The question of the improvement of the Port of Melbourne comprises many enquiries which extend far beyond the scope of a single paper. It had been the intention of the writer to compare the density of the traffic on the Melbourne wharves with that of other ports, and to have examined the conditions of traffic and trade in Melbourne with a view to pointing out how the landing, storing, and distributing arrangement can be altered, and what mechanical appliances can be utilised, in order to increase the capacity of the quays, and thereby to obviate the necessity for extending the quays and wharves away from the centre of the city.

Another point on which definite information is required, is the question of the rate of increase in size and depth of vessels actually frequenting the port, with a view to gaining, if possible, some clear idea as to the limits of depth and breadth of waterway necessary and sufficient to serve Melbourne for a reasonably long period of years.

Owing to temporary illness and to the calls of business, the first of these enquiries has had to be abandoned for the present, and the second is incomplete, although sufficient information has been collected to form an appendix.

It is hoped, however, that a short presentation of some outstanding requirements of the port may be of use in eliciting discussion on a subject that is of prime importance to the community, and on which professional opinion is of value.

The main point to be kept in view in any scheme of improvement is that it should be a scheme that can be undertaken part by part according to the requirements of the day, and that each part completed should not become obsolete, but should be capable of being brought up to date when the whole is complete.

Another point which is worthy to be kept in mind may be illustrated by the past:

In 1878 a plan of improvement was entered upon, which even during its execution has been extended in such manner that it may in many essentials be said to have been radically departed from. For the purposes of these improvements and their extensions, loans amounting to two millions sterling (£2,000,000) have
been raised. Before the extensions are completed the loans have commenced to fall due and are so being paid off, but the sting of the matter is this, that the necessities of the port at this stage are urgently demanding further great extensions to provide for a future that is already upon us.

It is necessary to insist, therefore, upon the inadequacy of any improvement that is virtually exhausted before it is paid for, as is the case to-day in Melbourne harbour, and this is a point in which the engineering profession is vitally interested, because its members are the responsible parties upon whose advice the authorities and financiers have to act.

The original scheme for the Yarra river wharves and Victoria Dock provided for masonry structures. At the time of their building the writer discussed with the late Mr. Brady, and was at one with him upon the question of the cheaper construction, which has fortunately been adopted by the Harbour Trust.

Had masonry wharves been built on the existing lines of quays the financial position, now that extensive improvements are required, would have been a serious one. Certainly, under such circumstances, the Harbour Trust would have been in no position to make the handsome contributions they have made for so many years to the State treasury.

In earlier years the question of floods was a very pressing one, and there is no reason to expect that in future years the conditions which raised the level of the waters in Hobson's Bay at the time heavy land floods came down the river will not recur.

Whatever action may be taken to mitigate the effects of these excessive floods, or to shorten their duration, the certainty of their recurrence must be taken into account in fixing the working levels of wharves and warehouses.

In Sir John Coode's report of February, 1879, he deals at length with the question of floods in the Yarra. He states that the depth above and below the Falls remained practically the same in 1878 as in 1863, and he attributes this to the natural scour, particularly of floods. He is careful to point out that the tidal range is the same at the city as in Hobson's Bay, and that there is little difference of level at any state of tide from McCallum's ferry downwards.

There is, therefore, no possibility of lowering the low water level in the river and improving the tidal scour, and the improvements proposed in Sir John Coode's report as regards the tidal regimen of the river, amount to a preservation of the status quo ante. The channel below the falls was shortened and increased in cross section and the removal of the falls would probably add not more than 100,000 to 120,000 cubic yards of water to the tidal flow. The floods remaining the same (to them Sir John attributed the scouring power of the river) the shortening of the course was balanced as regards scouring power by the enlargement of the cross section for purposes of navigation.
That the plans of that day did not make full use of the possibilities of the river is proved by the existence of the enlarged canal to-day, and we now see that the question of maintaining the depths in the river below the Queen's Bridge by natural scour, should not have influenced the consideration of the navigation requirements.

Another consideration which may affect the arrangement of traffic in the port in future is the future of the coal trade. In 1908 the total importation of coal into Melbourne Port, according to the last published annual report of the Melbourne Harbour Trust, appears to have been 889,034 tons, of which 608,220 tons paid wharfage. The total import amounts to 35 per cent. of the grand total of imports for the year as shown on page 58 of the Trust's report, while the wharfage received for coal amounts to nearly 13 per cent. of the total wharfage received. This is an important item of the Harbour Trust business, and the results of the crisis through which the coal trade has just passed are likely to make themselves felt in the trade of the port.

The Railway Department, having a State coal mine opened, may be expected to draw their supplies largely or wholly from Victorian sources, and this might cause a deduction equivalent to the whole of the coal imported for railway use in 1908, viz., 280,814 tons, leaving a consumption of sea borne coal for gas, steam and household purposes of 608,220 tons. As gas coal is not at present mined in Victoria and as both for the household and for the general trade the New South Wales coal will continue in much demand, and as allowance must be made for the natural expansion of the trade, it will not be safe to reckon upon a great reduction in the quantity likely to be imported to Melbourne in the future. It will probably be necessary to deal with a total importation of coal in the future of per annum, say, 400,000 to 500,000 tons.

The nett result to the Harbour Trust may therefore be considered to be a reduction of not more than 10 per cent. in the gross tonnage of imports, and of not more than 4 or 5 per cent. in wharfage receipts, but this reduction is not likely to be reached for some time.

Coming now to the alterations required to allow of the due expansion of trade in Melbourne it is probably not possible to make any proposal for wharf extension in the port of Melbourne that has not already been suggested and discussed, but it is proposed in this paper to set forth some of the proposals that appear to be necessary to make a first-class port of Melbourne. It may be that the community is not prepared for drastic changes, that, as things are at present, it may not be possible to embark on the course that is seen to be the best for the future of the port, but before condemning proposals as extravagant or chimerical there are certain considerations that we should look at.

First, as to expense. There is nothing to the mind of the
writer more extraordinary in the progress not only of engineering enterprise but in every phase of human enterprise, during one's own life-time than the enormous expansion of the scale upon which undertakings are launched. A few examples will illustrate this.

For seventy or eighty years the question of a bridge over the estuary of the Forth was discussed, and the discussion was quite as much financial as mechanical. With great diffidence at length the Tay bridge was built, and a company formed to bridge the Forth. Before, almost, the financial success of the Tay bridge was assured, it collapsed, and at once the railway companies find it absolutely necessary for their existence that not only must it be rebuilt, but both it and the Forth bridge must be built at any cost.

Look again at the matter of electric lighting. At the start it was a costly light, and one would have predicted that we would endeavour to economise by using less light, but the consequence of its introduction is that the aggregate lighting bill is not reduced, but we must use more light. Examples might easily be multiplied, for everywhere we see that whereas formerly public works expenditure was limited to hundreds of pounds value, nowadays the expenditure of thousands is necessary, and still it pays the community.

Therefore, if we reject a proposal to-day because it is beyond our means, to-morrow we may be compelled to undertake it to keep our business alive.

It is therefore useful to consider improvements as far as possible in advance of immediate requirements, if for no other purpose than to keep our immediate undertakings in line with the requirements of the future and that the cost of pulling down may not, when the time comes, exceed the cost of building up.

The Yarra has been improved on the lines partly of Sir John Coode's reports, and now, when the first loan only has been redeemed, we find the limit of improvement very near at hand.

This limit as regards the channel approaches has been fairly pointed out by Mr. William Ferguson, and Captain Vincent has asked for what may probably be found to be the limiting depth for the berthsage in the river and Victoria Dock—namely, 30 feet.

If depths materially greater than this have to be considered for the Yarra navigation, it will be found that the cost of the approach channels adds so much to the total cost of the deep wharfage (not to speak of the increased waterway required—eating into the valuable city lands), that the port is of necessity driven further from the city.

This forcing of the deep water accommodation further and further from the business centres of cities appears in every river port; e.g., Glasgow, London, the Tyne, and so on; and it
should once for all be established beyond question that the deep water port of Melbourne has to be at Port Melbourne.

The maintenance and expansion of the Coode Canal and the Yarra indicated by Mr. Ferguson will not be of much value, unless the enlargement of the waterway and the turning basins, somewhat on the lines proposed by the Harbour Master in 1907, be undertaken, and the whole harbour and dock from the Victoria Dock mouth upwards, be furnished with modern wharves, sheds and cranes.

The Spencer street goods yard isolates the Victoria Dock from the centre of the town, while the excavation of the "Railway Coal Canal" has cut it off at present from any part of the West Melbourne swamp that might have a value as industrial sites.

There is therefore a limit in sight as to the expansion of the river Yarra as a port in the centre of Melbourne.

Had not the question of floods obscured the outlook in 1877 the knot might have been cut by the excavation of a direct channel across Port Melbourne flats, together with an embankment carried across the Yarra bed, so as to connect the South Melbourne flat with Melbourne city. We now know that there are no engineering objections to this, provided that ample room for flood discharge were given. There would have been unlimited water frontage from the Queen's bridge on both sides of the channel and along the foreshore to Williamstown with excellent railway facilities on both sides and a magnificent area of land available for industrial expansion. The Footscray water frontages would have still been preserved, and would be in close proximity to the centre of the port.

Such a scheme cannot now be entertained, and the cramped nature of the port in Melbourne city must be overcome by the rearrangement of the wharves, and the landing and storing appliances, so as to have the wharves fully occupied by a rapid succession of ships.

It will not be sufficient to make the wharves wide, they must be backed by a deep strip of ground, running back from the water, whereon the merchants can have their permanent warehouses, served by railway and water carriage. To give quick despatch of the steamers, the waterways must be wide, and a turning basin of, if possible, 1,000 feet diameter provided. Among many disadvantages which a straight cut would have to-day, it would render difficult of utilisation the Port Melbourne flat, and this is one of the problems that are coming up at the moment. To utilise the Yarra wharves to the full, a widened waterway is essential. The vessels now using these wharves are already as long as can be handled and when the Harbour Master gives his serious opinion that a widened waterway is necessary, or desirable, it must be because he is faced with a difficulty in handling the traffic. Turning now to the plan. At "A" is shown, in thick lines, a suggested wharf line for the widened river, giving a width of waterway of 550 feet. This has been taken to utilise the
wharfage in the swinging basin, but it would be advisable to set the line back to not less than 600 feet clear in width.

On the south side of the Yarra a large ship-repairing industry has been built up by several firms, but much work is lost to the port, owing to there being no fitting-out berths where vessels can conveniently lie. The widening of the channel at this point would probably give the necessary facilities.

If the whole of these wharves were provided with high-level warehouses and transit sheds, worked with cranes on the quay side, and with road and railway below the sheds, each berth could be made to serve a very large increase of shipping, and such an equipment would obviate the construction of additional length of wharfage, while concentrating the shipping near the centre of the town.

For any further extension of waterway, it might be advisable to cut away, in part or altogether, the tongue between the river and the Victoria Dock. As regards sanitary condition this would render the dock more useful for general trade.

Before going further a few remarks may be made on the question of silting of the berths, etc.

Generally, harbours, and particularly docks, have grown quite beyond the stage at which it was possible to apply natural or induced scour to preserve the depth from silting, and in such a port as Melbourne, where there are no ocean tidal currents to carry away silt as it is brought within their range, whatever benefit may be done in the river by natural scour, would be counterbalanced by the deposit of the silt at the end of the channel or elsewhere in Hobson's Bay, whence eventually it has to be removed by dredging. In any form of dock or bye-water, sediment, where it exists in the water, must be deposited and must so be removed. It may be convenient to have the silt swept out of the river to a place whence it can be removed without inconvenience to traffic, but when the waterway has to be enlarged beyond the area necessary to concentrate the scouring power of the current, the scour fails, and the larger the channel the more room there is for dredgers to work without interfering with traffic. This is a point which most certainly should have had weight in determining the early plans of improvement. The neglect of it has caused the Harbour Trust immense expense in undoing and re-doing the work of protecting the sides of the channel.

The further consideration of the silting question is unnecessary, as the Harbour Trust has long since reached the point when dredging is the mainstay of the port's existence, and in this they are on all-fours with every other port authority of first magnitude.

There is, then, in the River Yarra and its wharves, and with its full development, an excellent second-class port, which at present deals with over 78 per cent. of the trade, but, in addi-
tion, Melbourne must have a first-class port, if the State is to reach its full development.

The old port at Sandridge has, throughout all vicissitudes, held its own as the deep-water port of Melbourne, and it must be dealt with in a manner similar to the Yarra. The wharves must be laid out, not as 100ft. or 150ft. piers, choked up with railway lines, but must be deep-water quays, with 3, 4, or 500 feet in depth of solid ground opposite the berths, upon which permanent transit or storage warehouses can be erected by the authorities or by the lessees. The railways, roads, and sheds must be kept back from the ships, the quayage being occupied by passenger gangways and by whips and cranes, delivering the goods on overhead tram lines, whence they can be delivered on waggon, truck, or in store in any direction. The outward cargo should pass into transit sheds, whence, as soon as the ship is ready to load, it can be smartly brought forward to the cranes.

The waterway between wharves must be commodious, to allow of the largest ships being handled speedily and safely, and so that waiting ships may lie near their berths, in readiness to take them up without delay. With such arrangements, properly organised, the accommodation afforded by each berth will be more than doubled, and a very small number of berths will be able to give safe despatch to a large trade.

This scheme can be developed on lines similar to that shown on the plan at "B," where a new harbour at Port Melbourne will be best laid out as a series of open basins, partly excavated on the foreshore and partly dredged in the bay. These basins would be constructed in lengths as required by the growth of trade from time to time, and they would be bounded by deep-water quays, while the east and west quays would be backed by reclamation from the excavation and from dredgings. Each quay is given a length of not less than 1,200 feet.

In process of time the old Railway Pier and the Town Pier could be converted into similar double-sided quays, and there is ample room for expansion westwards.

The plans of the new Railway Pier, as proposed by the Commissioners, show a step in the right direction, but stress must be laid upon the fact that piers do not give the accommodation afforded by quays, as they require double handling of goods, whereas quays backed up by warehouses do not.

The advantages offered by Port Melbourne as a position for the site for the port are manifest, and have been recognised from the beginning. The approach is the shortest from deep water in Port Phillip, the locality is as sheltered as any, and is sufficiently so for large ships. There is no undue or sudden silting to be feared, and it is within reasonable distance of town.

The first thing to be considered in connection with a harbour at Port Melbourne is the railway access.
The present railway connections are inadequate to serve this portion of the port, as the traffic is all backed through Flinders-street, and the Railway Commissioners have already had before them a proposal for a high-level railway bridge across the Yarra, below Spencer-street.

Such a bridge would practically destroy the value of the Yarra, and would increase the obstructions already surrounding the city on the south and west. How it would relieve any congestion of the railway traffic is not very obvious.

In appendix No. IX. of Mr. Ferguson’s report of April, 1908, is given a correspondence between himself and the Railway Commissioners, regarding the adequacy of the present railways, supplemented or not by a bridge over the Yarra below Spencer-street, to cope in future years with a heavy harbour traffic at Port Melbourne. In the correspondence none of the parties will commit themselves to any estimate of increase or otherwise of trade at Port Melbourne.

