OTHER PAPERS

Asa Binns, Presidential Address, "The Thames and its Docks." Trans. Instn Engr in Charge, vol. 42 (1936–37), p. 124.
H. J. Deane, "The Charterhouse Street Cold Stores of the Port of London Authority." Trans. Concr. Inst., vol. 9, p. k/1.
J. Thomas, "The Blowing up of the Old Dock Wall, Royal Albert Docks." Trans. Inst. Mar. Engrs, vol. 2, 1890–91.

Discussion

Mr Rudolph Glossop observed that the design of the transit shed at No. 19 Berth, Eastern Dock, London Dock, was based on a three-hinged portal frame, and so far as he knew, it was the first structure of its kind to be built in Great Britain. He then displayed a series of slides illustrating some practical details of its construction.

Each portal frame was composed of four comparatively simple precast units—two top booms and two vertical booms—the maximum weight of any unit being 3·1 tons, which was well within the capacity of an ordinary mobile crane. The vertical booms could be handled without prestress, but the top booms were designed to be stressed before removing from the casting bed. On the whole, those members had been found quite easy to handle on the site, although it had been necessary to be very careful to use the correct lifting points on the top boom. Those were at 2 feet from the tapered end and 9 feet from the outer end. As could be seen from the first slide, that construction gave a span of 74 feet and plenty of head-room clear of obstruction, so that it was well suited to a building in which cargo was to be moved and stacked.

All the members had been cast on the site, the concrete being mixed in an ordinary 10S mixer and barrowed to the shutters. The mix had consisted of $5\frac{3}{4}$ cubic feet of coarse aggregate ($\frac{3}{4} - \frac{3}{16}$ inch), 4 cubic feet of moist sand, and 2 cwt of Portland cement. The water/cement ratio had been 0·3, so that about 1 gallon of water had been added for every bag of cement. It was interesting to note that the natural water-content of the aggregate was usually about $1\frac{1}{2}$ gallon per bag of cement, so that slight variations in the natural moisture-content of the aggregate had been important and careful site control had been necessary.

The results obtained from that mix had been:

Strength at	3	days	(average value)	: 4,720 lb.
,, ,,	3	,,	(,, ,,)	: 5,670 lb.
,, ,,	14	,,	(,, ,,)	: 6,540 lb.
,, ,,	28	,,	(,, ,,)	: 6,980 lb.

For the large number of cubes tested, the standard deviation had been

$\pm$ 716 lb., and the coefficient of variation had been $12\frac{1}{2}$ per cent. That, according to the Stanton Walker scale, could be described as excellent.

Mr Glossop said a mix of that kind required intense vibration if it were to be placed in narrow members carrying duct tubes and reinforcement. For the case in question, eleven " Triller " vibrators had been attached to each shutter for an upper boom member, and in addition one immersion vibrator had been used at the ends ; it could not be used over the greater portion of the boom, since in the 4-inch web there was no room to insert the vibrator alongside the cables. For that portion of the work, two men had punned the concrete into place.

To make a concrete of that exceptional quality required no special plant, but it did require careful supervision. As a consequence, it was expensive —perhaps four or five times the price of ordinary concrete. It was also expensive in labour.

The average time taken to cast one upper-boom member had been $1\frac{1}{4}$ hour, and for a vertical-boom member the time had ranged from $\frac{1}{2}$ to $\frac{3}{4}$ hour.

The mild-steel reinforcement provided in the vertical boom was for handling purposes only. In the top boom it was for crack distribution, since that member was stressed before removal from the bed.

Four Freyssinet cables had been threaded into the vertical boom and stressed before the boom was lifted, so as to ensure that the cone fastening at the bottom was tight. Once that member was in position, there was no method of checking whether a true elongation had been obtained or whether some slipping might be taking place in the cone, which was by then out of reach.

When the vertical booms were in place and secured with a scaffolding frame, the upper booms had been picked up by a travelling crane and lowered on to the falsework, the vertical cables being threaded through the ducts as the member was lowered into place.

The falsework had been set so that a space of slightly less than $\frac{3}{4}$ inch was left between the contact surfaces of the two booms. A light timber frame had then been pulled into place to prevent any slight relative movement between them and to act as a ledge from which jointing compound could be caulked into place with special tools. That process had been evolved after some experiments. The jointing consisted of an earth-dry 1 : 1 sand-cement.

A period of from 18 to 20 hours had been allowed for that jointing to acquire strength, before the vertical cables had been stressed. The four main cables had then been stressed diagonally and in pairs, and during the stressing of each pair the jacks had been operated simultaneously.

The falsework had been designed on the site and had worked very well. It consisted of a structure of three inter-connected tubular scaffolding towers, and it could be quickly rolled into place. One end of the top boom had been carried on folding wedges and the other end had been supported by the central tower. The whole set-up had been extremely convenient. The frames were at 18-foot centres, and a complete bay could be placed in the 24 hours.

In order to distribute wind stresses, prestress had been applied through longitudinal beams connecting the four last frames at either end of the shed. Finally, a two-wire cable was carried throughout the length of the building in the ridge member and was lightly stressed to a total load of 5 tons.

The whole operation of casting and erecting that shed had been carried out without any serious technical hitches, but there was no doubt that for that kind of work to be successful, a very high standard of workmanship and constant expert site supervision were essential.

