Discussion.

The President. The PRESIDENT moved a vote of thanks to the Author for his Paper.

Mr. Matthews. Mr. WM. MATTHEWS, Vice-President, having been long associated with some of the harbours referred to in the Paper, desired to make a few remarks on those of Cape Town, Port Elizabeth and East London. The works at Cape Town, designed by Sir John Coode in the year 1860, consisted of a small dock or basin, without gates, about 8½ acres in extent, with an outside basin of about 4½ acres, and a breakwater 3,000 feet in length. Although engineers of the present day would look upon that as a very modest undertaking, the proposal to carry it out had been considerably criticized on account of the extent of the works, which were considered altogether beyond the requirements of that time. Sir John Coode had lived not only to see the execution of those works, which had answered their purpose, but also, in consequence of the great development of steamer traffic, to propose the outer Victoria Basin of 64 acres; and he had been engaged in the construction of that work at the time of his death. The harbour at Cape Town was not subject to reduction of depth by deposition of sand or silt. In that respect it differed entirely from the other harbours farther up the coast. At Port Elizabeth the jetties designed by the late Sir John Coode were of open iron piling, and when Mr. Matthews saw them about 11 years ago, although they had then been in existence for 15 years or more, the ironwork was almost as good as when it was put down. That satisfactory result might, he thought, be attributed to the marine growths and shell-fish adhering to the ironwork, which had formed an efficient protection to the iron. The Author spoke of the jetties not being available for the berthage of vessels; but they were not intended for that purpose. At Port Elizabeth, as would be seen from *Fig. 3*, there was a series of jetties extending from the shore, alongside which surf-boats and barges were berthed. The vessels themselves lay out in the roadstead; the cargo was discharged into the barges, brought alongside the jetties, lifted by hydraulic cranes, put into wagons, and then taken up country or put into the stores. Similarly, wool and other produce for home was brought down and shipped from the jetties. It was not intended that the jetties should do more than furnish accommodation for barges and small coasting craft. At Port Elizabeth the

Mr. Matthews.

sand-travel was very active. Before the erection of the jetties a local engineer built out from the shore a solid structure, almost at a right angle. In consequence of this the shore and the work itself became blocked by such an extensive accumulation of sand that Sir John Coode was called in to devise some means of getting rid of the sand, and he advised that the most economical and effective plan was to remove the structure, which was done. The accumulation which occurred, however, had furnished an indication of the rate at which sand was deposited there: that was really an important point, which had given a clue to the subsequent treatment of the harbour. The accumulation of sand was due partly to the oblique impingement of the waves on the coast and partly to sand blowing across the promontory, of which Cape Recife formed the south-eastern extremity, and travelling up the coast. When he was there 11 years ago the travel across the neck had been very considerably reduced, in fact it had been almost entirely overcome by distributing town refuse over the bare sands and planting rough seeds on it. A considerable vegetable growth had resulted on what were previously bare sands, so that the sand was stopped in its passage across the point, and was therefore prevented from travelling along the coast. The data obtained from the solid work to which he had referred showed that the rate of accumulation was about 600,000 cubic yards of sand per annum. The proposed new harbour, which was 740 acres in area, was based on the principle of leaving an opening at the shore end of the east breakwater through which the travelling sand could pass, to be dealt with by means of pump-dredgers inside, under the lee of the breakwater. He felt confident that modern dredging-appliances could easily deal with the sand which would travel into the harbour, and in that way the sheltered harbour which Port Elizabeth had been looking forward to for so many years would be secured. With regard to East London (*Figs. 6* and *7*) his old friend Mr. Charles Neate, M. Inst. C.E., went out there in 1869, for Sir John Coode, and obtained information on which Sir John prepared his design for the work. When the design was prepared it was possible to wade across the river; but when Mr. Matthews was there about 11 years ago vessels of 5,000 tons were going in and out of the port regularly. That result had been brought about by two causes. In the first place there was the concentration of the backwater, which, though not very extensive, was subject periodically to tremendous freshets which cleared everything out of the river for the time being. The sand then collected again; and for some time after the works had been projected and were in

Mr. Matthews. hand, accumulation of sand occurred. In consequence of the exposure of the coast it was not practicable to use bucket-dredgers, and it was only by the use of pump-dredgers that that harbour and Durban Harbour had been brought to their present condition. Of course, without the training-works the pump-dredgers would not have been so effective. The introduction of the pump-dredger was due to the Dutch. They were brought to England by Sir John Coode, who, as a Commissioner of the Suez Canal, went to Holland in connection with Suez Canal work, and there saw pump-dredgers at work. It struck him that they were exactly what he had been in search of for a long time to aid him in the creation of the deep entrance at East London. There, as the Author pointed out, the dredgers were continually at work, and Mr. Matthews believed that neither Durban, which had a much more effective backwater than East London, nor East London, could be kept open without the use of pump-dredgers. Both had been looked upon as being about the two worst bar-harbours in the world, and he thought the manner in which the entrances had been kept open, and in which the navigation of large vessels had been rendered possible, was a matter for congratulation.

