THE DEVELOPMENT OF THE ROLL-ON/ROLL-OFF SHIP

ON THE

AUSTRALIAN COAST

by

E.S. CLARKE

General Manager

Australian Shipbuilding Board

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THE DEVELOPMENT OF THE ROLL-ON/ROLL-OFF SHIP ON THE AUSTRALIAN COAST

1. PURPOSE OF PAPER

In view of the considerable and successful expansion of the use of vehicle deck or roll-on/roll-off ships on the Australian coast, the Committee of the Australian Branch of the R.I.N.A. believed it would be of interest to its members to hear a paper reviewing the history and development of this class of coastal vessel.

The Australian Shipbuilding Board*, as the Commonwealth Government instrumentality for administration of the shipbuilding subsidy, has played an important part in the design and construction of these ships and the R.I.N.A. therefore requested me to prepare the review.

This paper will refer to the first considerations of the vehicle deck design for the Australian coastal trade, its later adoption and the development of the design and the subsequent construction of the first such ship.

The evolution of subsequent designs will be reviewed and comparisons made of particular features with comments on the reasons for changes

The shipowner's operational requirement is the starting point for any ship design. This and his point of view on such matters as turn round, profitability and terminal facilities will be referred to and some thoughts expressed as to future prospects.

In considering the design and performance of a ship 'per se', it must be remembered that the ship is one link in a chain of transport of goods, for example from producer to consumer. The ship therefore cannot strictly be considered in isolation but must be related to the other links of the chain including packaging of goods - loose, palletised, containerised etc. - marshalling yards at terminals, ramp and berthing facilities etc. This paper deals therefore with part only of each of the relevant integrated transport systems.

2. INTRODUCTION.

Cargo which comes to the wharf for loading finally finishes up at about the same level in the ship. If the ship is conventional in its cargo handling the load in the meantime will have been slung, hoisted say 30 ft., slewed 40 or 50 ft. and lowered some 30 ft., pushed and pulled, and finally unslung.

The short-circuiting of the up-over-and-down method had indeed been preceded by direct access when Noah boarded his passengers through a shell door by a walk-on/walk-off technique. He understood the economics of not battling with gravity and of using the cargo's innate self-mobility.

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* The Australian Shipbuilding Board, under the Chairmanship of Mr. R.C. Reed, C.B.E. has 5 members and is appointed by the Minister for Shipping and Transport to advise him on matters affecting the shipbuilding industry including recommendations on the level of subsidy which should be applied in each case of an order for a new ship.

The staff, which carries out the functions of the design of ships, the administration of contracts and the supervision of the construction of ships, is the Shipbuilding Division of the Department of Shipping and Transport. As the head of this division I am responsible to the Secretary, Department of Shipping & Transport, Mr. M.M. Summers.
For brevity I will refer to both the Board and the Division as the A.S.B.

As almost all cargo reaches wharves on wheeled vehicles, the loading of transoceanic general cargoes by direct access was seen as a desirable objective. It had already proved its efficiency in cross channel rail ferries for example and in Australia with cross river punts or larger ferries on Sydney harbour in the 1920s.

During World War II, the first ocean-going roll-on/roll-off ships were developed by the Americans with their large tank landing craft. They were about 300 ft. long and were sufficiently seaworthy for voyages across the world.

After the war some of these vessels were used to transport cars and heavy road vehicles on sea routes of about 50 miles.

By 1950 investigations were going on in many countries into the construction of cross channel passenger vessels with vehicle decks to take cars and trucks, and between 1950 and 1953 a number were put into service, mainly across the English Channel, but also in Canada between Vancouver Island and the mainland.

3. AUSTRALIAN BEGINNINGS.

In 1949 and 1950 the A.S.B. had, on its own initiative and in view of overseas trends, been studying the suitability of the Ro-Ro concept for some Australian coastal trades.

At about this time the Commonwealth Government expressed its growing concern at the cost, by way of operating subsidy, of the Bass Strait shipping service and questioned the suitability of S.S. "Taroona" for the service. The subsidy in fact increased from about £40,000 in 1950 to about £150,000 in 1954.

The late Sir Ivan Holyman had asked the A.S.B. in about 1950 for advice on the suitability of wartime L.S.T.s for the service. Sea conditions in Bass Strait appeared likely to preclude the maintaining of a regular service and the proposal was dropped.

In 1955 a Committee was set up to examine the economics of the "Tarocna's" Bass Strait trade, the heavy subsidy being paid and whether a new design of ship could operate more efficiently and profitably. The "Taroona" carried 400 passengers, a few cars tediously loaded and discharged on slings by steam derricks, and negligible cargo.

The committee consisted of Mr. F. Stanton of the Department of the Treasury, the late Mr. F. Mercovitch of the Department of Shipping and Transport and Mr. H.P. Weymouth C.B.E. then Chairman of the A.S.B.

The Committee's study showed that a new ship specially designed for the trade could operate profitably but attempts to "sell" the idea to private shipping companies failed.

Nevertheless, following overseas investigations by Mr. Weymouth, under his direction the A.S.B. proceeded to develop a design of a fast twin-screw motor ship having a deadweight of about 1000 tons, the cargo being carried on a full-length vehicle deck with large stern door. In addition the ship had a passenger capacity for the overnight trip from Melbourne to northern Tasmanian ports of 334, 178 in cabins and 156 sitting up in lounges. For the comfort of passengers and to minimise damage to cargo, activated fin stabilisers were provided. To speed up arrival at and departure from terminals a 5 ton lateral thrust unit was installed at the bow.

In May 1956 the then Minister for Shipping and Transport, the late Sir Shane Paltridge, obtained Cabinet approval of the building of this ship.

Tenders were called by the A.S.B. and in November 1956 a contract was awarded to the State Dockyard, Newcastle for the construction of the ship for a contract price of £2½mn. At the launching in December 1958 the ship was named "Princess of Tasmania".

Upon completion "The Princess" was taken over by the newly-formed Australian Coastal Shipping Commission and entered service flying the Australian National Line's house flag on 2nd October 1959.

The "Taroona" was sold off the coast in October 1959.

The "Princess of Tasmania" differed from other vessels of her type then in service or entering service overseas in that she was designed to carry a larger proportion of cargo and heavy road vehicles, and to operate over distances in excess of 200 nautical miles. She was the first ship of this type with stabilisers, the second with a bow propeller and the first to have both.

The predictions of the Committee of investigation proved very quickly to be correct. The new ship handled a growing freight trade quickly and at acceptable freight rates. Passenger traffic varied seasonally but for about four months in summer, bookings were 100% and there were long waiting lists over much of the popular tourist season around Christmas.

