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The Engineering of the Port of Melbourne

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SUMMARY The early development of the port of Melbourne and the design, construction, operation and cultural significance of Victoria Dock are described.

1. INTRODUCTION

Port Phillip Bay was discovered in 1802 and was first settled by Europeans in 1835. In 1839 the first jetty, Gem Pier, was completed at Williamstown. The only landing on the River Yarra at Melbourne was then the natural northern bank downstream from the Falls, where a few piles had been driven. This was known as Queen's Wharf; but regular floods on the River Yarra prevented the construction of any more permanent facilities.

By 1841 the Melbourne district had a population of 10,000, but the mud bar at the mouth of the river prevented all vessels drawing more than 7 feet of water from entering. In 1840 this had led Captain Liardet to make a road from Sandridge Beach (later Port Melbourne) to Melbourne for the conveyance of mail and then to build a jetty to assist passengers landing from ships anchored in Hobson's Bay. Many of the early immigrants landed here, and by 1854 a railway had been constructed to Melbourne - the first passenger-carrying line in Australia. By the 1870's this was a busy part of the port of Melbourne, and it remained so until the advent of cheaper air travel.

Heavier goods, required for the mines, the railways and local industry, were usually landed at Williamstown. Here there was comparatively deep water and, after 1858, a railway connection to Melbourne. By 1870 this part of the port had several railway piers and a major share of the general cargo trade.

The river port of Melbourne was, by comparison, undeveloped; even though the city was several times the size of its satellites. Yet it took some forty years of agitation by city merchants, the City Council, and the local newspapers to establish, in December 1876, a harbor trust with responsibility for development of a river port.

2. THE MELBOURNE HARBOR TRUST

The Trust inherited a shallow river flowing by a circuitous path to the sea, with low-lying and swampy ground on either side subject to periodic flooding. They also acquired control over a patchwork of private and Government wharfage which had been constructed along both sides of the river. Between 1860 and 1872, over 60,000 pounds was spent on maintaining and improving these wharves, or more than twice that spent on the piers and jetties at Williamstown and Port Melbourne in the same period. Despite this, the Melbourne wharves lacked direct rail connections, they remained subject to violent floodings which regularly undermined the piles and damaged the wharves and, despite the removal of over one million cubic yards of silt, they could only be reached by the smaller vessels. Larger vessels anchored in Hobson's Bay, and cargo was conveyed by lighters and was prone to pilferage. If at all possible, both the Railways Department and vested interests at Williamstown and Port Melbourne would have wanted the Melbourne wharves to remain in this condition. They viewed with concern the formation of a Harbor Trust and so the early years of the Trust were tempestuous ones.

Of the various schemes for river improvement which had been considered up to this time, most favoured the formation of a wide channel from near the south-west corner of Melbourne to Hobson's Bay, with an outfall either at Port Melbourne to the west of Station Pier (Figure 1), or near the river entrance, opposite Spotswood. There was also general agreement that the land between Footscray and Melbourne was ideal for port development.

On 27 May 1877, at one of their very first meetings, the Melbourne Harbor Trust Commissioners appointed the eminent British engineer, Sir John Coode, to report on the port of Melbourne. At its next monthly meeting, the Commissioners appointed Joseph Brady as Resident Engineer, and so assembled the principal protagonists in a protracted argument about port development.

At the time of his appointment Coode was 61. He had been apprenticed to James Meadows Rendel, past president of the Institution of Civil Engineers, and had worked for the Great Western, the Bristol and Exeter, and the Royal North of Spain railways. Between 1847 and 1872 he supervised the construction of Portland Harbour, which became the largest artificial harbour in Britain; firstly as Resident Engineer and then as Engineer in Chief. During the same period Coode was appointed to the British Royal Commission on Harbours of Refuge and became Engineer in Chief for the harbour at Table Bay, South Africa. In subsequent years he was consulted on many harbour schemes both in Britain and South Africa; and, on completion of his work at Portland (for which he was knighted), Coode prepared plans for a breakwater and other harbour works for ocean-going steamers at Colombo, Ceylon (1). When appointed to Melbourne the Harbor Trust hoped that such a formidable visitor would silence all its critics.