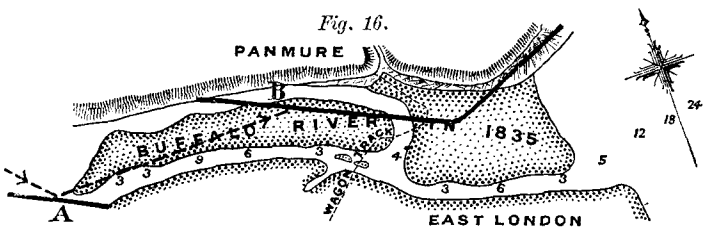
Mr. Gonsalves. Mr. GEORGE GONSALVES remarked that the fact that the Author had dealt solely with the harbours on the east coast of South Africa might lead to the supposition that no harbours existed on the west coast. He desired to draw attention to a fine natural harbour in Portuguese South-West Africa, namely, Lobito Bay, situated in about 12° south latitude. At present that harbour was little known, owing to the small quantity of shipping which made use of it; in fact, until within the last 12 months very few ships had called there. The construction of the Benguella Railway, starting from Lobito, was now, however, well in hand, and as that railway would eventually run from the coast about 900 miles into the interior of Africa, tapping the rich copper districts of Katanga and also shortening the route to the Rand by at least 6 days, he felt sure that in a very few years the harbour of Lobito Bay would be as well known as that of Delagoa Bay or Durban. The harbour at Lobito was undoubtedly the best on the south-west coast of Africa. It was formed by a tongue of land $3\frac{3}{4}$ miles long, running east and west and parallel to the mainland, which acted as a breakwater, and so enclosed a harbour 3 miles wide, with an entrance $\frac{3}{4}$ mile across. The bottom was sandy, and afforded good anchorage. On the north side of the bay the beach was very steep, there being in most places 10 fathoms of water within 300 feet of low-water mark, and as much as 30 feet within a few yards of the land itself, so that it was possible for

vessels to practically come alongside the tongue of land and discharge there. Captain Neilson, of the Union-Castle S.S. "Gascon," after taking his steamer into the harbour with material for the railway in July, 1904, reported very favourably on it to his company. There was no bar at the entrance, and the range of the tide was only about 4 feet. A timber pier 600 feet long had been built parallel to the shore, alongside which steamers drawing more than 30 feet of water could lie and discharge at any state of the tide. Mr. Gonsalves.

Mr. WOODFORD PILKINGTON considered that the idea of using the Zwartkops River was impracticable, because it faced south-east; moreover, the vested interests at Port Elizabeth would prevent such a scheme from being carried out. It was not the case, as the Author implied, that no really serious work was done on the Buffalo River before 1870, because in 1856 Mr. Pilkington constructed some training-banks there; and at that time 60 feet of water existed in the lagoon opposite Panmure. He also made, in 1866, the only trigonometrical survey of the river. The inshore quay-wall in *Fig. 7*, as far as the wave-trap inside the breakwater, was just what had been left so far finished when the work was taken over by the late Sir John Coode. This was proved by the two soundings, 11 feet 3 inches and 9 feet 9 inches, on rock surface close in. It had not been Mr. Pilkington's intention to leave a wave-trap, but quite the reverse, namely, to continue the line of the quay-wall to a junction with the breakwater, thus leaving the wave force at this point to help the incoming tide, so as to increase, as far as possible, the quantity of water coming into the estuary, and thus enhance the scour during the ebb-tide. The east pier was wrongly placed, if wanted there at all. The engineers had reached the maximum depth of water (18 feet) attainable in the centre with a rock bottom, by hugging the western bank. As the Author stated that the difficulty in the navigation of the entrance due to the east pier and the construction of the entrance some little distance within it would be remedied in course of time, it would be interesting to know what were the proposals for its improvement which were said to be under consideration. On the River St. Lawrence dredgers having the buckets fitted with tines cut into laminated schist 20 feet below the surface at the rate of 240 tons per day; but this could nowhere be done in igneous formation. If the authorities were content with the entrance of coasting steamers the east pier might remain; but if not, and if a possible depth of 30 feet to 40 feet at low water were desired, the pier should be simply cleared away. But first he considered that the cushions shown in *Fig. 16*, as originally designed by him in 1856–7, should be constructed to take advantage of the principle of "incidence and Mr. Pilkington.

