A view of Wellington harbour about 1879, showing Government Buildings on the left, and the breastwork marking the area of reclamation.

Harbour Engineering

With particular reference to the Port of Wellington

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Chairman's address for 1949 delivered to the Wellington Branch, N.Z.I.E.

Introduction

AS, for the last ten years or so, I have been engaged on harbour work, this is the subject upon which this address is based. In particular, reference will be made to Wellington Harbour, its early history and its development.

In 1935, the late Mr. Holderness in his presidential address to the Institution gave a most impressive talk on harbours, particularly New Zealand harbours, and this was followed in 1937 by another presidential address on the same subject given by the late Mr. McGregor Wilkie. It is difficult not to trespass on some of the ground covered by these two able harbour engineers, but I have done so as little as possible.

Early History

To New Zealand, harbours are of prime importance; we are isolated by large sea distances from other parts of the world and have to provide facilities for the shipping necessary to keep us in touch with other countries. It was natural, therefore, that the first places to be settled in the 1840's were adjacent to the good harbours to be found round our coast. It was natural also that later settlements developed round the secondary harbours where they could be served by coastal shipping.

Cook, in his voyages to New Zealand, did not enter Wellington Harbour, although twice he sailed past it. In fact, once he anchored off the Heads but apparently was not invited by the forbidding aspect of the entrance. According to Elsdon Best, there is no reliable record of any vessel entering the port until Captain Herd, of the *Rosanna*, arrived in 1826, bringing sixty people prepared to settle in New Zealand. While he was here, Captain Herd made a most excellent chart of the harbour, which is now in the Turnbull Library.

The *Rosanna* settlers did not stay, being frightened away by the hostile natives, but moved up north and subsequently drifted back to Australia. Thirteen years later, in September, 1839, Colonel Wakefield arrived in Wellington as the Agent of the New Zealand Company to found a settlement. Colonel Wakefield had been instructed by the New Zealand Company to select carefully a site for the new settlement, his instruction reading: "In making this selection, you will not forget that Cook Straits forms part of the shortest route from the Australian Colonies to England and that the best harbour in that channel must inevitably become the most frequented port of colonized New Zealand."

Wakefield inspected Queen Charlotte Sounds, but finally decided on Wellington as the site for the settlement. The natural advantages of Wellington Harbour made this inevitable, but it does show that the sites of the early settlements were decided by the harbour facilities.

The first wharf or landing stage in the harbour was erected on the beach at Petone early in 1840, when it was intended to establish the settlement in the Hutt Valley. The anchorage for ships was, however, much too exposed to southerly seas, being directly in front of the entrance to the harbour, and later the site of the town was moved to the Lambton basin, where there was much better shelter, although the area of flat land for the settlement was extremely limited. A number of small jetties or wharves were built by private individuals round the basin between Pipitea Point and Te Aro, but only small vessels could berth at these jetties and the work of the port was carried out mainly by lightering from ships at anchor.

The development of the port really dates from 1862, when the first section of Queen's Wharf was built by the Wellington Provincial Council. The approach or stem of the wharf extended from the shore line, which was then on Customhouse Quay in front of the Post Office, and on it were built an inner T at the edge of the existing reclamation and a second T, which was where the inner T is now. The wharf was extended from time to time and was completed to its present dimensions in 1898.

The Railway Wharf was another early wharf, part of it being built by the Railway Department in 1879, and the remainder about 1900 by the Harbour Board.

In 1878, the General Assembly of New Zealand passed the Harbours Act to regulate the management of harbours, and many harbour boards were brought into being by this Act, which, as amended from time to time, still lays down the constitution of the various boards and vests in them the control and management of their respective harbours. Harbour boards work quite independently of each other, employ their own officers and staff, decide their own policy on harbour improvements and management, and control their own finance, but all harbour works are subject to Government approval, and reclamations larger than five acres in extent must be authorized by special Act of Parliament.

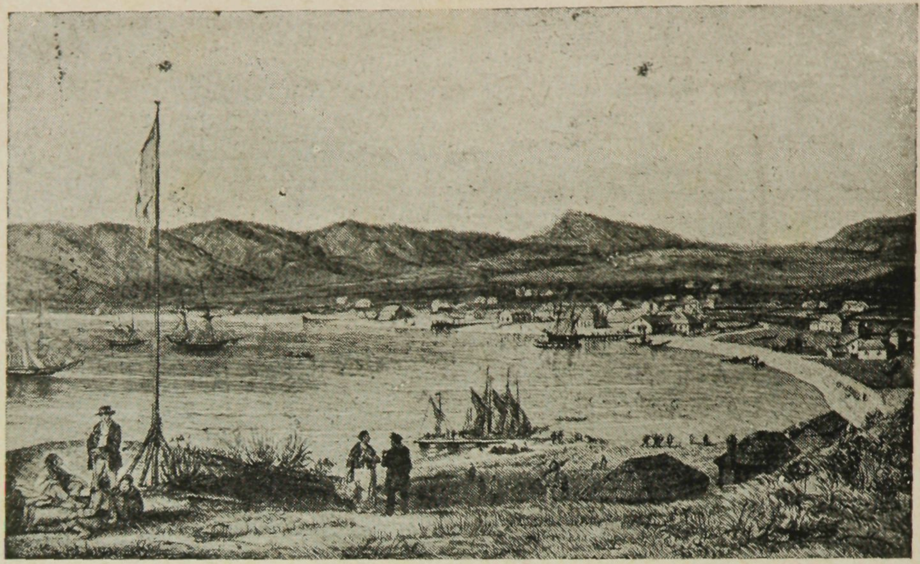
The policy of allowing harbour boards freedom in the management of their affairs has been of great benefit to the major ports, but it has resulted in public money being spent on some small and uneconomic harbours which are now used very little or in some cases not at all.