Mr R. A. Stephenson observed that although the engineering organization of the Port of London Authority was, broadly speaking, the same as that favoured by the Mersey Docks and Harbour Board, there were certain points of difference. The Board preferred that all maintenance work—except very highly specialized operations—should be done by direct labour. That preference also applied to operational functions, for example, the manning of pumping stations. In that way, they felt, the quality of the workmanship could invariably be relied upon, and there was the additional advantage that quantity surveyors were not needed.

The number of men employed on maintenance work at the Liverpool docks was 3,150, which compared with the number of men employed on the London docks. The area and length of quays involved at Liverpool was slightly less than at London, although direct comparisons were very difficult to make. Liverpool employed 816 men on floating plant and 1,120 in the Board's own workshops and dockyards.

Mr Stephenson said that the problems of conservancy on the Mersey were somewhat different from those of the Thames, in that the Mersey served not only Liverpool docks but also other self-governing ports. Stevedoring at Liverpool was done by private firms under licence and they, and the shipping companies which they served, could exercise some influence on the lay-out of quays and sheds.

There were great similarities, too, in finance. Liverpool had a statutory sinking fund, designed to provide for the debt incurred in capital expenditure in 90 years. That was supplemented by a non-statutory renewals and depreciation account, designed to meet short-life assets. It was always a very vexed question as to what extent the present should be prejudiced in a bad year by payments made into such funds, which were designed to protect the future. In other words, should payments be constant in good and bad years ?

London, although an ancient port historically, differed from Liverpool in the age of the docks catering for modern trade. It was the capital schemes decided upon in 1911, whose tremendous extent had been indicated in Sir Joseph Broodbank's book, quoted in the Paper, which had created the major part of the modern dock system at London. The expansion of the docks thus created had been met by an increase of trade. In the same way, at Liverpool, in the first half-century after the constitution of the Dock Board in 1858, the corresponding expansion had been met by a corresponding increase in trade. Today, however, they were not quite so happily placed, because they were faced with the need for modernization, but trade seemed to be virtually steady. Perhaps London would one day be faced with the same problem.

Mr Stephenson quoted a few tonnages to show how Liverpool compared and contrasted with London. The tonnage of goods handled at Liverpool and Birkenhead in 1952, excluding bulk oil and livestock, amounted to 15,145,854, made up as followed :—

Imports :	Foreign	7,959,649
	Coastwise	1,134,703
Exports :	Foreign	4,507,762
	Coastwise	1,543,740

Of those tonnages, 55 per cent of the disposal and 74 per cent of the assembly of goods for foreign ports had been handled by road vehicles—only 16 per cent import and 15·5 per cent export by rail. For coastwise vessels, the figures were about 42 per cent export and 49 per cent import by road, and 16·5 per cent export and 31·6 per cent import by rail. There was not a great deal of barge traffic at Liverpool—only 16 per cent of the imports and 10 per cent of the exports of the foreign trade and very little of the coastwise trade. Liverpool had been called a road port, and road congestion was certainly bad at times, but not quite so bad as the Author had suggested in the Paper.

Mr Stephenson then showed a series of lantern slides illustrating the development of transit sheds at Liverpool. He pointed out that the columns in the sheds built recently were spaced at 25-foot centres along the dockside and roadside, and at 50-foot centres under the valleys. The dockside doorways occupied every second bay between columns, and the roadside doorways every fourth.

The slides showed a great variety of arrangements, all of which had their advantages and disadvantages ; the reason for that variety was the private stevedoring system. Cargoes varied and the stevedores sometimes preferred to use ship's gear rather than the cranes if the cargo were of a type which could only be handled slowly in the hold. That tended to limit the width of the quay. The rate of discharge and loading was, of course, to a great extent governed by the speed with which operations were carried out in the ship's holds.

Another slide showed a design which Mr Stephenson considered to be almost ideal. The cranes were mounted on the roof of the shed, the only disadvantage of which was that it limited their out-reach to a certain extent because, apart from the rather heavy wheel-loadings unavoidable with a long jib, it restricted the use of the crane in high winds. With a 30-foot quay margin it was reasonable to reckon on an out-reach from the quay edge about 50 feet, but if there were a wider quay margin it might be necessary to reduce that.

The provision of four 3-ton cranes and one 5-ton crane to a ship's length —about 600 feet—had been adopted as standard at Liverpool. The speeds of the motions were much the same as those described for London—perhaps a little faster, except for travelling, for which the Liverpool figure was distinctly lower. Floor loadings at Liverpool had been standardized at 3 tons per square yard on the ground and 25 cwt per square yard on the first floor of a double-storeyed shed. Mobile cranes were used extensively. That had led to the adoption of a clear height of 22 feet for doorways, whilst internally, in the shed, a clear height of 24 feet to trusses or beams was provided.

Mr Stephenson said the number of mobile cranes owned by the Board was 171. During the 1939–45 war the number had risen to 245. In addition, a large number of privately owned mobile cranes were in use.

A further slide showed how roof cranes could be bunched together to work two or more cranes in a hatch quite comfortably. By using the luffing operation only, a very speedy working could be obtained without the cranes fouling each other. The cranes shown were of the crank-operated luffing type, as were those in the Gladstone Docks.

The next slide illustrated how extremely difficult it would be in present circumstances, with mixed cargoes, to introduce the pallet system at all effectively. Mr Stephenson believed that in the United States, where it had been possible to standardize sizes, the pallet system worked very well with fork-lift trucks, although breakages still occurred. Experience with fork-lift trucks in Liverpool could, in general, be said to be the same as that described in the Paper.