It was particularly convenient for passengers with cars to drop their families at the gangway with overnight baggage, then drive cars into the vehicle deck, park where instructed and proceed up to the passenger accommodation.

4. SECOND STAGE

The original design studies for the "Princess" had assumed that freight would be handled by road vehicles, trucks, semi-trailers and trailers, which would be driven on at one terminal, carried to the other and driven off.

As experience developed with "The Princess" A.N.L. found great advantages were obtained in handling specially prepared units of cargo with large fork-lift trucks which stayed at the terminals. This technique further developed into the handling by these fork-lifts of containers and rail-roaders. From the shippers' point of view this technique had the advantage of greatly reduced freight rate per net ton of cargo as the prime mover was not carried. For A.N.L. there was the benefit of a better stowage rate because of the elimination of the wasted air space below vehicles.

The rate of growth of freight traffic and their prediction of its trend lead A.N.L. to request A.S.B. to prepare a design for a second ship for the Bass Strait trade. This was to be purely a cargo ship though with accommodation for 12 vehicle drivers who might be required to drive their trucks to and from the destination of their loads.

The new ship was to provide for the shipment of heavier loads with fork-lift trucks by having the deck strengthened to carry a front axle load of 34 tons as against a maximum single wheel loading of 5.4 tons in the case of "The Princess", which had been designed to support loaded semi-trailers only.

Because of the growth of containerised and palletised cargo, advantage was taken of a considerable open deck area (about 150 ft. x 50 ft.) on the shelter deck abaft the 3 tier deck house, for the stowage of lift-on/lift-off cargo. This was to be handled by a fixed 25 ton jib crane at each of the terminals which could load and discharge simultaneously with the wheeled or fork-lift cargo in the vehicle deck.

A radical step was taken in the main propulsion of the new ship. Whereas "The Princess" had been equipped with twin direct coupled turbo-blown 2-stroke engines running at 230 r.p.m. it was decided to install small high-speed engines running at 1600 r.p.m., driving propellers at 172 r.p.m. through epi-cyclic gearing. The Napier "Deltic" engine had been in use in fast small naval vessels for a number of years but had not until then been adopted for merchant ships. It was a remarkably compact "whippet" of a machine, very much in the Napier aircraft tradition, developing 2200 b.h.p. in the remarkably small weight of 7 tons.

The engine offered several features which were attractive to the owner. Among these were great savings in weight and space, and maintenance by replacement again in the aircraft tradition. Engines were so small and light and relatively inexpensive that they could quickly be uncoupled, lifted out through a hatch in the vehicle deck and removed to a maintenance shop. A third engine would replace it and so a cycle of engine changing, survey and maintenance would be followed with a minimum of shipboard work ("pulling of pistons" etc.) and of interruption to the ship's tight schedule.

The opportunity was taken to incorporate bridge control to the variable pitch propellers and also to bring all engine room instrumentation and controls into a sound-proof room. The latter indeed turned out to be very necessary as the noise level in the engine room was extremely high (about 118 decibels between the engines) and engineers need to wear ear muffs during inspections at sea.

As interchangeability of the engines was fundamental to the proposal, "handing" of them to achieve conventional i.e. outward-over-for-ahead propeller revolution was not permissible. In addition "handed" epi-cyclic gears were not available. Therefore convention was challenged and dark apprehensions by the sceptics of unpredictable manoeuvrability and poor propulsive co-efficients were defied, and the propellers both made right hand (with reverse pitch, of course, for astern).

Tank tests predicted, and later service demonstrated, no problems in these respects.

Tenders were called for the new ship by A.S.B. and a contract was let, to State Dockyard in November 1958, for the construction of the ship. "Bass Trader" entered service alongside her elder cousin in April 1961.

Although she had during early years to carry the burden and anxiety of many problems with the main engines as design details were rectified or new components flown from U.K., "Bass Trader" has proved a most efficient ship and has pointed the way for future designs.

The engine repair and maintenance was carried out in a special annexe of the Department of Supply's Commonwealth Government Engine Works at Port Melbourne. Engine changes were frequent at first and practice reduced the time to about 5 hours.

It is worth recording that on one occasion in Bass Strait an engine broke down. The third engine happened to be on board and the resourceful Chief Engineer changed the engines over at sea. This may have been the first occasion of such a change of an engine of over 2,000 b.h.p.

5. SUBSEQUENT DEVELOPMENTS.

The above summaries of the first two vehicle deck ships on the Australian coast have been rather longer than will be necessary for the remainder. In them were developed most of the design characteristics which were followed in later vessels.

The next ship of the type to be built however showed an interesting change. The Adelaide Steamship Company's M.V."Troubridge" had an open area on the shelter deck abaft the house, which was loaded with roll-on/roll-off freight by a long shore-based ramp able to serve first the main vehicle deck and then this upper deck.

The Adelaide Steamship Co. had requested A.S.B. to develop a design for a twin screw ship to cater for the growing trade in holiday and other passengers and commercial freight, including livestock, between Port Adelaide and Kangaroo Island. The ship was also to serve similar traffic, as an extension of the above, to Port Lincoln. Distances were 70 miles to Kangaroo Island, 114 miles on to Port Lincoln and 151 miles direct return.

Only sit-up accommodation was provided for the passengers (licensed for 170) on the short overnight trips. This greatly simplified accommodation but not, of course, sub-division as the ship was classed as a passenger ship.

There were no existing stern loading facilities at the three ports.

The owners studied the cost of facilities for the loading of the upper deck and concluded that the least costly and most effective was to use the same ramp for both decks.

"Troubridge" was completed by Evans Deakin in November 1961.

Early in 1961 the Union Steamship Co. had advised A.S.B. that they required two cargo ships for their Tasmanian trade sailing on alternate weeks from Melbourne and Sydney respectively to Hobart.

The "Seaway Queen" and "Seaway King" were built by the Whyalla Shipbuilding and Engineering Works and completed in May and August 1964.

Unlike previous vehicle deck ships these had their accommodation and machinery right aft. This provided extensive holds below the vehicle deck which the owners wished to use for particular cargoes offering in the proposed trade e.g. newsprint from Hobart. Larger flush-fitting hydraulic hatch covers were fitted over these holds in the vehicle deck allowing fork-lift trucks to pass over them or cargo to be stowed on them. There were steel hatch covers above in the shelter deck. Cargo was loaded into the lower holds by electric jib cranes, 5, 10, and 15 t. capacity. These could also be used later to accelerate loading into the vehicle deck if required.

Like the previous ships these two had twin screws, fin stabilisers and bow thrusters.