The Wellington Harbour Board was constituted in 1880 and took over the Railway Wharf and adjoining breastworks from the Railway Department and later, after negotiations, acquired the Queen's Wharf from the City Council, the Council having controlled this wharf since about 1870. Thus, from 1880, the Board has administered the affairs of the port.

The earliest engineering work for the Board was carried out by E. C. Jones, A.M.I.C.E., who, from 1881 to 1883, was retained by the Board as its consulting engineer. His retaining fee at first was £25 per annum, but later this was raised to £75 and his commission was fixed at rates varying from 1 per cent. to 2½ per cent., depending on the size of the various jobs he carried out.

In 1883, the Board engaged Napier Bell, M.I.C.E., to prepare a scheme of harbour development. Mr. Bell presented his report to the Board a year later, but in the meanwhile the Board had appointed William Ferguson as engineer and secretary.

At this time, the shore line ran from Oriental Bay Parade, approximately along Wakefield Street, thence along the west side of Victoria Street to Customhouse Quay in front of the Post Office. Some reclamation had already been done seaward of Lambton Quay, and the shore had been built out to a line extending northward along Customhouse Quay and Waterloo Quay to Pipitea Point opposite where Pipitea Wharf is now. There were only three wharves—the



A sketch made about 1842 of Te Aro from Clay Point (now Stewart Dawson's corner to Clyde Quay).

Queen's, the Wool Jetty (now the Lyttelton Wharf) and the Railway Wharf, then only half its present width. The City Council had been given the right of reclamation over an extensive area of the harbour at Te Aro and was working on this reclamation.

Napier Bell in his report stressed that the city of Wellington was destined to be a port of great importance in the Colonies. He deplored the fact that reclamations being carried out by the City Council in the Te Aro area restricted the space for harbour development and occupied some of the most sheltered part of the harbour. He stated that his design could only make the most of what remained and could only remedy the injury as far as was practicable. South of Queen's Wharf his design did, however, interfere with part of the reclamation proposed by the City Council, and it was only after a long controversy that the present reclamation line along Jervois Quay was agreed to by the Harbour Board and the Council. North of Queen's Wharf, Napier Bell's scheme for the layout of breastworks and wharves was adopted with some modifications suggested by Mr. Ferguson. This plan has been worked to ever since, showing his foresight in planning for future development. He made a wise decision in planning the main wharves and breastworks to lie in the direction of the prevailing winds, and to-day tugs are seldom necessary in berthing even the largest vessels.

Reclamations

Since 1852, about 293 acres have been reclaimed round the city, and to retain this area 14,000ft. of sea walls have been built. All these are of the concrete gravity type, and some of them, particularly the older ones, are remarkably light in design—so much so that their stability can only be due to the good quality of the filling behind them. They are all founded on the harbour bottom, usually a mixture of clay and gravel, and the depth of filling they retain ranges from 5ft. to 45ft. Much of this filling was obtained from dredging, including a big quantity from the Falcon Shoal off Karaka Bay. Actually very little deepening of the harbour has been required except round the main berths and at the Falcon Shoal, which extended across the fairway about three miles from the entrance and which had a depth at low water of only 24ft. This was dredged to give 42ft. at low water, most of the spoil being used in the Waterloo Quay and Thorndon reclamations.

There have been two failures of the sea walls, one at the Lyttelton Ferry Wharf and the other near Clyde Quay Wharf. Both were due to ships' propellers scouring the foundations from beneath the wall. Some of these sea walls are now 60 years old and show signs of deterioration, particularly at the construction joints. A great deal of the concrete in them was deposited underwater, and the fact that they have stood so long is a tribute to the workmanship used in their construction. The problem of replacing some of the older walls will, however, have to be faced fairly soon.

Wharves

Up to about 1909, apart from a portion of the Queen's Wharf built with cast iron cylinders and steel caps and joists, all wharves were built of timber. Piles were sheathed with muntz metal or copper and were either totara or ironbark, and beams were of New Zealand timbers in the earlier wharves and later of ironbark. Stiffening was effected by using wales and braces down to low-water mark with deep cross braces down to the mud line at intervals.

Generally, the design provided for a uniform load of 6cwt./sq. ft., plus railway and crane loads, where necessary. The standard of workmanship, particularly in the earlier wharves, was high and the quality of materials good. Some of the timber wharves still in use were built 60 to 70 years ago.

From 1909 onwards, the more important wharves and breastworks were built of reinforced concrete.