It was very interesting to compare the systems of dredger lubrication at London and Liverpool. It seemed that at London the buckets were small. The buckets on the Board's dredgers had a capacity of 21 cubic feet, and ran at speeds of 54 to 66 feet per minute. The average weekly tonnage quoted for the P.L.A. dredgers appeared low, but the working time was not stated. The most recent bucket dredger at Liverpool, the "Mersey Engineer," had in the previous week loaded a 1,000-ton hopper in 50 minutes from a depth of 48 feet. That dredger had lubricated roller shafts and bearings, but the difference in the rate of wear of tumblers, buckets, pins, and links was little different from the wear on the older dredgers which had no such provision. The results recorded in the Paper for the wear after 40 weeks might be attributable to the small dimensions of the dredger, but, even so, they were astonishing.

Mr John Palmer strongly recommended any engineer who was engaged on the design of docks and harbours to study and re-study the interesting paragraphs in the Paper on the subject of port cranes, their working and grouping. The Author had admitted that the 3-ton crane was normally quite ample, but there had to be a 5-ton crane on hand and it was stated in the Paper that the latest P.L.A. practice was to provide one 5-ton and five 3-ton cranes at each berth. Mr Palmer said he did not find those figures reconcilable with Table 3 and with the statement that, under recent contracts, eighty-seven 3-ton and twenty-five 5-ton cranes had been ordered. One explanation might be that Table 3 included the eighty-seven 3-ton cranes as already in use ; obviously it did not include the twenty-five 5-ton cranes. In any case, the best ratio obtainable from the figures was 402 to 29 or, say, 13 to 1, which was a long way behind the desirable ratio of 5 to 1.

Mr Palmer asked the Author why the gauge of the portal crane had been increased to 18 feet instead of 13 feet 6 inches. Had there been a change in the loading gauge of the railways or was it to cater for bulky loads on road vehicles ? Referring to the statement in the Paper that: " Ships at deep-water berths generally have five or six hatches . . . and at first-class berths in London six or more cranes are provided," Mr Palmer asked the Author how many tons of general cargo were unloaded on the average from one hatch in one day's shift.

As had been pointed out, a large increase in road transport was fundamental to any port lay-out today, and Table 2 showed the astonishing change in the short period of 12 years. Mr Palmer had a lay-out under preparation in which he had incorporated specific lanes for road traffic moving on to the jetty, two separate lanes for road traffic moving off the jetty, and, in addition, separate and entirely clear lanes for road traffic—whether lorries or trailers—standing still to be loaded or unloaded. He was sure that if traffic was allowed to roam at will over the whole surface of a quay or a jetty the result would be indescribable confusion. If road traffic was to give the service to ports in the future that railway traffic had given in the past 50 years or more, then road vehicles would have to put up with being marshalled and regulated as the railway trucks had done.

The Author had referred to the arrangements of roads and railway tracks in Figs 6 and 7, Plate 1, and had picked on Fig. 7 as the " ideal." Mr Palmer considered that it was not an ideal arrangement to split each of the two groups of four railway tracks on each side of the shed. He preferred the road-rail lay-out shown in cross-section in Fig. 6.

Mr Stephenson had referred to travelling cranes on the top of warehouses, but Mr Palmer was glad to note the Author's comment that in some places lack of space had made it necessary to combine transit sheds and warehouses, " which otherwise would not be advocated." Mr Palmer was in full agreement with that.

He went on to refer to the quotation, on p. 558, from a book by Sir Joseph Broodbank, part of which read : " . . . the ideals of engineers, if unchecked by commercial expediency, might easily be the ruin of the greatest port in the world." The date of Sir Joseph Broodbank's criticism had been carefully pin-pointed as the year 1910, which meant that he had been specifically criticizing the first Chief Engineer of the P.L.A. Mr Palmer said he had at one time been rather well acquainted with that gentleman and, in his opinion, the recommendation for spending £700,000 on repairs to old properties was a secondary and trivial matter. He believed that that particular Chief Engineer's main contribution to the greatest port in the world had been to produce, in 1910, a scheme for nine major capital improvements spread over the 30-mile length of the River and estimated to cost £14 million. He suggested that if it had not been for the materialization of the ideals of that engineer, there would be today in the Port of London no King George V Dock and no Dry Dock or Passenger Landing Stage at Tilbury.

Much more important than all the points dealt with by Broodbank was the question of obsolescence. Surely the great problem for any port or harbour authority was always: " Will our entrance locks be large enough for the ships trying to use them 10 or 20 years hence ? Will our dry docks, jetties, and quays have sufficient depth of water 10 years from now ? "

Mr Palmer said he had been told that one of the giant tankers recently launched at a major port in the north of the British Isles would have to steam many miles, after it left the fitting-out berth, to another port to go into dry dock, because there was no dry dock in its home port of sufficient depth to take it !

Were the P.L.A.'s dry docks going to be wide enough and long enough to take the giant tankers which were already calling regularly at the Isle of Grain ? Mr Palmer quoted the following figures : the King George V Dry Dock was 750 feet in length and had a 100-foot entrance width ; the new Mauretania was 772 feet in length and had an 88-foot beam ; the the Tilbury Dry Dock would also be too short.

Many of the entrance locks of the P.L.A. had been reduced in size from the dimensions recommended in 1910. The recommended length of the Tilbury new entrance lock had been 1,050 feet and its recommended width, 130 feet ; it was actually built only 994 feet in length and 110 feet in width. The recommended length of the entrance lock of the King George V Dock had been 850 feet and the recommended width, 110 feet ; when built, it was in fact reduced to 800 feet by 100 feet.

