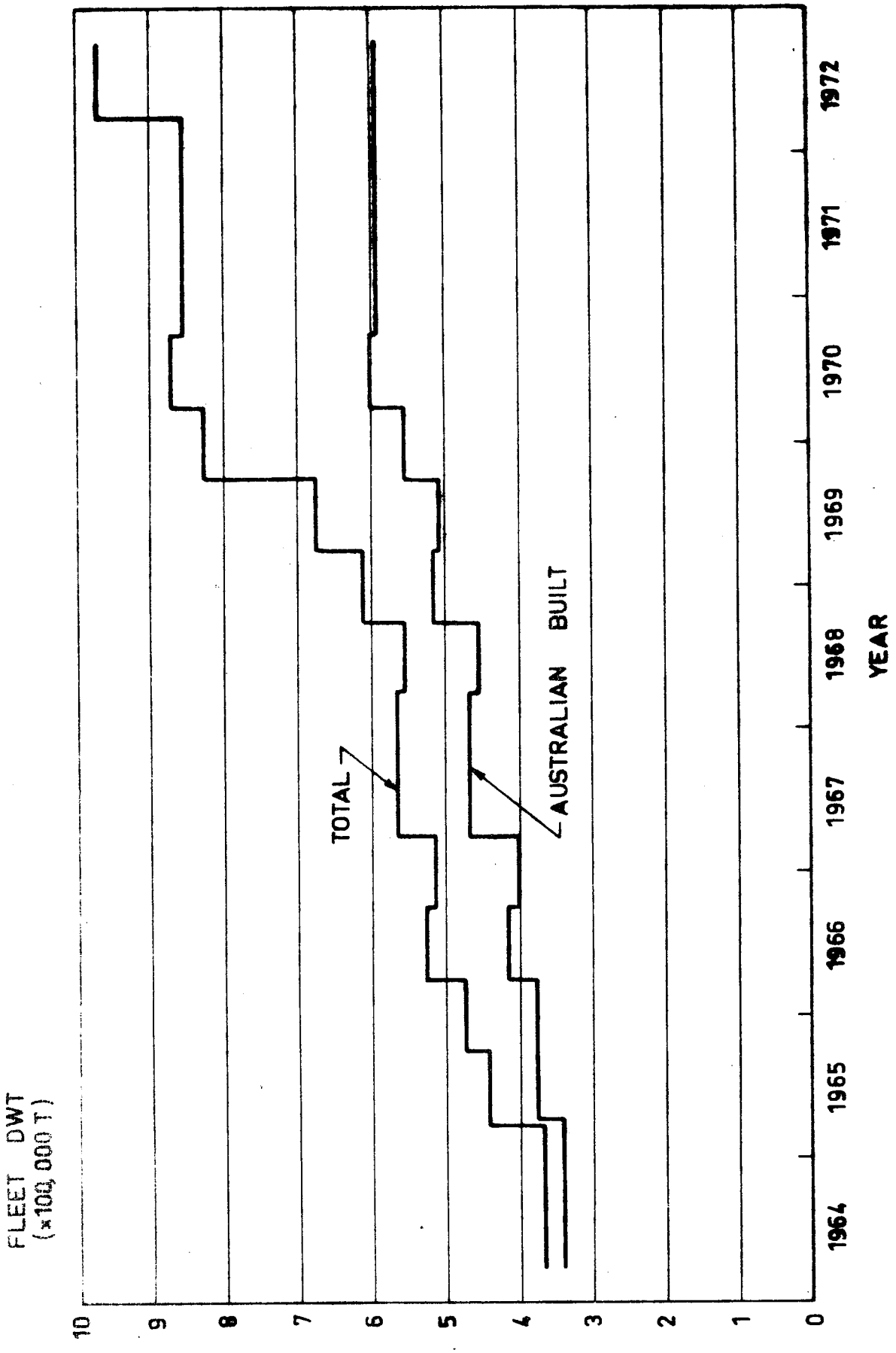


FIG. 2.5. GROWTH OF AUSTRALIAN COASTAL BULK-CARRIER FLEET 1964 - 1971

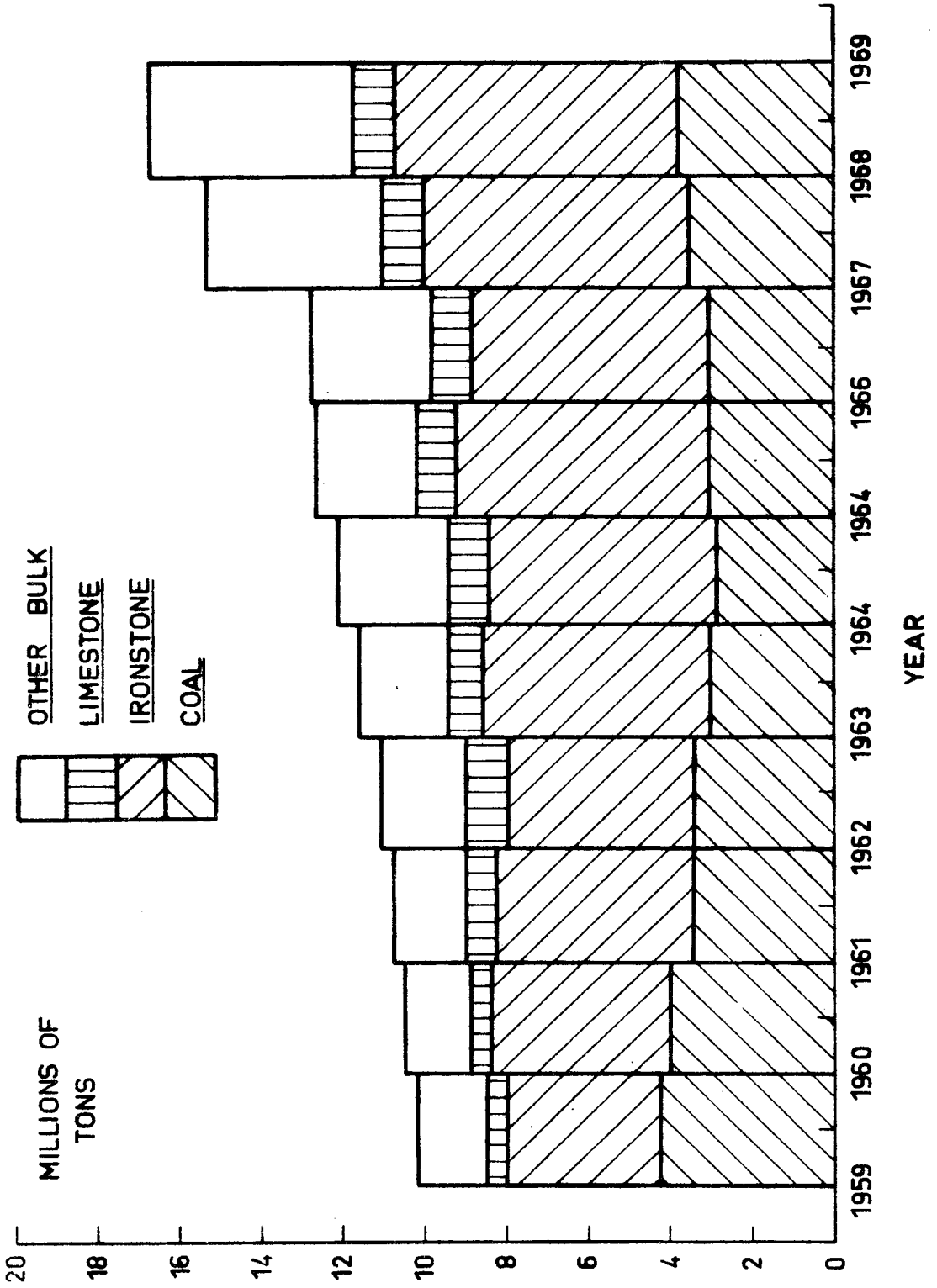


FIG. 2.6. DRY BULK CARGOES CARRIED ON AUSTRALIAN COAST 1959 - 1969

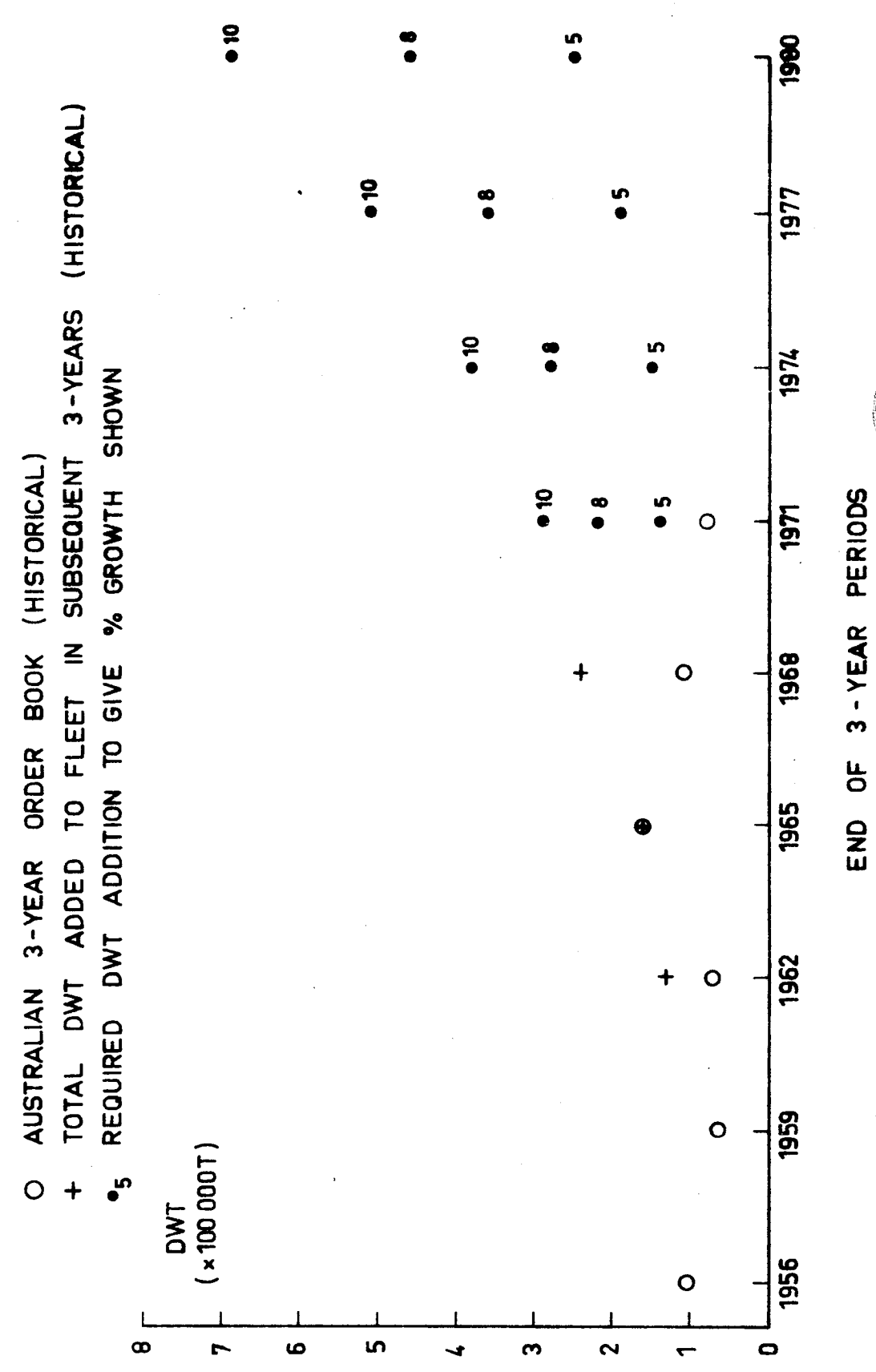


FIG. 2.7. HISTORICAL AND PROJECTED ADDITIONS TO COASTAL BULK-CARRIER FLEET PER 3-YEAR PERIOD

This figure also shows the amounts which must be added to the fleet in coming years to maintain deadweight growth rates of 5%, 8% and 10% per annum. From this chart it would appear that growth has been taking place at something like 10% p.a. over recent years.

Fig. 2.8 shows the fleet size achieved or required for the growth rates specified above over the next few years, from which it is seen that a 10% p.a. growth rate is quite large and may not be sustainable for long, particularly in the light of the present slump in world shipping. Table 2.7 shows a possible order schedule for ship requirements similar to that prepared for tankers in the previous section, Table 2.6. The same note applies here as there, that the numbers of ships and ship sizes are selected for illustrative purposes only, and do not reflect any studies indicating that these particular combinations are more suitable than others. In order to obtain some idea of the total demand, replacement, as well as expansion, must be considered.

According to current import regulations, the 202,941 DWT tons of shipping in part (a) of Table 2.15 and the IRON SOMERSBY (105,000 DWT) giving a total of 307,941 DWT should be replaced by Australian-built ships.

Of the Australian-built ships, several have been in service for some time and may soon be replaced. It must be noted that the replacement program proposed here is one which was devised to take account of existing tonnage in order to arrive at some idea of new-building demand; it is in no way the result of discussion with the owners concerned. The guiding principle in suggesting this program is that ships be replaced after 15 to 18 years (despite the 20 year mandatory depreciation period) and that they be replaced by larger ships, in some cases two or more being replaced by one, and so forth.

The replacement schedule is shown in Table 2.17. Not all ships are included as the task of making reasonable decisions in all cases is pointless. While those new ships in Table 2.17 represent some expansion on present deadweight and not merely replacement, because the accuracy of such predictions is so poor, prospective order books may be taken to be the sum of the ships suggested by Tables 2.16 and 2.17, further refinement appearing unwarranted, in the light of the approximate nature of the assumptions made. The same qualifications apply here as applied to tankers in Section 2.2 regarding a 3-year lag if imports are allowed and a completely changed situation should import restrictions be lifted.

Largely as a result of the variety of trades in which bulk-carriers engage, the bulk-carrier estimates are less reliable than those for tankers, but it is hoped that they give an approximate idea of possible development. Fig. 2.9 is a graphical representation of projected Australian orders similar to that prepared for tankers. It should be noted that at the time of writing (March,