In common with most parts of New Zealand, timber immersed in sea water in Wellington is attacked by *Teredo* and *Limnoria*, although some species resist attack more than others. For example, turpentine is highly resistant both to *Teredo* and *Limnoria*; heart totara resists *Teredo* well but is quickly attacked by the *Limnoria*. Jarrah resists *Teredo* and *Limnoria* fairly well but is not as good as totara. Ironbark is readily attacked by both *Teredo* and *Limnoria*.

In 1884, Mr. Ferguson reported that, where the sheathing on the piles on Queen's Wharf had been torn, the heart totara piles had resisted *Teredo* attack and in his opinion sheathing of heart totara piles was not necessary.

Fortunately, his recommendation was not adopted, and all timber piles, except turpentine, referred to later, were sheathed.

Recently the Board has been carrying out repairs to the Railway Wharf, part of which was built 70 years ago and part about 50 years ago, and it was noticed that, on the underwater timbers, although the sheathing had in some cases entirely disappeared, round the copper nails which still remained in the timber *Teredo* and *Limnoria* had not attacked, but in between the nails the timber had been severely eaten. This shows the toxic effect of copper or copper composition on the *Teredo* and *Limnoria*, and this is probably the reason why the totara piles reported on by Mr. Ferguson were immune.

Turpentine timber, which is very resistant to *Teredo* and *Limnoria* attack, was first used in Wellington about 1924 when the Miramar Wharf was extended. Here, turpentine piles were driven with the bark on, and on the new portion of the wharf turpentine wales and braces were used. After 25 years, the piles show no signs of *Teredo* attack, but some of the wales and braces need replacement, having been attacked by *Limnoria*, particularly at the ends. A disadvantage of turpentine compared with ironbark is that it is weak in bending and short in the grain, and so is liable, if overstressed, to snap like a carrot. A further disadvantage of turpentine when used for wales and braces is that the sticks open up badly at the ends if they are cut and stored for any length of time before being used. If should therefore be used within six months of delivery.

I must stress here that our experience with turpentine in Wellington will not necessarily apply to all ports of New Zealand. It is *Teredo*-resisting, but its life will depend upon the activity of the *Teredo* in the place where it is used.

In Melbourne, an interesting and ingenious method of replacing piles damaged by *Teredo* has been developed. The Central Pier, Victoria Dock, was built in 1915. It is 250ft. wide and consists of a 60ft. central roadway supported on turpentine piles, and wharves and sheds supported on Tasmanian stringbark piles. The turpentine piles are still in perfect condition, but the other piles above mud line became so badly affected by *Teredo* that they had to be replaced, although the portion below mud line was perfectly sound. On account of the bad foundations, all piles were cradled. The Melbourne Harbour Trust repaired the damaged piles by cutting them off at mud line, removing the top sections and replacing each of them with a new turpentine pile fitting at its lower end into a cast steel ferrule about 4ft. 6in. long. These ferrules varied from 9in. to 13in. in inside diameter, and had central diaphragms to act as stops for the new piles and cutting edges at the lower ends. The ferrule at the end of the new section of turpentine pile was placed on the pile stump at mud line and driven until the diaphragm came down on the top of the stump. In this way, the lengths of the old piles below mud line were used again.

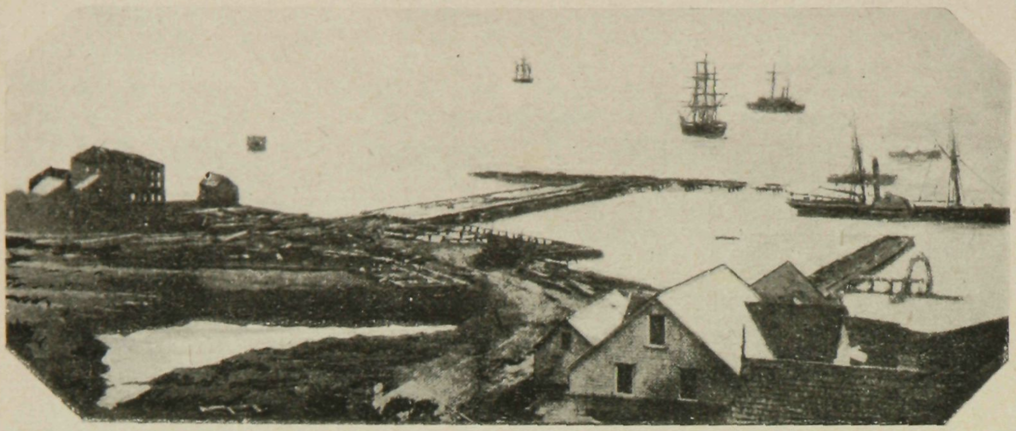
Much has been written about the problem of maintaining structures exposed to the action of sea water. A special committee of the Institution of Civil Engineers has been studying this question for the last 30 years. Recently it issued its 19th report, which gave a summary of its conclusions on the protection of timber. From experiments carried out all over the world, it has found that no species of timber is absolutely immune to borer attack, although some are resistant, and that the most satisfactory preservative is ordinary coal tar creosote. It also found that surface application of creosote is of little value, and for satisfactory protection deep impregnation is necessary. In many classes of timber this can be effected only by incising the timber and subjecting it to long pressure treatment.