It is, however, an undoubted fact that the whole of the railway traffic of the State between east and west and the harbour, together with an enormous and growing suburban passenger traffic, is throttled on the river frontage of Melbourne, between Flinders-street and Spencer-street, and it is not too soon to look around and devise means whereby the railway system may be relieved, and a second line of communication between Melbourne, from east to west, be found. In fact, when the railway problem in Melbourne is tackled, the first necessity will be found to be a direct connection between the Northern and Western and the Eastern systems, a connection that will bring these systems to Melbourne’s main port, and that will not pass through the centre of the city.

Such a line, taken through Port Melbourne, would create the harbour there, and the route now proposed is shown on plan by the thick dotted line between the Geelong and Sunshine railways at Newport on the west and the Gippsland line near Hawksburn on the east.

Starting from the Sunshine railway line north of its junction with the Geelong line at Newport, with which latter line also a connection would be made, the proposed line would come down to the Yarra in tunnel, on a gradient of 1 in 85. It would cross under the Yarra south of the existing sewer in a tunnel of which the extrados would be at a depth of 45 feet below low water, and would rise to surface level in Port Melbourne flat, by a gradient of 1 in 100.

After making connection with the Port Melbourne railway near Graham-street Station, and with the new harbour lines, it would pass eastward along Liardet-street, Cowie-street, and Richardson-street in cut and cover, thence up Kerford-street, Albert-road, Albert Park, under St. Kilda-road and Fawkner Park, in cut and cover and tunnel.
It would come into daylight east of Punt-road, so as to cross over the Sandringham railway just south of the South Yarra Station, and would continue alongside and to the south of the Gippsland line, which it could join near the Hawksburn Station.

This line would interfere with very little private property, being carried for the most of the distance under streets, parks, and public lands. The only serious interference with present street levels would be the crossing at Chapel-street, but it seems possible to raise Chapel-street at this point about 6 or 8 feet, and this would allow of the railway being carried under at an easy gradient.

Such a line would enable the oversea export trade to be concentrated at Port Melbourne, and would open a new district of Melbourne with water frontage on three sides. It would also give Melbourne a chance of becoming a coal port, and would give a direct railway communication between the whole of the State lines and the wharves on the south side of the Yarra.

On the Port Melbourne flat also, and in connection with this proposed line, could be situated a State Government power house, run by the State coal mine, and supplying energy for the port, the tramways, and possibly the suburban railway system.

The grain export trade of the whole State might continue at present to be carried on from Williamstown, but in order to carry it on to advantage the land at the root of the piers should be turned into an unloading, weighing, and stacking yard, wherein the sacks should be unloaded mechanically and weighed, and the cargo for each ship stacked ready for loading. Some of the stacking might be done on the piers, but, as a rule, the berths should be kept clear, and the loading from stack into the hold should be done by continuous transporters or travelling bands.

In any attempt to concentrate the export trade of Melbourne in one efficient port, the grain export traffic should be brought from Williamstown to Port Melbourne, and to assist in reaching this end, it may be desirable to consider whether the State could hand over the whole of the Williamstown railway piers, docks, and State property to the Commonwealth, together with the area of about 240 acres of old channel, foreshore, slob lands, and water area, lying south of the Williamstown ferry, and between the western training wall of the Yarra and the shore as far as the Stevedore Pier.

Some time ago a portion of land on the east side of the Yarra, and between the timber jetties and Williamstown-road, was acquired, or was sought to be acquired, by the Federal Government for the purposes of a naval arsenal. The site is too confined, and has no water area between it and the
actual channel, and is not sufficiently isolated from the commercial port.

If, however, a complete naval port, shipbuilding, and arsenal site, with unlimited room for expansion, were furnished by the removal of the commercial traffic from Williamstown, the Commonwealth could be given unique facilities for the establishment of every service. Here could be centred the lighthouses depot, the local military railways organisation, and engineer services of every description—the building slips, fitting-out basins, engine and boiler factories, the graving dock and repair yards, victualling yard, and a complete arsenal—everything, in fact, that does not require segregation, or cannot from its nature be segregated on account of strategic requirements.

The question of the improvement of the port of Melbourne is one in which the whole State of Victoria is interested, because, owing to the increase in size and speed of vessels, and to the facilities for concentration of traffic afforded by railways, it is not possible at reasonable cost to provide adequate accommodation at outports for large ships, and therefore a first-class port has to serve, not only a large territory, but also a great length of coastal line.

Owing, also, to the great depth and consequent cost of modern quays, it is necessary to keep down as much as possible their length and to work them at the highest possible pressure. This can only be done by extending in depth the land attached to the quay, to give room for a proper equipment of cranes, of transit sheds and warehouses, and road and railway accommodation.

Following a necessary fashion when dealing with the improvements of ports and waterways, the first thing an engineer does is to cast round and collect shipbuilding statistics bearing on the increase in dimensions of shipping at great ports, and another fashion which has prevailed ever since the advent of steamships is that shipbuilders are constantly complaining that engineers will never build docks and waterways big enough for the ships that shipbuilders are prepared to build. It is quite true, but it may reasonably be asked why should engineers lag behind shipbuilders in their proposals? It probably is that engineers' proposals are not competitive bids for work, as shipbuilders' are; they are made with reference to the possible amount obtainable for the purpose of carrying out works. In this the engineer has to cut down his proposals for the accommodation of the future to what the financiers consider safe; therefore, unless he can make an exceptionally strong case by some new departure in construction, he can never go the full length of what he considers desirable. Again, the limitations of mechanical art, in many cases, hamper the engineer.

In the case of the shipbuilder, however, the shipowner comes to him and asks for a design that shall fulfil certain conditions
in advance of existing practice. The builder very quickly tells the owner that his conditions can only be adequately fulfilled in a vessel of a certain size and proportions, and of course the two of them must join in a crusade against the port authorities and the engineers, because existing harbours won't accommodate such vessels. And so the struggle goes on, although the engineer tells his employers that all over the world bigger ships are being run, and their own port must not be behind in the race.

But, instead of instancing New York, Hamburg, or Marseilles, or even the Suez Canal, we might consider how the vessels actually visiting Melbourne have grown in size, and whether the Melbourne owners wish to bring larger ships to the port; we shall then probably arrive at some facts as to rate of growth and attainment of a maximum in this port, that will carry more weight, as being directly applicable to the case in point.

In order to get some first-hand information on this point as to the needs of the shipping community, inquiries have been addressed to the several shipping lines represented in Melbourne. A gratifying response has been made, although some of the firms, having in their minds the heaps of information that they have been asked for from time to time by the Government, which information lies buried without a hope of use, considered it useless to trouble themselves further.

The results deduced from the replies are embodied in the accompanying appendices.

APPENDIX I.

Diagram No. 1.—This diagram represents the draughts of the largest vessels belonging to ten different steamship lines trading to Melbourne, and II., the respective tonnages of the same vessels. The vessels represented are those vessels which were at the date of their first visit to Melbourne the largest or the deepest draughted vessels of their respective lines. The draughts are represented by full circles, and those of each shipping company are connected by distinctive lines.

In like manner the tonnage of each vessel is represented by dotted circles, and the lines joining the circles distinguish the shipping companies. In collecting this information the displacement of the vessels was asked for, as affording the best index of the actual size of ship. Such a measurement not being commercially used in the mercantile marine, there is a difficulty in arriving at the load-line displacement, especially in the cases of older vessels, and the information in many cases could not be supplied. The available information is, however, here set down. The lines form no comparison as to the actual
IMPROVEMENT IN THE PORT OF MELBOURNE.

The size of vessels, neither are they intended to represent the whole fleet of any line, nor yet the duration of time that the respective lines have been running.

The only point that is desired to illustrate is the slope of the several lines indicating the rates of increase of draught and of size. The lines show that there is no indication of any limit of size or of draught. The thick black lines are the means of draughts of the vessels, and they show a steady increase of draught throughout the period.

Diagram No. 2 gives on a scale the half of that of diagram No. 1 the increase in register tonnage of the successive largest steamers of the P. and O. fleet trading to Melbourne from the year 1854 onwards.

The opening of the Suez Canal in 1869 was followed by the advent of the "Assam" in 1873, and the regular increase in registered tonnage since that date, as shown by the diagram, is very remarkable.

Statement of dimensions of such vessels visiting the Port of Melbourne as were, at the time of their first visit to the Port, the largest or the deepest draughted vessels of their respective lines coming to Melbourne:

<table>
<thead>
<tr>
<th>Year of First Visit</th>
<th>Name of Vessel</th>
<th>Length over all or betw'n perps.</th>
<th>Beam</th>
<th>Load line draught</th>
<th>TONNAGE</th>
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<td></td>
<td></td>
<td>Tons Register</td>
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<tr>
<td>1852</td>
<td>Chusan</td>
<td></td>
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<td>699</td>
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<td>1854</td>
<td>Emeu</td>
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<td></td>
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<tr>
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<td></td>
<td></td>
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<td>Assam</td>
<td></td>
<td></td>
<td></td>
<td>4,890</td>
</tr>
<tr>
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<td>Ballaarat</td>
<td></td>
<td></td>
<td></td>
<td>6,532</td>
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<tr>
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<td>Victoria</td>
<td>466</td>
<td>52</td>
<td>26</td>
<td>6,532</td>
</tr>
<tr>
<td>1892</td>
<td>Himalaya</td>
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<td>7,911</td>
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<td>520</td>
<td>58</td>
<td>27</td>
<td>9,505</td>
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<tr>
<td>1909</td>
<td>Morea</td>
<td>540</td>
<td>61</td>
<td>28</td>
<td>10,890</td>
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### II. The Howard Smith Coy. Pty.

<table>
<thead>
<tr>
<th>Year of First Visit</th>
<th>Name of Vessel</th>
<th>Length over all or betw'n Beer.</th>
<th>Beam</th>
<th>Load line draught.</th>
<th>Tonnage</th>
<th>Dr.</th>
<th>Gross Register</th>
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<tr>
<td>1875</td>
<td>Barrabool</td>
<td>224 8</td>
<td>30 5</td>
<td>17 6</td>
<td>1,070</td>
<td>942</td>
<td></td>
</tr>
<tr>
<td>1878</td>
<td>Leura</td>
<td>250 8</td>
<td>32 8</td>
<td>16 6</td>
<td>1,540</td>
<td>1,186</td>
<td></td>
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<tr>
<td>1883</td>
<td>Gabo</td>
<td>279 7</td>
<td>38 4</td>
<td>19 1</td>
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<td>2,060</td>
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</tr>
<tr>
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<td>Buninyong</td>
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<td>38</td>
<td>20</td>
<td>3,380</td>
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</tr>
<tr>
<td>1888</td>
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<td>289 8</td>
<td>38 1</td>
<td>21 2</td>
<td>3,690</td>
<td>2,284</td>
<td></td>
</tr>
<tr>
<td>1889</td>
<td>Era</td>
<td>299 8</td>
<td>38 5</td>
<td>23 3</td>
<td>3,680</td>
<td>2,379</td>
<td></td>
</tr>
<tr>
<td>1890</td>
<td>Time</td>
<td>300 1</td>
<td>41</td>
<td>20 3</td>
<td>3,739</td>
<td>2,575</td>
<td></td>
</tr>
<tr>
<td>1898</td>
<td>Cycle</td>
<td>345 9</td>
<td>49 9</td>
<td>23 3</td>
<td>6,794</td>
<td>3,967</td>
<td></td>
</tr>
<tr>
<td>1903</td>
<td>Bombala</td>
<td>360 9</td>
<td>47 9</td>
<td>25 2</td>
<td>7,534</td>
<td>4,218</td>
<td></td>
</tr>
<tr>
<td>1906</td>
<td>Century</td>
<td>360 9</td>
<td>47 9</td>
<td>25 2</td>
<td>7,534</td>
<td>4,218</td>
<td></td>
</tr>
</tbody>
</table>

### III. The Union Steamship Coy. of New Zealand

<table>
<thead>
<tr>
<th>Year of First Visit</th>
<th>Name of Vessel</th>
<th>Length over all or betw'n Beer.</th>
<th>Beam</th>
<th>Load line draught.</th>
<th>Tonnage</th>
<th>Dr.</th>
<th>Gross Register</th>
</tr>
</thead>
<tbody>
<tr>
<td>1879</td>
<td>Rotomahana</td>
<td>298 2</td>
<td>35 2</td>
<td>21 0½</td>
<td>1,777</td>
<td>913</td>
<td></td>
</tr>
<tr>
<td>1882</td>
<td>Waikoro</td>
<td>255 0</td>
<td>36 2</td>
<td>21 9</td>
<td>2,003</td>
<td>1,269</td>
<td></td>
</tr>
<tr>
<td>1885</td>
<td>Mararoa</td>
<td>320 1</td>
<td>42 1</td>
<td>22 3</td>
<td>2,598</td>
<td>1,381</td>
<td></td>
</tr>
<tr>
<td>1890</td>
<td>Monowai</td>
<td>330 2</td>
<td>42 2</td>
<td>23 2</td>
<td>3,433</td>
<td>2,137</td>
<td></td>
</tr>
<tr>
<td>1897</td>
<td>Moana</td>
<td>350 4</td>
<td>44 1</td>
<td>23 9½</td>
<td>3,915</td>
<td>2,414</td>
<td></td>
</tr>
<tr>
<td>1902</td>
<td>Moeraki</td>
<td>368 7</td>
<td>47 2</td>
<td>23 0½</td>
<td>4,392</td>
<td>2,715</td>
<td></td>
</tr>
<tr>
<td>1903</td>
<td>Manuka</td>
<td>368 7</td>
<td>47 2</td>
<td>23 1</td>
<td>4,505</td>
<td>2,781</td>
<td></td>
</tr>
<tr>
<td>1905</td>
<td>Maheno</td>
<td>400 4</td>
<td>50 2</td>
<td>23 3½</td>
<td>5,282</td>
<td>3,277</td>
<td></td>
</tr>
<tr>
<td>1907</td>
<td>Marama</td>
<td>420 3</td>
<td>53 2</td>
<td>24 8</td>
<td>6,437</td>
<td>3,952</td>
<td></td>
</tr>
<tr>
<td>1908</td>
<td>Makura</td>
<td>450 0</td>
<td>57 7</td>
<td>25 5</td>
<td>8,075</td>
<td>4,921</td>
<td></td>
</tr>
</tbody>
</table>