Mr Palmer believed that what the Port of London needed, if it was to be the greatest port in the world, was plenty of idealism from engineers and not too much commercial expediency.

Mr E. A. Lewis observed that he had been particularly interested in the part of the Paper dealing with mechanization and the fork-lift truck. The Author had written :—

> " Concerning the much discussed fork-lift truck, with its attendant packaging and labour problems, 'if packing could be revolutionized

and palletization generally introduced, the future of the appliance would be assured, but at the present time its chief claim to fame is the latest idea."

Mr Lewis disagreed strongly with that comment, and gave a brief idea of what palletizing involved, indicating how the fork-lift truck was being used in the docks in a very simple way. That had no relation whatever to the general palletization of cargoes for throughout movement.

General adoption of the pallet system meant that the factory would make up a unit load on a small and cheap pallet which formed part of the pack. The pack, with the pallet underneath, was handled throughout, until it arrived at the consumer, by the fork-lift truck. That was at present " under very active consideration," and he had no doubt that in about 10 years' time most of the problems would have been overcome and it would be in general use. But the " throughout movement " method would not solve the docks' problems ; it would merely add to them.

Mr Lewis said that it would be necessary to treat the palletized units as individual packages—indeed, as normal cases—because the pallet had to be a special size for use in railway trucks and such places. When the unit arrived at the dock shed it would have to be placed on another type of pallet.

The special pallet which the Author had described had been devised and used in London. That was a pallet-landing board, and the great advantage was that it could be lifted on board ship or taken off the ship by engaging hooks in the four eyes, one on each corner. A very common piece of cargo-lifting gear was used, known as a " bunch of fours."

Fork-lift trucks had recently been introduced for handling Spanish oranges imported into London. That fruit had been imported in great quantities that season and it was necessary to discharge it rapidly so that the ship could be turned round as quickly as possible. The oranges had to be handled very carefully and sorted, which provided a great problem.

When the oranges had been handled manually, the gang on board the ship, in the hold, had loaded the cases on to ordinary wooden landing boards, which were about 5 feet square, with an eye at each corner. The boards were lifted on to the quay, where the cases were manually handled by the gang, consisting of twenty men. Each man hand-trucked cases into the shed and to the correct " bay " for that particular mark. It had never been possible to sort as quickly as the men on board could discharge, so the latter were generally working at three-quarters or half pace. The number of men receiving and sorting could not be increased, because five gangs meant a hundred men, which was too many for efficient working.

The following solution had been adopted : instead of a normal landing board, the pallet-landing board was used and the men on board loaded that pallet in the same way—about 35 to 40 cases on each pallet. The pallet was hoisted to the quay by crane and was immediately taken over by the fork-lift truck and moved into the shed, where seventeen were now engaged. The operation did not reduce the total number of men, because three men were needed with the fork-lift truck and pallets on the quay. All the seventeen men were sorting, however, instead of a lot of them hand-trucking from ship to shed—which took some time on the 50- to 60-foot-wide quays.

The result was that the men on board never had a set waiting on the quay. They knew that all they loaded would at once be whisked away. The system had not been in operation for very long, but the normal average output of 800 cases per gang had been stepped up to 1,000—and it was expected to achieve a still higher rate.

Mr Lewis suggested that that disposed of the error into which the Author had fallen—the error of believing that the general introduction of the pallet system was necessary before the fork-lift truck could be used in the docks.

Mr P. A. Scott observed that the Author had given the proportion of 3-ton to 5-ton cranes as 5 to 1. He himself would have suggested 3- and 6-ton cranes for operation abroad, because in some of the less developed countries the ports tended to have slightly heavier sling loads than ports in Great Britain. For that reason, as well as to provide a margin of safety against the rougher handling a crane was apt to get in those countries, he suggested 3- and 6-ton cranes. With the 6-ton he preferred two gears, so that it could be run at the normal speeds with 3-ton loads and at half or reduced speeds with 6-ton loads. That avoided isolating the 6-ton crane and prevented the difficulty of complicated cranage charges.

He was grateful to Mr Lewis for his remarks on mechanical handling, because he had intended to say that the adoption of the pallet system would have to be delayed until the introduction of a universal system, whereby goods could be put on to pallets in the factories and not removed until they were delivered to the warehouse of the man in another country who had bought them. It might then be possible to envisage a world-wide system of pallet exchange; it could be arranged so that pallets were not necessarily returned to their owners, but that the latter would be credited with the correct number of pallets.

Again on the subject of mechanical handling and the fork-lift truck, Mr Scott observed that the Author, on p. 565, in discussing the possible reconstruction of a shed, had suggested that if fork-lift trucks were to be used to any great extent, they would consider the removal of the platform at the rear of the shed. That was a problem which cropped up rather a lot at present, when universal use was not being made of the fork-lift truck. Supposing the new shed were designed without a raised platform at the back for loading the trucks or lorries, and supposing that fork-lift trucks were not adopted entirely, one would be faced with the problem of lifting the goods from the floor to the deck level of the truck. Was it not better to continue with a loading platform at the rear, because could not a fork-lift truck equally well load the lorry or railway truck from its deck level?

In those circumstances, they would be equipped for either fork-lift trucks or ordinary trolleys.

On p. 564, the Author had said :—

> " Lack of space makes it necessary to combine transit sheds and warehousing, which otherwise would not be advocated. . . ."