For many years, we in New Zealand have depended on supplies of timber for harbour works coming from Australia. Generally, we have used ironbark protected by some form of copper alloy sheathing, or unprotected turpentine. The supply of turpentine is becoming more and more difficult and the cost of an ironbark pile, say 50ft. long, sheathed with a copper alloy, would amount to about 30s. per linear foot without driving, which is higher than the cost of a reinforced concrete pile.

There are many cases where timber piles are an advantage in wharf construction. So far as I know, pressure-creosoted soft woods have not been used in New Zealand for underwater work, but it is likely that of necessity they will have to be used in the future.

I have mentioned above that, in Wellington, timber piles other than turpentine were sheathed with a copper composition alloy and naturally bolts of a similar aloy were used. In carrying out repairs on old wharves, it has been found that the sheathing, usually muntz metal, has dezincified. This occurs when the alloy is completely dissolved and subsequently the copper component is redeposited as a semi-porous and brittle material. Similarly, many bolts have been found with redeposited copper on the outside and a central core of unattacked metal, showing that dezincifica-

A sketch of Port Nicholson and the town of Wellington, made about 1842.



Queen's Wharf in 1862-3

tion had taken place progressively from the outside. Usually a brass or muntz metal containing 60 per cent. copper, 40 per cent. zinc, had been used for sheathing and bolts. It was also noticed that some cast brass nuts and washers which had been underwater for the same time as the bolts and the sheathing were in remarkably good condition. These were analysed and shown to be made of an entirely different alloy containing about 70 per cent. copper, 29 per cent. zinc and 1 per cent. tin.

It is now established that a brass with 70 per cent. copper, 30 per cent. zinc, resists corrosion much better than a muntz metal of 60-40 composition and, in future, a 70-30 alloy will be used. It must, however, be pointed out that the 60-40 composition used so much in the past had a long life, but had it been of 70-30 composition the life would have been even longer.

It is sometimes assumed by laymen—and, I fear, also by some engineers—that a structure built of concrete requires little or no maintenance. This is a fallacy, particularly on marine work, where concrete is subject, if not to wetting by waves or salt spray, at least to the action of a salt-laden atmosphere.

The main damage is caused by salt-laden moisture penetrating to the steel, causing corrosion which spalls off the concrete cover. Moisture may gain access to the steel either through cracks in the structure due to shrinkage or from shocks from vessels, or by penetrating the concrete cover. Once corrosion has started, the only cure is to cut out the concrete, clean down the steel thoroughly by sandblasting, and then replace the concrete.

To minimize cracks in a concrete wharf, a good fendering system which can cushion the blow from a ship touching the berth is very desirable, and care must be taken in placing the concrete to avoid shrinkage cracks as much as possible.

It goes without saying that good quality concrete and adequate cover over the steel are essential. However, no matter how carefully a concrete wharf is designed, and no matter what care is taken both with the materials of which it is built and with its construction, it is my experience that at some places between low-water mark and deck level, corrosion will take place. Regular inspections and continuous maintenance of all concrete wharves should therefore be carried out, but it is comforting to know that corrosion does not take place below low-water mark. On a well-designed and well-built concrete wharf, annual expenditure on maintenance should be about 0.1 per cent. of the capital cost. If the wharf is not well designed or well built, this maintenance cost may amount to three or four times this figure.

Gunite has been used on wharf maintenance. Our experience in Wellington is that where concrete has to be cut away to expose the steel it is not as satisfactory as concrete patching, owing to the rebound of the Gunite mixture from the concrete being caught behind the steel and forming semi-porous pockets.

The maintenance of concrete decks of wharves is another problem unless the surface is protected by a bituminous covering of some form. The steel wheels of hand trucks or of trailers cause considerable wear in doorways. Abrasions take place when slings are landed and damage occurs adjacent to rail tracks where the rails are sunk flush with the deck. Defects of this sort in a concrete surface are extremely difficult to repair, and once the surface has been damaged it deteriorates at a rapid rate. A hot mixed bituminous covering at least 1½in. thick is well worth while.*

