species of very wide covering strips, running in a vertical direction up the gate, and by their thickness unduly adding to the weight, and to the risk of imperfect jointing.

It must not, however, be concluded, that the inconveniences of the cylindrical mode of construction have been lost sight of. No doubt the curved work entails additional cost in the manufacture, and should only be intrusted to contractors of experience and reputation. It also to a certain, but not to a large extent, diminishes the surface of heel post in contact with the hollow quoin. It likewise, from the curved form and depth of the gate recess in the side walls, somewhat breaks the quay line, and, where the curvature is considerable, renders the application of fenders desirable, to prevent the concave side of the opened gates from being run into. Most of these are, after all, insignificant objections. The first, the cost of workmanship, is more than abundantly covered, by the great saving in material, shown by even the most unfavourable example.

The attempt has now been made to prove—

1. That a lock gate, of the cylindrical form, can be made with about half the quantity of material required for a straight gate;

2. That with the same ratio of rise to span, a saving of from $11\frac{1}{2}$ to 55 per cent. may be effected in the skins alone; and that a further saving may be made in the horizontal diaphragms; and,

3. That by this mode of construction great facilities are afforded, for rendering the gates water-tight, and greater certainty is attained in accomplishing this very important object.

One general observation may be offered, in conclusion, that while the primary object of scientific construction should be to select and apply materials directly to meet resistances and proportioned to them in amount, yet there are instances (especially in complex cases of combination where two, or more important objects are in view at one time), in which, a modification of the form of the structure, and thereby of the mode in which the forces act upon it, is productive of a great economy of material, besides accomplishing the other important purposes demanded. It is believed, that the lock gate, under discussion, is a prominent example of this, and it is worthy of consideration, whether there are not many other instances to which this principle might have wide and important application.

The Paper is accompanied by a complete series of Diagrams, from which Plates 5 and 6, and Woodcuts Figs. 1 and 2, have been compiled.

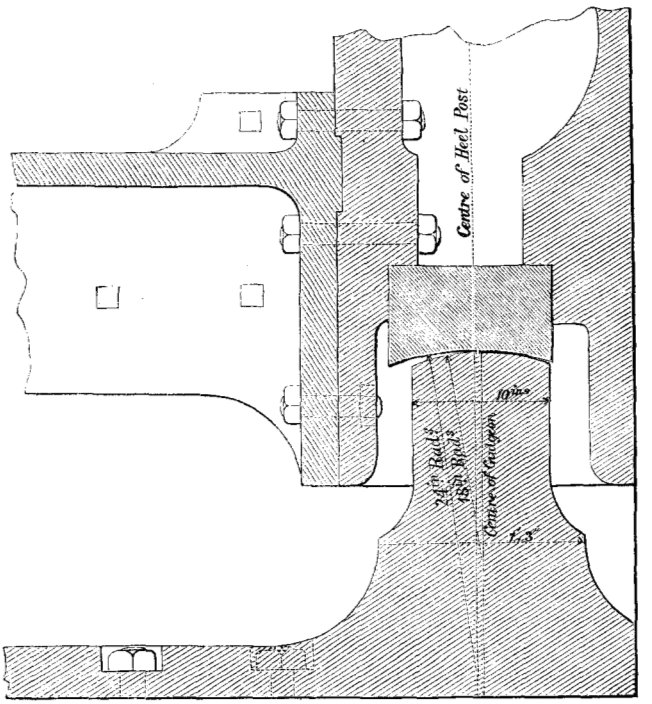
Mr. ABERNETHY said, he thought the system of cast-iron wharfing very appropriate for the wing walls of the entrance of the Victoria Docks, supposing provision to be made for receiving a timber covering to prevent the fracture of the plates. Cast iron wharves possessed great advantages in such situations, as the expense of coffer-dams and other costly works was avoided. The cast-iron cill was, he believed, exposed to great risk of fracture, as it was nearly impossible, at all times, to prevent soil, or hard substances, getting between the lower rib and the cill; and a cill so constructed had not, in his opinion, the permanent character which such a work ought to possess. He preferred a good granite cill, well dressed, which was the plan he had adopted at Aberdeen, at Swansea, and at other dock-works, where he had not had a single accident, nor was there any difficulty in making and maintaining the gates tight. In regard to the system of construction adopted for the jetty walls, that of brick arches between iron piles with concrete backing, the piles being retained in position by tie-rods, he thought it did not possess that amount of security which was required. The tie-rod, in such a case, was an equivalent for the abutment of an arch, and in a short time the iron would oxidize, and be apt to fail. Unless great economy could be shown by the adoption of this plan, he should prefer the usual mode of construction,—a substantial quay wall.