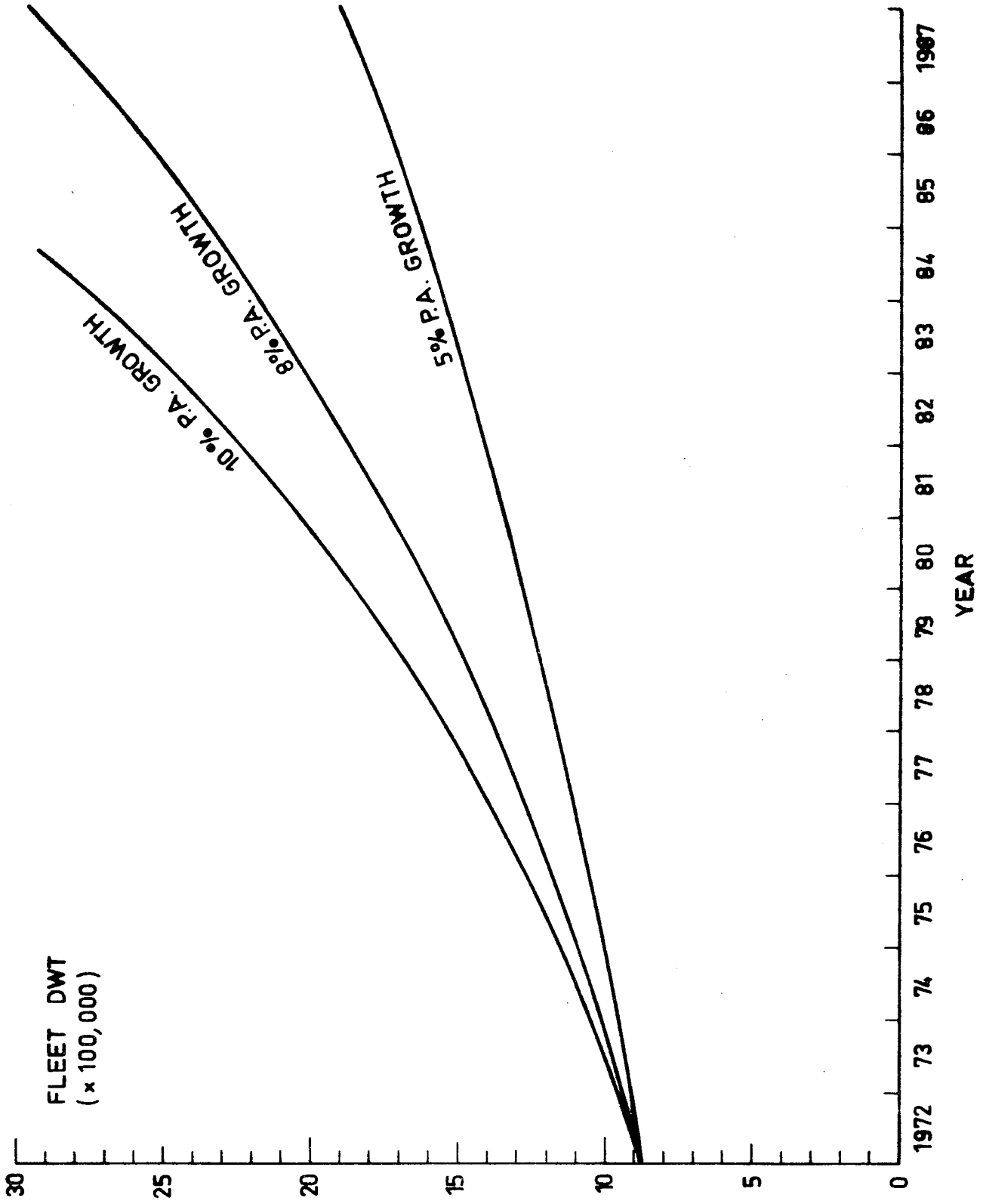


FIG. 2.8. AUSTRALIAN COASTAL BULK CARRIERS – PROJECTED DEADWEIGHT DEMAND

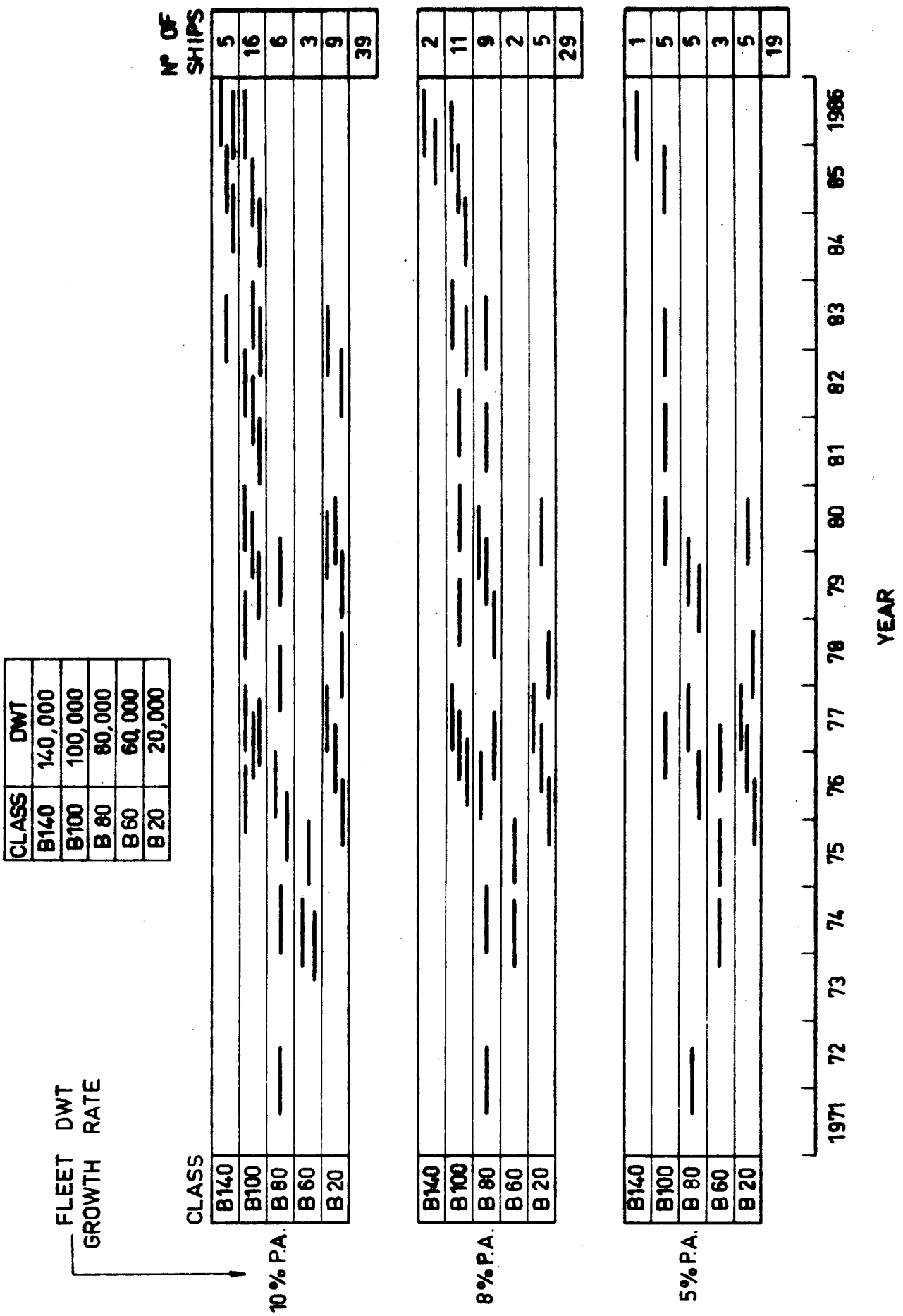


FIG. 2.9. PROJECTED AUSTRALIAN COASTAL BULK - CARRIER PRODUCTION SCHEDULE

1972) some 120,000 DWT of coastal bulk-carriers are laid up due to a slump in trade. This fact and the near-empty order book for bulk-carriers further complicate the demand picture.

2.4 Coastal General Cargo Ships

The ships considered here are those not considered previously as tankers or bulk-carriers.

In recent years, Ref. 2 has considered these ships under the categories:-

(i) Bulk/General Cargo
(ii) General Cargo
(iii) Passenger/General Cargo
(iv) Special Purpose

but for present purposes, they may be considered as one group.

The trading position of this group of ships is much more complex than that of the preceding two groups and it is almost impossible to make any projections of future trends either in type, size or number of ships. Moreover, reference to Table 2.2 will indicate that the amount of 'other cargo' carried has not altered greatly over the past decade. For these reasons the analysis made for tankers and bulk-carriers would not seem to be applicable to general cargo ships. As pointed out in Ref. 4, the major development in the general cargo field in the past decade has been the introduction of specialised ships of several types to replace older units, taking advantage of better methods of cargo handling. Further developments may be expected but these are dependent upon many and varied factors.

Some of the factors upon which the requirement for general cargo shipping depends are:

- Road, rail and air transport developments
- Government policy with regard to
  - shipping
  - roads and railways
- Technological development
- Industrial and rural development
- Extent of decentralisation

Because these factors are so difficult to predict, just as it would have been impossible in 1959 to foresee the developments in

general cargo shipping which took place in the '60s, it is as difficult to make any worthwhile predictions at this stage.

Table 2.18 lists ships, other than tankers and bulk-carriers, over 200 GRT built in Australian shipyards since December 31, 1955. This gives an idea of the historical requirement for ships of this type but sheds little light on possible developments.

TABLE 2.1

IMPORTED SHIPS TRADING ON THE AUSTRALIAN COAST, DECEMBER 31, 1971

Ship	DWT	Years on Coast
Interstate		
AUSTRALIAN PROGRESS	13,857	7
CALTEX KURNELL	5,250	4
CALTEX PORT KEMBLA	5,325	3½
CALTEX SYDNEY	5,500	3½
ECHUCA	3,400	1
ESSO MACQUARIE	16,645	6½
HEMIGLYPTA	18,153	7
HOWARD SMITH	58,280	2½
IRON CAVALIER	35,350	6
IRON CLIPPER	38,537	7
IRON ENDEAVOUR	69,115	3
MILLERS McARTHUR	19,200	7½
R.W. MILLER	19,100	7½
SAFIA (P/NG)	4,835	2
SARBIA (P/NG)	4,835	2
SILVERHARRIER	6,162	1
SILVERHAWK	10,494	2
SOLEN	71,270	2
TOLGA	59,939	2½
WILLIAM G. WALKLEY	18,260	7
Total: 20 Ships	483,507	Ave. 4 years
Intrastate		
CLIEVEDEN	1,806	3
LOORANA	280	1
ORE REGENT	45,379	2½
TOBICLIPPER	754	-