Mr. Pilkington. reflection." He would place a cushion at A to cause deflection of the ebb or freshet current direct to the Panmure side, where an esplanade on reclaimed ground would form a second cushion, B; and he would strictly avoid all such training-walls as the east pier. The Buffalo River had probably a winding length of 60 miles or 70 miles,

Fig. 16.



with a watershed twenty times that of the Kowie, with which it bore no comparison. It had once, towards the middle of the nineteenth century, been flushed down to the rocky bottom; whereas the estuary and swamp of the Kowie had probably not been so scoured within the memory of man.

Mr. Tripp. Mr. W. B. TRIPP, having been connected with the port of East London many years ago, was personally familiar with the action of freshets there before any works were built. Since then the magnificent works described in the Paper had been constructed, and had proved highly successful. He believed that since 1876 freshets had practically ceased to occur, though apparently one happened in 1905, as the result of a very heavy fall of rain (about 11½ inches) on the 9th, 10th, and 11th October. It would be interesting to know what the effect of that freshet had been on the present harbour at East London. Even without the aid of freshets, the dredgers maintained a depth of 18 to 20 feet of water.

Sir Guilford Molesworth. Sir GUILFORD L. MOLESWORTH, K.C.I.E., Past-President, mentioned that 16 or 17 years ago he was consulted on a scheme for the improvement of Port Elizabeth, the suggestion being that an open piled jetty should be constructed, approximately in the position of the east breakwater shown in *Fig. 3*. It was proposed to add to this jetty open breakwater screens, with the idea of quelling the waves, and producing still water within the area protected. He made many elaborate experiments with models of open screens of different forms, in order to ascertain the effect; and although it was of course not always safe to rely upon the results of experiments with models, the results in this case were such as to convince him that the scheme would be a failure: he could not recommend its adoption, and therefore it was abandoned.

Mr. R. ELLIOTT-COOPER remarked that 28 years ago Port Alfred was believed to have a promising future. At the time of his first visit to South Africa, in 1878, the harbour had just been commenced. Many years previously, about 1856, an attempt had been made to convert the Kowie River into a harbour, so as to render the entrance fairly practicable, at any rate for small ships. In 1878 Sir John Coode recommenced the work, and it had at that time apparently every prospect of success. The people of Grahamstown and of Port Alfred had such faith in the project that they obtained an Act of Parliament for the construction of a railway between Port Alfred and Grahamstown, the latter place being at that time the distributing centre for that part of South Africa, from which the interior was reached by means of bullock-wagons. The Act of Parliament was carried into effect by a company formed in London, to which he became the engineer. When he went out in 1878, to be present at the cutting of the first sod, he thought the place was going to be one of the ports of South Africa. But here, as in so many other cases in Cape Colony, political influences soon began to make themselves felt. Port Elizabeth looked with considerable jealousy upon the possibility of Port Alfred becoming a competitor; and when it was borne in mind that Port Alfred was only 40 miles from Grahamstown, whereas Port Elizabeth was 102 miles, it would readily be understood that the difference in railway-rates appeared as if it might have some effect upon Port Elizabeth. The effect of the influence which was brought to bear upon the Government was that the railway-administration was induced to lower the rates between Port Elizabeth and Grahamstown to such a degree that all the geographical advantages of Port Alfred in respect of access to Grahamstown were practically lost. As mentioned in the Paper, the trade began to fall of, and within about 4 or 5 years the harbour was entirely abandoned. He thought that was a great pity, because all the success which had followed upon the works at East London would, he believed, although perhaps to a less degree, have attended the works at Port Alfred, where there was a river navigable for about 14 miles, and about 250 feet to 400 feet wide. The land on each side of the river was comparatively low, and easily adaptable for the making of inland docks. The railway, of course, continued working, but it was now used almost entirely for taking people from the upper part of the country to Port Alfred as a health and seaside resort, and for local traffic. That was one of not a few instances in South Africa where political influences, and the jealousy which one district had of another, had retarded the progress which ought to have taken place. The illustrations of the Paper showed many sites of possible

Mr. Elliott-Cooper.