Brady, on the other hand, had been articled to his father, who was then a land surveyor in the south of England. In October 1844 he became an assistant engineer on the staff of Charles B. Vignoles and worked on railway surveys in Kent and Lincolnshire,

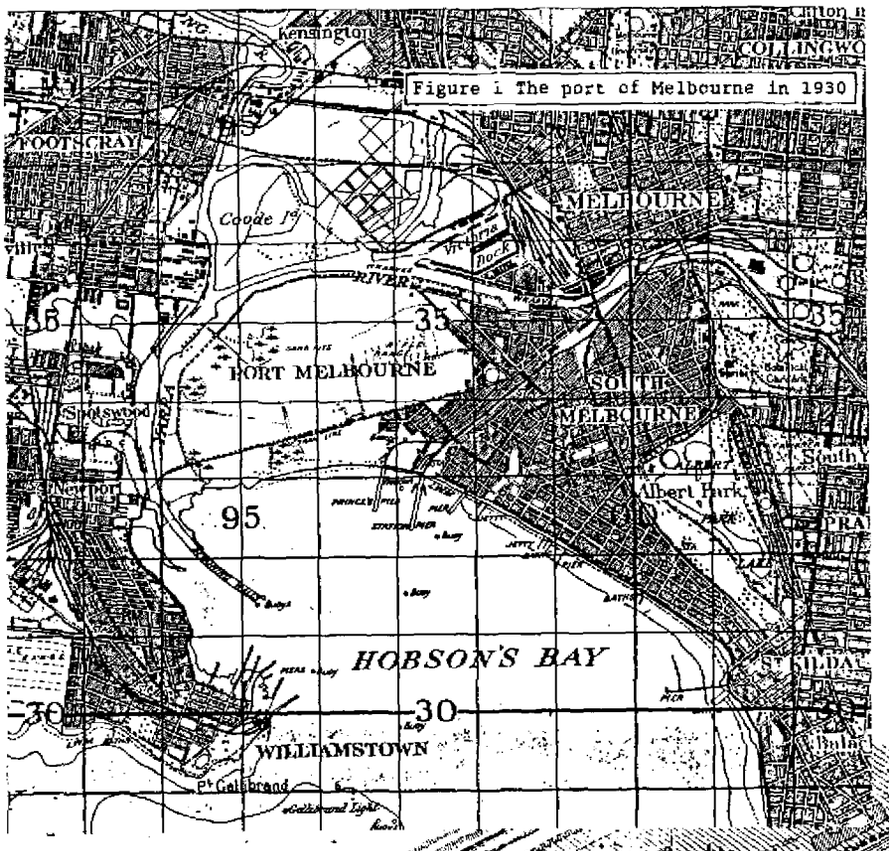

Figure 1 The port of Melbourne in 1930

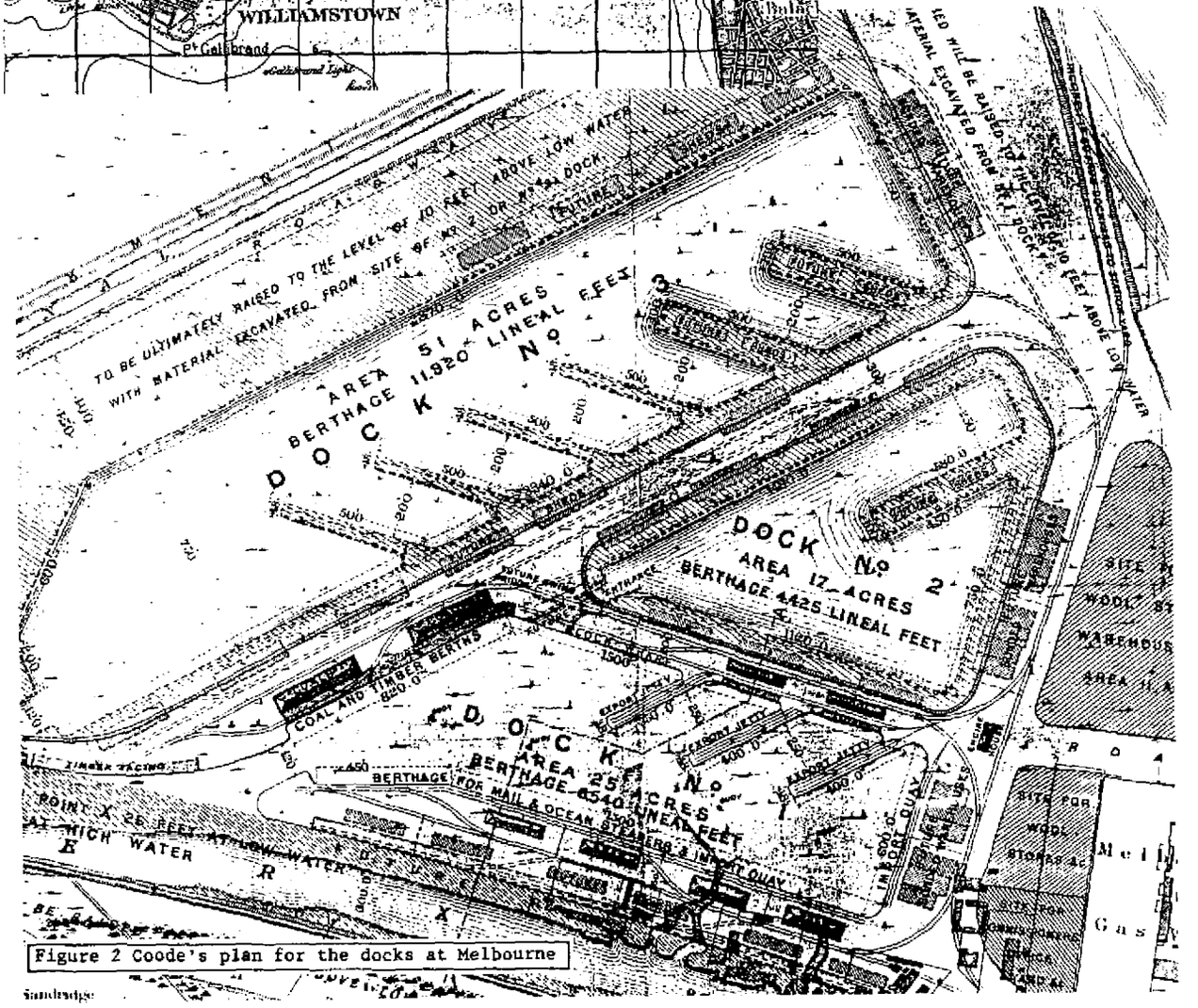

Figure 2 Coode's plan for the docks at Melbourne

and on the construction of the Skipton, Sedburgh and Lancaster railway. In March 1850, he emigrated to New South Wales and was appointed Assistant Engineer to F. W. Wentworth-Shields, Engineer for the newly-formed New South Railways Company. Brady assisted in the survey and construction of the main line between Sydney and Parramatta, and also surveyed the line from Sydney to Mittagong. In 1858 he became Engineer to the Bendigo water works, and designed and supervised the construction of the first water supply scheme for that town. In 1863 he was appointed Engineer to Cornish and Bruce and supervised construction of the Woodend to Castlemaine section of the Melbourne to Bendigo railway. During this time he won a prize of 500 pounds for the best design of a water supply for the Mount Alexander and Sandhurst gold fields, and this led to his appointment as Engineer for the Coliban water supply scheme. On the completion of this work Brady went to Queensland and was involved in improvements to the Brisbane and Bremer rivers. He became Engineer to the Brisbane Water Supply Board and designed and supervised the construction of the first water reservoir for Brisbane and the city's first reticulation system. In 1865 he was appointed as Engineer to the newly-created Harbours and Rivers Department and constructed timber wharves and dredged channels in the Brisbane and Fitzroy rivers. In 1867 he supervised construction of the railway between Toowoomba and Dalby and, two years later in Victoria, the construction of the railway line between Melbourne and Seymour. In 