Total: 4 Ships	48,219	Ave. 1½ years

TABLE 2.2

CARGO CARRIED BETWEEN AUSTRALIAN PORTS

'000 TONS

Type of Cargo	1959-60	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69
Ironstone	3,906	4,409	4,823	4,747	5,526	5,594	6,247	5,961	6,438	6,721
Limestone	517	506	751	943	866	900	846	1,038[1]	1,006[1]	1,056[1]
Dolomite	168	193	162	186	210	211	228	230	266	245
Petroleum Crude, Refined Feedstock	4,794	4,724	4,927	5,189	5,855	6,269	5,203	5,920	6,515	6,705
Coal and Coke	4,329	4,017	3,456	3,428	3,055	2,877	2,992	2,953	3,578	3,882
Other Bulk Lines	1,514	1,410	1,630	1,839	1,920	2,466	2,282	2,820	4,046	4,820
Steel Products	894	1,125	1,152	1,368	1,472	1,782	1,797	1,632	1,930	2,073
Other Cargo (2)	3,043	3,326	2,262	2,187	2,799	2,953	3,001	3,470	3,330	3,489
Total	19,165	19,710	19,163	19,887	21,703	23,052	22,596	24,024	27,109	28,991

[1] Includes lime sand

(2) Includes some bulk lines not itemised

Source: Department of Shipping and Transport, 22/6/71

TABLE 2.3

AUSTRALIAN REGISTERED COASTAL TANKER FLEET AS AT JUNE 30, 1965

Ship	DWT	Owner
AUSTRALIAN PROGRESS	13,857	Mobil Shipping Co. Ltd.
B.P. ENDEAVOUR	15,441	B.P. Tanker Co. Ltd.
B.P. ENTERPRISE	15,496	B.P. Tanker Co. Ltd.
CALTEX LIVERPOOL	17,460	Overseas Tankship (UK) Ltd.
CALTEX MANCHESTER	17,510	Overseas Tankship (UK) Ltd.
ESSO MACQUARIE	16,645	Esso Standard Eastern Tankers Ltd.
HEMIGLYPTA	18,153	Shell Bermuda (O'Seas) Ltd.
HEMIPLECTA	18,116	Shell Bermuda (O'Seas) Ltd.
MILLERS CANOPUS	15,330	Hong Kong Tanker and Traders Ltd.
MILLERS McARTHUR	18,500	Honk Kong Tanker and Traders Ltd.
R.W. MILLER	18,400	Honk Kong Tanker and Traders Ltd.
WILLIAM G.WALKLEY	18,200	Ampol (Queensland) Pty. Ltd.
Total DWT	203,308	

TABLE 2.4

VARIATIONS OF COASTAL TANKER FLEET BETWEEN JUNE 30, 1965 AND DECEMBER 31, 1971

Period	Added			Removed			Nett DWT	Fleet DWT
6 Mths. to	Ship	DWT	Built	Ship	DWT	Built		
Dec., 1965	None			None				203,308
June, 1966	None			None				203,308
Dec., 1966	None			MILLERS CANOPUS	15,330	O.S.	-15,330	187,978
June, 1967	B.P. EXPLORER	15,441	O.S.	B.P. ENDEAVOUR	15,441	O.S.	+33,150	221,128
	P.J. ADAMS	33,150	A					
Dec., 1967	B.P. ENDEAVOUR	19,500	A	B.P. ENTERPRISE	15,496	O.S.	- 8,206	212,922
	CALTEX KURNELL	5,250	O.S.	CALTEX LIVERPOOL	17,460	O.S.		
June, 1968	CALTEX SYDNEY	5,500	O.S.	-			+ 5,500	218,422
Dec., 1968	B.P. ENTERPRISE	19,480	A	CALTEX MANCHESTER	17,510	O.S.	+13,829	232,251
	CALTEX PT. KEMBLA	5,325	O.S.	HEMIPLECTA	18,116	O.S.		
	CELLANA	24,700	A					
June, 1969	HOWARD SMITH	58,280	O.S.	B.P. EXPLORER	15,441	O.S.	+42,839	275,090
	(P.J. ADAMS	(22,560)	A(J)	-				299,050
Dec., 1969	(MILLERS McARTHUR	(700)	O.S.*	-			+23,960	380,814
	(R.W. MILLER	(700)	O.S.*	-				
June, 1970	SILVERHAWK	10,494	O.S.	-			+81,764	380,814
	SOLEN	71,270	O.S.					
Dec., 1970	SILVERHARRIER	6,162	O.S.	-			+ 6,164	387,078
June, 1971	None			None				
Dec., 1971	AMANDA MILLER	62,000	A	-			+62,000	448,978

O.S. - Overseas
A - Australia
(J) - Jumboised

*Figures show change of DWT of MILLERS McARTHUR from 18,500 to 19,200 tons (700T) between June, 1969 and June, 1970 and for R.W. MILLER from 18,400 to 19,100 (700T).