### IV. Messrs. Huddart, Parker & Co. Pty.

<table>
<thead>
<tr>
<th>Year of First Visit</th>
<th>Name of Vessel</th>
<th>Length over all or betw'n Beer.</th>
<th>Beam</th>
<th>Load line draught.</th>
<th>Tonnage</th>
<th>Gross Register</th>
</tr>
</thead>
<tbody>
<tr>
<td>1881</td>
<td>Nemesis...</td>
<td>240 2</td>
<td>34</td>
<td>17 9½</td>
<td>1,393</td>
<td>1,393</td>
</tr>
<tr>
<td>1882</td>
<td>Wendouree</td>
<td>273 8</td>
<td>36 3</td>
<td>19 6</td>
<td>1,640</td>
<td>1,640</td>
</tr>
<tr>
<td>1885</td>
<td>Burrumbeet</td>
<td>300 4</td>
<td>40 1</td>
<td>19 4½</td>
<td>3,430</td>
<td>3,430</td>
</tr>
<tr>
<td>1888</td>
<td>Elingamite</td>
<td>310 5</td>
<td>40 8</td>
<td>21 1</td>
<td>2,585</td>
<td>2,585</td>
</tr>
<tr>
<td>1899</td>
<td>Moorabool</td>
<td>324 4</td>
<td>47</td>
<td>20 9</td>
<td>2,996</td>
<td>2,996</td>
</tr>
<tr>
<td>1905</td>
<td>Riverina</td>
<td>370 7</td>
<td>49 7</td>
<td>23 7</td>
<td>4,758</td>
<td>4,758</td>
</tr>
<tr>
<td>1908</td>
<td>Ulimaroa</td>
<td>400 3</td>
<td>52 2</td>
<td>24 6</td>
<td>5,777</td>
<td>5,777</td>
</tr>
</tbody>
</table>
V. Compagnie, Messageries Maritimes—

<table>
<thead>
<tr>
<th>Year of First Visit</th>
<th>Name of Vessel</th>
<th>Length over all or betw'n perps (ft. in.)</th>
<th>Beam (ft. in.)</th>
<th>Load line draught (ft.)</th>
<th>Tonnage, Displacement (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1889</td>
<td>Natal</td>
<td>413 9</td>
<td>39 7</td>
<td>21</td>
<td>6,500</td>
</tr>
<tr>
<td>1884</td>
<td>Yarra</td>
<td>416 7</td>
<td>41 6</td>
<td>21</td>
<td>6,700</td>
</tr>
<tr>
<td>1892</td>
<td>Ville de la Ciotat</td>
<td>485 8</td>
<td>49 9</td>
<td>26</td>
<td>10,400</td>
</tr>
</tbody>
</table>

VI. The Melbourne Steamship Coy.—

<table>
<thead>
<tr>
<th>Year of First Visit</th>
<th>Name of Vessel</th>
<th>Length over all or betw'n perps (ft. in.)</th>
<th>Beam (ft. in.)</th>
<th>Load line draught (ft.)</th>
<th>Tonnage, Displacement (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1885</td>
<td>Brisbane</td>
<td>230 33 2</td>
<td>18 5/6</td>
<td>1450</td>
<td>1119</td>
</tr>
<tr>
<td>1892</td>
<td>Melbourne</td>
<td>260 36 6</td>
<td>18 3</td>
<td>2539</td>
<td>1739</td>
</tr>
<tr>
<td>1898</td>
<td>Perth</td>
<td>264 37</td>
<td>19 4/6</td>
<td>2500</td>
<td>1799</td>
</tr>
<tr>
<td>1902</td>
<td>Sydney</td>
<td>280 38</td>
<td>19 2/3</td>
<td>2630</td>
<td>1989</td>
</tr>
<tr>
<td>1902</td>
<td>Hobart</td>
<td>306 45 1</td>
<td>19 2/3</td>
<td>3090</td>
<td>2463</td>
</tr>
<tr>
<td>1906</td>
<td>Monaro</td>
<td>306 45</td>
<td>19 8</td>
<td>3960</td>
<td>2657</td>
</tr>
<tr>
<td>1909</td>
<td>Kapunda</td>
<td>330 45</td>
<td>21 6</td>
<td>4140</td>
<td>3096</td>
</tr>
</tbody>
</table>

VII. Australian United Steam Navigation Coy.—

<table>
<thead>
<tr>
<th>Year of First Visit</th>
<th>Name of Vessel</th>
<th>Length over all or betw'n perps (ft.)</th>
<th>Beam (ft. in.)</th>
<th>Load line draught (ft.)</th>
<th>Tonnage, Displacement (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1887</td>
<td>Bulimbo &amp; Waroonga</td>
<td>316</td>
<td>38</td>
<td>23 6</td>
<td>5,000</td>
</tr>
<tr>
<td>1902</td>
<td>Wyandra</td>
<td>341</td>
<td>46</td>
<td>23 0</td>
<td>7,000</td>
</tr>
<tr>
<td>1903</td>
<td>Kyarra &amp; Kanowna</td>
<td>416</td>
<td>52</td>
<td>26 2</td>
<td>11,900</td>
</tr>
</tbody>
</table>

VIIA. Bucknall Line—

<table>
<thead>
<tr>
<th>Year of First Visit</th>
<th>Name of Vessel</th>
<th>Length over all or betw'n perps (ft.)</th>
<th>Beam (ft. in.)</th>
<th>Depth (ft. in.)</th>
<th>Tonnage, Deadweight Capacity (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1892</td>
<td>Pondo &amp; 7 others</td>
<td>310 40 5</td>
<td>17 5</td>
<td>4250</td>
<td></td>
</tr>
<tr>
<td>1901</td>
<td>Bantu &amp; 8 others</td>
<td>360 47</td>
<td>28</td>
<td>6600</td>
<td></td>
</tr>
<tr>
<td>1907</td>
<td>Kabinga &amp; 6 others</td>
<td>400 52</td>
<td>27</td>
<td>8500</td>
<td></td>
</tr>
</tbody>
</table>

These steamers are not included in the diagram, as their draughts are not ascertained.
### VIII. Norddeutscher Lloyd—

<table>
<thead>
<tr>
<th>Year of First Visit</th>
<th>Name of Vessel</th>
<th>Length over all or between perps.</th>
<th>Beam</th>
<th>Load line draught</th>
<th>Tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1896</td>
<td>Friedrich der Grosse</td>
<td>525 ft.</td>
<td>60</td>
<td>28</td>
<td>20,000 10,695</td>
</tr>
<tr>
<td>1897</td>
<td>Bremen</td>
<td>571 ft.</td>
<td>60</td>
<td>28</td>
<td>22,000 11,570</td>
</tr>
<tr>
<td>1900</td>
<td>Grosser Kurfurst</td>
<td>582 ft.</td>
<td>62</td>
<td>28</td>
<td>22,500 13,452</td>
</tr>
</tbody>
</table>

### IX. Federal-Houlder-Shire Line—

<table>
<thead>
<tr>
<th>Year of First Visit</th>
<th>Name of Vessel</th>
<th>Length over all or between perps.</th>
<th>Beam</th>
<th>Load line draught</th>
<th>Tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1903</td>
<td>Suffolk</td>
<td>460 ft.</td>
<td>58</td>
<td>28</td>
<td>14,000</td>
</tr>
<tr>
<td>1904</td>
<td>Ayrshire</td>
<td>460 ft.</td>
<td>59</td>
<td>28</td>
<td>14,000</td>
</tr>
<tr>
<td>1904</td>
<td>Everton Grange</td>
<td>475 ft.</td>
<td>56</td>
<td>28</td>
<td>14,000</td>
</tr>
</tbody>
</table>

### X. McIlwraith, McEacharn Line—

<table>
<thead>
<tr>
<th>Year of First Visit</th>
<th>Name of Vessel</th>
<th>Length over all or between perps.</th>
<th>Beam</th>
<th>Load line draught</th>
<th>Tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1909</td>
<td>Karoola</td>
<td>420 ft.</td>
<td>56</td>
<td>25</td>
<td>11,500</td>
</tr>
</tbody>
</table>

### APPENDIX II.

In view of the fact that many vessels run to a time-table, and that others may have to wait on cargo, queries as to the despatch of the ships were addressed to the Companies. The answers of nine companies are as follow:

A The approximate average time the vessels remain in port at Melbourne

B Would quicker despatch in working cargo enable vessels’ stay at Melbourne to be shortened or not?

C Whether with quicker despatch would vessels be able to carry away more cargo?

**Answers**

A **Answers** varied from 18 hours to 48 hours to 3 days and 7 days.

B **Answers**—

- 7 Lines—Yes.
- 2 Lines—Quicker despatch a desideratum: It would reduce overtime.

C **Answers**—

- 5 Lines—No.
- 2 Lines—Yes.

**No.**

1. Peninsular and Oriental.
3. Union Steamship Co. of N.Z.
5. Compagnie Messageries Maritimes.
6. The Melbourne Steamship Co.
8. Norddeutscher Lloyd.
10. McIlwraith, McEacharn Line.
<table>
<thead>
<tr>
<th>VIII. No.</th>
<th>Year of First Visit</th>
<th>Na.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1896</td>
<td>Friedr.</td>
</tr>
<tr>
<td></td>
<td>1897</td>
<td>Breme</td>
</tr>
<tr>
<td></td>
<td>1900</td>
<td>Grosse</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1903</td>
<td>Suffoll</td>
</tr>
<tr>
<td></td>
<td>1904</td>
<td>Ayrsh</td>
</tr>
<tr>
<td></td>
<td>1904</td>
<td>Evert</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>X. McII</th>
<th>Year of First Visit</th>
<th>Na.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1909</td>
<td>Karoo</td>
</tr>
</tbody>
</table>

In view of that others of the ships of nine companies:

A The appearance of the vessel at:

B Would the vessel be:

C Whether the vessel is:

<table>
<thead>
<tr>
<th>No.</th>
<th>Car</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>P</td>
</tr>
<tr>
<td>2.</td>
<td>M</td>
</tr>
<tr>
<td>3.</td>
<td>U</td>
</tr>
<tr>
<td>4.</td>
<td>N</td>
</tr>
<tr>
<td>5.</td>
<td>C</td>
</tr>
<tr>
<td>6.</td>
<td>T</td>
</tr>
<tr>
<td>7.</td>
<td>T</td>
</tr>
<tr>
<td>8.</td>
<td>T</td>
</tr>
<tr>
<td>9.</td>
<td>T</td>
</tr>
<tr>
<td>10.</td>
<td>T</td>
</tr>
</tbody>
</table>
The President said the discussion of the paper was open. There was time available, but there was a difficulty; until the paper was printed and circulated justice could not be done to it. There were points that were discussible, but probably few would be inclined to attempt this until they had an opportunity of pondering over them.*

Mr. A. W. Craven said the subject was an exceedingly interesting one. Before dealing with such a paper he would like to look at it quietly. A few years back the Railway Commissioners proposed to spend £70,000 on a pier at Port Melbourne. Parliament referred it to the Railways Standing Committee, of which he was then chairman. A great number of matters had been opened up, one of which was the question as to whether piers were obsolete. Then the question of the straight cut between the city and the sea came along, and they began to look up various reports issued many years ago by the Railway Commission which existed in the early fifties. The reports showed the remarkable grip of the matter the men of those days had. The straight cut had received very considerable attention, and had been advised, not, however, completing the connection to the river at the city end. Sir John Coode strongly objected to a connection on account of the transference of scouring action to the "cut," and its diminution in the longer river course, thus leading to silting. They looked at it from the point of view that a great deal could be done without tapping the river at all. They had looked into the question of reinforced concrete piles as a substitute for timber or masonry.

If they were to expand the frozen meat export trade they must construct enough wharfrage to accommodate a number of White Star liners, with railways on each side of the wharves. The idea was to have the slaughtering done down near Coode Island. The cattle would be sent there from up country to be slaughtered, frozen, and sent away in the ships at once. To his mind, there was a great deal to be done in that direction. The late Mr. W. Thwaite's took a very keen interest in the question, and voluntarily elaborated an alternative design—a series of circular quays. His idea was that the ships would enter the cut and go out again straight ahead. If he remembered rightly, Parliament dissolved, and that ended the whole business. There was a great deal in Mr. Thwaite's contention. He thought the proper construction would be the straight cut, or some modification of it.

They obtained a lot of interesting evidence from Mr. Franklin, manager for Mort's Dock in Sydney. They learned that there was an absolute rock bottom at the Sydney Heads, and, although the harbour was very deep indeed, it would cost millions of money to cut down the entrance rock bar in order that a ship like the Mauretania might enter. Vessels entering Sydney Harbour were necessarily limited in draught, and for

*A portion of the President's remarks appear under "Proceedings."
very much less money the Melbourne harbour could be made to take larger ships than Sydney. At Port Melbourne pier there was a strip that could be cut to any depth by dredging. The Harbour Trust dredged round the piers 2 feet deeper than they were required to do by law.

A good deal of silt came in from the Yarra. They went down to witness some of the boats coming in, and noticed that the whole place in the vicinity of the propellers was like porridge almost, showing that it would be a serious matter if they had deeper boats.

The whole matter was one of extreme interest, and Mr. Davidson's report would open up the question very fully. It was hoped they would before long make Melbourne the leading port of Australia.

The matter was one that would require a great deal of discussion. Other engineers would have their opinions, they would have full investigation of the whole thing, and in the end something worthy of the place would be carried out. It was a good thing when members of the Institute came forward and gave papers such as that by Mr. Bell. It would do the Institute much good.

The President asked whether the Commission of which Mr. Craven had been chairman had accumulated any actual data in reference to the formations at the site of the straight cut.

Mr. Craven said he thought as far as they could make out everything was soft; they could get it shovelled out. There were contractors who, if they were given the excavated sand, would open the cut free of cost. The great Melbourne sewers crossed the line of the cut at a level higher than the depth required for large vessels. Mr. Thwaites had made a proposal that he would put in two large tubes, at a much greater depth, but, unfortunately, this work would mean a cost of £30,000 extra.

The President asked what was the depth of the crown of the sewer.

Mr. Craven said it was shallower than they got at the pier. The Harbour Trust had to maintain a depth of 28 feet, and kept it a little deeper. The upkeep of the piers was high. The old town pier was a very expensive thing to keep up. The general impression of the committee was that they must be considered temporary structures.

The President said a timber pier certainly seemed a temporary expedient for a port of Melbourne's magnitude. He understood 40 feet was considered the probable limit of water depth required at great ports. They must plan on some such lines and look at least thirty or forty years ahead.

Mr. C. P. Fairie Wright said he did not think Mr. Bell had mentioned what depth he recommended; 30 feet was mentioned, but that was the harbour approach. He would like to
have some idea of the length of the approach channels required. There was another point. Mr. Bell had drawn attention to the probable reduction in the coal import trade. By reports which had been issued lately it would seem there would be a considerable reduction. It was possible there might be a further reduction if they developed the brown coal near Melbourne at Altona and Laverton. At Geelong they were developing the freezing works for export, and were catering for the export trade. They would take a certain proportion of Melbourne's export trade. Then there was the movement to develop Portland. That would also affect Melbourne to a certain extent.

He was interested in what Mr. Craven said with reference to the Sydney harbour, and the limitation of its capability for deepening. It was a reflection on Melbourne that White Star liners could not load here to their full capacity. They had to load here to 28 feet, and then go elsewhere. At Hobart they could load to their full capacity. The paper was a most interesting one, but it was necessary to read it over carefully before one could do justice to it.

The President said, in compiling his data for a recent address, he had been not a little surprised to see how small Victorian coal consumption figures were in comparison with the figures of some other countries. The Powlett coalfield was estimated at 25,000,000 tons as a minimum. That was only about a month's supply for Great Britain, the last record available for that country showing that about 270 million tons of coal were raised annually. Of that about 90 million tons were exported. The sea transport took a considerable further portion. The annual British output would exhaust all the known New South Wales and Victorian coalfields in some four years.