1871 he was re-appointed Engineer to the Bendigo Water Supply, and subsequently second to the Engineer in Chief for the Water Supply Department of Victoria. He was 49 when appointed by the Melbourne Harbour Trust (2). Of the two men, Brady probably had the wider experience, and his more detailed knowledge of local conditions and materials proved decisive.

Sir John Coode arrived in Melbourne in February 1878 and witnessed several floods on the River Yarra in March of that year. He also reviewed the work then being undertaken by the Railways Department on the construction of a dock on the Railway Reserve north of the gas works site. John Woods, Minister of Railways, had informed the Trust Commissioners of his intentions in November 1877, but they had not replied, pending the arrival of Coode. Wood went ahead with his scheme; presumably in an effort to pre-empt Coode's recommendations. Work on this site even continued after Coode's plans had been generally adopted, and in June 1882 the Commissioners had to inform the Railways Department that the hole they were still digging would have to be filled in again later.

In his report tabled in Parliament on February 1879, and received by the Commissioners in April, Coode recommended the widening and deepening of the river by dredging, and supported the proposal of the local engineer, G. Gordon, to straighten its course by the construction of a canal through the river flats to the south of Fishermen's Bend. This was to be almost 2,000 metres long, 130 metres wide, and to have a depth at low water of about 6 metres. The estimated cost was 476,000 pounds. Work on the canal began in July 1880 under the supervision of Joseph Brady, but proceeded slowly until the Trust had been granted additional land for the canal and an extension of their borrowing rights. It was officially opened on 27 July 1887, reduced the distance to the river wharves by 2 kilometres, and made the river navigable for ocean-going vessels for the first time.