With respect to the presumed advantages of wrought-iron gates, in all cases, over timber, he had not quite made up his mind; because lock gates of iron, exposed to the action of salt water (a case not applicable of course to the Victoria Docks), were liable to rapid oxidation, and there was some difficulty in getting between the skins of the gates to paint them. In time decay would take place, besides which, concussions from vessels were liable to start the rivets, and to render the gates leaky, in which case iron gates always worked heavily. He preferred, as far as his present experience went, good substantial timber gates. Much ingenuity had been displayed in the construction of the caisson, but he could not see the advantage of floating it on its side. A recess should be provided adjoining the site where it was to be used, and it should be floated to its place upright. It might then be placed out of the way; whereas large caissons, unless the dock area was very ample, were an incumbrance.

Mr. JOHN MURRAY, after complimenting the Author of the Paper on the admirable plans and drawings with which he had illustrated it, said as some failure had taken place in the working of the gates, where the error was not found out until the gates were taken from their places for examination, and then a remedy was applied, he would refer to the cast-iron heel posts of the dock gates at Sunderland. (Fig. 3.)

It would be seen, that a socket was left in its lower end to receive the gudgeon of the gate. Into this socket an octagonal

Fig. 3.



Cast-iron Heel-post of the Dock Gates at Sunderland.

step was fitted, on which the upper part of the gudgeon, struck with a different radius to that of the step, worked. He had placed the heel-post of the gate, or rather the step in its lower post, about half, or three quarters of an inch out of the centre of the gudgeon, so that by gradual working it would come to a bearing in the centre. He had been informed that the best millwrights usually adopted this practice. In the case of the three pairs of gates at the north end of the Sunderland Docks, the step was of brass, whilst at the south end it was of cast iron, and had worked exceedingly true; but for the future, if working in salt water, he should apply gun-metal. The caisson he much admired, and also the method by which it was floated into place; but it was omitted to be mentioned in the Paper in what part of the works it was applied.

Mr. KINGSBURY explained, that the caisson was placed in front of the lower gates, where the entrance began to narrow.

Mr. MURRAY said, the next point to which he wished to draw attention was the rollers of the gates. At Sunderland they were subjected to much action, and wore away rapidly. The ribs of the gates, and also the heel and mitre posts were of cast iron, and the ribs were planked with green-heart timber. They were intentionally made very heavy, to withstand a considerable action of the sea. After five years' work in salt water, and exposed to the fine sand at the entrances, which was drawn into the tidal basin and dock over the aprons, in consequence of the former being permitted, notwithstanding his frequent remonstrances on the subject, to silt up above the level of the cills, and to save trouble, the gates during flood were not kept back in the recesses, but allowed, when about half open, to work backwards and forwards, so that the rollers were in constant motion during the least swell. Whether it was from the action of the salt water, or the sand, or both combined, the rollers, which were originally 2 feet in diameter and 5 inches in breadth, were reduced in five years to 1 foot 10 inches in diameter. He was of opinion that, in similar cases, when subjected to the action of salt water, the rollers should be made of gun-metal. Those of the south entrance gates were made 6 inches in width, and the traction plates of the same width. The plates were solidly bedded in a groove of the masonry, to which they were bolted and run with lead. He thought that with heavy gates, the traction plates ought to have been laid on granite; as the stone employed at Sunderland, although strong in quality, like that of Bramley Fall, was not sufficient to prevent a tremulous motion being given to the ends of the plates when the rollers passed over them.