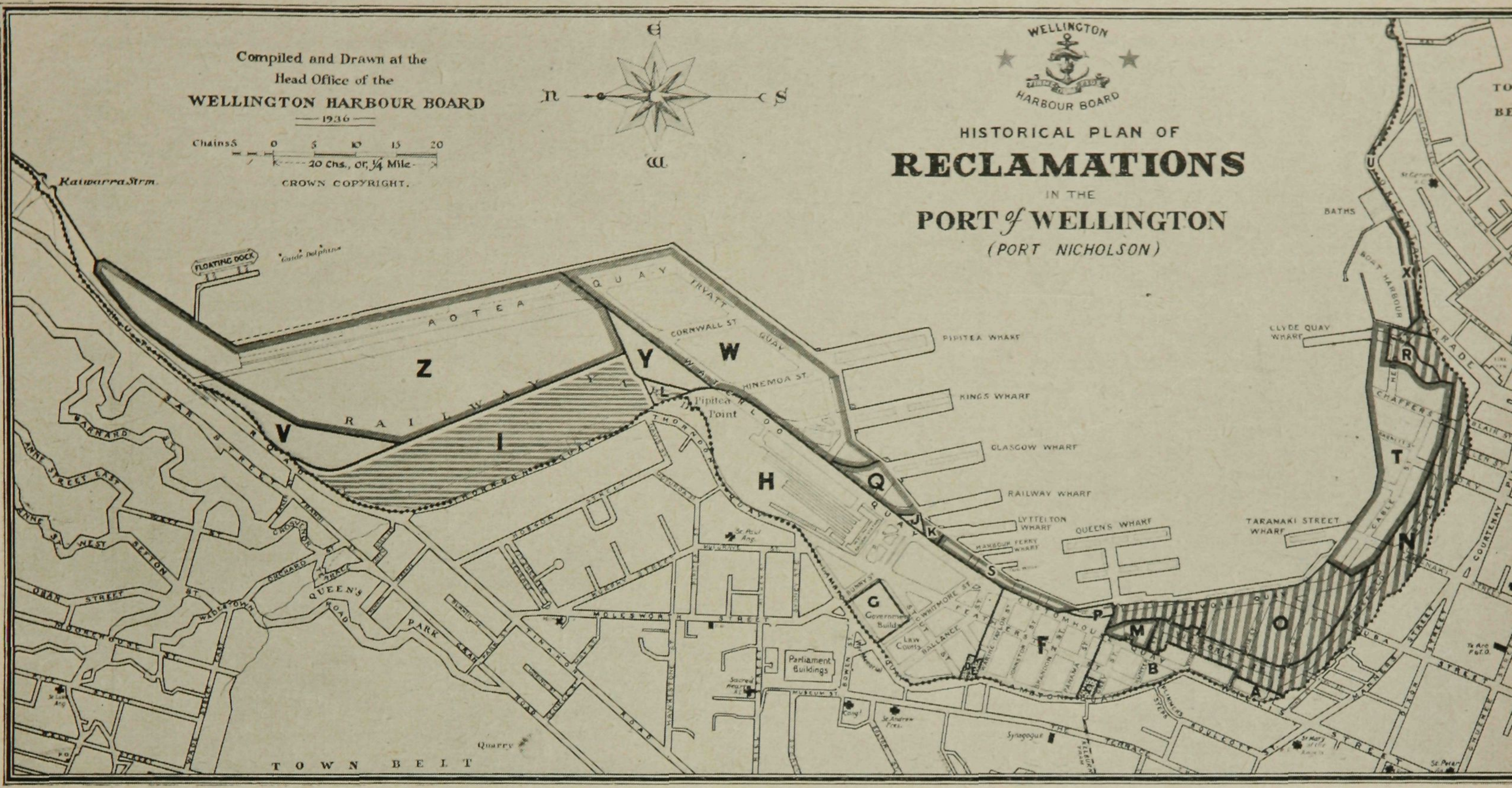
Cargo Sheds and Cargo Handling Equipment

It is not possible to lay down general rules on what sheds, warehouses or cargo-handling equipment should be provided at a port as the custom of the port, the nature of the goods to be handled, and, above all, economic considerations, must decide these matters.

In most ports, cargo is handled off and on to ships by stevedoring companies using either their own equipment or equipment hired from the port authority. In some ports—New York, for example—the piers are built by the port authority and are leased to various shipping

Queen's Wharf about 1880

* Since these notes on wharf maintenance were prepared, a copy has been received of a pamphlet giving a "Discussion on the Maintenance of Maritime Works" which took place in May, 1949, at a meeting of the Maritime Division of the Institution of Civil Engineers. Anybody interested in the problem should certainly read this discussion.



	Date	Area	Reclaiming Authority
A	1852	1	New Munster Government.
B	1857-63	8	Wellington Provincial Govt.
C	1859)		Order of Oddfellows.
D	1864)	1	Order of Foresters.
E	1865)		Jacob Joseph and Co.
F	1866-67	13	Wellington Provincial Govt.
G	1875	3	General Govt. (Govt. Bldgs.)
H	1876	47	Prov. Govt. completed by General Govt.
I	1882	29	Wgtn.-Manawatu Railway Co.
J	1882	1	General Government.
K	1882	1	Wgton. Harbour Board.
L	1884	1	Wgtn.-Manawatu Railway Co.
M	1886	1	Wgtn. Harbour Board.
N	1886	23	Wgtn. City Corporation.
O	1889	17	Wgtn. City Corporation.
P	1893	1	General Government.
Q	1893-1901	3	Wgtn. Harbour Board.
R	1895	2	Wgtn. City Corporation.
S	1901-03	3	Wgtn. Harbour Board.
T	1901-14	19	Wgtn. Harbour Board.
U	1902-25	4	Wgtn. City Corporation.
V	1904	9	Gen. Govt. (Hutt Rail., etc.)
W	1904-16	35	Wgtn. Harbour Board.
X	1906	1	Wgtn. Harbour Board.
Y	1910-13	5	General Government.
Z	1924-32	69	Wgtn. Harbour Bd. (57 acres vested in Railway Dept. and 11ac. 2r. 33p. Harbour Bd.).