Mr Scott said he whole-heartedly supported that comment, provided that there was sufficient space at the rear of the port. It always seemed to him a heresy to allow the transit-shed area to be cluttered up with storage sheds. The transit-shed and dock area should be regarded as a live area and the storage should be taken into the dead area at the back, where traffic would not interfere with traffic coming to and from the ships.

Mr Scott then referred to the apparently enormous cost of equipping a berth with mechanical equipment, as quoted by the Author. Even then, it had to be considered as almost worth while if the saving in the turn-round time of a ship were as great as the Author had claimed. After all, the essence of all port working was to get the ships away again quickly.

Mr Scott said he was also interested in the use of aluminum sheeting. He had been surprised to read, on p. 568, that aluminium was used on shed walls above 5 feet from the ground. Obviously, the bottom part should not be too fragile, but was aluminium also used on the quay-side face from 5 feet upwards ? He would have thought that from 5 feet upwards it was still subject to heavy damage from swinging loads from cranes in a wind or under imperfect control.

The use of aluminium in tropical countries was to be advocated because of its cooling properties, but in a port it was also necessary to bear in mind the trouble it caused, at certain times of the day, when it reflected the hot tropical sun back on to the captain's cabin or the passengers' cabins ! Had the Author had enough experience of the use of aluminium to know whether it stood up to the hard wear it was apt to get in a port ?

Finally, Mr Scott dealt with a reference to quantity surveyors, on p. 554. He was sure that the reason for employing quantity surveyors by the P.L.A. were good, but what could a quantity surveyor do that an engineer could not do ? A man could not be an engineer until he had learned to do quantity surveying—particularly in civil engineering. That the contractor and the Authority should be able to agree on one single quantity surveyor was very commendable ; Mr Scott could not imagine a contractor and an employer agreeing on one civil engineer to take out the quantities ! He did not know why it was that quantity surveyors attracted an impression of infallibility and impartiality which did not attach itself to engineers.

The only point in favour of the arrangement was mentioned on p. 557, where the Author had said that costs were reduced, " . . . partly from increased supervision by professional engineers, which has obtained more work for the same money." That was a flattering statement, if true, and one which Mr Scott hoped could be demonstrated. It suggested that perhaps the removal from the sphere of the engineer of the humdrum business of measuring and adding up—which any engineer could do—would leave his mind free to concentrate on the technical problems.

If, however, *quantity surveyor* " *fetish* " were carried to its logical conclusion, a race of engineers would be produced of the type generally known, nowadays, as back-room boys or technicians. They would have no experience of finance and the almost commercial outlook which was so necessary in design. They would merely be able to design something so that the quantity surveyor could take out the costs and tell them afterwards. Then, indeed, Sir Joseph Broodbank's criticism would perhaps become applicable and the broad-minded administrative engineer would become a man of the past, and would have to be replaced by the broad-minded administrator without engineering experience, to the detriment, Mr Scott thought, of the works they were discussing.

Mr C. W. N. McGowan observed that, on p. 572, the Author had referred to " . . . the transition from the 30-cwt non-luffing hydraulic cranes of 1913 or earlier to the 5-ton level-luffing electric cranes which are now being purchased. . . ." Whilst realizing that the Paper gave a very interesting survey of a unique opportunity given to a public authority to recover from colossal war damage in a period of 7 years, and so far as finances would allow, it was as well to visualize whether the direction of post-war mechanical port development so described had been, in fact, the right direction when considered in comparison with similar development in the United States. Development there had been basically on different lines, though not necessarily better lines.

First, no single pier in New York was equipped with a dockside crane. The cargo was transferred between pier and hold on the Burtoning system, employing ships' gear and a steel cargo mast which ran the length of the pier above the transit shed. Those two systems together had been invariably used in New York harbour since the date of the first steamship. Floating cranes up to 300 tons were used for heavy lifts.

Secondly, the Burtoning system was claimed to present greater flexibility in handling merchandise when used with pallets and fork-lift trucks. The practice in the United States was an allocation of about 700 pallets per truck.

Thirdly, ship's gear had been developed to a high degree of efficiency and versatility. Over there, the price of the travelling level-luffing quayside crane today was approximately three times the price of ships' modern gear.

The principle was that a ship was regarded as a trader with something to deliver or to load. Why not, therefore, let the owner of the ship carry out his own loading and discharging ?

The result was that the New York docks presented an extraordinarily clean lay-out because of the complete absence of dockside cranes. After having been accustomed to the general practice in Great Britain, the appearance in the United States was arresting.

Mr Palmer had referred to the problem of obsolescence. The practice in Europe was that the harbour authority would carry the whole of the cost of maintenance, improvement, modernization, scrapping, and replacement of all the mechanical equipment, whereas in the United States the harbour authority had been freed from that load and that capital and revenue expense.

It was admitted, of course, that the range of tides in the United States was low compared with the tides in Europe. It was probably the case that ships' gear would not be so easy to operate in Europe where tides had a higher rise and fall.

Investigations on the subject had been conducted by the International Cargo Handling Co-ordination Association at the Rotterdam Conference in May 1952, as well as by the International Association of Navigation Congresses and by Dr Neumann, Chief Mechanical Engineer, Port of Hamburg. The question always put was, "Does the quayside crane increase the capacity and economic efficiency of the port ?" It was probably true to say that if longshoremen trained in Europe in the use of quayside cranes, and similar men trained in the United States in the Burtoning system, were asked to reverse their methods, there would be a big decrease in the efficiency of port handling.