Mr. ALFRED GILES considered the plan of the jetties of the Victoria Docks gave the greatest facilities for the trade that could be well devised. There was no question as to the economy of jetties, where the quay space was limited. He would be glad to know the reason, why the cill was laid 18 inches below the bottom of the dock, which it appeared to be from the statement, that the depth of the dock was 24 feet below Trinity high-water mark, whilst the cill was 25 feet 6 inches under the same level. He thought in such a case there would be great liability to deposit, which would be apt to interfere with the working of the gates. It would also be interesting to be informed, why inverts were not built between the lock walls near to the gates, in the ordinary way, and why the cill and gate were constructed of level courses of brickwork, the whole being surrounded with piles? He knew it was the custom to use piles: in fact to build locks generally in a box of piles. But he had constructed several locks without the use of any piles, and he could never discover that piles were of any great advantage in keeping out the water, for where

there was a constant head of water of 20 or 30 feet, whether there were piles or not, the water would find its way in, and eventually subject the work to the full hydraulic pressure. The cost of the lock walls was stated to be £17. 0*s.* 6*d.* per lineal foot, a price which appeared to be high, as there was no invert. Without the iron piling, but taking the masonry and concrete together, he thought it might have been executed for less money. In that particular soil piles might possibly be advantageous; but taking into consideration the immense quantity of concrete used in front of them, he should have imagined that piles would have been unnecessary. The leakage of water into the cellars of the warehouses at the Victoria Docks coincided with his own experience. He had found much difficulty in keeping water out, and preventing its accumulation, where there was a constant head above the cellar floor, unless there was a drain to carry it off to low-water mark, when the water, as soon as it leaked in, found its way into the drain. It was stated, that the fracture of the iron cill had been overcome without difficulty: but it seemed to him, that the construction of gates 80 feet in width, without an invert cill, was a bold piece of engineering. He should like to know, whether the cill, which was simply a brick beam, had been found capable of resisting the upward pressure due to 18 feet of water. One of the principal items of expense in dock work was the depth of the stone cill which many engineers thought it necessary to put between the gates, and if it could be proved, practically, that this was not required, an important saving might hereafter be effected. He did not understand, how the roller path was fractured, when the weight upon it was increased by a certain amount of leakage in the gates. The roller path was stated to have been calculated to carry only 12 tons, but the weight of each leaf of the gates was 100 tons, which would give, in round numbers, 50 tons upon the pivot and 50 tons upon the roller track. Consequently in the process of fitting the gates, and before they were finished, there must have been a pressure of 50 tons upon the roller track, and it should, therefore, have been made capable of sustaining that weight. He would only further add, that the accommodation afforded by the Victoria Docks had been provided at much less expense than was usual in the port of London, so that vessels could be admitted at lower charges than heretofore; whilst the general arrangements were such as to facilitate trade, and they reflected the greatest credit on the engineer who designed the works. He looked upon the caisson as one of the most admirable inventions ever applied to dock works. It could be adapted to a variety of purposes, at a small cost, and having recently been engaged in designing a caisson, he regretted not to have had the advantage of knowing of this plan before.

Mr. COOPER believed, from his own experience that, on the River Thames, wood, where not liable to be attacked by worms, was preferable to iron for the construction of lock gates, partly on account of its comparative cheapness. There were timber gates in the port of London, which had been erected forty, fifty, and even sixty years, which were still in good condition; though they were not so large as those at the Victoria Docks. It had yet to be ascertained, how long iron gates would last, nor had the comparative first cost of the two materials been stated by the Author.

Mr. BRAMWELL said, there was one purpose to which the hydraulic apparatus at the Victoria Docks had been applied, which was not, he believed, intended by the Engineer, and which must have put the gates to rather a severe test. He was in the lock some time ago, in a small steamer, when, although the lock was nearly full of vessels, a barge attempted to enter, and succeeded in getting within the range of the gates, as they closed, and then they, worked by the hydraulic apparatus, were used to force it in amongst the rest of the shipping. He presumed such an employment of the apparatus was not contemplated.