Mr. Elliott-Cooper. harbours, and some members might fancy they would live to see works carried out there; but he had not the faintest hope that such would be the case. For instance, extension of the docks at Cape Town had been proposed by Sir John Coode and his firm ever since Mr. Elliott-Cooper had known South Africa. When he was in that country 5 years ago, at the time when Mr. J. C. Coode, M. Inst. C.E., was also there, it really looked as if some definite steps would be taken to carry out that great work; and he believed that if that had been done then it would have gone a long way towards maintaining the supremacy of Cape Town as the controlling port for the inward traffic of South Africa. But nothing had been done, and he was sorry to say that, in view of the present state of trade in South Africa, there did not appear to be any serious necessity for large extensions in Cape Town. The same remarks applied to Algoa Bay. In one form or another the piers shown in *Fig. 3* had been proposed certainly for the last 25 years, but they had never got beyond being proposals. Whenever an agitation arose, the Government obtained a report of what could be done; by the time that report had been circulated, a couple of years or so had probably elapsed, and the Government then dropped the matter for a few more years: and very often nothing further was heard of the scheme. That, he thought, was a great misfortune, because it destroyed the faith of the traders as to the intentions of the Government in regard to any great future developments. If a definite scheme, similar to those which had been carried out so successfully at East London and at Durban, were put in hand, instead of a large number of schemes being prepared, tenders obtained, and nothing done, it would save much money and be much better for the welfare of South Africa. It was impossible to exaggerate the advantages which had accrued from the two works which had been successfully completed at East London and Durban. When he first went out passengers had to land at East London in surf-boats—a miserable performance; but now, as Mr. Matthews had explained, the largest steamers were able to go into the port, and the same remark applied to Durban. With reference to the proposed dock at Zwartkops, he did not quite know how vessels would make the entrance in anything like bad weather. He had been in the bay when a storm was blowing, and it was then impossible to approach the shore, the coast being very dangerous.

Mr. Hunter. Mr. WALTER HUNTER, having seen the works at Table Bay and also those at Durban, thought it must be a source of great satisfaction to those towns, and also to the engineers who had carried out the works, that they had been so successful. That was parti-

cularly the case with regard to the magnificent sheet of water at Durban. When he first went there in 1903, vessels had to stop outside the bar; but when he visited South Africa again in 1904 and 1905, through the skill of the engineers in constructing the works, and owing to the dredging which had taken place, the largest steamers, such as the "Saxon" and the "Walmer Castle," both ships of more than 12,000 tons, were able to go safely into the harbour and alongside the quay. Mr. Hunter.

Mr. C. H. Colson desired to ask what considerations had led to the fixing of the length of the breakwater at Durban. He understood that dredgers had to be continually employed in order to remove the sand which accumulated across the entrance, and which swept up sideways across the breakwater. He presumed the breakwater had been constructed to its present extent in order to lessen the accumulation in front of the entrance; and it would appear that if it were prolonged the amount of dredging might be still further reduced. The question might be one of cost, but he thought it would be of interest if those who were responsible gave a little information with regard to the general lines of the design. Mr. Colson.

Mr. James Meldrum remarked that it would be extremely instructive if Mr. Methven would give diagrams of the forces which were acting, particularly one in reference to the harbour of Durban. Engineers desired to know not only the direction of the river-current (if any), but also the direction of the littoral current, of the prevailing waves, and of the prevailing winds. Without that information no engineer was in a position to decide whether the breakwaters had been originally designed in the correct direction. He laid great stress on that point, because he had had the pleasure of meeting the Author on the spot about 13 years ago, and they had agreed that it might have been possible to overcome the difficulty by adopting a single curved breakwater, arranged in such a way that the littoral current would assist in removing the deposit in front of the harbour, and not, as at present, cause the formation of one. Mr. Meldrum.

The Author, in reply, stated that he was well aware that, as Mr. Matthews had pointed out, the existing jetties at Port Elizabeth were not intended for the accommodation of large vessels, but only for lighters and small coasting craft. The system of discharging vessels in the open roadstead into lighters, which in turn discharged at these jetties, involved a great deal of handling and consequent expense, before the goods could be finally sorted and dispatched to their destinations; and the construction, either at the Zwartkops River or elsewhere, of a sheltered harbour, where the trade could be carried on in safety alongside wharves in the usual way, was The Author.