Nevertheless, the challenge was ever-present. For instance, on p. 574, the Author had declared that wall-cranes had possibly reached the limit of their development, owing to drivers' visibility difficulties.

Mr McGowan thought that the European method was right in the long run.

As Mr Lewis had observed, the Author had dealt with the fork-lift truck on p. 575, by stating that the chief claim to fame of the fork-lift truck was that it was the latest idea. It was appreciated that the dock workers were suspicious of mechanization and that employers were wary of sinking a great deal of money into machines, lest it be wasted. Unfortunately, whilst casual labour in the docks was dead, the casual mentality was dying only slowly. As a result, mechanization was well behind, despite the fact that the export trade of Great Britain was now at its highest in history.

As an example of that, Mr McGowan cited the case of a Liverpool firm which had spent £6,000 on six fork-lift trucks, but nobody had used them for 6 months.

He suggested that the answer might be a greater use of pallet trucks on the lines mentioned by Mr Stephenson and Mr Scott. The importance of that had been stressed by Lord Waverley at a British Standards Institution luncheon towards the end of 1952. Mr McGowan also said that there was room for improvement in the system of handling goods or operating inside the holds of ships. He understood that a French device had been produced which was capable of increasing the rate of discharge from within the hold.

The next developments, he suggested, were the greater use of whole trains of trucks on the quayside, and the greater use of pneumatic and belt conveyors for bulk cargo.

Mr J. H. Jellett observed that he was prompted to take part in the discussion because of Mr Palmer's impassioned plea for more and bigger works for docks engineers, a plea which, in theory, he heartily supported, although one had to be a realist in those matters. Mr McGowan had touched on one aspect of the problem when he had said that the whole burden of such works fell on the port authority. It was a fact that, under the present system of charging for services in most of the ports of Great Britain, shipowners were entirely free to make their ships of whatever size, shape, length, breadth, or depth they chose, provided they could get them into the port, and the port authority could recoup themselves only on the actual tonnage; whereas the dimensions of the ship, in the inconvenience of dealing with it, might far outweigh any extra payment received because of increased tonnage.

A few years ago, Mr Jellett had had occasion to make a calculation affecting Southampton, from which he had ascertained that, from the point of view of the port authority, the total dues collected per passenger out of one voyage of the *Queen Elizabeth* was the same, within a penny or two, as the total collected per passenger if those passengers had come, as they could have come, by three voyages on the *Mauretania*! He would not emphasize the difference in capital works involved in making a port capable of handling the *Queen Elizabeth*, as compared with one capable of handling the present *Mauretania*. It was the same Chief Engineer to whom Mr Palmer had referred, who had said that the cost of the capital works at a port varied approximately with the cube of the draft of the deepest ship for which the port was intended to cater.

If the salary of the chief engineer varied in the same proportion, Mr Jellett would be pleased, bearing in mind the ships which came to Southampton! In all seriousness, however, the point he had made should be borne in mind when considering whether port facilities were suitable for the larger ships which were being built.

Today, so far as he could see, almost the whole economic advantage of building bigger ships accrued to the shipowners and very little to the port authority.

Mr Jellett congratulated the Author on the courteous way in which he had "debunked" the excessive claims of the fork-lift truck. There was no doubt but that the fork-lift truck was a very useful device but it would not do everything and it brought with it certain disadvantages. Its innovation in Britain dated from shortly after the 1939–45 war, when it had been surrounded by a certain aura from the performance which had been witnessed when it was in the hands of the Americans who occupied some of our ports during the war.

If it were to be used in the loading of upper floors of warehouses, there were certain economic implications which could not be overlooked. Mr Jellett said that the same orange-handling problem as that described by Mr Lewis had been experienced also at Southampton, where they were using electric scooter platform trucks, combined with stillages under the landing boards, enabling each sling of cases to be brought straight into the shed where sorting took place.

*** **Professor Herbert Addison** observed that the Paper appeared to make no mention of the passenger traffic handled by the Port of London Authority, and he would therefore like to ask whether the Author could give any indication of the relative importance of that traffic in 1952 as compared with, say, 1939.

Since Professor Addison had himself had the privilege, as an incoming passenger, of using the Authority's facilities during 1952, he would like to record his impressions. Certainly his predominant feeling was one of admiration for the skill and judgement of all those who helped in any way to work the vessels into and out of Tilbury docks. The 20,000-ton mail steamer on which he had been travelling, after lying fog-bound for several hours, had negotiated the entrance lock while visibility was still poor but when river traffic was heavy. While watching that manoeuvre, he had remembered very clearly an earlier Paper presented to the Institution, in which the siting of that entrance lock had been discussed at length. He would therefore now like to ask whether, after many years' operating experience, the Authority's engineers were satisfied that the lock really had been built in the best position.

When, on that particular occasion, passengers had finally disembarked, they had had the opportunity of comparing reception facilities at Tilbury with those they had observed at an earlier stage of the voyage. At Naples, for instance, they had seen a very imposing passenger terminal building, reconstructed, so it was said, after the war. While trying to get away from Tilbury, passengers could appreciate a point raised in connexion with freight handling in the present Paper, namely, the growth in road traffic at the docks. Although a special boat-train had been provided for the journey to London, the number of motor-vehicles waiting for passengers and their friends had been so great that considerable congestion had occurred. Doubtless they would have received a more favourable impression if the ship had been able to come alongside the floating landing-stage; in any event, they had been much better off than they would have been 30 years previously, when passengers had had to come ashore in tenders. The question which arose was, therefore, were any improvements contemplated which would take into account (1) the continued construction of high-class passenger ships based on the Port of London; (2) the increase in road traffic in connexion with passenger embarkation and disembarkation; (3) the

*** This contribution was submitted in writing upon the closure of the oral discussion.—SEC. I.C.E.

competition of new ocean terminal buildings, with improved baggage-handling facilities, such as the one at Southampton ?