It would be long before the Australian consumption approached that figure, but in dealing with the point of the coal import trade they might quite reasonably anticipate in twenty years a coal requirement of 2,000,000 tons. They might discover some new fields here, but unless they did in a couple of decades they might have to look somewhere else for coal. In that case reduced import facilities might not be possible.

Mr. Craven said the Parliamentary Committee had had to deal with the coal question. They made a trip to Newcastle in connection with the coal mining there, and found an enormous quantity of coal being shipped to America. He was astonished at the quantity that was being exported.

The President said it seemed regrettable that we should export something that was so vital to future local engineering development.

Mr. Ferguson thought that on the completion of the Panama Canal there would be no more coal imported by America from Australia.

Discussion adjourned.
DISCUSSION.

The President declared the discussion on "The Improvement of Melbourne Port," by Mr. Wm. Reid Bell, open.

A series of contemporary photographs showing the effects of the great flood of 1863 in reference to the river, the wharves, and the low-lying areas in the heart of the city, was exhibited by the President. He also exhibited early plans (1854) for a direct connection or "straight cut" between the city and the Bay, explaining that the proposition then made did not differ essentially from those propositions recently advocated.

The President said in regard to Mr. Bell's scheme, there was ample room for an extended and valuable discussion to be contributed to by those who could speak with authority on the various special phases involved. It was to be hoped that Mr. W. Davidson, who had just returned from a mission abroad in connection with the same subject, and whose report was in the hands of the Cabinet, would assist, also that Mr. Stuart Murray would let them have the benefit of his views.

Capt. W. R. Creswell, C.M.G. (Commonwealth Naval Commandant), Mr. J. Halliday, Engineer-in-Chief to the Harbour Trust), and Mr. Rudd (Secretary to the Harbour Trust), were present as visitors, and would, he hoped, discuss the matter fully from their several points of view.

To him it seemed that the vital question was not to merely devise a scheme providing accommodation sufficient for the Melbourne of to-day, or of some ten or fifteen years hence, but to originate a design capable of indefinite, harmonious expansion as the State progressed.

Melbourne was not the Port of a portion of Victoria only. If reference were made to the diagram (Plate II.) which accompanied the Presidential address of March, it would be seen that the natural freight catchment area of the Port extended far beyond Victoria's political boundaries, almost, in fact, to Cobar.

Inevitably that traffic must ultimately find its way to Port Phillip, and instead of being gauged by the possibilities of a population of a little more than a million, the needs of ten or fifteen millions would require to be met. Within a comparatively few years twice the present traffic might be looked for. It was in that light that Mr. Bell's and other schemes must be considered.

In regard to the graph of the tonnage increments of the vessels trading to this port, as given in the paper: The graph was, in the period subsequent to 1865, virtually a straight line curve. That would imply, for similar models of hull, that the draught increased as the cube root of the tonnage, or time. For example,
whilst the tonnage (or time) increased twofold the draught would be increased by 26 per cent. only.

He did not know whether Mr. Bell intended to deduce from the curve the conclusion that the probable increment curve would follow the same law in the future. Personally he did not think it would. The condition might be radically changed at any time. It would certainly be changed when the Panama Canal was opened. Then the limit would not be some 10,000 tons, but would be the capacity of local provision. If the provision sufficed, at no distant date the trade would require and attract far larger vessels. If the provision was inadequate, especially as to draught, the port would be closed to the class of vessels which would otherwise use it.

It would be seen that there was every possibility of a radical change in the increment rate, and no probability of the specific rate shown in the graph being maintained.

In regard to the material of construction, Mr. Bell recommended masonry and earth work. Other schemes proposed the use of initially cheaper timber construction. Upon the basis of interest charges versus upkeep the masonry work would be, apparently, the dearest bargain. He was not certain that it would be so in fact, if considered, not as an isolated matter, but in regard to the finance of the State as a whole. It must be remembered that the cost was paid for, ultimately, in work; that in the case of the permanent construction the work accomplished was accomplished for always, that in the case of the periodically renewed construction there was a permanent cumulative drain. The question might not be a simple one; it was largely connected with the source of derivation, from loans or otherwise, of the funds.

In regard to coal traffic, Mr. Bell thought that there might be a reduction in imports. In regard to requirements based upon past consumption that might be true, he doubted whether it would be true as regarded the greater manufacturing and transport requirements of the future.

In reference to the proposed railway communication: He thought that this was quite novel and ingenious, and was, in fact, the crux of the paper. It was calculated to entirely deflect a large portion of the port traffic from the city and its present storage facilities and to create a new freight distributing centre.

It could not be assumed that freight could, except in the case of homogeneous wool or grain or similar traffic, be deviated from the present centre of concentration at the Spencer street yards and run direct to the water. A large proportion, and a growing percentage, of the freight required to be cut out from trains which contained freight from many points to many points on East, North East, North, North West, and West lines. There must, therefore, be central points to which all traffic converged, and
where it could be allotted either to extended storage, manufacturing or shipping areas.

He did not know whether Mr. Bell had considered these matters, but without central concentrating yards, and warehouse areas which could utilise the concentration and act as distributing sub-centres, the scheme could not be fully effective as regarded all lines and all freight.

There was no great difficulty in bringing the present railway yards into almost immediate connection with the Port. Years ago he had the matter under consideration when plotting, from a locomotion point of view, the station yards east of Princes Bridge and an engine shed site south of the river at the junction of the Port Melbourne and St. Kilda lines. The problem then was to deal with the interchange of locomotives and rolling stock between the north and the south sides of the river without interfering with the general traffic through a congested station, or with river traffic. It was recognised that the solution of the problem also contained a solution of the larger problem of handling general traffic.

It was found that a bridge on a curve of about six chains radius close to the Queen's Bridge, connecting the limbs of the V formed by the Flinders-street viaduct lines and the Port Melbourne Railway, would enable the desired end to be attained. By reducing, by a few hundred feet, the distance up-stream to which vessels could ply, the curve could be considerably eased. As the time was not then opportune the matter was dropped, and had, apparently, been forgotten.

He understood that Mr. Fowler had independently prepared sketches showing how such curved connections could be employed.

He would ask Mr. Halliday, Engineer-in-Chief to the Harbour Trust, to let them have his views on the paper.

Mr. J. Halliday said he had not come for the purpose of criticising the scheme, but rather to learn something. As engineer to the Harbour Trust, he was acquainted with what had been accomplished by the Trust. He did not think the Trust was given credit by the public and the press for the work done by it. In all British communities public bodies were expected to stand on their own feet, and not to be a drag on the finances of the State. From that point of view, the Melbourne Harbour Trust had a very good record. For the past 33 years the Trust had paid its way and very much more. They gave the Government every year 20 per cent. of their revenue before they could touch one penny. The Government had received from them over £1,148,000, and they now paid regularly between £50,000 and £60,000 a year. Therefore, he thought, from the commercial point of view, the Trust need not fear criticism. He did not think there was another public body in Australia with such a record. In addition to the foregoing, the Secretary
some time ago told the Commissioners that they had granted free wharfage to the Government, not included in the figures quoted, to the extent of £16,000 a year. The Government did not pay wharfage on the coal that came to the Railway Department, nor on the rails, nor any Government stores.

From the engineering point of view, he thought they had an equally good record. The Trust was formed in 1877. In that year no mail steamers in the Bay could approach the railway pier, but had to lie out in the bay and be lightered. Now all the mail steamers and the great White Star liners could come to the Railway pier. The position of the port of Melbourne was fixed by the available depth at the Heads. The pilots were asked some time ago what was the limit of draught at the Heads. The question was asked originally of the Marine Board. The Board refused to answer, but referred the matter to the pilots. The pilots' answer was 29 feet, and then subject to weather conditions and the choice of the tide. He understood there was some 37 feet at the Heads at present, but owing to the heavy seas at the Rip, a vessel ought to have about 8 feet play; 29 feet was the greatest draught at which a vessel could go out of the Heads, and they could accommodate a vessel of that description at the Railway pier. The Trust, under the Act of Parliament, was only required to dredge round the Railway pier and the channels leading to it, to a depth of 26 feet. But the Trust, without asking any monetary contribution, had dredged those channels to 31 feet 6 inches, with a guarantee of 30 feet, at a cost of fully £100,000.

With reference to the river, the Trust was formed with the intention of bringing vessels closer to the city. One of the first things the Trust did was to determine to get the best expert advice available at that time. The Commissioners made inquiries in London, and found that Sir John Coode was considered the marine expert. He came out and spent some months here. He went thoroughly into the matter, and gave the Trust a full report and a magnificent set of plans. The Trust did what any public body would be wise in doing—accepted the report of the expert and adopted the scheme. For the past 30 years they had been carrying out that scheme, with some minor alterations in it. At the time the Trust took over the port, vessels could only come up the river drawing 12 feet of water. The river then was of a very sinuous nature, and only 140 feet in width. The Trust had dredged the river to 26 feet in depth, and widened it from 140 feet to 300 feet, and vessels of 10,000 tons burthen, like the "Pericles," came into their docks. They had vessels in the river last year drawing 26 feet 10 inches, and vessels of 8,000 and 10,000 tons came up the river quite easily. So that Sir John Coode's predictions had been amply fulfilled.

From the point of view of a low-water depth, Melbourne con-
trasted very favourably with many of the so-called first-class ports. For instance, the “Lusitania” was a magnificent steamer. Before they could get her down the Clyde they had to do twelve months’ dredging. They hired dredges from the Tilbury Docks. At that time there was only 23 feet at low water in the Clyde. That spoke well for Melbourne. He lately read that Lord Pirie, in speaking about the Thames and London, said it was not possible for vessels of over 24 feet in draught to get up to Gravesend at low water; so that there was a greater low-water depth in the Yarra than in the Clyde or the Thames. Coming to some of the big ports, they heard a great deal about Hamburg. But Hamburg had not a greater low-water depth than Melbourne. They were just the same, according to Sir William Matthews, who said the low-water depth was 26 feet, and it cost £700,000 to get that. At Antwerp they had only 16 feet at low water. All these ports had the advantage of Melbourne in having a large rise of tide.

Any additional depth that might be obtained here would have to be got by dredging. At present any vessel that could come in at the Heads could be accommodated at the pier.

The Trust, following Sir John Coode’s scheme, had spent something like seven millions of money. They had spent over two and a half millions in new works; over half a million in plant—dredges, hopper barges, dock, etc.; and nearly a million and a half in maintenance. He did not think they fully recognised here the full advantage of their port. They did not get the credit that he thought they ought to get. The scheme as given to the Trust by Sir John Coode had been followed up to the present time. He noticed that Mr. Bell in his paper said it had reached its limit. He could not agree with Mr. Bell. It had not reached its limit. They could still get, without any trouble, a depth of 30 feet in the river.

The sewerage tunnel at Spotswoode had always been looked upon as the crux of the question. The crown of the tunnel was 34 feet below the surface, and Mr. Oliver (Chief Engineer to the Metropolitan Board) had assured him there was no objection at all to their going over the tunnel to a depth of 30 feet.

About 94 per cent. of the imports that came to Melbourne were landed at the Melbourne wharves. There was only about 6 per cent. of the imports landed at the Port Melbourne Railway pier. He had reported on the matter to the Commissioners some three years ago. There was only about 116,000 tons per annum landed at Port Melbourne. The total imports amounted to something like two million tons. The mail steamers brought very little cargo—600 or 1,000 tons perhaps. The railway charge to Melbourne, which was paid by the shipping companies, was 3s. per ton. That seemed to him a somewhat high charge, but it included delivery from the ship’s slings into the railway truck, carriage to Melbourne, and 10 days’ free storage, and sorting.
If the cargo were taken up the river, they would have to pay stacking charges, which amounted to about 8d. per ton. From a purely monetary point of view, rather than spend a great deal of money for these few ships of the White Star line, it would pay to carry the cargo up for nothing, because it represented 5 per cent. on £280,000 expenditure.

They were very far from the limit of their work in the Yarra. They brought up vessels of 26 feet 10 inches last year, and they ought in the future, by ordinary dredging operations, to reach 28 feet or 29 feet. He thought the Trust, from the commercial and engineering points of view, had done remarkably well. At present they were widening the Coode Canal to double its former width. They could get a bottom width of 300 feet without any trouble. They were also widening the wharves from 30 feet to 88 feet; 30 feet was altogether too narrow for the great depth they had now. They had over eight miles of wharfage and two and a quarter miles of sheds, and were in the happy position of having very level ground, consequently they could cart away very heavy loads. Officers at the wharves had spoken to ships' captains who came up the river, and the latter acknowledged that at no port did they get better accommodation than at Melbourne.

Mr. R. O. Thompson asked if Mr. Halliday, in his comparative statement of the imports landed at Port Melbourne had taken into consideration the town pier. The Metropolitan Gas Co. alone received 60,000 tons a year, and that would make the percentage much heavier.

Mr. Halliday said he had not. He was dealing simply with the Railway pier.

The President said Mr. Halliday had dealt with imports. What was the case in regard to exports?

Mr. Halliday said he was not dealing with exports, because the Harbour Trust did not get anything from exports. Everything went away free of wharfage rates, no charge being made by the Trust on exports.

The President asked if exports were not also dealt with under the jurisdiction of the Harbour Trust.

Mr. Halliday said yes. They were handled from their wharves, but the Trust derived its revenue entirely from imports, rents, etc., and provided for all exports free of charge.

The President said when Panama was completed that, rather than the Heads, would decide the depth as far as Australia was concerned. The vessel that Panama would pass might desire to come here, but, apparently, it could not pass the Heads.

Mr. Halliday said he was not quite aware yet what depth
they were providing at Panama; but he thought it would be a very long time before the port of Melbourne or Sydney, or any of our ports, would take vessels drawing up to 36 feet. The first consideration was improvement at the Heads.

The President said the depth of the Panama canal was about 40 feet.

Mr. Halliday said personally he was at one with Mr. Bell, in that he thought the larger ships would have to be dealt with at Port Melbourne. He had told the Commissioners that three years ago. Sir William Matthews was of the same opinion. The railway line on Mr. Bell’s plan would be dealt with by some of the railway engineers, but as far as he could see it would be a very expensive railway. There were 190 chains of tunnel to begin with, at a depth under the Yarra of probably 60 feet below low water. They all knew that the ground down there was very bad. The sewerage tunnel was driven through it, and they would remember the difficulties and accidents. It would have to be done with shields under compressed air. Then there was another tunnel of 52 chains near Toorak. That railway tunnel under the Yarra would be a most expensive matter. Tunnels of half the length had been put under the Thames in recent years, the Blackwall tunnel costing £871,000, and the Rotherhithe £1,080,000. It was a matter that the railway engineers would deal with.

The President said he was sure they were all pleased to have heard Mr. Halliday’s views. In regard to the tunnel figures just given by Mr. Halliday: on that basis the scheme would need to show a net annual saving of £80,000 to justify its adoption.

One part of Mr. Bell’s scheme was that the present site of the Williamstown pier and docks should be devoted to naval requirements, such as piers, docks, graving docks, manufacturing yards, slips, and so forth; everything, in fact, connected with our naval needs. In regard to that, and in regard to the available depth at the Heads in relation to the naval point of view, he was sure members would be glad to hear Captain Creswell’s (Commonwealth Naval Commandant) views.