3. THE DESIGN OF VICTORIA DOCK

Coode also recommended the construction of a system of three tidal basins on the swampy flood plains to the north of the river (Figure 2). He wanted Dock No. 1, complete with its own finger wharves, to be built first, and the other two docks later, as required. No. 1 dock would have a water area of 25 acres and a total length of wharf of 6,540 feet. The soil excavated was to raise the general level of the surrounding land to 10 feet above low water. Consistent with his own experience, and to provide adequate support on the marshy ground, Coode proposed to use massive masonry blocks. As the result, his first estimate was 646,385 pounds, with the total cost between one and 1.4 million pounds.

In May 1879 the Commissioners adopted Coode's plan in principle, subject to some minor amendments, with an estimated cost of 1,163,200 pounds. Brady, however, doubted that Coode's proposal could be built for anything like the amount estimated, thought that there should be a cheaper and quicker alternative, and began investigations to gather the necessary information. In September 1880 he suggested to the Works Committee of the Trust that tests should be undertaken on the durability of a variety of Australian and New Zealand timbers in a marine environment. Between 13 October and 9 December 1881 test piles of red gum, yellow box, stringybark, red box, bastard box, ironbark, messmate, mountain ash, blue gum, jarrah and totara were placed in Hobson's Bay at Williamstown.

In 1883, Brady reported that the use of timber in place of concrete and masonry in the construction of No. 1 dock would more than halve Coode's original estimate of 646,385 pounds. He also suggested that the area of Dock No. 1 would be altogether too small for the size of ship that was then coming into service. He proposed, instead, to combine the first two docks into one single dock, with a water area of 46 acres and 11,400 feet of wharfage. Later he planned to combine all three docks in one.