Dotted line shows high-water mark before reclamation

companies for their exclusive use. The shipping companies then provide their own equipment and, of course, provide only what is necessary for their own particular trade.

In Wellington, inward general cargoes are unloaded by the shipping company and are delivered to the Board at the sling on the wharf; the Board then stacks, sorts and delivers the cargo to merchants. The Board in Wellington has for this reason provided wharf cranes, overhead cranes in the stores, and tractors and trailers, but how far the Board should go in providing equipment of this sort is debatable. Shipping companies naturally are anxious to discharge and load as quickly as possible. The Board, on the other hand, does not wish to provide more equipment than can be economically used. If goods arrived in an even flow during the year, the problem would be simpler, but they do not, and the equipment provided is never used to capacity all the year round.

To give some idea of this problem of cargo handling, I cannot do better than include an extract from an address given by Captain P. B. Blanchard, a prominent stevedore of New York, to the American Association of Port Authorities. This is taken from the *Dock and Harbour Authority* of August, 1945.

To look at the waterfront problem right, we have to review it a little. In [New York] we have all or many of the ailments of all the ports of the world. Let us look back just a few years—say fifty—and see how we have improved here.

Fifty years ago the majority of piers in this port were simply uncovered piers, probably few of them more than 500 feet long and most of the cotton was hoisted into the vessels by one horsepower—just a plain every-day horse. It was all loaded into the one hatch in the middle of the ship, and most of the vessels were of the old wind type.

Then came the steamer, and we had to cover the piers. Cargo had to be assembled ahead of time or it had to be discharged from the vessels with speed. The old sailing vessel was loaded with the cargo the same day it was ordered down to the pier. . . . In the discharging of cargo, you discharged a certain amount of cargo to the pier and it was delivered from the pier that day. There wasn't any shed. And, mind you, a lot of that cargo was tea and spices from the Far East.

But, of course, when the steamer came and it was "Hurry! Hurry up!" instead of one gang and the horse, we had steam winches and many gangs. Cargo had to be thrown out with speed, piled on the pier, and the inward and outward had to be assembled prior to the arrival of the ship.

Then, of course, we had the longshoreman—with a strong back and feeble mind—with the hand truck. We worked them ten hours a day and more, sometimes. The production at that time was about one ton per man hour. I am telling you that because I want to show you that, with all the isms and improvements that we have, we haven't increased that one ton per man per hour.

The hand truck, of course, was a happy tool for many years, but the units which were being put into the ship ran about 1,500 pounds. We had to increase that. Labour was increased, and the units were increased to about two tons. That was due partly to the increased capacity of the ship's gear.

Then we brought in the travelling crane; the first one was a Ford tractor with a lot of mechanism attached to it, a horrible looking thing, but it seemed to do the work. Since then we have brought in the lift truck, which picks up the draft and takes it to the hatch.

At first labour was a little antagonistic against this equipment. In fact, in many cases, when the foreman wasn't looking, they used to drive it overboard. They jumped off in time to keep from going overboard themselves. But now there has been a change and they almost refuse to work unless we have that equipment.

But the number of men in the gangs, in spite of this equipment, has had to be increased, and the production per man per hour hasn't varied in the last forty years. It is about one ton per man per hour. That is a rather strange thing, when you stop to think that we have put on to the pier many, many thousands of dollars' worth of these patent toys.

One gang years ago was about eleven men and the equipment cost about a hundred dollars—a few trucks, and so on. The cost to-day, with a gang of twenty-two men, of the equipment is about five thousand dollars a gang. Still, with all that, we haven't increased our production over what we had in the olden days.

I don't know whether they wanted me to dwell on the dock equipment or not. That is, the cranes for loading and discharging the ships. There has been a lot of discussion on that, but the City of New York tried that experiment some years ago and it didn't work out so well.

You know the simplest thing in the loading and discharging of a ship is transferring the cargo from the ship's hold to the pier or vice versa. That is the easiest part of it all. If you will just look at the picture of a ship arriving here in New York loaded with cargo, consigned to probably 1,500 different consignees, and that cargo has been stowed in that ship without any regard as to how it will come out—it is simply put there so it won't roll and rattle around—you hoist out one draft of two tons of that cargo and you will find in it sometimes as high as twenty different consignees represented.

That has to be taken and separated and piled on the pier in different piles in order that it can be delivered to the consignees. That is the difficult problem and that is the problem that hasn't yet been solved.

Take the old California ships. We have had as high as 2,500 different consignees in a cargo, and in one draft of canned goods coming out and landing on the dock there have ben as high as thirty different consignees represented. In other words, that one draft had to be put into thirty different places on the pier.

That is the problem that has not been solved yet in the discharging of ships, and whether we can ever solve it or not, I don't know.

Take coffee. Coffee will come in here, perhaps there will be 300 marks of coffee in a ship and then the consignee will want it chalk-marked, which will step up those marks to perhaps four and five hundred different marks in the ship, and every one of the bags of coffee must be put in separate places on the dock, and it is put into the ship without any regard whatsoever to its discharge.

It is lowered over the ship as it is loaded and we dig right down to discharge it—which we have to do. So that you couldn't imagine how you could shuffle cargo up any more than it is being shuffled up in loading and discharging of ships.