A small vehicle deck ship which has handled an important inter-island trade for over 6 years is the "King Islander". This ship was built by the now defunct Phoenix Shipyard in Devonport in Northern Tasmania for R.H. Houfe and Company. She was built without the aid of the shipbuilding subsidy, as she was too small to qualify. "King Islander" carries a great variety of stores, machinery and other supplies to the rural and other people of King Island and returns principally with sheep and other livestock and rural production. Her terminal ports are in the Maribyrnong River near Footscray and Currie on King Island. Her unique feature is that the roll-on/roll-off, or as it has been called the hoof-on/hoof-off, deck is loaded and discharged through a bow door. This posed several problems especially in relation to water tightness and the pumping of water which gained access at sea and also because of the danger of the ship taking a "gulp" of water when a heavy load came aboard giving a sudden trim by the head. She has in fact sunk at her Footscray moorings once for a somewhat similar reason. Little major damage was suffered.

"King Islander" has a small but difficult trade to manage and has been remarkably successful. With strong westerlies which are frequently experienced at Currie, entry to the harbour can be difficult and hazardous.

The next five ships are cast in the same mould, at least in so far as lines are concerned. The "Empress of Australia" completed by Cockatoo Docks in Jan. 1965, the "Australian Trader" completed by State Dockyard in June 1969 and the three Searoaders being built by Evans Deakin and due for completion between now and early next year are all dimensioned : 405ft LBP x 70ft.BM x 41'6" DM.

The "Empress" had been designed to meet the A.N.L.'s requirements for a ship to re-establish a regular passenger and freight service between Sydney and Tasmanian ports, Hobart and northern ports on alternate trips. Although sometimes thought of as a second "Princess of Tasmania"

"The Empress" and "The Princess" differ in several basic respects. The dimensions of "The Empress" are considerably greater giving rise to a deadweight of 2,880 tons as against 1,075 for "The Princess". The vehicle deck has a much greater area and there is a lower hold for passengers' and trade cars served by a hydraulic hoist.

Because passengers spend up to 40 hours (Sydney - Hobart) on board there is cabin accommodation for all passengers and public rooms, cafetaria etc. are much more extensive.

"The Empress" has been very successful although the seasonal nature of the passenger traffic has been of concern to the A.N.L. This has been countered to some extent by the Line offering concession fares for parties travelling during normal off-seasons.

The A.N.L. has been increasingly concerned at the losses it was suffering in operating its services to north Queensland ports with slow and conventional general cargo ships which had been designed and built during or shortly after the war. The growing trade also presented opportunity for profitable business in competition with land transport.

The A.S.B. was requested to prepare a design for a modern vehicle deck ship and as a result of calling of tenders three of these so called "Searoaders" have been ordered from Evans Deakin. As mentioned earlier their lines are identical to those of "The Empress" but the ships revert in broad design to the "Bass Trader" concept of a pure cargo ship, though catering for 12 drivers. Each ship has an extensive high vehicle deck, a lift-on/lift-off shelter deck abaft the house and a large deck below the vehicle deck having only a 6'5" clear tween deck height for the stowage of trade cars, loaded down a ramp which is closed off by a hydraulic hinged hatch cover at the vehicle deck.

Like "The Empress" these ships are propelled by twin direct coupled slow speed turbo-blown 2-stroke diesel engines and have bow thrusters. The first of these ships is due for completion in August, the others following at 4 month intervals.

The use of the Searoader vessels on the Melbourne to north Queensland ports makes two important breaks with established practice with such ships. It is the first case of vehicle deck ships being used in a coastal as against an inter-island trade. They will therefore be in direct competition with land transport media.

Secondly with an extreme voyage length of about 1800 miles, this trade challenges the earlier belief of an economic limit of some 200 miles, though "The Empress" and "Seaway King" have operated profitably in trades of over 600 miles.

The last ship to be referred to is the "Australian Trader" which was completed by State Dockyard in June. Within the same lines as "The Empress" a design has been achieved which combines almost the passenger capacity of "The Empress" with a cargo deck area and deadweight approaching the Searoaders.

Unlike "The Empress" the house is quite far forward leaving an extensive lift-on/lift-off shelter deck space aft. Small, low medium speed engines require only a single engine casing in the vehicle deck instead of twin casings for "cathedral" engines. Passenger ship sub-division makes it difficult to use the lower hold space effectively but stowage for 27 cars is provided using scissors hoists from the vehicle deck.

The passenger cabins and public rooms are comfortable and well furnished and there are open decks and games areas.

In the engine room a central control room contains all necessary instrumentation including monitoring and data logging and the main engines can be controlled from the bridge.

The "Australian Trader" has both fin and passive tank flume stabilisers for passenger comfort and to ensure against cargo damage.

This fine ship has now entered service across Bass Strait from Melbourne in company with "The Princess" and the "Bass Trader" and should prove very successful as a combination of both her predecessors.

6. DESIGN FEATURES AND TRENDS.

The evolution of some of the basic design features over the 10 or more years of this review has been referred to earlier. Deadweight and therefore dimensions have increased. Speed and therefore power have been adjusted to suit particular voyage lengths and the convenience of passengers in having reasonable departure and arrival times.

Twin screws, twin rudders. bow thrusters have been common to all and stabilisers to all but one. There have been many variations of these common features, sometimes to suit particular conditions and sometimes to take advantage of new developments and as a guide for the future. Main propulsion engines have gone from direct-coupled direct-reversing engines through high-speed engines back to slow-speed engines and now to medium-speed V-engines through gearing. Considerations which have lead to these changes are head-room limitation imposed by the vehicle deck, improved fuel consumption, ease of maintenance and survey. Fleet standardisation has been a secondary consideration. Makers have been as numerous as types - Polar, Napier, M.A.N., Mirrlees, Pielstick.

The bow thrusters fitted in the first two ships were electrically driven cycloidal Voith-Schneider propellers. These proved very efficient but are somewhat complicated for this duty and are wasted to the extent that whereas they can produce an infinitely variable thrust in any direction in a horizontal plane, for a bow thruster, thrust is required only either to port or to starboard and need only be in a few quite widely spaced steps, perhaps only two.

Later units have been simpler axial types either with variable pitch propellers or in the case of the Union Company's "Seaway" ships twin fixed-pitch propellers with simple star-delta starters. These units which are interlocked to prevent simultaneous starting, draw surprisingly small starting currents by virtue of motor design and have proved very satisfactory.

Steering gears were initially ram-type but the rotary vane type has proved very reliable, smaller and easier to install for about the same cost.

The stern door of a vehicle deck ship is crucial to the basic concept of the design. It must be as large as possible to facilitate access by large vehicles, it must be water tight and of scantlings to the satisfaction of the Classification Society. The door must be able to be opened quickly during the last few minutes of approach to the terminal and quickly closed after departure.