Mr. ROBERT RAWLINSON had in former years, whilst in the Dock Engineers' Office at Liverpool, been much engaged in making drawings for dock gates. He thought one of the most instructive papers that could be written was one which would put the Institution in possession of the plans and details connected with lock gates and lock and dock building generally, as practised at Liverpool, together with the particulars of such failures as had occurred. With regard to the method of forming dock-gate aprons, or platforms, he could state, that Mr. Jesse Hartley never bonded a platform with the side walls, until the latter were carried fully up, and brought to a solid bearing. It would be interesting to have as much information as possible with reference to dock gates of large span. He had seen wooden gates of 75 feet span, whilst those at the Victoria Docks were only 80 feet in width. In the large gates put up by Mr. Hartley, the expedient was resorted to, of cutting the bars in two, and wedging them up, to produce the requisite curve. Dock gates of wood, as constructed at Liverpool, cost from 15 shillings to 30 shillings per superficial foot complete, and there were gates upwards of thirty years old. The marine worm attacked English oak, and the only wood used at Liverpool, which it did not attack, was green-heart. The common mussel attacked wood, and destroyed it, almost as rapidly as the teredo-navalis. The wrought-iron caisson used at the Victoria Docks was an admirable contrivance, obviating the necessity for a brick, or masonry stank wall, which had to be removed, and the material of which was all more or less destroyed. The cost of

removal would certainly not be paid for by any value in the material removed from an old stank wall.

Mr. GILES said, with respect to the comparative cost of iron and wooden gates, there was no difficulty in getting timber of sufficient scantling, at a reasonable cost, for straight gates of 50 feet or 60 feet in width, but when the width was increased to 80 feet, the size of the timber required would be so large and the price would be so high as to prohibit its use, and the Engineer had no alternative but to resort to iron. American oak had been used for the purpose, but it was not so durable as English oak. Green-heart was, also, occasionally used, but this wood was expensive to work, and was very liable to split. He thought, for gates of the large span of 70 feet or 80 feet, iron was both the cheapest and the best; and he was persuaded that if the attempt was made to construct gates of 80 feet span with wood, they would be considerably more costly than iron. He had made several pairs of wooden gates, and one pair of iron gates 80 feet wide. The size and cost, with other particulars, of some of these were as follows:—

Width of Gate.	Made of	To carry head of Water of	Area.	Cost per superficial Foot.
Feet.		Feet.	Sup. Feet.	Shillings.
46	Fir and Oak	16	1,416	9
51	Fir and Oak	15	1,003	20
56	American Oak	16	1,830	17
66	English Oak	22	1,764	26
80	Iron with Fir plank	27	2,534	33

He had seen the gates at the Victoria Docks opened in less than a minute and a half; whilst at Liverpool, he had known the operation of opening gates of 70 feet span, to occupy twenty minutes, and to require the labour of six men on each side; and with his own gates of 80 feet span, he thought he had done well to accomplish the operation of opening in six minutes and a half, with four men on each side. Therefore, there could be no question of the advantage of the hydraulic apparatus.

Mr. G. P. BIDDER, *V.P.*, said, having been professionally connected with the Victoria Docks, as Engineer-in-Chief, he naturally took great interest in the Paper that had been prepared by his friend Mr. Kingsbury, and which contained a full and detailed description of those works. He had expressed a wish, that no information should be withheld, which might be useful to the Members of the Institution, and especially that the casualties to which the works were exposed, should be freely commented upon, feeling convinced that the most valuable experience was derived from the honest description of such occurrences, and that

they ought accordingly to find a prominent place in every account of works, particularly of those of an extensive character.

It would be interesting to enter succinctly into the origin of these Docks. For this purpose it became necessary to go back to the years 1842-3. At that period he and three, or four friends were so strongly impressed with the importance of connecting the Eastern Counties Railway, at Stratford, with the River Thames, by means of a branch railway, that they undertook the responsibility of constructing a line, which was generally designated as "Bidder's Folly." It had its terminus in an extensive tract of marsh land, bordering the Thames, and it was altogether a project which the Railway authorities, to whom it was submitted, had not courage enough to carry out. This "Stratford and Thames Railway," however, proved at once so advantageous, that the Eastern Counties Railway Company took it at cost price. An extension was then projected to North Woolwich, which was reported against by the Board of Trade, on the ground that there was no public necessity for the line. This rendered it essential to appear before a Committee of the House of Commons; and although Mr. Austin, who was retained for the promoters, only received his brief as he walked to the Committee, he managed to speak for half an hour, and the Bill was obtained.