One other question, which perhaps lay just outside the scope of the Paper, related to the recent disastrous high-tide and storm floods. They had caused serious damage at dock and other installations on the south side of the Thames estuary, but apparently the Authority's own installations had remained immune. If that was indeed so, it would serve as a very high testimony to the foresight with which the works had been planned.

The Author, in reply, said that Mr Glossop's description of the site works for the prestressed-concrete transit shed was a valuable contribution to the discussion but he did not propose to make further comment on that point since it seemed likely that a Paper on the building would be presented during the 1953–54 Session.

He was very grateful to Mr Stephenson for giving so many facts and figures for the working of the Mersey Docks and Harbour Board for comparison, since that made the Paper more useful, and he was interested by the suggestion that it became necessary to modernize a port one hundred years after construction. The main docks reconstruction in London had occurred almost 50 years previously and the replacement of war damage had permitted a fair amount of modernization, so on Mr Stephenson's basis, London might be considered a fairly up-to-date port.

The practice of providing one 5-ton to five 3-ton cranes, to which Mr Palmer referred, only applied to deep-water berths and the figures in Table 3 included the numerous cranes at small berths for coastal vessels, where 30-cwt cranes were adequate. The Table did not include the 3-ton cranes on order. The increase in gauge from 13 feet 6 inches to 18 feet had been proposed because the greater width permitted a more economical design of the crane structure when the duty was of the order of a 5-ton lift at 90 feet radius and the height of the underside of the crane cabin was 50 feet. Clearance between the cabin and the overhang of the ship's superstructure was also improved. The deciding reason for adopting the 18-foot gauge in preference to the 15-foot gauge which was frequently recommended was, however, that the port had already some 18-foot-gauge cranes and interchangeability was considered to be important.

Referring to the road, rail, and shed lay-outs shown in *Figs 5* and in Figs 6 and 7, Plate 1, there was a lay-out which, having regard to all the known conditions, was the optimum one for a particular site but not necessarily for any other. In the lay-out in Fig. 7, two sets of rail tracks on either side of the back road were preferred, since in that way it was possible to provide access between the road and the shed where lorries could back-up for unloading without obstructing the running lines to which access was obtained by frequent cross-overs. Rail tracks were still required on the quay for direct ship-to-rail trans-shipment.

In quoting Sir Joseph Broodbank, the Author had taken the " ideals of engineers " as applying to maintenance, which agreed with the context. Certainly the development within the Port of London which had taken place under Sir Frederick Palmer had been the making of the modern port. It was, however, fair comment that, left to himself, an engineer might try to achieve too high a standard of maintenance. Full efficiency of plant and tidiness conducive to effort were essential, but beyond that maintenance expenditure had no economic function.

The need to keep port facilities abreast of ship development was a stimulating problem shared with airfield and highway engineers. Ships, aircraft, and vehicles had a comparatively short economical life whilst the permanent structures they required to serve them had a life three or four times as long. Since it was frequently impossible to design structures to resist the physical forces involved with a short life, it became necessary to forecast development by examining trends in recent design. That could be an unreliable procedure and, moreover, in rivers and estuaries, nature frequently provided a limit beyond which it was uneconomical to extend. If the conception of designing for obsolescence were being considered, allowance should be made for the fact that the giants of today were the normalities of tomorrow and it would only be the services at the bottom of the scale which would become obsolete. Medium-sized ships of 8,000 to 20,000 tons were producing a higher demand than ever before on the facilities available.

There was no reliable figure of wide application giving the numbers of tons of cargo which could be discharged through one hatch. However, taking a variable cargo, in a large vessel with five or six hatches, a figure of 100 tons per hatch per gang might be taken as conservative. The road traffic figures given on p. 564 had that basis. If two gangs were used on one hatch under favourable conditions, that figure might be doubled.

The Author particularly welcomed Mr Lewis's contribution to the discussion on the use of fork-lift trucks, because he was a pioneer in that technique. It was interesting to note the view that " throughout palletization " from manufacturer to distributor through the docks would add to the port operator's difficulties, but the Author hoped that when the demand arose for mass handling of standard pallets from quay to ship the engineer would be able to supply the answer. It was agreed that the use of fork-lift trucks could lead to a quicker turn-round of ships, but unless the reduction in loading time were consistent, the ship owners might not be able to take advantage of it in arranging new schedules. The type of goods which could be handled in that way at present seemed to be limited and the advantages of the fork-lift truck were correspondingly limited. It should be mentioned that the pallet and cargo boards illustrated in *Figs 16* had been patented by the firm that had manufactured them for the port.