In the outward cargo we haven't been very successful with this mechanical gear; that is, to put it in and take it out of the ship, because cargo comes in lighters, it comes in trucks. In the outward cargo I'd say about 40 per cent. of the cargo comes by lighter, and the only practical way is to have the ship properly equipped so that she can work off-shore or on-shore as the case may be.

The boom capacity of the old ships, years ago, was about one ton. We had a Victory ship the other day on which we hoisted in, with one boom and one gear, with a single winch, seven-ton pieces. We put into a ship here the other day a 67-ton piece to put on the deck, so you see the ships themselves carry mechanical equipment that equals any that there is in any port of the world.

Take Antwerp, which is a wonderful port . . . the equipment there is only about three tons. The majority of the cranes are only two-tons. Any of our Liberties will pick up five tons on a single fall with a winch in double gear, some with a winch in single gear. So that you have to proceed very carefully to be sure you do not throw away money in putting equipment on a pier to load or discharge a ship or to perform the easiest part of the operation, taking it from the ship and putting it on the dock or vice versa.

In the loading of the ship, you put a little railroad iron from the lighters alongside, put some heavy cases from the lighters alongside, jump on the dock and pick up some small stuff to stow in amongst them, and the ship's equipment will do that loading or transferring job better than anything else. It is more flexible than any other equipment.

We had a ship here . . . that had twelve sets of gear. . . . That ship has handled in one day in this port seven thousand tons of cargo with her own equipment. Now you couldn't put twelve sets of swinging derricks on a dock, because there wouldn't be room for them; they wouldn't swing, so proceed carefully before you throw away your money on that permanent, expensive dock equipment, because until the day comes when every pier in every port in all the world is equipped with dock equipment, you've got to properly equip your ships, and from a stevedoring and operating point of view, the equipment on the ship looks a great deal better to us than the toys on the pier.

This moving equipment on the piers is coming, and coming fast. You are going to see the units used; you are going to see cargo assembled in units of two and three tons. You see it now. The paper people are doing it, the canned goods people are doing it now, and that is the next thing. But it can't be done altogether, because you must have small stuff to stow around those units.

I think what Captain Blanchard says does apply to most ports, including Wellington, but he has omitted two very important things. One is that, although the rate per man-hour has not increased over the years, the total amount of tonnage handled per hour from a ship has.

Also, he has not stressed the main advantages of the wharf crane over the ship's gear, namely, that it has a longer reach, can plumb any part of the hold and can cover a wider area of the surface of the wharf. It can also, if necessary, be used to deliver cargo to multi-storey sheds. It will be seen from the above that generally the method of loading and unloading ships has not changed, although the size of the ship, capacity of its gear or of wharf cranes has increased.

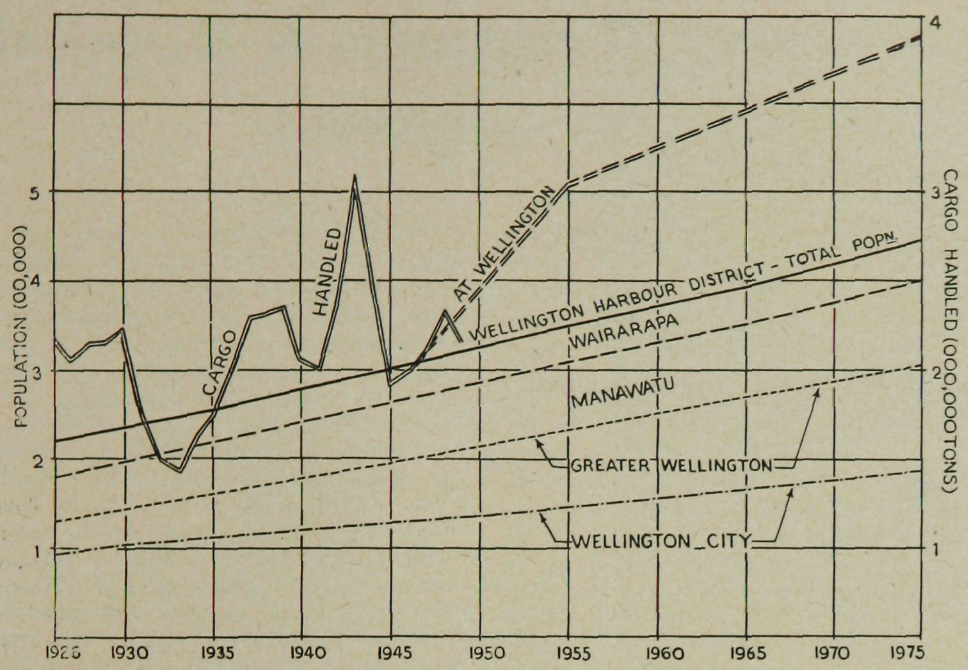
It does not seem that the method of lifting goods in and out of the hold by some form of tackle can be changed, but in many countries of the world the adoption of a standard size package for general goods is being advocated. If such a standard could be adopted, it would have many advantages, as equipment, cranes, trucks and trailers could all be designed to handle the standard package or multiples of it, and it would also permit pallet and fork lift trucks to be used more readily. Manufacturers could co-operate to their own advantage by designing their goods or containers so that they could be packed in the standard package. This, I am sure, would effect general economies in cargo-handling by reducing the number of small or odd-sized packages to be handled. One has only to look at any of the cargo sheds in Wellington to see the difficulties of handling, sorting and stacking a great number of varying-sized containers.