TABLE 2.5

AUSTRALIAN REGISTERED COASTAL TANKER FLEET AS AT DECEMBER 31, 1971

Ship	DWT	Where Built	Date Built	Date Imported	Yrs.on Coast
AMANDA MILLER	62,000	A	1971		
AUSTRALIAN PROGRESS	13,857	O.S.	1960	Jan., 65	7
B.P. ENDEAVOUR	19,500	A	1967	-	
B.P. ENTERPRISE	19,480	A	1968	-	
CALTEX KURNELL	5,250	O.S.	1965	Nov., 67	4
CALTEX PT. KEMBLA	5,325	O.S.	1955	July, 68	3½
CALTEX SYDNEY	5,500	O.S.	1963	June, 68	3½
CELLANA	24,700	A	1968	-	
ESSO MACQUARIE	16,645	O.S.	1953	Mar., 65	6½
HEMIGLYPTA	18,153	O.S.	1955	Nov., 64	7
HOWARD SMITH	58,280	O.S.	1964	June, 69	2½
MILLERS McARTHUR	19,200	O.S.	1951	June, 64	7½
P.J. ADAMS	55,676	A	1962	-	
R.W. MILLER	19,100	O.S.	1951	Aug., 64	7½
SILVERHARRIER	6,162	O.S.	1970	Nov., 70	1
SILVERHAWK	10,494	O.S.	1969	Feb., 70	2
SOLEN	71,270	O.S.	1961	Jan., 70	2
WILLIAM G. WALKLEY	18,260	O.S.	1954	Oct., 64	7
Total DWT	448,857				

A - Australia
O.S. - Overseas

TABLE 2.6

AUSTRALIAN TANKER PRODUCTION

Ships Completed as at December 31, 1971				
Ship	DWT	Completed	Owner	Builder
P.J. ADAMS	33,150	Oct., 1962	Ampol Petroleum	Whyalla*
B.P. ENDEAVOUR	19,500	Sept.,1967	B.P. Tanker Co.	State Dockyard
CELLANA	24,700	July, 1968	Shell International Marine	Whyalla*
B.P. ENTERPRISE	19,480	Aug., 1968	B.P. Tanker Co.	State Dockyard
AMANDA MILLER	62,000	Dec., 1971	R.W. Miller	Whyalla*
Total DWT	158,830			
On Order as at December 31, 1971				
		Delivery		
ESSO GIPSLAND	24,000	Dec., 1971	Esso	Evans Deakin
MOBIL AUSTRALIA	24,000	Jan., 1972	Mobil Oil	Whyalla*
BH54	23,400	Feb., 1973	Ampol	Whyalla*
ROBERT MILLER	62,000	Mar., 1973	R.W. Miller	Evans Deakin
BH57	62,000	Apr., 1974	Botany Bay Tanker Co.	Whyalla*
S92	23,400	May, 1974	Howard Smith	State Dockyard
Total DWT	218,800			

*Whyalla Shipbuilding and Engineering Company

TABLE 2.7

AUSTRALIAN COASTAL TANKER REQUIREMENT

-Order Schedule-

Order book at year n (for 3 years' work)
= DWT capacity (n + 3) - DWT capacity (n)

(read from Fig. 2.3)

These figures do not include replacement

Order Book at end of Year	Growth %	DWT (x100,000 Tons)			Class of Ships (no. off)					
		n+3	n	Orders	T25	T60	T85	T100	T150	Total
1971	5	5.2	4.5	0.7	1	1				2
	8	5.7	4.5	1.2	2	1				3
	10	6.1	4.5	1.6	3		1			4
1974	5	6.0	5.2	0.8	1	1				2
	8	7.2	5.7	1.5		1	1			2
	10	8.0	6.1	1.9	1		2			3
1977	5	7.0	6.0	1.0	1		1			2
	8	9.1	7.2	1.9	1		2			3
	10	10.3	8.0	2.3	1		1	1		3
1980	5	8.1	7.0	1.1	1		1			2
	8	11.4	9.1	2.3	2		1	1		4
	10	13.6	10.3	3.3	2		1	2		5
1983	5	9.3	8.1	1.2	1			1		2
	8	14.2	11.4	2.8			1	2		3
	10	18.7	13.6	5.1			2	2	1	5
Totals	5				5	2	2	1		10
	8				5	2	5	3		15
	10				7		7	5	1	20

Class T25 - 25,000 DWT
" T60 - 60,000 "
" T85 - 85,000 "
" T100 - 100,000 "
" T150 - 150,000 "

TABLE 2.8

IMPORTED SHIPS FOR WHICH REPLACEMENTS WERE ORDERED AT DECEMBER 31, 1971

Import	DWT	New Order	DWT
1. AUSTRALIAN PROGRESS	13,857	Mobil Australia	24,000
2. ESSO MACQUARIE	16,645	Esso Gipsland	24,000
3. W.G. WALKLEY	18,260	BH54	23,400
4. R.W. MILLER	19,100	(Amanda Miller	62,000 - Del.)
5. MILLERS McARTHUR	19,200	Robert Miller	62,000
6. HOWARD SMITH	58,280	S92	23,400
Total	145,342	Total	218,800

TABLE 2.9

IMPORTED SHIPS FOR WHICH NO REPLACEMENT WAS ORDERED AT DECEMBER 31, 1971

Ship	DWT	Owner	Yrs.on Coast
CALTEX KURNELL	5,250	Caltex	4
CALTEX PT. KEMBLA	5,325	Caltex	3½
CALTEX SYDNEY	5,500	Caltex	3½
HEMIGLYPTA	18,153	Shell	7
SOLEN	71,270	Shell	2
SILVERHAWK	10,494	Nile Steamship Co. Ltd.	2
SILVERHARRIER	6,162	Ship Mortgage Finance Co.Ltd.	1
Total DWT	122,154		

TABLE 2.10

POSSIBLE 1974 3-YEAR TANKER ORDER BOOKS

Case (a) - 5% p.a. Fleet Deadweight Growth Rate

2	x	10,000 DWT	REPLACEMENT
2	x	25,000 DWT	
1	x	60,000 DWT	
1	x	85,000 DWT	
1	x	25,000 DWT	EXPANSION
1	x	60,000 DWT	

Total - 8 ships, 300,000 DWT

Case (b) - 8% p.a. Growth Rate

As above			REPLACEMENT
1	x	60,000 DWT	EXPANSION
1	x	85,000 DWT	

Total - 8 ships, 360,000 DWT

Case (c) - 10% p.a. Growth Rate

As above			REPLACEMENT
1	x	25,000 DWT	EXPANSION
2	x	85,000 DWT	

Total - 9 ships, 410,000 DWT

TABLE 2.11

AUSTRALIAN HEAVY TRADES FLEET

-End of June, 1964-

Ship	DWT	Built	Where Built	Owner
AGE	6,310	1936	-	Howard Smith
BARALGA	6,470	1956	A	A.N.L.
ILLOWRA	7,119	1957	A	"
INYULA	7,119	1954	A	"
IRANDA	7,161	1957	A	"
JEPARIT	7,551	1964	A	"
LAKE BARRINE	10,437	1956	A	"
LAKE BOGA	10,388	1957	A	"
LAKE COLAC	10,170	1958	A	"
LAKE EYRE	10,280	1956	A	"
LAKE ILLAWARRA	10,383	1958	A	"
LAKE MACQUARIE	10,224	1958	A	"
LAKE SORELL	10,259	1959	A	"
LAKE TORRENS	10,437	1957	A	"
MOUNT KEIRA	13,710	1960	A	"
MOUNT KEMBLA	13,700	1960	A	"
RIVER BURNETT	8,525	1947	A	"
TALINGA	10,245	1955	O.S	"
TIMBARRA	10,220	1954	O.S.	"
IRON BARON	7,950	1936	A	B.H.P.
IRON DAMPIER	19,020	1961	A	"
IRON DERBY	12,359	1951	A	"
IRON DUKE	8,030	1943	A	"
IRON FLINDERS	19,100	1959	A	"
IRON KIMBERLEY	12,473	1949	A	"
IRON KING	7,950	1936	-	"
IRON KNIGHT	7,763	1948	O.S	"
IRON MONARCH	8,030	1943	A	"
IRON SPENCER	10,626	1957	A	"
IRON WARRIOR	6,240	1950	A	"
IRON WHYALLA	10,607	1954	A	"
IRON WYNDHAM	12,345	1953	A	"
IRON YAMPI	12,477	1948	A	"
MITTAGONG	16,500	1963	A	Bulkships
WOLLONGONG	16,520	1962	A	"
35 ships	368,693			

TABLE 2.12

VARIATIONS OF COASTAL BULK-CARRIER FLEET BETWEEN JUNE 30, 1964 AND DECEMBER 31, 1971

Period to	Added			Removed			Nett DWT	Fleet DWT
	Ship	DWT	Built	Ship	DWT	Built		
June, 1965	GERRINGONG	21,260	A	RIVER BURNETT	8,525	A	+72,437	441,130
	IRON CLIPPER	38,537	O.S					
	MUSGRAVE RANGE	21,165	A					
December, 1965	IRON CAVALIER	35,350	O.S	None			+35,350	476,480
June, 1966	DARLING RIVER	49,375	A	BARALGA	6,470	A	+46,050	522,530
	KAROON	3,145	O.S					
December, 1966	None			IRON BARON	7,950	-	- 7,950	514,580
June, 1967	BOGONG	55,090	A	IRON KING	7,950	-	+47,140	561,720
December, 1967	None			None				
June, 1968	None			AGE	6,310	-	- 6,310	555,410
December, 1968	IRON HUNTER	55,100	A	None				
June, 1969	MERINGA	7,035	O.S					
	BURWAH	3,400	O.S	TIMBARRA	10,220	O.S	+66,185	676,695
	IRON ENDEAVOUR	69,115	O.S	KAROON	3,145	O.S		
December, 1969	TOLGA	59,939	O.S					
	CLUTHA OCEANIC	55,100	A	JEPARIT	7,551	A	+152,867	829,562
	ORE REGENT	45,379	O.S					
June, 1970	YARRA RIVER	54,965	A	ILLOWRA	7,119	A	+47,846	877,408
December, 1970	None			IRON DUKE	8,030	A	-18,275	859,133
				TALINGA	10,245	O.S		
June, 1971	None			None				
December, 1971	None			None				