Connected with this undertaking was, what some thought and called, a land job, but in fact it was a land speculation forced upon the promoters by the landowners themselves. Before the introduction of steam-boats for the conveyance of cattle, this land, which was partly pasture, and partly arable, and as productive as any in the United Kingdom, let for £6 and £7 an acre. But, from a feeling that this high rental was not likely to be permanent, several of the landowners determined to oppose the railway, unless the whole of their land was purchased. The land, at that time, was never valued at more than £100 per acre; and even after the passing of the Act for the Victoria Docks, land was sold by auction at that price; so that whatever additional value had since been acquired by that land was due to the exertions of those who applied their minds and their capital to the development of the undertaking. The Dean and Chapter of Westminster received £8,000 for 47 acres of land, which was not worth more than £4,000, in order to get rid of their threatened opposition; and the Victoria Dock Company had paid for the 600 acres they possessed at the rate of £250 per acre, instead of at the rate of £100 per acre. Therefore a sum of £90,000 had gone into the landowners' pockets, over and above what they would have got, but for the carrying out of the first enterprise, and they ought to be satisfied.

The idea of the Victoria Docks did not originate with him, but

with Mr. Blyth, who however, after pointing out the site and some of the advantages connected with it, did not take any further interest in the matter, being satisfied to retain his connection with the West India Docks, and with the benefit resulting to his trade by the competition thus engendered. It fell, therefore, to Mr. Bidder's lot to develop the project, which presented several important facilities, among which might be enumerated :—1°. The land could be purchased for £250 per acre ; 2°. it could be excavated for £1,250 per acre ; and, 3°. it could be puddled for £250 per acre. Hence the cost of the water area, in that situation, amounted to £1,750 per acre. Again, the adoption of the jetty principle, which had been employed in the London Docks, afforded great facilities for working in the ships, and convenience for loading and unloading them. The peculiar mode of construction adopted was attended with considerable economy, while timber structures, of the same form, could at any future time be erected, when the extension of trade rendered it desirable. Lastly, the proximity of the Eastern Counties Railway placed the Docks, not only in connection with the City, by means of the Shoreditch and the Fenchurch Street Stations, but also, by means of the Great Northern, with the Midland and the whole of the manufacturing districts.

He was disappointed that so little had been said, in the course of the discussion, in the way of criticism, or suggestion, especially with regard to the form of the lock gates ; but he would, before he concluded, point out some modifications which might be advantageous.

Having had considerable experience in the construction of cast-iron wharfing, both at the Brunswick Pier, Blackwall, and at Fleetwood, he was led to adopt it at the Victoria Docks, where, there was no doubt, as regarded the entrance, the construction was amply sufficient. Experience showed, that if iron piling was made to penetrate a solid bed of gravel to a depth of 2 or 3 feet, an ample abutment was obtained, but if driven into clay, the depth must be much greater. In the lock at the Victoria Docks a portion of gravel was allowed to remain in front of the piling, but the greater portion was replaced by clay, as being an impervious material. Had the pumping been continued until the water was allowed to enter the lock, in all probability no failure would have occurred. Such, however, was not the case, and he believed the explanation given in the Paper to be the correct one, that the water which had been drained out of the bed of gravel by the pumping was, on its cessation, again taken up, and not being able to rise in the lock, brought a head of 14 or 15 feet (in addition to the filling) against the walls, and forced them forward, almost simultaneously on both sides.

The utility of enclosing the brick platforms with sheet piling

had been questioned, especially as the foundation was carried down to the London clay, but it was done as a precaution, and not on account of any apprehended danger from the percolation of water, and he thought it would always be advisable in similar cases. With regard to the water that found its way into the vaults of the jetties, it had been imagined that it had passed through the puddle, which in that case must have been imperfect; but this notion was not consistent with a fact he would mention. On referring to the general plan of the dock (Plate 5), a space would be noticed between the Eastern Counties Railway and the stank forming the termination of the eastern cut, which, being a bridge pit, was bared down to the gravel, and in which the water stood usually at the general water-level of the adjoining district. Westward from this, and on the south side of the dock, were the graving-docks designed by Mr. Edwin Clark (M. Inst. C.E.). As they were constructed after the Victoria Dock was in full operation, a coffer-dam was made in the dock, and the ground removed from behind it, to a depth of 8 or 9 feet below low-water mark. While the pumping was being proceeded with, in order to effect this operation, the water was lowered in the bridge pit 5 or 6 feet; in fact, it must have passed through the gravel laterally, and beneath the bottom of the dock, in order to reach the pumps. This showed that there was no connexion between the water in the dock and that which found its way to the pumps; therefore the puddle must have been sufficient, and he regarded the explanation offered in the Paper as correct and satisfactory.