The Author. imperative if Port Elizabeth was to compete successfully with such ports as East London, Durban and Delagoa Bay. The proposed new harbour in front of Port Elizabeth (*Fig. 3*) was, however, of so costly a nature, all quayage and working- or storage-area having to be reclaimed from the sea and therefore being necessarily limited in extent, that there was a great deal to be said in favour of the Zwartkops scheme, notwithstanding vested interests in the neighbourhood of the present jetties at Port Elizabeth. It was clear that the proposed harbour in front of the town would be practically useless unless both arms were constructed, and its completion, ready for traffic, would take much longer than the work necessary to render the Zwartkops River available for at least a large portion of the trade of the port; while the latter scheme would cost only about half as much as the former. The value of the almost unlimited area of land in immediate proximity to the proposed wharves at the Zwartkops was inestimable, especially in connection with the timber trade to the interior. The Zwartkops River was undoubtedly the natural site for the formation of a harbour for Port Elizabeth, and were that town springing into existence now—in the days of the modern sand-pump dredger which rendered the opening of such rivers possible—there could be little doubt that the position chosen would be at the Zwartkops River. South Africa was but in its infancy, and so was each of its few ports, including Port Elizabeth. Looking to the growth of the community, it would therefore appear to the Author unwise to allow the vested interests of the moment to govern too largely the future policy of development, and to force it into a scheme not only costly and defective as regarded lack of storage-space, but also, as the Author believed, by no means certain of success. It was true that the eastern arm of the proposed harbour was intended to be left open at its shoreward end; but the western arm was a solid work, and a harbour of this nature, constructed across a sandy foreshore where, as Mr. Matthews had said, the sand travel was very active, though now partly reduced so far as wind-blown sand was concerned, was almost certain to cause large accumulations of sand on both sides of it, with an advancement of the foreshore and reduction of the depths of water. No doubt sand-pump dredgers might keep down any accumulations of sand on the inside of the harbour, but they would be unable to prevent such a shoaling to the eastward as that alluded to. In 1890 a detached breakwater was proposed opposite the town in 30 to 33 feet of water, but the proposal was condemned by a commission of engineers in London, on the ground that it "would interfere with and prejudicially impede the sand travel along the shore, and cause accumulations in front of

the town." Although the action of a work such as this was of course different from that of works projected across the littoral, the Author was of opinion that the latter were equally liable, if not more so, to cause an advance of the foreshore on both sides, and an accompanying diminution of depth ultimately affecting the entrance. The same shoaling influences, it might be urged, would follow on the projection of the entrance-breakwaters at the Zwartkops River, but these works would be comparatively insignificant in extent as compared with the two great arms of the proposed harbour in front of the town, and less difficulty would probably be experienced in maintaining navigable depths between and in front of them by dredging, aided by the scour from the river, than at East London or Durban. At the latter port the average depth on the bar at low water of spring-tides for 1905 was 28 feet 8 inches. The Author could not agree with Mr. Woodford Pilkington that the use of the Zwartkops River was impracticable because it faced south-east. Severe south-easterly gales were only occasional, and were gales from the east or south-east to form an impracticable barrier to the opening of harbours on this coast, the harbours of East London and Durban would not be in existence. It would be difficult to picture any two sand-barred harbours which in their earlier days looked more hopeless. Before the extension of the north pier and subsequent dredging-operations, the Author had walked dry-shod on the bar at Durban just within the end of the breakwater where there was now a depth of about 28 feet at low water. As Mr. Matthews had pointed out, however, Durban was fortunate in possessing a much more effective backwater than East London, the scour from which, directed by the north pier, had greatly assisted the work of the dredgers. The Author hardly thought that Mr. Gonsalves was justified in assuming that because the Paper dealt only with the harbours on the south-east coast, it might lead to the inference that no harbours existed on the west coast. The Paper dealt with the harbours between Cape Town and Delagoa Bay, these being the cases with which the Author had been professionally connected. In addition to Lobito Bay, there was, indeed, only about 80 miles northward from Cape Town, Saldanha Bay,[1] a very fine natural harbour with great capabilities, and proposals for its development were, he believed, at present under consideration. With regard to Mr. Tripp's desire to know the effect of the freshet of the 9th, 10th and 11th October, 1905, on the mouth of the Buffalo River at East London, the Author had ascertained from Mr. J. W Sowarsby, M. Inst. C.E., the Resident Harbour Engineer at East

The Author.