A - Australia
O.S - Overseas

TABLE 2.13

AUSTRALIAN BULK CARRIER FLEET, DECEMBER 31, 1971

Ship	DWT	Where Built	Date Built	Date Imported	Years on Coast
BOGONG	55,090	A	1967		
BURWAH	3,400	O.S		1956	(15)
CLUTHA OCEANIC	55,100	A	1969		
DARLING RIVER	49,375	A	1966		
GERRINGONG	21,260	A	1965		
INYULA	7,119	A	1954		
IRANDA	6,161	A	1957		
IRON CAVALIER	35,350	O.S		1965	6
IRON CLIPPER	38,537	O.S		1966	7
IRON DAMPIER	19,020	A	1961		
IRON DERBY	12,650	A	1951		
IRON ENDEAVOUR	69,115	O.S		1969	3
IRON FLINDERS	19,100	A	1959		
IRON HUNTER	55,100	A	1968		
IRON KIMBERLEY	12,559	A	1949		
IRON KNIGHT	7,458	O.S		1956	15
IRON MONARCH	7,620	A	1943		
IRON SPENCER	12,683	A	1957		
IRON WARRIOR	6,247	A	1950		
IRON WHYALLA	12,560	A	1954		
IRON WHYNDAM	12,868	A	1953		
IRON YAMPI	12,897	A	1948		
LAKE BARRINE	11,187	A	1956		
LAKE BOGA	11,391	A	1957		
LAKE COLAC	11,320	A	1958		
LAKE EYRE	10,401	A	1956		
LAKE ILLAWARRA	10,601	A	1958		
LAKE MACQUARIE	11,364	A	1958		
LAKE SORELL	11,430	A	1959		
LAKE TORRENS	10,647	A	1957		
MERINGA	7,035	O.S		1958	(13)
MITTAGONG	16,500	A	1963		
MOUNT KEIRA	13,710	A	1960		
MOUNT KEMBLA	13,700	A	1960		
MUSGRAVE RANGE	21,165	A	1964		
ORE REGENT	45,379	O.S		1969	2
TOLGA	59,939	O.S		1969	2½
WOLLONGONG	16,520	A	1962		
YARRA RIVER	54,965	A	1970		
39 Ships	870,503DWT				

TABLE 2.14

AUSTRALIAN BULK-CARRIER PRODUCTION

-Ships Completed between December 31, 1955 and December 31, 1971-

Ship	DWT	Completed	Owner	Builder
BARALGA	6,470	March, 1956	A.N.L.	-
LAKE BARRINE	10,437	August, 1956	"	E.D.
LAKE EYRE	10,280	June, 1956	"	B.H.P.
ILLOWRA	7,119	December, 1957	",	S.D.
IRANDA	7,161	July, 1957	"	S.D.
LAKE BOGA	10,388	August, 1957	"	E.D.
LAKE TORRENS	10,437	September, 1957	"	B.H.P.
IRON SPENCER	10,626	February, 1957	B.H.P.	"
LAKE COLAC	10,170	August, 1958	A.N.L.	E.D.
LAKE ILLAWARRA	10,383	March, 1958	"	B.H.P.
LAKE MACQUARIE	10,224	September, 1958	"	"
LAKE SORELL	10,259	June, 1959	"	E.D.
IRON FLINDERS	19,100	August, 1959	B.H.P.	B.H.P.
MOUNT KEIRA	13,710	May, 1960	A.N.L.	"
MOUNT KEMBLA	13,700	November, 1960	"	"
IRON DAMPIER	19,020	June, 1961	B.H.P.	"
WOLLONGONG	16,520	May, 1962	Bulkships	"
MITTAGONG	16,500	April, 1963	"	"
JEPARIT	7,551	February, 1964	A.N.L.	E.D.
MUSGRAVE RANGE	21,165	November, 1964	"	B.H.P.
GERRINGONG	21,240	June, 1965	Bulkships	"
DARLING RIVER	49,375	May, 1966	A.N.L.	"
BOGONG	54,100	January, 1967	Bulkships	"
IRON HUNTER	55,100	September, 1968	B.H.P.	"
CLUTHA OCEANIC	55,100	October, 1969	Clutha	"
YARRA RIVER	54,965	April, 1970	A.N.L.	"
	531,100			
On Order:				
BH53	78,000	July, 1972	Clutha	"

TABLE 2.15

REPLACEMENT OF IMPORTED SHIPS

(i) Imported Ships for which a Replacement is Ordered

Imported Ship	DWT	New Order	DWT
ORE REGENT	43,379	BH53	78,000

(ii) Imported Ships for which no Replacements are Ordered

	Imported Ship	DWT		Owner	Years on Coast
(a)	IRON CAVALIER	35,350		B.H.P.	6
	IRON CLIPPER	38,537		"	7
	IRON ENDEAVOUR	69,115		"	3
	TOLGA	59,939		A.N.L.	2½
	Sub-Total (a)		202,941		
(b)	*BURWAH	3,400		A.S.P.	15
	*IRON KNIGHT	7,458		B.H.P.	15
	*MERINGA	7,035		A.S.P.	13
	Sub-Total (b)		17,893		
(c)	**IRON SOMERSBY	105,000		B.H.P.	0
	Sub-Total (c)		105,000		
	GRAND TOTAL		325,834		

*Not built in Australia but not liable to reexport.

**Imported after December 31,1971, to be reexported at a later date.

TABLE 2.16

AUSTRALIAN COASTAL BULK-CARRIER REQUIREMENT

-Order Schedule-

Order book at year n (for 3 years' work)
= DWT capacity (n+3) - DWT capacity (n).

(read from Table 2.8)

These Figures do not Include Replacement

Order Book at end of Yr.	Growth %	DWT (x100,000^{-1} tons)			Class of Ships (no. off)					
		n+3	n	Orders	B20	B60	B80	B100	B140	Total
1971	5	10.1	8.7	1.4		1	1			2
	8	10.9	8.7	2.2		1	2			3
	10	11.6	8.7	2.9		2	2			4
1974	5	11.6	10.1	1.5		1	1			2
	8	13.8	10.9	2.9			1	2		3
	10	15.4	11.6	3.8			1	3		4
1977	5	13.5	11.6	1.9			1	1		2
	8	17.4	13.8	3.6			2	2		4
	10	20.5	15.4	5.1	2		1	4		7
1980	5	15.6	13.5	2.1				2		2
	8	22.0	17.4	4.6			2	3		5
	10	27.4	20.5	6.9	2			5	1	8
1983	5	18.1	15.6	2.5				1	1	2
	8	17.6	22.0	5.6				3	2	5
	10	36.3	27.4	8.9				3	4	7
Totals	5				-	2	3	4	1	10
	8				-	1	7	10	2	20
	10				4	2	4	15	5	30

TABLE 2.17

POSSIBLE REPLACEMENT SCHEDULE FOR PRESENT AUSTRALIAN-BUILT BULK-CARRIERS

Owner	Old Ship	Replaced before	New DWT
A.N.L.	IRANDA	1977	20,000
	INYULA 8 x "LAKE" SHIPS	1977	2 x 20,000 1 x 60,000
	MT KEIRA MT KEMBLA	1977	1 x 80,000
	MUSGRAVE RANGE	1980	20,000
B.H.P.	IRON DERBY IRON KIMBERLY IRON WARRIOR IRON WHYALLA IRON YAMPI	1974	2 x 15,000 Steel Product Carriers (on order) + imports (not incl. in Fig. 5)
	IRON KNIGHT IRON WYNDHAM IRON SPENCER IRON FLINDERS	1977	100,000
Bulkships	MITTAGONG WOLLONGONG GERRINGONG	1980	1 x 20,000 1 x 80,000

Resulting Replacement 3-Year Order Books

1974	3 x 20,000 DWT
	1 x 60,000 DWT
	1 x 80,000 DWT
	1 x100,000 DWT
1977	2 x 20,000 DWT
	1 x 80,000 DWT

TABLE 2.18

AUSTRALIAN-BUILT CARGO SHIPS, OTHER THAN TANKERS AND BULK-CARRIERS, COMPLETED SINCE DECEMBER 31, 1955 AND AT PRESENT ON ORDER

Year Completed	Ship	DWT	GRT	Type
1956	KOOJARRA	2,320	2,959	G.C./Passenger
1957	NORTH ESK	2,014	1,603	G.C.
1958	Nil	-	-	-
1959	PRINCESS OF TASMANIA	1,073	3,981	V.Dk./Passenger
	SOUTH ESK	1,318	1,616	G.C.
1960	MUNDOORA	5,002	4,116	G.C.
1961	BASS TRADER	1,644	4,129	V.Dk.
	TROOBRIDGE	869	1,996	Ro-Ro/Passenger
	WILLIAM HOLYMAN	2,180	1,957	Container
1962	KANGAROO	2,233	4,129	G.C./Passenger
1963	KING ISLANDER	236	352	Ro-Ro
	KOORINGA	6,699	5,976	Container
1964	SEAWAY KING	3,155	2,961	Ro-Ro/Container
	SEAWAY QUEEN	3,155	2,961	Ro-Ro/Container
1965	EMPRESS OF AUSTRALIA	2,880	12,037	V.Dk./Passenger
1966	Nil	-	-	-
1967	Nil	-	-	-
1968	Nil	-	-	-
1969	AUSTRALIAN TRADER	3,523	7,005	V.Dk./Passenger
	BRISBANE TRADER	4,417	6,326	V.Dk.
	KANIMBLA	15,674	13,312	Container
	MANOORA	15,674	13,312	Container
	SYDNEY TRADER	4,417	6,326	V.Dk.
1970	DARWIN TRADER	12,100	10,802	Bulk/Container
	JOHN BURKE	1,500	1,661	Ro-Ro/G.C.
	TOWNSVILLE TRADER	4,417	6,326	V.Dk.
	Total: 22 Ships	96,500	115,843	