Captain W. R. Creswell said he was glad of the opportunity of being present, though he had come to listen and learn, rather than take any part in the discussion. His expectations in this had been amply fulfilled by what he had heard from Mr. Halliday, the Harbour Trust Engineer. He would confine his remarks to the naval proposals in the paper.

As to the Yarra bank site mentioned, its sole recommendation had been as a suitable site for building slips for destroyers— it had no other. To-day our naval views had considerably expanded. The London conference which he had attended had given them definite shape. One point in the scheme they were
considering he appreciated was its long view ahead. This was evident in the position allotted to naval works. Naturally these were considerable, but they must be so in a land without any military frontier and that must depend for its existence on naval power. He, however, questioned the wisdom of including in one port the main naval base and a great commercial centre. Their ways differed and he feared they would find themselves uncomfortable bedfellows. The naval centres in England were naval centres only, and only in a very minor way were they commercial ports. The railway engineers would presumably discuss the land arrangements in reference to the suggested railway.

The main scheme of quays he hailed as an advance upon the custom that seemed to have such a hold everywhere for digging channels far inland instead of boldly placing all the facilities for shipping and working cargoes and transport conveniences at the natural water side.

The President said that the "bottle neck" was, apparently, the Heads. What would ensue if a vessel crippled in, say, an action outside the Heads sought shelter with some of her compartments flooded?

Captain Creswell said that, given 37 feet as the deepest water along the recognised channel (as they had heard stated authoritatively that night,) then no damaged Dreadnought with one or two compartments filled, and drawing far more than her normal draught, could hope to enter the "Rip" in heavy weather. She would either make Western Port or remain outside. [Captain Creswell has since communicated that though 37 feet is the deepest on the recognised channel along the "leads," there is a deeper channel possible by day, in which a vessel drawing 40 feet and over could enter safely.] One enquiry he wished to make referred to Mr. Bell's diagram of the curve of tonnage. It was said to be practically a straight-line curve. From what was heard of the great increase in individual tonnage, was not the curve one of a gradually increasing upward tendency? If this tonnage continued to increase with accelerated rate of increase, then since they heard of a rocky bar just inside Sydney heads and other places determining their limit, so far as accommodating big deep draught ships was concerned, did it not suggest the idea of one great central port for Australia, with a deep and sheltered anchorage, whence feeding lines of steamers would distribute the trade round the Commonwealth? Perhaps they might hear from others present something on that possibility, and its effect on harbour engineering.

The President said if they would refer to the paper they would see the line was almost straight since 1865; the abrupt increase was at that time. The individual tonnage increase shown did not, however, indicate the proportional advance for the world, but for this port only.
He invited Mr. Rudd, Secretary to the Harbour Trust, to give his views upon the general question.

Mr. R. P. Rudd said he was not an engineer, but had to see where the money was to come from to carry out these works. When he arrived here some years ago he had noticed a great many permanent looking works of all sorts, including a huge stone bridge at Princes Bridge. These things had all disappeared. Would it not therefore be wiser for them, instead of tying the hands of their children by proceeding with concrete works on docks, to still stick to the timber? Then they could alter such works eight or ten years hence, and they would have the money. Whereas if they laid out the money on concrete works they might want to alter them just the same.

Ideas were so rapidly changing here that it almost seemed a mistake from an economic point of view to sink a lot of money in permanent looking solid masonry work down at Port Melbourne, instead of sticking to the timber jetties. They should not tie their people ahead too far by keeping much ahead of what was required at the time.

As to the defects the merchants had to guard against: it was not that the Trust had not the accommodation; but that the merchants themselves had built their warehouses at a time when they were getting 100 tons on a ship, and now they got 600 tons, and they could not take in goods fast enough into their warehouses from the vehicles, and consequently the things got jammed and the wharves congested. But other ports he had seen had nothing like the opportunity of getting away with goods from the wharves that Melbourne had. When he was in Scotland he went down to see the goods taken away at Glasgow, and noticed they were jammed in getting the goods away owing to the narrowness of the roadway. That difficulty had been avoided in Melbourne, and the goods could be taken away very quickly if the warehouses could take them in.

As to the strictly engineering questions, he knew nothing about engineering, so could not deal with them.

The President said he thought some discussion would arise out of what Mr. Rudd had said. Some of their electrical members were present, and they would probably desire to show how by modern appliances the capacity of a port could be increased by increasing the speed of handling.

The President desired Mr. R. O. Thompson to take the chair during his absence at the Building Regulations Conference.

Mr. A. F. Smith pointed out that Mr. Halliday had said that the sewerage tunnel at Spotswood governed the depth of the river; but they could get more than the 29 feet that Mr. Halliday said was the limiting depth at the Heads. They could accommodate 31 feet over the tunnel at Spotswood.
Mr. R. O. Thompson said he had laid two gas mains across the canal, and asked what effect these would have.

Mr. Halliday said these would soon have to be altered in position.

Mr. Edmond Clarke read the following notes:—

Within the last few years several reports have been made and schemes brought forward for the improvement of the Port of Melbourne. These seem to divide themselves into two classes: (1) Large and complete schemes for an ideal port, such as proposed by Mr. Ferguson in his report, and also the scheme suggested by Mr. W. Reid Bell in his paper, which involved a great expenditure running into millions of pounds; and (2) reports such as those of the Engineer and the Harbour Master of the Melbourne Harbour Trust, and, latest of all, that by Sir William Matthews and Mr. Davidson, which were meant to fulfil the full requirements of the port at present and in the near future, involving far less expenditure, and which should at the same time work in as part of some greater scheme which may be required in the more distant future.

Consideration of the probable draught of vessels which might hereafter visit Melbourne led to the conclusion that with the deepening of the Suez Canal, mail steamers drawing 31 or 32 feet might have to be catered for, also cargo vessels coming by the deep sea route of still greater draught. In the discussion started at the last meeting, the depth at Sydney Heads was mentioned as a ruling factor in arriving at the draught of vessels coming into Australian waters. In conjunction with that factor, it must be remembered that vessels from Europe, travelling on to Sydney from here, and vice versa, were not as fully loaded as they might be when entering Melbourne and leaving homeward bound, and it would always be of advantage for the port of Melbourne to have a few feet greater depth than existed at Sydney Heads. All surrounding circumstances seemed to combine in fixing a limit to the navigation of the Yarra at about 30 feet depth of water. If that were accepted, the largest steamers must be accommodated at Port Melbourne.

In dealing with the traffic at Port Melbourne, Sir W. Matthews mentioned the weak point when he stated “that the principle of dock construction at Port Melbourne, involving railway carriage of all goods landed there, is not sound, so long as it is feasible for vessels to enter a dock on the Yarra at Melbourne to discharge or take in cargo close to the city.” This short railway journey and the extra handling of goods entailed thereby, coupled with the apparent heavy charges made by the Railway Department, appeared to be a handicap to the landing of freight at Port Melbourne, and to deprive the trading community of any economy derivable by transporting goods in the largest class of cargo carriers.

With the quays and wharves suggested in Mr. Bell’s paper,
merchants had the opportunity of taking delivery of their goods at the ship's side and thence by road straight to their destination, whereas in Sir W. Matthews's proposal of a new pier, the Railway Department still maintained its monopoly and the right to enforce any charge it might think proper, the merchant still having to cart his goods from the Railway Department to his warehouse. Mr. Bell's suggestion as to connecting the railway lines from east and west with Port Melbourne, including a tunnel under the Yarra, was a bold attempt to solve the difficulty which some day must be faced, and when that time came no intermittent bridge service would be as acceptable as a tunnel in giving free access to the south side of the Yarra.

The question of cost must naturally in the end be the ruling one, and before the estimated annual amount available for interest, sinking fund, and maintenance could be arrived at, and from which the amount of capital which might be legitimately expended on improvements could be obtained, certain inquiries regarding administration appear necessary.

Mr. Percy Rosling said when the "Pericles" came out first she was not allowed to go into Victoria Dock, because there was not sufficient rise and fall of the tide to scour the dock for sanitary purposes, and the large number of people on a passenger boat had to be catered for while they were in the river. He would like to know if there had been any trouble already as to the water becoming stagnant in the docks. Had an opinion been formed as to what it meant to get a better depth over the Rip? That seemed to be the crux of the question. It settled Melbourne as a deep-water port as it would be considered forty years hence.

Mr. Halliday said it had always been the desire of the Trust as far as possible to get passenger vessels up the river. They had no trouble on sanitary questions. They had endeavoured heretofore to keep large passenger steamers out of the Victoria Dock. It was not a dock exactly. It was a tidal basin. They had had no trouble yet. Most of the passengers landed. But the Pericles was not a deep-draughted vessel. The mail steamers could come up to Melbourne if they wanted to. The deepest vessels they had here were half-a-dozen of the White Star liners.

Mr. Rosling said he was not quite satisfied as to the sanitary arrangements. Did Mr. Halliday think the water in the dock could be kept sweet?

Mr. Halliday said mussels grew on the piles all around the dock, and there was an abundance of fish, which went to show that the water must be sweet.

Mr. T. W. Fowler said he felt rather at a disadvantage in speaking to this subject, having had recently to concentrate his attention on other matters, and he had not the advantage of
being present at the last meeting to hear the paper read, consequently it was not until quite recently he was fully seized of the views expressed.

The discussion was on the improvement of the Port of Melbourne. First of all, he wished to advance the view—which was not original—that Melbourne was not a seaport at all. It was an inland town. It was very fortunate for Melbourne that it was not a seaport, but an inland town connected with the sea by a magnificent canal similar to what Manchester had constructed for herself at an enormous expense. Contrast the position of Melbourne with that of a number of other ports, and see what a splendid position Melbourne had. Sydney was on the extreme eastern boundary of New South Wales, consequently the territory which she supplied was all to the westward. Melbourne, on the other hand, was nearly in the heart of Victoria. That was, if they took what might be called the outer southern boundary of Victoria, a line from Cape Otway across to Wilson’s Promontory, how much was Melbourne to the north of that line? About 80 miles. Then they could take the nearer boundary—the Heads—they were between thirty and forty miles north of that. Thus Melbourne was situated so that the country which it had to supply radiated over about 270 deg. Melbourne was an inland town, having the advantage of water communication.

Then, again, they had the advantage of other Australian ports—and Sydney more especially—in that the traffic from the inland country passed over the main Dividing Range at much lower altitudes than elsewhere. For instance, at altitudes varying from 1,600 to 1,800 or 1,900 feet they were able to cross the main Dividing Range of Victoria, and tap the northern plains. For a similar purpose in New South Wales, saddles at altitudes in the neighbourhood of 3,000 feet had to be crossed. Up to the present Victoria had had a great disadvantage in not having a plentiful supply of coal of her own; but it might be hoped that recent developments would put Melbourne in a much more favourable position in that respect. Undoubtedly Melbourne was remarkably well situated in being located so near to the territory it had to supply.

Members would be shown an Admiralty chart of Sydney Harbour, corrected up to January, 1905. [The chart was passed round for inspection.] It was one he obtained a few years ago when he was inquiring into some of these questions, and it showed the available depth at the entrance of the Sydney Harbour. Between the heads the depth was given as 13 to 16 fathoms. Just inside it shelved down to about 10 fathoms, and turning up towards Port Jackson, the Sow and Pigs (a rocky ledge, which had practically no water at all) was approached. On the western side of that obstruction a shallow channel existed, having only 3½ fathoms over it, while the eastern channel was the deep one. The shal-
lowest sounding marked there was 5½ fathoms, whilst the distance between the 5 fathom lines bounding this eastern channel was about 100 yards. That would seem to imply that all the heavy shipping in Sydney must pass through a channel in which the minimum depth at low water was about 31 feet 6 inches, and that the width of that channel did not exceed 300 feet at its narrowest point. The rise was about 4 feet at neap tides, and 5½ at spring tides, so that apparently the facilities for deep-draught vessels were not much greater than in Melbourne. Smooth water would always exist in the channel.

The present Melbourne harbour works were largely based on the designs of Sir John Coode. He could well remember the condition of the river before Sir John Coode came out here, and he was sure that the improvements which had been effected as the result of his scheme were something magnificent. Those who could remember the time when all the intercolonial boats, with few exceptions, lay at the Sandridge Railway Pier (to use the then name), and only vessels of small size came up the Yarra, and compared it with what they had at the present time, must acknowledge the splendid work that had been done. Those vessels were not a quarter the size of the Interstate boats that now lay alongside our wharves.

He would like to refer to Sir John Coode's report. He was called upon to advise first of all as to the possibility of bringing the shipping up to Melbourne. It was recognised it would be a great advantage if this could be done. Also he was asked to advise as to the relative advantages of what were called the straight cut and the natural river. After very careful consideration, he reported against the straight cut and in favour of the improvement of the river. Sir John stated very clearly that the straight cut could be constructed more economically than the improvement of the river, but he considered that the latter was the preferable course to adopt.

His reasons for making this recommendation were four—First, that since, if the straight cut were made, the distance would be very much less than if the natural river were rectified, consequently in times of flood the velocity in the straight cut would become so great that it would be dangerous to shipping. The fall, which in the one case would be spread over a distance of six or seven miles, would in the other case be concentrated in about half the distance, and consequently the water would run at much greater velocity, and it would be a menace to navigation.

The second reason was the existence of natural drift along the foreshore from east to west, which would tend to silt up to the eastward of any piers that might be constructed in Hobson's Bay for the purpose of keeping the entrance to the straight cut open. He thought this drift would give trouble in keeping the-
entrance open, and it would cause a very objectionable silting in the vicinity of the Port Melbourne town and railway piers.

In the third place he considered that the main natural agency in keeping the river open was the scour of the upland waters, and hence it was very desirable to concentrate the whole of the upland waters into one channel, so as to utilise their scour action to the utmost.

The fourth reason was that it was very desirable to combine the whole tidal scour effect (limited though it was) that would be obtained from the two rivers. It always seemed to him (the speaker) that in this matter, perhaps Sir John Coode overestimated the value of the Saltwater, inasmuch as a fuller local knowledge showed that the Saltwater was not nearly so good a catchment area as the Yarra as regards discharge and scouring effect. He was not able to follow Sir John Coode as to the dangerous velocity of the straight cut. It seemed to him that was rather a fallacy. If they had a channel of a given cross section carrying a given quantity of water that channel would be filled to a certain level, and find its own hydraulic grade according to the volume of water coming down. Assuming the two channels were made of precisely the same cross section, the velocity in the straight cut would not be greater than in the main river channel, but the construction of the straight cut would have caused a great lowering of the flood level in Melbourne.

But the other point—the possibility of silting—seemed to him to be a very important one. He gathered that there was a regular drift in Hobson’s Bay from east to west. The appearance at the mouth of the river seemed to indicate that, and no doubt Sir John Coode had good reason for saying he did not desire to move the river entrance from its present position. How far that drift and consequent silting might be due to the river discharging at the extreme western end of Hobson’s Bay was a matter which one could not very readily determine. He would like to test it by experiments with models, and could quite conceive that the river which, discharging into the bay, carried the bay waters along with it, caused a drift in the south-east direction, and consequently that the water must be dragged along the foreshore of Hobson’s Bay to replace that which was carried out, and that the water being dragged along the foreshore would drag the sand with it. Thus, if they changed the conditions they might not have the same drift.