Coode expressed the strongest possible disapproval of the use of timber instead of masonry for the wharves, but the potential savings were so great that the Commissioners asked him to respond further on the proposal in 1885, during his visit to Western Australia. Further borings were carried out on the site of the dock, and the results were submitted to Coode for further comment when he had returned to England in December of that year. Coode appears to have conceded that increases in the general size of ocean-going cargo vessels made Brady's proposal for a single large dock far more attractive, but he remained adamant that a timber construction would not last, and that maintenance costs would be prohibitive. Nevertheless, when his report was submitted by the Trust to its Works, Dredging and Stores Committee, economics won over tradition and past experience. At this time Brady also proposed further cost reductions by dredging initially to a depth of only 22 feet, where Coode had proposed 27 feet, and to delete the iron swing bridge across the entrance to the dock. Lingering doubts about the suitability of masonry and concrete on such poor ground, and the relative cheapness of the timber construction (12 pounds per lineal foot against 81 pounds for concrete) persuaded the Commissioners on 16 March 1887 to adopt Coode's plan for a single dock in the West Melbourne Swamp as amended by their Resident Engineer.

4. THE CONSTRUCTION OF VICTORIA DOCK

The first contracts, for what later became known as Victoria Dock, were awarded in 1888 to Hughes and Miller for excavating 42,000 cubic yards of material at the dock site; to James Forbes and Company for the construction of 1,650 feet of wharfage along the south west side of the proposed dock; and to James Cowan for the construction of a floating bridge at the entrance. The main contracts for the excavation were awarded to Arthur T. Robb in 1890 and 1891 for the removal of a further 3.2 million cubic yards of material. The second of these two contracts, for almost a million cubic yards of material, probably extended the area of the dock from the 70 acres approved in 1887 to one with a water area of 96 acres. The first wharves, along the southern perimeter of the dock, were built between 1888 and 1891.

Water was let into the dock on 22 March 1891, after the site had been excavated to a depth of 17 feet below low water. The dock was subsequently dredged to an initial depth of 22 feet by the Melbourne Harbour Trust bucket dredges, and this was lowered to 26 feet between 1906 and 1908. The first vessel to enter the dock was the Lund Line steamship "Hubbuck" on 20 February 1893.

In 1897 work began on constructing wharves along the north-east side of the dock, together with a roadway (later named "Cowper Street") at the rear. By 1904 wharves had been constructed around the entire perimeter of the dock and rail connections had been made along the north-west side, so linking the Melbourne wharves with the Victorian rail network for the first time.

The first cargo sheds were constructed on the southern wharves by Johnson and Sons and by Johns and Waygood between 1896 and 1902. There were no rail connections. This contrasted with the other side of the dock, and for much of its operational life it operated with two distinct forms of cargo handling.

5. THE OPERATION OF VICTORIA DOCK

By 1903 the amount of traffic using the dock must have been sufficient to justify the Commissioners' decision, on 11 March, to close the pontoon bridge at the entrance to the dock as a hazard to shipping, and to re-route road traffic between Melbourne and Footscray beyond the north-west perimeter of the dock. By 1911, Victoria Dock was handling over half a million tons of general cargo, and was third in importance in this respect to North Wharf and the piers at Williamstown. By the following year the tonnage of general cargo handled at the dock had exceeded that at Williamstown, but it was not until 1922 that Victoria Dock became the leading general cargo handling area within the port of Melbourne. By 1924 about 20 per cent. of all the cargo handled within the port passed through Victoria Dock, and it remained the principal general cargo handling area until 1970.

The rapid growth in cargo tonnages at the end of the nineteenth century and during the first decade of this century - doubling between 1897 and 1910- forced the Commissioners to contemplate further port development. In 1910, at an estimated cost of one million pounds, they decided to widen the river by 100 feet; to make a swinging basin 1500 feet by 500 feet at the junction of the canal and the river; to deepen the river channel to 30 feet; to widen the wharves on the north-east side of Victoria Dock by 100 feet and erect cargo sheds on them; and to build a central pier in the Dock.