ON ORDER

Delivery				
October, 1972	S90	(A.N.L.)	7,600	V.Dk.
March, 1973	S91	(A.N.L.)	7,600	V.Dk.
May, 1973	BH55	(B.H.P.)	15,000	Steel Prod.
October, 1973	BH56	(B.H.P.)	15,000	Steel Prod.
October, 1972	A72	(A.T.L.S.)	6,500	G.C.
February, 1973	A73	(A.T.L.S.)	6,500	G.C.
	Total:	6 Ships	58,200	

3. AUSTRALIAN OVERSEAS SHIPPING

3.1 Introduction

The entry of the cellular container-ship, AUSTRALIAN ENDEAVOUR, into the Australian-Europe trade in 1969 marked the return of the Australian flag to overseas trading after an absence of many years. Since that date the vehicle-deck ships, AUSTRALIAN ENTERPRISE, and MATTHEW FLINDERS have entered the Australia-Japan trade and the Roll-on/Roll-off ship, ALLUNGA, has joined the PAD service to the U.S. West Coast. Another cellular container-ship of 26,000 DWT is building for the PACE service to the U.S. East Coast. Three other small ships are trading overseas, mainly to the Pacific Islands.

With regard to the important question of whether Australian ships are able to compete satisfactorily in overseas trading, Sir John Williams wrote in the 1971 Annual Report of the Australian National Line (Australian Coastal Shipping Commission), Ref. 5;

> *"The answer is that the Japanese trade has proved viable; that the Pacific Australia Direct Line looks promising: whilst, as to the AUSTRALIAN ENDEAVOUR, since the crew cost differential between a British and an Australian ship is not yet of sufficient magnitude to affect the competitive ability of the latter; and since the vessel herself has been held up neither more nor less than all the rest on the same run, the situation is still as it was when over-seas trading was first projected, i.e. that the wage differential, while adding to the cost of the operation, is not at this date the most important factor in any profit accruing or loss sustained."*

> *"In short, therefore, the loss on the Australia/U.K.-Europe trade has not come about because of some huge gap between the cost of running an Australian ship and her British counterpart, but because of the slow turnround and other disabilities suffered by every cellular ship-owner in the trade."*

> *"Nevertheless, should the gap referred to widen through industrial pressures to a point at which the foregoing is no longer valid, the question as to whether an Australian overseas merchant fleet is a practicality is likely to be revived."*

"The above statement disregards subsidies, investment allowances and the like granted by governments to national flag operators, an advantage not yet open to Australian owners, but one which, when added to the wage differential, places others in a more favourable position than ourselves."

If this question will be 'revived' under the conditions given in the third paragraph quoted, it might be inferred that it is for the moment 'dead' and that Australian-flag overseas operation is as practical as operation by other nations, success or failure depending upon the trade rather than upon some inherent disadvantage to Australian operations.

Australian overseas shipping is said to have cost the nation in the vicinity of $800m in the last financial year so that it is of considerable significance, and Australian participation could prove beneficial. As pointed out by Sir John Williams, whether or not this comes about will depend heavily on the amount and nature of government assistance afforded to ship owners, as absence of this, which is received by operators in most maritime nations, places Australian operators at a disadvantage.

It must be noted that there is no import restriction on ships to be used in overseas trades and all those so employed have been built overseas. The need for a government policy statement with regard to application of subsidy and other assistance to vessels engaged in the overseas trade is clearly seen.

In the light of the Ship Industry Concept proposed in Ref. 1, i.e. that the various sections of the industry, shipowners, shipbuilders, port authorities, stevedores,etc., should not be considered in isolation, it would appear that no import restriction should be imposed on ships to be used in overseas trading but that assistance and inducements should be afforded so that costs of building in Australia should be competitive with those of importation. These could take the form of tax concessions to owners who build here, or similar means, as well perhaps, as some building subsidy.

It would appear even more desirable to improve the efficiency of Australian shipyards so that the amount of assistance would be minimised. This could, in part, be achieved by improving the design, both overall design and design for production, of Australian ships. Depending, of course, on demand, an Australian Standard Ship Program may be beneficial in this regard because of the advantages which it might bring as outlined in Ref. 1. The figures which follow seem to indicate that, if Australia seriously considers entering overseas trading and if suitable government assistance is provided, there is a potentially high demand for Australian-built ships which could form the basis of a Standard Ship Program which, as outlined in Ref. 1, should be of assistance in reducing the costs of Australian ships and thus improving their competitive position.

3.2 Overseas Tankers

Difficulty is experienced in determining the overseas shipping task as most recorded data in cargos shipped is expressed in terms of the value, rather than the tonnage, weight or volume of the cargos.

Table 3.1 is a summary of the value of Australian overseas trade in petroleum and petroleum products including crude oil over the period 1966/67 to 1970/71. Table 3.2 shows origin and destination of major amounts of the 1969/70 cargo. Table 3.3 shows the destination and origin, by Australian states of the 1969/70 cargo. Table 3.4 shows the *tonnage* of New South Wales imports and exports for 1969/70 - taken from 'Port Statistics - 1969/70', published by the Maritime Services Board of New South Wales (Ref. 6).

Thus from Tables 3.3 and 3.4 we find that in 1969/70, 7,157,187 tons of imports into *New South Wales* had a value of $86,248,000. This gives a rate of 83.2 tons per $1,000 and if this figure is applied to the total of imports, the total import tonnage for 1969/70 emerges as 21.15 million tons.

Using a similar process to calculate exports, these are found to be 990,000 tons in 1969/70. Similar calculations, which of course give only approximate results, may be made for other years as required.

With exports at about 1,000,000 tons per year it is clear that these are relatively insignificant, particularly with regard to future demand for Australian-built ships.

With regard to imports, 83.8% came from the Arabian Gulf area; the remaining 16.2% came from Indonesia.

Taking the Gulf trade first, this route is of the order of 7,000 nautical miles each way. If a ship speed of 15 knots is maintained, this will require about 20 days sailing (i.e. 40 days return sailing). Thus a return trip will take about 1½ months giving approximately 8 trips per ship per year. As 83.8% of 21.15m. tons was carried on this route in 1969/70, that is, 17.8m. tons, and if cargo deadweight is about 85% of total ship deadweight, the fleet deadweight requirement would be about (17.8 - 8)/0.85 or 2.6m. tons.

For the Indonesian trade, with 3.4m. tons of cargo, and a route of about 3,500 miles, under the same conditions as mentioned above, the fleet requirement was about 280,000 deadweight tons in 1969/70. This gives a total import fleet capacity of the order of 2.9m. deadweight tons. The cost of freight or imports for 1969 was about $84m. - that is, a rate of about four dollars per ton (Ref.3).

Fig. 3.1 shows the growth of the importing fleet assuming 5,8 and 10% p.a. growth in Australian consumption. This assumes that imports continue to account for about 90% of consumption.

We are not able to say whether Australian-flag vessels will be able to participate in the oil-import trade. If the position stated in the Introduction (3.1) is valid, it ought to be technically and economically possible to participate given the type of government policy afforded to other operators in the trade. Whether participation eventuates would seem to depend on political and company policy considerations.

The figures presented here merely give an idea of the cost of this trade ($84m. in 1969) and the size of the trading fleet (2.9m. DWT) together with a rough estimate of possible future capacity.

If Australian participation becomes possible, a considerable amount of new shipbuilding and expansion of the Australian trading fleet could result. The tankers required for this trade could provide some demand for a standardisation program. Table 3.5 gives some idea of the number of ships involved assuming 5%, 8% and 10% p.a. growth in trade and a 25% Australian participation by 1986 in each case. The 3-year order books from 1971 to 1983 are considered.

For other percentages of participation, numbers of ships will be approximately proportionate to that percentage and the 25% figures shown in Table 3.5.

3.3 Overseas Dry Bulk-Carriers

As stated by Sir John Williams in the 1971 Annual Report of the Australian National Line (Ref. 5);

"In view of the collapse of the overseas freight market and with recovery in the future problematical, plans to charter or purchase one or more bulk-carriers to compete with foreign flag vessels in the carriage of Australian bulk exports have been deferred."

This summarises the position with regard to Australian flag participation in the dry bulk trades at present and makes any statement of possible developments very difficult. Cuts in Japanese demand for iron ore and coal tend to make the position appear even more gloomy. The figures which follow give some idea of the present size of the overseas bulk trade in terms of a few major commodities.