One point not noticed in connection with any of the propositions for constructing the straight cut was that if the Saltwater River was discharging in its present position, and the Yarra by the straight cut, two rivers would be discharging very close to each other, at a distance of perhaps a mile apart, and a very confused set of eddies would be formed in the vicinity. It seemed to him that the straight cut should be combined with
a deviation of the Saltwater River into such straight cut, and if that were added to the cost of the straight cut the estimated saving by constructing the latter, as compared with the rectification of the river might be wiped out. They should have one entrance only.

It seemed to him that Sir John Coode’s scheme had been a magnificent success. And to attempt now to open a straight cut as had been advocated in recent years, and more especially to do it, and keep the Yarra open as well, would result in a disastrous failure. For that would mean that the scouring action that was now concentrated into one stream would spread over two. Much more sedimentation would take place, and the dredging bill would be enormously increased. That was a point of which Sir William Matthews made much in his present report. He was pleased to find that Sir William Matthews had confirmed the views he had expressed to members of the Bent Government on this subject.

Mr. Bell had referred to the value of expenditure of £2,000,000 on the Coode scheme as being practically exhausted. He must say he could not agree with him at all. The magnificent set of wharfage and splendid river channel leading up to the city was a complete refutation of that statement. He would like specially to refer to one point. Sir John Coode proposed a channel very much smaller than that which was now found to be necessary. Was Sir John Coode to be blamed for that? He thought not. Sir John proposed a depth which was suitable to the then condition of the river, and in his report he very clearly indicated that if they made a channel wider or deeper than what the river would maintain they would have to maintain that additional width and depth by dredging. Hence, if they did more than what was really required the maintenance dredging would be increased necessarily. The river itself would not maintain itself at the depth he proposed without constant dredging. The deeper and wider it was made, although that deepening and widening might become necessary, the greater the dredging bill which had to be met each year.

Turning to the railway scheme, there were a number of points which required very careful consideration. The connection across the Yarra at Spotswood suggested by Mr. Bell meant a very deep and expensive tunnel. Was it necessary, and what did it provide for? It provided for the traffic from the west and the north-west, but not the traffic from the north-east. Every railway man would agree with him that the north-eastern traffic was a very large factor, and could not be ignored. And then it was proposed to go to a large expense to bring in the Gippsland traffic. As far as he could see, that traffic would not for many years develop to justify an expensive scheme such as Mr. Bell had proposed. If direct connection from Gippsland to Port Melbourne became necessary he would endeavour to make it
DISCUSSION—THE IMPROVEMENT OF MELBOURNE PORT.

from the Port Melbourne line to the St. Kilda line, and from thence to Oakleigh. He would like, however, to point out that there was a possibility of making an effective connection at much less expense and without involving any serious diminution of the wharfage in the heart of the city, such as would be the case with a bridge below Spencer-street, as suggested in Mr. Ferguson’s report. He considered the wharfage above Spencer-street was very valuable to the city, and any scheme that would spoil that would be greatly to be deplored. He had indicated on the accompanying plan the positions which curves of radii from 6 chains to 15 chains would take, if fitted to connect the Flinders-street viaduct and the Port Melbourne Railway. He thought the 6-chain curve under the circumstances would be quite sufficient for the purpose. The traffic would be entirely goods traffic, and it necessarily would go at a low rate of speed, and they had any amount of instances where curves of such radius were successfully worked under these conditions.

Mr. R. O. THOMPSON said they had had a very interesting discussion. But the subject was not nearly exhausted. He would, therefore, be glad of a motion for postponement.

Mr. T. W. FOWLER moved and Mr. Wm. ISON seconded that the discussion be postponed to next meeting. Carried.

At 10.25 the meeting closed.
Discussion—Improvement of Melbourne Port.

The President said that Mr. Wm. Reid Bell’s paper on “The Improvement of Melbourne Port” was open for further discussion.

The President exhibited a series of papers presented to Parliament in 1860. In these papers, and in reports for 1854, a large number of propositions for the improvement of the shipping accommodation of the port were delineated. Many more recent schemes in relation to “straight cuts” or direct canal connection with the sea, and other matters, follow the earlier plans.

Mr. T. W. Fowler forwarded the following remarks in continuation of his previous contribution.

I have but little further to add to the discussion, but to state that in my opinion the policy of the past in bringing the shipping as close as possible to the city has been sound. The discussion shows that an ultimate depth of 31 feet may be obtained in the river, and this will be sufficient to provide for the greater proportion of the shipping which will come to Melbourne. Provision must be made at Port Melbourne for vessels whose draught may be such as to require a greater depth of water than this, and also for those vessels whose stay in port must be so short that the additional time required for going up the river becomes a matter to be avoided, at even considerable cost. As pointed out by Mr. Edmond Clarke, the rail journey from Port Melbourne and the railway charges in connection therewith must put vessels berthing there at a disadvantage in the matter of freight as compared with those going up the river.

I cannot see that the Victoria Dock is placed in such an unfavourable position with reference to the city as Mr. Bell states. Bourke-street, if produced westerly 30 chains from Spencer-street, would strike the junction of the roads on the southern and eastern sides of the dock, whilst the distance from this point to the Spencer and Bourke-streets corner, via Flinders-street extension, is about 75 chains. Hence the dock is fairly close to all warehouses in the west end of the city and between Bourke-street and the river. In the Melbourne of the future, however, this part of the city may be required for other purposes, and the warehouse area be relegated to the portion of the city north...
of Lonsdale-street. In such case the access would be via Dudley-street, and it may be noted that the distance this way from the north corner of the Victoria Dock to the intersection of Spencer and Latrobe-streets is about 54 chains. Should more direct access become necessary, it would be possible to carry a viaduct across the Spencer-street Station in line of Lonsdale or Latrobe-street, but this is not likely to become necessary. The large area available for dock extensions to the north-west of the Victoria Dock should be noted in considering this problem.

Mr. A. McCowan said that he had not thought of speaking to the matter under discussion, before that morning, but on looking through what had been said, he thought the discussion would not be complete unless reference were made to a felt want in the Port, namely, suitable accommodation for vessels laid up for overhaul and repairs.

Ships had not only to load and discharge cargoes at the wharves. Repairs due to wear and tear or to damage from other causes had also to be effected from time to time; it was therefore necessary that suitable berthing should be provided on the south side of the river in the vicinity of the repairing shops. Without casting any reflection on the Harbour Trust or its officers, who were most obliging in providing berthing for which no charge was made—for it must be understood that no berthing charge was made by the Harbour Trust for vessels undergoing repairs—still there was no wharf nor basin near the repairing shops where a ship might lie up undisturbed.

The frequent moving of vessels during the progress of repairs caused considerable loss of time to men engaged on the work, amounting occasionally to as much as 10 per cent. additional on the labour cost. This fact had led some of our Melbourne shipowners to consider the advisability of sending their ships to Sydney, where better facilities in this respect existed. At that port, Mort's Dock and Engineering Company—the principal repairing establishment—had complete control of all vessels laid up in the bay or basin alongside their works. This matter was worth considering from a public standpoint, as no one wished to see the legitimate trade of the port transferred to Sydney, and therefore local shipowners should be given every facility for carrying out repairs in close proximity to the workshops here.

Mr. C. P. Farie Wright said in Captain Creswell's remarks at the previous meeting reference was made to a depth of 40ft. at the Heads. Did that mean that vessels drawing 40ft. could enter, or was it the depth of the channel there?

The President said he had been informed privately that there were channels through which vessels drawing more than 40ft. might pass. But they were not recognised channels. They were somewhat narrow and would require careful navigation.
Mr. Wright said a question he would like explained was what the deepening of the approach to the Heads would involve. He did not know whether they had information bearing on that—whether the present depth was limited by a series of rock pin- nacles or by a flat shelf of rock. Mr. Ferguson in his report said the resident engineer at the Heads at that time could not give him an idea as to what the deepening would involve. It was an important point in providing for deep draught vessels. Could it be done at a practicable cost?

Another point was the suggestion that instead of piers they should have quays, with a large depth of ground on which ware- houses could be built and the goods shipped or discharged direct from the warehouse to the ship. Mr. Rudd had mentioned that half the complaints that arose were due to fault on the part of the warehouses, who were not able to receive the cargo quickly enough. Further information might be given as to whether there would be an advantage in having the warehouses close to the quays.

In connection with Melbourne, it seemed they had great natural advantages in that way, having a large amount of practically vacant land adjacent to the wharves, that the other capitals did not possess. Take Hobart for instance. There they had a depth of from 70 to 90 feet all the way up the harbour, and 40 ft. at the wharves, but they had little or no ground for warehouses. Going back a few hundred yards they got into a hill of solid bluestone.

The President said they had Mr. Halliday present. Could he give them any information on that point or any additional information on the matters already touched upon?

Mr. Halliday said with reference to the work at the Heads he thought the Engineer for Ports and Harbours, or the Port Surveyor, would be able to say what it was going to cost. A great many of the pinnacles had been removed, and as they got deeper it would not be a question of pinnacles. It would be somewhat expensive. As to the warehouse question, business men seemed to prefer them up about Flinders street. He did not know whether they would care for a warehouse down at Port Melbourne.

Mr. J. Borrie said he gathered that Mr. Bell wanted all roads under the sheds, and that he desired that all goods should be taken up to the second floor, and that the author thought this would give greater facilities than at present, enabling increased quantities of goods to be handled at each berth. He thought the effect would be the reverse. At present the goods were taken away from the wharves, where there was good accommodation for a number of vehicles to load at the same time. If the goods were handled through lifts it would cripple the facilities for removal.
There was no doubt the Harbour Trust had an excellent method of handling goods down at the wharves by means of the four-wheel trucks they had in use. He had brought this matter under his principals’ notice, and got them to adopt it. On the second day of use they were quite prepared to double the equipment. He did not think it would be a difficult matter to arrange a system of handling the goods from the ships’ slings. They could handle them on the level more expeditiously, and a number of vehicles could be loaded at the same time.

Mr. Rudd had touched on a very important matter in connection with the taking away of the goods from the wharves. He had shown that warehouses and importers who formerly handled 100 tons per ship now received up to 600 tons, and were no longer able to handle it expeditiously. Merchants would have to consider the question of getting out of the heart of the city, and building in a place where they could handle their goods quickly. At present there was too much handling and re-handling of goods before they were stored in the warehouse. Motor transit was coming, and goods must be handled much more expeditiously than now.

In Mr. Bell’s scheme storage warehouses at Port Melbourne were advocated. Distributors did not want them down there. It was too far away. He thought they wanted their warehouses in such places that they could be easily reached not only from the piers and wharves, but from the various factories in and throughout the city. From what he had seen he thought handling the goods from the ships’ slings into the trucks and taking them up to Spencer street was the most economical way it could be done. If the goods were taken from the ships’ slings and put in the sheds on the piers that had been recommended, then examined and put in railway trucks, and then taken away, there would be considerable extra handling. He thought it was a very important question to consider; they wanted to save that cost. He did not see the advantage in inward or outward handling by having sheds on the Port Melbourne pier.

Mr. J. T. Noble Anderson said one point seemed to be, not lost sight of, but to have received less attention than it deserved. That was that in proportion to the greatness of the interests at stake, and keeping in view the splendid harbour which Melbourne had naturally got, the provision that had been made so far by the Government for the country was entirely disproportionate and inadequate. Comparing it with other ports in older parts of the world, one was astonished that so little money had been expended in Melbourne and so much had been done. He well remembered more than twenty years ago when he first landed here, the boat, drawing 26ft. of water, was stuck for some four or five hours before she could land her passengers at Williamstown.

Sir John Coode’s works were then just being completed. Im-
provements which he had seen from year to year ever since had been progressive. Compared with harbour works elsewhere they had been comparatively cheap. If Mr. William Ferguson had seen, as most of those present had seen, the almost complete fulfilment of all that Sir John Coode had predicted, he ventured to say he would not have lightly thrown aside Sir John Coode's works. It was not a history of frequent changes of design—of frequent reversals of what the designers expected. Here they had nothing of that sort. The work as laid down had been a success, and a remarkable success.

They had one of the cheapest harbours for its size in the world. It was not unusual in large harbours that expenditure should reach not only £5,000,000 or £10,000,000, but £30,000,000. There were large ports, such as New York, Liverpool, London and Antwerp, that had cost considerably more than £30,000,000. If he remembered correctly the recent proposals for the extension of the Liverpool dock passed the £40,000,000 mark. Compared with the cost of harbours that had to operate the same amount of tonnage, the cost of Melbourne was very small. The whole expenditure was somewhat paltry. Even Mr. Ferguson's report had not risen to the occasion. Compared with what had been done in other countries—what had been done in Melbourne harbour compared with New York—we were very much behind. They did not realise the magnitude of the question. The Government of Victoria might reasonably spend in the next ten years £15,000,000.

As to the question of handling goods from the ships, he thought they would have to approach that very tentatively. The whole problem of warehousing was one which would work itself out as the times required. He had listened to what the previous speaker had said, and thought that when they proposed to make any alteration they certainly ought to harness electricity, and possibly it would be found in many places they would have two and perhaps three-decker wharves. These things could only be built up as development demanded. He had come to the meeting not intending to speak to the subject at all, but he felt from a glance at the paper that the immensity of this question to Southern Australia had not been sufficiently emphasised.

The President said the larger relations of the Port to the continent had not been overlooked by any means. At the last meeting he had contributed some remarks on that phase himself (p. 2, par. 5 et. seq. of the May issue). Then, in the last Presidential address he had drawn attention to the fact that the freight catchment of Port Phillip far exceeded the limits of Victoria. The natural point at which traffic would, with equal economy, measured by length of haulage, diverge towards Adelaide, Melbourne, or Sydney, was a very few miles from Cobar—far beyond the Victorian frontier, and well into N.S. Wales. And it seemed inevitable, in time—when the railways were
unified in gauge and purpose, and when there was less provincialism—that the export freight would follow its natural lines—the least distance to a port.

With regard to the limitation of tonnage capacity, it had already been pointed out that the Panama Canal, rather than Port Phillip Heads, would be the gateway to Melbourne. Through that cut the great traffic of the world would pass and to accommodate it there was being provided a depth of 41 ft. Possibly vessels not much less than that would pass the Canal from Atlantic America and from Europe, to the Pacific, and anyone of those vessels should be able to enter here.

It was a question of passing the Heads—and making the Heads passable—and berthing at Port Melbourne.

In relation to the relative merits of seaboard accommodation, and accommodation carried inland by canal or river: All freight was not railed to or from a distant part. A large portion of it was for local distribution or local storage, or manufacture prior to distribution. Hence it was a subject for road, not rail, traction. The point was that if accommodation were provided on the seaboard the average haul by road, in relation to a given area, would be twice as great as it would be were the freight first brought, at practically no cost, into the heart of the district by canal or river. That in a year would amount to a very heavy expenditure—it might mean all the difference between profit and loss.