As ships' beams have gone up door sizes have increased because of the need to serve existing terminals some of which require port-side-to berthing, while others are starboard-side-to. Door weights have therefore increased and this has brought problems with hydraulic mechanisms, heavily stressed components and sealing.

Doors and their operation have varied considerably from a single leaf design horizontally hinged at the shelter deck and operated by winches and wires via a U.K.-built horizontal sliding door to the present very large centrally articulated doors operated either hydraulically or by long electrically driven screws. It seems that the ideal has not yet been reached in simplicity and reliability and the centrally articulated door with a hydraulic hinge offers promise in these respects.

Electric supply in "The Princess" was D.C. except for lighting and similar services. The "Bass Trader" was ahead of her times with 60 cycle A.C.

in an attempt to reduce costs with smaller pumps and motors. Almost standard now is 50 cycle A.C. and it is proving reliable in regard to motors and switchgear. There is a cost saving of some 5% in A.C. as against D.C. installations but this varies considerably with type of ship.

Control of manoeuvring from the bridge was first used in the "Bass Trader" with the so-called "Combinator" controls which simultaneously adjusted the variable pitch propellers and the fuel to the main engines and ensured that the engines were not overloaded. This system proved very successful and facilitated manoeuvring into the terminals as bow thruster and Combinator controls were alongside one another on the wing of the bridge. Other ships such as "The Empress" and the "Seaway" ships have had conventional telegraphs and controls.

As has been mentioned earlier the "Australian Trader" has bridge control of manoeuvring. Instrumentation, data-logging etc. are in an air-conditioned room in the machinery space.

The extra investment in such remote and "automated" controls can be justified only if they result in either reduced engine room or other crew or greater efficiency of the running of the machinery. The A.N.L. has been very advanced in its requirements in these respects and expects to gain considerable benefit from the advanced system installed for example in the "Australian Trader".

A comparison of engine room crews in four ships is as follows :

	Princess	Seaways	Empress	Australian Trader
Total b.h.p.	8600	7160	13,500	13,000
Chief Engineer	1	1	1	1
Engineer Officers	8	4	8	5
Electrical officers	2	1	3	2
Total Engineer Officers	11	6	12	8
Donkeyman/Wiper	1	1	1	
Oilers/Greasers/Motormen	3	3	3	4
Total E.R. Crew	4	4	4	4
Total E.R. Manning	15	10	16	12

There are many other aspects of design which have changed for various reasons, examples being generators, stabilisers, air-conditioning. In this overall review however it is not possible to go further into such detail.

7. CONCLUSIONS

The adoption of the roll-on/roll-off design and the building of "The Princess" resulted from the need to eliminate the loss suffered by a specific "cross-channel" trade operated by a conventional ship.

The design was an imaginative and far-seeing plunge into a new concept in Australian coastal shipping and subsequent designs have shown relatively minor

departures or evolutions from it.

One important evolution has been from the carrying of vehicles themselves to the use of fork-lift trucks for the loading and unloading of containers, "flats", palletised and unitised cargoes with benefit to both the shipper and shipowner. The term "roll-on/roll-off" now is therefore somewhat of a misnomer. A.N.L. favours "vehicle deck container ship" but this is perhaps less than satisfactory in that it does not embrace one of the great virtues of the design, its flexibility in being able to handle not only containers but a great variety of cargo as mentioned above, including wheeled cargo such as semi-trailers, trade cars, earth moving equipment, military vehicles etc.

Of the 11 ships of this basic type ordered or in construction all but the last three are for mainland to island trades. Of the eight 'inter-island' vessels 6 have been for the Tasmanian trade. The three not on 'inter-island' trade will be in competition with road and rail transport and with modern cellular container ships. The results of this competition, especially with the very great increase in voyage length, will provide clear pointers to the relative efficiencies of the various modes of transport in so far as future inter-state transport is concerned.

The only roll-on/roll-off ship so far confronted with competition from road transport is the "Troubridge" in the service between Port Adelaide and Port Lincoln. In spite of the road distance round the Gulfs being 420 miles as against 151 nautical miles direct, much of the freight formerly carried by the "Troubridge" now goes by road. As recent press statements have shown, the continued profitability of the sea service is in doubt.

It is interesting to note that the forthcoming "Eastern Searoad Service" trade between Australia and Japan will be operated by modern fast roll-on/roll-off ships. The voyage length will be over 4,000 miles, some 20 times the distance thought 10 years ago to be the economic maximum for such ships. The success of this service will be a guide to the use of similar ships for all appropriate overseas trades of whatever length.

The provision of costly terminal facilities has often been quoted as a cost burden to roll-on/roll-off ships. But large paved marshalling areas, transit sheds, fork-lift trucks and cranes are essential to the efficient handling of cargo and the fast turn-round of modern ships of whatever type. The particular facility necessary for the roll-on/roll-off ship, the stern ramp and its approaches, are a small part, perhaps only 5%, of the total cost of a terminal.

Terminal staffs make a vital contribution to efficiency and the speed of turn-round. From the outset A.N.L. has had the greatest possible cooperation from these staffs. The Line has arranged engagement contracts and has included such benefits as provision of uniforms and long service leave, while retaining the right of selection. "The Empress" can arrive at Mort Bay in the morning, be completely discharged and loaded (2,500 tons off and 2,500 tons on) and depart in the evening, all with 12 terminal staff.

This sort of experience appears to be typical of the experience of other owners.

The future use of vehicle deck ships on the Australian coast in "cross-channel" trades, on which their use was founded, appears to be limited at least in the next decade. The principal "channel", Bass Strait, is well catered for.

The population of Tasmania has been rising at less than 1% per annum in recent years but industrial growth has been capital-intensive and investment is about 8% per annum while the annual growth of electricity consumption is about 10%. Since late 1961 the growth of "tons to Tasmania"

shipping capacity is of the order of 25% per annum, so that by comparison with likely increase in freight task, demand for new ships for this service will probably be limited to specialised ships for particular cargoes.

On the mainland, in spite of the growth of road and rail transport, including the benefits of rail standardisation, the coastal shipment of freight has grown markedly in recent years. Three modern cellular container ships will serve western, southern and eastern ports. Three vehicle deck ships will serve eastern and northern ports and it is possible that others will follow according to the success of these.

Speed is an expensive feature of ships but will be crucial in their competitive situation. Quick turn-round and flexibility of cargo will be assisted by large stern doors, side shell openings, quicker handling of lower hold cargoes and vehicle decks free of engine casings and other obstacles to fast manoeuvring of container handling trucks in the vehicle deck. The new U.K.-built Union Steamship Company trans-Tasman ship "Maheno" has its engine exhausts at either side at the aft end of the vehicle deck, leaving the whole deck clear.