[1] See *post*, p. 66.—Sec. Inst. C.E.

The Author. London, that the narrow portion of the river within the entrance had been scoured out from 22 feet to 32 feet deep, and that the entrance had been scoured down until a hard bottom was reached. Such effects, however, were only temporary, and the Author had always held that in the inception of harbour-works in South Africa it was unwise to place any reliance on freshets as scouring-agents, and that only the tidal volume, and the normal amount of upland waters, should be considered as available for scouring. Freshets were exceedingly variable in South Africa, and the main consideration in connection with them was the protection of shipping in the harbours from their violence. The Author entirely shared the views of Mr. Elliott-Cooper with regard to the capabilities of Port Alfred and the great advantage it possessed over East London in the large areas of flat land on both sides of the river. The beach immediately to the west of the entrance, however, held immense volumes of sand, which was not the case at East London, and this might throw a greater strain on any dredging-plant employed to keep the entrance open. Mr. Elliott-Cooper was in error in stating that the largest steamers now went into East London. The mail-boats now regularly entered Durban Harbour, but the conditions of the entrance at East London had not yet rendered this a safe operation. With regard to the general lines of the design of the entrance-works at Durban, and the forces which were acting there, as to which Mr. Colson and Mr. Meldrum thought further information would be of use, the Author, although he stopped further extension of the Durban breakwater in 1892 until the north pier could be brought up, held that both works should be extended 600 feet, in order to reduce dredging to a minimum. His reasons were given in the Paper (pp. 38 and 39). He was not responsible for the points from which the two entrance-works were started, and was of opinion that equally good results would have been attained with shorter works had the breakwater been started from a point farther to the south-east and the north pier from a point farther to the north, the two works converging at their outer ends. The inducement to start the breakwater from the point where its present root was situated had been a reef of rocks extending a short distance into the sea, and a desire not to receive the seas so square on to the work. With regard to the forces at work about the entrance, and the changes which took place from year to year, the Author had made the fullest investigations, and many of the diagrams of these were to be found in the valuable report on Durban Harbour by Sir Charles Hartley and Sir John Wolfe Barry, dated 15th April, 1897. Generally, it might be stated that the prevailing winds were from N.N.E. to

E.S.E. and from S.S.E. to W. The prevailing seas were from southerly to south-easterly directions, and these, wheeling round, crossed the entrance about east to west. Seas from southerly directions tended to increase the bar and those from north-easterly to easterly directions usually assisted the action of the tides in lowering it. The prevailing littoral current flowed from south to north, and its velocity seldom exceeded about ½ knot per hour; it was therefore not of sufficient velocity to materially affect the case. The sea-bottom was for the most part sand, and the beach for about 100 miles south of the entrance was heavily charged with it. The rise of tide at springs was 6 feet, and the tidal volume a few years ago would be about 25,000,000 cubic yards. The Author had never been of opinion that a single curved breakwater such as that described by Mr. Meldrum would be successful at Durban. It was possible that such a breakwater in conjunction with the north pier, as in the scheme proposed by Sir John Coode in 1870, would have been more or less successful, but the aspect of the entrance was too far to the north. Any solid work, curved or otherwise, projected seaward from the end of the Bluff, alone and without a northerly work of at least equal length, could only result, as the present breakwater had resulted when projected too far beyond the north pier, in collecting sand under its lee and finally blocking the entrance. The Author.

Correspondence.

Mr. W. Dyce Cay had been much struck with the similarity of the problems and conditions of the harbours of South Africa to those he had had to deal with in the improvement of the entrance at Aberdeen, and of its bar and channel. The drawing of East London harbour at the mouth of the Buffalo River (*Fig. 7*) was almost identical with the Aberdeen design, though of later date, the Aberdeen parliamentary plans having been lodged in 1867. This similarity, and the wonderful success of Aberdeen harbour, led him to remark on the plan of East London shown in *Fig. 7*. One feature was the want of spending beach in the river, and the contraction, mentioned as a defect in the Paper, caused by a south pier or wharf near the entrance, at a point only 200 yards landward of the sea at the end of the east pier. At Aberdeen the works on the south side, the old south pier and the old breakwater, were removed, so that measuring from the open sea at the end of the north pier, Mr. Dyce Cay.