Mr. J. S. DETHRIDGE said he had listened with interest to Mr. Rudd when he spoke to the effect that there were some structures which they should not make monumental. There was a good deal in that point of view. At the same time timber was advocated, he thought some regard should be paid to the fire risk. He thought it was only about eleven years since there was one case of a very serious wharf fire in New York, where not only the wharves and merchandise, but many vessels, were burnt. Possibly as a compromise between masonry structures and the cheaper timber, reinforced concrete would be the material to use. It might be possible to get something that would not be too permanent to be altered and at the same time would have greater durability than timber alone.

Further discussion adjourned.
The improvement of Melbourne Port.

The discussion on Mr. William Reid Bell’s paper, on “The Improvement of Melbourne Port,” was resumed.

Mr. Stuart Murray wrote as follows:

The principal question dealt with in the paper is whether the deep water port should be at the city, on the Yarra, or on the sea at Hobson’s Bay. Another important issue referred to in the debate is whether a direct cut should be made from the existing swinging basin to the sea at Port Melbourne, and whether, if made, it should be a flood escape only, or should be suitable also for navigation.

As to the first of these, the balance of advantage, save in one respect not alluded to by any of the speakers, seems clearly to lie with the sea port proposal. The contention is fully justified that the silting question need not be considered; dredging is, and must continue to be, the mainstay of the Port’s existence. As to the relative shortness of approach from deep water, when cargo is on board a ship for a voyage half round the world, a few miles more or less to the port of discharge is of no consequence. It is the handling, not the length of carriage that then costs the money. That the shelter at Port Melbourne, or for the matter of that at Williamstown, is sufficient for large sea-going vessels even when there is danger to smaller craft, is beyond question.

The point above-mentioned as not having been alluded to in the discussion is the probable effect on the value of city property of creating a permanent deep water harbour at the Port, and meeting the ever-growing tendency to increase the size of ships by increasing the depth there, rather than by deepening the river channel that constitutes the approach to the city. This element of the case, however, affects chiefly owners of property in Flinders Street and elsewhere in the vicinity of the river wharves. From the broad public standpoint it is of merely secondary concern. In the interest of the State as a whole, a deep-water port on the sea shore has unrivalled advantages, while freight trains from the interior might be run direct to the river wharves, or to the outer harbour, as the nature of their loading should demand.

Turning to the direct cut proposal, there can be no serious objection, after the lapse of more than eight years from the date of the report of the Yarra Floods Board, to explaining how its recommendation came to be made in favour of that work. The chairman of the Board, since deceased, had been from a remote time an ardent advocate of it; the other members were generally either opposed to it, or gave it but a half-hearted support. The chairman was strong willed and appeared inflexible. In the circumstances, there was the imminent prospect of no report,
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or of one in which opinion would be so much divided that it would carry little weight. Resort was had to compromise. A proposal was framed that secured the adhesion, without protest, of eleven out of the fourteen members of the Board; the three dissentients concurring, with the proviso that additional floodway should be secured by enlargement of the existing river channel, not by opening a new one. There is no doubt that a majority would have concurred in this course but for the fact that its adoption would have resulted in no general recommendation whatever. Several certainly signed, without protest, in the belief that their primary duty was discharged by pointing out the necessity for enlarged flood escape, leaving the means by which it was to be provided to be further considered. The majority favoured Sir John Coode's view, against opening a second mouth to the river.

A contention somewhat strongly urged by one of the speakers in the debate on Mr. W. Reid Bell's paper is that to attempt to open a straight cut, and keep the Yarra open as well, would result in disastrous failure. It is perhaps unnecessary to go so far as this, even if one does not concur in the policy of opening a second mouth to the river. But all experience points to the conclusion that the adoption of the straight cut scheme would entail a large initial outlay and heavy annual cost of up-keep, with no tangible benefit that could not be more cheaply attained by other means.

Another objection urged against the straight cut, and equally against the deepening of the river, is the level of the Melbourne sewers. These, it is stated, cross the line of the cut at a level higher than required for large shipping; shallower even than the depth at the piers. The engineer to the Harbour Trust says that the crown of the tunnel at Spotswood is 34ft. below surface (what surface is not reported); and that the Metropolitan Board's engineer holds there will be no objection to going over the tunnel to a depth of 30ft. He further says that, last year, vessels of 26ft. draught were brought up the river; and they ought, by ordinary dredging, to reach 28ft. or 29ft. Well, even if this be absolutely correct, it by no means follows that it will be deep enough for the shipping of a few years hence; nor that it will be better, from any point of view, to deepen the river to even 28ft. or 29ft., than to provide for vessels over 26ft. draught at a deep water port at Hobson's Bay. The sea port being, in that case, quite near to the city, less than 2½ miles by the direct route, and the river port close to the business centre, the natural and proper course seems to be to deepen the river to accommodate vessels up to 26ft. draught only; and to widen it, at that depth, sufficiently to discharge a maximum flood, without raising the surface level, at the city, sensibly above what it would be raised by a high spring tide in Hobson's Bay.

We should then have the seaport, for the larger shipping, within a few minutes' run of the warehouses and merchants' offices;
the river port, for smaller vessels, close to their doors; and the discharge of land floods provided for to the lowest level possible, without having recourse to an expedient so questionable as that of opening a second mouth to the river.

The President said that the expression of opinion of an engineer of Mr. Murray’s standing in all that related to Victorian rivers had an unquestionable value. The inner history of the Flood Board’s proceedings, and Mr. Murray’s reading of the motives which led the various members to subscribe to that Board’s report were very interesting, but there must always be difficulty in going behind a signed statement embodying expressed views.

In regard to the present limitation of draught imposed by the sewerage tunnel: The matter had been referred to by various speakers; he thought they were placing too much weight on that point. After all, it was a relatively minor matter in comparison with the large issues involved in the making of Melbourne the great port of South-Eastern Australia.

In re-perusing Mr. Ferguson’s report on the improvement of the port, he had noted that Mr. Ferguson had presumed 35 feet as the depth of the Panama Canal. That was the depth contemplated at the date of the report; but, on the recommendation of a commission acting at a subsequent date, the Canal was now being cut to a depth of 41 feet. Mr. Ferguson’s report must now be read in the light of a knowledge of that increase in depth.

One of their members, Mr. C. W. MacLean (Engineer for Ports and Harbours) was unable to be present, but he had delegated one of his assistants, Mr. T. H. Smith, to attend and give them all information in his power. Mr. Smith had been responsible for the conduct of the marine surveying and deepening operations at the Heads, and therefore could give them first-hand information of an important nature.

He introduced Mr. Smith, and invited him to give his views.

Mr. T. H. Smith read notes as under:

As a visitor and an officer representing (on behalf of the Chief Engineer, Mr. C. W. Maclean) the engineering branch of the Ports and Harbours Department, it affords me pleasure to attend this meeting, and give information concerning the work of our department in the improvement of the Port.

In Mr. Halliday’s valuable contribution it is mentioned that the capacity of the Port is fixed by the depth of water at the Heads. That, of course, is an obvious fact, and a position so well recognised by our department that for the past eight years we have been steadily engaged upon deepening and widening the navigable channel at the entrance to Port Phillip by blasting the reef that extends more or less across the full width of the fairway. Owing to the locality of the operations being exposed to the ocean swell with strong tidal currents, the working season is.
limited to six or seven months in the year, so that progress is necessarily difficult and slow, but as a result the depths have been increased from 30ft. to 37ft. at low water for a width of channel 700 yards, and heavy draught steamers like the White Star liners are enabled to leave the Port loaded to 29ft. 6in. Previous to such deepening the maximum draught of vessels leaving was about 26ft., and as 4ft. extra draught to such steamers represent roughly about 3,200 tons dead weight, or over 4,000 tons measurement, it may be admitted that some credit is due the Government and the Department. To say that it is a reflection that White Star liners could not load to their maximum draught is undue criticism, when it is considered that the Port is not blessed by nature with exceptional advantages, and that mammoth cargo vessels are a creation of the present decade only, and that such vessels are taxing the capacities of the greatest ports of the world.

Port Phillip Heads no longer constitutes a barrier to deepening and other improvements at Hobson's Bay, for the authorities at this end of the harbour can have my confident assurance that we can keep pace at the Heads in obtaining the depths required. It is true that the deeper you go the greater the area there is to be operated upon. Many of the obstructions at the beginning of the work consisted of pinnacles of rock standing 3ft. to 5ft. above the general level of the submerged rocky plateau. They were the results of long-continued marine erosion of the softer portions of the rock, but there need be no anxiety or doubt as to the practicability of further deepening the Heads to 40ft. at a reasonable cost. The work up to the present has cost £25,000, and a further expenditure of £5,000 a year for eight years (£40,000) would, in my opinion, be sufficient to deepen the channel to 40ft.

With regard to the deeper channel through the Heads referred to by Captain Creswell: The department does not recognise it as the main fairway. Although the least depth, as far as known, is 42ft., the passage is narrow, with depths of 37ft. 300ft. off the line of beacons marking its axis. Vessels being navigated through this passage would be broadside to the heavy seas and athwart the tide, so that it would be difficult for a mariner to steer a straight course. As an emergency channel for a disabled warship making the harbour perhaps it could be used, but for heavy commercial steamers it cannot be recommended.

Comparison has been made between Sydney and Melbourne as to their capacities for meeting future requirements. Nature was certainly in a kindly mood when she evolved the harbour of Sydney, bestowing both the beautiful and useful, but, as it has been shown, Port Jackson has at present its limitations. Sydney enjoys the advantage of being a terminal port, thus heavy draught steamers leaving that port have not completed their loading. The shoal portion of the harbour, pointed out by Mr. Craven and known as the East Channel, is so well pro-
tected by the South Head that little scend is produced, but when a full ship has to leave Sydney drawing 30ft., there will be trouble unless the position is anticipated by preparation.

Mr. Bell is to be complimented upon tackling such a comprehensive and important subject. The main feature of the paper appears to be the diversion of the traffic from the country lines on the north side of the river to the south side by a shorter route, so that export goods traffic may not be dependent upon and hindered by the congestion of general traffic in the city through Spencer and Flinders streets stations. This, in my opinion, is the crux of the position, and should be made the main guiding feature in the consideration of future proposals. The wealth of this country is its production from the land, and the main desideratum is that the export cargo from the country sides should be taken as directly to the shipping terminus as may be consistent with the utilisation of the railway system connecting with the best site for harbour accommodation of large export vessels. That this can be done as effectively and at less cost than by the proposal outlined in the paper is, in my opinion, quite practicable; but the points cannot be sufficiently explained in a short discussion.

Mr. H. Gilbert wrote as follows.—

When I first saw the Yarra I had no great difficulty in conjuring up in my mind, "The River Clyde," on a small scale, picturing Melbourne as Glasgow and S. Melbourne as Paisley, and Princes Bridge as the Caledonian Bridge, I think it was called.

I merely submit this as an illustration of the possibilities, and it must be obvious to everyone that the water area is small and must be very materially increased in the near future.

In doing this it must be carried out on a plan that can be extended out to completion, that is to say, by adopting as a model a successfully worked river port, for instance, Liverpool, Hull, Antwerp, and others, but Glasgow and environment is the model which in physical features, etc., lends itself most easily for adoption as a model. In Glasgow, Liverpool, and elsewhere the main stream or thoroughfare is kept clear, the various docks opening up from it on either side.

The principal cause of trouble in the Yarra at present is that ships are berthing in the stream. In Glasgow, thirty years ago, there were twenty-knot boats running to a regular time table, and landing passengers very close to the Caledonian Bridge. This, to me, appears to be quite a future possibility on the Yarra; but developing the river will cost money—and a lot of it. But a dock or basin just below Queen's Bridge, on the S. Melbourne side, would give a good start to the next generation; it would be hardly fair for this to be expected to carry out the work to completion.

There is nowhere that I know of that presents less engineering difficulty than does Melbourne; the rise and fall of tide is
hardly worth considering, and for excavations there is very little above high water on the S.E. side of the river. For repairs a “Rotten Row” should be provided, adjacent to the graving dock, where a ship could be dismantled or prepared for dock without obstructing the regular traffic of commerce.

As regards the storage and sheds, there is a great deal to be considered; it must be remembered that different cargoes require different storage accommodation—bonded, perishable, and otherwise.

In every case I should provide the usual storage sheds, with a line of rails running between the water front and same, so that ordinary goods could be stored in the shed, whilst goods requiring other treatment could be trucked and run where desired for storage.

Electric cranes could also be run on the same rails for the convenience of shipping, etc., when particularly heavy lifts, such as boilers, etc., that require more than the average ship’s derrick, were desired.

From what I can remember of it, I think it is nearly time Sir J. Coode’s schemes were forgotten—they could be with advantage to the port.

I do not think there would be any necessity for two or three deck wharves if proper facilities are provided for removing the goods as they are landed.

As regards making a structure monumental, which I understand as analogous to permanent, I know of no structure that has a greater right to be considered as monumental than accommodation for shipping. I don’t think that aviation is likely to reach that stage of perfection for some time to come that would justify us in staying our hands in regard to shipping and its accommodation. I would discard wood entirely if there were a rise and fall of tide like St. John, N.B., or Tsientang, in China, where they get from 60ft. to 75ft. tides; then, from an economical point of view, it would be perhaps necessary to consider pile work. As it is, the tidal deposits under a wood wharf adjacent to a town are, in my opinion, sufficient to condemn this system.

The President said that the author of the paper, Mr. Bell, was absent in Tasmania. As there could, therefore, be no reply at that meeting, he would suggest the postponement of the discussion at that stage.

On the motion of Mr. T. W. Fowler, seconded by Mr. J. T. N. Anderson, the discussion was further postponed.
ANNOUNCEMENTS.

Building Regulations: The President said that certain representative bodies had forwarded voluminous suggestions and objections to the draft regulations to the City Council. Copies had been sent to all concerned. Most of the matters dealt with in the communication did not directly concern them as engineers, but some points certainly demanded attention. It was objected that the proposed factor of safety for timber of six was too high, and it was claimed that leading builders in Melbourne were content with a factor of four—the same as that proposed for steel of the most reliable grades.

He thought they would agree that the practice in Melbourne generally was to use a factor far higher than even six. The authorisation of a lower factor for timber—any kind of timber, for all modes of use—would endanger public safety.

A circular already issued to members stated the Institute’s finding in detail.

University Engineering School: On the previous day a deputation of representative engineers had, upon the invitation of the University Council, waited upon the Minister for Education (the Hon. A. A. Billson) to request that the sum of £30,000 should be put aside to build and equip an effective engineering school at the Melbourne University.

He had accompanied the deputation as the representative of the Institute, and had placed the Institute’s views before the Minister. The Minister had been most sympathetic, and had promised his full support in obtaining the whole sum asked for. He had suggested that a small committee should be formed to meet himself and the State Treasurer to discuss the matter in detail.

The Vice-Chancellor of the University (Dr. MacFarland), Professor Payne, Mr. Swinburne, Mr. Mais, and himself had been selected to form the committee. He had every reason to believe that a full reorganisation of the equipment would now soon be possible.