Australian designed and built vehicle deck ships have provided fast and efficient services and the benefits they offer the shipper of speed, quick turn-round, flexibility and low freight rate should ensure continued demand for them in the future.

As far as their design and construction in Australia is concerned, there is now a great accumulation of such design experience at A.S.B. and the four largest shipyards have each built one or more vehicle deck ships. It need hardly be said that they would welcome the opportunity to build more!

8. ACKNOWLEDGEMENTS.

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Mr. H.P. Weymouth C.B.E., Vice Chairman of the Australian Coastal Shipping Commission has given me very helpful information on the early stages of the development of these designs when he was Chairman of the Shipbuilding Board.

Slides and information have also been provided by the shipowners namely Australian National Line, Adelaide Steamship Co., Union Steamship Co., and R.H. Houfe and Co.

The staff of the A.S.B. has provided or checked much of the detailed information.

I acknowledge my dependence on such help and record my gratitude for it.

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AUSTRALIAN BUILT ROLL ON/ROLL OFF SHIPS

LEADING PARTICULARS

Ship	Date of Completion	Dimensions L.B.P.	B	D	Deadweight draft	tons	Speed & Power service speed	BHP	Complement Pass	Crew	Stern-restricting dimensions ht. × width	Areas available for Cargo (sq. ft.) Veh. Deck.	Mezzanines Holds	Open Deck	Total
"Princess of Tasmania"	1959	341'-9"	58'-0"	36'-3" 20'-9"	15'-6¾"	1075	17¾	2/4300	334	67	14'-6" x 19'-2"	13000	3000	-	16000
"Bass Trader"	1961	293'-9"	57'-0"	31'-3" 15'-6"	15'-0¾"	1515	12½	2/2200	12	32	13'-0" x 13'-0"	10500	3700	6800	21000
"Troubridge"	1961	282'-0"	50'-0"	31'-0" 15'-6"	12'-1½"	869	14½	2/2205	36	29	14'-0" x 15'-0"	10000	1200	2200	13400
"Seaway King" "Seaway Queen"	1964 1964	340'-0"	52'-0"	29'-6" 19'-6"	18'-9"	3155	15½	2/3580	-	33	13'-0" x 19'-0"	10500	5700	3300	19500
"Empress of Australia"	1965	405'-0"	70'-0"	41'-6" 24'-6"	20'-07/8"	2880	18½	2/6750	250	106	14'-6" x 27'-0"	18000	3500	-	21500
"Australian Trader"	1969	405'-0"	70'-0"	41'-6" 24'-6"	20'-0-7/8"	3523	17½	2/6500	200	69	14'-6" x 28'-0"	19000	4000	4500	27,500
"Brisbane Trader" "Sydney Trader" "Townsville Trader"	1969 1969 1970	405'-0"	70'-0"	41-6" 24'-6"	21'-0"	4350	17½	2/5320	12	43	14'-6" x 31'-0"	19000	29000	9000	57,000

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E.S. CLARKE, GENERAL MANAGER, A.S.B.

16TH JULY 1969

DISCUSSION

1. MAIN PROPULSION MACHINERY

Mr. K. Murray, Union Steamship Co.

The Napier-Deltic engines used in the "Bass Trader" were based on the concept of repair by replacement of a complete engine. Why has that concept not been carried on in subsequent construction?

Mr. E.S. Clarke

The essence of that concept is that you must have a light engine, like an aircraft engine, that makes it easy to replace. In order to obtain the power in a light engine you have to have equipment similar to the Deltic engine or else it becomes unmanageable. The answer to your question is that the Deltic has not performed up to its expectations and is still giving trouble in service. Consideration was therefore given in later ships to the use of more conventional, proven engines such as Mirrlees and M.A.N. running at slower crankshaft speeds.

Commodore B.W. Mussared, R.A.N.

Another point was the consideration of size, both of ship and deck heights and with the "Bass Trader" the ship's size with Deltic engines was the ideal to give a flush vehicle deck.

Mr. E.S. Clarke

Yes, but Mr. Murray's question was on the repair by replacement concept. In order to have it light enough for the power required an ultra high speed engine was essential and there was simply no other available.

Mr. W.C. Millar

The answer lies in the speed and length of the ship, in this case 12½ knots and 282 feet. There was not one or even two engines of this type powerful enough to put in later ships.

Commodore B.W. Mussared, R.A.N.

As I see it the main concern was deck height more than repair by replacement which in fact came as a bonus.

Mr. W.C. Millar

That is correct but the speed and size of the ship was variable.

Mr. K. Murray, Union Steamship Co.

My real reason for commenting is that I think the concept of repair by replacement is the ideal because you lose a tremendous amount of operating time in surveys and inspections of that nature. Why could not the Napier-Deltic engine have been used in multiplicity to give the necessary power through gearing or some other form of transfer of power to the shafts? I was wondering why someone has not gone ahead with that ideal concept.

Mr. E.S. Clarke

Mr. Millar has suggested part of the answer is that only a fairly low power was required in the case of "Bass Trader". To achieve this engine replacement concept you need a powerful, light weight engine and the Deltic had not proved reliable enough in service to fill this role in later ships.

Mr. J. Coleman, Cockatoo Docks

The R.A.N. deliberately removed the previous engines from the "Ton" Class Minesweepers and replaced them with Deltics. Have you any information on the reliability of that series of installations.

Mr. E.S. Clarke

One of the differences between the Minesweeper type of service and merchant ship service is the continuous high demand on the engine in the latter case. My belief is that the minesweepers have been fairly satisfactory but perhaps Commodore Mussared would like to comment.

Commodore B.W. Mussared, R.A.N.

The Deltic has not lived up to its expectations completely as it never met its service life in either your application or ours. Keep in mind that subsequent applications of the later supercharged Deltic, used in the Scandinavian Navy gunboats, has been successful. Our experience with them has been unfortunately spoilt by the fact that they were used in tropical waters during "confrontation". We had lubricant problems which made it necessary to derate them from about 3,500 to 2,500 hours for maintenance and we are continuing this even though we know we could now extend it. The answer is that the cost of maintenance is too high although they are extremely reliable and very powerful engines.

Captain J.F. Bell, Evans Deakin

The reason for changing from the Mirrlees, which were in the minesweepers, to the Deltic was because of the very much reduced magnetic content of the Deltic engine as compared to the Mirrlees. It had nothing to do with the reliability of the engine at that time and was primarily to achieve a satisfactory magnetic signature.