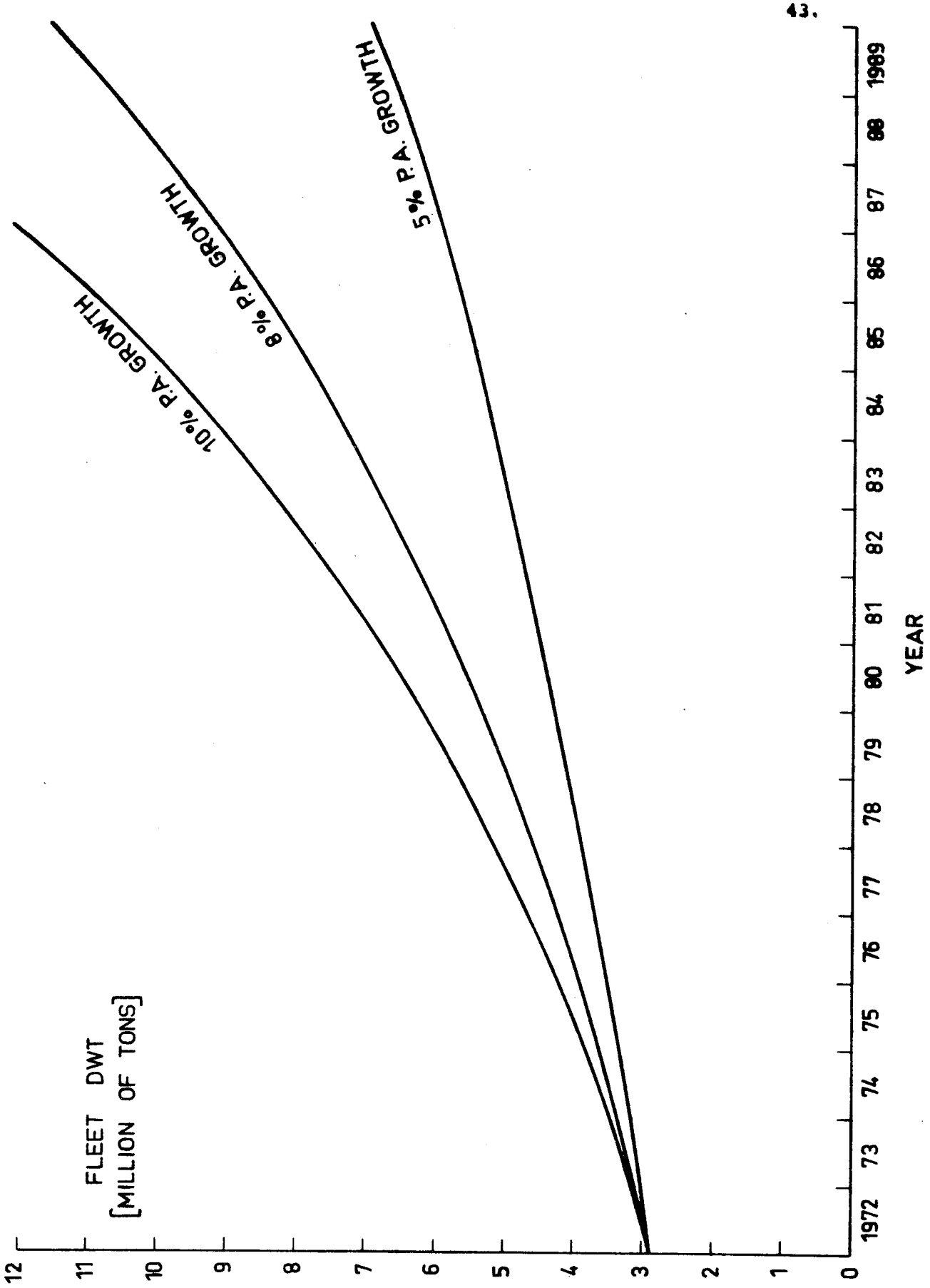


FIG. 3.1. PROJECTED GROWTH OF TANKER FLEET CARRYING AUSTRALIAN OIL IMPORTS

Table 3.6 shows the amount and destination of major items of bulk exports in 1970/71 and an estimate of the number of 50,000 DWT (B50) or 100,000 DWT (B100) bulk-carriers which may have been required to shift the 1970/71 cargo. (Note that the trade data quoted here is more reliable than that of Tables 3.8 to 3.13 of Ref. 1.) The assumptions made in developing the numbers of ships required are similar to those made with reference to the importing tanker fleet in Section 3.2.1.

Trade routes were considered to fall into three groups; 4,500, 7,000 and 12,500 nautical miles one way. Estimates of the amount of cargo shifted by a 50,000 DWT and a 100,000 DWT bulk-carrier on each of these routes are given in Table 3.7.

With reference to Table 3.6, it was assumed that iron ore and coal would be carried in the larger ships and the other cargos in the smaller. The requirement of, for example, 5.3 50,000 DWT ships for the sugar trade indicates that 5 ships of this size could be fully employed and that another of the same size would be employed for about 0.3 of the year (3½ months).

Considerable amounts of bulk cargos are carried in ships chartered for a small number of voyages, perhaps only one. Whether Australian-flag ships could compete in the international short-term charter market is perhaps doubtful. It would seem that long-term contracts would be more suitable. Thus, participation in the coal and iron ore trades may be more likely than in the grain trades where more charter work is seen. Little can be said with any certainty about these matters and the above is only a brief outline of the present position.

With a requirement for something like 35 ships of 50,000 DWT and 75 ships of 100,000 DWT at present, it is seen that the requirement is sizeable, and significant Australian participation in the incremental trade as measured from the present would require considerable numbers of ships. These could possibly represent sufficient demand for a Standard Ship Program. (Note that if trade expands at 5% p.a., it doubles in about 14 years; if at 8% p.a., in about 9 years, and if at 10% p.a., in about 7 years.)

3.4 Overseas General Cargo

As pointed out in Section 3.1, all Australian-flag overseas trading ships are at present engaged in general cargo trades. Their trading results would seem to indicate that, given a viable trade, they can operate competitively. As with the case of coastal general cargo trading, the complex trading patterns involved make it extremely difficult to say much about future developments. Some expansion is likely; e.g. two new ships are proposed for the

Eastern Searoad Service to Japan, but the numbers and types required over a long period are not discernible.

Again there is a heavy dependence on government policy, on conference arrangements and on the extent by which improved production methods and costs in Australia can attract owners to build here. However, the overall world trade position will have a marked effect on the viability of an Australian fleet, and developments in technology, particularly in the cargo handling area, would have a dominant effect on determining the type of ships required.

TABLE 3.1

AUSTRALIAN OVERSEAS TRADE

PETROLEUM AND PETROLEUM PRODUCTS

Year	Exports (m$)	Imports (m$)
1970/71	41.6	188.7
1969/70	27.7	254.4
1968/69	26.4	251.2
1966/67	30.4	246.2

TABLE 3.2

ORIGIN AND DESTINATION OF AUSTRALIAN 1969/70 OVERSEAS PETROLEUM AND PETROLEUM PRODUCT TRADE

Country of Origin		Value (m$)
Imports:	Indonesia	43.7
	Saudi Arabia	32.1
	Kuwait	45.6
	Qatar	21.4
	Brunei	14.4
	Trucial States	13.0
	Bahrain	18.0
		254.(4)
Exports:	Singapore	10.2
	New Zealand	8.6
	South Africa	1.5
	Japan	0.1
	Fiji	1.4
	New Caledonia	1.5
	Papua/New Guinea	1.2
		27.(7)

TABLE 3.3

DESTINATION AND ORIGIN, BY AUSTRALIAN STATES, OF 1969/70 OVERSEAS PETROLEUM AND PETROLEUM PRODUCT TRADE

State		Value ($'000)
Imports to:	New South Wales	8,360
	Victoria	14,271
	Queensland	782
	South Australia	432
	Western Australia	3,735
	Tasmania	2
	Northern Territory	140
		27,722
Exports from:	New South Wales	86,248
	Victoria	73,692
	Queensland	31,088
	South Australia	21,285
	Western Australia	36,114
	Tasmania	1,415
	Northern Territory	4,546
		254,390

TABLE 3.4

N.S.W. IMPORTS AND EXPORTS OF PETROLEUM AND PETROLEUM PRODUCTS, 1969/70

	Imports (Tons)	Exports (Tons)
Sydney	2,581,400	244,049
Newcastle	323,903	3,691
Botany Bay	4,164,992	51,982
Port Kembla	87,092	132
	7,157,387	299,854

TABLE 3.5

POSSIBLE DEMAND FOR AUSTRALIAN-FLAG OVERSEAS TANKERS

EoP = End of Period
SoP = Start of Period

25% Australian Participation by 1986

3-Year Order Book (SoP)	% Australian Participation (EoP)	Trade Growth Rate %	Fleet DWT (EoP) x10^{-6}	Aust. DWT x10^{-6}		New Aust. DWT x10^{-6}	Ships			
				SoP	EoP		T 100	T 150	T 200	T 250
1971	5	5	3.3	0	0.165	0.165	1			
		8	3.6	0	0.180	0.180	2			
		10	3.9	0	0.195	0.195	2			
1974	10	5	3.9	0.165	0.390	0.225	3			
		8	4.6	0.180	0.460	0.280	1	1		
		10	5.2	0.195	0.520	0.325		2		
1977	15	5	4.5	0.390	0.675	0.285		2		
		8	5.8	0.460	0.870	0.410	1	2		
		10	6.8	0.520	1.030	0.510		2	1	
1980	20	5	5.2	0.675	1.040	0.365		1	1	
		8	7.3	0.870	1.460	0.590		3		
		10	9.1	1.030	1.820	0.790		4		
1983	25	5	6.0	1.040	1.500	0.460			2	
		8	9.2	1.460	2.300	0.840			3	1
		10	12.1	1.820	3.020	1.200			1	4
		5	T O T A L S				4	5	3	
		8					4	3	6	1
		10					2	4	6	4

T100 = 100,000 DWT
T150 = 150,000 DWT
T200 = 200,000 DWT
T250 = 250,000

TABLE 3.6

DESTINATION AND TONNAGE OF MAJOR BULK EXPORT CARGOS FOR 1970/71
Tons (x1,000T)

Item	Destination	1968/69	1969/70	1970/71	Ships (1970/71) B50	Ships (1970/71) B100
Wheat	China	1,163	2,477	1,289	2.6	-
	Japan	1,128	998	808	1.6	-
	Malaysia	251	278	307	0.6	-
	Singapore	105	206	273	0.5	-
	Sudan	-	88	227	0.8	-
	U.A.R.	-	5	1,255	7.5	-
	U.K.	761	1,008	1,717	10.0	-
					23.6	-
Barley	Taiwan	56	96	225	0.5	-
	West Germany	3	27	188	1.1	-
	Japan	136	116	222	0.4	-
	U.K.	140	240	257	1.5	-
					3.5	
Sugar	Canada	212	150	319	1.1	-
	Japan	573	510	476	1.0	-
	U.K.	507	319	447	2.6	-
	U.S.A.	176	164	191	0.6	
					5.3	
Iron Ore	Belgium	291	503	756	-	2.2
	France	233	508	322	-	0.9
	West Germany	727	796	1,326	-	3.9
	Greece		244	379	-	1.1
	Italy	670	659	1,073	-	3.2
	Japan	17,195	28,903	41,271	-	41.3
	Netherlands	344	370	71	-	0.2
	U.K.	314	542	836	-	2.5
	U.S.A.	271	583	704	-	1.2
						56.5
Titanium and Zinconium	Japan	174	315	366	0.8	-
	U.K.	254	274	306	0.9	-
	U.S.A.	256	314	323	1.1	-
					2.8	
Coal	West Germany		518	506	-	1.5
	Japan	13,447	16,260	15,940	-	15.9
	Netherlands		154	209	-	0.6
	New Caledonia	233	171	286	-	0.3
						18.3
				Grand Total	35.2	74.8

Trade Date Source - "Overseas Trade, 1970/71" - Table 13,
Bureau of Census and Statistics, Ref. 7.