Some pertinent questions had been put, relative to the application of hydraulic power in docks. No doubt it was advantageous in these docks, but it must not, therefore, be considered to be of universal application, for it would be quite inexpedient in a dock where the trade was small, and the opening of the gates infrequent, or in the case of a swing-bridge that was opened only once, or twice a-day. But where there was a large traffic, it was a great advantage to be able to open the gates in a minute and a half, especially in spring tides, when the tides remained for a short time only on a level, and frequently, from there being a pressure of shipping, it was of the highest importance to work the lock to the latest moment. A few facts would make this more apparent. On the 1st of April, 1859, eighty-three craft (barges) and sixteen ships, making up a gross tonnage of 6,072 tons, were admitted. On the 29th of that month, sixty-one craft and twenty-one ships, amounting to 5,519 tons;—on the 4th of May, forty-two craft and thirteen ships, or 8,494 tons;—while on the 12th of March, 1858, the day on which the greatest amount of work was done, forty-one

craft and seventeen ships, or 11,711 tons, came in at one tide. During the month of April, 1859, the number of

Craft entering the dock was . . .	1229
Ditto leaving	1288
Ships entering	250
Ditto leaving	258

or an aggregate of two thousand five hundred and seventeen craft and five hundred and eight ships entering and leaving in that period. This statement would enable an estimate to be formed of the advantage of being able to open the gates in a minute and a half, instead of occupying ten, or twelve minutes.

Another useful application of the hydraulic power was to work the capstans on each pier-head. These each required thirty men to work them, so that at times, the confusion and labour of from thirty to forty men were obviated by this contrivance. Again, there were one hundred and forty-five hydraulic cranes, all worked by two engines of 60 HP. each, consuming, when in full work, about 17 tons of coal per week. In addition, Mr. Cory had a coal apparatus, worked by hydraulic power, by which a ship of 1,200 tons burthen had been received at one tide, and completely discharged and sent out of dock at the next.

In reply to the observations which had been made, as to the construction of the jetties, that they were not of a permanent character, referring no doubt to the wrought-iron tie-rods, it was desirable to know what was meant by permanence, whether it was thought they ought to last for fifty, a hundred, or five hundred years, as without some stated limit the observations were useless. It could hardly be asserted that, covered up as they were and excluded from the atmosphere, these tie-rods of 2 inches diameter would decay and become useless within the next two hundred years. Again, a preference had been expressed for timber in place of iron for lock gates, and it was apprehended that the concussion of the ships would start the rivets and make the gates leaky. Now the fact was, that all timber decayed, and even oak would not last so long as rivets and plates; and as regarded danger from strain, the gates which were under discussion were subject to a maximum compression of one ton to the square inch, while they would be perfectly safe if it were increased to four, or five times that amount. It had not been stated how wooden gates of eighty feet span were to be constructed, and although Mr. Jesse Hartley had made wooden gates of 100 feet span for the Liverpool Docks, yet in that case they were divided into three compartments, with whole timbers; and though considerable ingenuity was displayed in the design, Mr. Bidder did not think they would stand anything like

the wear and tear which iron gates would do, and indeed they were not to be compared to them. Iron had been injudiciously used in some lock gates—those of the Caledonian Canal for example; where the ribs were of cast iron, and the heel and mitre posts and the sheathing of timber;—it was hardly possible to conceive a worse distribution of material.

Passing on to the caisson, he considered it as particularly worthy of attention. The idea originated, in a great measure, with Mr. Edwin Clark, and the details and mode of floating were worked out by Mr. Kingsbury. It cost £2,000 and had proved perfectly successful; and seen in its present position, it would be admitted there was no foundation for fear, that it would be in the way.