In reply to Mr Scott's remarks concerning the proportion of 3-ton to 5-ton cranes, the proportion of five to one had been arrived at as a result of a study of actual loads handled. London shipped goods to and from all parts of the world and it would appear that the loads experienced in London would reflect general practice in most other ports, although the proportion of heavy to light lifts might be expected to vary. In the new cranes on order for the Authority, the hoist speed for a 5-ton crane lifting $1\frac{1}{2}$ ton was faster than that of a 3-ton crane with the same load. The slewing speeds were the same, but the luffing and travelling speeds of the 5-ton crane were slower. The Author had not suggested that it was necessary to consider the removal of loading platforms at the rear of sheds to enable fork-lift trucks to be used. The present need for those platforms frequently required sloping floors in the transit sheds. That was not an entirely satisfactory feature and if the development of the fork-lift truck rendered the platforms redundant, their removal should be considered to enable the shed floor to be laid flat.

Corrugated aluminium-alloy sheeting of suitable gauge was a strong and robust material almost equalling steel, but with greater deflexion for a given bending moment. With suitable purlin and sheeting-rail spacing it seemed probable that a blow that would damage aluminium alloy sheeting would also damage steel sheeting. In the Authority's experience, the bottom 5 feet of the shed wall, both on the quay side and at the rear of the shed, was most vulnerable. With wide quays, the walls above that level were unlikely to be damaged by swinging sets. Thus 5-foot-high brick perimeter walls would have been built even if steel sheeting had been provided. In another transit shed, shortly to be constructed, it had been decided to provide brick walls for the full height of the shed and a useful comparison of maintenance cost would become available.

There was much that the Author agreed with in Mr Scott's remarks about the employment of quantity surveyors. The responsibility for estimating, specifying, and financial control rested with the Authority's engineers, but where a maintenance contractor was employed on a schedule of prices basis, the services of specialists (and that was, in fact, what quantity surveyors were) were useful and economical.

The merits and demerits of the quay cranes as opposed to ships' gear, as mentioned by Mr McGowan, had formed the subject of discussion for some time. The subject had been very well reviewed by Dr Neumann of Hamburg in a recent article in the technical press. The Author viewed the problem from the standpoint that it was the duty of a public authority to provide the best service within economic limits. Shipping companies and stevedores required and, in the long run, paid for quay cranes; otherwise they would not be provided. It seemed probable that the practice of not providing quay cranes in America had developed because the finger piers in the most important port in the United States of America—namely, New York—did not lend themselves to their installation. To compensate for that, the use of ships' and other mechanical appliances had been highly developed in America and the longshoreman had, by practice, developed a high proficiency in their use. It was not possible, in the Author's opinion, to arrive at a satisfactory comparison of the merits of the two systems from a consideration of the output per man-hour in America and Europe, for that output depended to a large extent on the complex question of labour relations.

The problems which arose from the increase in dimensions of ships, which had been raised by Mr Jellett, had already been discussed. It would appear that the system of dues in use at Southampton would, from Mr Jellett's description of it, encourage the shipping companies to build even larger ships. The problem was, of course, one which required co-operation between the interests concerned, and the Author hoped that the "Committee on the Depths in Sea Ports," set up by the British Section of the Permanent International Association of Navigation Congresses, might do some useful work.

The increased use of the mechanical handling appliances had a great effect on the design of dock structures, as mentioned in the Paper, and the increased cost of such structures had to be borne in mind in assessing the economic value of the use of the appliances.

Professor Addison's inquiry regarding the relative importance of post-war as compared to pre-war passenger traffic might best be answered by quoting the figures for the Tilbury passenger landing stage.

In an average pre-war year the inward and outward total had been slightly more than 100,000. In 1952, the corresponding figure was slightly less than 170,000. In addition there were passengers embarked and disembarked in Tilbury and other docks.

In Tilbury Docks the Authority had authorized the construction of a new quay on the north side of the main Dock. The quay would be 830 feet long with a return section 240 feet long. A "T"-shaped single-storey transit shed would be built, the main portion being 550 feet long and 120 feet wide. The shed was to accommodate passengers, as well as cargo traffic, and passenger platforms together with arrangements in the area for service buildings, railways, roads, and parking and other special facilities would be provided. A scheme for improved road access to the docks from the north had been planned in conjunction with other authorities concerned and would be undertaken when conditions permitted.

With regard to the main Tilbury entrance lock, some difficulty was experienced at certain states of the tide owing to the current which set across the line of the lock, but information given by Davis and MacKenzie amplified by Sir Cyril Kirkpatrick in a Paper [1] presented to the Institution required no qualification after about 30 years' experience. Considered today, the decision to place the entrance almost east and west from

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[1] F. W. D. Davis and W. MacKenzie, "Major Improvement-Works of the Port of London Authority, 1925–1930." Min. Proc. Instn Civ. Engrs, vol. 240 (1934–35), p. 258. See also *Discussion* by Sir Cyril Kirkpatrick, p. 325.

Northfleet Hope seemed to make the best possible provision, since ships arrived on the flood tide during which (and the subsequent slack water) the best conditions prevailed at the entrance. It might be that experiments which it would eventually be possible to undertake in the Authority's hydraulic model might indicate a simple way in which the ebb-tide current across the entrance could be reduced. However, unless the expenditure required to make that modification was small, it would not be worth while.

The docks had suffered practically no damage from the floods of January–February 1953 because the flood levels recommended by Sir George Humphrey and Sir Frederick Palmer in their report to the London County Council following the 1928 floods had been adopted.

In conclusion, the Author thanked those members who had taken part in the discussion. A great deal of work had been and was being done in London and other ports and he considered that the interchange of information regarding those works and the organizations developed to carry them out was one of a vital interest to the Maritime Division.

The closing date for Correspondence on the foregoing Paper has now passed without the receipt of any communication.—SEC. I.C.E.