In 1913 they considered a design for a central pier which had a length of 1630 feet and a total width of 250 feet, with a 57 foot roadway between the sheds. The pier was to be constructed of timber, with the roadway laid on wooden blocks on reinforced concrete plates supported on turpentine piles. This was the first use of concrete in wharf construction within the port. There were to be six cargo sheds, each 486 feet long by 60 feet wide and high enough to allow battery operated trucks and fork lifts to be used for cargo handling. Rail connections, although considered desirable, could not be achieved and this aspect of the scheme was abandoned. The estimated cost was 228,000 pounds. The first contracts were awarded in 1913, and the work was completed in 1919.

In 1914 three new general cargo docks to the west of Dudley Street were proposed. Each dock would be 800 feet wide, offer between 2660 and 6200 feet of simple linear wharfage, 32 feet of water, an entrance 200 feet wide, and rail connections to each berth. In addition, there was to be a special coal dock and coal yards alongside the Maribyrnong River. Although this ambitious scheme was never fully realized, in it can be seen the form and shape of Appleton and Swanson docks, and the presiding genius of Joseph Brady.

In the meantime, two sheds had been built along the north-east side of the dock by Johns and Waygood, between 1912 and 1913, although they were not brought into full use until 1920, after the Central Pier had been finished. By this time the first group of cargo sheds along the north-west side of the dock had also been built, in connection with Government cool stores on land leased from the Melbourne Harbor Trust between 1912 and 1914. The remainder of the wharves along the north-west side were used at first for landing coal.

In 1923 the Commissioners resolved to widen and realign the entrance to the dock so as to allow ships to enter at an angle of 30 rather than 45 degrees, as formerly. Three river entrance berths were constructed as the result and the coal trade was transferred there so that between 1926 and 1927 a large cargo shed could be built at berths 19 to 21. Eventually, with the completion of berths E and F at Appleton Dock in 1957, the coal trade was transferred away from Victoria Dock altogether, and between 1949 and 1956 two large cargo sheds were constructed at berths 22 and 24. This completed the traditional form of the dock, with 24 berths.

The berths along the southern perimeter of the dock were the first to be used, and remained the busiest general cargo handling area of the dock until about 1950. Throughout this period the average annual tonnage was about 500,000 tons. Once the north-west side began to be developed, however, it became the busiest part of the dock. By 1915 it was handling almost half a million tons of cargo, much of it coal. In 1937, and again in 1941-1942, it handled over one million tons of cargo; and by 1950, when both rail and road traffic could be used it had exceeded all other parts of the dock in the volume of general cargo handled.

The Central Pier rivalled for a time the other two principal areas of the dock, but the discovery in 1936 of substantial damage by marine borers, reduced the number of berths which could be used. The war and the subsequent shortage of materials prevented these berths from being fully used again until 1954, but thereafter the amount of cargo handled was comparable to, and sometimes even ex-

ceeded, that handled by the berths on the southern side of the dock.

Only the wharves along the north-east side failed to live up to their early promise. For up to 1914 there had been considerable growth in the tonnage of cargo handled, but the construction of the central pier reduced this to an insignificant level by 1920, after which there was a slow recovery, hampered both by the lack of rail connections, and the difficulty of manoeuvering vessels into the shortened berths. They were the first to suffer in, and the last to recover from any recession in trade.

By 1950 the total tonnage of cargo handled at Victoria Dock exceeded two million tons. The opening of Appleton Dock in 1956 reduced this level over the next few years, but by 1968 Victoria Dock was again handling over two million tons of cargo, despite the transferral of the coal trade (with its high tonnages) to Appleton Dock. This was achieved by providing rail connections to berths 1 to 4 and reconstructing them for handling containers between 1961 and 1966. But this revival was short-lived. In 1969 Swanson Dock was opened. This was specifically designed for the handling of containers, and within two years it had become the major cargo handling facility in the port of Melbourne.