In ports or at wharves where full shipments of a particular class of cargo are handled, special equipment is very often used. An example of this is the handling of bananas in bunches, to and from the hold, by elevators delivering on to belt conveyors.

Bulk cargoes such as coal, wheat or phosphates can be readily handled either by grabs or by special equipment when the trade in the particular commodity justifies the expenditure on the equipment. Bulk oils can, of course, be easily pumped.

Trade

The diagram shows the total tonnage of goods inward and outward handled at the Port of Wellington, and the population of the Wellington Harbour district,



Graph showing projected trade for the port of Wellington in relation to population.

since 1926. The Harbour district includes the Wellington metropolitan area plus the Wairarapa and Manawatu.

It would be expected that trade would depend upon population, but the fluctuations caused by economic conditions and the last war can be seen.

The depression starting in 1930 caused a big drop, and it was not until 1937 that the trade again reached the 1930 figure of 2,250,000 tons. By 1939, the tonnage handled had reached 2,360,000. Because of the war, it fell away for two years but rose again to a record figure of just over 3,000,000 tons in 1942, when a great amount of war material for the American forces was landed and shipped. From this peak, it fell to under 2,000,000 tons in 1945, rose again to 2,350,000 in 1948, and fell again for the year ending last September to about 2,200,000, or roughly 160,000 tons below the 1939 figure.

The difficulty of planning under these conditions is apparent. Further, the trade of the port is not uniform over the year, and the facilities provided should be capable of handling the peaks.

In attempting to estimate future requirements, the population curve has been extended, as shown by the dotted line, to give an estimated population of about 450,000 in the Harbour district in 1975. This estimate of future population is based on the forecast prepared by Mr. G. C. Calvert.

The present tonnage of goods handled per head of population is just under 7 tons. The 1939 tonnage represented 9 tons of goods per head. The projected trade of the port shown by the dotted double line has been based on 9 tons per head being reached in 1955 and carrying on uniformly thereafter. This gives about 4,000,000 tons of goods in 1975.

Statistics are not yet available for the year completed in September last, but for 1948, the total tonnage of about 2,350,000 tons inward and outward was made up as follows:

	%
General cargo	53
Bulk oils	18
Coal	12
Butter, cheese, meat and fruit	11
Wool	4
Timber	2
	100

This is a rough classification in which general cargo includes all goods not otherwise listed. It shows that the main exports—namely, wool, butter, cheese, meat and fruit—represented only 15 per cent. of the total tonnage handled, although their value was 85 per cent. of the exports and 32 per cent. of the total trade.

The volume of primary produce and coal does not alter much from year to year, and fluctuations in trade occur mainly in general cargo and bulk oils, the biggest items.

Future Development

The Board has always taken pride in providing facilities in advance of requirements. For a long time it has had plans for the future development of the port, but the war stopped any major works being carried out.

During 1948, a start on a development programme was made, and plant for handling coal is at present being provided at Aotea Quay. Store No. 39, an old timber structure beyond repair, is being replaced with a concrete building and it is intended to start Store No. 51 on Aotea Quay immediately. These new stores will increase the storage capacity by about 15,000 tons. The new coal plant at Aotea Quay will release the existing Railway Wharf, and it is proposed to convert this to a passenger wharf for the Sydney and Lyttelton ferry services. Other works projected include the Lambton and Thorndon Wharves, possibly two additional wharves at Te Aro, and the rebuilding of Jervois Quay breastwork, including the widening of Jervois Quay roadway. Essential works which will not increase the capacity of the port but which are necessary for working the port include a new waiting room and engagement shelter for waterside labour, a new workshop for the Board, and replacement of some of the older hydraulic cranes with larger electric cranes as the older ones have not sufficient reach to span the more modern ships. This programme will naturally be spread over a long period, but when it is completed the port will be able to handle 4,000,000 tons of goods which, from the curve of projected trade, should be sufficient for the next thirty years or so.

Generally, it can be said that the port is well equipped for the trade it is required to handle. Some enthusiasts have even said that it is the best-equipped port in the world, but when our trade of 2,000,000-odd tons is compared with the 50,000,000 tons handled by the Port of London Authority or the 12,000,000 tons handled in Sydney, it will be realized that this might be a slight exaggeration.

Conclusion

I began preparing this address by making copious notes on harbour facilities, but very soon found that it was assuming the proportions of a book. I have finished up with a rather scrappy talk which, I fear, contains little that is new or original. I wish I could have described to you some large works we had carried out, but the Board, owing to many factors, has not carried out major works in recent years.

Volumes 33 (1947) and 34 (1948) of Proceedings Wanted

Owing to requirements of these two volumes being underestimated, an urgent need for two or three copies of each has arisen.

If any retired members not now requiring these volumes for reference purposes would be willing to assist, the secretary would be grateful for an opportunity to repurchase a few copies.