Visit: The Hon. Treasurer, Mr. T. Hill, was arranging a visit to the new ammunition works at Maribyrnong. The date would be announced as soon as possible.

DISCUSSIONS.

IMPROVEMENT OF MELBOURNE PORT.

The President said that as there was no further contribution to the discussion on Mr. Wm. Reid Bell’s paper on "The Improvement of Melbourne Port," the author’s reply would be read.
Mr. R. Winstanley read Mr. Bell’s reply, as follows:

He ventured to say that there is nothing proposed in the paper that upsets the broad lines of past port development; it is the full utilisation thereof that he would insist upon, and, further, there is nothing in Sir William Matthew’s and Mr. Davidson’s proposals that differ in any essential from the ultimate requirements set forth in the paper. Some of the criticism has referred to the existing system of handling traffic as giving the most satisfaction to the merchants; that may be, and if new appliances and arrangements be adopted that result in double handling, the sooner they are dispensed with the better, but it is not that kind of appliances and arrangements that is proposed, and if improved facilities are judiciously chosen, and are adapted to their purpose, merchants will not fail to use them.

It seems hard if the authorities are not able to offer merchants improved methods of handling their business, but must always follow on the lines the merchants, who are not technical men, have used of old. If a merchant goes to an architect or an engineer he expects to be given some improvement upon his own suggestions.

The President’s remarks are particularly to the point in advocating that a scheme of harbour improvement should be originated capable of indefinite and harmonious expansion, and it cannot be too often insisted upon that, under Federation, the political boundaries of States must eventually be broken down as regards questions of transport to the great ports. This paper is an attempt to bring this prominently into view, in the hope that the splendid results of the past may be followed by continued expansion in the future.

Reference has been made by one or two speakers to diagram No. 2, showing tonnage increasement. This diagram is a record of the rate of increase of tonnage in the vessels of the Peninsular and Oriental fleet.

It is the remarkable record of one line of steamships only, and, as to the future, he would draw no deduction whatever from it. The object of the inquiries, of which the results are shown in diagrams 1 and 2, was to ascertain the increase of depth of water required by shipping in Melbourne in the past, and to see whether, as time went on, the increase became greater or whether there be any limiting ratio in sight. The deduction to be drawn from the curve is that the increase is still going on, and must be provided for. Whether Melbourne is to lead or to follow other ports in this particular is strictly a financial question. If too far ahead, she is saddled with a burden, and if too far behind she is handicapped. But the point that can and must be attained is this—that whatever works are projected, they must be capable of providing additional depth in future at the least sacrifice of existing outlay.

The question of masonry versus timber is a complicated one.
Economy hitherto has been undoubtedly on the side of timber, and in the case of the Yarra wharves the use of timber in the past has been amply justified.

As to future works, particularly at Port Melbourne, earthwork will be necessary to provide the large area of land required for the accessories of modern quays, but it is not necessary to confine ourselves to solid masonry quays. The writer did not mention masonry in the paper, and would deprecate the employment of solid walls.

As a matter of fact, the employment of concrete piles on the Simplex system offers a solution of the problem, in which the employment either of solid facing to the quays or of earthwork for the buildings can be done away with, with great economy.

The remarks in the paper regarding the coal trade were intended rather to show that the shrinkage in the coal traffic would not be very great.

As to an increase in the future, the writer, with due deference to the President's opinion, would suggest that a great manufacturing industry built upon the import of coal from another State does not seem economically satisfactory, though on the other hand it is much better to buy coal out of our neighbour's land, and to keep our own for the future.

Mr. Bell agrees with the President in that the railways require extensive sorting sidings and marshalling yards, but the Spencer Street shipping sheds are not sorting sidings, and, with adequate connections, the flat at Port Melbourne offers an ample site of less value than that at Spencer Street. This, however, is precisely a case in which we are compelled to reject for the time a scheme that is beyond our means, but, if Melbourne grows, the necessity for some such railway connection will in all probability be forced on the community, and for that reason it should be kept in view in developing Port Melbourne.

The information given in Mr. Craven's remarks is very interesting and useful, and it might be well worth while if some senior member of the Institute would give a paper bringing out and discussing the points of the early railway and harbour reports and commissions.

In reply to Mr. C. P. Farie Wright: the writer does not recommend any maximum depth for the port—Mr. Davidson is doing that for the immediate requirements. It should not be impossible (financially), with modern systems of construction, to lay out the new work so that in future years the depth suggested by the President could be attained.

The 30ft. depth mentioned in the paper is, in the writer's opinion, a reasonable depth for the Yarra, and he thinks that beyond that depth, financial considerations and the question of water area will necessitate a falling back on Port Melbourne for the deep water accommodation.

Mr. Halliday is to be congratulated on his valuable state-
ment of the work done by the Melbourne Harbour Trust. The amazing tax of 20 per cent. payable to the Government out of revenue from imports is an unfailing source of wonder. Surely in constituting a body charged with functions vital to the State, it would have been only fair to grant them the endowment of the land handed over, and to charge them with the value of works as a debt.

Mr. Halliday is too modest in stating that Sir John Coode's scheme has been carried out with some minor alterations in it. The adoption of timber wharves in place of masonry was a very material alteration, and, in view of Sir John Coode's insistence on the importance of maintaining the scour in the Yarra, the enlargement of the Coode Canal from the original section of 4,375 square feet to 10,200 square feet is a complete and necessary abandonment of the original regimen of the river.

Mr. Halliday might have pointed out as an instance of how in the old country the harbour authorities foster their trade, that the deepening of the Clyde for the "Lusitania" was undertaken beforehand by the Clyde Trust to allow of the vessel being built. He did not state that the limit of depth (i.e., in the Yarra) had been reached. He said that the limit of improvement was very near at hand, and he considered that as regards the Yarra depth, the limit was probably 30 feet. Ferguson, Captain Vincent, and Mr. Halliday all ask for or recommend this depth. But Sir John Coode's scheme never contemplated a depth of 30 feet.

The point for consideration is not that 94 per cent of the imports are landed at Melbourne at present, but when the great expansion of trade and manufacture takes place that is talked about when harbour improvement is mentioned, is the percentage still to be the same in favour of the Melbourne wharves?

The Harbour Trust have done excellently well, and, as Mr. Halliday says, very little is thought about their work by the general public, and, in view of their successful and gratuitous work in the interests of the State, one would think that the Government would be only too willing to grant wider powers to such a body, that, in contrast to most local Government bodies in the State, relieves the Government of a heavy burden of responsibility, instead of coming continually for State assistance.

Mr. Bell is glad to learn Captain Creswell's view is for the separation of the naval from the commercial port. The idea of a naval port began with the proposal to get the Naval authorities to share the expense of a graving dock. Then the State wished to attract the Naval shipbuilding to Melbourne. Now the proposal has reached Williamstown, and when the question reaches the stage of action it is to be hoped that the fortification of Westernport and its adoption as the Naval base for the Southern Coast of Australia will have full consideration. In the event of a war, it is pretty certain that if Westernport be not used by the Commonwealth as a base, it will be so used by the enemy if they can get it.
He had already dealt with Captain Creswell's query regarding the diagram of tonnage increase.

It is to be regretted that Mr. Rudd condensed his remarks, as the points he dealt with are precisely such points as engineers require instruction upon in laying out plans. The warehouses, the railways and roads, the landing appliances, and the berthage are all inter-related, and must be designed as parts of a whole if the most economical and convenient port is to be realised.

The contention of Sir William Matthews, mentioned by Mr. Edmond Clarke, must be strictly construed. It does not say that the principle of dock construction at Port Melbourne is not sound, but only that as regards local traffic it is not sound so long as the traffic can be handled up the river.

But if the river wharves be pushed further down the river, the handling of traffic then by road will be as costly, or more so than the handling of the same traffic from Port Melbourne.

Mr. Fowler's proposal to connect the Port Melbourne railway with the St. Kilda line, and thence to Oakleigh is an alternative to the line proposed, and was considered by the author in preparing the paper. Taking into account the purchase of the land, the cost of bridging and heavy cuttings, the St. Kilda-Oakleigh line would possibly cost more than the other, but on the other hand it might form part of the outer circle railway, of which already a large part has been constructed and practically abandoned.

The scheme for a direct railway from Spencer Street across the Yarra to the Port Melbourne railway does not touch the question at all; it simply perpetuates the present state of affairs, and is only an expedient.

Mr. Fowler complains that the North-eastern lines are not connected with the Port Melbourne tunnel approaches. The cost of reproduction of the process block may be held responsible for that omission, but by the time we are prepared to swallow the tunnel it is not likely that a small connection of a mile or two of surface railway will choke us.

With regard to the Victoria Dock in relation to the city, Mr. Fowler rather proves the writer's contention when he shows that traffic has to go a mile round to get three furlongs in distance. With regard to dock extension north-west of the Victoria Dock, I have heard that piles have been driven down in that locality to a depth of 200 feet, in which case a new dock would offer fine scope for piling. Perhaps some of our members could say whether this be so.

The deepening of the channel at the Heads, as pointed out by various speakers, is the crux of the question as regards the future development of Melbourne. When the time comes that a continuous body of rock has to be removed a method has already been devised whereby this may be undertaken at a cost comparable with that of rock removal in sheltered channels.
Mr. Wright is in error in regard to the space available for traffic at the Hobart wharves. Warehouses do not require a few hundred yards in depth, but at Hobart there is 250 to 450 feet from the edge of the breastwork to the foot of the hill.

Mr. Borrie's argument as to the handling of goods is not easy to follow. If the merchants are receiving 600 tons for every 100 tons formerly received, and are no longer able to handle the traffic expeditiously, it shows that the present facilities and methods are inadequate, and in London and elsewhere, where traffic (such as railway traffic, let us say) cannot be handled on the level, they pile it up in two, three, or four-storey goods stations.

Where mistakes have been made in regard to railway or harbour accommodation, it will generally be found that the fault lies in having recourse to expedients, and our endeavour in determining the proper course for future expansion should be to set our minds upon what is best, and not upon what is good enough. As long as two particles of matter cannot occupy the same space at the same time, so long will it be impossible to completely satisfy all requirements as between quays, roads, railways, and warehouses; but, looking broadly at the map, it does seem that anyone who went to lay out a port at the present head of the Yarra navigation (I am not speaking of the years 1877-79, as this is a matter quite beyond the scope of Sir John Coode's Commission), would have laid out streets of warehouses round the quays, with railways and loading sheds throughout, but all standing, sorting, and marshalling yards would have been banished outside of the city. Naturally, the Railway Department took all the land they could close to the town, and they are at this moment endeavouring to run the harbour for the benefit of the department.

Take, again, Williamstown. We have a small area "reserved for dockyard purposes," sandwiched between the Harbour Board property and the railway pier, and literally choked with dry docks and slips of all sorts and sizes. These must eventually make way for works on a homogeneous plan.

There is no disparagement of the past implied in pointing out these things, but the position may fitly be compared to a private manufacturing business, or even a private mansion.

As the business or the family grow, additions are made from time to time to meet the circumstances of the moment, but a time comes when necessities demand, and the importance of the business justifies, a clean sweep being made, and demands the erection of a new and co-ordinated establishment.

The work at the water's edge and under the water reflect nothing but credit upon the Harbour Trust, but on the landward side, if we are to successfully meet the future expected by every Victorian, the several authorities must unite to co-ordinate their requirements, for a glance at the map shows that hitherto there
has been no real co-ordination, and prepare the way at least for a clean sweep that will utilise to the full the natural advantages of the place, and the benefits provided under Sir John Coode's scheme in the first place, and its subsequent enlargements.

Someone will probably object to the expression "clean sweep." As to that, we may instance the Coode Canal, which was finished and protected on both sides with extensive revetments and other works, all of which on the widening of the channel had to be swept away at great cost. There is nothing unusual or unnecessary in such a process, nor does it imply that the work removed was ineffective in its day.

Much of the discussion very naturally brings in the question of depth obtainable in other Australian harbours, and the enormous cost of the Yarra tunnels. The author holds that the annual saving, whatever it may be, required to justify the tunnel construction is not to be looked for from railway working expenses or revenue alone. The tunnel is a terminal accommodation, and it is notorious that throughout the whole history of railways the administrations are continually forced into huge terminal expenditure that are non-productive per se.

Melbourne is indeed fortunate in that it can afford to maintain hundreds of acres of pleasure grounds and tens of acres of railway yards in the centre of a population of half a million, but there are cities where the site of Spencer Street goods yard would fetch a rental of £80,000 per annum.

Further, the author holds that what is or can be done in other Australian ports has little to do with the question.

The competitors of Victoria are the Argentine, India, and South Africa. The country that justified the enormous outlay on railways such as has been faced in Victoria will justify the cost of a real port at Port Melbourne, with a direct railway to it, when the time is ripe.

If other ports cannot follow Melbourne as to depth, then Captain Creswell's suggestion of a central distributing port will have been realised, but in the author's opinion all of the great ports of Australia will be compelled to provide the same facilities for shipping.

Mr. Stuart Murray introduces the question of the influence of the existence of the port upon the value of properties in the locality. In the first place, the writer does not consider that the creation of a deep-water port at Port Melbourne would do anything but raise the permanent value of city property.

In the second place, he deprecates putting the river wharves in comparison with a deep-water port at Port Melbourne. The two places stand each on their own bottom; that is to say, the river wharves are necessary for local interstate trade, but the river is approaching a depth beyond which it will not be financially practicable to extend it; while for any further depth, and for
mail and heavy oversea export traffic a deep-water port at Port Melbourne is admittedly essential both now and later on.

Thirdly, were relative land values as affected by engineering works considered, the real issues would be obscured, as the object of the paper is to throw light upon technical matters affecting the ultimate welfare of Melbourne as a whole, and the development of the whole State.

Mr. Smith shows conclusively that the deepening of Port Phillip entrance can be effected at a very moderate cost indeed, but even if the operations required were much more extensive, the writer is prepared with a plan for the continuous and economical removal of the rock by a proved system of excavation and dredging. As Mr. Smith points out the railway connections between the east and west and Port Melbourne can be effected in several ways, but when the urgent necessity arises for the completion of these connections it will, the writer ventures to say, be found that the underground connections, although not the cheapest, are the most effective and economical solution of the problem.

In conclusion, the writer cannot but feel gratified at the valuable discussion elicited by the reading of his paper, and at the reception accorded to the views expressed therein. Such discussions, when taken part in by responsible members of the profession, cannot fail to be of help to the authorities, whether in strengthening them in their position, in pointing out requirements that may have been overlooked, or in subjecting their proposals to legitimate criticism. As regards the present position, the author ventures to say that the paper and discussion throughout is in strong support of Sir William Matthews's and Mr. Davidson's proposals as part of the ultimate scheme of harbour extension. He would also, as a word of warning, quote Mr. Halliday's words: "The Trust did what any public body would be wise in doing—accepted the report of the expert, and adopted the scheme." If it cannot be adopted without alteration, the only alternative is to leave Port Melbourne alone for the present, and develop the Yarra to its utmost extent in the first place.

The President said the right of reply was with Mr. Bell, and that reply closed the discussion.

He thought they owed much to Mr. Bell for bringing the matter forward, thanks both as to material and the mode in which the material had been presented.

Discussion closed.