The improvements which had suggested themselves during the progress of the works were few in number. As regarded the jetties, he would add 9 feet more concrete to the walls, and leave out the long tie-rods, merely tying the piles to the back of the walls, though at a cost of £6. 10*s*. per foot instead of £4. 10*s*. A modification in the form of the bottom of the gates, by rounding them, as had been done in the Jarrow Docks, on the Tyne, was no doubt advantageous, and Mr. Bidder had adopted that form in the gates now constructing for the Grand Surrey Docks, under his superintendence. In them a further improvement had also been effected, by making the cill a straight line instead of a curved one on plan, thereby facilitating the construction, and affording an opportunity of giving more flotation to the bottom of the gate.

The jetty walls, the gates, and a pontoon for a graving-dock, were the subjects of patents. This might be a matter of surprise to the Members, after the remarks he had so frequently felt it his duty to make about patents. The fact was, that when his friend, the late Mr. Charles Heard Wild, was taking out a patent for lock gates, he allowed the improvements just enumerated to be included, with the express view of guarding against "fishing patents," which, without some precaution, were so continually springing up to trouble the Engineer.

In conclusion, the following figures represented, in a summary form, the cost of the works:—

Cost of works . . .	£706,462	3	6
Steelyard estate for the purpose of building up-town warehouses .	73,991	4	9
Extra lands . . .	128,678	19	9
Parliamentary expenses, outfit &c.	29,032	3	4
	£938,164	11	4

Cost of wrought-iron gates, each pair	£4,500	0	0
Lock and gates complete, with hydraulic machinery . .	58,000	0	0
Caisson	2,000	0	0
Entrance	18,000	0	0
Jetties, each	12,000	0	0
Jetties, with warehouses and cranes complete, each . . .	42,000	0	0

Mr. HAWKSHAW, *V. P.*, thought, that the economical system of construction adopted at the Victoria Docks had not been sufficiently dwelt upon in the discussion. It was the perfection of constructive art to suit every structure to the physical circumstances of each case, both as regarded the site and the materials at hand, as well as to the funds at the disposal of the Engineer. This was an instance of a large and important undertaking, successfully carried out, which with more costly treatment might not have been brought into existence. It had been said, that the works were not of such a permanent character as they should be; but the question might be asked, what was meant by permanency? A definition was certainly needed, if that was to be the standard of criticism. It might be bad economy, in many cases, to treat works, were that indeed possible, as if they were to endure for ever. Engineers should always have in view, what seemed to have been especially attended to in this case, that besides creating a durable and lasting work, care should be taken to make it bring some return to the capitalist.

Mr. HUMPHRYS inquired, whether the sums paid for the construction of the gates, caisson, and other iron work at the Victoria Docks were such as would be likely to reimburse the manufacturers who executed them. He had understood the iron work was in hand about two years, and that at the end of that period it would have been better for the manufacturers not to have had the contract at all; that in point of fact they lost a considerable sum of money.

Mr. BIDDER said, the gates were not put up to tender, and the price at which the work was taken was, he had reason to believe, satisfactory to the contractors. At all events, gates had been constructed since at a less cost per ton.

Mr. G. HURWOOD said, through the Secretary, it had occurred to him as worthy of consideration, whether in lock gates of great width, where there was more than one bearing roller, some self-acting contrivance might not be advantageously employed for the intermediate roller, so as to insure a more certain and uniform bearing of the several parts. He was led to make this suggestion from having applied a contrivance of the kind to one of the lock gates

at Ipswich, (which had but one roller), to meet a difficulty that arose from a settlement of the masonry in the lock chamber, upon which the segment rested. In this case the segment was so much out of the true level, that the roller, when the gate was open, did not touch it but hung entirely by the heel-post. The contrivance had now been in operation for some time, and appeared to answer very well.

Mr. LOCKE, MP., President, could not allow the discussion to close, without expressing, what he felt persuaded was the unanimous opinion of every Member present, that the thanks of the Institution were eminently due to the Author of this Paper; the preparation of which must have occupied a considerable time, and which was rendered all the more valuable, by the detailed information and elaborate illustrations that accompanied it.

In pursuance of the notice on the card of the Meetings, it was proposed and—

Resolved, unanimously, that in order to insure a fuller attendance of Members than could be obtained on Easter Tuesday, the Meeting should be adjourned until Tuesday evening, May 3rd.