Mr. W.C. Millar

Another very important point regarding the Napier-Deltic used in the "Bass Trader" was that the engine was not a Navy version but developed for merchant service by Napier with a view to establishment in the cargo trade. There were features of the original Napier-Deltic which were cut out in the Mark 2 version in order to make them cheaper and these unfortunately were a failure causing a number of the subsequent troubles. The changes in design were one of the reasons for all the troubles we had in the early stages.

Captain J.F. Bell, Evans Deakin

The principal trouble with the Deltics in the "Bass Trader" was associated with the cracking of the liners in way of the injectors. The particular version fitted in the "Bass Trader" went in service without prior testing, resulting in all types of difficulties which would have been corrected if the prototype had been fully tested.

2. PASSENGER ACCOMMODATION

Mr. R.C. Ellis

One thing that has concerned me for many years is the arrangement of the "Princess of Tasmania" which was based on that of the "Princess of Vancouver" built by Alexander Stephens. The arrangement of aircraft seats with great big windows was for people to look at the view, also the cafeteria which was really a coffee shop as known in Canada and the United States. On the "Princess of Vancouver" and other vessels this was run by female personnel who made it very attractive, like a coffee shop on land. The whole purpose of these ships was to cater for hundreds of passengers who could comfortably look at the view. The "Princess of Vancouver" incidently ran right round the clock as its trip was only a short distance and the crew operated in shifts.

Has any thought been given to running this ship with a single shift each way making it into a daylight crossing of Bass Strait because I can not see the purpose of sitting up looking through great big windows at the stars.

Mr. E.S. Clarke

This also applies to the games deck which could not be used very much under the stars but perhaps Mr. Millar or Mr. Campbell could comment on this especially in regard to the development of the "Australian Trader" where that must have been considered.

Mr. W.C. Millar

Yes it was. The S.S. "Taroona" was costing the Australian Government in the order of £200,000 per year in subsidy and it cost nearly £400,000 for the last 4 yearly overhaul. The Government decided they would stop the service across Bass Strait or a ship was to be designed that would at least break even. The "Princess of Tasmania" was the answer and at that time there was no thought that the ship would ever make a profit. The ship was designed to accommodate a maximum number of passengers which was 334. There were no public rooms as such; there was a bar anticipated to pay for itself, also a cafeteria and the rest of the ship given over to cabins, both being expected to pay for themselves.

The original idea was that the ship would leave Melbourne at 8.30 at night, all passengers having had their evening meal before they came on board and that they would go straight to bed, get up in the morning, have a cafeteria style breakfast and go ashore. Incidently with the ship being in harbour during the day, loading and unloading would take place during daylight hours with a reduction in charges. That was the thinking behind the "Princess of Tasmania". Basically the "Taroona" was losing money and this was an attempt if possible to break even on the cost of the service.

Incidently the design arrived at was the only way to get 334 people into the ship and even then 156 had to sit up to accommodate that total.

Mr. K. Murray, Union Steamship Co.

I might be able to help Mr. Ellis in one respect. As you know we had an unfortunate incident in New Zealand in April 1968 and by virtue of this our management had to consider how they would maintain their service between Wellington and Lyttleton. The "Maori" was converted at Taikoo Dockyard, Hong Kong, to a roll-on ship and was then pressed into service. It is now operating in both directions on a daily service which gives 1½ to 2 hours in port at each end depending on the weather. That service is now operating successfully with one vessel where previously we had two. The "Maori" can carry just on 1,100 passengers on daylight sailing and 800 on a night sailing.

Mr. E.S. Clarke

What you are saying is that the basic premises applied to the "Princess of Tasmania" must be wrong. For example you must be working cargo at night in New Zealand.

Mr. K. Murray, Union Steamship Co.

This is correct.

Mr. E.S. Clarke

Perhaps that was one of the basic things wrong with our original design.

Mr. W.C. Millar

One of the basic reasons was that they did not want to feed the passengers except to give them breakfast. It did not happen that way because the people came on board at from 7.00 to 7.30 and demanded an evening meal which the National Line had eventually to give them; but the original concept was to provide breakfast only.

One of the problems here was the length of run which is 15 hours from Bell Bay to Melbourne, the longest of the Tasmania runs. If you try to do that in daytime you have either to start very early in the morning from Bell Bay or you would arrive very late at night in Melbourne. By the time you had your car off the ship it would be well into the middle of the night which would not suit people with families including young children. This is another reason for having it a night run where you have a full day in Tasmania to board the ship and you arrive reasonably early in the morning to disembark.

Mr. R.C. Ellis

I did a number of trips on the old "Lordwarden" and its average time to discharge 120 cars was 20 minutes. I understood from your comments that people do not drive their cars onto either the "Princess" or the "Empress" now. Is this correct?

Mr. E.S. Clarke

No, passengers do drive their cars on board. My comments were in relation to freight where the original concept was that complete trucks would be driven on at one terminal and off at the other. Now fork lift trucks load containers or unitised cargo on and off while the prime mover is not carried between ports. Passenger and trade cars roll-on and roll-off in the ordinary way.

Mr. Ellis,

Surely the desired time between two ports is relative in designing a ship and you power it accordingly. A trip of 15 hours does not make sense to me when you could do it in 12 hours if you wanted to. In similar services in other countries they do not have the expensive crew and accommodation. They have a minimum of recreation and mess rooms but no overnight accommodation on numerous ferries. I know that this run is longer but surely if the ship could do it in 12 hours you could run with 12 hour shifts. One crew to take it across to Tasmania and one to bring it back. They had three shifts in the "Princess of Vancouver" with a short trip of $2\frac{1}{2}$ hours running right round the clock with 3 complete changes of crew from the Captain right down.

Mr. W.C. Millar

Mr. Ellis is losing sight of the fact that the Commonwealth Government was losing £200,000 per year on providing a Bass Strait service and Treasury were going to stop it. The only way to maintain

a service was to make sure, from the best information available, that the Commonwealth Government would not lose more than £20,000 or £30,000 which was the maximum they would accept. If it was to be any greater the ship would not be built and the service would cease. It was for this reason that everything had to be cut down. The size of the ship had to be kept to a minimum, also more speed meant a bigger engine room and less paying passengers. The public rooms were cut to a minimum and they were put that way in order to get the ship built. It was all a question of economics.

Mr. E.S. Clarke

In other words the capital cost was a prime consideration and a small addition to the running cost was of secondary consideration.