Between 1972 and June 1975 berths 5 to 7 at Victoria Dock were reconstructed at a cost of 8.2 million dollars, in order to transfer the roll-on roll-off berths from Nos. 1 and 2 North Wharf. By June 1977 construction had also begun at No. 16 Victoria Dock of a new multi-purpose general cargo handling facility. This was finished in December 1980. A 45 tonne single lift container crane was installed there in mid-1982, and No. 17 Victoria Dock was similarly reconstructed by December 1984 at a cost of 7 million dollars. As these new facilities were constructed, other berths in Victoria Dock were progressively de-commissioned, so that today, not quite one hundred years after the dock opened, only the most recently constructed facilities are being used for their original purpose.

6. CONCLUSIONS

The world has about 2,000 ports, of which no more than 200 can be regarded as major ones, where the gross annual tonnage of trade exceeds a million tons. The port of Melbourne exceeded this threshold by about 1880 and currently (1985/86) handles some 20 million revenue tons (15 million mass tonnes) of cargo annually. For most of this period much of the general cargo within the port, and most of the international cargo, was handled through Victoria Dock.

At the time of its opening in 1892 Victoria Dock, with an enclosed water area of 96 acres, was the second largest single dock in the world. It was slightly smaller than Cavendish Dock, Barrow-in-Furness, which never attained anything like the economic significance of Victoria Dock, and which is now no more than a reservoir for water with all but a fragment of the wharfage removed.

Although wharves were constructed on all four sides, the north-east wharves at Victoria Dock came to be used less frequently (particularly after the construction of the Central Pier) so that the dock functioned as two sub-docks with long continuous lengths of linear wharfage which, particularly on the north-west side, could be used by vessels of any length whatsoever. In this respect Victoria Dock resembled the Royal Docks, London, with the additional advantage that it was large enough to swing all but the very largest ships within its perimeter. The Victoria Dock was planned this way at the outset and, like the Cavendish Dock, was a conscious break with the British tradition of dock construction; the majority of which were quite small. The arrangement at Victoria Dock foreshadowed by at least two decades the rather more conscious development of linear quayage at King George V Dock, London, constructed in 1921, and the New Quays at Southampton, which were begun in 1927. In neither case, however, did these quays appear to have functioned as other than individual berths for the larger cargo vessels and trans-atlantic passenger liners of that period.

Victoria Dock remains a significant monument to Joseph Brady. Where Coode had proposed to build three small docks Brady persuaded the Commissioners to build one large one; and where Coode had insisted that the wharves be built from costly concrete Brady had argued for a cheaper method of construction using local timbers, many of which still support the wharf aprons and other structures today. Victoria Dock has also been commercially viable for most of its operational existence; its shape and size has allowed it to be adapted when other, busier, docks became obsolete. And in terms of what he had saved the Trust in capital expenditure the value of Brady's contribution to the development of the port has been estimated at over 5 million dollars (3).

7. ACKNOWLEDGMENTS

I am grateful to the archives, drawing office and library staff of the Port of Melbourne Authority who helped me gain access to early photographs, annual reports and other records. This work was undertaken in 1991 as part of a heritage study of the Port of Melbourne for the Docklands Task Force (4).

8. REFERENCES

1. Obituary, Sir John Coode, Institution of Civil Engineers, Minutes of Proceedings, cxiii, 1893, 334-343.
2. Obituary, Joseph Brady, Institution of Civil Engineers, Minutes of Proceedings, clxxiv, 1907-1908, Part IV, 374-376.
3. C. F. Kerr, "The man from County Fermanagh." Port of Melbourne Quarterly, 16, no.3, July-September 1956, 33-37.
4. P. Milner, "Victoria Dock, West Melbourne." Technology Citation, Department of Mechanical and Industrial Engineering, University of Melbourne, No. TC-91/1, June 1991.