TABLE 3.7

ESTIMATE OF CARGO CARRIED BY BULK-CARRIERS OVER DIFFERENT ROUTES

(tons)

One-Way Voyage (Nautical Miles)	Ship Size	
	50,000 DWT	100,000 DWT
4,500	500,000	1,000,000
7,000	300,000	600,000
12,500	170,000	340,000

4. CONCLUDING REMARKS

4.1 Coastal Shipping: 1972-1986

At 8% p.a. fleet DWT growth, the probable demand for coastal tankers suggests about 26 ships, and the same growth rate of bulk-carrier fleet DWT suggests about 29 ships, giving a total bulk-ship requirement of about 55 ships over the period.

This gives an average of some 4 ships per year - 2 or 3 large by present Australian standards and 2 or 1 smaller.

The aggregated tanker and bulk-carrier 3-year order books at 8% p.a. fleet DWT growth are:-

3-Year Book	DWT
1971	340,000
1974	440,000
1977	590,000
1980	690,000
1983	840,000

We note that the Whyalla Shipbuilding and Engineering Co. order book for mid-1971 to mid-1974 totals 279,400 DWT (7 ships) of which 15,000 DWT are special Ro/Ro ships. Thus the estimated requirement of 340,000 DWT capacity for 'simple' bulk-ships could perhaps have been met by that shipyard alone.

If one shipyard of this type were to develop over the period, improving productivity, concentrating on bulk-ships and increasing

size of facilities to allow construction of larger ships*, it is not unreasonable to expect that such a shipyard could meet virtually the whole of the coastal bulk-ship demand. This might provide the one shipyard with a healthy diet, but there would be little left for others.

The demand of the last few years and present orders for non-bulk ships are given in Table 2.18. These orders are not very heavy but are more complicated in detail than the bulk-ships. Little can be said quantitatively about future trends, but qualitatively one might expect that an efficient shipyard of the State Dockyard type could readily handle all these orders. To meet peak demands - e.g. the A.N.L. vehicle deck and the A.T.L.S. ships are all to be delivered by about the end of 1972 - this one shipyard would need to expand somewhat or another shipyard should be available to take up the load, as the Adelaide Ship Construction shipyard has done in the case mentioned above. Both these 'specialised' shipyards would need to consider other work as well, such as dredges, tugs, and other service craft since the flow of general cargo type ships may well not be consistent, though some work in this area may reasonably be expected.

In summary, then, as regards demand for coastal shipping, this would seem to warrant one 'bulk' shipyard of sizeable deadweight capacity and perhaps two 'specialised' shipyards of smaller deadweight capacity but able to build more complicated ships and with facilities of such a size as to build fairly large specialised ships up to, say, 30,000 DWT. These yards would take off-peak loads in general orders and compete to some extent with the large 'bulk' shipyard for the smaller bulk ships. The ship size capacity of the 'bulk' shipyard would need to grow with time from a present maximum of about 80,000 DWT.

The 'bulk' shipyard may be expected to have a satisfactory order book, provided of course the fleet expands at a reasonable rate and that the necessary government policy and assistance is available. Perhaps the position for the two specialised shipyards mentioned above is a little lean and they would need to 'look for work' but, given sufficient fleet development, and a continuing requirement for service and special craft, they may do reasonably well. However, some of the so-called 'unrecognised' shipyards may capture much of the smaller work and this would make the position more difficult unless there are significant improvements in productivity in the currently 'recognised' shipyards.

Considering principally, then, the present 'recognised' shipyards, and assuming that Cockatoo Island Dockyard and Williamstown Dockyard do not become active in the merchant building field, the industry may well be over-capacity to the extent of one shipyard.

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*It is sometimes argued that these factors require the setting up *de novo* of a modern shipyard at a fresh site.

The above discussion and the data presented in this report seem to suggest that this trend could continue and as long as the threat of over-capacity is real the whole shipbuilding industry - and hence the Ship Industry and the national economy - will suffer.

Still considering only coastal shipping and assuming that this must, or preferably will, because of inducements to owners and improvements by builders, continue to be built in Australia, and if the above analysis is reasonably valid, the present situation will continue. It has been said that there is inadequate competition between Australian shipyards, costs being dependent upon demand, availability of building berths and for the largest ships there is no direct competition.

If this is the case then the following government policy would seem to be most beneficial to the *overall* Ship Industry:

(a) Taxation and other inducements to owners to build in Australia, as well as assistance of a type similar to that provided by governments of other maritime nations to these nations' shipowners.

(b) Assistance to shipyards to enable them to improve productivity to such an extent that, given the advantages to them of policy of type (a) above, they can compete against overseas builders for orders. This assistance may be in the form of capital aid rather than direct subsidy though some of this too may be necessary.

(c) Import restriction to be lifted. This move, in association with those already mentioned, should ensure a truly competitive position between shipbuilders and give shipowners that freedom of action which is desirable for efficient and economic operation.

The above policy may result in some orders being 'lost' to overseas builders, but it should lead to greater prosperity for the overall industry than the present no import/direct subsidy system. However, the writer does not have the resources for the thorough costing of the proposal against the cost of alternatives which is necessary to make it secure from attack!

4.2 Overseas Shipping: 1972-1986

The data presented in Section 3 of this report seems to suggest that a moderate participation of Australian flag ships in Australian/overseas bulk trades would generate a significant demand for new building. The same comment may well be true of the general cargo area though this is even less quantifiable than the already vague bulk trade position.

If participation eventuates and government assistance, both to owners and builders is extended to ships in any trade, then considerable shipbuilding capacity must be required. For example, given an 8% p.a. growth in the oil import and dry-bulk export trades and a 25% Australian participation in each by 1986 (that is, that Australian ships would carry 37% of the increment of trade between now and then) the requirement may be

Large tankers	100,000	DWT	4
(See Table 3.5)	150,000	"	3
	200,000	"	6
	250,000	"	1
			14
Bulk carriers	50,000	"	24
	100,000	"	30
	150,000	"	10
			64
Grand Total			78 ships

This is a very large number and as no indication is yet available as to how this demand might be met, little can be suggested here as to the possible size and number of Australian shipyards which might be required to meet all or part of it. However, we note that the goal of a 25% Australian participation is not moderate nor has it been costed in any kind of sensitivity study. It is put forward simply as an illustrative example. Yet this large potential demand may imply that government policy should be directed towards encouragement for all forms of Australian-flag shipping. The general form of the assistance to be applied to overseas ships ought, it would seem, to be the same as that applicable to coastal ships as outlined above. Significant expansion of shipbuilding facilities might result with associated benefits of scale of production.

4.3 Exports of Ships

The third possible source of orders for Australian-built ships is direct export of ships to foreign owners. This possibility seems rather remote at present, at least as regards large ships. Given the coastal shipping demand outlined above and some building for Australian-flag overseas operation, direct export would not seem to be essential to a viable industry of some size.

If there is no demand for Australian-flag overseas vessels, the '3-yard' industry outlined above may survive on coastal demand. The addition of Australian-flag overseas demand would cause industry expansion but would not necessarily require direct export for viabil-

ity. If productivity is increased - and perhaps there are now too many optimistic 'ifs' - particularly by many orders for Australian overseas ships, direct export may become a possibility, more as a result of other factors than as a cause or necessary condition of development.

In general, a government intention to support the shipbuilding industry implies that its policy should provide similar conditions to all prospective owners, whether they are Australian or not, and regardless of whether or not their ships will trade with Australia. Suitable trade-off studies might indicate the extent to which it would be wise to extend such assistance to foreign owners.

4.4 Standard Ship Program

Given adequate coastal fleet growth, series of tankers and bulk-carriers of sufficient numbers of ships to justify standardisation may be required. However, the dependence of the argument on trade growth is significant. The large numbers of ships which could be required for overseas trading would appear to justify standardisation, if there is any development in that area.

As pointed out in Ref. 1, the viability of a standard ship program would become clearer after the series of studies recommended in that paper has been made and that, regardless of the result of those studies with reference to a standard ship program, they would be of benefit to the overall Ship Industry, resulting in better design and hence, hopefully, reduced costs for future ships. It is seen that there is a certain amount of feedback in all this - there is not a simple cause-and-effect relationship between various components or policies involved in the Ship Industry, and it is not possible to consider a system in isolation nor without due regard to the effects produced upon itself as a result of its effects on other elements of the industry.

While ship standardisation in the bulk fields seems possible, the extent to which it can be carried out for non-bulk ships is quite uncertain. Sub-system standardisation, i.e. standardisation of components such as deck-houses, machinery and equipment with but little structural standardisation may be more beneficial. Again more research, particularly in the areas outlined in Ref. 1, is required and should shed light on the matter.

.. /ACKNOWLEDGEMENT

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