Mr. R. Campbell, Australian Shipbuilding Board

As Mr. Clarke referred to earlier, the general concept of the roll-on/roll-off ship has not appreciably altered from the days of the "Princess". Recent development has been aimed at obtaining better utilisation of the cubic space and area on subsequent ships, and in particular making better use of the under-vehicle deck spaces which can be served either by ramps or hoists. The hoists involve a break in the roll-on/roll-off concept in that you roll-on, go down, then roll again. There are a number of features being evolved which help this variation, such as rolling beams and bearers, micro-movers and possibly air cushion pallets, all of these possibly reducing the external labour. Other developments include investigations in the field of propulsion systems such as medium speed engines, stabilisation, mooring equipment, and automation, all tending to reduce manning on the ships.

One factor mentioned about the casings on the "Australian Trader" that must be borne in mind is that it is not a passenger ship and the casings did take up valuable side space where you obtain light and air into the accommodation.

3. STANDARDISATION OF DESIGN

Mr. E.S. Clarke

There are many things I did not mention in this brief review and one of the most important was firefighting and the problems associated with fire hydrants. There have been considerable changes in an endeavour to find an optimum for the future. Some of you may think that the National Line have considerably changed their policy but I believe they are looking for a future optimum and are not being bound by standardisation. Standardisation within a fleet is a transitory thing anyway and main engines even of the one make change and the piston of to-day's engine will not fit the same bore in three to four years' time.

It is often said that "stardardisation breeds stagnation". Perhaps it does as things inevitably improve and to continue too long with standardisation is to stagnate.

4. POWER ALLOWANCES

Mr. R.J. Tuft, University of N.S.W.

What was the service power allowance for these ships in general? Perhaps Mr. Murray might be able to enlarge on the "Seaway King" and "Queen" on the service power allowance over and above the normal for clean hullconditions and the trial conditions.

Mr. E.S. Clarke

I will attach a table to the transcript of the discussion giving some information on this. It will include Mr. Murray's ships also.

Mr. R.J. Tuft, University of N.S.W.

I am interested to know what the allowance is on the Australian Coast as various parts of the world make varying allowances on power according to the prevailing weather conditions. In the North Atlantic they may allow 15% to 30% extra power to cope with the bad conditions and in calmer waters it may be only 12%.

Mr. E.S. Clarke

In the Shipbuilding Board this type of question arises from the trend towards longer periods between dockings and provides considerable discussion as to what percentages to allow for fouling between dockings and what margin should be allowed between trial and service speed powers.

Mr. R. Campbell, Australian Shipbuilding Board

From memory service power margins of about 50% to 60% are allowed over clean hull, smooth water conditions. Apart from effects of the weather and fouling a considerable factor is that these ships have to maintain a regular service over a short distance so a good reserve of power to compensate for all eventualities is essential.

Mr. R.J. Tuft, University of N.S.W.

It is a very essential piece of information in the powering of a ship.

Mr. R. Campbell, Australian Shibuilding Board

We do have discussions and there is an increasing trend to extending from six months between dockings to twelve months between dockings. There is very little reliable data on this and it is an area where the shipowners could provide designers with useful reliable information.

Mr. R.J. Tuft, University of N.S.W.

The marine engineer does not like to run his engines at near full power and always prefers to keep something in reserve. This can be rather expensive for the company but it might reduce the maintenance cost.

Mr. E.S. Clarke

Over cautiousness or conservativeness in powering can have an opposite effect but surely the emphasis varies. In the early days where they found themselves able to meet the schedules easily and were running the engines at low power they suffered from carbonising and similar problems as a result.

Mr. K. Murray, Union Steamship Co.

As far as particular engines are concerned we have troubles with the Mirrlees alternators in our ships. They were virtually running at about half power and carbonising so that eventually, to use some of the excess power, electric elements were put in the calorifier instead of using the hot water boiler. With Mirrlees main engines we only have about one knot in reserve between full power and actual service speed power and it is rarely that we have a ship late.

5. STABILISERS

Mr. C.E.B. Boden

Have you any information about the effectiveness of the stabilising systems and to what extent there may have been damage to vehicles during the course of a trip?

Mr. E.S. Clarke

The fin-type stabiliser is extraordinarily effective with reduction of rolls of 15° down to 3° or 4° or of that order, being achieved. The other thing that is noted in the paper is that the "Australian Trader" has fin stabilisers, bilge keels and flume stabilisers. I am not at all sure why that is so. I do not feel that was necessary and doubt whether the flume stabilisers are going to contribute anything except a loss of deadweight. I feel that the positive and effective action of fin stabilisers is preferable and if you must have a stand-by, put bilge keels on the ship.

Mr. M.D. Pearson, Newcastle State Dockyard

I understand this was a result of an incident of the "Empress of Australia" where she slowed down off Sydney heads in a heavy sea with fins operating and apparently the loads of some trailers shifted causing damage to the cargo. Stabilising fins are not so successful at slow speeds. Although "Australian Trader" had both stabilisers we did not try them together; only separately. The fins do give practically complete damping but impart a rather shuddering motion whereas the flume does not give complete damping but is much smoother. On a trial with the flume in Bass Strait we achieved over 70% roll reduction. The actual roll is probably only about 3 degrees less with either the flume in or out. From memory the double roll would be about 12° with the flume out which is 6° either side and about 9° with the flume in.

With the flume stabiliser the ship gave about three large rolls and then the flume took hold and there was no roll for about six passes of the flume, followed by a roll again, whereas without, she just rolls all the time. As far as I can see you do not obtain much reduction in the amplitude of the big rolls but you do have a reduction in the total rolling which is taken as the area under a curve of amplitude against time.

Mr. E.S. Clarke

It seems that your description indicates a badly adjusted flume because you are getting boats in the system indicating that it is out of phase with the roll and this suggests the need for an adjustment of the amount of water in the system.

Mr. M.D. Pearson, Newcastle State Dockyard

This is true. We adjusted it in accordance with the maker's recommendations but I think it would take the full 15 hours to tune it completely.

Mr. Tuft, University of N.S.W.

This is one of the problems with flume tanks I understand. I believe it was suggested that flume tanks be used on one of the supply vessels to the oil wells but the captain said he could not spend all his time adjusting the tanks as he was too busy up top. Evidently they require frequent adjustment especially when the loading and sea state varies.

Mr. M.D. Pearson, Newcastle State Dockyard

This is true as the basic adjustment is for GM. You can either calculate it, which is what we did, or else you can measure the period of the roll with a stopwatch which is the way the makers recommend. After you have the period of roll you work backwards to obtain the GM, then look up the table and decide how much water to put in the flume tank.

Mr. R.J. Tuft, University of N.S.W.

Does the ship heading effect the frequency?

Mr. R.C. Ellis

There are a considerable number of oil rig supply vessels with flume tanks but I do not know of one with fins. The main reason for this, as pointed out by Mr. Pearson, is that they require a steady ship approaching the rig under hardly any way when fins would not be of any use. Also there would be obstruction in the way of the rig. After a settling in period, flumes do have a free surface effect that is quite severe on stability. The large amount of free surface in the flume tank in most cases goes right across the ship and it is a fact that the lower the GM the more effective is the flume.

Mr. E.S. Clarke

Returning to Mr. Boden's question apart from some early damage in the "Princess" due to inadequate lashing of cargo and slight motion on the tyres there has been very little cargo damage except for the one instance when the "Empress" slowed down.

Mr. K. Murray, Union Steamship Co.

We had an instance in the case of the "Seaway King", with her fins operating, when she was making a turn into Sydney harbour in a very strong southerly wind while coming in close under Hornby light. She caught a quartering sea which gave her a tremendous roll tossing all her deck cargo straight over the side. The violence actually rolled her over to about 45° despite the fins operating at the time and there was a general shift of cargo. I calculated afterwards that she had virtually a 10° permanent list because of the movement of cargo down below. It was caused by a combination of being in too close to Hornby light, with the consequent steepness of the wave structure. Of course you can always see the errors afterwards. That is the only incident we have had. All of our masters are now quite well aware of the penalty in doing this and in very strong southerly weather they make a bigger turn into the harbour.

Mr. E.S. Clarke

What carried away? Was it the deck load fastenings or lashings, both or what?

Mr. K. Murray, Union Steamship Co.

There is a deck securing system of chains that carried away; they broke off like carrots I believe. Fortunately for us the cargo went straight off as if it was being launched over the side of the ship and did not do any damage whatsoever to the ship. The only thing that did cause a little bit of consternation was that it was all carbide!

Mr. R.J. Tuft, University of N.S.W.

Do you know of any conditions when the stabiliser fins are retracted at sea and not allowed to operate, possibly under very severe conditions.

Mr. E.S. Clarke

If you are suggesting that the scantlings of the mountings of the fins might be inadequate to cope with any seas, to my knowledge we have no such limitations. There is a theory among the National Line masters that the fin stabilisers do have a reducing effect on speed probably a quarter to half a knot and when very tight for time they maintain that if the flume works well they will use it and not the fins.

Mr. K. Murray, Union Steamship Co.

We have found in practice that we make far better time in really heavy conditions with the fins out than what we would with the fins in, irrespective of the movement of the ship.

Mr. M.D. Pearson, Newcastle State Dockyard

That is having either fins or no stabilisation whatever?

Mr. K. Murray, Union Steamship Co.

That is correct.

Mr. C.E.B. Boden

When you referred to using the hatches for stowing cargo, this cargo would not be lashed to the cringle bars. What provision is made for keeping this unitised cargo in position in the event of bad weather?

Mr. E.S. Clarke

I thought it was lashed, is not that so?

Mr. K. Murray

Not necessarily

Mr. R. Campbell, Australian Shipbuilding Board

The stowages are particularly designed for definite units of cargo and there is a device of spacers, wedges, etc. between them but I think the National Line do generally lash most of theirs.

Mr. K. Murray, Union Steamship Co.

We are not lashing a large proportion of our cargos in the "Seaway" ships but rely purely on rubber pads.

6. BOTTOM DAMAGE

Mr. S.R.L. Tait, Bureau Veritas

In driving your ships through heavy seas with stabilisers have you had any damage to the bottom of the ship or on the bows.

Mr. K. Murray, Union Steamship Co.

None whatever.

Mr. S.R.L. Tait, Bureau Veritas

I do recall a case of rather a large passenger liner driving through the Bay of Biscay and having the forecastle deck driven down.

7. STERN DOORS AND SIDE PORTS

Captain J.F. Bell, Evans Deakin

I know that some of the recent thoughts in America tend towards the side loading ports in preference to stern doors for roll-on/roll-off vessels. Have the two conditions been examined here and if so were there any clear conclusions either way?

Mr. E.S. Clarke,

One of the things you will notice in all these ships is that the stern door is at right angles to the centre line and we are certainly thinking that perhaps this should not necessarily be so. We are considering putting our stern doors at an angle to the centre line with the object of having a ramp onto a conventional wharf thus reducing the cost of the ramp and its mountings.

I think the side shell port, though admirable, in view of turnables gives you problems in regard to the manouvering and discharge of cargo.

Mr. R. Campbell, Australian Shipbuilding Board

Probably in the early stages, apart from anything else, a large side port was thought to some extent to interfere with the strength of the ship by cutting the shear strake. Having once decided to adopt the stern loading ship of course the rest followed because the facilities were there and it was natural to want to use these for subsequent ships.

Recently we have considered a type of ship which could be either stern loaded or angled side loaded from a conventional wharf if this was a necessity.

Captain J.F. Bell, Evans Deakin

I think the merits vary with the size of the ship. Once above a certain size where a large side port can be fitted without interfering with the structural continuity of the upper strength deck and where you have sufficient breadth of ship for manouvering, there are considerable advantages in a port door amidships. Alternatively some lines have incorporated side loading ports in the bow and quarter so that in fact you can have through traffic with fork lifts and other vehicles.

Mr. R.J. Tuft, University of N.S.W.

A small number of ships are being built with a loading port on the starboard quarter which overcomes the difficulty of providing a special dock for side loading facilities.

Mr. E.S. Clarke

Mr. Campbell's crutial point is that A.N.L. had existing terminals and wanted to use the same terminals because of the savings involved. As he said the pattern was fixed in the early days.

Mr. W.C. Millar

In addition the beam of the first two ships was 62 feet for the "Princess" and 67 feet for the "Bass Trader". On investigation it was found that there was more waste space after vehicles were run in through side doors and that was what initially determined the stern loading doors. Having been committed to stern ramps they were followed for the later ships.

8. CONCLUSION

Mr. R.J. Tuft, Branch President

I am sure you will agree with me gentlemen we have had a very interesting evening and plenty of audience participation has brought together our knowledge of all these ships on the Australian coast. It has been a gradual evolution and I do not think we have appreciated the thinking behind it. It is a completely new era and Australia has something to be proud of because it has been one of the pioneers in this era of roll-on/roll-off ships. I am sure we will see considerable innovation in the time to come.

I would like you to show your appreciation of Mr. Clarke's paper by acclamation.

POWER MARGINS ON ROLL ON/ROLL OFF SHIPS

	Service speed	BHP (measured mile conditions)	BHP (service)	% power margin
"Princess of Tasmania"	17¾ kn.	5600	7500	35%
"Bass Trader"	14½ kn.	2650	3890	47%
Seaway ships	15 kn.	4500	6100	35%
"Empress of Australia"	18½ kn.	7750	11300	46%
Searoader ships	17½ kn.	6000	9600	60%